Faculty of Science, including School of Computer Science (Undergraduate)

Programs, Courses and University Regulations

2020-2021

This publication provides guidance to prospects, applicants, students, faculty and staff.

1 . McGill University reserves the right to mak

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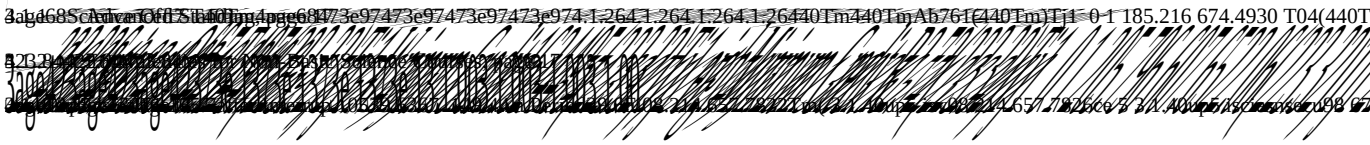

10.2.6 Bachelor of Science (B.Sc.) - Honours

1 About the Faculty of Science (Undergraduate)

1.1 Location

Dawson Hall
853 Sherbrooke Street West
Montreal QC H3A 0G5
Canada
Telephone: 514-398-5442
Faculty website: *www.mcgill.ca/science*
Science Office for Undergraduate Student Advising (SOUSA): *www.mcgill.ca/science/undergraduate/advice/sousa*

The Science Office for Undergraduate Student Advising (SOUSA) and the Office of the Director of Advising Services of the Faculty of Science are located in Dawson Hall, room 405. SOUSA serves students in the B.Sc. and B.A. & Sc. degrees.

1.2 McGill's Faculty of Science

- **McGill's second-largest faculty**: Consisting of 15 schools and departments focused on teaching, research, and outreach — including the Redpath Museum, Canada's oldest museum of natural history — and 20 research centres and institutes
- **Students**: Over 4,000 undergraduate and over 1,000 graduate students
- **Over 250 faculty members**, including tenured and tenure-track professors
- Has ties with **ten Nobel laureates**: seven were Faculty of Science graduates, while three winners were either Science faculty members or staff
- **Canadian leader** in astrophysics and cosmology, climate change and extreme weather, green chemistry, life sciences (developmental biology), earth systems science, biodiversity and conservation, nanoscience, social neuroscience, sustainability science, and artificial intelligence
- Offers students a variety of **Field Study** opportunities, which take students out of the traditional classroom environment and into a world of strong interdisciplinary, international, and research-based education. Students have opportunities to work with local and indigenous communities, governmental agencies, and NGOs in places as far-ranging as East Africa, Barbados, Panama, and the Arctic
- Offers the **Reginald Fessenden Professorships and Prizes in Science Innovation**, the first such endowed program in Canada, to encourage and support the commercialization of research in science conducted by world-class scholars
- **McGill's most multidisciplinary faculty**, which conducts teaching and research in collaboration with many of the University's other faculties, including Medicine, Engineering, Music, Arts, Education, and Management
- State-of-the-art facilities including the **$120 million McGill Life Sciences Research Complex**, consisting of the **Francesco Bellini Building** and **Cancer Research Building**, which are physically linked to the McIntyre Medical and Stewart Biology Buildings
- Established Canada's first comprehensive **Earth System Science Program**, to study and research new forms of energy and gain a better understanding of climate change and natural hazards
- The **Tomlinson Project in University-Lev**

Director of Advising Services

Nicole Allard; B.A.(W. Ont.), M.A.(Guelph), M.Ed.(McG.)

Chief Academic Adviser

Pete Barry; B.Sc.(C'dia), M.Sc.(McG.)

Associate Dean (Graduate Education)

Laura Nilson; B.A.(Colgate), Ph.D.(Yale)

Associate Dean (Research)

John Stix; A.B.(Dart.), M.Sc., Ph.D.(Tor.)

1.4 Science Office for Undergraduate Student Advising (SOUSA)

The Science Office for Undergraduate Student Advising (SOUSA) provides ongoing advice and guidance on academic issues related to programs, degree requirements, registration, course change, withdrawal, deferred exams, supplemental exams, Academic Standing, inter- and intra-faculty transfer, year or term away, transfer credits, second programs, second degrees, and graduation.

Every student in the B.Sc. degree is assigned an adviser in SOUSA. The adviser's name appears near the top of your Advising Transcript on Minerva. You can contact your adviser directly, or if you do not yet have a SOUSA adviser, at *adviser.science@mcgill.ca*.

SOUSA advisers provide assistance with degree planning and are a valuable referral source. They are a good place to start if you are not sure where to address your question. They also offer help managing academic situations during periods of personal, financial, or medical problems, by working with you to identify various possibilities and strategies for making informed decisions.

Special requests can be made, in writing, to the Director of Advising Services.

The Committee on Student Standing (CSS) will consider appeals of the Director of Advising Services' decisions. For information about CSS, see the Director of Advising Services' assistant.ng 41 67.52 418.48 418DirThe Committee on O4e Commi

3.1 Minimum Credit Requirement

The minimum credit requirement for your degree is determined at the time of acceptance and is specified in your letter of admission.

Students are normally admitted to a four-year degree requiring the completion of 120 credits.

3.1.1 Advanced Standing

Advanced Standing of up to 30 credits may be granted to students who obtain satisfactory results in International Baccalaureate, French Baccalaureate, Advanced Levels, Advanced Placement tests, or the Diploma of Collegial Studies (DCS). Quebec students with a DCS in Science are granted 30 credits Advanced Standing and will have normally completed the equivalent of, and are therefore exempt from, the basic science courses in biology, chemistry, mathematics, and physics. Students with satisfactory results in International Baccalaureate, French Baccalaureate, Advanced Levels, and Advanced Placement tests may be exempt from some or all of the basic science courses. You will not be given additional credit toward your degree for any McGill course where the content overlaps substantially with any other course for which you have already received credit, such as for Advanced Standing results.

AP Examination results with a score of 4 or 5 **must** be declared by you at the time of initial registration at the University.

For more information about Advanced Standing,1 T

3.4 Program Requirements

The Faculty of Science offers a vast array of study and research opportunities at the undergraduate level, and it is very important that you familiarize yourself with all the alternatives open to you before deciding on a program of study. For an overview of programs offered in the B.Sc., see the Faculty of Science Programs of Study at *www.mcgill.ca/science/programs*.

3.4.1 Liberal, Major, and Honours Programs

As a Science student, if you need 96 or fewer credits to complete your degree requirements, you are required to select your courses in each term with a view to timely completion of your degree and program requirements. You must register in one of the following types of departmental programs leading to the degree of Bachelor of Science:

3.4.1.1 Liberal Programs

Liberal programs provide students with the opportunity to study the core of one science discipline along with a breadth component from another area of science or from many other disciplines. In a liberal program, you must complete a Core Science Component (CSC) (45–50 credits), plus a Breadth Component (at least 18 credits). The requirements for the Core Science Components are given under departmental sections of this publication whenever applicable.

For the Breadth Component, you must complete one of the following:

- Minor Program (18–24 credits) – one of the programs listed in *section 7.2: Minor Programs*.
- Arts Minor or Major Concentration (18 or 36 credits) – one of the programs listed in *section 7.5: Arts Major and Minor Concentrations Open to Science Students*.
- A Core Science Component in a second area (45–50 credits) – at least 24 credits must be distinct from the courses used to satisfy the primary Core Science Component. Note that a second Core Science Component can be selected from any of the Science groups.

3.4.1.2 Major Programs

Major programs are more specialized than liberal programs and are usually centred on a specific discipline or department.

3.4.1.3 Honours Programs

Honours programs typically involve an even higher degree of specialization, often include supervised research, and require students to maintain a high academic standard. Although honours programs are specially designed to prepare you for graduate studies, graduates of the other degree programs may also be admissible to many graduate schools. If you intend to pursue graduate studies in your discipline, you should consult a departmental adviser regarding the appropriate selection of courses in your field.

3.4.2 Minor and Minor Concentration Programs

In addition to the liberal, major, and honours degree programs, as a student in the Faculty of Science, you may select a minor or approved minor concentration program. These are coherent sequences of courses in a given discipline or interdisciplinary area that may be taken in addition to the courses required for the degree program.

Science minors consist of up to 24 credits.

Arts minor concentrations consist of 18 credits.

