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**Statement of Academic Integrity:**

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see [www.mcgill.ca/integrity](http://www.mcgill.ca/integrity) for more information).
USEFUL WEB SITES

African Field Semester         http://www.mcgill.ca/africa/
Biology Department            http://biology.mcgill.ca/
Career Planning Services      http://www.mcgill.ca/caps/
Continuing Studies            http://www.mcgill.ca/continuingstudies/
Courses permitted outside Sci. faculty http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/
Huntsman Marine Institute     http://www.huntsmanmarine.ca/
Important Dates               http://www.mcgill.ca/importantdates/
Minerva                       http://www.mcgill.ca/minerva-students/
McGill School of Environment  http://www.mcgill.ca/mse/
myCourses (WebCT Vista)       http://www.mcgill.ca/lms
Neuroscience Programs         http://www.mcgill.ca/neuroscience/
Panama Field Semester         http://www.mcgill.ca/pfss/
Student Affairs Office (Arts) http://www.mcgill.ca/oasis/
Student Affairs Office (Science) http://www.mcgill.ca/science/sousa/
Student Exchange & Study Abroad http://www.mcgill.ca/students/international/ and
Student Services:
  Advising                     http://www.mcgill.ca/students/advising/
  Counselling Services        http://www.mcgill.ca/counselling
  Campus Life & Engagement    http://www.mcgill.ca/firstyear/
  Health                      http://www.mcgill.ca/studenthealth/
  International Students Office http://www.mcgill.ca/internationalstudents
  Scholarships & Student Aid  http://www.mcgill.ca/studentaid/
  Students with Disabilities  http://www.mcgill.ca/osd/
  Student Society of McGill Univ https://ssmu.ca
  Summer Studies              http://www.mcgill.ca/summer/
WELCOME TO THE BIOLOGY DEPARTMENT

Biology is the study of life. Its scope ranges from the molecular interactions within cells to the complex biodiversity of a rain forest. Biology deals with fundamental questions such as the origin and evolution of plants and animals, interactions between living organisms and their environment, mechanisms of embryonic development, structure and function of the living cell and its organelles, molecular basis of inheritance, biochemical and genetic basis of human diseases, and the operation of the brain and the nervous system. The study of Biology has vast practical applications in agriculture, medicine, biotechnology, genetic engineering, environmental protection and conservation.

The programs in Biology provide you with an introduction to the broad spectrum of Biological Sciences in contrast to more specialized programs in Biochemistry, Microbiology, Pharmacology, Physiology and Anatomy and Cell Biology. The B.Sc. degree in Biology prepares you for a wide range of employment opportunities as well as entry to professional schools in medicine, veterinary science, dentistry, agriculture, nursing, education and library science. It also provides solid background for those interested in careers related to environmental protection, wildlife management, biotechnology and genetic engineering. The B.Sc. degree in Biology can also lead to post-graduate studies and research careers in universities, research institutes, hospitals, and industrial or governmental laboratories.

The Department of Biology's well-equipped research laboratories are located in the Stewart Biology Building, 1205 Docteur Penfield Avenue and in the adjacent Bellini Life Sciences Building. Due to massive renovations that began in the Fall of 2017, only the North Wing of the Stewart Building is currently in use and freshman biology labs have temporarily moved into the Duff Medical Building. The Department includes many biologists who are international leaders in their research fields, but who nevertheless remain deeply committed to undergraduate education. We have outstanding infrastructure for cell, developmental and neurobiology research, and extensive links to biomedical scientists throughout McGill and all over the world. Our ecology and evolutionary biology group is also internationally prominent and dedicated to studying aquatic and terrestrial ecosystems.

We have created a core undergraduate program that will expose you to the broad areas of biology at all of these levels of complexity. At the same time you will be able to concentrate on topics related to your specific interests through complementary and elective courses. Once you are past the large introductory classes, our class sizes are relatively small and you will have lots of opportunities for contact with your instructors; this is one of our strengths! Biology's teaching and research resources are extended by affiliation with the Redpath Museum, the hospitals and research institutes of the McGill University Health Centre, the Montreal Neurological Institute, the Sheldon Biotechnology Institute and the Smithsonian Tropical Research Institute in Panama. Field courses enable you to study biology in a natural setting, in local ecosystems (e.g., at McGill's Gault Nature Reserve), and in distant ones such as Barbados, Panama, and East Africa. The Biology Department is also deeply committed to providing individual research experiences to its undergraduates. U2- and U3-level students, not just Honours program students, can carry out semester- or year-long independent study projects for course credit in Biology department research labs. Numerous summer opportunities are also available.

Undergraduate students are represented by the MBSU (McGill Biology Students Union) in the Departmental Assembly and in Standing Committees.

Our Bluebook provides more detailed information on our programs and courses than can fit in the University Calendar. The Bluebook can be downloaded from, or read on, the web at http://biology.mcgill.ca/undergrad/bluebook.html. We hope you find it useful!

Gregor Fussmann
Chair, Biology Department
THE CURRICULUM

The Biology curriculum is taken within the three year, 90-credit BSc or BASC; it follows a two-year CEGEP program or McGill’s Freshman Program, or equivalent. Minimum entrance requirements include two courses in Biology, two in Chemistry, two in Math and one or two in Physics, depending on program and courses chosen.

The Department offers the following Programs of Study:

B.Sc.

1) Liberal Program in Biology
2) Major Program in Biology – includes an option in Quantitative Biology
3) Joint Major in Biology and Mathematics
4) *Joint Major in Computer Science and Biology
5) *Joint Honours in Computer Science and Biology
6) Honours Program in Biology – includes an option in Quantitative Biology
7) Minor Program in Biology
8) Minor Program in Biotechnology

BASC

1) Major Concentrations in Biology
2) Minor Concentrations in Biology

* These programs are administered by the Department of Computer Sciences

The Department also coordinates the BSc. Minor in Biotechnology and the Minor in Science for Arts Students.

Liberal Program in Biology

The Liberal Program in Biology is less specialized than the Major Program. It comprises a core Science component in Biology, and a breadth component (generally, but not always, a minor) in another area of study.

Major Program in Biology

Students following the Major Program in Biology receive a general education in all aspects of Biology in the first year. In the final two years, students may follow a more specialized concentration, or may continue to take courses from diverse areas of Biology. A Major Program in Biology can also be combined with a Minor Program in another department in Science, Arts, Management or other programs.

Biology Major or Honours: Quantitative Biology Option

Interdisciplinary research that draws from the natural and physical sciences is an important aspect of modern biology. The Quantitative Biology option is designed for students with a deep interest in biology who wish to gain a strong grounding in physical sciences and their application to biological questions. The program has two streams; an Ecology and Evolutionary Biology stream and a Physical Biology stream. Both streams provide a balance of theory and experimental components.

Joint Major in Biology and Mathematics

This program is built on a selection of mathematics and biology courses that recognizes mathematical biology as a field of research, with three streams within biology: Ecology and Evolutionary Ecology, Molecular Evolution, and Neuroscience.

Joint Major or Honours in Computer Science and Biology

This program trains students in the fundamentals of Biology – with a focus on Molecular Biology – and will give them the computational and mathematical skills needed to handle and analyze large biological data sets. Students may choose an unofficial stream.
Honours Program in Biology
The Honours Program in Biology is designed to provide students with an enriched training in Biology and more extensive research experience in a chosen area. A student may apply to enter the Honours program from the Biology Major at the end of the U2 year.

Minor Program in Biology
This 24 credit sequence of Biology courses may be selected by science students taking their primary programs in other departments.

Minor Program in Biotechnology
This is a 24-credit minor offered by both Science and Engineering. There are 15 credits of required courses and 9 credits of complementary courses.

Major Concentration in Biology for the B.A. & Sc. Degree
This Major Concentration in Biology which is restricted to students in the B.A. & Sc., is a planned sequence of courses designed to permit a degree of specialization in either cell/molecular or organismal biology.

Minor Concentration in Biology for the B.A. & Sc. Degree
This Minor Concentration in Biology, which is restricted to students in the B.A. & Sc., is a sequence of courses designed to yield a broad introduction to either cell/molecular or organismal biology.
ADVISING SERVICES

Many sources of information (such as Faculty and Departmental advisors) are available to you in planning your academic program, exploring career opportunities, and clarifying policies and procedures.

The most important function of Departmental Advisors is to advise and assist you in planning a realistic and meaningful program, and they are responsible for the degree programs which are administered by their departments. All new Biology students requiring 96 credits or fewer to complete their degree should see the Undergraduate Advisor, Nancy Nelson (398-4109), in Room N7/9B to assist them in selecting a program and to discuss first year requirements. Returning students will register in March/April and should contact the Undergraduate Advisor.

In preparation for their interviews with their Advisor, students should consult the timetable available on Minerva and in the Biology Department Bluebook which is available on the web at: http://biology.mcgill.ca/undergrad/bluebook.html to develop a preferred list of courses, including possible electives, noting their scheduled lecture hours. U3 students accepted into the Honours Program should verify their program requirements with the Honours Coordinator (398-4109) before registration.

Other important sources of information include Service Point, Faculty Advisors, the Financial Aid Office, McGill’s Career Planning Service (CaPS) with its various workshops, Counselling Services, the Office of Students with Disabilities and the Office for International Students.

For information on registration procedures, program selection, course change, course/university withdrawal, faculty transfer and exact dates of events, see the general McGill Calendar.
OPPORTUNITIES IN BIOLOGY

Students who graduate with an undergraduate degree in Biology tend to follow three traditional paths:

1. **Applying to a Professional School** to work in a specified career such as:
   a. Medicine
   b. Dentistry
   c. Nursing
   d. Physical and Occupational Therapy
   e. Law
   f. Speech Therapy
   g. Veterinary Medicine
   h. Pharmacy
   i. Physiotherapy
   j. Teaching (eg Master’s Program in Teaching and Learning)

2. **Applying to Graduate School** to work in research and development in places like:
   a. Academia
   b. Research Institutes
   c. Government Agencies
   d. Research Funds Administration
   e. Private Industry
   f. Genetic Counseling

3. **Applying to Work** in an entry level position such as:
   a. Lab or Research Assistant
   b. Technician
   c. Clinical Assistant
   d. Biological Researcher
   e. Ecologist

Depending on a student’s area of interest, skill set, additional training, and experience gained through summer employment, internships, extra curricular activities, and volunteering, they can potentially use their science knowledge in combination with:

1. **Business** in positions such as:
   a. Marketing
   b. Public Relations
   c. Consulting
   d. Human Resources
   e. Investment Advisor
   f. Quality Control / Quality Assurance
   g. Sales Representative

2. **Education** in positions such as:
   a. Teaching Assistant
   b. Educator / Trainer
   c. Advisor

3. **Communications** in positions such as:
   a. Technical / Scientific Writer
   b. Editor
   c. Web Developer / Producers
   d. Journalist
   e. Medical Illustrator
4. **Other** positions such as:
   a. Patent Agent
   b. Policy Analyst
   c. Fundraiser
   d. Data Management Administrator
   e. Public Health Officer

The opportunities following a bachelor degree in Biology are quite diverse. Many graduates will work in a variety of **industries** for a variety of **employers** such as:

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<th>Conservation</th>
<th>Environmental</th>
<th>Government</th>
<th>Health Care</th>
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<td>Legal</td>
<td>Manufacturing</td>
<td>Museum</td>
<td>Pharmaceutical</td>
<td>Publishing</td>
</tr>
<tr>
<td>Public Health</td>
<td>Research Centers</td>
<td>Academia</td>
<td>Wildlife / Fisheries</td>
<td>Biomedical</td>
</tr>
<tr>
<td>Rehabilitation Centers</td>
<td>Medical Supply Companies</td>
<td>Management Consulting</td>
<td>International Agencies</td>
<td>Agriculture and Forestry</td>
</tr>
</tbody>
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**For more information and assistance regarding your future career plans and how to succeed,**

*Check out [http://www.mcgill.ca/caps/students/services](http://www.mcgill.ca/caps/students/services) and [http://www.mcgill.ca/caps/publications](http://www.mcgill.ca/caps/publications)*

**Visit the**

**McGill Career Planning Service (CaPS)** in person at 3600 McTavish, suite 2200, online at [www.mcgill.ca/caps](http://www.mcgill.ca/caps/)

*Or call to schedule an appointment with a Career Advisor at 514-398-3304 ext.0321.*
**BIOLOGY B.Sc. PROGRAMS**

There are several types of departmental programs in Biology with differing levels of specialization.

- Liberal Program in Biology (45-47 credits)
- Major Program in Biology (58-59 credits)*
- Joint Major in Biology and Mathematics (76 credits)
- Joint Major in Computer Science and Biology (63-74 credits)
- Joint Honours in Computer Science and Biology (66-77 credits)
- Honours Program in Biology (71-72 credits)**
- Minor Program in Biology (24 or 25 credits) for BSc. students whose primary program is in another department.
- Minor Program in Biotechnology (24 credits)

*Within the Biology Major Program is an Option in Quantitative Biology (73 credits).
**Within the Honours Program in Biology is an Option in Honours Quantitative Biology (79 credits)

Students in the Faculty of Science may also select a 18-25 credit Minor Program which is completed in parallel with the departmental program. **These require a minimum of 18 non-overlapping credits.** Minors are offered by the Faculty of Science; also several Minor Concentrations offered by the Faculty of Arts and other faculties are open to science students (Minor programs are listed in the Science section of the Calendar).

Courses used to fulfill program requirements must be passed with grades of "C" or better. The remaining credits for the bachelor degree (electives) may be selected from offerings of the Faculties of Arts and Science plus a limited number of courses from other faculties.


Students who have already passed the equivalent of a required course at CEGEP, or have exemptions granted for work done elsewhere, should consult the Undergraduate Advisors regarding substitutions.

**Pre-Program Requirements**

Requirements for the Major and Honours programs in Biology are 2 courses in elementary Biology, 2 courses in general Chemistry, 2 courses in Mathematics and 2 courses in Physics (Mechanics and Electromagnetism). Students entering into the BA & SC, the Liberal Program and the Biology Science Minor have the same Biology, Chemistry and Mathematics requirements. The Physics requirements will vary according to their future direction. All students need to take PHYS 101 or 131. If the student intends to eventually take either BIOL 301 or BIOL 306, then PHYS 102 or 142 is also required.

Note: Students planning to take one of the Joint Programs or the Quantitative Biology Option should consult the Undergraduate Advisor to ensure they are taking the appropriate pre-requirements.
LIBERAL PROGRAM: CORE SCIENCE COMPONENT IN BIOLOGY (45-47 credits)

B.Sc. Liberal Program in Biology

The BSc Liberal program is a science option which allows students to combine a core science component with a breadth component. The Biology core science component consists of 45-47 credits with a breadth component of at least 18 additional credits, chosen from: a minor in another Science area; a science field study; a minor from a wide variety of other disciplines (Arts, Kinesiology, Education, Engineering, Biotechnology and Management); an Arts Major Concentration, a second core science component or a General Science breadth.

By combining the core science component of Biology with the breadth component, the Liberal option is a flexible program, offering students the benefit of a fundamental knowledge of Biology with an opportunity to broaden their studies both inside and outside of Science. This program is well suited to students with varied interests who don’t want to focus solely on Biology in their studies.

CORE BIOLOGY COMPONENT

REQUIRED COURSES (19 CREDITS)

<table>
<thead>
<tr>
<th>CREDITS</th>
<th>DEPT.</th>
<th>COURSE #</th>
<th>COURSE TITLE</th>
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<tbody>
<tr>
<td>3</td>
<td>Biology</td>
<td>BIOL 200</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>3</td>
<td>Biology</td>
<td>BIOL 201</td>
<td>Cell Biology and Metabolism</td>
</tr>
<tr>
<td>3</td>
<td>Biology</td>
<td>BIOL 202</td>
<td>Basic Genetics</td>
</tr>
<tr>
<td>3</td>
<td>Biology</td>
<td>BIOL 205</td>
<td>Biology of Organisms</td>
</tr>
<tr>
<td>3</td>
<td>Biology</td>
<td>BIOL 215</td>
<td>Introduction to Ecology and Evolution</td>
</tr>
<tr>
<td>4</td>
<td>Chemistry</td>
<td>CHEM 212*</td>
<td>Introductory Organic Chemistry 1</td>
</tr>
</tbody>
</table>

*If a student has already taken CHEM 212 or its equivalent, the credits can be made up with a complementary course approved by the advisor.

COMPLEMENTARY COURSES (27-28 CREDITS)

3 or 4 credits selected from:

<table>
<thead>
<tr>
<th>CREDITS</th>
<th>DEPT.</th>
<th>COURSE #</th>
<th>COURSE TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Biology</td>
<td>BIOL 206</td>
<td>Methods in Biology of Organisms</td>
</tr>
<tr>
<td>4</td>
<td>Biology</td>
<td>BIOL 301</td>
<td>Cell and Molecular Laboratory</td>
</tr>
</tbody>
</table>

Plus 24 credits of Biology courses, 9 credits of which, in consultation with the Program Advisor, can be replaced with appropriate Science courses from other departments. Up to 6 of the 24 complementary credits may be taken at the 200 level.
MAJOR PROGRAM IN BIOLOGY (58-59 CREDITS)

The Biology Major Program has been designed to offer broad training in those areas of biology in which the department has outstanding human and physical resources. The Major consists of 58-59 credits: 22 basic required biology credits and 36-37 additional complementary credits which are to be chosen by students in consultation with their advisor. Students interested in advanced studies in any biological discipline are strongly advised to develop their skills in computing as appropriate. As an aid to students wishing to specialize, the concentrations set out below list key and other suggested courses by discipline. They are suggestions, not requirements.

REQUIRED BIOLOGY COURSES (25-26 CREDITS)

<table>
<thead>
<tr>
<th>CREDITS</th>
<th>DEPT.</th>
<th>COURSE #</th>
<th>COURSE TITLE</th>
</tr>
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<tbody>
<tr>
<td>3</td>
<td>Biology</td>
<td>BIOL 200</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>3</td>
<td>BIOL 201</td>
<td>Cell Biology and Metabolism</td>
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<td>BIOL 202</td>
<td>Basic Genetics</td>
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<tr>
<td>3</td>
<td>BIOL 205</td>
<td>Biology of Organisms</td>
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<td>BIOL 206</td>
<td>Methods in Biology of Organisms</td>
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<tr>
<td>3</td>
<td>BIOL 215</td>
<td>Introduction to Ecology and Evolution</td>
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<tr>
<td>4</td>
<td>BIOL 301</td>
<td>Cell and Molecular Laboratory</td>
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</tr>
<tr>
<td>4</td>
<td>Chemistry</td>
<td>CHEM 212*</td>
<td>Introductory Organic Chemistry 1</td>
</tr>
</tbody>
</table>

*If a student has already taken CHEM 212 or its equivalent, the credits can be made up with a 3-credit course approved by the Biology Advisor

CORE COMPLEMENTARY COURSES (12 CREDITS)

12 CREDITS SELECTED FROM:

| 3       | Biology | BIOL 300 | Molecular Biology of the Gene     |
| 3       | BIOL 303 | Developmental Biology               |
| 3       | BIOL 304 | Evolution                               |
| 3       | BIOL 306 | Neural Basis of Behaviour             |
| 3       | BIOL 308 | Ecological Dynamics                   |

OTHER COMPLEMENTARY COURSES (21 CREDITS)

21 CREDITS OF BIOLOGY COURSES:

These must all be at the 300+ level, of which 6 credits must be at the 400+ level as of Fall 2014 entry. With permission of the Biology Adviser, up to 9 credits may be taken from other Science department courses (300+-level).

Unless part of the Major Program, prerequisites for these courses must be taken as electives.
BIOLOGY CONCENTRATIONS FOR THE MAJOR PROGRAM

These concentrations are only guidelines for specialized training. They do not constitute sets of requirements, nor will the name of the concentration appear on your transcript. Courses below the 300 level, however, can only be taken as electives in the Biology Major. For courses taken outside the Faculties of Arts and Science, please see University guidelines (http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/)

ANIMAL BEHAVIOUR

Understanding the diverse ways in which animals navigate their physical and social environments and process information to maximize survival and reproductive success constitutes the subject matter of behaviour. Multiple approaches are used to study these questions, frequently being employed together. Some focus on the ecological consequences and determinants of animal behaviour, linking behaviour and environment. Others focus on the physiological, neural, genetic, and developmental mechanisms of behaviour, and still others on the evolution of behaviour. Consequently, many courses from the fields of ecology, evolutionary biology, neurobiology, psychology and anthropology will be relevant. Some courses that focus on a particular taxonomic group such as birds (Natural Resource Sciences WILD 420), amphibians and reptiles (BIOL 427) and marine mammals (BIOL 335) include a significant amount of material on behaviour as well.

KEY COURSES

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BIOLOGICAL DIVERSITY AND SYSTEMATICS

The immense variety of living things is one of the defining features of the natural world. The study of biological diversity is a scientific discipline in its own right, closely connected to ecology and evolutionary biology. Biodiversity science addresses how new species are formed, the ecological processes that maintain such a wide variety of different kinds of organisms, and why organisms become extinct. It is concerned with the characteristics of different organisms, and emphasizes the detailed study of particular groups. Our knowledge of diversity is organized through the study of systematics which seeks to understand the history of life through the phylogenetic and genetic relationships of living things. An appreciation of diversity and knowledge of the principles and procedures of systematics are essential in ecology and evolutionary biology, and underlie all work in resource utilization and conservation biology.
### KEY COURSES

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**CONSERVATION BIOLOGY**

Conservation biology is the study and protection of biological diversity. It is a scientific discipline closely connecting ecology and evolutionary biology with applications in public policy and management. Conservation biology focuses on protecting biological diversity and keeping normal evolutionary processes working within a functional ecological context. As a science, it deals with issues of how the wide variety of organisms and ecosystems can be maintained and prevented from declining. It considers population and habitat viability and complexity in the face of threats and perturbations. Cognizance of biological diversity, knowledge, and expertise in both ecology and evolutionary biology, and appreciation for the political, social, and economic contexts of the biodiversity crisis underlie all work in conservation biology.

**KEY COURSES**

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CONCENTRATIONS AVAILABLE WITHIN THE AREA OF ECOLOGY

Ecology is the study of the interactions between organisms and environment that affect distribution, abundance, and other characteristics of the organisms. A strong analytical and quantitative orientation is common to all areas of ecology, and thus students wishing to specialize in these areas are strongly encouraged to develop their background in statistical analysis, computing, and mathematical modeling (e.g. BIOL 373, COMP 204). Many of our ecology courses feature a strong analytical component, and students will find that background preparation in this area is very useful, if not essential. Ecology depends heavily on field courses, which should be considered as vital to all concentrations in this area.

GENERAL AND APPLIED ECOLOGY

The concentration in General and Applied Ecology is designed to introduce the breadth of contemporary ecology, at the levels of the ecosystem, communities and populations, and at the level of the individual organism, with an accent on the application of this material to the practical problems of environmental biology, including the management of natural resources and pests. The concentration focuses on ecology courses dealing with general principles and with particular groups of organisms, combined with field courses in ecology and courses in statistics and computing. Students are encouraged to supplement courses listed as part of this concentration with allied subjects from aquatic ecology, behavioural ecology, evolutionary biology, marine biology, and other concentrations in Biology and from other sciences. Such selections should be made with the help of the academic advisor. By appropriate selection of courses, students can complement these courses with a minor in Environmental Studies.

The group of ecologists available at McGill is among the largest, most diverse, and most active in Canada. There is ample opportunity through independent study and summer employment for involvement in a wide range of contemporary research, including terrestrial, aquatic, theoretical, evolutionary and behavioural ecology.

KEY COURSES

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OTHER SUGGESTED COURSES (for rules and restrictions of courses taken outside Arts & Science, please consult http://www.mcgill.ca/science/student/continuingstudents/bsc/outside

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AQUATIC ECOLOGY

This concentration is designed to introduce the principles of ecology as they pertain to aquatic biota and, more broadly, aquatic ecosystems. Since it is essential to know how knowledge is obtained, as well as what has been learned, one of the courses (Limnology) places an emphasis on field work and one of the courses (Biological Oceanography) concentrates on the techniques used in the laboratory. To give students an opportunity to work through all of the steps involved in initiating a project of their own design, we also offer a research methods course (Advances in Aquatic Ecology). There is also a variety of courses in aquatic disciplines offered in other departments that complement the aquatic ecology courses offered in Biology. By appropriate selection of courses in consultation with advisors, it is possible to complement this concentration with a minor in Environmental Studies.

There are many ecologists at McGill with aquatic interests, and they are among the best and most active in Canada. Consequently, there is ample opportunity through independent study and Honours projects as well as summer employment for involvement in a wide range of contemporary research. Current research projects include: the cycling of nutrients and contaminants through aquatic ecosystems, the ecology of lake eutrophication, research on invasive species in the St. Lawrence system, and the ecology of foraging and respiration in fishes.

KEY COURSES

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OTHER SUGGESTED COURSES

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MARINE BIOLOGY

This concentration is designed to offer students a broad introduction to Marine Biology and Marine Ecology which will form the basis for graduate studies in these fields, or for employment in Aquatic Biology and Oceanography.

KEY COURSES

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For students intending to proceed to graduate work, one independent studies course (BIOL 466; BIOL 467 or BIOL 468) is recommended. Due to the importance of numerical analyses in all fields of Ecology, courses in biostatistical analysis (e.g., BIOL 373) and computer science (COMP 204) are highly recommended.

EVOLUTIONARY BIOLOGY

Evolutionary biology is an organizing principle of biology. It is the study of the patterns of the history of life and the processes that shaped it. Evolutionary biologists aim to understand how biodiversity is generated and lost over time. Research approaches include: how organisms are related, how organisms adapt to their environment, how the processes of natural selection, genetic drift, and migration shape natural and laboratory populations, what the fossil record reveals about the history of life, and how novelty in organisms arise.

KEY COURSES

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<td>Biology</td>
<td>BIOL 314</td>
<td>Molecular Biology of Oncogenes</td>
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**HUMAN GENETICS**

The courses recommended for students interested in Human Genetics are designed to offer a broad perspective in this rapidly advancing area of biology. Genetics is covered at different levels of organization (gene, genome, chromosome, cell, organism and population), using pertinent examples from all species, but with a special emphasis on humans.

**KEY COURSES**

**OTHER SUGGESTED COURSES**
**MOLECULAR GENETICS AND DEVELOPMENT**

The discoveries that have fuelled the ongoing biomedical and biotechnology revolution have been derived from the fusion of a number of fields of biological investigation, including molecular biology, genetics, cellular and developmental biology, and biochemistry. A substantial amount of this research has been conducted upon model eukaryotic organisms, such as yeast, the fruit fly (*Drosophila*), the nematode (*C. elegans*), and the mustard weed (*Arabidopsis*). In the molecular genetics and development concentration, students will obtain a comprehensive understanding of how the study of these "model eukaryotes" has advanced our knowledge of the mechanisms responsible for cellular function and organismal development. Graduates from this concentration will be well prepared to pursue higher degrees in the fields of basic biology, biotechnology, and biomedicine or to assume a wide variety of positions in government, universities, and medical or industrial institutions.

**KEY COURSES**

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*HGEN 396 can only be taken as an elective. It can count towards the requirements of the Dean's Multidisciplinary Undergraduate Research List (DMURL).*
NEUROBIOLOGY

Nervous systems are perhaps the most complex entities in the natural world, being composed of up to trillions of interconnected cells that must operate in a coordinated manner to produce behaviour which can range from the mundane (e.g., regulation of heart rate) to the magnificent (e.g., musical composition). The discipline of Neurobiology, one of the fastest growing areas of modern biology, seeks to understand the evolution, development, and operation of nervous systems. The Neurobiology concentration addresses these issues by examining neural structure, function and development at levels of organization that range from the molecular to the organismal.

KEY COURSES

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</table>
Students may complete this program with a minimum of 71 credits or a maximum of 72 credits. The Honours program in Biology is designed expressly as a preparation for graduate studies and research, and provides students with an enriched training in biology and some research experience in a chosen area.

Acceptance into the Honours program requires a CGPA of 3.50 and approval of a 9- or 12-credit Independent Studies proposal (see listing of BIOL 479 and BIOL 480 for details). Students also complete a 4-credit Honours Seminar course, BIOL499. For an Honours degree, a minimum CGPA of 3.50 in the U3 year and adherence to the program as outlined below are the additional requirements.

First Class Honours will be awarded to students graduating with a CGPA of 3.75 or better who have successfully completed the Honours program.

Students may apply to enter the Honours Program in Biology near the end of the U2 year by contacting the Biology Undergraduate Advisor, Nancy Nelson, Stewart Biology N7/9B; phone 398-4109, E-mail: nancy.nelson@mcgill.ca

It is the responsibility of students to visit professors in the department with whom they wish to do their Honours Independent Study and discuss research projects and research space availability. There is a list of professors and outlines of their research interests posted on the Biology web site (see the Faculty listing)

**Required courses** (32-33 credits):
- BIOL 200 (3) Molecular Biology
- BIOL 201 (3) Cell Biology and Metabolism
- BIOL 202 (3) Basic Genetics
- BIOL 205 (3) Biology of Organisms
- BIOL 206 (3) Methods in Biology of Organisms
- BIOL 215 (3) Introduction to Ecology and Evolution
- BIOL 301 (4) Cell and Molecular Laboratory
- BIOL 373* (3) Biometry
- BIOL 499D1/D2 (4) Honours Seminar in Biology
- CHEM 212** (4) Introductory Organic Chemistry 1

*If a student has already taken an equivalent statistics course, the credits can be made up with a 3-credit Biology complementary course.

**If a student has already taken CHEM 212 or its equivalent, the credits can be made up with a 3- or 4-credit complementary course to be approved by the Biology Adviser.

**Honours complementary course** (9-12 credits)
- BIOL 479D1/D2 (9) Honours Research Project 1
- OR
- BIOL 480D1/D2 (12) Honours Research Project 2

**Core complementary courses** (12 credits):
12 credits selected from:
- BIOL 300 (3) Molecular Biology of the Gene
- BIOL 303 (3) Developmental Biology
- BIOL 304 (3) Evolution
- BIOL 306 (3) Neural Basis of Behaviour
- BIOL 308 (3) Ecological Dynamics

Other Complementary Courses (15-18 credits):
18 credits of Biology courses at the 300+ level if taking BIOL 479, and 15 credits if taking BIOL 480.

With permission of the Biology Adviser, up to 6 credits may be taken from other Science department courses (300+-level). Up to 6 credits of previous independent research courses may be included.

**DEADLINES**
- June 1 Notification of intent
- Sept. 1 Completed application form with abstract
- Sept. 1 Start of Academic Year and Honours Program
- October 15 Research Proposal due
- January add/drop Mid-Year Review
- Last day of class in April Research project due
**BIOLOGY MAJOR PROGRAM, OPTION IN QUANTITATIVE BIOLOGY**

(73 credits)

Program Requirements

Interdisciplinary research that draws from the natural and physical sciences is an important aspect of modern biology. The Quantitative Biology option is designed for students with a deep interest in biology who wish to gain a strong grounding in physical sciences and their application to biological questions. The Quantitative Biology option has two streams: an ecology and evolutionary biology stream, and a physical biology stream. Both streams provide a balance of theory and experimental components.

**Advising notes for U0 students**

It is highly recommended that freshman BIOL, CHEM, MATH, and PHYS courses be selected with the Program Advisor to ensure they meet the core requirements of the Quantitative Biology option.

(Program Advisor: Nancy Nelson, nancy.nelson@mcgill.ca; or Coordinator of the QB Option: Dr. Jackie Vogel, jackie.vogel@mcgill.ca)

This program is recommended for U1 students achieving a CGPA of 3.20 or better; and entering CEGEP students with a Math/Science R-score of 28.0 or better.

**Required Courses (43 credits)**

**Bio-Physical Sciences Core (31 credits)**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>BIOL 219</td>
<td>Physical Biology of the Cell</td>
</tr>
<tr>
<td>4</td>
<td>BIOL 301</td>
<td>Cell and Molecular Laboratory</td>
</tr>
<tr>
<td>1</td>
<td>BIOL 395</td>
<td>Quantitative Biology Seminar</td>
</tr>
<tr>
<td>4</td>
<td>CHEM 212*</td>
<td>Introductory Organic Chemistry I</td>
</tr>
<tr>
<td>3</td>
<td>COMP 204**</td>
<td>Computer Programming for Life Sciences</td>
</tr>
<tr>
<td>3</td>
<td>MATH 222*</td>
<td>Calculus 3</td>
</tr>
<tr>
<td>3</td>
<td>MATH 223</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>3</td>
<td>MATH 315</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>3</td>
<td>MATH 323</td>
<td>Probability</td>
</tr>
<tr>
<td>3</td>
<td>MATH 324</td>
<td>Statistics</td>
</tr>
</tbody>
</table>

*Students who have taken the equivalent of CHEM 212 or MATH 222 can make up the credits with complementary 3 or 4 credit courses in consultation with a stream adviser.

**Students who have sufficient knowledge of programming should take COMP 250 Introduction to Computer Science rather than COMP 204

Biology (6 credits):

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BIOL 202</td>
<td>Basic Genetics</td>
</tr>
<tr>
<td>3</td>
<td>BIOL 215</td>
<td>Introduction to Ecology and Evolution</td>
</tr>
</tbody>
</table>

Physics (6 credits)

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>PHYS 230</td>
<td>Dynamics of Simple Systems</td>
</tr>
<tr>
<td>3</td>
<td>PHYS 232</td>
<td>Heat and Waves</td>
</tr>
</tbody>
</table>

Course requirements for Quantitative Biology Streams (21 credits)

21 credits from one of the following two streams:

**Stream 1: Theoretical Ecology and Evolutionary Biology (21 credits)**

Biology: 12 credits:

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BIOL 205</td>
<td>Biology of Organisms</td>
</tr>
<tr>
<td>3</td>
<td>BIOL 206</td>
<td>Methods in Biology of Organisms</td>
</tr>
</tbody>
</table>
Field Courses  3 credits from the following list or any other field course with permission:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 240</td>
<td>Monteregian Flora</td>
</tr>
<tr>
<td>BIOL 331</td>
<td>Ecology/Behaviour Field Course</td>
</tr>
<tr>
<td>BIOL 334 D1/D2</td>
<td>Applied Tropical Ecology</td>
</tr>
<tr>
<td>BIOL 432</td>
<td>Limnology</td>
</tr>
</tbody>
</table>

6 credits chosen from the following list at the 400-level or above:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 432</td>
<td>Limnology</td>
</tr>
<tr>
<td>BIOL 434</td>
<td>Theoretical Ecology</td>
</tr>
<tr>
<td>BIOL 435</td>
<td>Natural Selection</td>
</tr>
<tr>
<td>BIOL 465</td>
<td>Conservation Biology</td>
</tr>
<tr>
<td>BIOL 509</td>
<td>Methods in Molecular Ecology</td>
</tr>
<tr>
<td>BIOL 510</td>
<td>Advances in Community Ecology</td>
</tr>
<tr>
<td>BIOL 515</td>
<td>Advances in Aquatic Ecology</td>
</tr>
<tr>
<td>BIOL 540</td>
<td>Ecology of Species Invasions</td>
</tr>
<tr>
<td>BIOL 594</td>
<td>Advanced Evolutionary Ecology</td>
</tr>
<tr>
<td>BIOL 596*</td>
<td>Advanced Experimental Design</td>
</tr>
<tr>
<td>BIOL 597*</td>
<td>Advanced Biostatistics</td>
</tr>
<tr>
<td>BIOL 598*</td>
<td>Advanced Design and Statistics</td>
</tr>
</tbody>
</table>

* Students choose either both BIOL 596 and BIOL 597, or BIOL 598

Stream 2: Physical Biology (21 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 319</td>
<td>Introduction to Biophysics</td>
</tr>
<tr>
<td>PHYS 329</td>
<td>Statistical Physics with Biophysical Application</td>
</tr>
<tr>
<td>PHYS 446</td>
<td>Majors Quantum Physics</td>
</tr>
</tbody>
</table>

300-level complementary courses: 6 credits from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 300</td>
<td>Molecular Biology of the Gene</td>
</tr>
<tr>
<td>BIOL 303</td>
<td>Developmental Biology</td>
</tr>
<tr>
<td>BIOL 306</td>
<td>Neural Basis of Behavior</td>
</tr>
<tr>
<td>BIOL 309</td>
<td>Mathematical Models in Biology</td>
</tr>
<tr>
<td>BIOL 313</td>
<td>Eukaryotic Cell Biology</td>
</tr>
</tbody>
</table>

500-level complementary courses: 6 credits from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 518</td>
<td>Advanced Topics in Cell Biology</td>
</tr>
<tr>
<td>BIOL 520</td>
<td>Gene Activity in Development</td>
</tr>
<tr>
<td>BIOL 524</td>
<td>Topics in Molecular Biology</td>
</tr>
<tr>
<td>BIOL 530</td>
<td>Advances in Neuroethology</td>
</tr>
<tr>
<td>BIOL 551</td>
<td>Principles of Cellular Control</td>
</tr>
<tr>
<td>BIOL 588</td>
<td>Advances in Molecular/Cellular Neurobiology</td>
</tr>
</tbody>
</table>

Complementary Courses (9 credits)

Quantitative Biology - Theoretical Ecology and Evolutionary Biology, and Physical Biology streams

Note: QB students may not use BIOL 592 as a Program course

9 credits from the following:

Recommendations for either Theoretical & Evolutionary Biology or Physical Biology streams

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 466</td>
<td>Independent Research Project 1</td>
</tr>
<tr>
<td>COMP 206</td>
<td>Introduction to Software Systems</td>
</tr>
<tr>
<td>COMP 250</td>
<td>Introduction to Computer Science</td>
</tr>
<tr>
<td>COMP 251</td>
<td>Algorithms and Data Structures</td>
</tr>
<tr>
<td>COMP 350*</td>
<td>Numerical Computing</td>
</tr>
<tr>
<td>MATH 235**</td>
<td>Algebra 1</td>
</tr>
<tr>
<td>MATH 240**</td>
<td>Discrete Structures 1</td>
</tr>
<tr>
<td>MATH 314</td>
<td>Advanced Calculus</td>
</tr>
<tr>
<td>MATH 317*</td>
<td>Numerical Analysis</td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>MATH 319</td>
<td>Introduction to Partial Differential Equations</td>
</tr>
<tr>
<td>MATH 326</td>
<td>Nonlinear Dynamics and Chaos</td>
</tr>
<tr>
<td>MATH 327</td>
<td>Matrix Numerical Analysis</td>
</tr>
<tr>
<td>MATH 348</td>
<td>Topics in Geometry</td>
</tr>
<tr>
<td>MATH 437</td>
<td>Mathematical Methods in Biology</td>
</tr>
<tr>
<td>MATH 447</td>
<td>Introduction to Stochastic Processes</td>
</tr>
</tbody>
</table>

*Students may take COMP 350 or MATH 317

** MATH 235 or MATH 240 is required as a pre-req for COMP 251

**Recommendations for the Physical Biology Stream**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIEN 310</td>
<td>Introduction to Biomolecular Engineering</td>
</tr>
<tr>
<td>BIEN 320</td>
<td>Molecular, Cellular and Tissue Biomechanics</td>
</tr>
<tr>
<td>BIEN 340</td>
<td>Transport Processes in Biological Systems</td>
</tr>
<tr>
<td>BIEN 510</td>
<td>Nanoparticles in the Medical Sciences</td>
</tr>
<tr>
<td>BIEN 530</td>
<td>Imaging and Bioanalytical Instrumentation</td>
</tr>
<tr>
<td>CHEM 222</td>
<td>Introductory Organic Chemistry 2</td>
</tr>
<tr>
<td>PHYS 242*</td>
<td>Electricity and Magnetism</td>
</tr>
<tr>
<td>PHYS 257</td>
<td>Experimental Methods 1</td>
</tr>
<tr>
<td>PHYS 342</td>
<td>Majors Electromagnetic Waves</td>
</tr>
<tr>
<td>PHYS 434</td>
<td>Optics</td>
</tr>
<tr>
<td>PHYS 519</td>
<td>Advanced Biophysics</td>
</tr>
<tr>
<td>PHYS 534</td>
<td>Nanoscience and Nanotechnology</td>
</tr>
</tbody>
</table>

*PHYS 242 is required for PHYS 342 and PHYS 434

**Recommendations for Theoretical Ecology and Evolutionary Biology Stream**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 310</td>
<td>Biodiversity and Ecosystems</td>
</tr>
<tr>
<td>BIOL 324</td>
<td>Ecological Genetics</td>
</tr>
<tr>
<td>MATH 242</td>
<td>Analysis 1</td>
</tr>
<tr>
<td>MATH 340</td>
<td>Discrete Structures 2</td>
</tr>
<tr>
<td>MATH 423</td>
<td>Regression and Analysis of Variance</td>
</tr>
<tr>
<td>MATH 524</td>
<td>Nonparametric Statistics</td>
</tr>
<tr>
<td>MATH 525</td>
<td>Sampling Theory and Applications</td>
</tr>
<tr>
<td>PHYS 329</td>
<td>Statistical Physics with Biophysical Application</td>
</tr>
</tbody>
</table>

Notes:

Option coordinator: Jackie Vogel (Biology)

Stream advisors: Axel Hundemer (Mathematics)
Paul Francois (Physics)
Mathieu Blanchette, Jerome Waldispühl (Comp Sci.)
HONOURS IN BIOLOGY, QUANTITATIVE BIOLOGY OPTION
(79 credits)

Students must attain a 3.50 CGPA to enter (in U3) and to complete the Honours QB option. First Class Honours will be awarded to students in the QB Honours Option graduating with a CGPA of 3.75 or greater.

Required Courses (49 credits)

Bio-Physical Sciences Core (31 credits)

(4) BIOL 219  Physical Biology of the Cell
(4) BIOL 301  Cell and Molecular Laboratory
(1) BIOL 395  Quantitative Biology Seminar
(4) CHEM 212*  Introductory Organic Chemistry 1
(3) COMP 204**  Computer Programming for Life Sciences
(3) MATH 222*  Calculus 3
(3) MATH 223***  Linear Algebra
(3) MATH 247***  Honours Applied Linear Algebra
(3) MATH 315+  Ordinary Differential Equations
(3) MATH 325+  Honours Ordinary Differential Equations
(3) MATH 323++  Probability
(3) MATH 356++  Honours Probability (3 credits)
(3) MATH 324+++  Statistics
(3) MATH 357+++  Honours Statistics (3 credits)

*Students who have taken the equivalent of CHEM 212 or MATH 222 can make up the credits with complementary 3 or 4 credit courses in consultation with a stream adviser.

** Students who have sufficient knowledge of programming should take COMP 250 Introduction to Computer Science rather than COMP 204

*** Students take either MATH 223 or MATH 247

Students take either MATH 324 or MATH 357

++ Students take either MATH 323 or MATH 356

Students take either MATH 324 or MATH 357

Note: 6 credits of either MATH or PHYS courses to be taken at the honours level. Honours equivalents of core Math and Physics courses are listed. All 500-level Math courses are considered as honours courses and can be applied to the 6-credit requirement

Biology (6 credits):

(3) BIOL 202  Basic Genetics
(3) BIOL 215  Introduction to Ecology and Evolution

Research Component (6 credits)

(6) BIOL 468  Independent Research Project 3

Physics (6 credits)

(3) PHYS 230*  Dynamics of Simple Systems
(3) PHYS 232**  Heat and Waves
(3) PHYS 251*  Honours Classical Mechanics
(3) PHYS 253**  Thermal Physics

*Students take PHYS 230 or PHYS 251

**Students take PHYS 232 or PHYS 253
Course requirements for Quantitative Biology Streams

21 credits from one of the following two streams:

Stream 1: Theoretical Ecology and Evolutionary Biology (21 credits)

Biology: 12 credits:
(3) BIOL 205 Biology of Organisms
(3) BIOL 206 Methods in Biology of Organisms
(3) BIOL 304 Evolution
(3) BIOL 308 Ecological Dynamics

Field Courses 3 credits from the following list or any other field course with permission:
(3) BIOL 240 Monteregian Flora
(3) BIOL 331 Ecology/Behaviour Field Course
(3) BIOL 334 D1/D2 Applied Tropical Ecology
(3) BIOL 432 Limnology

6 credits chosen from the following list at the 400-level or above:
(3) BIOL 432 Limnology
(3) BIOL 434 Theoretical Ecology
(3) BIOL 435 Natural Selection
(3) BIOL 465 Conservation Biology
(3) BIOL 509 Methods in Molecular Ecology
(3) BIOL 510 Advances in Community Ecology
(3) BIOL 515 Advances in Aquatic Ecology
(3) BIOL 540 Ecology of Species Invasions
(3) BIOL 594 Advanced Evolutionary Ecology
(1) BIOL 596* Advanced Experimental Design
(2) BIOL 597* Advanced Biostatistics
(3) BIOL 598* Advanced Design and Statistics
* Students choose either both BIOL 596 and BIOL 597, or BIOL 598

Stream 2: Physical Biology (21 credits)

9 credits
(3) BIOL 319* Introduction to Biophysics
(3) PHYS 319* Introduction to Biophysics
(3) PHYS 329 Statistical Physics with Biophysical Application
(3) PHYS 446 Majors Quantum Physics

*Students choose either BIOL 319 or PHYS 319

300-level complementary courses: 6 credits from the following:
(3) BIOL 300 Molecular Biology of the Gene
(3) BIOL 303 Developmental Biology
(3) BIOL 306 Neural Basis of Behavior
(3) BIOL 309 Mathematical Models in Biology
(3) BIOL 313 Eukaryotic Cell Biology

500-level complementary courses: 6 credits from the following:
(3) BIOL 518 Advanced Topics in Cell Biology
(3) BIOL 520 Gene Activity in Development
(3) BIOL 524 Topics in Molecular Biology
(3) BIOL 530 Advances in Neuroethology
(3) BIOL 551 Principles of Cellular Control
(3) BIOL 588 Advances in Molecular/Cellular Neurobiology

Complementary Courses (9 credits)
Quantitative Biology - Theoretical Ecology and Evolutionary Biology, and Physical Biology streams

Note: QB students may not use BIOL 592 as a Program course.

9 credits from the following:
Recommendations for either Theoretical and Evolutionary Biology or Physical Biology streams

(3) COMP 206  Introduction to Software Systems
(3) COMP 250  Introduction to Computer Science
(3) COMP 251  Algorithms and Data Structures
(3) COMP 350*  Numerical Computing
(3) MATH 235**  Algebra 1
(3) MATH 240**  Discrete Structures 1
(3) MATH 314  Advanced Calculus
(3) MATH 317*  Numerical Analysis
(3) MATH 319  Introduction to Partial Differential Equations
(3) MATH 326  Nonlinear Dynamics and Chaos
(3) MATH 327  Matrix Numerical Analysis
(3) MATH 348  Topics in Geometry
(3) MATH 437  Mathematical Methods in Biology
(3) MATH 447  Introduction to Stochastic Processes

*Students may take COMP 350 or MATH 317
** MATH 235 or MATH 240 is required as a pre-req for COMP 251

Recommendations for the Physical Biology Stream

(3) BIEN 310  Introduction to Biomolecular Engineering
(3) BIEN 320  Molecular, Cellular and Tissue Biomechanics
(3) BIEN 340  Transport Processes in Biological Systems
(3) BIEN 510  Nanoparticles in the Medical Sciences
(3) BIEN 530  Imaging and Bioanalytical Instrumentation
(4) CHEM 222  Introductory Organic Chemistry 2
(2) PHYS 242*  Electricity and Magnetism
(3) PHYS 257  Experimental Methods 1
(3) PHYS 342  Majors Electromagnetic Waves
(3) PHYS 434  Optics
(3) PHYS 519  Advanced Biophysics
(3) PHYS 534  Nanoscience and Nanotechnology

*PHYS 242 is required for PHYS 342 and PHYS 434

Recommendations for Theoretical Ecology and Evolutionary Biology Stream

(3) BIOL 310  Biodiversity and Ecosystems
(3) BIOL 324  Ecological Genetics
(3) MATH 242  Analysis 1
(3) MATH 340  Discrete Structures 2
(3) MATH 423  Regression and Analysis of Variance
(4) MATH 524  Nonparametric Statistics
(4) MATH 525  Sampling Theory and Applications
(3) PHYS 329  Statistical Physics with Biophysical Application

Notes:
Option coordinator: Jackie Vogel (Biology)
Stream advisors:  Axel Hundemer (Mathematics)
    Paul Francois (Physics)
    Matthieu Blanchette, Jerome Waldispuhl (Comp Sci.)
JOINT MAJOR IN BIOLOGY AND MATHEMATICS (76 credits)

This program is built on a selection of mathematics and biology courses that recognizes mathematical biology as a field of research, with 3 streams within biology: Ecology and Evolutionary Ecology, Molecular Evolution, and Neurosciences.

Program coordinators: Frederic Guichard (Biology) and Axel Hundemer (Mathematics).

Advising notes for U0 students

It is highly recommended that freshman BIOL, CHEM, MATH, and PHYS courses be selected with an advisor to ensure they meet the core requirements of the program.

This program is recommended for U1 students achieving a CGPA of 3.2 or better; and entering CEGEP students with a Math/Science R-score of 28.0 or better

Required courses (37 credits)

Bio-Physical Sciences Core (28 credits)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BIOL 219</td>
<td>Physical Biology of the Cell</td>
</tr>
<tr>
<td>4</td>
<td>BIOL 301</td>
<td>Cell &amp; Molecular Biology Laboratory</td>
</tr>
<tr>
<td>1</td>
<td>BIOL 395</td>
<td>Quantitative Biology Seminar</td>
</tr>
<tr>
<td>4</td>
<td>CHEM 212</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>3</td>
<td>* COMP 204</td>
<td>Computer Programming for Life Sciences</td>
</tr>
<tr>
<td>3</td>
<td>* MATH 222</td>
<td>Calculus 3</td>
</tr>
<tr>
<td>3</td>
<td>*** MATH 223</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>3</td>
<td>or *** MATH 247</td>
<td>Honours Applied Linear Algebra</td>
</tr>
<tr>
<td>3</td>
<td>MATH 315</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>3</td>
<td>MATH 323</td>
<td>Probability</td>
</tr>
</tbody>
</table>

* If a student has already taken CHEM 212 or its equivalent, or MATH 222 or its equivalent, the credits can be made up with complementary courses in consultation with the Program Adviser.

** Students who have sufficient knowledge in a programming language should take COMP 250 "Introduction to Computer Science" rather than COMP 204.

*** Students may take either MATH 223 or MATH 247.

Biology and Mathematics Core (9 credits)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BIOL 215</td>
<td>Introduction to Ecology and Evolution</td>
</tr>
<tr>
<td>3</td>
<td>MATH 242</td>
<td>Analysis 1</td>
</tr>
<tr>
<td>3</td>
<td>MATH 243</td>
<td>Analysis 2</td>
</tr>
</tbody>
</table>

Complementary Courses (39 credits)

For the 39 credits, students complete 21 credits of BIOL, NEUR, PHGY, PSYC courses including one of three streams (Ecology and Evolutionary Ecology, Molecular Evolution, Neurosciences); And 18 credits of MATH courses

Math or Biology Research Course (3 credits)

Note: Students selecting a BIOL course count this toward their 21 credits of BIOL, NEUR, PHGY, PSYC courses while students selecting a MATH course count this toward their 18 credits of MATH courses.

3-6 credits from the following Math or Biology Research courses:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BIOL 466</td>
<td>Independent Research Project 1</td>
</tr>
<tr>
<td>3</td>
<td>BIOL 467</td>
<td>Independent Research Project 2</td>
</tr>
<tr>
<td>6</td>
<td>BIOL 468</td>
<td>Independent Research Project 3</td>
</tr>
<tr>
<td>3</td>
<td>MATH 410</td>
<td>Majors Project</td>
</tr>
</tbody>
</table>

Of the remaining complementary courses, at least 6 credits must be at the 400-level or above.
MATH Courses
15 credits (if MATH 410 was selected as research course) or 18 credits of MATH courses chosen from Stream 1 or 2 and from "Remaining Math Courses" as follows:

Stream 1 Theory: 12 credits from the following courses
3
MATH 314 Advanced Calculus
3
*MATH 317 Numerical analysis
3
MATH 319 Introduction to Partial Differential Equations
3
MATH 326 Nonlinear Dynamics and Chaos
3
*MATH 327 Matrix Numerical Analysis
* Students may take either MATH 317 or MATH 327

Stream 2 Statistics: 9 credits from the following:
3
MATH 324 Statistics
3
MATH 423 Regression and Analysis of Variance
3
MATH 447 Stochastic Processes

Remaining Math Courses
The remaining 3-9 credits of MATH courses may be chosen from any of the two preceding streams and/or from the following list:
3
MATH 204 Principles of Statistics 2
3
MATH 340 Discrete Structures 2
3
MATH 437 Mathematical Methods in Biology
4
MATH 523 Generalized Linear Models
4
MATH 524 Nonparametric Statistics
4
MATH 525 Sampling Theory and Applications

BIOL, NEUR, PHGY, PHYS, PSYC courses
18 credits (if 3 credit BIOL research course was selected) or 15 credits (if 6 credit BIOL research course was selected) or 21 credits (if a MATH research course was selected) of BIOL, NEUR, PHGY, PHYS, PSYC courses including one of three streams.

Note: Some courses in the streams may have prerequisites.

Ecology and Evolutionary Ecology stream
At least 15 credits selected as follows:
3
BIOL 206 Methods in Biology of Organisms
3 credits from the following field courses or any other field course, with permission
3
BIOL 331 Ecology/Behaviour field course
3
BIOL 334D1/D2 Applied Tropical Ecology
3
BIOL 432 Limnology
3
BIOL 573 Vertebrate Palaeontology Field Course
At least 9 credits chosen from the following list:
3
BIOL 202 Basic Genetics
3
BIOL 205 Biology of Organisms
3
BIOL 304 Evolution
3
BIOL 305 Animal Diversity
3
BIOL 308 Ecological Dynamics
3
BIOL 310 Biodiversity & Ecosystems
3
BIOL 324 Ecological Genetics – requires BIOL 202
3
BIOL 434 Theoretical Ecology
3
BIOL 509 Methods in Molecular Ecology
3
BIOL 569 Developmental Evolution
3
BIOL 594 Advanced Evolutionary Ecology

Molecular Evolution Stream
At least 15 credits selected as follows:
3
    BIOL 202 Basic Genetics

At least 12 credits chosen from the following list:
3
    BIOL 303 Developmental Biology
3
    BIOL 304 Evolution
3
    BIOL 313 Eukaryotic Cell Biology
3
    BIOL 518 Advanced Topics in Cell Biology (requirements: see notes)
3
    BIOL 569 Developmental Evolution
3
    BIOL 592 Integrated Bioinformatics

**Neurosciences Stream**

At least 15 credits selected as follows:
3
    BIOL 306 Neural Basis of Behaviour

At least 12 credits selected from:
3
    BIOL 202 Basic Genetics
3
    BIOL 320 Evolution of Brain and Behaviour
3
    BIOL 389 Laboratory in Neurobiology
3
    BIOL 530 Advances in Neuroethology
3
    BIOL 580 Genetic Approaches to Neural Systems
3
    NEUR 310 Cellular Neurobiology
3
    NEUR 507 Topics in Radionuclide Imaging
3
    NEUR 570 Human Brain Imaging
3
    PHGY 314 Integrative Neuroscience
3
    PHGY 425 Analyzing Physiological Systems
3
    PHGY 552 Cell and Molecular Physiology
3
    PSYC 427 Sensorimotor Behaviour
3
    PSYT 455 Neurochemistry
3
    PSYT 502 Brain Evolution and Psychiatry

**Remaining BIOL, NEUR, PHGY, PSYC**

For the remaining BIOL, NEUR, PHGY, PSYC complementary course credits, if any, students top up their credits to the necessary 18-21 credits with any course listed in the above three streams. Other relevant courses may be substituted with the approval of the Program Adviser.

*Note: In the Ecology and Evolution stream, as well as in the Neuroscience stream, BIOL 202 should be taken as a complementary since it is a strictly enforced pre-requisite for BIOL 301*

*Program coordinators: Frederic Guichard (Biology), Axel Hundemer (Mathematics).*
JOINT MAJOR IN COMPUTER SCIENCE AND BIOLOGY (63 - 74 CREDITS)

This program will train students in the fundamentals of Biology and will give them the computational and mathematical skills needed to manage, analyze and model large biological datasets. Two integrative features of the program are a three-credit joint independent studies course (COMP 401), and a one-credit seminar (BIOL 395).

Students may complete this program with a minimum of 63 credits or a maximum of 74 credits. This depends upon the student’s choice of required courses and whether or not the student is exempt from taking COMP 204, CHEM 212 and MATH 222.

Program Prerequisites:

To ensure they meet the core requirements of the program, it is highly recommended that the following courses be selected by U0 (Freshman) students: BIOL 111-112, CHEM 110-120, MATH 133, MATH 140-141 or MATH 150-151, PHYS 101-102 or PHYS 131-142. Note that MATH 150-151 provides equivalence for required course MATH 222. It is also advisable to take COMP 204 during U0, if possible.

Required Courses (36-46 credits)

**Bio-Physical Sciences Core**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>BIOL 219</td>
<td>Physical Biology of the Cell</td>
</tr>
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<td>BIOL 301</td>
<td>Cell and Molecular Laboratory</td>
</tr>
<tr>
<td>1</td>
<td>BIOL 395</td>
<td>Quantitative Biology Seminar 1</td>
</tr>
<tr>
<td>4</td>
<td>*CHEM 212</td>
<td>Introductory Organic Chemistry 1</td>
</tr>
<tr>
<td>3</td>
<td>**COMP 204</td>
<td>Computer Programming for Life Sciences</td>
</tr>
<tr>
<td>3</td>
<td>*MATH 222</td>
<td>Calculus 3 (3 credits)*</td>
</tr>
<tr>
<td>3</td>
<td>MATH 223</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>3</td>
<td>MATH 323</td>
<td>Probability</td>
</tr>
</tbody>
</table>

**Computer Science and Mathematics**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>COMP 206</td>
<td>Introduction to Software Systems</td>
</tr>
<tr>
<td>3</td>
<td>COMP 250</td>
<td>Introduction to Computer Science</td>
</tr>
<tr>
<td>3</td>
<td>COMP 251</td>
<td>Algorithms and Data Structures</td>
</tr>
<tr>
<td>3</td>
<td>MATH 240</td>
<td>Discrete Structures 1</td>
</tr>
</tbody>
</table>

**Biology**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BIOL 202</td>
<td>Basic Genetics</td>
</tr>
<tr>
<td>3</td>
<td>BIOL 215</td>
<td>Introduction to Ecology and Evolution</td>
</tr>
</tbody>
</table>

**Joint**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>COMP 401</td>
<td>Project in Biology and Computer Science</td>
</tr>
</tbody>
</table>

* Students with CEGEP-level credit for the equivalents of MATH 222 and/or CHEM 212 (see [http://www.mcgill.ca/students/courses/plan/transfer/](http://www.mcgill.ca/students/courses/plan/transfer/) for accepted equivalents) may not take these courses at McGill and should replace them with elective courses to satisfy the total credit requirement for their degree.

**Students who have sufficient knowledge in a programming language are not required to take COMP 204**

**Complementary Courses (27-28 credits)**

3-4 credits from the following:

<table>
<thead>
<tr>
<th>Credits</th>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>COMP 462</td>
<td>Computational Biology Methods</td>
</tr>
<tr>
<td>4</td>
<td>COMP 561</td>
<td>Computational Biology Methods and Research</td>
</tr>
</tbody>
</table>

3-6 credits from the following:

<table>
<thead>
<tr>
<th>Credits</th>
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</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>MATH 315</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>3</td>
<td>MATH 324</td>
<td>Statistics</td>
</tr>
</tbody>
</table>

The remaining 18-21 credits is to be chosen from the following, with at least 9 credits at the 400 level or above:
Computer Science Block
9-12 credits from the following, with 3-6 credits at the 400 level or above:
All courses at the 400 level or above (except COMP 400, 401, 499, 462, 561)
3 COMP 273 Introduction to Computer Systems
3 COMP 302 Programming Languages and Paradigms
3 COMP 303 Software Development
2 COMP 307 Principles of Web Development
3 COMP 310 Operating Systems
1 COMP 322 Introduction to C++
3 COMP 330 Theory of Computation
3 COMP 350 Numerical Computing
3 COMP 360 Algorithm Design
6 ** COMP 361 D1/D2 Software Engineering Project
**Students must take both COMP 361D1 and COMP 361D2

Biology Block
9-12 credits from the following, with 3-6 credits at the 400 level or above
3 BIOL 300 Molecular Biology of the Gene
3 BIOL 303 Developmental Biology
3 BIOL 304 Evolution
3 BIOL 306 Neural Basis of Behaviour
3 BIOL 308 Ecological Dynamics
3 BIOL 309 Mathematical Models in Biology
3 BIOL 310 Biodiversity and Ecosystems
3 BIOL 313 Eukaryotic Cell Biology
3 BIOL 314 Molecular Biology of Oncogenes
3 BIOL 319 Introduction to Biophysics
3 BIOL 320 Evolution of Brain and Behaviour
3 BIOL 370 Human Genetics Applied
3 BIOL 389 Laboratory in Neurobiology
3 BIOL 416 Genetics of Mammalian Development
3 BIOL 434 Theoretical Ecology
3 BIOL 435 Natural Selection
3 BIOL 509 Methods in Molecular Ecology
3 BIOL 514 Neurobiology of Learning and Memory
3 BIOL 518 Advanced Topics in Cell Biology
3 BIOL 520 Gene Activity in Development
3 BIOL 524 Topics in Molecular Biology
3 BIOL 530 Advances in Neuroethology
3 BIOL 532 Developmental Neurobiology Seminar
3 BIOL 546 Genetics of Model Systems
3 BIOL 551 Principles of Cellular Control
3 BIOL 568 Topics of the Human Genome
3 BIOL 569 Developmental Evolution
3 BIOL 575 Human Biochemical Genetics
3 BIOL 580 Genetic Approaches to Neural Systems
3 BIOL 588 Advances in Molecular/Cellular Neurobiology
3 NEUR 310 Cellular Neurobiology

Notes:

BIOL 592 is NOT an acceptable complementary course in this program

Program coordinators: Mathieu Blanchette, Bettina Kemme, Derek Ruths (Computer Science) and Jackie Vogel (Biology)
**JOINT HONOURS IN COMPUTER SCIENCE & BIOLOGY (66-77 credits)**

This honours program will train students in the fundamentals of biology - with a focus on molecular biology - and will give them computational and mathematical skills needed to manage, analyze, and model large biological datasets. Two integrative features of the program are a six-credit joint independent studies course, and a one-credit seminar. Compared to its non-Honours counterpart, the Honours program requires additional research credits and a larger number of advanced courses. Students must have and maintain a minimum CGPA of 3.5. Students may complete this program with a minimum of 66 credits or a maximum of 79 credits. This depends upon the student's choice of required courses and whether or not the student is exempt from taking COMP 204, CHEM 212 and MATH 222.

Program prerequisites: To ensure they meet the core requirements of the program, it is highly recommended that the following courses be selected by U0 (Freshman) students: BIOL 111-112, CHEM 110-120, MATH 133, MATH 140-141 or MATH 150-151, PHYS 101-102 or PHYS 131-142. Note that MATH 150-151 provides equivalence for required course MATH 222. It is also advisable to take COMP 204 during U0 if possible. It is highly recommended that Freshman BIOL, CHEM, MATH, and PHYS courses be selected with an adviser to ensure they meet the core requirements of the COMP-BIO program.

*Note that students with CEGEP-level credits for the equivalents of MATH 222 and CHEM 212 may not take these courses at McGill and should replace them with elective courses to satisfy the total credit requirement for their degree.*

**Required Courses (39-49 credits)**

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<td>Discrete Structures 1</td>
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</tr>
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<tbody>
<tr>
<td>6</td>
<td>COMP 402D1/D2</td>
<td>Honours Project in Biology and Computer Science</td>
</tr>
</tbody>
</table>

* Students with CEGEP-level credit for the equivalents of MATH 222 and/or CHEM 212 (see [http://www.mcgill.ca/students/courses/plan/transfer/](http://www.mcgill.ca/students/courses/plan/transfer/) for accepted equivalents) may not take these courses at McGill and should replace them with elective courses to satisfy the total credit requirement for their degree.

**Students who have sufficient knowledge in a programming language are not required to take COMP 204**

**Complementary Courses (27-28 credits)**

3-4 credits from the following:

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<td>4</td>
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</table>
3-6 credits from the following
3 MATH 315 Ordinary Differential Equations
3 MATH 324 Statistics

The remaining 18-21 credits is to be chosen from the following, with at least 9 credits at the 400 level or above:

**Computer Science Block**
9-12 credits from the following, with 3-6 credits at the 400 level or above:
All COMP courses at the 400 level or above (except COMP 400, 401, 499, 462, 561).

3 COMP 273 Introduction to Computer Systems
3 COMP 302 Programming Languages and Paradigms
3 COMP 303 Software Development
2 COMP 307 Principles of Web Development
3 COMP 310 Operating Systems
1 COMP 322 Introduction to C++
3 COMP 330 Theory of Computation
3 COMP 350 Numerical Computing
6 COMP 361 D1/D2 Software Engineering Project*
3 COMP 362 Honours Algorithm Design

*Students must take both COMP 361D1 and COMP 361D2

**Biology Block**
9-12 credits from the following, with 3-6 credits at the 400 level or above:
3 BIOL 300 Molecular Biology of the Gene
3 BIOL 303 Developmental Biology
3 BIOL 304 Evolution
3 BIOL 306 Neural Basis of Behaviour
3 BIOL 308 Ecological Dynamics
3 BIOL 309 Mathematical Models in Biology
3 BIOL 310 Biodiversity and Ecosystems
3 BIOL 313 Eukaryotic Cell Biology
3 BIOL 314 Molecular Biology of Oncogenes
3 BIOL 319 Introduction to Biophysics
3 BIOL 320 Evolution of Brain and Behaviour
3 BIOL 370 Human Genetics Applied
3 BIOL 389 Laboratory in Neurobiology
3 BIOL 416 Genetics of Mammalian Development
3 BIOL 434 Theoretical Ecology
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3 BIOL 532 Developmental Neurobiology Seminar
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3 BIOL 551 Principles of Cellular Control
3 BIOL 568 Topics of the Human Genome
3 BIOL 569 Developmental Evolution
3 BIOL 575 Human Biochemical Genetics
3 BIOL 580 Genetic Approaches to Neural Systems
3 BIOL 588 Advances in Molecular/Cellular Neurobiology
3 NEUR 310 Cellular Neurobiology

**Note:** BIOL 592 is NOT an acceptable complementary course in this program
MINOR PROGRAMS DIRECTED BY THE BIOLOGY DEPT

MINOR IN BIOLOGY (24 OR 25 CREDITS)

The Minor in Biology may be taken in conjunction with any primary program in the Faculty of Science (other than programs offered by the Department of Biology). Students are advised to consult the Undergraduate Advisor in Biology as early as possible (preferably during their U1 year), in order to plan their course selection. (Nancy Nelson, Stewart Biology Building, 398-4109 E-Mail: nancy.nelson@mcgill.ca)

Six credits of overlap are usually allowed between the Minor and the main program.

Required Courses (15 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 200</td>
<td>3</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>BIOL 201</td>
<td>3</td>
<td>Cell Biology and Metabolism</td>
</tr>
<tr>
<td>BIOL 202</td>
<td>3</td>
<td>Basic Genetics</td>
</tr>
<tr>
<td>BIOL 205</td>
<td>3</td>
<td>Biology of Organisms</td>
</tr>
<tr>
<td>BIOL 215</td>
<td>3</td>
<td>Introduction to Ecology and Evolution</td>
</tr>
</tbody>
</table>

Complementary Courses (9 or 10 credits)

To include
CHEM 212* (4) Introductory Organic Chemistry 1

Plus an additional 2 courses from the Biology Department's course offerings, at the 300 level or above.

*Students who have already taken CHEM 212 or its equivalent will choose another appropriate course, to be approved by the advisor.

MINOR IN BIOTECHNOLOGY: (24 CREDITS)

Biotechnology, the science of understanding, selecting and promoting useful organisms and specific gene products for commercial and therapeutic purposes, is the success story of this generation. It demands a broad comprehension of biology and engineering as well as detailed knowledge of at least one basic subject such as molecular genetics, protein chemistry, microbiology, or chemical engineering.

The Minor in Biotechnology is offered by the Faculties of Engineering and of Science and students combine the Minor with the regular departmental Major (or Honours) program. The Minor emphasizes an area relevant to biotechnology which is complementary to the main program.

Students should identify their interest in the Biotechnology Minor to their departmental academic advisor and to the Program Supervisor of the Minor and at the time of registration for the U2 year, should declare their intent to embark on the Minor. Before registering for the Minor and with the agreement of the Academic Advisor, students must submit their course list to the Program Supervisor who will certify that the student's complete program conforms to the requirements for the Minor. Students should ensure that they will have fulfilled the prerequisite requirements for the courses selected.