A minimum of 18 new credits must be completed in the Minor or Minor concentration.

For a list of "Minor Programs," see *section 7.2: Minor Programs*; for minor concentrations that are approved for Science students, see *section 7.5: Arts Major and Minor Concentrations Open to Science Students*.

3.4.3 Other Second Programs

In addition to a major or honours program, you may pursue a second major or honours program, or an Arts major concentration program. Each major or honours program must contain a minimum of 36 credits that are distinct from the courses used to satisfy the other program.

3.4.4 Special Designations

The Faculty of Science recognizes Bachelor of Science (B.Sc.) students who have gone beyond a typical B.Sc. experience by awarding certain special designations to their student record and degree at graduation.

3.4.4.1 B.Sc. Global Designation

For details on the B.Sc. Global Designation, students should refer to *www.mcgill.ca/science/undergraduate/programs/bsc-global*.

3.4.4.2 Internship Program Designation

All B.Sc. programs can include an internship component. For more details, students should refer to *section 9: Science Internships and Field Studies* and *www.mcgill.ca/science/undergraduate/internships-field/internships*.

3.4.5 McGill School of Environment

The Faculty of Science is one of the four faculties in partnership with the McGill School of Environment. For more information, see *McGill School of Environment* .

3.5 Course Requirements

All required and complementary courses used to fulfil program requirements, including the basic Science requirements, must be completed with a grade of C or better. If you fail to obtain a Satisfactory grade in a required course, you must either pass the supplemental examination in the course or do additional work for a supplemental grade, if these options are available, or repeat the course. Course substitution will be allowed only in special cases; you should consult your academic adviser.

Normally, you are permitted to repeat a failed course only once. (Failure is considered to be a grade of less than C or the administrative failures of J and KF.) If a required course is failed a second time, you must appeal to the Director of Advising Services for permission to take the course a third time. If permission is denied by the Director of Advising Services and/or by the Committee on Student Standing, on appeal, you must withdraw from the program. If the failed course is a complementary course required by the program, you may choose to replace it with another appropriate complementary course. If you choose to substitute another complementary course for a complementary course in which a D was received, credit for the first course will still be given, but as an elective. If you repeat a required course in which a D was received, credit will be given only once.

Full details of the course requirements for all programs offered are given in each unit's section together with the locations of departmental advisory offices, program directors, and telephone numbers should further information be required.

3.5.1 Course Overlap

You will not receive additional credit toward your degree for any course that overlaps in content with a course for which you have already received credit at McGill, CEGEP, at another university, or Advanced Placement exams, Advanced Level results, International Baccalaureate Diploma, or French Baccalaureate. It is your responsibility to consult with a Faculty Adviser in *Arts OASIS*, the *Science Office for Undergraduate Advising* (SOUSA), or the department offering the course as to whether or not credit can be obtained and to be aware of exclusion clauses specified in the course description in this publication. Please refer to the following website for specific information about Advanced Standing credits and McGill course exemptions: *www.mcgill.ca/transfercredit*.

Sometimes the same course is offered by two different departments. Such courses are called "double-prefix" courses. When such courses are offered simultaneously, you should take the course offered by the department in which you are obtaining your degree. For example, in the case of double-prefix courses CHEM XYZ and PHYS XYZ, Chemistry students take CHEM XYZ and the Physics students take PHYS XYZ. If a double-prefix course is offered by different departments in alternate years, you may take whichever course best fits your schedule.

Note for Arts Students: Credit for computer courses offered by the School of Computer Science is governed by rules specified in each individual course description.

Note for Science and Bachelor of Arts and Science students:

Credit for statistics courses offered by faculties other than Arts and Science requires the permission of the Director of Advising Services, Science, except for students in the B.Sc. Major in Environment, who may take required statistics courses in the Faculty of Agricultural and Environmental Sciences necessary to satisfy their program requirements.

Credit for computer courses offered by faculties other than Science requires the permission of the Director of Advising Services and will be granted only under exceptional circumstances.

For Arts, Science, and Bachelor of Arts and Science students

Credit for statistics courses will be given with the following stipulations:

- Credit will be given for **only one** of the following introductory statistics courses: AEMA 310, BIOL 373, ECON 227D1/D2, ECON 257D1/D2, GEOG 202, MATH 203, MGCR 271, MGCR 273, POTH 204, PSYC 204, SOCI 350.
- Credit will be given for **only one** of the following intermediate statistics courses: AEMA 411, ECON 227D1/D2, ECON 257D1/D2, GEOG 351, MATH 204, PSYC 305, SOCI 461, with the exception that you may receive credit for both PSYC 305 and ECON 227D1/D2 or ECON 257D1/D2.
- Students who have already received credit for MATH 324 or MATH 357 will **not** receive credit for any of the following: AEMA 310, AEMA 411, BIOL 373, ECON 227D1/D2, ECON 257D1/D2, GEOG 202, GEOG 351, MATH 203, MATH 204, MGCR 271, MGCR 273, PSYC 204, PSYC 305, SOCI 350.
- For 500-level statistics courses not listed above, students must consult a program adviser to ensure that no significant overlap exists. Where such overlap exists with a course for which the student has already received credit, credit for the 500-level course will not be allowed.
- PSYC 204 may not be taken if a grade of 75% was received in an equivalent course completed at CEGEP.

3.5.2 Courses Outside the Faculties of Arts and Science

As a student in the Faculty of Science, you should consult the statement of regulations for taking courses outside the Faculties of Arts and of Science (see below). A list of approved/not-approved courses in other faculties is posted on the SOUSA website

You may take only one First-Year Seminar. If you register for more than one, you will be obliged to withdraw from all but one of them. Please consult the departmental listings for course descriptions and availability.

First-Year Seminars	
CHEM 199	FYS: Why Chemistry?
EPSC 199	FYS: Earth & Planetary Exploration

7 Overview of Programs Offered

Programs Offered

section 7.1: Bachelor of Science Program Groups

7.1.1.3 Honours Programs

- Anatomy and Cell Biology: *section 10.2.6: Bachelor of Science (B.Sc.) - Honours Anatomy and Cell Biology (73 credits)*
- Biochemistry: *section 10.4.6: Bachelor of Science (B.Sc.) - Honours Biochemistry (73 credits)*
- Biology: *section 10.5.11: Bachelor of Science (B.Sc.) - Honours Biology (72 credits)*
- Biology – Quantitative Biology: *section 10.5.12: Bachelor of Science (B.Sc.) - Honours Biology - Quantitative Biology (79 credits)*
- Immunology (Interdepartmental): *section 10.18.3: Bachelor of Science (B.Sc.) - Honours Immunology (Interdepartmental) (75 credits)*
- Microbiology and Immunology: *section 10.23.6: Bachelor of Science (B.Sc.) - Honours Microbiology and Immunology (72 credits)*
- Pharmacology – application required, see departmental section for information: *section 10.29.6: Bachelor of Science (B.Sc.) - Honours Pharmacology (76 credits)*
- Physiology: *section 10.31.8: Bachelor of Science (B.Sc.) - Honours Physiology (75 credits)*
- Psychology: *section 10.33.9: Bachelor of Science (B.Sc.) - Honours Psychology (60 credits)*

7.1.2 Bio-Physical-Computational Sciences Group

7.1.2.1 Major Programs

- Biology and Mathematics: *section 10.5.10: Bachelor of Science (B.Sc.) - Major Biology and Mathematics (76 credits)*
- Computer Science and Biology: *section 10.9.11: Bachelor of Science (B.Sc.) - Major Computer Science and Biology (74 credits)*
- Physiology and Mathematics: *section 10.31.6: Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (79 credits)*
- Physiology and Physics: *section 10.31.7: Bachelor of Science (B.Sc.) - Major Physiology and Physics (82 credits)*

7.1.2.2 Honours Program

- Computer Science and Biology: *section 10.9.15: Bachelor of Science (B.Sc.) - Honours Computer Science and Biology (77 credits)*

7.1.3 Neuroscience Group

7.1.3.1 Major Program

- Neuroscience – application required, see *section 10.26: Neuroscience* for information, and *section 10.26.4: Bachelor of Science (B.Sc.) - Major Neuroscience (65 credits)*

7.1.3.2 Honours Program

- Neuroscience – application required, see *section 10.26: Neuroscience* for information, and *section 10.26.5: Bachelor of Science (B.Sc.) - Honours Neuroscience (74 credits)*

7.1.4 Physical, Earth, Math & Computer Science Group

7.1.4.1 Liberal Program – Core Science Components

- Atmospheric Science: *section 10.3.5: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Atmospheric and Oceanic Sciences (48 credits)*
- Chemistry – General option: *section 10.7.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - General (49 credits)*
- Computer Science: *section 10.9.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Computer Science (45 credits)*
- Earth and Planetary Sciences: *section 10.10.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Earth and Planetary Sciences (45 credits)*
- Geography: *section 10.17.7*

7.1.4.2 Major Programs

- Atmospheric Science: *section 10.3.6: Bachelor of Science (B.Sc.) - Major Atmospheric Science (62 credits)*
- Chemistry: *section 10.7.8: Bachelor of Science (B.Sc.) - Major Chemistry (59 credits)*
- Chemistry – Atmosphere and Environment option: *section 10.7.9: Bachelor of Science (B.Sc.) - Major Chemistry - Atmosphere and Environment (63 credits)*
- Chemistry – Bio-organic option: *section 10.7.10: Bachelor of Science (B.Sc.) - Major Chemistry - Bio-organic (63 credits)*
- Chemistry – Biophysical option: *section 10.7.11: Bachelor of Science (B.Sc.) - Major Chemistry: Biophysical Chemistry (66 credits)*
- Chemistry – Materials option: *section 10.7.12: Bachelor of Science (B.Sc.) - Major Chemistry - Materials (62 credits)*
- Chemistry – Measurement option: *section 10.7.13: Bachelor of Science (B.Sc.) - Major Chemistry - Measurement (62 credits)*
- Computer Science: *section 10.9.10: Bachelor of Science (B.Sc.) - Major Computer Science (63 credits)*
- Computer Science – Computer Games option: *section 10.9.12: Bachelor of Science (B.Sc.) - Major Computer Science - Computer Games (67 credits)*
- Earth System Science: *section 10.11.4: Bachelor of Science (B.Sc.) - Major Earth System Science (57 credits)*
- Environment – Atmospheric Environment and Air Quality domain: *: Bachelor of Science (B.Sc.) - Major Environment - Atmospheric Environment and Air Quality (60 credits)*
- Environment – Biodiversity and Conservation domain: *: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Biodiversity and Conservation (63 credits)*
- Environment – Earth Sciences and Economics domain: *: Bachelor of Science (B.Sc.) - Major Environment - Earth Sciences and Economics (66 credits)*
- Environment – Ecological Determinants of Health domain – Cellular: *: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Ecological Determinants of Health - Cellular (63 credits)*
- Environment – Ecological Determinants of Health domain – Population: *: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Ecological Determinants of Health- Population (63 credits)*
- Environment – Environmetrics domain: *: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major En*

- Chemistry – Atmosphere and Environment option: *section 10.7.15: Bachelor of Science (B.Sc.) - Honours Chemistry - Atmosphere and Environment (75 credits)*
- Chemistry – Materials: *section 10.7.18: Bachelor of Science (B.Sc.) - Honours Chemistry - Materials (74 credits)*
- Chemistry – Measurement: *section 10.7.19: Bachelor of Science (B.Sc.) - Honours Chemistry - Measurement (74 credits)*

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Major Concentrations

Art History, *: Bachelor of Arts (B.A.) - Major Concentration Art History (36 credits)*

Classics, *: Bachelor of Arts (B.A.) - Major Concentration Classics (36 credits)*

East Asian Studies, *: Bachelor of Arts (B.A.) - Major Concentration East Asian Studies (36 credits)*

Economics, *: Bachelor of Arts (B.A.) - Major Concentration Economics (36 credits)*

English - Cultural Studies, *: Bachelor of Arts (B.A.) - Major Concentration English - Cultural Studies (36 credits)*

English - Drama and Theatre, *: Bachelor of Arts (B.A.) - Major Concentration English - Drama and Theatre (36 credits)*

English - Literature, *: Bachelor of Arts (B.A.) - Major Concentration English - Literature (36 credits)*

Gender, Sexuality, Feminist, & Social Justice Studies, *: Bachelor of Arts (B.A.) - Major Concentration Gender, Sexuality, Feminist, & Social Justice Studies (36 credits)*

Geography (Urban Studies), *: Bachelor of Arts (B.A.) - Major Concentration Geography (Urban Studies) (36 credits)*

German Studies, *: Bachelor of Arts (B.A.) - Major Concentration German Studies (36 credits)*

Hispanic Languages, *: Bachelor of Arts (B.A.) - Major Concentration Hispanic Studies - Languages (36 credits)*

Hispanic Literature and Culture, *: Bachelor of Arts (B.A.) - Major Concentration Hispanic Studies - Literature and Culture (36 credits)*

History, *: Bachelor of Arts (B.A.) - Major Concentration History (36 credits)*

International Development Studies, *: Bachelor of Arts (B.A.) - Major Concentration International Development Studies (36 credits)*

Italian Studies, *: Bachelor of Arts (B.A.) - Major Concentration Italian Studies (36 credits)*

Jewish Studies, *: Bachelor of Arts (B.A.) - Major Concentration Jewish Studies (36 credits)*

Langue et littérature françaises - Études et pratiques littéraires, *: Baccalauréat ès Arts (B.A.) - Concentration majeure Langue et littérature françaises - Études et pratiques littéraires (36 crédits)*

Langue et littérature françaises - Traduction, *: Baccalauréat ès Arts (B.A.) - Concentration majeure Langue et littérature françaises - Traduction (36 crédits)*

Latin American Studies, *: Bachelor of Arts (B.A.) - Major Concentration Latin American Studies (36 credits)*

Linguistics, *: Bachelor of Arts (B.A.) - Major Concentration Linguistics (36 credits)*

Music (available to students in B.Sc. Liberal only), *: Bachelor of Arts (B.A.) - Major Concentration Music (36 credits)*

Philosophy, *: Bachelor of Arts (B.A.) - Major Concentration Philosophy (36 credits)*

Political Science, *: Bachelor of Arts (B.A.) - Major Concentration Political Science (36 credits)*

Religious Studies, *: Bachelor of Arts (B.A.) - Major Concentration World Religions (36 credits)*

Russian, *: Bachelor of Arts (B.A.) - Major Concentration Russian (36 credits)*

Sociology, *: Bachelor of Arts (B.A.) - Major Concentration Sociology (36 credits)*

World Islamic and Middle East Studies, *: Bachelor of Arts (B.A.) - Major Concentration World Islamic & Middle East Studies (36 credits)*

7.5.2 Minor Concentrations

Minor Concentrations

African Studies, *: Bachelor of Arts (B.A.) - Minor Concentration African Studies (18 credits)*

Anthropology, *: Bachelor of Arts (B.A.) - Minor Concentration Anthropology (18 credits)*

Arabic Language, *: Bachelor of Arts (B.A.) - Minor Concentration Arabic Language (18 credits)*

Art History, *: Bachelor of Arts (B.A.) - Minor Concentration Art History (18 credits)*

Canadian Studies, *: Bachelor of Arts (B.A.) - Minor Concentration Canadian Studies (18 credits)*

Classics, *: Bachelor of Arts (B.A.) - Minor Concentration Classics (18 credits)*

Communication Studies – see Art History and Communication Studies, *: Bachelor of Arts (B.A.) - Minor Concentration Communication Studies (18 credits)*

East Asian Language and Literature, *: Bachelor of Arts (B.A.) - Minor Concentration East Asian Language and Literature (18 credits)*

East Asian Cultural Studies, *: Bachelor of Arts (B.A.) - Minor Concentration East Asian Cultural Studies (18 credits)*

Minor Concentrations

East Asian Language, Supplementary, *: Bachelor of Arts (B.A.) - Supplementary Minor Concentration East Asian Language (18 credits)*

Economics, *: Bachelor of Arts (B.A.) - Minor Concentration Economics (18 credits)*

English – Cultural Studies, *: Bachelor of Arts (B.A.) - Minor Concentration English - Cultural Studies (18 credits)*

English – Drama and Theatre, *: Bachelor of Arts (B.A.) - Minor Concentration English - Drama and Theatre (18 credits)*

English – Literature, *: Bachelor of Arts (B.A.) - Minor Concentration English - Literature (18 credits)*