Additional information on the program may be obtained from

Program Director: Prof. Elias Georges, Inst. of Parasitology, Macdonald Campus
398-8137/elias.georges@mcgill.ca.
Program Advisor: Nancy Nelson, Stewart Biology N7/9B, 398-4109/nancy.nelson@mcgill.ca
Engineering students should consult the Student Centre, Frank Dawson Adams Room 22
General Regulations

To obtain the Minor in Biotechnology, students must:

a) Satisfy the requirements both for the departmental program and for the Minor
b) Complete 24 credits, 18 of which must be exclusively for the Minor program
c) Obtain a grade of C or better in all courses presented for the Minor.

Required Courses (15 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 200</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>BIOL 201</td>
<td>Cell Biology &amp; Metabolism</td>
</tr>
<tr>
<td>or BIOT 212</td>
<td>Molecular Mechanisms of Cell Function</td>
</tr>
<tr>
<td>BIOL 202</td>
<td>Basic Genetics</td>
</tr>
<tr>
<td>BIOT 505</td>
<td>Selected Topics in Biotechnology</td>
</tr>
<tr>
<td>MIMM 211</td>
<td>Introductory Microbiology</td>
</tr>
</tbody>
</table>

Complementary Courses (9 credits)

9 credits selected from courses outside the department of the student's main program. Students may select three courses from one of the lists below, or may choose three alternate courses with the advisor’s approval. In the case of more than 6 credits of potentially overlapping courses, students add additional complementary courses to replace the credits.

Biomedicine

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANAT 541</td>
<td>Cell and Molecular Biology of Aging</td>
</tr>
<tr>
<td>EXMD 504</td>
<td>Biology of Cancer</td>
</tr>
<tr>
<td>PATH 300</td>
<td>Human Disease</td>
</tr>
</tbody>
</table>

Chemical Engineering

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEE 200</td>
<td>Introduction to Chemical Engineering</td>
</tr>
<tr>
<td>CHEE 204</td>
<td>Chemical Manufacturing Processes</td>
</tr>
<tr>
<td>CHEE 474</td>
<td>Biochemical Engineering</td>
</tr>
</tbody>
</table>

Chemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>CHEM 382</td>
<td>Organic Chemistry: Natural Products</td>
</tr>
<tr>
<td>CHEM 502</td>
<td>Advanced Bio-organic Chemistry</td>
</tr>
<tr>
<td>CHEM 552</td>
<td>Physical Organic Chemistry</td>
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</table>

Immunology

<table>
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<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANAT 261</td>
<td>Introduction to Dynamic Histology</td>
</tr>
<tr>
<td>BIOT 503</td>
<td>Immunoochemistry</td>
</tr>
<tr>
<td>MIMM 214</td>
<td>Introductory Immunology: Elements of Immunity</td>
</tr>
<tr>
<td>MIMM 414</td>
<td>Advanced Immunology</td>
</tr>
<tr>
<td>PHGY 513</td>
<td>Cellular Immunology</td>
</tr>
</tbody>
</table>

Management

<table>
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<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ECON 208</td>
<td>Microeconomic Analysis and Applications</td>
</tr>
<tr>
<td>MGCR 211</td>
<td>Introduction to Financial Accounting</td>
</tr>
<tr>
<td>MGCR 341</td>
<td>Finance 1</td>
</tr>
<tr>
<td>MGCR 352</td>
<td>Marketing Management 1</td>
</tr>
<tr>
<td>MGCR 472</td>
<td>Operations Management</td>
</tr>
</tbody>
</table>

(These courses should be in addition to courses selected as credit towards a Management Minor.)

Microbiology

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>MIMM 323</td>
<td>Microbial Physiology</td>
</tr>
<tr>
<td>MIMM 324</td>
<td>Fundamental Virology</td>
</tr>
<tr>
<td>MIMM 413</td>
<td>Parasitology</td>
</tr>
<tr>
<td>MIMM 465</td>
<td>Bacterial Pathogenesis</td>
</tr>
<tr>
<td>MIMM 466</td>
<td>Viral Pathogenesis</td>
</tr>
<tr>
<td>Subject</td>
<td>Course Code</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Molecular Biology (Biology)</td>
<td>BIOL 300</td>
</tr>
<tr>
<td></td>
<td>BIOL 314</td>
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<td></td>
<td>BIOL 520</td>
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<td></td>
<td>BIOL 524</td>
</tr>
<tr>
<td></td>
<td>BIOL 551</td>
</tr>
<tr>
<td>Molecular Biology (Biochemistry)</td>
<td>BIOC 311</td>
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<td>CIVE 553</td>
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</tbody>
</table>

**MINOR CONCENTRATION IN SCIENCE FOR ARTS STUDENTS (18 CREDITS)**

*Note: This program is NOT open to Science students, but its required course, BIOL 210, is open – as an elective.*

Freshman students interested in this Minor Concentration should seek advice at the earliest opportunity, by contacting the Program Advisor. In general, students should declare their intention to obtain this Minor Concentration during their U1 year and consult the Program Advisor regarding approval of courses to meet the requirements.

This Minor Concentration is administered by the Department of Biology. For more information contact the program advisor, Ms. Nancy Nelson in the Biology Department, Stewart Biology Building N7/9B, 514-398-4109; or the Program Director, Professor Louis Lefebvre, Stewart Biology Building, 514-398-6457.

The Minor welcomes students who transfer from the faculty of science to the faculty of arts and want to include a coherent set of their previous science courses, but they should be aware that doing so in U3 cannot exempt them from completing all requirements of the program.

**REQUIRED COURSES (3 CREDITS)**

BIOL 210 (3) Perspectives of Science (usually taken in U1)

**COMPLEMENTARY COURSES (15 CREDITS)**

15 credits are taken in one of the disciplinary areas given below. Where suggested courses have prerequisites at the 200 or 300 level associated with them, credit for the associated prerequisites may also be counted as part of the 15 credits.

Courses at the 100 level cannot be counted towards the Minor Concentration.

With the prior written approval of the Program Advisor, an appropriate alternative set of courses may be substituted...
DISCIPLINARY AREAS

Atmospheric & Oceanic Sciences
Prerequisites which cannot be counted towards the Minor Concentration: MATH 140 and MATH 141 or equivalents; PHYS 101 or PHYS 131 and PHYS 102 or PHYS 142, or equivalents recommended

ATOC 214 (3) Introduction: Physics of the Atmosphere
ATOC 215 (3) Oceans, Weather and Climate
ATOC 309 (3) Weather Radars and Satellites
ATOC 315 (3) Thermodynamics and Convection
MATH 222 (3) Calculus 3

Biochemistry
Prerequisites which cannot be counted towards the Minor Concentration: BIOL 111 and BIOL 112 plus CHEM 110 and CHEM 120 or their equivalents.
15 credits taken from the following courses and their associated 200- or 300-level prerequisites

ANAT 262 (3) Introductory Molecular and Cell Biology
BIOC 212 (3) Molecular Mechanisms of Cell Function
BIOL 200 (3) Molecular Biology
CHEM 212 (4) Introductory Organic Chemistry 1
Students who have completed CHEM 212 and CHEM 222 or their equivalents may take one or both of the following:
BIOC 311 (3) Metabolic Biochemistry
BIOC 312 (3) Biochemistry of Macromolecules

Biology
Students interested in Biology can choose between two streams. One is oriented toward cell and molecular biology and leads to upper level courses in developmental biology, human genetics, molecular biology, or allied fields. The other is oriented more toward organismal biology and leads to upper level courses in biodiversity, ecology, neurobiology, behaviour, or conservation biology. See Ms. Nancy Nelson in the Biology Department, Stewart Biology Building, to arrange a counselling session on choice of courses above the 200 level.
Prerequisites which cannot be counted towards the Minor Concentration: BIOL 111 and BIOL 112 plus CHEM 110 and CHEM 120 or their equivalents; in addition, PHYS 101 or 131 for the Organismal Stream, and MATH 140 and PHYS 102 or 142 if taking BIOL 306

A) Cell and molecular stream: Note: CHEM 212 or its equivalent is a co-requisite for BIOL 200

BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 202 (3) Basic Genetics
CHEM 212 (4) Introductory Organic Chemistry 1

Plus a selected subset of these or related upper level courses:

BIOL 300 (3) Molecular Biology of the Gene
BIOL 303 (3) Developmental Biology
BIOL 313 (3) Eukaryotic Cell Biology
BIOL 314 (3) Molecular Biology of Oncogenes
BIOL 370 (3) Human Genetics Applied

B) Organismal stream: Note: CHEM 212 or its equivalent is a co-requisite for BIOL 200

BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 205 (3) Biology of Organisms
BIOL 215 (3) Introduction to Ecology and Evolution
CHEM 212  (4) Introductory Organic Chemistry 1

Plus a selected subset of these or related upper level courses:

<table>
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<th>Course</th>
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<tbody>
<tr>
<td>BIOL 304</td>
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<td>BIOL 310</td>
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<tr>
<td>BIOL 465</td>
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</table>

Chemistry

Prerequisites which cannot be counted towards the Minor Concentration: BIOL 112 and CHEM 110 and CHEM 120 or their equivalents; MATH 140 and PHYS 101 or PHYS 131 and PHYS 102 or PHYS 142 or their equivalents if taking CHEM 334.

The Department also strongly encourages students to take one or more courses involving a laboratory because the science of chemistry is rooted in laboratory experience.

Students select 15 credits from the following courses and their associated prerequisites:

Note that CHEM 212 or its equivalent is a prerequisite to all 200-level or higher courses.

<table>
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<tr>
<th>Course</th>
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<tbody>
<tr>
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One of:

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<td>CHEM 203</td>
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<tr>
<td>CHEM 204</td>
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</table>

Computer Science

Please see calendar listing for Bachelor of Arts Minors in Computer Science

Earth & Planetary Sciences

A combination of EPSC 201 or EPSC 233, together with EPSC 210 and EPSC 212 provide a grounding in Earth and Planetary Sciences and preparation for more specialized courses. Students should meet with an EPSC departmental advisor prior to selecting their courses, as some 200-level courses have specific prerequisites. Prerequisites which cannot be counted toward the Minor concentration: CHEM 110 and CHEM 120, and MATH 140 or equivalents.

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
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<td>EPSC 334</td>
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<tr>
<td>EPSC 425</td>
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</tbody>
</table>

*Note: students may take either EPSC 201 or EPSC 233
Geography

Students in any Minor or Major Concentration or Honours Program in Geography cannot choose this disciplinary area. Geography advisers recommend including some preparation in chemistry, statistics and calculus for study in this area even if formal prerequisites are not in place. A selection of courses should be taken from:

- GEOG 203 (3) Environmental Systems
- GEOG 205 (3) Global Change: Past, Present and Future
- GEOG 272 (3) Earth’s Changing Surface
- GEOG 305 (3) Soils and Environment
- GEOG 321 (3) Climatic Environments
- GEOG 322 (3) Environmental Hydrology
- GEOG 350 (3) Ecological Biogeography
- GEOG 372 (3) Running Water Environments

Mathematics and Statistics

Students in any Minor or Major Concentration or Honours Program in Mathematics and Statistics cannot choose this disciplinary area. Prerequisites which cannot be counted toward the Minor: MATH 133, MATH 140 and MATH 141 or equivalents.

Suggested courses:

- MATH 203 (3) Principles of Statistics 1
- MATH 204 (3) Principles of Statistics 2
- MATH 222 (3) Calculus 3
- MATH 233 (3) Linear Algebra
- MATH 338 (3) History and Philosophy of Mathematics

Microbiology and Immunology

Prerequisites which cannot be counted towards the Minor Concentration: BIOL 111 and BIOL 112, CHEM 110 and 120 or their equivalents.

Students select the 15 credits from the following courses and their associated prerequisites.

Note: CHEM 212 or its equivalent is prerequisite, or co-requisite, to these courses.

- BIOL 200 (3) Molecular Biology
- BIOL 201 (3) Cell Biology and Metabolism (or ANAT/BIOC 212)
- CHEM 212 (4) Introductory Organic Chemistry 1
- MIMM 211 (3) Introductory Microbiology
- MIMM 214 (3) Introductory Immunology: Elements of Immunity
- MIMM 323 (3) Microbial Physiology
- MIMM 324 (3) Fundamental Virology

Pathology

Prerequisites which cannot be counted towards the Minor Concentration: BIOL 111 and BIOL 112 plus CHEM 110 and CHEM 120, MATH 140 and PHYS 101 or PHYS 131 and PHYS 102 or PHYS 142, or their equivalents. PATH 300, together with its associate prerequisites, is well suited to students with an interest in medicine.

- BIOL 200 (3) Molecular Biology
- BIOL 201 (3) Cell Biology and Metabolism (or ANAT/BIOC 212)
- CHEM 212 (4) Introductory Organic Chemistry 1
- PATH 300 (3) Human Disease
PHGY 209  (3)  Mammalian Physiology 1
PHGY 210  (3)  Mammalian Physiology 2

Physics

Prerequisites which cannot be counted towards the Minor Concentration: PHYS 131, PHYS 142, MATH 140 MATH 141, MATH 222 or their equivalents.

Honours courses may be substituted for their Major equivalents only with the permission of the Department.

PHYS 214  (3)  Introductory Astrophysics
PHYS 224  (3)  Physics of Music
PHYS 230  (3)  Dynamics of Simple Systems
PHYS 232  (3)  Heat and Waves
PHYS 241  (3)  Signal Processing
PHYS 242  (2)  Electricity and Magnetism
PHYS 257  (3)  Experimental Methods 1
PHYS 258  (3)  Experimental Methods 2

Physiology

Prerequisites which cannot be counted towards the Minor Concentration: BIOL 111 and BIOL 112, CHEM 110 and CHEM 120, MATH 140, PHYS 101 or PHYS 131 and PHYS 102 or PHYS 142, or their equivalents.

Students should select:

BIOL 200  (3)  Molecular Biology
BIOL 201  (3)  Cell Biology and Metabolism (or BIOC/ANAT 212)
CHEM 212  (4)  Introductory Organic Chemistry 1
PHGY 209  (3)  Mammalian Physiology 1 and
PHGY 210  (3)  Mammalian Physiology 2

and if credits permit, one or more of these intermediate-level courses:

PHGY 311  (3)  Channels, Synapses & Hormones
PHGY 312  (3)  Respiratory, Renal, & Cardiovascular Physiology
PHGY 313  (3)  Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314  (3)  Integrative Neuroscience

Psychology

Students in any Minor or Major Concentration or Honours Program in Psychology cannot choose this disciplinary area.

Prerequisites which cannot be counted towards the Minor Concentration: PSYC 100

Students in the Minor Concentration 15 credits of Psychology selected as follows:

PSYC 204  (3)  Introduction to Psychological Statistics 1

Plus 6 credits from the following core courses:

PSYC 211  (3)  Introductory Behavioural Neuroscience
PSYC 212  (3)  Perception
PSYC 213  (3)  Cognition
PSYC 215  (3)  Social Psychology

Plus 6 credits Psychology courses at the 300 level or higher (excluding PSYC 305).
ADDITIONAL MINOR PROGRAMS FOR BIOLOGY STUDENTS

MINOR IN NEUROSCIENCE (25 CREDITS)

This Minor is intended to provide students with a basic understanding of how the nervous system functions. The minor is composed of 24-25 credits: 9 required and 15-16 complementary. For the 15-16 complementary credits, at least 12-13 must be from outside the student’s home department and at least 6 of the 12-13 must be at the 400 or 500 level. All course selections for the Minor must be approved by the program’s advisor, Ryan Bouma (email: ryan.bouma@mcgill.ca; Office: Dawson Hall, Rm. 405). Note 1: A maximum of 6-7 credits can be counted for both the student’s primary program and for the Minor in Neuroscience.

Required Courses (9 credits)

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<td>NSCI 201</td>
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</table>

Complementary Courses (16 credits)

15-16 credits selected as follows:
- At least 12-13 credits must be from outside the student’s home department.
- At least 6 of the 12-13 credits have to be at the 400- or 500-level

0-10 credits from the following list of 200 and 300 level courses:
- Students may select either BIOL 212 or BIOC 212 or BIOL 201
- **Students may select either BIOL 306 or PHGY 314**

Note 2: Since CHEM 212 is a prerequisite/corequisite for NSCI 200 and BIOL 200, students must take CHEM 212 if they have not yet done so.

<table>
<thead>
<tr>
<th>Course</th>
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<td>BIOC 212*</td>
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<td>BIOL 300</td>
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<td>BIOL 306**</td>
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<td>BIOL 389</td>
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<td>PHGY 311</td>
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<td>PSYC 311</td>
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<td>PSYC 318</td>
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<td>PSYC 342</td>
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6-15 credits from the following list of 400 and 500 level courses
- ***Students may select either BIOL 514 or PSYC 514

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<td>BIOL 588</td>
<td>3</td>
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<td>NEUR 502</td>
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</table>

ANAT 212* Molecular Mechanisms of Cell Functions
BIOC 212* Molecular Mechanisms of Cell Functions
BIOL 201* Cell Biology and Metabolism
BIOL 202 Basic Genetics
BIOL 300 Molecular Biology of the Gene
BIOL 306** Neural Basis of Behaviour
BIOL 320 The Evolution of Brain and Behaviour
BIOL 389 Laboratory in Neurobiology
CHEM 212 Introductory Organic Chemistry 1
LING 390 Neuroscience of Language
NEUR 310 Cellular Neurobiology
PHGY 311 Channels, Synapses and Hormones
PHGY 314** Integrative Neuroscience
PSYC 302 The Psychology of Pain
PSYC 311 Human Cognition and the Brain
PSYC 315 Computational Psychology
PSYC 317 Genes and Behaviour
PSYC 318 Behavioural Neuroscience 2
PSYC 342 Hormones and Behaviour

BIOL 514*** Neurobiology of Learning and Memory
BIOL 530 Advances in Neuroethology
BIOL 532 Developmental Neurobiology Seminar
BIOL 580 Genetic Approaches to Neural Systems
BIOL 588 Advances in Molecular/Cellular Neurobiology
NEUR 502 Bas and Clin Aspects of Neuroimmu.
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<td>PHGY 425</td>
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<td>Analyzing Physiological Systems</td>
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<tr>
<td>PHGY 451</td>
<td>(3)</td>
<td>Advanced Neurophysiology</td>
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<td>PHGY 520</td>
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<td>Ion Channels</td>
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<td>PHGY 524</td>
<td>(3)</td>
<td>Chronobiology</td>
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<tr>
<td>PHGY 556</td>
<td>(3)</td>
<td>Topics in Systems Neuroscience</td>
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<td>PSYC 410</td>
<td>(3)</td>
<td>Special Topics in Neuropsychology</td>
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<td>PSYC 427</td>
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<td>Sensorimotor Behaviour</td>
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<td>PSYC 433</td>
<td>(3)</td>
<td>Cognitive Science</td>
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<td>PSYC 444</td>
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<td>Sleep Mechanisms and Behaviour</td>
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<td>PSYC 470</td>
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<td>Memory and Brain</td>
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<td>PSYC 501</td>
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<td>Auditory Perception</td>
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<td>PSYC 506</td>
<td>(3)</td>
<td>Cognitive Neuroscience of attention</td>
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<tr>
<td>PSYC 514***</td>
<td>(3)</td>
<td>Neurobiology of Learning and Memory</td>
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<td>PSYC 522</td>
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<td>Neurochemistry and Behaviour</td>
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<td>PSYC 526</td>
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<td>PSYT 500</td>
<td>(3)</td>
<td>Advances: Neurobiology of Mental Disorders</td>
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<tr>
<td>PSYT 505</td>
<td>(3)</td>
<td>Neurobiology of Schizophrenia</td>
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**MINOR IN NATURAL HISTORY (24 credits)**

The Minor in Natural History involves the exploration of the natural world via specimen-based studies, object-oriented investigations and field studies. Museum collections are used to provide hands-on experience with real objects and specimens. The required course brings students to the Redpath Museum and other McGill natural science museums and exposes them to natural history methodologies and the value of specimen-based studies. Complementary course lists are drawn from a variety of disciplines to emphasize breadth and integration with the inclusion of specimen- or object-based courses and field courses in zoology, botany, and earth and environmental sciences. To ensure breadth, students are required to choose courses from among these lists. A compulsory field course component rounds out the program. The program advisor is Rowan Barrett, Redpath Museum, 398-4086x00856, rowan.barrett@mcgill.ca

**Required Course (3 credits)**
REDM 400 (3) Science and Museums

**Complementary Courses (21 credits)**
Students select 21 credits from among four course lists: A (Zoology), B (Botany), C (Earth and Environmental Sciences), and D (Field Courses) with the following specifications.
- At least 3 credits and no more than 9 credits from each of Lists A, B, and C.
- At least 3 credits from List D.
- **No more than 3 credits from any one list may be at the 200 level.**

Note: Students may take up to a maximum of 9 credits of courses outside the Faculties of Arts and of Science.

**List A: Zoology**
* Note: BIOL 205 and BIOL 215 may be applied to either List A or List B.
** Note: Students may take either ENTO 330 or BIOL 350 as these courses have similar content.

<table>
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<tr>
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<td>ANTH 312</td>
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<td>Zooarchaeology</td>
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<td>BIOL 215</td>
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<td>Introduction to Ecology and Evolution*</td>
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<td>BIOL 305</td>
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<td>Animal Diversity</td>
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<tr>
<td>BIOL 350</td>
<td>(3)</td>
<td>Insect Biology and Control**</td>
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<td>BIOL 352</td>
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<td>Dinosaur Biology</td>
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<td>Freshwater Invertebrate Ecology</td>
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<td>ENTO 535</td>
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<td>Aquatic Entomology</td>
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<td>Invertebrate Paleontology</td>
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<td>Mammalogy</td>
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**List B: Botany**

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<td>Biology of Organisms</td>
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<tr>
<td>BIOL 215</td>
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<td>Introduction to Ecology and Evolution</td>
</tr>
<tr>
<td>PLNT 304</td>
<td>3</td>
<td>Biology of Fungi</td>
</tr>
<tr>
<td>PLNT 353</td>
<td>3</td>
<td>Plant Structure and Function</td>
</tr>
<tr>
<td>PLNT 358</td>
<td>3</td>
<td>Flowering Plant Diversity</td>
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<tr>
<td>PLNT 460</td>
<td>3</td>
<td>Plant Ecology</td>
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</table>

**List C: Earth and Environmental Sciences**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIOL 540</td>
<td>3</td>
<td>Ecology of Species Invasions</td>
</tr>
<tr>
<td>ENVR 200</td>
<td>3</td>
<td>The Global Environment</td>
</tr>
<tr>
<td>ENVR 202</td>
<td>3</td>
<td>The Evolving Earth</td>
</tr>
<tr>
<td>EPSC 210</td>
<td>3</td>
<td>Introductory Mineralogy</td>
</tr>
<tr>
<td>EPSC 233</td>
<td>3</td>
<td>Earth and Life History</td>
</tr>
<tr>
<td>ESYS 200</td>
<td>3</td>
<td>Earth System Processes</td>
</tr>
<tr>
<td>ESYS 300</td>
<td>3</td>
<td>Investigating the Earth System</td>
</tr>
<tr>
<td>GEOG 203</td>
<td>3</td>
<td>Environmental Systems</td>
</tr>
<tr>
<td>GEOG 272</td>
<td>3</td>
<td>Earth’s Changing Surface</td>
</tr>
<tr>
<td>GEOG 470</td>
<td>3</td>
<td>Wetlands</td>
</tr>
<tr>
<td>GEOG 550</td>
<td>3</td>
<td>Historical Ecology Techniques</td>
</tr>
</tbody>
</table>

**List D: Field Studies**

Note that students may take either of the cross-listed courses NRSC 405 and REDM 405, but not both. Students may also take other field courses with the permission of the Program Advisor, Rowan Barrett (rowan.barrett@mcgill.ca)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 331</td>
<td>3</td>
<td>Ecology/Behaviour Field Course</td>
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<tr>
<td>BIOL 334</td>
<td>3</td>
<td>Applied Tropical Ecology</td>
</tr>
<tr>
<td>BIOL 335</td>
<td>3</td>
<td>Marine Mammals</td>
</tr>
<tr>
<td>BIOL 573</td>
<td>3</td>
<td>Vertebrate Palaeontology Field Studies</td>
</tr>
<tr>
<td>ENTO 340</td>
<td>3</td>
<td>Field Entomology</td>
</tr>
<tr>
<td>EPSC 231</td>
<td>3</td>
<td>Field School 1</td>
</tr>
<tr>
<td>NRSC 405</td>
<td>3</td>
<td>Natural History of East Africa</td>
</tr>
<tr>
<td>REDM 405</td>
<td>3</td>
<td>Natural History of East Africa</td>
</tr>
<tr>
<td>WILD 475</td>
<td>3</td>
<td>Desert Ecology</td>
</tr>
</tbody>
</table>

Program Coordinator: Prof. Rowan Barrett, Redpath Museum, Rm 207, (514) 398-4086 x00856; rowan.barrett@mcgill.ca
CONCENTRATION ADVISORS IN BIOLOGY

The advisor in Biology is Nancy Nelson and she should be consulted about your program on a regular basis. For further information about your chosen major (such as graduate schools, research and job opportunities etc.), the following professors can also be consulted.

I MAJOR PROGRAM CONCENTRATIONS
1. MOLECULAR GENETICS AND DEVELOPMENT
   Cell Biology – Brouhard, Dankort, Gerhold, Hayer, Schoeck, Vogel, Weber, Western, Zetka, Zheng
   Developmental Biology -Abouheif, Dent, Lasko, Moon, Nilson, Roy, Schoeck, Western
   Mammalian Genetics – Dankort, Hekimi, Palmour
   Molecular Genetics - Dankort, Hekimi, Lasko, Moon, Schoeck, Western, Zetka, Zheng
2. NEUROBIOLOGY - Dent, Guigueno, Hendricks, Ohyama, Reader, Sakata, Watt, Woolley
3. HUMAN GENETICS – Rosenblatt, Palmour
4. EVOLUTIONARY BIOLOGY - Abouheif, Bell, Bureau, Davies, Green, Hargreaves, Hendry, Larsson, Schoen
5. BIOLOGICAL DIVERSITY AND SYSTEMATICS - Abouheif, Bell, Davies, Gonzalez, Green, Hendry, Larsson
6. BEHAVIOUR - Guigueno, Lefebvre, Reader, Sakata, Woolley
7. GENERAL AND APPLIED ECOLOGY - Chapman, Fussmann, Gonzalez, Gregory-Eaves, Guichard, Hargreaves, Potvin, Schoen, Sunday
8. AQUATIC ECOLOGY – Chapman, Fussmann, Gregory-Eaves, Guichard, Price,
9. MARINE BIOLOGY – Guichard, Price
10. CONSERVATION BIOLOGY – Chapman, Gonzalez, Green, Potvin

II QUANTITATIVE BIOLOGY OPTION
Advisors – Biology: Guichard, Vogel; Mathematics: Hundemer; Physics: François; Comp Sci: Blanchette, Ruths, Waldispuhl; Honours QB - Vogel

III HONOURS PROGRAM
Honours Program in Biology, Advisor – Brouhard
Honours QB - Vogel

IV INDEPENDENT STUDIES
Advisor – Nelson

V DOUBLE MAJORS
BIOLOGY & MATHEMATICS - Guichard, Hundemer
COMPUTER SCIENCE & BIOLOGY - Vogel, Blanchette

VI MINORS
1. MINOR IN BIOLOGY: Nelson
2. BIOTECHNOLOGY: BSc students please see Nancy Nelson for advising
   BENG students please see Engineering Student Affairs for advising
3. MINOR IN NATURAL SCIENCE: Rowan Barrett
4. MINOR IN NEUROSCIENCE: Ryan Bouma
5. SCIENCE FOR ARTS STUDENTS: Lefebvre

THE FOLLOWING PROFESSORS WILL BE ON SABBATICAL

Rowan Barrett  Sept 1, 2019 – August 31, 2020
Irene Gregory-Eaves  Sept 1, 2019 – August 31, 2020
Paul Harrison  Sept 1, 2019 – August 31, 2020
Michael Hendricks  Sept 1, 2019 – August 31, 2020
Paul Lasko  Sept 1, 2019 – August 31, 2020
The B.A. & Sc. is an interdisciplinary degree intended for students who want to pursue simultaneously a program offered by Arts and one offered by Science. The overall objective is to provide a broad education spanning substantive areas in the two faculties so that students can learn diverse content and varied methods of inquiry. Students should meet regularly with each of their program advisors. They should consult their Faculty of Science advisor to ensure they complete degree requirements, including the Freshman program and integrative credits.

Advising Note: Freshman students should be aware that PHYS 101 and/or PHYS 102 are required for some of the courses in the major and minor concentrations in Biology.

**BIOLOGY MAJOR CONCENTRATIONS**

**Biology – Cell/Molecular Option (36 credits)**

The Major Concentration in Biology, Cell/Molecular Option, which is restricted to students in the BA. & Sc., is a planned sequence of courses designed to permit a degree of specialization in cell/molecular biology.

Required Courses* (29 credits)

<table>
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<tr>
<th>Course</th>
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<th>Description</th>
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<td>Molecular Biology</td>
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<tr>
<td>BIOL 201</td>
<td>3</td>
<td>Cell Biology and Metabolism</td>
</tr>
<tr>
<td>BIOL 202</td>
<td>3</td>
<td>Basic Genetics</td>
</tr>
<tr>
<td>BIOL 205</td>
<td>3</td>
<td>Biology of Organisms</td>
</tr>
<tr>
<td>BIOL 215</td>
<td>3</td>
<td>Introduction to Ecology and Evolution</td>
</tr>
<tr>
<td>BIOL 300</td>
<td>3</td>
<td>Molecular Biology of the Gene</td>
</tr>
<tr>
<td>BIOL 301</td>
<td>4</td>
<td>Cell and Molecular Laboratory</td>
</tr>
<tr>
<td>BIOL 303</td>
<td>3</td>
<td>Developmental Biology</td>
</tr>
<tr>
<td>CHEM 212</td>
<td>4</td>
<td>Introductory Organic Chemistry 1</td>
</tr>
</tbody>
</table>

*Required courses taken at CEGEP or elsewhere that are not credited toward the B.A. & Sc. must be replaced by 3-credit courses from the Complementary Course List. Regardless of the substitution, students must take at least 36 credits in this program.

Complementary Courses (7 credits minimum)

At least 7 credits selected from

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
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<tbody>
<tr>
<td>BIOL 306</td>
<td>3</td>
<td>Neural Basis of Behaviour</td>
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<tr>
<td>BIOL 313</td>
<td>3</td>
<td>Eukaryotic Cell Biology</td>
</tr>
<tr>
<td>BIOL 314</td>
<td>3</td>
<td>Molecular Biology of Oncogenes</td>
</tr>
<tr>
<td>BIOL 316</td>
<td>3</td>
<td>Biomembranes and Organelles</td>
</tr>
<tr>
<td>BIOL 370</td>
<td>3</td>
<td>Human Genetics Applied</td>
</tr>
<tr>
<td>BIOL 373</td>
<td>3</td>
<td>Biometry</td>
</tr>
<tr>
<td>BIOL 413</td>
<td>1</td>
<td>Directed Reading</td>
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<tr>
<td>BIOL 568</td>
<td>3</td>
<td>Topics on the Human Genome</td>
</tr>
<tr>
<td>BIOL 575</td>
<td>3</td>
<td>Human Biochemical Genetics</td>
</tr>
</tbody>
</table>

Or other appropriate course at the 300-level or higher with permission of the Biology Advisor

**Biology – Organismal Option (37 credits)**

The Major Concentration in Biology, Organismal Option, which is restricted to students in the B.A. & Sc., is a planned sequence of courses designed to permit a degree of specialization in organismal biology. Students may complete this program with a minimum of 36 credits or a maximum of 37 credits depending on whether they have already taken CHEM 212 or its equivalent, and on their choice of complementary courses.
Required Courses* (28 credits)
BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 202 (3) Basic Genetics
BIOL 205 (3) Biology of Organisms
BIOL 206 (3) Methods in Biology of Organisms
BIOL 215 (3) Introduction to Ecology and Evolution
BIOL 304 (3) Evolution
BIOL 308 (3) Ecological Dynamics
CHEM 212 (4) Introductory Organic Chemistry 1

*Required courses taken at CEGEP or elsewhere that are not credited toward the B.A. & Sc. must be replaced by 3-credit courses from the Complementary Course List. Regardless of the substitution, students must take at least 36 credits in this program.

Complementary Courses (9 credits)
9 credits selected from
BIOL 303 (3) Developmental Biology
BIOL 305 (3) Animal Diversity
BIOL 306 (3) Neural Basis of Behaviour
BIOL 307 (3) Behavioural Ecology
BIOL 310 (3) Biodiversity and Ecosystems
BIOL 331 (3) Ecology/Behaviour Field Course
BIOL 350 (3) Insect Biology and Control
BIOL 352 (3) Dinosaur Biology
BIOL 373 (3) Biometry
BIOL 427 (3) Herpetology
BIOL 418 (3) Freshwater Invertebrate Ecology
BIOL 435 (3) Natural Selection
BIOL 441 (3) Biological Oceanography
BIOL 463 (3) Mammalian Evolution
BIOL 465 (3) Conservation Biology
Or other appropriate course at the 300-level or higher with permission of the Biology Advisor

BIOLOGY MINOR CONCENTRATIONS

Biology – Cell/Molecular Option (18 or 19 credits)

The Minor Concentration in Biology (Cell/Molecular Option), which is restricted to students in the B.A. & Sc., is a sequence of courses designed to yield a broad introduction to Cell and Molecular Biology.

Required Courses (9 or 13 credits)
BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 202 (3) Basic Genetics
CHEM 212 (4) Introductory Organic Chemistry 1

Complementary Courses (9 or 6 credits, depending on whether CHEM 212 has been taken prior to entering McGill)
Plus 2 or 3 appropriate courses at the 300-level or higher with permission of the Biology advisor.

Biology – Organismal Option (18 or 19 credits)

Required Courses (12 or 16 credits)
BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 205</td>
<td>3</td>
<td>Biology of Organisms</td>
</tr>
<tr>
<td>BIOL 215</td>
<td>3</td>
<td>Intro to Ecology &amp; Evolution</td>
</tr>
<tr>
<td>CHEM 212</td>
<td>4</td>
<td>Introductory Organic Chemistry 1</td>
</tr>
</tbody>
</table>

Complementary Courses (6 or 3 credits, depending on whether CHEM 212 has been taken prior to entering McGill)

Plus 1 or 2 appropriate courses at the 300-level or higher with permission of the Biology Advisor.
THE CREDIT WEIGHT/WORKLOAD POLICY

The Science Faculty has adopted the following policy on Credit Weight/Workloads:

"The credit assigned to a particular course should reflect the amount of effort it demands of the student. For the average student, one credit will represent an average of three hours total work per week over one semester - including a combination of lecture hours, other contact hours, such as laboratory periods, tutorials, and problem periods, as well as personal study time."

e.g. BIOL 112: 3 credits (2-3-4) signifies a three credit course with 2h lecture, 3h lab and 4h personal study time per week.