Gender, Sexuality, Feminist, & Social Justice Studies, *: Bachelor of Arts (B.A.) - Minor Concentration Gender, Sexuality, Feminist, & Social Justice Studies (18 credits)*

Geography, *: Bachelor of Arts (B.A.) - Minor Concentration Geography (18 cr*

8 Undergraduate Research Opportunities

McGill is a research-intensive university and research is therefore a cornerstone of undergraduate science education at McGill. Most Science B.Sc. students take part in research during their undergraduate studies, and there are many undergraduate research opportunities at McGill, in affiliated hospitals, at other universities, and in the field. Many of these are organized through formal courses or programs organized by the Faculty of Science or its departments. For more information, see the following:

- *section 8.1: Research Project Courses*
- *section 8.1.1: "396" Undergraduate Research Project Courses*
- *section 8.2: Undergraduate Student Research Awards* – such as NSERC USRA and SURA
- *section 8.3: Undergraduate Research Conference*
- *section 8.4: Other Opportunities*
- Dean's Multidisciplinary Undergraduate Research List – see description in *University Regulations and Resources* > *Undergraduate* > *Graduation* > *Graduation Honours* > *: Faculty of Science Dean's Multidisciplinary Undergraduate Research List*

Because internships and field study programs *may* include a research component, please also see: *section 9: Science Internships and Field Studies*

8.1 Research Project Courses

Departments offer a variety of research-based courses that allow you to perform research under the supervision of a McGill researcher for academic credit. Depending on the unit, courses featuring undergraduate research may bear names such as: majors project, honours project, advanced lab, independent research, technical project, independent study, or research project and seminar. For more information, refer to the research course list at *www.mcgill.ca/science/research/undergraduate-research/researchcourses* or browse the course listings at *www.mcgill.ca/study/courses/search*. Research courses can also help you qualify for the *Dean's Multidisciplinary Undergraduate Research List* or the *B.Sc. Global Designation*.

8.1.1 "396" Undergraduate Research Project Courses

"396" under

See *www.mcgill.ca/science/research/undergraduate-research/sura* for details.

8.3 Undergraduate Research Conference

Each year, the Faculty of Science holds an undergraduate research conference to celebrate the research accomplishments of our undergraduate students. The Poster Showcase, sponsored by the Office of Science Education, is a chance for undergraduate students to present research, projects, or assignments. All levels are welcome, including first-timers.

Everyone is welcome to attend. This is an excellent opportunity to see what McGill undergraduates undertake as research projects.

For more details and the date, please refer to *www.mcgill.ca/ose/events*.

The Internship Program will also give you the opportunity to enhance your degree: if you are a student in the Faculty of Science and you complete two *Industrial Practica* (IP) or participate in an *Internship Year in Science* (IYS), the name of your program will change to include the Internship Program designation (e.g., Bachelor of Science – Computer Science - Internship Program).

For more information on IP and IYS, please see *www.mcgill.ca/science/undergraduate/internships-field/internships*.

9.2 Field Study and Study Abroad

McGill's Field Study Semester programs (in Africa, Arctic, Barbados, and Panama) are research-based, as are many shorter field courses offered by the Departments of Biology, Earth & Planetary Sciences, and Geography. See *Study Abroad & Field Studies* > *Undergraduate* > *: Opportunities for Field Study and Study Abroad* and *www.mcgill.ca/science/undergraduate/internships-field/field* for more information about these programs and courses.

9.3 B.Sc. Global Designation

The above internship and study abroad opportunities form part of a special B.Sc. Global designation awarded to eligible students at graduation; visit *www.mcgill.ca/science/undergraduate/programs/bsc-global* for more information.

10 Browse Academic Units & Programs

What is a Major Program?

A major is a versatile, comprehensive primary area of study. Most major programs require about two-thirds of your total credits. With the remaining credits, you can choose electives, or you may want to use those additional credits to take a minor, which can be chosen from a wide variety of areas both within and outside Science.

What is an Honours Program?

Honours programs typically involve an even higher degree of specialization than majors, include supervised research, and require students to maintain a high academic standard. An honours program provides solid preparation for graduate school. With an honours program, you will have fewer elective credits.

What is a B.Sc. Liberal Program?

This is a flexible and modular program. You combine a core science component (CSC) in a Science discipline with a breadth component, which may be a minor from a wide variety of areas, a major concentration from the Faculty of Arts, or a second CSC from any group in Science. Consider the Liberal program if you do not want to overly specialize—plus, you will still have room left over for elective courses.

What about Joint Programs?

The Faculty of Science also has quite a few joint programs. These programs combine two different disciplines, which allow you to gain expertise in two fields.

What about Interdisciplinary Programs?

There are many ways to create interdisciplinary programs in the Faculty of Science. You can add a minor to a major or honours program, you can take a liberal program that contains both a core science component and a breadth component, or you can select an explicit interdisciplinary major. The Faculty of Science offers three such interdisciplinary programs: Earth System Science, Environment, and Neurs: Earth System Scien(Sc.3 Tm(we80EEarams in the F)T 1 1s Pr)Tj

Full details are av

Second calculus course, one of:

MATH 141	(4)	Calculus 2
MATH 151	(4)	Calculus B

First physics course, one of:

PHYS 101	(4)	Introductory Physics - Mechanics
PHYS 131	(4)	Mechanics and Waves

Second physics course, one of:

PHYS 102	(4)	Introductory Physics - Electromagnetism
PHYS 142	(4)	Electromagnetism and Optics

Electives

Students wishing to take elective courses may choose them from introductory courses offered by departments in the Faculties of Science or of Arts. A list of recommended courses is found at http://www.mcgill.ca/science/student/newstudents/u0/bscfreshman/suggested-elective-courses. Certain courses offered by other faculties may also be taken, but some restrictions apply. Consult the SOUSA website at http://www.mcgill.ca/science/student/continuingstudents/bsc/outside/ for more information about taking courses from other faculties.

10.2 Anatomy and Cell Biology (ANAT)

10.2.1 Location

Strathcona Anatomy and Dentistry Building, Rooms M21-M31
3640 University Street
Montreal, Quebec H3A 0C7
Telephone: 514-398-6350
Website: *www.mcgill.ca/anatomy*

10.2.2 About Anatomy and Cell Biology

The Department of Anatomy and Cell Biology offers courses that deal with:

- cell biology;
- histology;
- embryology;
- neuroanatomy; and
- gross anatomy.

The **Honours** program is designed as the first phase in the training of career cell and molecular biologists. The **Major** and **Liberal** programs offer decreasing levels of specialization in Anatomy and Cell Biology but with a broader base in other biological sciences. These programs also form a sound background for graduate studies in Anatomy and Cell Biology, or for further professional training, including medical school and other health programs. A B.Sc. in Anatomy and Cell Biology provides an excellent preparation for technical and administrative positions in laboratories of universities, research institutions, hospitals, and pharmaceutical and biotechnological industries.

The Department is equipped to perform protein purification; recombinant DNA technology; micro-injection of molecules into single cells; cytochemical, immunocytochemical, and fluorescent analysis and electron microscopy; proteomics; and genomics. The Department has a well-equipped centre for electron microscopy as well as a centre for confocal and immunofluorescence. The Department's cryo-electron microscope facility is unique and provides cutting edge technology with which to apply fundamental discoveries to therapeutic applications. Human anatomy classes are taught in the fully-equipped cadaver lab and students have access to 3D printers and other learning tools.

Assistant Professors

Nicole Ventura; Ph.D.(Qu.)

Associate Members

Daniel Bernard (*Pharmacology and Therapeutics*)

Claire Brown (*Physiology*)

Colin Chalk (*Neurology and Neurosurgery*)

Jean-François Cloutier (*Neurology and Neurosurgery*)

Claudio Cuello (*Pharmacology and Therapeutics*)

Giovanni DiBattista (*Medicine*)

Allen Ehrlicher (*Bioengineering*)

Alyson Fournier (*Neurology and Neurosurgery*)

Lisbet Haglund (*Surgery*)

Janet Henderson (*Medicine*)

Loydie A. Jerome-Majewska (*Pediatrics and Human Genetics*)

Mari T. Kaartinen (*Dentistry*)

Svetlana Komarova (*Dentistry*)

Stephane Laporte (*Medicine*)

Andréa Leblanc (*Neurology and Neurosurgery*)

Stéphanie Lehoux (*Medicine*)

Heidi McBride (*Montreal Neurological Institute*)

Peter Metrakos (*Surgery*)

Makato Nagano (*Obstetrics and Gynecology*)

Christian Rocheleau (*Endocrinology and Metabolism*)

Edward S. Ruthazer (*Neurology and Neurosurg*

Adjunct Professors

Stephane Lefrancois; B.Sc., Ph.D.(McG.)