Definition

Lecture Hours
Required class meetings.

Other Contact Hours
e.g. Labs; Conferences; Tutorials; Seminars

Personal Study Time
This refers to unscheduled, personal study time which will vary from student to student, but is a measure of the instructor's expectation of the work required for an average student to get an average course grade.
# UNDERGRADUATE COURSES FOR THE FALL TERM 2019

*Note: All classes have limited capacity. Register early*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
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<tbody>
<tr>
<td>101</td>
<td>Organismal Biology Laboratory</td>
<td>A. Hendry &amp; Staff</td>
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<td>111</td>
<td>Principles: Organismal Biology</td>
<td>A. Hendry &amp; Staff</td>
</tr>
<tr>
<td>115</td>
<td>Essential Biology</td>
<td>/S. Woolley/J. Vogel</td>
</tr>
<tr>
<td>200</td>
<td>Molecular Biology</td>
<td>M. Zetka/K. Hastings/R. Roy/T. Bureau</td>
</tr>
<tr>
<td>206</td>
<td>Methods in Biology of Organisms</td>
<td>M. Cristescu &amp; Staff</td>
</tr>
<tr>
<td>210</td>
<td>Perspectives of Science</td>
<td>L. Lefebvre</td>
</tr>
<tr>
<td>215</td>
<td>Introduction to Ecology &amp; Evolution</td>
<td>N. Price/E. Abouheif/TBA</td>
</tr>
<tr>
<td>219</td>
<td>Introduction to Physical Biology of the Cell</td>
<td>S. Weber/J. Vogel/A. Hendricks</td>
</tr>
<tr>
<td>300</td>
<td>Molecular Biology of the Gene</td>
<td>F. Schoeck/N. Moon</td>
</tr>
<tr>
<td>301</td>
<td>Cell and Molecular Laboratory</td>
<td>H. Zheng/R. Reyes</td>
</tr>
<tr>
<td>304</td>
<td>Evolution</td>
<td>G. Bell</td>
</tr>
<tr>
<td>306</td>
<td>Neural Basis of Behaviour</td>
<td>A. Watt/J. Dent/J. Sakata</td>
</tr>
<tr>
<td>308</td>
<td>Ecological Dynamics</td>
<td>F. Guichard</td>
</tr>
<tr>
<td>309</td>
<td>Mathematical Models in Biology</td>
<td>G. Bub</td>
</tr>
<tr>
<td>314</td>
<td>Molecular Biology of Oncogenes</td>
<td>D. Dankort &amp; Staff</td>
</tr>
<tr>
<td>316</td>
<td>Biomembranes and Organelles</td>
<td>H. Zheng/A Watt</td>
</tr>
<tr>
<td>324</td>
<td>Ecological Genetics</td>
<td>D. Schoen</td>
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<tr>
<td>331</td>
<td>Ecology/Behaviour Field Course</td>
<td>S. Reader &amp; Staff</td>
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<td>350</td>
<td>Insect Biology and Control</td>
<td>G. Dunphy</td>
</tr>
<tr>
<td>370</td>
<td>Human Genetics Applied</td>
<td>R. Palmour &amp; Staff</td>
</tr>
<tr>
<td>373</td>
<td>Biometry</td>
<td>B. Leung</td>
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<td>Independent Reading Project</td>
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<td>395</td>
<td>Quantitative Biology Seminar</td>
<td>A. Hayer</td>
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<td>396</td>
<td>Undergraduate Research Project</td>
<td>Staff</td>
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<td>413</td>
<td>Directed Reading</td>
<td>Staff</td>
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<tr>
<td>414</td>
<td>Invertebrate Brain Circuits &amp; Behaviour</td>
<td>T. Ohyama</td>
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<td>427</td>
<td>Herpetology</td>
<td>D. Green</td>
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<td>432</td>
<td>Limnology</td>
<td>G. Fussmann</td>
</tr>
<tr>
<td>436</td>
<td>Evolution and Society</td>
<td>E. Abouheif/S. Reader</td>
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<tr>
<td>465</td>
<td>Conservation Biology</td>
<td>L. Chapman/A. Gonzalez</td>
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<td>466</td>
<td>Independent Research Project 1</td>
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<td>467</td>
<td>Independent Research Project 2</td>
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<td>Independent Research Project 3</td>
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<tr>
<td>507</td>
<td>Animal Communication</td>
<td>J. Sakata/K. Onishi</td>
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<tr>
<td>510</td>
<td>Advances in Community Ecology</td>
<td>A. Gonzalez</td>
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<tr>
<td>524</td>
<td>Topics in Molecular Biology</td>
<td>H. Clarke/D. Dankort</td>
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<tr>
<td>544</td>
<td>Genetic Basis of Life Span</td>
<td>S. Hekimi</td>
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<td>546</td>
<td>Genetics of Model Systems</td>
<td>S. Hekimi</td>
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<tr>
<td>565</td>
<td>Cell and Tissue Mechanobiology</td>
<td>A. Hayer</td>
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<tr>
<td>570</td>
<td>Advanced Seminar in Evolution</td>
<td>Staff</td>
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<tr>
<td>575</td>
<td>Human Biochemical Genetics</td>
<td>N. Brauerman &amp; Staff</td>
</tr>
<tr>
<td>580</td>
<td>Genetic Approaches to Neural Systems</td>
<td>A. Watt</td>
</tr>
<tr>
<td>588</td>
<td>Molecular/ Cellular Neurobiology</td>
<td>K. Hastings/S. Carbonetto</td>
</tr>
<tr>
<td>592</td>
<td>Integrated Bioinformatics</td>
<td>P. Harrison</td>
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<tr>
<td>594</td>
<td>Advanced Evolutionary Ecology</td>
<td>A. Hendry</td>
</tr>
</tbody>
</table>
# Undergraduate Courses for the Winter Term 2020

(Classes underlined are not offered this term)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
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<tr>
<td>102</td>
<td>Cell and Molecular Biology Methods</td>
<td>J. Dent/F. Schoeck &amp; Staff</td>
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<tr>
<td>112</td>
<td>Cell and Molecular Biology</td>
<td>J. Dent/F. Schoeck</td>
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<tr>
<td>201</td>
<td>Cell Biology and Metabolism</td>
<td>G. Brouhard</td>
</tr>
<tr>
<td>202</td>
<td>Basic Genetics</td>
<td>D. Schoen/N. Moon/L. Nilson</td>
</tr>
<tr>
<td>205</td>
<td>Biology of Organisms</td>
<td>J. Sakata/A. Hargreaves</td>
</tr>
<tr>
<td>301</td>
<td>Cell and Molecular Laboratory</td>
<td>H. Zheng/R. Reyes-Lamothe</td>
</tr>
<tr>
<td>303</td>
<td>Developmental Biology</td>
<td>A. Gerhold/D. Dufort/Y. Rao</td>
</tr>
<tr>
<td>305</td>
<td>Animal Diversity</td>
<td>A. Hendry/H. Larsson/D. Green/G. Bell</td>
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<tr>
<td>307</td>
<td>Behavioural Ecology</td>
<td>S. Reader/M. Guigueno</td>
</tr>
<tr>
<td>310</td>
<td>Biodiversity and Ecosystems</td>
<td>A. Gonzalez/J. Sunday</td>
</tr>
<tr>
<td>313</td>
<td>Eukaryotic Cell Biology</td>
<td>S. Weber/M. Zetka</td>
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<td>319</td>
<td>Introduction to Biophysics</td>
<td>P. Wiseman (Physics Dept)</td>
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<td>320</td>
<td>Evolution of Brain &amp; Behaviour</td>
<td>S. Woolley/J. Sakata</td>
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<td>342</td>
<td>Contemporary Topics in Aquatic Ecology</td>
<td>I. Gregory-Eaves/N. Price</td>
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<tr>
<td>352</td>
<td>Dinosaur Biology</td>
<td>H. Larsson</td>
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<tr>
<td>377</td>
<td>Independent Reading Project</td>
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<td>389</td>
<td>Laboratory in Neurobiology</td>
<td>A. Watt/Dent/T. Oyama</td>
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<td>396</td>
<td>Undergraduate Research Project</td>
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<tr>
<td>413</td>
<td>Directed Reading</td>
<td>Staff</td>
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<tr>
<td>416</td>
<td>Genetics of Mammalian Development</td>
<td>D. Dufour/T. Taketo &amp; Staff</td>
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<td>418</td>
<td>Freshwater Invertebrate Ecology</td>
<td>A. Ricciardi</td>
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<td>Biological Diversity in Africa</td>
<td>M. Guigueno</td>
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<td>East African Ecology</td>
<td>L. Chapman</td>
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<td>Biological Oceanography</td>
<td>N. Price</td>
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<td>Research in Ecology and Development in Africa</td>
<td>L. Chapman</td>
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<td>Mammalian Evolution</td>
<td>V. Millien</td>
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<td>509</td>
<td>Methods in Molecular Ecology</td>
<td>M. Cristescu/R. Barrett/D. Schoen</td>
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<td>Ecology of Species Invasions</td>
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<td>Advanced Seminar in Evolution</td>
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<td>598</td>
<td>Advanced Design &amp; Statistics</td>
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**Note:** All classes have limited capacity.  
Register early.
### UNDERGRADUATE COURSES SPANNING TWO SEMESTERS

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<td>468D1/D2</td>
<td>Independent Research Project 3</td>
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<td>469D1/D2</td>
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### UNDERGRADUATE COURSES GIVEN IN SUMMER 2019

*See McGill Summer Studies Calendar for dates*

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<td>Monteregian Flora</td>
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<td>573</td>
<td>Vertebrate Palaeontology Field Course</td>
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INTRODUCTORY
CEGEP-EQUIVALENT COURSES

BIOL 101 (Fall)
Organismal Biology Laboratory (1 credit)

Not open to students who have passed the CEGEP Competency Code in Biology, or are taking, or have taken BIOL 111. Enrolment in this course is limited. Requires permission of the Biology Advisor

Instructor: A. Hendry (Coordinator) Redpath 398-4086x 00880 andrew.hendry@mcgill.ca
A. L’Heureux DUFF D-6 398-6404 annemarie.lheureux@mcgill.ca

Restrictions: May only be taken by transfer students who have completed elsewhere the lecture component but not the laboratory of BIOL 111 and only with permission of the Biology Advisor. *Not open to students who have taken or are taking BIOL 111.

Content: The laboratory component of BIOL 111. Weekly, 2 hrs. Exploration of microbial, plant and animal biology through the use of dissections, demonstrations, computer simulations and a student-paired research project.
Once registered, email annemarie.lheureux@mcgill.ca to be entered on BIOL 111 myCourses

Method: One two-hour lab per week

Evaluation: Lab work 100% (including laboratory assignments, a lab student-paired research project and shared presentations).

Note: Attendance at first lab is mandatory to confirm registration in the course. Students who fail to attend will lose their place to others on the waiting list.

Note: One or more additional morning labs may open up if enrolment is high

BIOL 102 (Winter)
Cell and Molecular Biology Methods (1 credit)

Not open to students who have passed Biology Objective 00XU at CEGEP, or are taking, or have taken BIOL 112. Enrolment in this course is limited. Requires permission of the Biology Advisor

Instructors: J. Dent (Coordinator) N4/7A 398-3724 joseph.dent@mcgill.ca
F. Schoeck N8/12 398-6434 frieder.schoeck@mcgill.ca
A. L’Heureux (Lab Coordinator) DUFF D-6 398-6404 annemarie.lheureux@mcgill.ca.

Restrictions: May be taken only by transfer students who have completed elsewhere the lecture component but not the laboratory of BIOL 112 and only with permission of the Biology Advisor. Not open to students who have taken or are taking BIOL 112.

Content: The laboratory component of BIOL 112.

Method: One two hour lab per week.

Evaluation: Lab-related work 100% (including weekly pre-lab summaries and one laboratory presentation).

Note: Attendance at first lab is mandatory to confirm registration in the course. Students who fail to attend will lose their place to others on the waiting list.
## BIOL 111 (Fall)
### Principles: Organismal Biology

**Instructors:**
- A. Hendry (Coordinator)  Redpath  398-4086x 00880  andrew.hendry@mcgill.ca
- G. Bell  Redpath  398-6458  graham.bell@mcgill.ca
- M. Cristescu  N6/1  398-1053  melania.cristescu@mcgill.ca
- A. Hargreaves  N6/11  398-7401  anna.hargreaves@mcgill.ca
- A. L’Heureux (Lab Coordinator)  DUFF D-6  398-6404  annemarie.lheureux@mcgill.ca

**Workload:**  3 credits (2-3-4)

**Prerequisite:**  None.

**Restrictions:**  Not open to students who have passed CEGEP Biology objective 00UK (301) or equivalent, or BIOL 115. Enrolment in this course is limited.

**Content:**
This course introduces the basic principles of organismal biology through the study of representative groups of unicellular organisms, plants and animals. The principles include the origins of life, major events in the history of life, adaptations of organisms to particular environments, patterns of reproduction in plants and animals, form and function, physiology, locomotion, and behavior in animals and ecology.

1) **PROKARYOTES, PROTISTS, AND FUNGI**
The origin of life, photosynthesis, cellular organization, protists, algae, mosses and fungi.

2) **PLANT EVOLUTION STRUCTURE AND FUNCTION**
Adaptations to terrestrial life among plants, morphology, physiology, reproduction, and life history of ferns, gymnosperms and angiosperms.

3) **ANIMAL EVOLUTION, STRUCTURE AND FUNCTION**
Early multicellular animals, tissue organization, muscular and skeletal system, body plans and symmetry, cephalization and nervous systems, adaptive radiations among mollusks, arthropods and chordates, respiration and respiratory systems, hormone function, circulatory systems, vertebrate evolution.

4) **ECOLOGY AND EVOLUTION**
Ecology of populations, communities and ecosystems and global change. Mechanisms of evolution and speciation.

**Readings:**  *Biological Science*, by Freeman, Harrington, Sharp, 2nd Canadian edition, 2014. This or any other recent general biology text book is optional to support your learning, but is not required reading for the exams.

**Evaluation:**  Course work (midterm and final exams); lab work, including weekly laboratory assignments, a student-paired lab research project with shared presentation.

**Laboratory:**  Weekly, 2 hrs. Exploration of microbial, plant and animal biology through the use of dissections, demonstrations, computer simulations and a student-paired research project.

*Biol 111 and 112 serve as equivalents to required CEGEP courses and as pre-requisites to several key courses in Biology programs.*

*Attendance at first lab is mandatory to confirm registration in the course. Students who fail to attend will lose their place to others on the waiting list. Attendance at all labs is mandatory.*
BIOL 112 (Winter)
Cell and Molecular Biology

Instructors:  J. Dent (Coordinator)  N4/7A  398-3724  joseph.dent@mcgill.ca
F. Schoeck  N8/12  398-6434  frieder.schoeck@mcgill.ca
A. L’Heureux (Lab Coordinator)  DUFF D-6  398-6404  annemarie.lheureux@mcgill.ca.

Workload:  3 credits (2-3-4)

Prerequisite:  None; however, a year of college general chemistry is strongly recommended. Enrolment in this course is limited.

Restrictions:  AEBI 122. Not open to students who have passed Biology Objective 00XU (401) at CEGEP.

Content:  The course provides an over-view of cell and molecular biology for all Science students and others intending to pursue further studies in the biological sciences. For several of the topics, the emphasis in the lectures is on the scientific method and historical development of our current understanding. In a weekly one-hour conference, students will have the opportunity to discuss many of the important social issues that arise out of the discipline.

- Biomolecular Structures of Proteins, Nucleic acids, and Lipids
- Organization of the Cell
- Biomembrane Structure and Function
- Enzymes and Enzyme Catalysis
- Cell Energetics and Thermodynamics
- Respiration
- Photosynthesis
- Mitosis and Meiosis
- Mendelian Genetics
- DNA Replication
- Gene Transcription
- Protein Synthesis
- mRNA Splicing
- Control of Gene Expression
- Recombinant DNA Technology
- Genetic Disease

Readings:  Biological Science, by Freeman, Harrington, Sharp, 2nd Canadian edition, 2014 (optional)

Method:  Two hour-lectures and one two hour-lab per week

Evaluation:  Lecture: multiple-choice midterm and final examinations.
Lab: weekly in-lab discussions and pre-lab summaries, one lab presentation.

BIOL 111 and 112 serve as equivalents to required CEGEP courses and as pre-requisites to several key courses in Biology programs.

Attendance at first lab is mandatory to confirm registration in the course. Students who fail to attend will lose their place to others on the waiting list.
GENERAL AND ADVANCED COURSES IN BIOLOGY

BIOL 115 (Fall)
Essential Biology

Instructors: S. Woolley  N4/8  398-2324  sarah.woolley@mcgill.ca
J. Vogel  Bellini 269  398-5880  jackie.vogel@mcgill.ca

Workload:  3 credits (3-0-6)

Prerequisite:  Not open to those who have had BIOL 111 OR BIOL 112, or equivalents.

Content:  In this course, we will learn about living organisms at a variety of levels, from molecules to populations. Since Biology is an enormous field, it is impossible to cover it completely in a single course. As a consequence, this course will address five fundamental themes (see below). Within those themes, an effort will be made to relate the facts presented to pressing matters in our daily lives. For instance, when we discuss genetics we will talk about genetic engineering and its impact on society. This approach means that the course will tend to be topical, focusing on interesting observations and trying to explain them on the basis of biological knowledge.

MODULE 1: SCIENCE & LIFE (Vogel)
Biology - Life & Diversity
Intro to the Scientific Method
Chemistry & Molecules of Life

MODULE 2: CELL BIOLOGY (Vogel)
Cell Function & Structure
Enzymes & Metabolism
Cellular Respiration
Carbon Flow & Photosynthesis

MODULE 3: GENETICS, CANCER & BIOTECHNOLOGY (Vogel)
DNA Structure, Replication & Forensics
Genes, Proteins & Gene Regulation
Cell Cycle, Mitosis, Cell Division
Checkpoints, Mutations & Cancer
Meiosis, Sex & Chromosomal Abnormalities
Mendelian Genetics
Complex Inheritance & Human Genetics
Stem Cells, Cell Differentiation & Development

MODULE 4: NEUROSCIENCE & BEHAVIOUR (Woolley)
How does the brain work?
Brain in action: the fiction of memory

MODULE 5: EVOLUTION (Woolley)
Fundamentals of Evolution: Natural Selection, Sexual Selection, Drift & Speciation
Evolution and You: Bacteria and Viruses, Global Change, Human Evolution and Language

Readings:  Belk and Maier “Biology; Science for Life with physiology” 5th edition
(earlier editions are also acceptable), Pearson
(Note: subject to change; do not purchase before receiving course syllabus)

Method:  Two 1.5 hour lectures per week.

Evaluation:  Two one-hour midterm exams. Written assignments. Three-hour final exam.
BIOL 200 (Fall)
Molecular Biology

**Instructors:**
- R. Roy (Co-ordinator)  S3/22. 398-5137  richard.roy@mcgill.ca
- T. Bureau  N4/1 398-6472  thomas.bureau@mcgill.ca
- M. Zetka (Coordinator)  S3/24 398-6445  monique.zetka@mcgill.ca
- K. Hastings  MNI 398-1852  ken.hastings@mcgill.ca
- T. Bernhardt (Administrator)  N8/10 398-6416  torsten.bernhardt@mcgill.ca

**Workload:**  3 credits (3-0-6)

**Prerequisite:**  BIOL 112 or equivalent

**Corequisite:**  CHEM 212 or equivalent

**Content:**  The aim of this course is to understand the molecular basis of biological phenomena with emphasis on the fundamental processes common to all organisms (enzymatic catalysis, DNA, RNA and protein synthesis; genome structure; mechanisms of gene expression; mechanisms of regulating gene activity).

**Readings:**  Recommended Reading: *Molecular Cell Biology* by H. Lodish et al, WH Freeman & Co. 8th edition

**Method:**  Three lectures per week, with occasional online quizzes during class time for the evaluation of student progress

**Evaluation:**  Mid-term exam, on-line quizzes, final examination
BIOL 201 (Winter)
Cell Biology and Metabolism

Instructors:  G. Brouhard  Bellini 267  398-2984  gary.brouhard@mcgill.ca
T. Bernhardt (Administrator)  N8/10  398-6416  torsten.bernhardt@mcgill.ca

Workload:  3 credits (3-0-6)

Prerequisites:  BIOL 200; not open to students who have taken ANAT 212/BIOC 212 or who have taken BIOL 219.

Content:  The cell is the basic unit of life, but each cell contain thousands of different enzymes and proteins. These proteins can be viewed as tiny, intricate, molecular machines. Our goal will be to understand how these machines work. More precisely, we will study how proteins and enzymes (1) harness energy from the environment, (2) use this energy to change their structure/conformation, and (3) use these conformational changes to do the work of staying alive. We will learn how malfunctions in protein machines are the basis of many diseases. No protein works alone, of course. Therefore we will study how groups of proteins interact, either working together in teams or competing against one another. The balance of these interactions is what defines cell physiology.

The lectures will focus on key experiments that established what we know now, paying attention to the individual scientists who drove progress. In addition, we will look at experiments being performed at world-class research institutions today. Students will learn how to analyze the data produced by these experiments and to predict results. The exams will emphasize the concepts behind cell biology rather than rote memorization. Topics will be selected from the following:

How Cells Harness Energy
- Thermodynamics and the basic design of metabolism
- Glycolysis, gluconeogenesis, citric acid cycle, fatty acid oxidation, Photosynthesis
- Redox reactions, the respiratory chain, Chemiosmotic coupling

Building the Cell
- Bringing in nutrients: movement across biomembranes, endocytosis
- Making proteins: protein synthesis and the endoplasmic reticulum
- Putting proteins in place: protein targeting, secretion, exocytosis

How Cells Move
- Giving cells their shape: the cytoskeleton, microtubules, actin filaments
- Moving things around: motor proteins, intracellular transport

Cells and their Environment
- Receiving signals: hormones and their receptors, signalling cascades
- Attachment into tissues: the extracellular matrix and adhesion
- Nerve cells and communication by ion fluxes

The Life Cycle of Cells
- Growing up: regulation of cell size
- Making new cells: mitosis and the cell cycle
- Death: apoptosis


Method:  Three lectures per week.

Evaluation:  Mid-term, quizzes and final examination
BIOL 202 (Winter or Summer)
Basic Genetics

Instructors:
N. Moon (Coordinator)  Bellini 266  398-2982  nam.moon@mcgill.ca
D. Schoen  N3/8A  398-6461  daniel.schoen@mcgill.ca
L. Nilson  N5/8  398-6448  laura.nilson@mcgill.ca
D. Dankort (summer)  Bellini 264  398-2307  david.dankort@mcgill.ca
D. Hipfner (summer)  IRCM  987-5508  david.hipfner@ircm.qc.ca
T. Bernhardt (Administrator)  N8/10  398-6416  torsten.bernhardt@mcgill.ca

Workload:  3 credits (3-0-6)

Restriction:  LSCI 204

Prerequisite:  BIOL 200 or BIOL 219.

Restriction:  Not open to students who have taken or are taking CELL 204

Content:  The course is designed to convey basic information on the principles of heredity in the light of modern advances in molecular biology, problems, and applications deemed relevant for the various major programs in the biological sciences. The topics covered (not necessarily in this order) include:

1)  CHROMOSOMAL BASIS OF INHERITANCE
2)  CLASSICAL DIPLOID GENETICS
3)  EXTRACHROMOSOMAL GENETICS
4)  MOLECULAR ASPECTS OF GENETICS AND GENETIC ANALYSIS
5)  MOLECULAR ASPECTS OF MUTAGENESIS, MUTATIONS AND REPAIR OF MUTATIONS
6)  MOLECULAR MARKERS, GENE CLONING; OTHER MOLECULAR TOOLS.
7)  GENOMICS AND BIOINFORMATICS
8)  GENETIC ANALYSIS OF DEVELOPMENT
9)  EUKARYOTIC CHROMOSOME MAPPING IN DIPLOIDS: MAPPING GENES IN MODEL SYSTEMS AND HUMAN
10) HUMAN GENETICS, CANCER GENETICS, PROSPECTS FOR GENE THERAPY, GENETIC COUNSELING
11) POPULATION GENETICS, QUANTITATIVE INHERITANCE


Method:  (Winter course) Three one-hour lectures and one (optional) problem based conference per week.

Evaluation:  (Winter and Summer course) Mid-term and final multiple choice exams.
BIOL 205 (Winter)
Biology of Organisms

Instructors:  J. Sakata (Coordinator)  N4/8  398-3636  jon.sakata@mcgill.ca
              A. Hargreaves  N6/11  398-7401  anna.hargreaves@mcgill.ca

Workload:  3 credits (3-0-6)

Prerequisites:  BIOL 200 or BIOL 219, PHYS 101 or PHYS 131 or equivalent

Corequisite:  BIOL 201 or BIOL 219 or ANAT 212/BIOC 212

Content:  This course is designed to provide a unified view of the form and function of living organisms. Rooted in comparative physiology and functional morphology, it relates the laws of physics and chemistry to the fundamental processes of living organisms. These processes include the acquisition, distribution, storage, and allocation of energy and materials, and the mechanisms involved in growth, development, reproduction, and communication. The focus is on the integrated functioning of the whole organism and its component organ systems. Implications for population, community and ecosystem processes are discussed. Examples are drawn from a wide range of organisms, but the emphasis is on higher plants and vertebrate animals. The course assumes a background in basic biology, chemistry and physics.

1. INTRODUCTION
   Introduction to the course & organisms

2. ENERGY
   Energy, light and life
   Carbon assimilation (photosynthesis carbon reactions)
   Whole plant and whole crop photosynthesis
   Acquisition of food and digestion in animals
   Aerobic and anaerobic energy production
   Uptake of water & cell water relations
   Uptake & assimilation of nutrients, especially Nitrogen in plants
   (In-class Quiz)

3. MATERIALS, GROWTH & DEVELOPMENT
   Blood circulation & material transport in animals
   Heat exchange and thermoregulation in animals
   Body size & structural support plants & animals
   Growth and development: plants & animals
   Lifespan & senescence
   Transpiration in plants
   Distribution of photosynthetic materials

4. REPRODUCTION, SENSES, BEHAVIOUR, HORMONES PLANTS
   Plant reproduction: flowers
   Plant reproduction: seeds
   Plant senses
   Poisons, medicines, drugs: plant secondary metabolites
   Plant competition
   Hormones in plants

5. REPRODUCTION & HORMONES ANIMALS
   Hormones in animals
   Reproduction in animals

6. IMMUNE SYSTEMS & STRESS
   Immune system function: plants
   Immune system function: animals
   Coping with stressful environments – plants

7. LOCOMOTION, SENSES & BEHAVIOUR ANIMALS
   Locomotion on land
   Locomotion in air & water
Introduction to the nervous system
Nervous system function: sensory systems
Nervous system function: Neural control of behaviour
Nervous system function: Neural control of behaviour

Readings: Only the Course Pack is required.

Method: Three lectures per week, and optional conference sessions for review and clarification of course material.

Evaluation: Four open-book quizzes consisting of conceptual (applying knowledge to novel scenarios) multiple choice questions. Two of the quizzes are in-class promoting discussion and peer-to-peer learning. Two midterm examinations and a final exam of multiple choice and short answer questions.
BIOL 206 (Fall)
Methods in Biology of Organisms

Instructors: M. Cristescu (Coordinator)  N6/1  398-6457  melania.cristescu@mcgill.ca
& Staff
S. Bujold (Lab Coordinator)  Redpath 105  398-6408  sonia.bujold@mcgill.ca

Workload: 3 credits (1.5-3-4.5)

Prerequisites: BIOL 111 or equivalent.

Content: This course is designed to provide experience and training in the use of techniques important in organismal biology, and is normally taken in U1. It is organized in a series of 6 modules. Each module consists of an introductory lecture and one to two 3hr laboratory sessions.


Module 2: Biological variability and the problems of sampling. Techniques include sampling designs, descriptive statistics, collection of data in the field, use of software R for data manipulation, calculation and graphical display, interpretation of data. Field trip to Mount Royal.

Module 3: Experimental design using the effects of plant hormones on seed germination and seedling growth. Statistical tests (t-tests). Scientific reporting

Module 4: Model systems and systematics: Dissections, species identification using traditional methods and molecular tools.

Module 5: Form and function: Statistical tests.

Module 6: Experimental evolution: Can evolution rescue declining populations

Method & Evaluation: Each module will be graded based on a written report, oral presentation or test appropriate to the module. In some modules there is also assessment of technical skills learned. The final grade for the course will be based on the accumulated grades for 6 modules. Modules are weighted for grading. There will be no final examination.

Readings: There is no textbook. The course manual, available online, summarizes both the theoretical base and the technical instructions needed for each module.
BIOL 210 (Fall)
Perspectives of Science
(also open to Biology students as an elective)

Instructor: L. Lefebvre  N7/19  398-6457  louis.lefebvre@mcgill.ca

Workload: 3 credits (3-0-6)

Content: The goal of this course is to allow you to read through a series of papers in various sciences, listen to a series of conferences, take a series of science courses (for most of you, in the Minor in Science for Arts or the Science for Teachers majors) and obtain and transmit the maximum amount of information concerning them: what is going on in terms of content, purpose, process, form and human activity; how is consensus about a particular scientific issue built or destroyed? You will be required to attend and summarize a series of public lectures in the Faculty of Science, as well as read a series of papers taken mostly from the journals Science and Nature.

1. Introduction: myths, community and consensus in science.
2. How scientists communicate with the general public.
3. How scientists communicate with other scientists.
4. The scientific method.
5. How scientists gather the facts required to test their questions.
6. Traditions, institutions and biases in science.
7. What if something goes wrong? Checks and balances in the system.
8. Conclusions

2) Lecture notes on myCourses

Method: Two lectures per week, plus 4 conferences in different science departments.

Evaluation: Mid-term, final examination, conference reports

Not open to U0 students
BIOL 215 (Fall)
Introduction to Ecology & Evolution

Instructors:  
N. Price (Coordinator) N6/12 398-6468 neil.price@mcgill.ca  
E. Abouheif N3/6 398-4087 ehab.abouheif@mcgill.ca  
TBA

Workload:  
3 credits (3-0-6)

Prerequisites:  
BIOL 111 (or equivalent). Not open to students who have taken ENVR 202

Content:  
A core-level introduction to evolutionary and ecological processes. The general topics are those dealing with processes acting in all populations at all times, especially including those that bear on the assembly of communities and ecosystems. These include population dynamics, selection, competition, cladogenesis and trophic interactions.


Readings:  
Evolution by B.J. Hall (Jones and Bartlett Publishers) 1st ed. 2011

Method:  
Two 1.5-hour lectures per week; tutorial conferences for discussion and clarification of material

Evaluation  
Assignments, midterm exam and final examination
BIOL 219 (Fall)
Physical Biology of the Cell

Instructors:  S. Weber (Co-ordinator)  N5/16  398-2042  steph.weber@mcgill.ca
             J. Vogel  Bellini 269  398-5880  jackie.vogel@mcgill.ca
             A. Hendricks  McConnell 356  398-8925  adam.hendricks@mcgill.ca

Workload:  4 credits (3-1-5)

Prerequisites:  1 year of college calculus, chemistry and physics or equivalents, BIOL 112 or equivalent

Corequisites:  MATH 222 or equivalent

Restrictions:  Not open to students who have taken ANAT 212, BIOC 212, BIOL 200 and/or BIOL 201.
             Open only to students in the following interdisciplinary programs: Major and Honors Quantitative Biology; Joint Major and Honors Computer Science and Biology; Joint Major Math and Biology; Joint Major Physiology and Math; Joint Major Physiology and Physics; Major and Honors Biophysical Chemistry; and Major and Honors Biological Physics.

Content:  BIOL 219 is an introduction to molecular and cell biology using physical biology perspectives, and equally prepares interdisciplinary students for more advanced courses in the biological and physical sciences. Technologies and methodologies, both experimental and computational, are included in the presentation of each thematic module.

Module 1: Overview of physical biology
1.1. Overview of molecules and cells
1.2. Length and time scales relevant to molecular and cellular biology
1.3. Energy
1.4 Mechanical forces
1.5 Membranes

Module 2: Protein structure and function
2.1. Protein Structure
2.2. Protein folding
2.3. Binding and Enzyme Catalysis
2.4. Protein Regulation
2.5 Allostery

Module 3: Information storage and flow
3.1. Nucleic acid structure
3.2. Genomes
3.3. Prokaryotic transcription
3.4. Regulation of transcription
3.5. Eukaryotic transcription
3.6 mRNA processing
3.7. Translation

Module 4: Molecular self-assembly and transport
4.1. Physical properties of the cytoplasm
4.2. Phase separation
4.3. Polymerization
4.4. Diffusion
4.5. Molecular motors

Module 5: Cell cycle control
5.1. CDK oscillator
5.2. G1 phase
5.3. S phase
5.4. Mitosis
5.5 Checkpoints

Module 6: Cell signaling and polarity
6.1. Cell morphology
6.2. Intracellular signaling
6.3. Asymmetric cell division
6.4. Cell fate
6.5. Intercellular signaling

Module 7: Neuroscience
7.1. Neurons and electrical potential
7.2. Neurotransmitters
7.3. Circuits
7.4. Optogenetics


Method: 3 Lectures plus 1 compulsory tutorial per week

Evaluation: Weekly quizzes, midterm and final exams
BIOL 240
Monteregian Flora (3 Credits)

Instructors:  
V. Millien (Co-ordinator)  Redpath 202  514-398-4848  virginie.millienn@mcgill.ca  
M. Lapointe  melanie.lapointe@mcgill.ca

Prerequisites:  
BIOL 111 or permission of the instructor. The course has been taken successfully by students in Arts, Architecture, Education and Management as well as Science.

Restrictions:  
Students who have already taken PLNT 358 (Plant Science) cannot take this course, but PLNT 358 can be taken after taking BIOL 240.

Content:  
This course is an introduction to the diversity of plants in the area surrounding Montreal, Quebec, concentrating specifically in the Saint Lawrence River Valley and on one of the Monteregian Hills, Mont Saint Hilaire. Plant groups studied include fern allies, ferns, conifers and flowering plants. Studies will be conducted at McGill's Gault Nature Reserve field station where there are dormitories, a laboratory and a wide variety of habitats and different plant communities. Emphasis will be on field and laboratory work but some lectures will be included for background material. The course will focus mainly on plant identification, including sight recognition and use of taxonomic keys. You will learn over 200 species in the context of their habitats. For each plant group, lectures will present key characteristics for field identification of family and genera. Fieldwork will include exercises in field recognition and keying. We will take advantage of the diversity of habitat found on and around Mont Saint Hilaire to study a variety of hardwood and conifer forests, rock outcrops, marshes, bogs, floodplains and lakes. Fieldwork will also include habitat analysis with the goal of explaining and predicting species occurrence.

Readings:  

Method:  
Course is taught at the Gault Nature Reserve field station where students and staff are in residence during the week. Mornings will be devoted to lectures and observations in the field and afternoons to laboratory sessions. Fieldwork will consist of hiking (possibly in rain) to make plant collections, sight identification of plants, and habitat analyses. There is a course fee for lodging, meals, the textbook and course supplies. Students MUST contact Susan Gabe (susan.gabe@mcgill.ca) to secure permission to register for the course on Minerva and contact the course coordinator (virginie.millienn@mcgill.ca) for more details on course and appropriate preparations for field work. The course runs two weeks in mid-July, exact dates varying slightly year to year. Contact the course coordinator well in advance to discuss the course schedule and logistics. For more information on the course, consult the web site: http://biology.mcgill.ca/undergrad/c240t/c240add.htm

Evaluation:  
Grades will be based on field sight identification, plant keying and class contribution. The quiz and exam format includes a mix of field and laboratory identifications.
BIOL 300 (Fall)
Molecular Biology of the Gene

Instructors: F. Schoeck (Coordinator)  N8/12  398-6434  friedere.schoeck@mcgill.ca
N. Moon  Bellini 266  398-2982  nam.moon@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 200, BIOL 201 or ANAT 212/BIOC 212; or BIOL 219

Part 1: Nam-Sung Moon
I. Regulation of gene expression
   A. Introduction and overview (1 lecture)
      1. Nucleic acids and gene structure
      2. Basic transcriptional mechanisms (initiation, elongation, termination)
      3. Gene structure in prokaryotes and eukaryotes
   B. Gene expression in prokaryotes (1 lecture)
      1. Transcription initiation (RNA polymerase, sigma factors)
      2. Regulation of transcription by activators and repressors
      3. Transcription termination (Rho dependent and independent, attenuation)
   C. Transcription initiation in eukaryotes (8 lectures)
      1. RNA polymerase II (holoenzyme, core promoter elements)
      2. General transcription factors and preinitiation complex assembly
      3. Mediator complexes
      4. Enhancesomes and gene expression (example: Interferon β)
      5. Insulators (example: gypsy and su(Hw))
      6. Chromatin, nucleosomes and the histone code
      7. Chromatin remodeling complexes
      8. Non-coding RNA and transcriptional control.
   D. Transcription elongation (1 lecture)
   E. Review (1 lecture)

II. Post-transcriptional control of gene expression
   A. Processing of eukaryotic pre-mRNA (1 lecture)
      1. Capping, polyadenylation, splicing
      2. Coupling of transcription and processing events
   B. Regulation of pre-mRNA processing (3 lectures)
      1. Splice site recognition
      2. Alternative splicing/splice site selection
      3. RNA editing
      4. Molecular consequences of RNA processing
   C. Genome editing (1 lecture)

Part 2: Frieder Schöck
III. Signal transduction and Post-transcriptional cytoplasmic control of gene expression
   A. Macromolecular transport across the nuclear envelope (2 lectures)
      1. Nuclear import and export
      2. Regulated transport of transcription factors
      3. Nuclear export of mRNPs
      4. Transport of unspliced transcripts
   B. Cytoplasmic mechanisms of post-transcriptional control (5 lectures)
      1. mRNA degradation: decapping, deadenylation, nonsense-mediated decay
      2. mRNA localization
      3. Cytoplasmic polyadenylation
      4. Translational repression
      5. Regulation of translation initiation
6. Translational Regulation and Unfolded Protein Response
7. Feedback regulation of protein folding
8. Micro RNAs and regulation of mRNA translation and stability

C. Biochemical and genetic principles of signal transduction (3 lectures)
   1. Biochemical isolation of ligands and receptors
   2. Ligand binding to receptors
   3. Kinases and their analysis
   4. Genetic analysis of signal transduction cascades

D. G protein-linked receptors (2 lectures)
   1. Signaling through cAMP (example: fight-or-flight response)
   2. Signaling through ion channels (example: vision)
   3. Signaling through inositol phospholipids (example: CamKII-mediated short-term memory)

E. Enzyme-linked receptors and intracellular receptors (4 lectures)
   1. Receptor tyrosine kinases (example: eye development)
   2. Integrins (example: upregulation of RTK signaling in cancer)
   3. Cytokine receptors
   4. Receptor serine/threonine kinases
   5. Intracellular receptors

F. Principles of developmental signaling (1 lecture)
   1. Signal memory
   2. Lateral inhibition (example: Notch signaling)

G. Review session (1 lecture)


Method: Three lectures per week

Evaluation: Mid-term exam; Final exam
BIOL 301 (Fall or Winter)
Cell and Molecular Laboratory

Instructors:  
H. Zheng (Coordinator)  N5/10  398-1328  hugo.zheng@mcgill.ca  
R. Reyes Lamothe  Bellini 271  398-5137  rodrigo.reyes@mcgill.ca  
A.M. Sdicu (Lab Coordinator)  N4/2C  398-4917  anne-marie.sdicu@mcgill.ca

Workload:  
4 credits (1-6-5)

Prerequisites:  
PHYS 102 or PHYS 142, BIOL 200, BIOL 201 or ANAT 212/BIOC 212; or BIOL 219; BIOL 202; BIOL 206 recommended.

Restriction:  
BIOC 300

Content:  
One 1-hr lecture and one 6-hr laboratory period per week. This course focuses on modern tools for molecular and cell biological analyses of cellular systems. Lectures will introduce students to the range of possibilities of techniques as well as their application to solve biological problems. Students will then have the opportunity to perform selected techniques in the weekly laboratories. In addition, an introduction will be provided to bioinformatics methods and their role in analysis. In-lab reports will focus on experimental design, theory and data analysis.

Readings:  
The Laboratory Manual is essential and available online through myCourses. There is no assigned textbook, but texts used in BIOL 200 and 201 (for e.g. Lodish) are very useful and highly recommended. Selected articles are recommended in the Manual and in lectures and are available online through PubMed and McGill Libraries.

Evaluation:  
The grade for the course is based on two assignments, laboratory quizzes, reports and on a comprehensive final essay examination. Lab reports are required when each experiment is completed; these are evaluated by the lab demonstrators. The final examinations stresses the theoretical and analytical aspects of the course material.

Enrolment in this course is limited. Departmental approval for both sessions of BIOL 301 must be obtained from the Biology Department by e-mailing anne-marie.sdicu@mcgill.ca prior to registering in Minerva. Be sure to include in that email your student I.D. number, the semester and two choices of lab day.
BIOL 303 (Winter)
Developmental Biology

Instructors:  
A. Gerhold (Coordinator)  N3/11B  398-6423  abigail.gerhold@mcgill.ca
D. Dufort  RVH  934-1934x34743  daniel.dufort@mcgill.ca
Y. Rao  MGH  934-1934x42520  yong.rao@mcgill.ca

Workload:  3 credits (3-0-6)

Prerequisites:  BIOL 200, BIOL 201 or ANAT 212/BIOC 212; or BIOL 219; BIOL 300 strongly recommended.

Corequisite:  BIOL 202

Content:  This introductory course in developmental biology is designed to acquaint the student with the
fundamental processes operating during embryonic development and cellular differentiation, with a
focus on animal development. Development will be considered at the organismal, cellular, and
molecular levels to provide a total appreciation of developmental phenomena. The emphasis will
be on the interpretation of important experiments that have led to an understanding of the basic
principles of development.

1) Introduction, history, principles of experimental embryology (2 lectures)
2) The germ line, gametogenesis, and fertilization (2 lectures)
3) Early invertebrate development (3 lectures)
4) Principles of cellular differentiation and morphogenesis (3 lectures)
5) Reading a research paper and writing a scientific review (1 lecture)
6) Axis specification in vertebrates (4 lectures)
7) Sex determination (1 lecture)
8) Development of the nervous system (2 lectures)
9) Organogenesis and limb development (3 lectures)
10) Growth, metamorphosis, regeneration, and aging (2 lecture)
11) Plant development (2 lectures)
12) Evolution and development (1 lecture)

Readings:  Recommended text: Principles of Development, 5th ed. by Lewis Wolpert, Cheryll Tickle, Alfonso
Martinez Arias, Oxford University Press. 2015. (Note: subject to change; do not purchase before
receiving course handout.)

Method:  There are two 90-minute lectures and optional tutorials every week.

Evaluation:  Students evaluation is based on two examinations and a term paper. Examinations will stress the
ability to design and interpret simple experiments on developing organisms. The term paper will be
a summary and critique of a research article from a relevant scientific journal.
BIOL 304 (Fall)
Evolution

Instructors: G. Bell (Coordinator) Redpath Mus. 398-6458 graham.bell@mcgill.ca

Workload: 3 credits (2-3-4)

Prerequisite: BIOL 205, BIOL 215 or ENVR 202

Content: This course provides a comprehensive introduction to evolutionary biology. It covers both short-term and long-term evolutionary processes. The material is presented in six major sections:


The course as a whole will provide a set of principles based on the observed patterns and established processes of evolution that enable biologists to account for the diversity of all life and explain how the modern biota came to be.

Reading: The Evolution of Life (G. Bell), Oxford University Press, 2015.

Method: Two one-hour lectures and one three-hour laboratory weekly.

Evaluation: Laboratory reports (40%), midterm lecture exam (25%) and final lecture exam (35%).
BIOL 305 (Winter)
Animal Diversity

Instructors:  
H. Larsson  Redpath Mus.  398-4086 x 089457  hans.ce.larsson@mcgill.ca
D. Green  Redpath Mus.  398-4088  david.m.green@mcgill.ca
A. Hendry  Redpath Mus  398-4086 x 00880  andrew.hendry@mcgill.ca
G. Bell  Redpath Mus  398-6458  graham.bell@mcgill.ca

Workload:  3 credits (2-3-4)

Prerequisite:  BIOL 215 or both ENVR 200 and ENVR 202

Content:  This course will provide a systematic survey of the major animal groups, emphasizing their evolution and phylogeny. It will use the collections and exhibits of the Redpath Museum to provide first-hand experience of the groups described in the lectures.


Each lecture will be posted on myCourses and may be accompanied by required and / or supplementary readings. Laboratory handouts will be made available each week on myCourses

Method:  One one-hour lecture and 1 three-hour laboratory each week. The lectures are intended to provide a systematic treatment of the major groups of animals. Lab sessions are intended to provide first-hand experience of the animal groups described in the lectures. Each lab will feature comparative material from the Museum collections, giving examples of the principal types within major groups of animals. Labs may also make use of material from the permanent exhibits of the Museum and audio-visual presentations.

Evaluation:  Midterm exam; final exam; weekly lab assignments and quizzes;
BIOL 306 (Fall)
Neural Basis of Behaviour

Instructors:  J. Sakata (Coordinator)  N48  398-3636  jon.sakata@mcgill.ca
             J. Dent  N4/7A  398-3724  joseph.dent@mcgill.ca
             A. Watt  Bellini 265  398-2806  alanna.watt@mcgill.ca

Workload:  3 credits (3-0-6)

Prerequisites:  PHYS 102 or PHYS 142 and BIOL 201 or ANAT 212/BIOC 212 or BIOL 219 or NSCI 200

Content:
This course examines the structure and function of neurons and neural circuits, with emphasis on
the role of the nervous system in animal behaviour. A variety of animal models is considered.
Highlights from the history of the field are integrated with the most recent experimental findings.

Basic Neurophysiology (6 lectures)
We will explore the mathematical biophysics of excitable cells and how they use
membrane potential to store and transmit information. Topics include the ionic
mechanisms underlying the electrical activity of nerve cells, the cellular mechanisms of
synaptic transmission, and the impact of these basic mechanisms on the operation of
neural circuits.

Sensory and motor systems (23 lectures)
This section explores concepts of neural information processing using a variety of
vertebrate and invertebrate model systems. The focus is on peripheral and central
processes underlying well-defined behaviours. The fruitfulness of multidisciplinary
approaches is stressed, ranging from physics and behavioural experimentation to
electrophysiology and computational neuroscience.

Neurogenetics (8 lectures)
We will survey examples of behaviours whose genetic basis has been elucidated. The
emphasis is on integration of genes, neurophysiology, circuits and behaviour to generate a
deep understanding of how nervous systems evolve and how they can be manipulated on
the genetic level. Topics will include: sleep, circadian rhythms, aggression and sexual
behaviour.

A detailed listing of lecture topics from the most recent offering of the course is available on
Minerva

Readings:  Course Pack

Method:  Three lectures weekly.

Evaluation:  Midterm examinations, final examination
BIOL 307 (Winter)
Behavioural Ecology

Instructor: S. Reader  N7/12  398-6421  simon.reader@mcgill.ca
M. Guigueno  N7/3  398-2688  melanie.guigueno@mcgill.ca

Workload:  3 credits (2-1-6)

Prerequisites: BIOL 205, BIOL 215 or permission of instructor.

Content: This course is designed as an introduction to animal behaviour and to ecology at the level of the individual organism. It takes an evolutionary perspective on the relationships between the behaviour of individual animals and their physical environment, their predators and prey, and the activities of members of their own and other species. Emphasis will be on general principles emerging in this rapidly developing field. Application of these principles to the biology of humans will be briefly discussed. An important secondary theme of the course is the process of critical and creative reading of primary research articles in the field. The conferences will involve discussions of research articles to enrich understanding of the lecture material and to illustrate the process of critical reading. The written critiques require evaluation of the strengths and weaknesses of a particular research article and its significance for the major themes of the course.

Lecture 1. Introduction: Why study behavioural ecology?
Lecture 2. History of the field
Lecture 3/4. The analysis of behaviour: Observing and quantifying behaviour
Lecture 5. Testing hypotheses and interpreting results
Lecture 6. Levels of analysis, evolution, and development
Lecture 7. Adaptive explanations of behaviour
Lecture 8. Optimal foraging
Lecture 9. Predator avoidance
Lecture 10. Game theory and resource competition
Lecture 11. Living in groups
Lecture 12. Social foraging
Lecture 13. Learning and cognition
Lecture 14. Midterm review
Lecture 15. Social learning and social cognition 1
Lecture 16. Social learning and social cognition 2
Lecture 17. Sexual selection and mate choice
Lecture 18. Parental care
Lecture 19. Mating systems
Lecture 20. Communication
Lecture 21-23. Evolution of social behaviour 1-3: Kin selection and eusociality
Lecture 22-23. Evolutionary approaches to human behaviour
Lecture 24. Mechanisms of behaviour
Lecture 25. New topics and controversies in behavioural ecology
Lecture 26. Summing up


Method: Two lectures a week plus seminar.

Evaluation: Take-home exam consisting of critiques of research papers during term, conference attendance and participation, oral presentation and a midterm and final examination.
BIOL 308 (Fall)
Ecological Dynamics

Instructor: F. Guichard  N8/14  398-6464  frederic.guichard@mcgill.ca

Workload: 3 credits (3-1-5)

Prerequisites: BIOL 215 or both ENVR 200 and ENVR 202.

Content:
- **Population dynamics**
  - Population growth
  - Regulation of population growth
  - Time delays and stochastic processes
  - Metapopulation dynamics

- **Species interactions**
  - Competition
  - Predator-prey
  - Epidemics
  - Mutualism

- **Community dynamics**
  - Multispecies communities and niche theory
  - Island biogeography
  - Successions
  - Food chains and trophic interactions
  - Food webs


Method: Two 1.5 hour lectures per week; four 2-hour tutorials over the semester.

Evaluation: Midterm exam and final examination. The exams will consist of multiple choice questions, short answer questions and problems.
BIOL 309 (Fall)
Mathematical Models in Biology

Instructor: G. Bub (Physiology) McIntyre, Room 1128 398-8148 gil.bub@mcgill.ca & Staff

Workload: 3 credits (3-0-6)

Prerequisites: 1 year of calculus; an additional course in Calculus is also recommended; or permission of instructor.

Content: The main objective is to give the student basic skills necessary to understand the ways mathematics can be applied to study biological systems.

1) FINITE DIFFERENCE EQUATIONS IN BIOLOGY (12 lectures) dynamics in 1-dimensional finite difference equations modeling ecosystems including concepts of steady states, cycles and chaos. Boolean switching networks as applied to genetic regulation. Cellular automata and fractals.

2) DIFFERENTIAL EQUATIONS (14 lectures)


Readings: Understanding Nonlinear Dynamics by Daniel Kaplan & Leon Glass (Springer-Verlag, 1995)

Method: 2-1/2 hours lecture per week.

Evaluation: Critical review of a scientific article, homework, class test, final.
BIOL 310 (Winter)
Biodiversity and Ecosystems

Instructor: A. Gonzalez N3/2 (514) 398-6444 andrew.gonzalez@mcgill.ca
J. Sunday N8/3 (514)-398-8885 jennifer.sunday@mcgill.ca

Workload 3 credits (3-0-6)

Prerequisite: BIOL 215 or both ENVR 200 and ENVR 202, MATH 112 or equivalent; or permission of the instructor

Content: This course provides undergraduate students with a strong ecological and evolutionary basis to understand the natural causes and consequences of current global environmental changes. It explores the origin and distribution of biodiversity, how biodiversity is defined and measured, how it varies in space and time, and how its loss impacts human societies. BIOL 304, BIOL 308 and BIOL 310 will be highly complementary. BIOL 310, however, does not require BIOL 308 or BIOL 304 as prerequisites. Students with an environmental interest will find much relevant material in this course.

Topics covered include:
- Biodiversity: concepts & measurement
- The spatial distribution of biodiversity
- Evolutionary origins of diversity
- Ecological determinants of species richness, from local to global scales
- Ecosystems: productivity, regulation, stability, regime shifts
- Biodiversity and ecosystem services
- Global change: biogeochemical cycles, climate, biodiversity
- Species extinction and the biodiversity crisis
- Global conservation priorities


Method: Two 1.5-hour lectures per week. Two assignments with problem sets to be analyzed on a computer during the semester. One field trip to Mont St-Hilaire followed by a tutorial to analyze data from the field trip, and a written report

Evaluation: Final exam, problem sets, field trip report, in-class presentation
**BIOL 313 (Winter)**

**Eukaryotic Cell Biology**

**Instructors:**

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<thead>
<tr>
<th>Name</th>
<th>Office</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. Weber</td>
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<tr>
<td>M. Zetka</td>
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<td>398-1328</td>
<td><a href="mailto:monique.zetka@mcgill.ca">monique.zetka@mcgill.ca</a></td>
</tr>
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**Workload:**

3 credits (3-0-6)

**Prerequisites:**

BIOL 200, BIOL 201 or ANAT 212/BIOC 212; or BIOL 219; BIOL 202

**Content:**

This course offers an in-depth examination of the structure and function of eukaryotic cells, with an emphasis on experimental design and interpretation. Lectures will explore the molecular mechanisms of various cellular processes, including protein homeostasis, intracellular transport, cytoskeletal dynamics, multicellular organization and cell cycle control. Through assignments and class discussions, students will learn how to read and critically evaluate the primary literature.

**Cell Biology**

- Cell theory
- Light microscopy, including super-resolution techniques
- Electron microscopy and tomography

**Protein homeostasis**

- Protein folding
- Protein degradation

**Intracellular transport**

- Protein sorting
- Nucleocytoplasmic transport
- Vesicle trafficking

**Cytoskeletal structure and dynamics**

- Polymerization
- Regulation
- Molecular motors
- Cell motility

**Multicellular organization**

- Epithelial polarity
- Intercellular junctions
- Extracellular matrix

**Cell cycle control**

- Cell growth and size control
- S phase, DNA replication
- Mitosis and meiosis
- Mechanics of cytokinesis
- Apoptosis
- Cancer

**Readings:**


**Method:**

Three hours of lectures each week.

**Evaluation:**

Assignments based on readings from the primary literature; a mid-term exam and a cumulative final exam.
BIOL 314 (Fall)
Molecular Biology of Oncogenes

Instructors: D. Dankort (Coordinator)  Bellini 264  david.dankor@mcgill.ca
L. Majewska  Glen Campus  loydie.majewska@mcgill.ca
K. Christensen  Glen Campus  karen.christensen@mail.mcgill.ca
S. Del Rincon  Lady Davis Institute  sonia.delrincon@mcgill.ca

Workload:  3 credits (3-0-6)

Prerequisites:  BIOL 200, BIOL 201 or ANAT 212/BIOC 212; or BIOL 219 (or permission of instructor)

Content: Successive accumulation of mutations of normal genes in a single cell results in the alteration of several physiological pathways/events/molecules, which collectively contribute to the genesis of cancer. Genetic damage found in cancer cells is of two types: 1. One is dominant and in this process the genes are termed proto-oncogenes. A proto-oncogene is a normal gene whose protein product has the capacity to induce cellular transformation given it sustains some genetic insult. An oncogene is the gene that has sustained some genetic damage and, therefore, produces an abnormal protein capable of cellular transformation and cancer. 2. The other is recessive and the genes involved in this process are variously termed as tumor suppressors, growth suppressors, recessive oncogenes or anti-oncogenes. Events known to promote the formation of oncogenes, the biochemical properties of the proteins encoded by these mutated genes, and their functions will be analyzed in an attempt to understand the molecular basis of human cancers. We will also examine current molecular targets for cancer therapy and the concepts and consequences of inheriting mutations in genes that predispose to cancer.

The Aim of this course is to:
Evaluate the relationship between oncogenes and cancer;
Analyze the key physiological changes in cancer cells and oncogenes involved in the induction of such changes
Compare the major requirements for cancer
Analyze these requirements during normal development
Critically analyze research papers in cancer
Propose hypothetical new molecular targets for cancer therapy

I. Evaluate the relationship between oncogenes and cancer
1- Identify and define cellular structure and components from gene to proteins
2- Define cellular homeostasis and apply the concept to a concrete example
3- Provide a comprehensive classification of proto-oncogenes
4- Identify some common facts about cancer
5- Compare and identify the common activation mechanisms of normal genes to activate oncogenes
6- Define concepts of cancer predisposition in the context of heritable mutations in cancer associated genes

II. Characterize the role of growth factor receptors and major signal transduction pathways in cancer
1- Growth factor receptors as oncoproteins and the role of tyrosine phosphorylation in cancer. (Provide example of GFR and means of abnormal activation)
2- Intra-cellular signaling: describe major oncogenes and signaling pathways involved in cancer including src, ras and Akt; integrate molecular events from the cell surface to the nucleus.
3- The contribution of aberrant signal transduction to cancer cell using specific examples for cell surface, intracellular and nuclear events. Provide specific examples of known cancers that thrive on aberrant signaling events and how different oncogenic signals can be integrated in the same cell.
III. Cell cycle, inflammation and apoptosis in cancer
1. Review the cell cycle and describe the two major cell cycle pathways p53 and Rb.
2. Describe the mechanisms of cell death and inflammation.
3. Explain how evasion of apoptosis can lead to cancer (Oncogenes bcl/bax; p53).
4. Define the limitless replicative potential (immortalization)-Telomere, telomerase and immortalization (oncogene hEST2/hTERT/hTRT).
5. Describe the one carbon metabolism pathway and its relationship to cancer.
6. Justify the need for genomic instability - Loss of genes involved in sensing and repairing DNA damage or chromosomal segregation during mitosis (example: MSH2 family of genes, hSecurin gene).

IV. Angiogenesis, epithelial mesenchymal transition and cancer models
1. Define Sustained angiogenesis and explain its role in cancer- Production of angiogenesis.
2. Analyze the need for cancer cells to invade tissues and to metastasize - Functional elimination of genes that suppress the cell’s ability to invade tissues and to metastasize (example: E-cadherin gene, CDH1 gene).
3. Compare the role of EMT in development with cancer – does E-cadherin and stromal genes play similar roles?

V. Translating molecular events to cancer therapy: How a precise molecular understanding of cancer can directly affect cancer therapy.
1. An overview of molecules designed or selected to target major oncogenes and are currently used in cancer therapy.
2. What cancers can be molecularly targeted? Example of Chronic Myelogenous Leukemia, Gastro-intestinal stromal tumours, breast, lung, melanoma and brain cancers.
3. The role of gene therapy in cancer. Other perspectives currently under investigation in cancer therapy.
4. Immunotherapy and cancer (hairy cell leukemia, BCG inoculations, stem cell transplantation).
5. Through the example of one highly aggressive cancer the review of major oncogenes, oncogenic pathways and available molecular targets for adjuvant treatments will be performed.

Readings: The lectures and notes will be based on primary literature (reviews or papers that will be assigned by each professor). Students are strongly encouraged to attend lectures and use, as a reference, The Biology of Cancer by Robert Weinberg. Garland Science, 2nd ed., 2013.

Method: Three hours of lectures per week.

Evaluation: Mid-term(s), written assignments, final examination. Exams will be based on materials presented and discussed in class and on assigned readings.
BIOL 316 (Fall)
Biomembranes and Organelles

Instructor: H. Zheng (Coordinator) N5/10 398-1328 hugo.zheng@mcgill.ca
A. Watt Bellini 265 398-2806 alanna.watt@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisite: BIOL 201 or ANAT 212/BIOC 212 or BIOL 219

Contents: “Long ago it became evident that the key to every biological problem must finally be sought in the cell, for every living organism is, or at some time has been, a cell.” The central importance of Cell Biology in biological sciences was well summarized by E.B. Wilson (1856-1939), a pioneering American zoologist and geneticist. The emphasis of this course is on the molecular basis of the structure, generation and function of eukaryotic cell membranes and organelles and their medical impacts. The lectures will discuss some advanced topics, such as membrane structure, ion transport, cell energetics in different organelles, endomembrane system, vesicle trafficking, cell-cell contact and communications. As a subject of experimental science, the rapid advance in cell biology is largely dependent on and driven by results from laboratory research. Therefore, some classical and modern experimental methods to study cells will also be discussed

The lectures will discuss the following advanced cell biology topics:

1) Membrane structure: membrane lipid and proteins; membrane transport; ion channels in nerve cells

2) Cellular energetics: function and biogenesis of mitochondria and chloroplasts, the role of mitochondria in aging

3) Endomembrane system: The dynamics and function of ER, Golgi and post-Golgi organelles; protein trafficking and human diseases

4) Social interaction of cells: extra-cellular matrix and plant cell walls


Method: Three hours of lectures per week

Evaluation: Two assignments and a final exam
BIOL 319 (Winter)
Introduction to Biophysics

Instructor: P. Wiseman  Otto Maass Chem/Rutherford Buildings  398-5354  paul.wiseman@mcgill.ca

Workload:  3 credits (3-0-6)

Prerequisites: BIOL 200 or BIOL 219, MATH 222, PHYS 230, PHYS 232 or PHYS 253 or permission of the instructor

Restrictions: Not open to students who have taken or are taking PHYS 319.

Content: Emerging physical approaches and quantitative measurement techniques are providing new insights into longstanding biological questions. This undergraduate course will present underlying physical theory, quantitative measurement techniques, and significant findings in molecular and cellular biophysics. Principles covered include Brownian motion, low Reynolds-number environments, forces relevant to cells and molecules, chemical potentials and free energies, models of biopolymer folding and kinetics in a biological context. Those principles are applied to study proteins, DNA, RNA, lipids and membranes in a biophysical context at the cellular level. U2 and U3 students with training in physics and quantitative biology will be well-suited to the course.

Topics covered (not necessarily in order):
Introduction to physical biology and quantitative modeling.
Brownian motion and diffusion.
Stokes-Einstein relation and applications.
Gibbs free energy and Entropy.
Random walks for modeling biopolymer folding.
Mechanical and chemical equilibrium in the living cell.
Chemical binding kinetics, membrane receptors
Intermolecular forces.
Electrostatics in salty solutions.
Cellular membranes and membrane potential
Cytoskeleton and dynamics.
Biophysics applications of fluorescence and super-resolution optical microscopy

Readings: Physical Biology of the Cell, 2nd ed. by Rob Phillips, Jane Kondev, Julie Theriot, Hernan Garcia
Garland Science 2012

Method:  3 hours lecture

Evaluation:  Assignments, two in-class midterms and final exam
**BIOL 320 (Winter)**

**Evolution of Brain and Behaviour**

**Instructors:**
- S. Woolley (Coordinator)  
  N4/8  
  398-2324  
  sarah.woolley@mcgill.ca
- Jon Sakata  
  N4/8  
  398-3636  
  jon.sakata@mcgill.ca

**Workload:**
3 credits (2-1-6)

**Prerequisites:**
NSCI 201 or BIOL 306

**Content:**
The diversity of behaviour that exists across vertebrate taxa is rooted in variation in the organization and structure of specific neuroanatomical circuits. We will examine how particular brain systems differ across species and how these species differences in neuroanatomy contribute to species differences in behaviour. This course will build upon rudimentary principles of neuroscience, behavioural control, and evolution.

**Readings:**
Readings will be taken from textbooks as well as journal articles.

**Method:**
2 hours lecture and 1 hour mandatory seminar per week

**Evaluation:**
Midterm and final exams, short written assignments, class participation
BIOL 324 (Fall)
Ecological Genetics

Instructors: D. Schoen (Coordinator) N3/8A 398-6461 daniel.schoen@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 202

Content: The aim of this course is to present evolutionary genetics within an ecological context. The course will cover theoretical and applied topics together with relevant data from natural populations of plant and animals. As part of this course we also aim to provide students with experience in reading and presenting the primary scientific literature and in gaining experience with some of the principle methodological tools in the field (e.g., use of molecular ecological tools for identification of organisms, phylogenetic analysis of molecular data, estimation of genetic diversity).

1) THE ECOLOGICAL CONTEXT OF EVOLUTIONARY CHANGE
2) TYPES OF GENETIC VARIATION: DNA, PROTEINS, QUANTITATIVE VARIATION
3) ORGANIZATION OF GENETIC VARIATION
   A) Population, races, ecotypes, species
   B) Hardy-Weinberg equilibrium
   C) Two loci. Linkage equilibrium
4) POPULATION STRUCTURE
   A) Inbreeding theory and mating systems
   B) Population subdivision
   C) Effective population size and genetic drift
   D) Shifting balance theory
5) EFFECTS OF NATURAL SELECTION ON GENE FREQUENCIES IN POPULATIONS
   A) Differential survival, reproduction, and fitness variation
   B) Basic modes of selection
   C) Frequency- and density-dependent selection
   D) Selection in heterogeneous environments
   E) Selection and gene flow
   F) Selection and mutation
   G) Selection and genetic drift
   H) Fisher's fundamental theorem
6) POLYGENIC TRAITS AND EVOLUTION
   A) Polygenic inheritance and the analysis of phenotypic variation
   B) Phenotypic description of selection
   C) Heritability, genetic correlation, and selection
7) EVOLUTION AT THE MOLECULAR LEVEL
   A) Rate and patterns of sequence evolution
   B) Neutral theory
   C) Gene duplication, unequal crossing over, transposition, and concerted evolution
   D) Mobile genetic elements and selfish DNA

Readings: To be announced

Method: Two lectures per week; one group discussion or lab per week.

Evaluation: Mid term, final exam, participation in discussions and short assignments
BIOL 331 (Fall)
Ecology/Behaviour Field Course (3 credits)
(given last two weeks of August)

Instructors:  
S. Reader (Coordinator)  N7/12  398-6421  simon.reader@mcgill.ca  
A. Hargreaves  N6/11  398-7401  anna.hargreaves@mcgill.ca  
R. Barrett  REDMUS 303A  398-4086 x00856  rowan.barrett@mcgill.ca

The professors teaching the course vary from year to year, as do the specific dates of the course but in general the course is taught the last two weeks before classes begin. Check the course web site in late winter for specific teachers and course dates for the coming fall.

Prerequisites:  BIOL 206, BIOL 215

Content:  The aim of this course is to provide training in basic methods for the quantitative study of plant and animal systems and the testing of hypotheses in nature. The course is held at McGill's Gault Nature Reserve on Mont St. Hilaire. During the first part of the course students participate in 3-4 modules structured to provide experience in the study of both aquatic and terrestrial environments. Each module is organized around a research problem and includes elements of experimental design, data collection, analysis and interpretation. Two-and-a-half days are devoted to independent research projects designed and executed by students working singly or in small teams. This independent study project forms the basis of a written report which is completed in September after the conclusion of the field component. This is an excellent introduction to field studies in the environmental sciences that provides an affordable and stimulating experience under the guidance of 3-4 professors representing a variety of perspectives on ecology and animal behaviour.

Method:  Although this is technically a fall course, it is in fact completed by October. The course begins with a 12-day field course during the last two weeks of August just before fall classes (specific dates vary year to year), followed by completion of an independent project in early fall. You can count on spending the equivalent of one full week during the first three weeks of the fall term in analysis of results, literature review and report writing.

Evaluation:  On basis of field work and written report.

Registration:  Students should contact Susan Gabe (Stewart Building, N7/9A before May 1 to sign up for the course (20 slots, first come first served) and pay a deposit of $150 toward room and board costs. The required application form and additional information can be found on the BIOL 331 web site (http://www.biology.mcgill.ca/undergrad/C331A/index.htm). Be aware that your deposit will be refundable up to June 30, but not after that. We will maintain a waiting list once 16 people have signed up on MINERVA; if someone drops the course than students on the waiting list will be allowed to register in the order in which their applications were received. A minimum of 12 students is required for the course to be offered. Deposits will be returned to students if the course is not given.
BIOL 334D1/D2 (Winter/Summer)
Applied Tropical Ecology (3 credits)
(Winter meetings; 2 weeks in May)

Instructors:  
F. Guichard (Co-ordinator)  N8/14  398-6464  frederic.guichard@mcgill.ca  
N. Price  N6/12  398-6468  neil.price@mcgill.ca  
L. Nilson  N5/8  398-6448  laura.nilson@mcgill.ca

Prerequisites:  BIOL 206, BIOL 215 OR both ENVR 200 and 202, and permission of instructor.

Content:  This course focuses on aspects of marine and terrestrial tropical ecology relevant to conservation of natural resources and other applied problems. It is taught at McGill's Bellairs Research Institute in Barbados, for two weeks in May. The course is organized as a series of small-group field exercises and projects. Limited enrolment. Students interested in taking the course should fill out an application form and attend the information session in October or November. The course fee (approx. $1600) covers all expenses in Barbados but not tuition and airfare. See the web site for more details:  http://www.biology.mcgill.ca/undergrad/c334b/  
N.B. This course is completed in the summer term. Students in their last year will only graduate in Summer (Oct/Nov convocation) at the earliest.

Readings:  Course Pack and articles available through myCourses

Method:  12-day field course. Students should expect to work all day, every day, of the course. Field work often involves both aquatic and terrestrial studies, but topics change from year to year.

Evaluation:  Based on participation in field work, evaluation of a project carried out during the course and results of an examination before the start of the course which tests understanding of preliminary readings.