Alexei Pshezhetsky; Ph.D.(Moscow St.)

ANAT 321 (3) Circuitry of the Human Brain

Complementary Courses (24 credits)

Complementary courses are selected as follows with a minimum of 6 credits at the 400 level or higher:

12 credits of advanced anatomy courses (AAC) selected from:

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 565	(3)	Diseases-Membrane Trafficking
NEUR 310	(3)	Cellular Neurobiology

12 credits of biologically oriented courses (BOC) selected from:

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Immunochemistry
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
BIOL 514	(3)	Neurobiology Learning and Memory
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 532	(3)	Developmental Neurobiology Seminar

BIOL 544	(3)	Genetic Basis of Life Span
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 575	(3)	Human Biochemical Genetics
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BIOT 505	(3)	Selected Topics in Biotechnology
COMP 204	(3)	Computer Programming for Life Sciences
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
		Advanced Applied Respiratory Ph

PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

10.2.6 Bachelor of Science (B.Sc.) - Honours Anatomy and Cell Biology (73 credits)

Students should register at the Major level in U1 and, if accepted, may enter the Honours program at the beginning of U2. To enter the program, the student must obtain a CGPA of at least 3.20 at the end of U1. For promotion to the U3 year of the Honours program, or for entry into the program at this level, the student must have a CGPA of at least 3.20 at the end of their U2 year. It is expected that at the beginning of the third year, the students who wish to continue in the Honours program will be those who feel that they are seriously interested in a career in Cell Biology. The Honours degree will be recommended after successful completion of the program with a CGPA of at least 3.20.

Required Courses (52 credits)

Note: ANAT 261 must be taken in U1.

* Students who have taken the equivalent of CHEM 212, CHEM 222, and/or MATH 203 in CEGEP (as defined at http://www.mcgill.ca/students/courses/plan/transfer/) are exempt and must replace these credits with elective course credits to satisfy the total credit requirement for their degree.

ANAT 212	(3)	Molecular Mechanisms of Cell Function
ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 432	(9)	Honours Research Project
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

One of the follo

ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANA	(3)	Diseases-Membrane Trafficking

EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes
NEUR 310	(3)	Cellular Neurobiology
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 451	(3)	Advanced Neurophysiology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Cellular Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
		Physiology5.8652u)

10.3 Atmospheric and Oceanic Sciences (ATOC)

10.3.1 Location

Burnside Hall, Room 945
805 Sherbrooke Street West
Montreal QC H3A 0B9
Telephone: 514-398-3764
Fax: 514-398-6115
Email: *info.aos@mcgill.ca*
Website: *www.mcgill.ca/meteo*

10.3.2 About Atmospheric and Oceanic Sciences

The Department of Atmospheric and Oceanic Sciences offers, at the undergraduate level, a broad range of courses and degree programs in atmospheric science (meteorology). At the postgraduate level, programs of study are offered in physical oceanography, air-sea interaction, and climate research as well as in different branches of atmospheric science. The study of atmospheric science is based largely on physics and applied mathematics. All required courses except those at the introductory level generally have prerequisites or corequisites in physics, mathematics, and atmospheric science. One of the goals of the discipline is to develop the understanding necessary to improve our ability to predict the weather, but atmospheric science is more than weather forecasting.

Another important area of study focuses on the changes in global climate caused by the changing chemical composition of the atmosphere. The approach to the study of climate change is quantitative in the Department of Atmospheric and Oceanic Sciences. Like other parts of physics, atmospheric science attempts to create theoretical models of its complex processes as a means of analyzing the motion and composition of the air, its thermodynamic behaviour, and its interaction with radiation and with the solid or liquid surface beneath it.

From one viewpoint, the atmosphere may be studied as a large volume of gas by the methods of fluid mechanics: winds, circulation patterns, turbulence, and energy and momentum exchanges are the ideas employed in this approach. Alternatively, the atmosphere may be studied from the point of view of its detailed physics: how water condenses in the air; how cloud droplets make rain; how sunlight warms the ground and the ground w

ATOC 309	(3)	Weather Radars and Satellites
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
ATOC 357	(3)	Atmospheric and Oceanic Science Laboratory
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 548	(3)	Mesoscale Meteorology.
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics

10.3.5 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Atmospheric and Oceanic Sciences (48 credits)

45-48 credits

Required Courses (21 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (27 credits)

24-27 credits:

Note: All students are encouraged to consult with the Undergraduate Adviser for help selecting from among the complementary courses.

3-6 creditsu1 0 dhm(r314)Tj1 0 0 1 221.920 460 0 1 2 (Adv1 0 0 1 221.920 460 0 d 348.022 Tm(Al9.594 0 1 221.920 7 646.96 Tm(a5/Fser 1 221.920 atellit307.5165.8

PHYS 251	(3)	Honours Classical Mechanics 1

3 credits selected from:

PHYS 232	(3)	Heat and Waves
PHYS 253	(3)	Thermal Physics

12-16 credits selected from (at least 6 of which must be ATOC):

ATOC 309	(3)	Weather Radars and Satellites
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering
MATH 203	(3)	Principles of Statistics 1
MATH 319	(3)	Introduction to Partial Differential Equations
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism

10.3.6 Bachelor of Science (B.Sc.) - Major Atmospheric Science (62 credits)

Required Courses (24 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (38 credits)

36-38 credits

Note: Students are required to fulfill the core complementary requirements along with one of the four streams listed below. In cases of overlap, each course can only be used once toward the satisfaction of the core complementary courses or the chosen stream.

Core (21 credits)

3-6 credits selected from:

ATOC 215	(3)	Oceans, Weather and Climate
ATOC 219*	(3)	Introduction to Atmospheric Chemistry
CHEM 219*	(3)	Introduction to Atmospheric Chemistry

* Note: students may select ATOC 219 or CHEM 219 but not both.

3 credits selected from:

ATOC 357	(3)	Atmospheric and Oceanic Science Laboratory
PHYS 257	(3)	Experimental Methods 1

3 credits selected from:

PHYS 230	(3)	Dynamics of Simple Systems
PHYS 251	(3)	Honours Classical Mechanics 1

3 credits selected from:

PHYS 232	(3)	Heat and Waves
PHYS 253	(3)	Thermal Physics

6-9 credits selected from:

CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
MATH 203*	(3)	Principles of Statistics 1
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations

ATOC 309	(3)	Weather Radars and Satellites
ATOC 521	(3)	Cloud Physics
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion

3-4 credits selected from:

ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids

+ Students cannot receive credit for both ATOC 404 and PHYS 404.

++ Students cannot receive credit for both PHYS 432 or MATH 555.

Climate Science Stream (15 credits)

6 credits from:

ATOC 404+	(3)	Climate Physics
ATOC 531	(3)	Dynamics of Current Climates
PHYS 404+	(3)	Climate Physics

+ Students cannot receive credit for both ATOC 404 and PHYS 404.

9 credits (at least 6 of which must be ATOC) selected from:

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics

EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 542	(3)	Chemical Oceanography
ESYS 300	(3)	Investigating the Earth System
	(3)	Earth System Modelling

GEOG 372	(3)	Running Water Environments
MATH 555++	(4)	Fluid Dynamics
PHYS 4041 0 0 1 82.67 709.83 Tr561 2284 Tr561 2284 Tr561 2284 Tr561 1 0 0 1 700.463r561 2284 T0 1 1 of s	(3)	Classical Physics

ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 404*	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 439	(3)	Majors Laboratory in Modern Physics
PHYS 449	(3)	Majors Research Project

* Students cannot take both ATOC 404 and PHYS 404.

10.3.8 Bachelor of Science (B.Sc.) - Honours Atmospheric Science (74 credits)

72-74 credits

Students can be admitted to the Honours program after completion of the U1 year of the Major in Atmospheric Science program with a minimum GPA of 3.30. Students having completed a U1 year in a different program with high standing may be admitted to the Honours program on the recommendation of that department.

A minimum GPA of 3.30 in the Honours program courses (taken as a whole) is required to remain in the program. A CGPA of 3.30 on the total program is also required to graduate with honours.