BIOL 335 (Summer)
Marine Mammals (3 credits)
Huntsman Marine Science Centre (HMSC), New Brunswick  
(2 weeks in August)

Instructor:  A. Babin  Huntsman Marine Science Centre  amanda@babin-labs.com

Prerequisite:  BIOL 205

Content:  The course is taught at the Huntsman Marine Science Centre, St. Andrews, N.B. during the middle two weeks of August. It is an introduction to the biology of marine mammals with special emphasis on the whales and seals of the Bay of Fundy and Northwest Atlantic waters, though the diversity of marine mammals throughout the globe will be discussed. There will be frequent field trips to observe marine mammals in their natural habitat. Lectures and laboratory sessions will cover such topics as: species identification, evolution, adaptations and current research techniques. For more information see the Undergraduate Coordinator in N7/9A - Stewart Biology Building, or visit the web site at:  http://www.huntsmanmarine.ca/education-outreach/courses/university/  

Method:  The minimum of 130 contact hours over the two-week period combines lectures, laboratory exercises, field trips, and individual research projects.

Evaluation:  Individual and group presentations and reports, class debate, final exam

Note:  Students must APPLY EARLY TO HUNTSMAN, well before registering with McGill
BIOL 342 (Winter)
Contemporary Topics in Aquatic Ecology (3 credits)
Not offered in 2019-2020

Instructor: I. Gregory Eaves (coordinator) N4/8 398-6425 irene.gregory-eaves@mcgill.ca
N. Price N6/12 398-6468 neil.price@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 205, and BIOL 215 or both ENVR 200 and ENVR 202

Restrictions: Not open to students who have taken or are taking BIOL 432

Content: The course teaches fundamental concepts in aquatic ecology by addressing topics that represent some of the most pressing issues environmental issues of the day. Seminars provide baseline knowledge about the structure and function of aquatic ecosystems and how these are altered by processes including climate change, ocean acidification, habitat loss and eutrophication.

Readings: Selected book chapters and the primary literature

Method: 3 hours of seminar per week

Evaluation: Short written assignments, oral presentations, final term paper and class participation:

BIOL 350 (Fall)
Insect Biology and Control

Instructor: G.B. Dunphy Dept. Natural Resource Sciences Phone: 398-7903
Macdonald Stewart Building Fax: 398-7990
Macdonald Campus E-mail: gary.dunphy@mcgill.ca

Workload: 3 credits (2-0-7)

Prerequisites: BIOL 205 or permission of the instructor. Students without the necessary prerequisite are strongly encouraged to contact the professor for permission

Restrictions: Not open to students who are taking or who have taken ENTO 330 or ENTO 350.

Content: A lecture course designed to introduce insect structure, physiology, behaviour, biochemistry, development, systematics, evolution, ecology and control. The course stresses interrelationships and integrated pest control. (Minimum enrolment 12 students).

1) Introduction
2) External anatomy
3) Internal anatomy
4) Physiology
5) Test of material from lectures to date
6) Sensory systems
7) Insects and their environments
8) Pest insects in agriculture, forestry and medicine
9) Pest control by chemical, cultural and physical methods
10) Test of material covered since previous test
11) Predators and parasitoids in biological control
12) Virus control of pest insects
13) Bacterial control of pest insects
14) Insect immunity

Readings: *The Insects, an Outline of Entomology* by P.J. Gullan and P.S. Cranston, 4th ed. 2010 Chapman & Hall

Method: Lectures, modules and term papers.

Evaluation: Final exam, 2 midterm tests, and term paper

**BIOL 352 (Winter)**  
**Dinosaur Biology**

Instructor: H. Larsson  
Redpath Museum  
398-4087  
hans.ce.larsson@mcgill.ca

Workload: 3 credits (2-3-4)

Prerequisite: BIOL 215 or ENVR 202 or EPSC 233 or permission of the instructor.

Content: Using dinosaurs as exemplars, this course teaches aspects of comparative, functional, and developmental morphology, macroevolution, macroecology, and phylogenetic systematics. Lab dissections will explore vertebrate anatomy. Extensive collections and exhibits of the Redpath Museum will be used. The material is presented in seven major sections.

- **Part 1: Origins** | Evolutionary origins of dinosaurs.
- **Part 2: Organs** | Comparative and functional anatomy.
- **Part 4: Dinosaur diversity** | A survey of all taxonomic groups of non-avian dinosaurs.
- **Part 5: Transitions** | The origin of birds: ecology, biomechanics, and developmental biology.
- **Part 6: Bird diversity** | A survey of all taxonomic groups of birds.
- **Part 7: Conclusions** | Future directions in dinosaur research.

Readings: There is no textbook or course pack. Each lecture may be accompanied by readings available through the course’s myCourses site.

Method: Two one hour lectures and one three-hour laboratory per week.

Evaluation: Mid-term exam, lab quizzes, presentations and a written project and final exam
**BIOL 370 (Fall)**  
**Human Genetics Applied**

**Instructors:**  
R. Palmour (Coordinator)  
Irving Ludmer Bldg  
398-7303  
roberta.palmour@mcgill.ca  
& Staff  
Administrative office  
W-315 Strathcona  
398-4198  
ross.mackay@mcgill.ca

**Workload:**  
3 credits (3-0-6)

**Prerequisites:**  
BIOL 200, BIOL 201 or ANAT 212/BIOC 212; or BIOL 219; and BIOL 202

**Content:**  
The extraordinary expansion in the applicability of human genetics to human welfare has created not only exciting possibilities for reducing disease and improving health, but also real and potential problems -- ethical, moral and practical. This course will summarize the factual basis of the issues at a level intelligible to second- and third-year undergraduates, using the following topics, and drawing upon examples from the experience of the lecturers.

1. **GENETIC VARIATION** (2 lectures)  
   Phenotype, protein, DNA

2. **THE HUMAN GENOME** (2 lectures)  
   Sequencing and mapping the human genome  
   The genetics of gene expression

3. **MENDELIAN AND NON-MENDELIAN TRAITS** (7 lectures)  
   Linkage analysis; genotype-phenotype relationships;  
   Defining and mapping complex traits; whole genome association

4. **EPGENETICS** (1 lecture)  
   Post-natal modifications of the somatic genome and its effects on gene expression

5. **BEHAVIOUR** (2 lectures)  
   Behavioral traits; major psychiatric disorders

6. **POPULATION GENETICS** (2 lectures)  
   Basic concepts; mutation and selection; founder effect and genetic drift

7. **DEVELOPMENTAL AND REPRODUCTIVE GENETICS** (3 lectures)  
   Basic concepts; dysmorphologies; preimplantation diagnosis

8. **DIAGNOSIS SCREENING AND THERAPY OF GENETIC DISEASE** (2 lectures)  
   Theory (sensitivity; specificity; cost-benefit); practice  
   Phenotherapy, genotherapy, ethics/eugenics

9. **CANCER GENETICS** (1 lecture)  
   From families to genes; clinical applications

10. **GENE THERAPY AND GENE EDITING** (1 lecture)  
    Approaches and methodologies; promises and risks

11. **GENETIC COUNSELLING** (1 lecture)  
    Risks (empirical, Bayesian, chromosomal); prenatal diagnosis;  
    ethical and social issues

**Readings:**  
*Human Molecular Genetics* 4th ed by Strachan & Reed; Genetics and Genomics in Medicine, 1st ed. Strachan, Goodship & Chinnery
Method: Two 1.5 hour lectures per week.
Evaluation: Mid-term, Take-home paper; Final exam;

BIOL 373 (Fall)
Biometry

Instructor: B. Leung N6/13 398-6460 brian.leung2@mcgill.ca
Workload: 3 credits (2-2-5)
Prerequisite: MATH 112 or equivalent.
Content: The aim of this course is to introduce students to the foundations of the analysis of biological data while emphasizing the assumptions behind statistical tests and models. I shall not as in the mathematical statistics course, go into detail about the specific mathematical derivations. The course is designed to give a student the ability to intelligently use the statistical techniques typically available on computer packages such as SYSTAT or SPSS.

APPROXIMATE ORDER OF TOPICS COVERED
- Course introduction; Introduction to data presentation
- Populations and samples; Pseudoreplication; Central tendency and variability
- Introduction to probability
- Normal distribution
- Introduction to hypothesis testing
- One-sample hypotheses
- Two-sample hypotheses: the t-test
- Non-parametric statistics: Mann-Whitney; Data transformation
- Paired-sample hypotheses
- Multi-sample hypotheses: single-factor ANOVA
- Multiple comparisons
- Power, sample size, and assumptions in ANOVA; non-parametric ANOVA: Kruskal-Wallis test
- Two-Factor ANOVA with equal replication
- Two-Factor ANOVA: theory and multiple comparisons.
- Two-Factor ANOVA without replication; Randomized block; Repeated measures
- Hierarchical ANOVA, MANOVA
- Linear Regression
- Linear Regression; Hypothesis testing
- Multiple regression, Polynomial Regression, ANCOVA
- Goodness of fit: Chi-square
- Contingency tables
- Advanced topics

You may not be able to get credit for this course and other statistic courses. Be sure to heck the Course Overlap section under Faculty Degree Requirements in the Arts or Science section of the Calendar. Check out: http://www.mcgill.ca/study/2013-2014/faculties/science/undergraduate/ug_sci_course_reqs#booknode-52063

Method: Lectures and labs.
Evaluation: Labs, class assignments, and a final exam.
BIOL 377 (Fall, Winter, Summer)
Independent Reading Project (3 credits)

Instructor: Any staff member of the Biology Department.

Coordinator: N. Nelson N7/9B 398-4109 nancy.nelson@mcgill.ca

Prerequisite: BIOL 200 and BIOL 201 (or ANAT/BIOC 212); or BIOL 219; or BIOL 215; or permission

Restriction: Open to U2 or U3 students in Biology only


Cannot be taken under the S/U option

BIOL 389 (Winter)
Laboratory in Neurobiology

Instructors: J. Dent (Coordinator) N/7A 398-3724 joseph.dent@mcgill.ca
A. Watt Bellini 265 398-2806 alanna.watt@mcgill.ca
T. Oyama N5/25 398-2124 tomoko.oyama@mcgill.ca

Workload: 3 credits (1-5-3)

Prerequisites: BIOL 306 or NEUR 310 or NSCI 200 or PHGY 311 or permission of instructor. Enrolment is limited to 32 students (16 per section)

Content: The main objective of the course is to allow students to experience firsthand how neurobiological questions are asked and answered. In each of the following three course sections, you will first be introduced to the relevant experimental techniques and then conduct a small independent research project.

1) Introduction to electrophysiology and neurogenetics (4 labs). Recordings of the electrical activity of neurons has formed the foundation of our understanding of the neural basis of behavior. You will learn to use the electrophysiology equipment and a simple extracellular recording technique which you will use to explore mutations affecting neurotransmission in the nematode Caenorhabditis elegans. You will design experiment to test the effect of mutants and/or neuroactive drugs on neurotransmission.

2) Intrinsic and network properties of identified neurons (4 labs). In many invertebrate animals, such as the leech, which will be used here, neurons are individually identifiable based on their morphology and physiology. You will learn to perform intracellular recordings from specific neurons in the leech nervous system and how to determine the electrical properties of nerve cells in a quantitative manner using basic biophysical experiments. Finally, in an experiment designed by yourself, you will have the opportunity to study the role of specific ion channels and synaptic input for the electrical activity of individual neurons.

3) Synaptic plasticity (4 labs). Using a mammalian in vitro preparation, you will use extracellular stimulation combined with field recordings to study long-term potentiation (LTP) and/or long-term
depression (LTD) at synapses; mechanisms believed to be the cellular basis of learning and memory. With input from the instructor and colleagues, you will then design and conduct experiments to delve more deeply into the mechanistic underpinnings of synaptic plasticity.

Readings: Selected journal articles.

Method: 1 hour lecture, 5 hours laboratory; students work in pairs.

Evaluation: The grade will be based on three written laboratory reports, each of which follows the format of published journal articles.

BIOL 395 (Fall)
Quantitative Biology Seminar 1

Instructors: A. Hayer    Bellini 268    398-8574    arnold.hayer@mcgill.ca

Workload: 1 credit (1-0-2)

Prerequisites: BIOL 200 or BIOL 219, CHEM 212, COMP 250 and MATH 222

Restrictions: Registration is restricted to U2 students in the following programs: Major and Honors Quantitative Biology; Joint Major and Honors Computer Science and Biology; Joint Major Math and Biology; Joint Major Physiology and Math; Joint Major Physiology and Physics; Major and Honors Biophysical Chemistry; and Major and Honors Biological Physics.

Content: This course provides an overview of concepts and current research in quantitative biology: theoretical ecology and evolution, computational biology, and physical biology.

Each week a faculty member will present on their research in a lecture. Readings from the literature or a publication from the lecturer’s research group may be assigned for each lecture to enhance understanding of the material. Readings are available through on-line journal access provided through McGill University.

Readings: Research papers and reviews will be assigned by participating faculty

Method: One hour seminar a week

Evaluation: Mid-term and final exam, consisting of short-answer questions. Exams will cover only material discussed in class. Performance during the midterm (40%) and final exam (60%) provides the total mark. No make-up or extra credit assignments are permitted.
**BIOL 396 (3 credits)**  
(*Fall, Winter or Summer*)  
**Undergraduate Research Project**

**Instructor:** Any staff member of the Biology Department  
**Coordinator:** N. Nelson  N7/9B  398-4109  nancy.nelson@mcgill.ca  

**Restrictions:** This course cannot be taken under the S/U option, and must be elective credits. Students cannot be supervised by the instructor for two 396 Science courses. Open to students in programs offered by the Faculty of Science only. Not open to Biology students.

**Content and Procedures:** Independent research project with a final written report worth at least 50% of the total grade. See **http://www.mcgill.ca/science/ours** for more information about available projects and application forms and procedures.

*Cannot be taken under the S/U option*

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**BIOL 413 (Fall, Winter, Summer)**  
**Directed Reading (1 credit)**

**Instructor:** Any staff member of the Biology Department.  
**Coordinator:** N. Nelson  N7/9B  398-4109  nancy.nelson@mcgill.ca  

**Prerequisites:** BIOL 200, 201 or ANAT 212/BIOC 212; or BIOL 219; BIOL 202, 205, 215. Registration form is required as for the Independent Study courses.

**Content:** Special topics paper under the guidance of a staff member of the Biology Department. The course presents the opportunity to improve scientific writing skills and to ease compliance with the number of credits required for graduation. See **http://biology.mcgill.ca/undergrad/res_opps.html**, Application forms and Suggested Criteria.

**Method:** Review written in scientific format.

*Cannot be taken under the S/U option*
**BIOL 414 (Fall)**  
**Invertebrate Brain Circuits & Behaviour**

**Instructor:** T. Ohyama  
N5/25  
514-398-2124  
tomoko.oyama@mcgill.ca

**Workload:** 3 credits (2-1-6)

**Prerequisites:** Basic of neurobiology (as provided by prerequisite courses BIOL 306, NSCI 200, NSCI 201, PHGY 311, or NEUR 310) and basic computer skills (such as those offered by COMP 201 or its equivalent) are essential.

**Content:** BIOL 414 is a lecture course that covers the neural and molecular underpinnings of animal behavior, elucidating how such mechanisms work together in the context of neural circuits to drive specific behaviors. Topics will include odor-guided navigation and pheromone communication, visual processing of color and shape, the neuroscience of circadian rhythms, and the molecular and genetic basis of learning and memory. We will touch upon the emerging field of bio-robotics, where principles of insect sensory integration and locomotion are incorporated into robot design.

**Readings:** Readings will be taken from textbooks as well as journal articles

**Method:** 2 hours lecture and 1 hour mandatory seminar per week

**Evaluation:** Midterm and final exams, short written assignments, class participation
BIOL 416 (Winter)
Genetics of Mammalian Development

Instructors: D. Dufort (Co-ord) MUHC-RI GLEN 3220 934-1934x34743 daniel.dufort@mcgill.ca
T. Taketo MUHC-RI GLEN 3220 934-1934x34197 teruko.taketo@mcgill.ca
& Staff

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 202, 300, 303 or permission.

Content: This course aims to examine problems, theories, and experimental evidence on several concepts of mammalian developmental processes at molecular to organogenesis levels. Emphasis will be put on recent developments in the field and novel approaches to address various developmental issues.

Topics covered in class (selected from the following)
- Gametogenesis
- Preimplantation development
- Stem cells
- Implantation
- Placental development
- Body axis establishment
- Kidney development
- Muscle regeneration
- Epigenetics

Readings: Selected research articles.

Method: 5 topics will be covered during the semester. Each topic will have an introductory overview given by the Instructor (or invited lecturer), followed by presentations of recent articles by students followed by a research seminar given by the Instructor responsible for each section. Students are expected to present 2 articles and write 2 critique from the articles presented in class. Emphasis will be put on identifying the strengths and weaknesses of each paper presented in order to develop critical thinking abilities.

Evaluation: Students will be evaluated on the basis of participation and discussion, presentations, and critiques.

BIOL 418 (Winter)
Freshwater Invertebrate Ecology

Instructor: A. Ricciardi Redpath Museum 398-4089 tony.ricciardi@mcgill.ca

Workload: 3 credits (2-3-4)

Prerequisites: BIOL 205; BIOL 215 or both ENVR 200 and ENVR 202; or permission of the instructor. Enrolment is limited to 25 students.

Content: This course explores the life history and ecology of freshwater invertebrates in lakes, rivers and wetlands. It will focus on their habitat requirements, functional ecology and food web interactions. We will also examine how invertebrates affect the functioning of aquatic ecosystems, and how their diversity is threatened by human activities.

Lectures – The course will begin by exploring the special features of freshwater habitats, the major distinctions between freshwater and marine invertebrates, the constraints of living in a freshwater
environment, and general patterns of freshwater biodiversity and zoogeography. The next series of lectures will examine invertebrate life cycles, food web interactions, and the faunal groups that characterize various types of freshwater habitats. Emphasis will be placed on the adaptations and functional ecology of invertebrates in different habitats, while introducing concepts such as functional feeding guilds and the river continuum. The final series of lectures will examine the role of anthropogenic stressors as threats to freshwater invertebrate diversity, and the value of invertebrates as sentinels of environmental change.

Labs – The labs will demonstrate techniques of identification of major invertebrate groups, using both preserved and living specimens. The final lab will familiarize students with the use of invertebrate data in biomonitoring and environmental assessment. A field sampling trip may be scheduled for the second or third week.

Readings: Selected journal articles will be posted on the course web site.

Method: Two 1hr lectures per week and one 3hr lab session per week.

Evaluation: Midterm exam, Lab exam, Final exam

**BIOL 427 (Fall)**

**Herpetology**

(Given in alternate years; Not offered in 2019-2020)

**Instructor:** D. M. Green  Redpath Museum  398-4086x4088  david.m.green@mcgill.ca

**Workload:** 3 credits (2-3-4)

**Prerequisite:** BIOL 205 and BIOL 305 or permission of instructor

**Content:** This course considers the evolution and diversity of amphibians and reptiles, emphasizing detailed discussions of aspects that illustrate general principles of organismal and evolutionary biology. As such, the course explores the evolution and diversity of amphibians and reptiles (origins and phylogeny; diversity and systematics of extinct and modern forms), reproduction (development, metamorphosis, neoteny; phenotypic plasticity), communication and social behaviour (Vocalizations, acoustic communication, sensory systems, reproductive behaviour, social behaviour and parental care). physiology (hibernation and cold tolerance; venoms and toxicology, defensive strategies), biomechanics (jaw mechanics; Locomotion, limbleness, arboreality, fossorial life, swimming), genetics (sex determination; Parthenogenesis and hybridization) and ecology (predator/prey relations, population ecology, conservation and endangered species. The laboratories emphasize structure and identification of representative forms, especially local and North American species.


**Method:** Two lectures, one laboratory per week. One field trip.

**Evaluation:** One final examination and quizzes on lecture material; one final laboratory examination. Students will also be graded on an essay which will include its presentation as a seminar.
BIOL 428 (Winter)  
Biological Diversity in Africa  
(Part of the Africa Field Semester)

Instructor: TBA  N7/3  398-2688  melanie.guigueno@mcgill.ca

Workload:  3 credits

Prerequisites:  BIOL 305 or equivalent, or permission of instructor

Co-requisites:  BIOL/NRSC 451 and ANTH/GEOG 451

Restriction:  Not open to those students who have taken BIOL 328

Content:  This course deals in depth with biological diversity as exemplified by one or more taxonomic groups of organisms in Africa that are the specialities of particular instructors. As such, it will be a course in field herpetology, ornithology, mammalogy, ichthyology, entomology, invertebrate zoology and/or botany. It is taught at a series of locations in Uganda, Kenya and/or Tanzania taking advantage of a variety of physical locations and ecosystems to impart practical training in species identification and field research. Biological principles embodied in the organisms concerned will also be discussed. Specific lecture topics may include, as appropriate, evolution, diversity, systematics, reproduction, communication, social behaviour, physiology, biomechanics, genetics, and/or conservation biology. Numerous field exercises will introduce students to the indigenous biota, local habitats and field research methods. Students must register for the Africa Field Study Semester.

Readings:  Text and independent readings as assigned by the instructor.

Method:  Daily lectures and field exercises, together totaling at least 60 hours, over a three-week period in East Africa.

Evaluation:  Depending upon the instructor(s), may include a field project report, participation in field work, seminar and/or one mid-term and one final examination on lecture material.
BIOL 429 (Winter)
East African Ecology
(Part of the Africa Field Semester)

Instructor: L. Chapman  N3/12A  398-6431  lauren.chapman@mcgill.ca

Workload: 3 credits

Prerequisites: BIOL 215 or equivalents

Co-requisites: BIOL/NRSC 451 and ANTH/GEOG 451

Restrictions: Not open to those students who have taken BIOL 329

Content: This course deals in detail with aspects of ecology particularly pertinent to East Africa and conservation of biological diversity in the region at the discretion of the instructor. The course uses field settings to impart training in ecological principles critical to tropical conservation with an emphasis on research design and field research exercises. It is taught at a series of locations in Uganda and/or Kenya taking advantage of the variety of physical locations and ecosystems in the region to facilitate practical experience using real-world examples. Specific lecture topics may include, as appropriate, ecological diversity, community composition, ecosystem structure and maintenance, trophic dynamics, and conservation biology with an emphasis on ecosystems of East Africa. Numerous field exercises will introduce students to local ecosystems, local biodiversity, and field research methods. Students must register for the Africa Field Study Semester.

Readings: Independent readings as assigned by the instructor.

Method: Daily lectures and field exercises, together totaling at least 60 hours, over a three to four week period in Uganda and/or Kenya.

Evaluation: Depending upon the instructor, may include a field project report, participation in field work, seminar and/or one mid-term and one final examination based on lecture material.
BIOL 432 (Fall)
Limnology
Two weekend Field Trips

Instructor: G. Fussmann  N8/15  398-1370  gregor.fussmann@mcgill.ca

Workload: 3 credits (2-3-4)

Prerequisite: BIOL 206 and BIOL 215 or permission of instructor.

Restriction: ENVB 432

Content: Limnology is the study of inland waters: lakes, rivers and wetlands. Wetzel (2001) defines limnology as “the study of structural and functional interrelationships of organisms of inland waters as they are affected by their dynamic physical, chemical and biotic environment”.

For this class, we will provide students with an introduction to lake communities and the physical and chemical properties of their environment. Rivers and wetlands will be covered only briefly, but students may choose to do their independent projects on these systems. Topics covered during the class will include the watershed and its hydrology; fluxes of nutrients and materials to and within lakes; the pelagial and littoral zones and their dynamics; sediments and paleolimnology, and the structure and dynamics of major plant and animal communities. Interwoven will be lectures on nutrient and heavy metal pollution.

There are two mandatory weekend field trips in this course (in lieu of a lab). All students must attend these two field trips in September/October which will start at 5 pm on Friday and end at 5 pm on Sunday. An additional fee will be charged to cover the accommodation and transportation (this course cost is in addition to the regular course fee scheduled by McGill University). As a final requirement, students must be able to swim, as we will spend a fair amount of time working off of boats. See the web site for application procedures and more detail:
www.biology.mcgill.ca/undergrad/c432


Method: The topics will be covered in twice-weekly lectures and 2 weekend field trips

Evaluation: Midterm, final exam, field project proposal, field project oral report and field participation
Biology 436 (Fall)
Evolution and Society

Instructors:  E. Abouheif (Co-coordinator)  N3/6  398-7190  ehab.abouheif@mcgill.ca
            S. Reader (Co-coordinator)  N7/12  398-6421  simon.reader@mcgill.ca

Workload:  3 credits (3-0-6)

Prerequisites:  BIOL 304 or permission of the instructor

Content:  Explores the impact that biological evolution and evolutionary thinking has on society. Topics
          covered include intelligence, language, race, sex, medicine, politics, and creationism. We will
          introduce each topic and lead discussion, while an invited lecturer will focus on a particular aspect
          of that topic.

Introduction:
Lecture 1:  Approaches to studying evolution and culture I
Lecture 2:  Approaches to studying evolution and culture II

Evolution and Sex:
Lecture 3:  Introduction
Lecture 4:  Presentation by guest lecturer: Professor Sarah Turner (Concordia)
Lecture 5:  Discussion and debate

Evolution of Intelligence and the Brain:
Lecture 6:  Introduction
Lecture 7:  Presentation by guest lecturer (TBA)
Lecture 8:  Discussion and debate

Evolution, Human Health, Disease & Medicine:
Lecture 9:  Introduction
Lecture 10: Presentation by guest lecturer (TBA)
Lecture 11: Discussion and debate

Evolution and Food:
Lecture 12: Introduction
Lecture 13: Presentation by guest lecturer (TBA)
Lecture 14: Discussion and debate

Evolution and Politics:
Lecture 15: Introduction
Lecture 16: Presentation by Professor (TBA)
Lecture 17: Discussion and debate

Evolution and Race:
Lecture 18: Introduction
Lecture 19: Presentation by guest lecturer (TBA)
Lecture 20: Discussion and debate

Evolution and Religion:
Lecture 21: Introduction: Creationism and evolution, evolution of religion
Lecture 22: Presentation by guest lecturer (TBA)
Lecture 23: Discussion and debate

General Discussion:
Lecture 24: Term paper presentations

Method: Each topic will be considered over three class periods. During the first period the professor will present a lecture introducing the material. The next meeting will host an expert from the McGill or wider community who will present an in depth analysis of one aspect of the topic. Experts will come from a range of fields, allowing students to compare evolutionary and other approaches to the topics. Finally, the third period will be devoted to a guided discussion of the material presented in the first two periods.

Evaluation: Summary presentation (10%) – will be based on role-playing presentations of the problems discussed in the previous two lectures. Role-playing presentations are meant to both summarize key aspects of the content of the two previous lectures, as well as raise several “controversial points of discussion” in order to spark debate and discussion among the group. The criteria for how these role-playing presentations will be graded will be given to the students at the beginning of the course, and the students will receive feedback on their performance shortly after the discussion.

Participation in Discussions (20%): We expect that students will be prepared for the discussion periods by the take home assignments (see below), and that the summary presentations at the beginning of these periods will serve as a catalyst to ignite the discussions. Marks will be accorded for evidence that the students are using lecture material to inform and advance their arguments. Students will be given feedback on their performance once half-way during the term. This feedback will include advice on improving performance where necessary. Attendance will also be taken at lectures and discussions, and will form part of the participation grade.

Take home assignments (35%): these will be given after each guest lecturer has spoken. Thus, there will be seven assignments over the term. The students will be asked to summarize the previous two lectures on a particular topic, highlighting those elements of the presentations that they think are cardinal in understanding the topic. In addition, they will be given a list of questions related to the topic, of which they will choose one to answer in a short essay. The students are encouraged to discuss their questions with each other. The assignments will be due on the day of the discussion period for the topic, before the discussion period commences. Note that the lowest-graded assignment will be excluded from the mean grade.

Term Paper (35%): topics for the term paper will be chosen from a list provided by the professors.
BIOL 441 (Winter)
Biological Oceanography

Instructor: N. Price  N6/12  398-6468  neil.price@mcgill.ca

Workload: 3 credits (2-3-4)

Prerequisites: BIOL 206, BIOL 215 or both ENVR 200 and ENVR 202. Enrolment limited.

Content: The course examines aspects of plankton biology and ecology, emphasizing small-scale (physiological/biochemical) and large-scale (ocean basin/global) processes. The unifying theme of the lectures and lab exercises is the control and fate of production in the sea. The course will provide the student with an understanding of the structure and function of pelagic marine ecosystems.

Readings: Course pack and laboratory manual.

Method: Lectures and laboratories.

Evaluation: Final exam, labs and term paper.

BIOL 451 (Winter)
Research in Ecology and Development in Africa
(Part of the African Field Studies Semester, AFSS)
(Offered in 2019-2020)

Instructors: L. Chapman  N3/12A  398 6431  lauren.chapman@mcgill.ca & Staff

Workload: 3 credits

Co-requisite: ANTH 451 or GEOG 451

Restriction: Not open to students who are taking or have taken NRSC 451

Content: This course contributes to the core curriculum for students participating in the African Field Studies Semester. The course focuses on development of observation and independent inquiry skills in the areas of ecology and development in Africa through: participation in short-term project modules in collaboration with existing researchers; participation in interdisciplinary team research on topics selected to allow comparative analysis of field sites; active and systematic observation, documentation, and integration of field experience in ecology and development issues. Students must register for the African Field Studies Semester.

Readings: Independent readings as assigned by instructor.

Methods: Lectures at field sites, interdisciplinary research (group projects), field exercises, field observation records.

Evaluations: Research project, module assignments, and field observation records and participation.
BIOL 463
Mammalian Evolution (Winter)
(Given in alternate years; Offered in 2019-2020)

Instructor: V. Millien Redpath 202 398-4849 virginie.millien@mcgill.ca

Workload: 3 credits (2-3-4)

Prerequisite: BIOL 305 or WILD 350 or permission of the instructor.

Content: This course will provide the students with detailed knowledge of the origin, evolutionary history, diversity and adaptation of mammal species to their environment. Beside a systematic review of fossil and living orders of mammals, aspects of mammalian paleoecology, functional morphology and adaptation will also be explored. The course will use the extensive collections and exhibits of the Redpath Museum as a resource for weekly laboratories.

Readings: There is no text book or course pack.

Method: 2 hours of lecture and a 3-hour lab each week.

Evaluation: Final exam, weekly lab quizzes, team assignment with oral presentation.

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BIOL 465 (Fall)
Conservation Biology

Instructor: L. Chapman (Co-ordinator) N3/12A 398-6431 lauren.chapman@mcgill.ca
A. Gonzalez N3/2 398-6444 andrew.gonzalez@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisite: BIOL 215 or both ENVR 200 and ENVR 202

Content: Conservation biology deals with the impoverishment of biodiversity through human related activities. As such, students in this course will be exposed to the pattern of biological processes involved in changes in biodiversity, and current examples of biodiversity loss. The course will focus on the key biological concepts that relate to conservation biology. The course will define diversity, review how diversity is lost and consider important genetic and demographic attributes of populations that make them more or less susceptible to extinctions. The structure and stability of multi-species communities, including the effects of the removal or introduction of species, and other perturbations upon community dynamics will be taught. Specific issues as population viability analysis, fragmented habitats, the effect of introduced or exotic species, and restoration ecology will be presented. Each of these biological topics will be discussed to the extent that they relate to conservation and help in formulating solutions towards reducing the loss of biodiversity. The course will also examine the importance of non-biological disciplines such as ethics, anthropology and history on conservation action. Guest speakers will cover complementary issues.

Readings: Selected journal articles, review papers. The text “Conservation Biology for All” (Sodhi & Ehrlich, editors), Oxford University Press, 2011, is suggested but not required.

Method: Two 1.5 hour lectures per week

Evaluation: 2-3 Individual assignments; one group project, final exam
BIOL 466 and BIOL 467 (3 credits each)  
(Fall, Winter or Summer)  
Independent Research Project 1 and Independent Research Project 2

**Instructors:** Any staff member of the Biology Department

**Coordinator:** N. Nelson  N7/9B  398-4109  nancy.nelson@mcgill.ca

**Workload:** 3 credits (0-0-9)

**Prerequisites:** BIOL 206 or 301, or other suitable -300-level laboratory course. Open to U3 Biology students. All projects have to be arranged with individual instructors of the Biology Department. Honours Biology students may include a maximum of 6 credits of independent research as complementary credits. Liberal and Major Biology students may include a maximum of 9 credits of independent research as complementary courses. *A form, available online at http://biology.mcgill.ca/undergrad/res_opps.html, must be completed and returned to Nancy Nelson at the beginning of the term in order to register for these courses on Minerva.*

**Content:** Projects to be carried out independently by students under the guidance of individual staff members. The projects will include experimental work with exposure to published data and theories. Emphasis is on acquisition of skills in technique, analysis, and communication in the process of generating a scientific report. Students interested in Independent Studies should consult “Guidelines for Independent Studies”, available at http://biology.mcgill.ca/undergrad/res_opps.html. Students are expected to work a **minimum** of 9 hours per week for 13 weeks on the project.

**Evaluation:** The full-time or affiliated staff member of the Biology Department supervising the project evaluates the overall performance in the various stages of the project, including the final written report. Work performed and the report will receive separate marks summarized in a final mark with weighting (70/30, 60/40, 50/50) at the discretion of the supervisor. One copy of the marked report must be submitted electronically to nancy.nelson@mcgill.ca.

*Cannot be taken under the S/U option*

**BIOL 468 (Fall, Winter or Summer)**  
Independent Research Project 3 (6 credits)

**Instructor(s):** Any staff member of the Biology Department.

**Coordinator:** N. Nelson  N7/9B  398-4109  nancy.nelson@mcgill.ca

*For course details see Biology BIOL 466.  
Cannot be taken under the S/U option*

**BIOL 469 D1/D2 (Fall and Winter)**  
Independent Research Project 4 (9 credits)

**Instructor(s):** Any staff member of the Biology Department.

**Coordinator:** N. Nelson  N7/9B  398-4109  nancy.nelson@mcgill.ca

*For course details see Biology BIOL 466  
Cannot be taken under the S/U option*
**BIOL 479 D1/D2 (Fall and Winter) Honours Research Project 1 (9 credits)**

and **BIOL 480 D1/D2 (Fall and Winter) Honours Research Project 2 (12 credits)**

**Instructors:**

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<tr>
<th>Instructor</th>
<th>Office</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>G. Brouhard (Director) &amp; Staff</td>
<td>Bellini 267</td>
<td>398-2984</td>
<td><a href="mailto:gary.brouhard@mcgill.ca">gary.brouhard@mcgill.ca</a></td>
</tr>
<tr>
<td>N. Nelson (Advisor)</td>
<td>N7/9B</td>
<td>398-4109</td>
<td><a href="mailto:nancy.nelson@mcgill.ca">nancy.nelson@mcgill.ca</a></td>
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**Procedures & Prerequisites:**

Restricted to U3 students in the Biology Honours Program. Projects must be arranged individually with and accepted by a staff member of the Biology Department. Students must email the Honours Advisor their intent by June 1 of the year prior to the final year. The proposed supervisor must also email acceptance of the student. A completed application form available on the web ([http://biology.mcgill.ca/undergrad/honours/index.htm](http://biology.mcgill.ca/undergrad/honours/index.htm)) and an Abstract must be submitted to the Honours Director and Advisor by the first week of September. Applications should, therefore, be considered as competitive. A research proposal must be submitted by October 15. The proposal will be reviewed by the student’s Honours Committee member(s), an instructor in the student's field of study. The major objective of the course is to provide an introduction to the design, execution and reporting of research. The number of projects that can be handled is limited and their quality will be examined carefully.