Required Courses (27 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
ATOC 480	(3)	Honours Research Project
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (47 credits)

45-47 credits

Note: Students are required to fulfill the core complementary requirements along with one of the four streams listed below. In cases of overlap, each course can only be used once toward the satisfaction of the core complementary courses or the chosen stream.

Core (24 credits)

3-6 credits selected from:

ATOC 215	(3)	Oceans, Weather and Climate
ATOC 219*	(3)	Introduction to Atmospheric Chemistry
CHEM 219*	(3)	Introduction to Atmospheric Chemistry

* Students may take ATOC 219 or CHEM 219 but not both.

3 credits selected from:

ATOC 357	(3)	Atmospheric and Oceanic Science Laboratory

6-7 credits selected from:

ATOC 404+	(3)	Climate Physics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids

+ Students cannot receive credit for both ATOC 404 and PHYS 404.

++ Students cannot receive credit for both PHYS 432 or MATH 555.

Climate Science Stream (22 credits)

(21-22 credits)

15 credits from:

ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 531	(3)	Dynamics of Current Climates
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
PHYS 404+	(3)	Climate Physics

+ Students cannot receive credit for both ATOC 404 and PHYS 404.

Students cannot receive credit for both MATH 203 and MATH 324.

6-7 credits (3 of which must be ATOC) selected from:

ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 542	(3)	Chemical Oceanography
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling

MATH 423	(3)	Regression and Analysis of Variance
MATH 555++	(4)	Fluid Dynamics
PHYS 432++	(3)	Physics of Fluids

+ Students cannot receive credit for both PHYS 432 or MATH 555.

Atmospheric Chemistry and Physics Stream (21 credits)

15 credits from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods

6 credits selected from:

ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 558	(3)	Numerical Methods and Laboratory
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 542	(3)	Chemical Oceanography
MATH 423	(3)	Regression and Analysis of Variance
PHYS 404+	(3)	Climate Physics

+ Student cannot receive credit for both ATOC 404 and PHYS 404.

General Stream (22 credits)

21-22 credits (at least 15 of which must be ATOC) selected from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1

ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
ATOC 548	(3)	Mesoscale Meteorology.
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 542	(3)	Chemical Oceanography
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
MATH 423	(3)	Regression and Analysis of Variance
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids

+ Students cannot receive credit for both ATOC 404 and PHYS 404.

++ Students cannot receive credit for both PHYS 432 or MATH 555.

10.3.9 Diploma (Dip.) Meteorology (30 credits)

The Department offers an intensive, one-year program in theoretical and applied meteorology to B.Sc. or B.Eng. graduates of suitable standing in physics, applied mathematics or other appropriate disciplines, leading to a Diploma in Meteorology. The program is designed for students with little or no previous background in meteorology who wish to direct their experience to atmospheric or environmental applications, or who need to fulfil academic prerequisites in meteorology to qualify for employment. For further information, consult the Administrative Officer, Burnside Hall, Room 946.

An exemption of up to 6 credits may be allowed for courses already taken. Students granted such exemptions are required to add complementary courses from an approved list to maintain a total credit count of 30 completed at McGill.

Required Courses (15 credits)

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 521	(3)	Cloud Physics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2

Complementary Courses (15 credits)

6 credits selected from the courses below.

* Students take either ATOC 519 or CHEM 519.

ATOC 309	(3)	Weather Radars and Satellites
ATOC 315	(3)	Thermodynamics and Convection
ATOC 519*	(3)	Advances in Chemistry of Atmosphere
CHEM 519*	(3)	Advances in Chemistry of Atmosphere

9 credits ordinarily selected from:

* Students take either PHYS 432 or MATH 555.

ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 555*	(4)	Fluid Dynamics
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432*	(3)	Physics of Fluids

10.3.10 Atmospheric and Oceanic Sciences (ATOC) Related Programs

10.3.10.1 Internship Year in Science (IYS)

IYS is a pregraduate work experience program available to eligible students and normally taken between their U2 and U3 years. For more information, see *section 9: Science Internships and Field Studies*.

The following programs are also available with an internship component:

- Major in Atmospheric Science
- Honours in Atmospheric Science

10.3.10.2 Earth System Science Interdepartmental Major

This program is offered by the Department of Atmospheric and Oceanic Sciences; Earth and Planetary Sciences; and Geography.

Students in the Department of Atmospheric and Oceanic Sciences interested in this program should contact Professor Bruno Tremblay (*bruno.tremblay@mcgill.ca*). For more information, see *section 10.11: Earth System Science (ESYS)*.

10.4 Biochemistry (BIOC)

10.4.1 Location

McIntyre Medical Building
3655 Promenade Sir-William-Osler, Room 905
Montreal QC H3G 1Y6
Telephone: 514-398-7262
Email: *undergrad.biochem@mcgill.ca*
Website: *www.mcgill.ca/biochemistry*

10.4.2 About Biochemistry

What is Biochemistry?

Biochemistry is the application of chemistry to the study of biological processes at the cellular and molecular level. It emerged as a distinct discipline around the beginning of the 20th century when scientists combined chemistry, physiology, and biology to investigate the chemistry of living systems.

- *The study of life in its chemical processes*: Biochemistry is both a life science and a chemical science—it explores the chemistry of living organisms and the molecular basis for the changes occurring in living cells. It uses the methods of chemistry, physics, molecular biology, and immunology to study the structure and behaviour of the complex molecules found in biological material and the ways these molecules interact to form cells, tissues, and whole organisms. Biochemistry graduates are interested, for example, in mechanisms of brain function, cellular multiplication and differentiation, communication within and between cells and organs, and the chemical bases of inheritance and disease. The biochemistry student seeks to determine how specific molecules such as proteins, nucleic acids, lipids, vitamins, and hormones function in such processes. Particular emphasis is placed on regulation of chemical reactions in living cells.

- *An essential science*: Biochemistry has become the foundation for understanding all biological processes. It has provided explanations for the causes of many diseases in humans, animals, and plants. It can frequently suggest ways by which such diseases may be treated or cured.
- *A practical science*: Because biochemistry seeks to unravel the complex chemical reactions that occur in a wide variety of life forms, it provides the basis for practical advances in medicine, veterinary medicine, agriculture, and biotechnology. It underlies and includes such exciting new fields as molecular genetics and bioengineering. The knowledge and methods developed by biochemistry scientists are applied in all fields of medicine, in agriculture, and in many chemical- and health-related industries. Biochemistry is also unique in providing teaching and research opportunities in both protein structure/function and genetic engineering, the two basic components of the rapidly expanding field of biotechnology.
- *A varied science*: As the broadest of the basic sciences, biochemistry includes many subspecialties such as neurochemistry, bioorganic chemistry, clinical biochemistry, physical biochemistry, molecular genetics, biochemical pharmacology, and immunochemistry. Recent advances in these areas have created links among technology, chemical engineering, and biochemistry.

The Department of Biochemistry offers three undergraduate programs:

- **Liberal Program**

  This is the most flexible of the departmental programs offered, providing students with a useful concentration in biochemistry while allowing them to pursue a minor in another speciality or to broaden their education in the sciences.

- **Major**

  The Major program becomes more specialized in biochemistry during the final two years. This program requires skills and insight from all areas of chemistry, and from other areas such as biology, physiology, microbiology and immunology, statistics, and pharmacology. For students aiming for a professional career in the biological sciences or in medicine, these programs can lead to postgraduate studies and research careers in hospital, university, or industrial laboratories.

- **Honours**

  The Honours program in Biochemistry combines the substantial background given by the Major program with a challenging opportunity to carry out laboratory research projects in the U3 year. These courses provide students with research experience under the supervision of a professor in the Department. Honours students intending to pursue an M.Sc. in Biochemistry may be interested in the B.Sc./M.Sc. track, which offers a streamlined path to a graduate degree.

Our Major and Honours programs provide a sound background for students aiming for a professional career in biochemistry. The less specialized Liberal program allows students to select courses in other fields of interest. The Liberal program provides students with the opportunity to study the core of one science discipline along with a breadth component from another area of science or from many other disciplines; for more information, see *Faculty of Science > Undergraduate > Faculty Degree Requirements > Program Requirements > section 3.4.1: Liberal, Major, and Honours Programs*.