**Content:**

These courses are intended to allow students to obtain in-depth training in their major field of interest. Programs of independent study pursued under these course numbers will usually consist of a project and include preparatory reading and a comprehensive written report and an oral presentation.

**Evaluation:**

On overall performance in the various parts of the program. Evaluation will be the responsibility of the supervisor in consultation with the member(s) of the supervisory committee.
BIOL 499 D1/D2 (Fall and Winter)
Honours Seminar in Biology (4 credits)

Instructors: G. Brouhard (Director) Bellini 267 398-2984 gary.brouhard@mcgill.ca
& Staff

Prerequisites: Acceptance to U3 Honours Program.

Content: The aim of this course is two-fold: on the one hand it is intended to further interest in a wide range of biological topics, and on the other to promote acquaintance with recent advances and research techniques in a chosen area of concentration.

Readings: Research papers.

Method: All students will attend 6 guest speaker seminars designated "honours seminars" by the Honours Director. For each seminar the students will read research articles in advance, participate in discussion with the speaker and prepare a written summary of the talk. In April the students will organize a symposium and present their own research data.

Evaluation: Participation in discussion and written summaries (3 credits) and quality of presentation in the conference (1 credit).

BIOL 507 (Fall)
Animal Communication

Instructors: Jon Sakata (Coordinator) N4/8 398-3636 jon.sakata@mcgill.ca
K. Onishi 398-1725 kris.onishi@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites/
Co-requisites: Students should have taken or be currently enrolled in a course in introductory neurobiology (e.g. BIOL 306 or NEUR 310 or NSCI 200 or NSCI 201 or PHGY 311) and a course in Behavioural Ecology (e.g. BIOL 307). Since all co-requisites may not be offered in the same term, students are advised that they may have to plan their schedules so that they register in these courses in the term prior to BIOL 507. Or students may enroll with the permission of instructor. Enrolment is limited.

Content: This course provides an introduction to communication between animals. We will discuss the basic setup of communication systems, but also take a close look at the physical and historical constraints shaping the production and reception of communication signals. The course will cover the relevant physics of communication as well as sensory physiology and the physiology of signal production. Examples will be drawn from all major communication channels. Specifically, we will study acoustic, vibrational, visual, chemical, and electrical communication in a variety of animals (including humans) and contexts (courtship, aggression, predator evasion). Emphasis will be laid on the evolution of communication systems. Discussion will include the neural systems underlying human language and the relationship between human language and communication systems of other animals.

Method: A set of lectures will introduce basic aspects of animal communication and its evolution. Each student will present an original research article from the recent literature and will write a review paper on a current topic in animal communication research.

Evaluation: Discussion contributions, assignments on myCourses related to articles covered in student presentations, presentation of original research article, term paper

BIOL 510 (Fall)
Advances in Community Ecology
(Given in alternate years; Offered in 2019-2020)

Instructor: A. Gonzalez  N3/2  398-6444  andrew.gonzalez@mcgill.ca

Workload: 3 credits (2-1-6)

Prerequisites: BIOL 308 or GEOG 350 or permission of instructor

Content: “Ecology is the science of communities. A study of the relation of a single species to the environment conceived without reference to communities and, in the end, unrelated to the natural phenomena of its habitat and community associations is not properly included in the field of ecology” (Shelford 1929).

We will cover the central concepts in community ecology organized around three major themes:
1. Maintenance of biodiversity at local and regional scales
2. Historical and phylogenetic perspectives
3. Ecological networks: food webs, mutualisms and metacommunities
4. The links between biodiversity and ecosystem functioning.

Particular emphasis will be placed on the principal theories, their historical development, and the observational and experimental support for them. By the end of the course the student will have a broad appreciation of current knowledge in community ecology.

Readings: Although not an official course text, selected chapters from R. E. Ricklefs and D. Schluter (1993) *Species Diversity in Ecological Communities* (Chicago Press) will be read. Readings from the primary literature will be provided throughout to address topics not covered by the text.

Method: Weekly, 1.5-hour lecture and discussion and 1.5-hour seminar for paper discussion.

Evaluation: Class participation, 3 short essay assignments, 1 oral presentation
BIOL 514 (Winter)
Neurobiology of Learning and Memory
(Cross-listed with PSYC 514)

Instructors: TBA

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 306 or NEUR 310 or NSCI 201 or PHGY 311 or permission of instructor.

Restrictions: PSYC 514

Content: Properties of nerve cells that are responsible for learning and memory. Recent advances in the understanding of neurophysiological, biochemical and structural processes relevant to neural plasticity in adult animals. Emphasis on a few selected model systems involving both vertebrate and invertebrate species.

Topics to be covered include the following:

1) Electrophysiology of synaptic plasticity, principally long-term potentiation (LTP) and long-term depression (LTD). Events that induce synaptic modifications; hebbian synapses; mechanisms that change synaptic strength; metaplasticity.

2) Intracellular signaling pathways. Ions, kinases, transcription factors and other molecules that mediate changes in synaptic transmission.

3) Memory consolidation and reconsolidation. Why some memories quickly fade and other memories can last a lifetime. Gene expression; receptor trafficking

4) Morphological plasticity. Do memories require the growth of existing synapses, the generation of new synapses, changes in dendritic structure or the appearance of new neurons?

5) Specificity of learning. How certain synapses can be modified by stimuli while other synapses on the same postsynaptic cell remain unaffected.

6) Memory deficits, memory changes and memory enhancement; commercial and medical applications.

Method: Students are expected to have read the articles before class and to be prepared for a critical discussion in class.

Readings: There is no text. Articles for discussion are posted on Web CT.

Evaluation: Participation in discussion, written assignment, final presentation
BIOL 515 (Winter)
Advances in Aquatic Ecology
Not offered in 2019-2020

Instructor: I. Gregory-Eaves N4/8 398-6425 irene.gregory-eaves@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 432 or BIOL 441 or permission of the instructor. Enrolment in this course is limited.

Content: This course is designed to allow senior undergraduate and graduate students to become intimately acquainted with the key primary literature in aquatic ecology and the major issues challenging the field, while also stimulating them to develop their own ideas on how to overcome these and expand the discipline. There are four main exercises in the course: 1) a student-led discussion of primary literature; 2) a critical review; 3) a meta-analysis, and 4) a grant proposal. These exercises are designed to encourage independent thinking, to give students an appreciation of how different types of investigations are initiated, how innovative approaches emerge, and how novel theoretical concepts are synthesized in the area of aquatic ecology.

1) Student-led paper discussions.
The students will discuss a pair of papers, one of which will be among the most highly cited papers on this topic and the second of which will have had more modest citations.

2) A critical review (oral presentation and abstract).
Students should critically analyze a paper by addressing its strengths and weaknesses, asking what questions remain unanswered and how additional questions might be addressed. Students should also take a historical view to the critique by developing an appreciation of the studies which formed the foundations of the paper in question. A 250-word abstract should also be prepared summarizing the above points. Class members are expected to read the focal paper and abstract such that they can participate actively in the class discussion.

3) Meta-analysis (oral presentation and extended abstract)
The literature regarding many basic questions in aquatic ecology is full of similar studies that have reported small – moderate effects, but often there is no quantitative synthesis (aka meta-analysis) to identify a general pattern. Students will be given a background in meta-analyses in the form of a lecture and background readings. For the meta-analyses assignment, each student will be responsible for identifying a topic, conducting an appropriate meta-analysis of the available literature and presenting this analysis to the class orally. Students are also expected to develop a two-page extended abstract, which will allow fellow class members to prepare to participate in the discussion.

4) Grant proposal (oral presentation and abstract)
Identifying exciting new avenues for research and building on existing literature is a major activity of any research scientist. The goal of this exercise is to build on our earlier discussions identifying emerging areas of research and understanding what makes for a successful project. This grant proposal project will be conducted in two steps. During week 6 of the course, each student will submit a one page letter of intent that clearly outlines their question, set in the context of existing literature, and provides some details regarding their approach (e.g. lab experiment, field experiment, and/or field survey). A week later, the students will receive feedback from the class grant panel such that they might further develop their ideas. In the last three weeks of the course, each student will give a presentation summarizing their grant proposals.

Readings: Readings from journal articles will be assigned
Additional recommended reading:
*Inland Water Ecosystems: a textbook of Limnology* by J. Kalff (Prentice-Hall, 2001)
Limnoecology: The Ecology of Lakes and Streams by W. Lampert and U. Sommer (Oxford University Press, 1997)

Method: Two 1.5 hr seminars per week

Evaluation: Based on: 1. student-led paper discussion; 2. tracking an idea - oral presentation (could be with partner) and abstract (individual); 3. meta-analysis - oral presentation (individual or group) and extended abstract (individual); 4. grant proposal - oral presentation (individual), letter of intent (individual), and written proposal (individual); 5. general class participation

BIOL 517 (Winter)
Cognitive Ecology
(awating final approval)

Instructors: M. Guigueno N7/3 398-2688 melanie.guigueno@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 307 or permission of the instructor

Content: This course is designed to introduce upper-level undergraduate students and graduate students to the ecology and evolution of cognition and its underlying neural mechanisms, and examine links between cognition, behaviour in the wild, and the brain. This course will build upon the principles of behavioural ecology and neuroscience. As a second theme of the course, students will further develop writing and presentation skills from BIOL 307. Students will learn how to write for general and scientific audiences, and to give full lectures on topics within cognitive ecology (also known as neuroecology).

Module 1: Introduction to cognitive ecology
Module 2: Learning – Mechanisms, Ecology, and Evolution
Module 3: Neural representation and the evolution of signal form
Module 4: Cognitive ecology of bird song
Module 5: Cognitive ecology of spatial memory and navigation
Module 6: Cognitive ecology of mating systems
Module 7: Structural plasticity in invertebrate brains
Module 8: Evolution of large brains
Module 9: Cognition and sociality

Readings: Special Issue: Cognitive Ecology in the journal Animal Behaviour (Last updated Jan 2019)

Additional articles from the primary literature

Method: Two 1.5 hour lectures a week.

Evaluation: Assignments consisting of writing a Wikipedia article and a research proposal, an oral presentation (lecture), and participation, including evaluating peers on their oral presentation.
BIOL 518 (Winter)
Advanced Topics in Cell Biology

Instructors: R. Reyes Lamothe  Bellini 271  398-5137  rodrigo.reyes@mcgill.ca
A. Gerhold  Stewart N5/7  398-6423  abigail.gerhold@mcgill.ca

Workload: 3 credits (0-2-7)
Prerequisites: BIOL 313 or permission

Content: This course is for advanced undergraduate and graduate students. Readings are recent and classic journal articles and reviews. Specific topics vary but typically include the evolution of cells, cell biology of bacteria, chromosome biology, cell biology in development, mitosis and cell division. The course emphasizes the development of important ideas in the field. By the end of this class, students should (1) be able to read, interpret and critique works from the primary literature, (2) be familiar with modern techniques and approaches in cell biology, (3) be able to formulate and articulate their ideas both in writing and orally, and (4) be able to provide constructive criticism to their peers.

Readings: Recent research papers and reviews.

Method: The course grade is based on an oral presentations, participation, assignments and a term paper. Since participation is a major part of the grade, missed classes will decrease your final grade.

Evaluation: The course grade is based on an oral presentation, a research paper, participation and assignments. Since participation is a major part of the grade, missed classes will decrease your final grade.

BIOL 520 (Winter)
Gene Activity in Development

Instructor: R. Roy  S3/22  398-6437  richard.roy@mcgill.ca

Workload: 3 credits (3-0-6)
Prerequisites: BIOL 300, 303, or permission of instructor.

Content: A critical examination of recent literature on the role and regulation of gene activity during development. The emphasis will be on molecular and genetic analyses. Topics will vary from year to year but are likely to include: transcriptional and post-transcriptional regulation of gene expression during cellular differentiation; analyses of factors and pathways involved in cell fate determination and patterning. These topics will be presented with emphasis on a few currently important developmental systems chosen from: insects (Drosophila), nematodes (C. elegans), non-mammalian vertebrates (Xenopus/zebrafish), mammals (mice), and plants (Arabidopsis).

Readings: Recent research papers and reviews.

Method: Discussions will be initially led by professor, but each student will lead one class as well during the term. Recent research papers will be discussed in class.

Evaluation: Students will be evaluated on the basis of their oral and written presentations and on course participation.
BIOL 524 (Fall)
Topics in Molecular Biology

Instructors: H. Clarke MUHC Research Inst. 934-1934x34748 hugh.clarke@mcgill.ca
D. Dankort Bellini 264 398-2307 david.dankort@mcgill.ca

Workload: 3 credits (0-2-7)

Prerequisites: BIOL 300 and 303 or equivalents or permission of the instructor. Enrolment is limited to 12 students.

Content: This seminar course will consider the most recent literature in the fields of molecular biology of development and cancer. Topics will be drawn from the genetics of model organisms and humans, cell biology, cell differentiation and development, and genetic diseases.

Readings: Research papers and recent reviews.

Method: Each student will present a seminar and lead the subsequent discussions. Each student will present a one-hour seminar and lead the subsequent discussion. Students also submit written questions pertaining to the research papers being discussed at each seminar presentation and are expected to participate in the discussion of those papers. Each student also submits an end-of-term paper providing a critical evaluation of two papers that he or she has chosen from the literature and which are relevant to one of the topics presented in class.

Evaluation: The students will be graded on the quality of their presentations, the submitted questions for other presentations, their participation in group discussions and the end-of-term paper.

BIOL 530 (Winter)
Advances in Neuroethology

Instructors: S. Woolley (Coordinator) N4/8 398-2324 sarah.woolley@mcgill.ca
T. Ohyama N5/25 398-2124 tomoko.ohyama@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 306 or NSCI 200 or NSCI 201 or PHGY 311 or permission of instructor.

Content: The course will consider the neural mechanisms underlying behaviour, focusing on specializations of neural circuits for particular behavioural functions. Specific topics will vary according to the current literature, but may include communication, navigation, social behaviour, visually guided behaviour, escape behaviour, orientation, neurogenetics of behaviour and locomotion.

Readings: Recent research articles and reviews.

Method: Each new topic will be introduced by a lecture, supplemented by assigned reading. The following classes will be devoted to student seminars and critical discussions of recent research articles.

Evaluation: Participation in discussions, presentation of an original research article, assignments on myCourses related to articles covered in student presentations, term paper
BIOL 532 (Winter)
Developmental Neurobiology Seminar

Instructors:  
D. Van Meyel (Co-ord.) MGH 934-1934x 42995 don.vanmeyel@mcgill.ca  
A. Kania IRCM 987-5526 artur.kania@ircm.qc.ca  
J-F. Cloutier MNI 398-6351 jf.cloutier@mcgill.ca  
E. Ruthazer MNI 398-4022 edward.ruthazer@mcgill.ca  
A. Fournier MNI 398-3154 alyson.fournier@mcgill.ca

Workload:  
3 credits (1-2-6)

Prerequisites:  
BIOL 303 or 306, or permission of instructor.

Content:  
The development of the nervous system is examined with particular emphasis on the processes which underlie the appearance of complex but highly ordered neural circuits during embryonic development. Among the specific topics to be discussed are: neural induction and patterning, birthdays and migrations, the specification and diversification of neurons; axon guidance, target selection and topographic mapping; the influence of neuronal activity on CNS development, neurotrophic factors and neuronal cell death, synapse formation, stem cells, and CNS repair and regeneration. The course emphasizes the application of modern cellular and molecular approaches used to investigate these problems.

Readings:  
Assigned from the recent literature

Method:  
The course is organized into modules that cover specific topics in developmental neurobiology. Each module starts with an introductory lecture by the professor followed by student presentations of related research papers that have been selected from the recent literature

Evaluation:  
Based on two seminar presentations, short written assignments, a written term paper, and participation in class discussions.

BIOL 540 (Winter)
Ecology of Species Invasions
(cross-listed with ENVR 540)

Instructor:  
A. Ricciardi, Redpath Museum, 398-4089 tony.ricciardi@mcgill.ca

Workload:  
3 credits (3-0-6)

Prerequisites:  
BIOL 215 (or ENVR 200 plus 202), and at least one 300- or 400-level course in ecology, evolution, or conservation biology. (new prerequisite, awaiting approval)

Restrictions:  
Not open to students who have taken ENVR 540

Content:  
Invasions by alien species are increasing in frequency around the world. They are leading threats to biodiversity, and they can alter ecosystem processes, and damage economic resources and human health. This course will explore the causes and consequences of invasion. Using concepts from population biology, community ecology and evolution, we will examine the reasons why some species are highly invasive and why some ecosystems are more vulnerable to invasion than others. We will also look at methods of risk assessment and management strategies for dealing with this global environmental problem.

Readings:  
Readings to be assigned.

Method:  
Three 1 hour lectures per week

Evaluation:  
Students will be evaluated based on two midterm exams, a research paper and a seminar
BIOL 544 (Fall)
Genetic Basis of Life Span
(Given in alternate years; Not offered in 2019-2020)

Instructor: S. Hekimi    Bellini 268    398-6440    siegfried.hekimi@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 202 or 219, 300 or permission; BIOL 303 recommended

Content: The course will consider how gene action is determining the duration of life in various organisms, focusing on the strengths and limitations of the genetic approach. The course will focus particularly on model organisms such as yeast, Caenorhabditis, Drosophila and mouse, as well as on the characterization of long-lived people.

Readings: Recent research articles and reviews. No textbook will be used.

Method: Each new topic will be introduced by the instructor. Classes will be devoted to student seminars and critical discussions of recent research articles.

Evaluation: One long oral presentation and participation in discussions.

Enrolment limited to 12 students

BIOL 546 (Fall)
Genetics of Model Systems
(Given in alternate years; Offered in 2019-2020)

Instructor: S. Hekimi    Bellini 268    398-6440    siegfried.hekimi@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 202, 300 or permission; BIOL 303 recommended

Content: The course will provide an introduction to the genetics and molecular genetics of unicellular, plant, invertebrate and vertebrate model systems, including, among others, E. coli, yeast, Arabidopsis, Caenorhabditis, Drosophila, Zebra fish, and mice. We will examine the characteristics of each system, how the systems have been most successfully used (their advantages and disadvantages) and, using chosen topics, how findings with these systems are shaping our understanding of basic principles in the life sciences.

Readings: Recent research articles and reviews. No textbook will be used.

Method: Each new topic will be introduced by the instructor and sometimes by an invited lecturer specialized in the use of a particular model system. Classes will be devoted to student seminars and critical discussions of recent research articles.

Evaluation: One long oral presentation and participation in discussions, and 3-5 simple answer quizzes.

Enrolment limited to 12 students
BIOL 551 (Winter)
Principles of Cellular Control
(Given in alternate years; Offered in 2019-2020)

Instructor: J. Vogel Bellini 269 398-5880 jackie.vogel@mcgill.ca
P. Francois Rutherford Physics 398-1635 paul.francois2@mcgill.ca
Instructors to be announced

Workload: 3 credits (3-0-6)

Prerequisites: CHEM 115 or 120; MATH 133 and 141; PHYS 142; or equivalents; BIOL 201 or BIOL 219 or ANAT/BIOC 212. COMP 204, PHYS 230 and BIOL/PHYS 319 are recommended

Content: This course attempts to overview fundamental principles of cellular control. Cell cycle control is a major theme. Biological and physical concepts will be brought to bear on control systems in healthy cells, largely based in studies using model organisms. Concepts are related to human cells with relevance to disease (cancer), but disease and cancer are not a focus of this course. It should be remembered that understanding what constitutes a healthy system, and how that state is maintained, is just as critical as understanding the basis of disease. This course is designed with the understanding that students come from both the biological/biomedical sciences and physical sciences and thus the material covered must be accessible to all regardless of their background.

Topics include:
- Cell cycle control
- Switches, thresholds in biological systems
- Oscillators
- Symmetry and symmetry breaking
- Organization of cellular systems
- Biological machines
- Methods of analysis

Readings: Assigned readings are primarily research articles and reviews. Readings from Physical Biology of the Cell (PBoC) will be posted on myCourses. An online version of Molecular Biology of the Cell (4th edition) is available through PubMed and is recommended as a general cell biology reference.

Method: Faculty lectures and student presentations. Two 1.5 hr sessions per week

Evaluation: Presentation, written assignment, team project and participation.
BIOL 553 (Winter)
Neotropical Environment (3 credits)
Winter Term in Panama

Instructor: C. Potvin S3/27 398-3730 catherine.potvin@mcgill.ca

Prerequisite: Spanish Language Elementary HISP 218 or equivalent, Principles of Statistics MATH 203 or equivalent, BIOL 215 or both ENVR 200 and ENVR 202, and permission of Panama program coordinator.

Co-requisite: ENVR 451 (Research in Panama), AGRI 550 (Sustained Tropical Agriculture) and GEOG 498 (Humans in Tropical Environments)

Restriction: This course is limited to those students taking the full Field Study Semester in Panama. (See page 132)

Content: This course is taught over three weeks in January at the Smithsonian Tropical Research Institute (STRI) in Panama. Students study tropical ecology and species richness through field trips. These excursions develop an understanding of the challenges of sampling and measuring biodiversity in species rich areas. Ecological theory and methodology is revisited in view of tropical conditions. The course also documents the conservation status of ecosystems, communities and species in Panama. It ends with a workshop on indigenous knowledge.

Methods: The course is intensive and involves two continuous weeks of field work. Field-trips bring students in contact with forest canopy, semi-dry, cloud and mangrove forests.

Evaluation: Based on participation in field work, practical exercises and a diary.
BIOL 565 (Fall)
Cell and Tissue Mechanobiology

Instructor: Arnold Hayer Bellini 275 514-398-8574 arnold.hayer@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: One 300-level cell biology course or equivalent and/or instructor’s approval.

Restrictions: Restricted to senior undergraduate and graduate students of the Faculty of Science, Faculty of Medicine, and the Department of Bioengineering, who fulfill the prerequisites or those approved by the instructor. Enrolment restricted to 25 students.

Content: During tissue development and homeostasis, cells interact mechanically with other cells and with their environment. In three modules, this course explores the emerging field of mechanobiology and mechanotransduction, and their relevance in the context of multicellular physiology in health and disease. In the first module, the molecular and cellular foundations of mechanobiology are covered. During the second module, current literature on the topic will be presented and discussed by students. In the third module, students will identify gaps in current knowledge and propose research to address them.

Readings: No required text book. Recent research articles and reviews.

Method: Faculty lectures (first module), in-depth discussion of primary literature (second module), and work on a research proposal (third module). Two 1.5h sessions per week.

Evaluation: Based on quizzes, oral research paper presentation/discussion, research proposal and participation.
**BIOL 568 (Winter)**

**Topics on the Human Genome**

**Instructors:**
- R. Slim (Coordinator)  
  MUHC-RI, Glen 934-1934x44550  
  rima.slim@muhc.mcgill.ca  
- R. Mackay (Administrator)  
  SADB 398-4198  
  ross.mackay@mcgill.ca

**Workload:** 3 credits (3-0-6)

**Prerequisites:** BIOL 202, 300, 370 or permission of instructor.

**Content:**
The course covers recent advances in next generation sequencing and their applications to various fields in biology. The course also covers various examples of inherited and acquired human diseases, approaches to study and modeling them, and ethical implications related to the use of data derived from human subjects.

1. Genome wide association studies: design, linkage disequilibrium, genetic risk scores (3 hours).
2. Next generation sequencing methods: Applications to RNA, genomic DNA and cDNA including a workshop and work with your own real data (9 hours).
3. Transcriptional regulation, chromatin structure and methods to study them including a workshop and hands-on CHIP-seq data analysis (6 hours).
4. DNA Methylation and human diseases (3 hours)
5. Genetic mosaicism and de novo mutations in human diseases (3 hours).
6. Genetics of cancer ontogeny (4.5 hours)
7. General developmental genetics and use of pluripotent stem cells (3 hours).
8. Ethical, Legal, and Social Aspects of Human Genomics Research (4.5 hours).

**Readings:** Selected journal articles.

**Method:** Two 1.5 hour lectures per week.

**Evaluation:** Mid-term, participation and final exam

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**BIOL 569 (Winter)**

**Developmental Evolution**

*(Given in alternate years; Not offered in 2019-2020)*

**Instructors:**
- H. Larsson (Coordinator) Redpath Mus. 398-4086 x089457  
  hans.ce.larsson@mcgill.ca  
- E. Abouheif N3/6 398-7190  
  ehab.abouheif@mcgill.ca

**Workload:** 3 credits (3-0-6)

**Prerequisites:** BIOL 303 and BIOL 304, or permission

**Content:**
This course is intended for advanced undergraduate and graduate students. Developmental Evolution (DE) examines the influence of developmental mechanisms on evolution. This course will focus on the emerging principles of DE, and will draw on data and examples from plants and invertebrate and vertebrate animals. The course will cover topics such as: homology, modularity, dissociation, co-option, evolutionary novelty, evolution of genetic cis-regulation, developmental constraint and evolvability, heterochrony, phenotypic and genotypic plasticity, and canalization to understand how development influences evolution.

**Readings:** Recent research articles, reviews and current text addressing a timely theme in the field.
Method:  The course will follow a seminar style format, in which the instructors present key lectures throughout the course, followed by student group presentations and discussions of topics chosen by groups of students from a list of suggested topics. Each student will also write a scientific-format paper on a topic approved by the instructors. The paper may be a review of current issues or a presentation of a novel approach to issues in developmental evolution.

Evaluation:  Student presentations, scientific paper and class participation

BIOL 573 (Summer)
Vertebrate Palaeontology Field Course (3 credits)

Instructors:  H. Larsson  Redpath Museum  398-4086 ext. 089457  hans.ce.larsson@mcgill.ca

Prerequisites:  BIOL 304, BIOL 352, or permission of instructor.

Content:  This course is intended for advanced undergraduate and graduate students. The primary objective for the course is to train students in collecting and analysis methods in vertebrate palaeontology. The course will be given at a selected Late Cretaceous (~70 million years old) locality in Alberta and/or Saskatchewan. Fieldwork will be conducted for approximately 18 days. During that time, students will have practical training with stratigraphic mapping, fossil prospection, identification and collecting. An emphasis will be placed on terrestrial vertebrate fossils (i.e. dinosaurs, crocodiles, and other reptiles) and palaeocommunity analysis.

Readings:  Recent research articles and reviews. No textbook will be used.

Method:  Two-week field course in August.

Evaluation:  Based on results of an examination at the start of the course that tests understanding of preliminary readings, participation in field work, field book logs and discussions in the field.

Registration:  Students should contact Prof. Larsson no later than April 1 to sign up for the course (15 slots first come first served) and receive an instruction sheet. The course fee is approximately $1000 but will vary slightly from year to year. It covers all personal expenses such as equipment, camping and museum fees, food, vehicle rentals and fuel, but not tuition or transportation to a designated Alberta/Saskatchewan meeting place. A minimum of 6 students is required for the course to be offered. Further information appears on notices in the Redpath Museum in February/March and on the course web site that can be accessed from Prof. Larsson’s home page. The latter can be reached via the Biology home page Faculty link.
BIOL 575 (Fall)
Human Biochemical Genetics
(Not offered in 2019-20)

Instructors: N. Braverman (Coordinator)  MUHC  934-1934x23404  nancy.braverman@mcgill.ca
& Staff
R. Mackay (Administrator)  SADB  398-4198  ross.mackay@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 202, 300 or permission.

Content: The science of genetics has allowed major advances into our understanding of the basis of human
disease. This course touches on how the study of human systems has led to advances in basic
biology. Topics to be covered include disorders of folate and cobalamin transport and metabolism,
lysosomal storage disease, peroxisome disorders, genetics of lipoproteins and human disease,
genetics of steroid receptors, genetics of collagen and mitochondrial disease.

Readings: Research and review articles selected from current literature.

Method: Two 1.5 hour lectures per week. In addition, 3-4 student groups will be established from the class
and each will be responsible for giving presentations in areas related to the topics covered. Each
presentation will be done during an allotted lecture time.

Evaluation: 1.5 hour mid-term; group presentations, 3 hour final

BIOL 580 (Fall)
Genetic Approaches to Neural Systems

Instructor: A. Watt  Bellini 265  398-2806  alanna.watt@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 306 or NSCI 200 or NSCI 201 or PHGY 311 or permission of instructor.

Content: This course is an examination of recent research employing cutting-edge genetic tools to
examine the functional and structural properties of the nervous system. The focus will be
on genetic methods for studying neural circuits and behavior, in a range of model
organisms. Topics will include recent technological advances, such as optogenetics for
modifying and controlling neuronal activity, and animal models of neurological diseases.
Students will critically analyze the application of these methods to current research
through in-class discussion of primary literature, student presentations, and written
assignments, as well as peer evaluation of the work of other students.

Readings: Recent research articles.

Method: Background lectures will be given on specific topics. The focus of the class will be on
student presentations, discussion and critical evaluation of primary research articles.

Evaluation: Participation in discussions, presentation, term paper, assignments, peer evaluation
BIOL 588 (Fall)
Advances in Molecular/Cellular Neurobiology
(Not offered in 2019-2020)

Instructors:  
K. Hastings  
MNI  
398-1852  
ken.hastings@mcgill.ca  

S. Carbonetto  
MGH L7-121  
934-1934x 44237  
sal.carbonetto@mcgill.ca

Workload:  
3 credits (1.5-1.5-6)

Prerequisite:  
BIOL 300 and 306, or permission of instructor.

Content:  
The main objectives of the course are to expose final year neurobiology undergraduates and graduate students in neuroscience disciplines to:

1) Recently published studies in which molecular biological research methods have provided new insight into the role of specific genes and proteins in the nervous system.
2) The critical analysis of scientific research papers in an organized round table discussion setting. The lecture topics vary somewhat from year to year but the following are almost certain to be covered in one form or another in each year: gene expression in the nervous system, gene and protein isoform families and alternative RNA splicing, membrane protein synthesis, neuronal growth factors, synaptogenesis, cell adhesion molecules/extracellular matrix, cytoskeleton, ion channels, signal transduction systems and molecular genetics of neurological mutants in man and experimental animals. Students develop skills in understanding and communicating scientific information.

Readings:  
There is no required textbook. A neuroscience text with a strong cell/molecular component, such as *Fundamental Neuroscience* (Zigmond et al, Academic Press) would be useful, as would a good cell/molecular biology text such as *Molecular Biology of the Cell* (Alberts et al, Garland Publishing) or *Molecular Cell Biology* (Lodish et al, W.H. Freeman & Co.).

Method:  
Following a short series of introductory lectures, the course consists of an alternating series of topic-focused lectures (Thursdays) and corresponding discussion sessions (Tuesdays). Each lecture will cover the basic principles of some aspect of cell/molecular neurobiology. A recently published research article related to the lecture topic will be assigned, and the paper will be discussed in detail in the next discussion session. During discussion sessions students are asked to interpret specific Figures and Tables in the research articles in terms of experimental technique, conclusions drawn, and relevance to the overall point of the paper. Towards the end of the term the class has an informal meeting with a guest scientist who is an invited seminar speaker at the university and whose recent work they have already discussed as a group. Besides providing the investigator’s own viewpoint of specific neurobiology issues, this meeting is an opportunity to consider broader research issues including career development and the behind-the-scenes thinking and work that underlies published scientific papers.

Evaluation:  
Participation in discussion sessions counts for three-quarters of the grade. A class test will count for the remainder.
BIOL 592 (Fall)
Integrated Bioinformatics
Not offered in 2019-2020

Instructors: P. Harrison N7/16 398-6420 paul.harrison@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 301 (or equivalent); or permission

Restriction: Not open to students who are taking or have taken, BINF 511; may not be used as a program course for students in Computer Science programs

Content: This course is an integrated overview of bioinformatics, primarily for biology students. We will cover a range of bioinformatics methods that are useful for the experimental biologist to aid in interpretation of data and experimental design. We will work through some specific examples, primarily using internet-based tools. The course is also useful as an introduction for students wishing to progress to further study in bioinformatics.

Topics will be as follows:
- Introduction to databases
  - Basic tips for use of bioinformatics tools and manipulation of bioinformatics data on the computer.
- Sequence alignment and database searching for homologs.
- Gene annotations and how to interpret them; ‘next-generation’ sequencing data.
- Annotation of non-coding DNA: transposable elements, pseudogenes and RNAs.
- Comparing genomes
- Networks and pathways of proteins and genes
- Classifications of protein function and their use for analyzing data sets of genes/proteins.
- Annotating and examining features in proteins (protein domains, motifs, disordered regions)

Readings: List of papers, to be assigned during the course. Some documents supplementary to lecture slides will also be distributed.

Method: There are two 1.5 hour lecture, demonstration or discussion sessions per week. The demonstration sessions are for bioinformatics tools on the internet, or which can be installed on a computer. There are six short take-home assignments, based on the lecture material. Students are asked to make a 15-minute presentation on a bioinformatics paper that they can choose from a list provided, or which they can pick for themselves.

Evaluation: Assignments, presentation and class participation
BIOL 594 (Fall)
Advanced Evolutionary Ecology
(Not offered in 2019-2020)

Instructor: A. Hendry  
Redpath Museum  
398-4086 x00880  
andrew.hendry@mcgill.ca

Workload: 3 credits (3-0-6)

Prerequisites: BIOL 304, BIOL 308 or permission

Content: Interactions between ecology and evolution, particularly as they play out on contemporary time scales. The class is based on 12 chapters of an in-press book by the instructor on Eco-Evolutionary Dynamics. Chapters (and therefore lecture/discussion topics) include natural selection, adaptation, adaptive divergence, gene flow, ecological speciation, population dynamics, community structure, ecosystem function, plasticity, and genetics.

Readings: Chapters of Eco-evolutionary Dynamics and additional readings from the primary literature.

Method: You must read assigned chapters/papers, attend classes, and regularly contribute to class discussions. In addition, each student will design and complete a scientific paper in a style suitable for submission to a peer-reviewed journal. Actual submission to journal is not necessary but every effort will be made to facilitate submission of suitable papers. Papers can include new theoretical models or literature reviews that test the predictions of existing models. Many previous papers from the class have been published in peer-reviewed journals and some have garnered many citations.