During the first year, each program provides introductory lecture and laboratory courses in biochemistry, as well as basic courses in cell and molecular biology and organic and physical chemistry. In the second and third years, the programs offer an expanded focus in biochemistry through lecture courses, a second laboratory course in biochemistry, and opportunities to carry out research projects in faculty members' laboratories through our BIOC 396, BIOC 462, and BIOC 491 courses. Students can also take a variety of complementary courses in other biological, biomedical, and chemical disciplines in their second and third years.

Increasingly complex technology requires training in both chemistry and biology. As well, the combination of chemistry, molecular biology, enzymology, and genetic engineering in our programs provides the essential background and training in biotechnology. With this, our graduates can work in a variety of positions in industry and health. These range from R&D in the chemical and pharmaceutical industries, to testing and research in government and hospital laboratories, to management. Many graduates pursue higher degrees in research and attain academic positions in universities and colleges.

Additional information is available on the *Department of Biochemistry website*.

10.4.3 Biochemistry Faculty

Chair

Albert Berghuis

Emeritus Professors

Rhoda Blostein; B.Sc., M.Sc., Ph.D.(McG.), F.R.S.C.

Philip E. Branton; B.Sc., M.Sc., Ph.D.(Tor.), F.R.S.C. (*Gilman Cheney Professor of Biochemistry*)

Peter E. Braun; B.Sc., M.Sc.(Br. Col.), Ph.D.(Calif., Berk.)

Robert E. MacKenzie; B.Sc.(McG.), M.N.S., Ph.D.(Cornell)

Walter E. Mushynski; B.Sc., Ph.D.(McG.)

John R. Silvius; B.Sc., Ph.D.(Alta.)

Clifford P. Stanners; B.Sc.(McM.), M.A., Ph.D.(Tor.)

Maria Zannis-Hadjopoulos; B.Sc., M.Sc., Ph.D.(McG.) (*joint appt. with Oncology and Medicine*)

Professors

Associate Members

Stéphane Richard (*Depts. of Medicine and Oncology*)

Selena M. Sagan (*Dept. of Microbiology & Immunology*)

Reza Salavati (*Inst. of Parasitology*)

Erwin Schurr (*Ctr. for Host Resistance, MGH*)

Peter Siegel (*Goodman Cancer Ctr., Dept. of Medicine*)

Ivan Topisirovic (*Dept. of Oncology*)

Youla S. Tsantrizos (*Dept. of Chemistry*)

Bernard Turcotte (*Dept. of Medicine*)

CHEM 302	(3)	Introductory Organic Chemistry 3

U2 Complementary Courses** (3 credits)

** Complementary courses listed for U1 and U2 may be taken in later years if necessary to accommodate courses that must be taken in U1 and U2 as part of the breadth component of the program.

3 credits selected from:

BIOL 373	(3)	Biometry
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
COMP 202	(3)	Foundations of Programming
COMP 204	(3)	Computer Programming for Life Sciences
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
PSYC 204	(3)	Introduction to Psychological Statistics

U3 Complementary Courses (3 credits)

3 credits selected from:

BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids

10.4.5 Bachelor of Science (B.Sc.) - Major Biochemistry (64 credits)

Students may transfer into the Major program at any time, provided they have met all course requirements.

U1 Required Courses (23 credits)

* Note: Students with CEGEP-level credit for the equivalents of CHEM 212 and/or CHEM 222 (see 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.

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOC 220	(3)	Laboratory Methods in Biochemistry and Molecular Biology 1
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
		Introductory Or

U2 Required Courses (20 credits)

ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules

Adv

BIOC 320	(3)	Laboratory Methods in Biochemistry and Molecular Biology 2 Ph

CHEM 572	(3)	Synthetic Organic Chemistry
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses and Hormones

10.4.7 Biochemistry (BIOC) Related Programs

10.4.7.1 Interdepartmental Honours in Immunology

For more information, see *section 10.18: Immunology*. This program is offered by the Departments of Biochemistry, Microbiology and Immunology, and Physiology.

Students interested in the program should contact:

Dr. C. Piccirillo
Microbiology and Immunology
Telephone: 514-934-1934, ext. 76143
Email: *ciro.piccirillo@mcgill.ca*

OR

Dr. Monroe Cohen
Physiology
Telephone: 514-398-4342
Email: *monroe.cohen@mcgill.ca*

10.5 Biology (BIOL)

10.5.1 Location

Stewart Biology Building, Room N7/9B
1205 avenue Docteur Penfield
Montreal QC H3A 1B1
Telephone: 514-398-4109
Website: *biology.mcgill.ca*

10.5.2 About Biology

Biology is the study of living things at the molecular, cellular, organismal, and ecosystem levels. It 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 individual molecules within it;
- molecular basis of inheritance;
- biochemical and genetic basis of human diseases; and
- how the brain and the nervous system control behaviour.

The study of biology also has vast practical applications. The knowledge, methods, and concepts developed through research in the various fields of biology are applied extensively in agriculture, medicine, pharmaceutical development, biotechnology, genetic engineering, environmental protection, and wildlife management.

The Department of Biology offers:

- **Liberal** program;

- **Major** program;
- **Joint Majors** with Computer Science and with Mathematics;
- **Honours** program;
- **Joint Honours** with Computer Science;

Telephone: 514-398-4109

to ensure they are taking the appropriate prerequisites.

10.5.4 Biology Concentrations

Note: The concentrations set out below are only guidelines for specialized training. *They do not constitute sets of requirements.*

Note: ***Courses used to satisfy the complementary course components of the Major program must be at the 300+ level. Any 200 level courses listed below must be taken as electives.***

Note: Please see guidelines and policies for taking courses outside Arts and Science at *www.mcgill.ca/science/student/continuingstudents/bsc/outside*.

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, key and suggested courses are listed by discipline.

10.5.4.1 Animal Behaviour Concentration

Understanding the diverse ways in which animals feed, mate, care for their offspring, avoid predators, select their habitats, communicate, and process information constitute the subject matter of behaviour. Several approaches are used to study these questions: some focus on ecological consequences and determinants; some on physiological, genetic, and developmental mechanisms; and others on evolutionary origins.

Key courses: BIOL 304, BIOL 305, BIOL 306, BIOL 307, BIOL 320, BIOL 331, or BIOL 334D1/D2 or another field course with a significant behavioural

10.5.4.4.1 General and Applied Ecology Concentration

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 science to practical problems in environmental management, and the management of resources and pests. In addition to general courses dealing with general principles, there is a selection of courses dealing with particular groups of organisms. Since it is essential to know how knowledge is obtained, the concentration includes a field course in ecology.

Key courses: BIOL 305, BIOL 308, BIOL 331 or BIOL 334D1/D2, BIOL 342, BIOL 350, BIOL 373, COMP 204, COMP 273.

Other suggested courses: BIOL 307, BIOL 324, BIOL 377, BIOL 418, BIOL 427, BIOL 428, BIOL 429, BIOL 432, BIOL 441, BIOL 465, BIOL 466, BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, BIOL 510, BIOL 515, BIOL 517, BIOL 540, BIOL 594, GEOG 302, REDM 405.

Macdonald campus: PLNT 460.

10.5.4.4.2 Aquatic Ecology Concentration

This concentration is designed to introduce the principles of ecology as they pertain to aquatic ecosystems and aquatic biota. Since it is essential to know how knowledge is obtained, as well as what has been learned, one of the courses (Limnology) involves field work, and one (Biological Oceanography) involves a laboratory component; these courses stress the techniques used to study aquatic ecology. In addition, the concentration includes a field course in ecology. There are also a variety of courses in aquatic disciplines offered in other departments that complement the Biology Department's aquatic ecology courses.

Key courses: BIOL 305, BIOL 308, BIOL 331 or another field course, BIOL 342, BIOL 373, BIOL 418, BIOL 427, BIOL 432, BIOL 441, BIOL 465, BIOL 515, COMP 204, COMP 273.

Other suggested courses: BIOL 307, BIOL 429, BIOL 466, BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, BIOL 540, GEOG 305, GEOG 306, GEOG 308, GEOG 322, REDM 405.

10.5.4.4.3 Marine Biology Concentration

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: BIOL 305, BIOL 308, BIOL 335, BIOL 342, BIOL 373, BIOL 441, BIOL 515.

Other suggested courses: ATOC 512, ATOC 550, BIOL 331, BIOL 334D1/D2, BIOL 418, BIOL 429, BIOL 432, BIOL 465, BIOL 540, EPSC 542.