Evaluation: Class participation and scientific paper

BIOL 596 (Winter, 1 credit)
Advanced Experimental Design
(Not offered in 2019-2020)

Instructors: Jon Sakata  
N4/8  
514-398-3636  
jon.sakata@mcgill.ca

Prerequisite: BIOL 373 or equivalent and permission of instructor

Content: This course is aimed at graduate students in the Department of Biology and at upper-level undergraduates planning for data collection. As the course title indicates, the focus is on experimental design as a key step in experimentation with, and observation of, biological systems. The course will be oriented to help the students with the specific challenges that they are facing (or will be facing) in their own research. It will consist of three blocks: (i) formal lectures, (ii) discussions of scientific papers and of model experiments, and (iii) students presentation of their own experiments including hypothesis, design and challenges.

Readings: Selected readings from textbooks, journal articles

Evaluation: Based on discussions, presentation and written reports
BIOL 597 (Winter, 2 credits)
Advanced Biostatistics
Not offered in 2019-2020

Instructors: Jon Sakata N4/8 514-398-3636 jon.sakata@mcgill.ca

Prerequisites: BIOL 373 or equivalent, and permission of instructor; BIOL 596 recommended

Content: This course will be oriented to help graduates and upper division undergraduates with data analysis challenges they are facing in their own research. It is designed to be an extension of BIOL 596, Advanced Experimental Design. ANOVA, regression, mixed models, information theory, etc.

Readings: Selected readings from textbooks, journal articles

Method: It will consist of formal lectures, discussions of scientific papers and model experiments, student discussions of analytical techniques, and student presentations of the application of statistical approaches to their own data.

Evaluation: Based on written assignments, class presentations and participation.

BIOL 598 (Winter, 3 credits)
Advanced Design and Statistics
Not Offered in 2019-2020

Instructor: Jon Sakata N4/8 514-398-3636 jon.sakata@mcgill.ca

Prerequisite: BIOL 373 or equivalent and permission of instructor

Restrictions: Not open to students who have taken BIOL 596 and/or BIOL 597

Content: The first part of the course focuses on experimental design as a key step in experimentation with and observation of biological systems. The second part of the course will help graduate and upper division undergraduate students with data analysis challenges they are facing in their own research. ANOVA, regression, mixed models, ordination, information theory, etc.

Method: It will consist of formal lectures, discussions of scientific papers and model experiments, student discussions of analytical techniques, and student presentations of the application of statistical approaches to their own data.

Readings: Selected readings from textbooks, journal articles

Evaluation: Based on written assignments, class presentations and participation.


**STUDY ABROAD**

**EXCHANGE PROGRAMS**

McGill has bilateral exchange agreements with over 100 universities around the world, plus the Quebec university system has additional agreements (called CREPUQ exchanges) with many more, mainly in France. Exchange students pay McGill tuition fees and register as Non-Resident students while they are away and register as Visiting Students (no fees) at the host university. Credits completed satisfactorily at the host university count towards the McGill degree but not the McGill CGPA. Exchanges are for one semester or one academic year. Check out the Study Abroad Fair held annually in early October.

The best time to participate in an exchange program is during the year before you graduate (U2). You must have a CGPA of 3.0 or better to be considered. The deadline for applying for an exchange is January before your expected Fall departure. You should start planning your exchange and researching possible exchange destinations during October of your U1 year. Watch for notices of the Student Exchange Information Sessions.


For Exchange Partners, see: [https://www.mcgill.ca/mcgillabroad/students-going-abroad/where-can-i-go](https://www.mcgill.ca/mcgillabroad/students-going-abroad/where-can-i-go)

For academic information about credit transfer consult: Nancy Nelson, Biology Undergraduate Advisor, at nancy.nelson@mcgill.ca

**STUDY AWAY**

You may study for one semester or one academic year at a 3- or 4-year degree granting university of your choice. If there is no exchange agreement, you pay the prevailing tuition fees at the host university and you deal directly with the host university for making inquiries, applying for acceptance and paying fees. You must get Faculty approval. Check out [http://www.mcgill.ca/science/student/general/studyaway](http://www.mcgill.ca/science/student/general/studyaway)
FIELD COURSES OFFERED BY HUNTSMAN MARINE SCIENCE CENTRE

HUNTSMAN MARINE SCIENCE CENTRE

The Huntsman Marine Science Centre is located in St. Andrews, New Brunswick. It offers several summer field courses for which credit can be gained towards your degree. These courses are highly recommended for a career in Marine Biology and would be useful for ecologists, future teachers and many others. Only the 3 credits from BIOL 335 can be applied to the GPA. The other courses will be treated as transfer credits. Note that enrolment is limited. Apply early.

PROCEDURES FOR APPLYING FOR HUNTSMAN COURSE(S)

1. Download an application form from the web site (www.huntsmanmarine.ca and go to Education/University Courses)
2. Complete the Huntsman application and mail it with a deposit to Huntsman Marine Science Centre: Brandy Cove Road, St. Andrews, N.B., Canada E0G 2X0. Phone: (506) 529-1200, Fax: (506) 529-1212, E-Mail: tdean@huntsmanmarine.ca
3. Register on Minerva and pay tuition fees to McGill (you will be reimbursed the McGill tuition fees for this course). Contact S. Gabe for approval (susan.gabe@mcgill.ca)

WE STRONGLY ADVISE

Before you start the course, confirm your registration on Minerva. (Remember if you are not registered at McGill, you will not get credit for the course).

NOTE

There are other courses offered by Huntsman Marine Science Center, and courses sponsored by other Universities that are not published in our Summer Studies Calendar. Please see the Huntsman web site for details.

Courses sponsored by other Universities (eg. University of Toronto, Guelph etc.) will be treated as Transfer Credits. Courses sponsored solely by Huntsman are treated as general interest course and no credits will be given.
FIELD STUDY SEMESTERS

PANAMA FIELD STUDY SEMESTER

Teaching staff members: Catherine Potvin, (Director) Department of Biology
Oliver Coomes, Department of Geography (2018)
Thom Meredith, Department of Geography (2017)
Daviken Studnicki-Gizbert, Department of History (2017)
Caroline Begg, Department of Plant Science (2018)

The program specifically addresses issues relevant to the understanding of the Latin America Neotropical environment. It is a joint venture between McGill University and the Smithsonian Tropical Research Institute (STRI) in Panama.

Enrolment of McGill students will be limited to 26 students by housing capacity. The courses will also be made available to 3 or 4 Panamanian students. Courses will be taught in English, but Spanish will be essential for communication.

Three courses, for a total of 9 cr., will provide formal training. Field trips and transdisciplinary approaches will be structuring elements of these courses.

BIOL 553  Neotropical Environments
AGRI 550  Sustained Tropical Agriculture
GEOG 498  Humans in Tropical Environments

In addition, hands-on experience in an internship setting will be gained through the 'Research in Panama' course (ENVR 451, 6 credits), an independent studies project organized around multidisciplinary environmental issues. The nature of these projects will center on practical environmental problems/questions important for Panama. Students will form teams of 2-3 that will work with Panamanian institutions (NGO, governmental or research)

Of the 15 credits taken, biology students may apply as many as 12 credits toward the Biology Major/Faculty program (depending on their particular independent study). A CGPA of 3.0 or higher is recommended.

Pre-requisites for the Field Study Semester in Panama are: Spanish Language Elementary HISP 218, or equivalent, and Principles of Statistics MATH 203, or equivalent.

The cost of the program is $5,500 CDN (subject to change). This amount does not include airfare, tuition, insurance or meals (unless travelling). Students have reported requiring approximately an additional $2,000 in total for food, clothing, travel, etc. Once accepted into the program, students must pay a NON REFUNDABLE $1,000 deposit. The remaining balance must be paid by early October

Application instructions can be found online at:  http://www.mcgill.ca/pfss/application

For further information, see the website at: www.mcgill.ca/pfss

For information contact: Martine Dolmière
Faculty of Science,
Dawson Hall, Room 408
E-mail: martine.dolmiere@mcgill.ca
AFRICA FIELD STUDY SEMESTER

An opportunity to spend the Winter Semester in East Africa is offered by McGill. The semester includes 15 credits of coursework in Anthropology, Geography and Biology which are suitable for credit transfer. Details from Professor Jon Unruh, Department of Geography, Burnside Hall, Room 3088 E-Mail: jon.unruh@mcgill.ca
For more information, see the web site: www.mcgill.ca/africa/

BARBADOS FIELD STUDY SEMESTER

Located at the Bellairs Research Institute, this full 15-credit semester is for undergraduate students in the Faculties of Agriculture & Environmental Science, Arts, Engineering, Science and the McGill School of the Environment with an interest in international development and sustainable management of resources and the environment.

It is coordinated by the Department of Bioresource Engineering on the Macdonald Campus. Interested students should submit (via email) a CV, an unofficial transcript and a cover letter to: jocelyne.begin@mcgill.ca.
For more information, including application deadlines and, see the web site: http://www.mcgill.ca/bfss/
## STUDENT RESOURCES

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**Full-Time & Affiliated Professorial Staff**

**Biology Department, McGill University**

ABOUHEIF, Ehab  Professor  N3/6  (514) 398-7190
EHAB.ABOUHEIF@MCGILL.CA
Evolutionary developmental biology: comparative and functional gene expression studies in ants and other insects are used to study the evolution of developmental regulatory genes and gene networks; the importance of ecological influences on development and evolution; and the relationship between molecular and morphological evolution.

ALTIERI, Andrew  Adjunct Professor  STRI  507-6374-6340
ALTIERIA@SIE.EDU
Community ecology: the consequences of species extinction, invasions, habitat degradation, and overfishing on the emergent properties of coastal ecosystems; how human activities affect the distribution, abundance, and diversity of key organisms in coastal habitats; the consequences of biodiversity change for ecosystem functions; how do synergistic community interactions and physiological tolerances mediate trajectories of decline and resilience in ecosystems? Results of my research thereby integrate from the organismal to ecosystem levels of ecological organization, and provide a practical understanding of coastal ecosystems that is based in both natural history and ecological theory.”

BARRETT, Rowan  Associate Member  Redpath Museum Rm 207  (514) 398-4086  X00856
ROWAN.BARRETT@MCGILL.CA
My work is motivated by a desire to understand the genetic basis of adaptation to changing environments. My research bridges theoretical and empirical approaches in population genetics, evolutionary ecology, and molecular biology to ask questions about the reciprocal interactions between ecological and evolutionary processes. I pursue this research program with a variety of key study systems, including stickleback fish, deer mice, and microbes.

BELL, Graham  Professor and Chairman  (514) 398-6458
GRAHAM.BELL@MCGILL.CA
Experimental studies of adaptation using yeast, *Chlamydomonas* and bacteria as model systems. The rate and effect of mutations and the dynamics of selection. Genetic variation and species diversity in environments that vary in space and time, and the evolution of specialists and generalists. Field experiments using genetically well known model organisms.

BELLINI, Francesco  Adjunct Professor  FBELLINI@PICCHIO-INTL.COM  BELLUS Health Inc

BROUHARD, Gary  Associate Professor  Bellini 267  (514) 398-2984
GARY.BROUHARD@MCGILL.CA
Cells adopt a range of shapes and can build an amazing variety of structures from proteins. We are interested in the biophysical mechanisms by which cells engineer these large-scale structures--in other words, the molecular basis of morphology. The subject of our current research is the microtubule cytoskeleton. We investigate the proteins that control the microtubule cytoskeleton, namely microtubule polymerases, motor proteins, and other microtubule-associated proteins. The lab uses the techniques of single-molecule biophysics, which shed light on the fundamental workings of these important enzymes.

BROWN, Gregory G.  Emeritus and Post-Professor  GREG.BROWN@MCGILL.CA
Organization and expression of plant mitochondrial DNA; cytoplasmic male sterility in plants.

BUREAU, Thomas E.  Associate Professor  N4/1  (514) 398-6472
THOMAS.BUREAU@MCGILL.CA
Molecular evolution of genes and genomes, with an emphasis on the involvement of mobile elements in the evolution of developmentally important genes. Determination of the transposition mechanisms of novel mobile
elements, including MITEs (miniature inverted-repeat transposable elements). Development of genomics-based approaches to study genome evolution. Examination of the role of retroelement-mediated cellular gene transduction in the evolution of retroviruses.

BUSSEY, Howard  Professor Emeritus  HOWARD.BUSSEY@MCGILL.CA  Yeast genomics. Molecular biology of protein secretion and cell surface assembly in yeast.

CARROLL, Robert L.  Professor Emeritus  ROBERT.CARROLL@MCGILL.CA  

CHAPMAN, Colin  Associate Member  Anthropology and MSE/ Peterson Hall Rm 22A  COLIN.CHAPMAN@MCGILL.CA  Experimental and observational approaches to determine how plant communities influence animals (primate population regulation, determinants of primate group size) and how animals influence their environment (herbivory, seed dispersal, community restoration). This research has often been developed to permit direct application to conservation.

CHAPMAN, Lauren  Professor  N3/12A  LAUREN.CHAPMAN@MCGILL.CA  Aquatic ecology and conservation, evolutionary and ecological consequences of respiratory strategies in fishes, Ecophysiology, ecomorphology, adaptive divergence, tropical inland waters, Africa. Recent work focuses on divergent selection across oxygen gradients in fishes, the interaction of hypoxia with other environmental stressors (e.g., introduced species) and value of tropical wetlands in the maintenance of fish faunal structure and diversity.

CHARRON, Frédéric  Adjunct Professor  IRCM  FREDERIC.CHARRON@IRCM.QC.CA  Molecular Biology of Neural Development

CHASE, Ronald  Professor Emeritus  RONALD.CHASE@MCGILL.CA  

CLARKE, Hugh  Associate Member  Royal Victoria Hospital  HUGH.CLARKE@MCGILL.CA  Mammalian oogenesis and early embryogenesis. Changes in chromatin composition during oogenesis and early embryogenesis with the aim of identifying how these might control initial programming of gene expression. Intracellular signalling mechanisms that regulate oocyte growth.

Cristescu, Melania  Associate Professor  N6/1  MELANIA.CRISTESCUC@MCGILL.CA  Invasive species; genetic diversity and mutations of organism; aquatic ecosystems.

Dankort, David  Associate Professor  Bellini 264  DAVID.DANKORT@MCGILL.CA  Cancer represents a failure of built-in protection mechanisms to quell rogue cells that have sustained oncogenic mutations. Paradoxically, many of the same mutated oncogenes that cause cancer also elicit a permanent growth arrest (senescence) or induce apoptotic cell death of primary cells: two such oncogenes are RAS and BRAF. One research goal of my laboratory is to determine mechanistically how a tumour cell subverts these growth restraints leading to unbridled proliferation and ultimately malignancy. We will use the power of mammalian genetics in ‘state-of-the-art’ genetically engineered mouse model and cell culture systems to define causative roles for RAS and BRAF-cooperating genes involved in lung cancer and melanoma developments and progression.
DAVIES, Jonathan  Adjunct Professor  
J.DAVIES@UBC.CA  
Research Interests include: phylogenetic methods in ecology; phylogenetic community structure and ecosystem processes; evolutionary conservatism in plant phenology and responses to global change; and Integrating phylogenetic diversity metrics within conservation triage

DENT, Joseph A.  Associate Professor  
JOSEPH.DENT@MCGILL.CA  
Molecular genetics of behaviour in C. elegans. Understanding the structure and function of ligand-gated chloride channels, how they are integrated into the synapse, and how they contribute to behavioural circuits. Evolution of channel subunit diversity. Developing new tools for the analysis of nervous systems.

DHINDSA, Rajinder S.  Professor Emeritus  
RAJ_DHINDSA@MCGILL.CA  

DUFORT, Daniel  Associate Member  MUHC-RI, Glen EM0.3230  
DANIEL.DUFORT@MUHC.MCGILL.CA  
My laboratory is interested in understanding the molecular mechanisms involved in the process of embryo implantation. We have demonstrated that the embryo secretes Wnt proteins which activate Wnt signalling in the uterus. We further demonstrated that inhibition of Wnt signalling impairs the implantation process illustrating the importance of this pathway in embryo implantation (in press, PNAS). This project will be aimed at characterizing the function of Wnt signalling in the uterus during the implantation process.

FAGOTTO, Francois  Adjunct Professor  CNRS-CRBM  
Our group is interested in two related subjects. Firstly, the mechanisms regulating signal transduction by β-catenin, focusing in particular on the role of subcellular localization and trafficking of the various components. Secondly, the integration of cell signalling and regulation of cell adhesion/cytoskeleton during morphogenetic movements, using gastrulating Xenopus embryos as a model system. One of our candidate “integrators” is β-catenin, which has a dual function in signalling and cell-cell adhesion.

FRANÇOIS, Paul,  Associate Member  Rutherford Physics Bldg Rm 221  
PAUL.F@PHYSICS.MCGILL.CA  
Theoretical biological physics: modelling of physical properties gene networks and their evolution, in the context of embryonic development.

FUSSMANN, Gregor  Professor  
GREGOR.FUSSMANN@MCGILL.CA  
Community ecology. Population and community dynamics; stability and complexity of food webs; the interplay of ecological and evolutionary dynamics; clonal structure of populations. Approach: both theoretical and empirical (laboratory and field experiments with aquatic organisms).

GERHOLD, Abigail  Assistant Professor  
A.R.GERHOLD@GMAIL.COM  
We are interested in how cell division occurs “in situ”, that is, how are fundamental mitotic processes adapted to the native environment in which a cell divides. We address this question using the adult germline stem cells and embryonic blastomeres of C. elegans as a model. We use a combination of live-cell imaging, quantitative image analysis and genetic approaches to investigate how different aspects of mitosis are modified by the adoption of cell fate during development, by physiological changes in the adult organism and by the complex architecture of mature tissues.

GONZALEZ, Andrew  Associate Professor  
ANDREW.GONZALEZ@MCGILL.CA  
Community ecology through a blend of experiment (both in the lab and in the field) and theory. Two major themes: 1) The causes and consequences of extinction in fragmented landscapes, and 2) Diversity and persistence in variable environments.
GREEN, David M.  Associate Member  Redpath Museum  (514) 398-4086 x4088
DAVID.M.GREEN@MCGILL.CA
Evolution, biosystematics, and conservation biology. Geographic variation, population biology, cytogenetics, and molecular genetics of amphibians.

GREGORY-EAVES, Irene  Assistant Professor  (514) 398-6425
IRENE.GREGORY-EAVES@MCGILL.CA
My lab’s long term research goals are to make essential progress in our understanding of the structure and functioning of lakes and to quantify how these ecosystems have responded to the accelerated rate of change introduced by human activities over the Anthropocene. Central to this program is the ability to develop, scrutinize and integrate data from different sources: lake surveys, time series and field experiments.

GUICHARD, Frédéric  Professor  (514) 398-6464
FREDERIC.GUICHARD@MCGILL.CA
Theoretical ecology and complex system theory applied to inter-tidal ecosystems and to marine reserve design. Emergence of large scale patterns and dynamics from local interactions among individuals. Multi-disciplinary approach involving mathematical modelling, field experiments and remote sensing.

GUIGUENO, Mélanie  Assistant Professor  MELANIE.GUIGUENO@MAIL.MCGILL.CA
We combine field and laboratory approaches to examine natural behaviour in natural settings and to examine links between behaviour, cognition, and the brain. Brain measures include fine-scale differences, such as neurogenesis. An important study system is avian brood parasitism, in which some parasitic species show female-biased sex differences in spatial behaviour in the field with associated sex differences in spatial memory and in the hippocampus (part of the brain responsible for spatial memory).

GUZMAN, Hector  Adjunct Professor  STRI  (507) 212-8733
GUZMANH@SI.EDU
Ecology and population dynamic of coral reefs; sclerochronology; conservation biology; human impacts on marine ecosystems, coastal management and marine pollution.

HARGREAVES, ANNA, Assistant Professor  ANNA.HARGREAVES@MCGILL.CA
Evolutionary ecology of species distributions and species interactions. We tackle topics of both theoretical and conservation interest, including: local adaptation and dispersal evolution at range edges; how these affect range stability and responses to global change; geographic patterns in biotic interactions (e.g. pollination, herbivory, competition) and biodiversity. Research emphasizes field experiments (usually with plants because they're the best), complimented by data synthesis, simulation models, and lab or greenhouse experiments.

HARRISON, Paul  Associate Professor  (514) 398-6420
PAUL.HARRISON@MCGILL.CA
Bioinformatics and computational biology. Genome evolution and annotation; analysis and annotation of pseudogenes and their implications; protein folding, amyloidogenesis and the prion phenomenon; methods for protein structure prediction.

HASTINGS, Kenneth  Associate Member  Montreal Neurological Institute  (514) 398-1852
KEN.HASTINGS@MCGILL.CA
Muscle gene regulation, evolution of muscle gene families and muscle cell subtypes, evolution and function of SL trans-splicing in the chordates.

HAYER, ARNOLD  Assistant Professor  Bellini 268  (514) 398-8574
ARNOLD.HAYER@MCGILL.CA
Our research is focused on three main areas: (1) Cytoskeletal dynamics during autonomous and collective mammalian cell migration, (2) polarity signaling within and between collectively migrating cells, and (3) coordination of cell motility between cells during vascular morphogenesis. We follow an interdisciplinary approach, using live-cell microscopy, fluorescence-based biosensors, microfabrication, and computational methods.
image analysis. By studying mechanisms that control autonomous and collective cell behavior, we aim to understand the fundamental principles of how cells are organized into tissue.

HEKIMI, Siegfried  Professor
SIEGFRIED.HEKIMI@MCGILL.CA
(514) 398-6440
Molecular genetics of aging. To understand the mechanisms that govern the life span of animals, we use the nematode Caenorhabditis elegans as well as mice and human cells in culture to identify and characterize genes that affect physiological rates, including the rate of aging.

HENDRICKS, Adam  Associate Member  McConnell Engineering Bldg
ADAM.HENDRICKS@MCGILL.CA
(514) 398-8925
Molecular genetics of aging. To understand the mechanisms that govern the life span of animals, we use the nematode Caenorhabditis elegans as well as mice and human cells in culture to identify and characterize genes that affect physiological rates, including the rate of aging.

HENDRICKS, Michael  Assistant Professor
MICHAEL.HENDRICKS@MCGILL.CA
(514)-398-6581

HENDRY, Andrew  Professor
ANDREW.HENDRY@MCGILL.CA
(514) 398-4086x00880
Redpath Museum
The evolution of biological diversity: adaptive radiation, ecological speciation, "rapid" evolution, natural selection and gene flow. Empirical systems currently include salmon, sticklebacks, and guppies. Methods include surveys of biological diversity, field and laboratory experiments, molecular genetics, quantitative genetics, and theoretical modelling.

HIPFNER, David  Adjunct Professor
DAVID.HIPFNER@IRCM.QC.CA
514-987-5508
IRCMs
Dr. Hipfner has continued to study how epithelial tissue size and shape are controlled in the developing fly. In particular, his group has focused on a class of proteins, called kinases, that are key transducers of the signals inside cells that control these processes. By focusing on kinases that have clearly identifiable counterparts in more complex animals, this research will provide basic insights into how tissue growth and organization are regulated in humans, and how perturbation of this regulation may contribute to the establishment and progression of tumours.

KALFF, Jacob  Professor Emeritus
JACOB.KALFF@MCGILL.CA

KRAHE, Rudiger  Adjunct Professor
RUEDIGER.KRAHE@HU-BERLIN.DE
Humboldt University
Neuroethology. Information processing in sensory systems using behavioural, electrophysiological, computational, and neuroanatomical approaches. Animal communication studies in the lab and in the field

KRAMER, Donald  Emeritus
DONALD.KRAMER@MCGILL.CA

LARSSON, Hans  Associate Member
HANS.CE.LARSSON@MCGILL.CA
Redpath Museum
(514) 398-4086 x089457
Vertebrate palaeontology and developmental evolution. Palaeontological work focuses on terrestrial Mesozoic vertebrates in the Canadian arctic and explores signatures of ancient climate shifts in palaeo-faunas. Developmental evolution work addresses what developmental mechanisms (morphological and molecular) are responsible for changes in the evolution of vertebrate morphology.

LASKO, Paul F.  Professor
PAUL.LASKO@MCGILL.CA
Bellini 277
(514) 398-6721
LECHOWICZ, Martin J. Emeritus & Post-Retirement Professor  
MARTIN.LECHOWICZ@MCGILL.CA  

LEFEBVRE, Louis Professor  
LOUIS.LEFEBVRE@MCGILL.CA  
Animal behaviour, feeding strategies of flock-feeding birds, social learning.

LEUNG, Brian Associate Professor  
BRIAN.LEUNG2@MCGILL.CA  
Biological invasions, ecology of diseases, anthropogenic stressors. Addressing environmental issues through the synthesis of models (mathematical, computational, and statistical) with empirical data (literature, field or lab studies). Creating models for ecological forecasting, given uncertainty and sparse data. Developing decision theory, using risk analysis.

MCMILLAN, Owen Adjunct Member  
STRI  
MCMILLANO@SLEDU  
Origins of adaptive variation, the genetic basis of mating behaviour, and the ecological and evolutionary processes that shape genetic variation in natural populations.

MILLIEN, Virginie Associate Member  
VIRGINIE.MILLIEN@MCGILL.CA  
The evolution of body size and morphological diversity in relation to environmental change: Ecotypic variation and climate change; The evolution of species on islands; The effects of climate change and isolation on morphological evolution; Functional morphology in fossil rodents and other mammals; Competition and community size structure among coexisting species; Species range shift under climate change and the emergence of Lyme disease in Southern Quebec.

MOON, Nam-Sung Associate Professor  
Bellini 266  
NAM.MOON@MCGILL.CA  
Molecular genetics of cancer genes in Drosophila melanogaster. Multiple genetic changes are responsible for the development of human cancer. Often, genes that are altered in cancers are evolutionarily conserved and their functions can be studied in a model organism such as the fruit fly (Drosophila melanogaster). My research is focused on studying cancer related genes using Drosophila as a model organism. In particular, I am interested in understanding the in vivo function of RBF1, the Drosophila homologue of the RB (Retinoblastoma) gene, which is functionally inactivated in most types of cancer.

NILSON, Laura Professor  
N5/8  
LAURA.NILSON@MCGILL.CA  
Developmental genetics in Drosophila melanogaster. Identification and analysis of genes required in the somatic follicle cells of the ovary for patterning of the future embryo. Genetic and molecular analysis of organization and morphogenesis of the ovarian follicular epithelium.

OHYAMA, Tomoko Assistant Professor  
TOMOKO.OYAMA@MCGILL.CA  
How is sensory information processed to generate specific behaviour? Studies neuronal circuits and mechanisms in sensory-integration of behaviour using Drosophila larvae as a model system.

PAGE, Rachel, Adjunct Professor  
PAGER@SLEDU  
Vertebrate behavior, in particular predator-prey interactions, the sensory and cognitive ecology of foraging, and the effect of eavesdroppers on signal evolution.
POLLACK, Gerald  Professor Emeritus  
GERALD.POLLACK@MCGILL.CA  
Neurophysiological, developmental and anatomical studies of the neural basis for behaviour. Acoustic communication.

POTVIN, Catherine  Professor  
CATHERINE.POTVIN@MCGILL.CA  
Physiological ecology; global change; photosynthesis and productivity; experimental design and biostatistics; conservation biology; tropical ecology.

PRICE, Neil M.  Professor  
NEIL.PRICE@MCGILL.CA  

RAO, Yong  Associate Member  
YONG.RAO@MCGILL.CA  
The molecular mechanism of axonal guidance and target recognition in the fly visual system and the molecular mechanism of neuronal migration.

READER, Simon  Associate Professor  
SIMON.READER@MCGILL.CA  
Animal behaviour, behavioural ecology, behavioural neuroscience, cognitive evolution. Research focuses on social behaviour and social learning in the laboratory and the field.

REYES LAMOTHE, Rodrigo  Assistant Professor  
RODRIGO.REYESLAMOTHE@MCGILL.CA  
Dynamics of replication; chromosome organization, segregation and cell division.

RICCIARDI, Anthony  Associate Member  
TONY.RICCIARDI@MCGILL.CA  

Roff, Derek, Emeritus

ROSENBBLATT, David  Associate Member  
DAVID.ROSENBBLATT@MCGILL.CA  
Inborn errors of cobalamin (Vitamin B12) and folate metabolism. Gene discovery and studies of gene product function in the cobalamin pathway. Gene discovery for autosomal recessive Mendelian disorders.

ROY, Richard  Professor  
RICHARD.ROY@MCGILL.CA  
The normal development of an organism depends on the precise orchestration of cell division, differentiation and morphogenesis. Although much is understood about how developmental regulatory genes affect cell differentiation, little is understood about how they control cell proliferation. Using both genetic analysis and molecular approaches, the Roy Laboratory is engaged in the identification and characterization of genes that affect cell division throughout the course of development in C. elegans.

ROZEN, Rima  Associate Member  
RIMA.ROZEN@MCGILL.CA  
Molecular genetics of inherited diseases; genetic risk factors for cardiovascular disease and neural tube defects; folic acid metabolism in cancer.
SAKATA, Jon  Associate Professor  N4/8  (514) 398-3636
JON.SAKATA@MCGILL.CA
I integrate behavioural, neurophysiological and molecular approaches to investigate the neural
circuity underlying social influences on vocal learning and control.

SCHOECK, Frieder  Associate Professor  (514) 398-6434
FRIEDER.SCHOECK@MCGILL.CA
We study cell-matrix adhesion and the actin cytoskeleton, in particular, how integrin-associated
proteins regulate adhesion during muscle attachment and myofibril assembly in the fruit fly
Drosophila. Our research will shed light on the regulation of integrin adhesion and its coordination
with the actin cytoskeleton, and will lead to a better understanding of muscle disorders.

SCHOEN, Daniel J.  Professor  N3/8A  (514) 398-6461
DANIEL.SCHOEN@MCGILL.CA
Evolution, ecology and population genetics of plants. Conservation genetics. Application of theory and
molecular genetic data to studies in plant evolution.

SUNDAY, Jennifer  Assistant Professor  N8/3  (514) 398-8885
JENNIFER.SUNDAY@MCGILL.CA
We are interested in understanding how species distributions respond to environmental change, through
direct effects, adaptive capacities, and biotic interactions. We use macroecology, natural experiments, and
controlled experiments - informed by theory - to build a predictive understanding of how population and
communities will respond further to climate change. We focus mainly on marine, but also terrestrial
ecosystems, to understand global and general processes.

TAKETO, Teruko  Associate Member  MUHC-RI, Glen EM0.3220l  (514) 934-1934 x34197
TERUKO.TAKETO@MCGILL.CA
Genetic mechanism of gonadal sex determination and differentiation in mouse models for sex reversal.
Cause of infertility in the XY sex-reversed female mouse. Analysis of meiotic chromosomes

TORCHIN, Mark  Adjunct Professor  STRI  (703) 487-3770
TORCHINM@SI.EDU
Marine population and community ecology, host-parasite interactions, invasion ecology, conservation
biology.

VALLES, Henri  Adjunct Professor  Univ. of the West Indies  246-417-7101
HENRI.VALLES@CAVEHILL.UWI.EDU
Settlement and post-settlement processes of reef organisms; Coral disease and bleaching; Reef
fisheries; Ecological indicators; Lionfish invasion; Queen conch management; Quantitative methods in
ecology.

VAN MEYEL, Donald  Associate Member  Centre for Research in Neuroscience  (514) 934-1934 x42995
DON.VANMEYEL@MCGILL.CA
The overall objective of research in our laboratory is to understand molecular and organizational
principles that underlie the assembly of functional neural circuits during development. Our research
program is divided into two primary themes that focus on 1) the importance of neuron-glial
interactions during development, and 2) the patterned growth and guidance of axons and dendrites.
We are also interested in how perturbations of these processes contribute to neurological diseases,
and how improved understanding of the underlying mechanisms can be used to promote repair in the
injured or diseased CNS.

VOGEL, Jacalyn  Associate Professor  Bellini 269  (514) 398-5880
JACKIE.VOGEL@MCGILL.CA
The mitotic spindle plays an essential role in the transmission of genetic information during cell
division in all eukaryotic cells. Our research focuses on spindle dynamics and cell cycle control
mechanisms. We use budding yeast as a model for the detailed analysis of these evolutionarily
conserved processes, using high-resolution microscopy, biochemistry, molecular genetics, and the
analysis of relevant genetic networks and protein structure-function relationships using genomic and
bioinformatics methods.
WATT, Alanna  Associate Professor  Bellini 265  (514) 398-2806  
ALANNA.WATT@MCGILL.CA  
We are interested in the development of neuronal circuits, and the early patterned network activity that is thought to play a role in this process. Using electrophysiology combined with two-photon and confocal imaging, my lab studies how network activity and other early events play a role in sculpting the developing cerebellum.

WEBER, Stephanie  Assistant Professor  N5/16  (514) 398-2042  
STEPH.WEBER@MCGILL.CA  
Cells are crowded with macromolecules that form highly organized yet dynamic structures. While advances in fluorescence microscopy enable us to visualize this spatiotemporal heterogeneity, the mechanisms underlying intracellular organization remain largely unknown. The Weber lab uses quantitative live-cell imaging and physical modeling to understand how biological systems establish and dynamically regulate spatial order in the cell and ultimately how these processes affect the growth and size of the whole organism.

WESTERN, Tamara  Associate Professor  N5/7  (514) 398-2574  
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Correct growth and development in plants is inextricably linked with the characteristics of their cell walls. My research focuses on the mechanisms of cell wall production and modification using a combination of genetics and cell biology. We also address the ramifications of changes in cell wall properties on plant development through morphological and biomechanical studies.

WOOLLEY, Sarah  Assistant Professor  N4/8  (514) 398-2324  
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Neuroethology. Neural mechanisms underlying the production and perception of social communication behaviors in songbirds using electrophysiology, behavioral analysis, molecular biology and computational methods.

ZETKA, Monique  Associate Professor  (514) 398-6445  
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Proper chromosome morphogenesis is required for the faithful segregation of chromosomes during meiosis and can be readily studied in the nematode Caenorhabditis elegans. The research goals of my laboratory are to investigate the function and regulation of meiotic chromosome organization using a combination of genetics, molecular biology and high-resolution cytogenetics.

ZHENG, Hugo  Associate Professor  N5/10  (514) 398-1328  
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The overall goal of my research is to understand how plant intracellular membrane trafficking is regulated as cell morphology changes during plant development and in response to environmental stresses. We are using a GFP-based living cell imaging technology combined with genetic approaches to study how plant genes control these important processes. Another research we are interested is to use reverse genetic and chemical genomic approaches to study the molecular regulation and function of very-long-chain fatty acid (VLCFA) biosynthesis and secretion in the production of waxes, seed oils, and sphingolipids.