For students intending to proceed to graduate work, one independent studies course (BIOL 466, BIOL 467, BIOL 468D1/D2, or BIOL 469D1/D2) is recommended. Because of the importance of numerical analyses in all fields of ecology, courses in Biometry (e.g., BIOL 373) and Computer Science (COMP 202 or COMP 273) are recommended.

10.5.4.5 Evolutionary Biology Concentration

Evolutionary biology is the study of processes that change organisms and their characteristics through time. Evolutionary biologists are concerned with adaptations of organisms and the process of natural selection.

Key courses: BIOL 304, BIOL 305, BIOL 307, BIOL 320, BIOL 324, BIOL 331, BIOL 352, BIOL 373, BIOL 377, BIOL 463, BIOL 466 or BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, BIOL 517, BIOL 569, BIOL 573, BIOL 594.

Other suggested courses in Orrecommended. Becaurd BIOL 331Tj1.26 TlE1s231.0191.88lTm(rec: 308, BIOL 335, B(OC 550, BIOL 427, BIOL 428, B6MP 27

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 and industrial institutions.

Key courses: BIOL 300, BIOL 301, BIOL 303, BIOL 373, BIOL 569; CHEM 203 or CHEM 204 combined with CHEM 214, CHEM 212, CHEM 222.

Other suggested courses: BIOL 313, BIOL 314, BIOL 316, BIOL 370, BIOL 416, BIOL 466, BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, BIOL 518, BIOL 520, BIOL 524, BIOL 544, BIOL 546.

10.5.4.8 Neurobiology Concentration

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 that can range from the mundane (e.g., regulation of heart rate) to the magnificent (e.g., musical composition). The neurobiology discipline, 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. As a result of exposure to a wide range of experimental and intellectual approaches, students receive a sound, broadly based education in biology.

Key courses: BIOL 306, BIOL 320, BIOL 373, BIOL 389, BIOL 414, BIOL 507, BIOL 514, BIOL 517, BIOL 530, BIOL 532, BIOL 580, BIOL 588.

Other suggested courses: ANAT 321, ANAT 322, BIOL 300, BIOL 303, BIOL 466, BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, NEUR 310, NSCI 200, NSCI 201, PHAR 562, PHGY 311, PHGY 314, PHGY 425, PHGY 451, PHGY 556, PSYC 311, PSYC 318, PSYC 342, PSYC 410, PSYC 470, PSYT 455, PSYT 500.

10.5.5 Biology Faculty

Chair

Gregor Fussmann

Graduate Program Director

Frédéric Guichard

Emeritus Professors

Gregory G. Brown; B.Sc.(Notre Dame), Ph.D.(CUNY)

A. Howard Bussey; B.Sc., Ph.D.(Brist.), F.R.S.C.

Robert L. Carroll; B.S.(Mich.), M.A., Ph.D.(Harv.), F.R.S.C.

Ronald Chase; A.B.(Stan.), Ph.D.(MIT)

Rajinder S. Dhindsa; B.Sc., M.Sc.(Punj.), Ph.D.(Wash.)

Jacob Kalff; M.S.A.(Tor.), Ph.D.(Ind.)

Donald L. Kramer; B.Sc.(Boston Coll.), Ph.D.(Br. Col.)

Martin J. Lechowicz; B.A.(Mich. St.), M.S., Ph.D.(Wisc.)

Barid B. Mukherjee; B.Sc., M.Sc.(Calc.), M.Sc.(Brigham Young), Ph.D.(Utah)

Gerald S. Pollack; M.A., Ph.D.(Princ.)

Ronald Poole; B.Sc., Ph.D.(Birm.)

Derek Roff; B.Sc.(Syd.), Ph.D.(Br. Col.), F.R.S.C.

Rolf Sattler; B.Sc.(Tübingen), Ph.D.(Munich)

Professors

Ehab Abouheif; B.Sc., M.Sc.(C'dia), Ph.D.(Duke) (*James McGill Professor*)

Graham A.C. Bell; B.A., D.Phil.(Oxf.), F.R.S.C. (*James McGill Professor*)

Lauren Chapman; B.Sc.(Alta.), Ph.D.(McG.) (*on sabbatical*)

Gregor Fussmann; Dipl.(Free Univ., Berlin), Ph.D.(Max Planck) (*Strathcona Chair in Zoology*)

Andrew Gonzalez; B.Sc.(Nott.), Ph.D.(Imperial Coll.) (*Liber Ero Chair in Biodiversity Conservation*)

Frédéric Guichard; B.Sc.(Montr.), Ph.D.(Laval)

Siegfried Hekimi; M.Sc., Ph.D.(Geneva), F.R.S.C. (*Strathcona Chair in Zoology; Robert Archibald & Catherine Louise Campbell Chair in Developmental Biology*)

Andrew Hendry; B.Sc.(Vic., BC), M.Sc., Ph.D.(Wash.) (*joint appt. with Redpath Museum*) (*Canada Research Chair in Eco-Evolutionary Dynamics*)

Professors

Paul F. Lasko; A.B.(Harv.), Ph.D.(MIT), F.R.S.C. (*James McGill Professor*) (*John & Anne Molson Chair in Genetics*)

Laura Nilson; B.A.(Colgate), Ph.D.(Yale) (*Associate Dean (Graduate Education) Faculty of Science*)

Catherine Potvin; B.Sc., M.Sc.(Montr.), Ph.D.(Duke), F.R.S.C. (*Canada Research Chair in Climate Chang*

Associate Members

Glen site: Hugh J. Clarke, Daniel Dufort, Teruko Taketo

Medical Genetics, Chair: David Rosenblatt

MNI: Kenneth Hastings

Physics: Paul Francois

Redpath Museum: Rowan Barrett, David Green, Hans Larsson, Virginie Millien, Anthony Ricciardi

Adjunct Professors

BELLUS Health Inc.: Francesco Bellini; B.Sc.(C'dia), Ph.D.(New Br.)

Humboldt Univ., Berlin: Rudiger Krahe; Ph.D.(HU Berlin)

IRCM: David Hipfner; B.Sc., Ph.D.(Qu.)

STRI: Hector Guzman; M.Sc.(Costa Rica), Ph.D.(Newcastle, UK), William Owen McMillan; B.Sc.(Duke), M.Sc., Ph.D.(Univ. Hawai'i), Rachel Page; Ph.D.(Texas), Mark Torchin; B.A.(Calif., Santa Barbara), M.Sc.(Ore.), Ph.D.(Calif., Santa Barbara)

Univ. of British Columbia: Jonathan Davies; M.Sc.(Cape Town), Ph.D.(Imperial Coll.)

Univ. of the West Indies: Henri Valles; M.Sc.(UWI), Ph.D.(McG.)

10.5.6 Bachelor of Science (B.Sc.) - Minor Biology (25 credits)

The Minor 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 adviser in Biology as early as possible (preferably during their first year), in order to plan their course selection.

See Nancy Nelson, Stewart Biology Building, 514-398-4109, email: nanc25 creultyothe feretwd Gsult The Miandsult (y primary pro.G.))Tj/F3 8.1 Tf1 0 0 1 67386 528

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution
CHEM 212*	(4)	Introductory Organic Chemistry 1

Complementary Courses (28 credits)

Students complete a minimum of 27 credits or a maximum of 28 complementary course credits selected as follows:

3 or 4 credits selected from:

BIOL 206	(3)	Methods in Biology of Organisms
BIOL 301	(4)	Cell and Molecular Laboratory

24 credits of Biology courses

9 credits of which, in consultation with the Biology Program Adviser, can be replaced with appropriate Science courses from other departments.

No more than 6 of the 24 credits can be taken at the 200 level.

10.5.8 Bachelor of Science (B.Sc.) - Major Biology (59 credits)

The Major requires 58 or 59 credits depending on a student's choice of complementary courses.

Students in the Major program are permitted to take a maximum of 9 credits of research courses.

Required Courses

25-26 credits:

BIOL 200	(3)	Molecular Biology
	(3)	Cell Biology and Metabolism

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

10.5.9 Bachelor of Science (B.Sc.) - Major Biology - Quantitative Biology (73 credits)

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 options: an ecology and evolutionary biology stream, and a physical biology stream. Both streams provide a balance of theory and experimental components.

Students may complete this program with a minimum of 68 credits or a maximum of 73 credits depending on whether MATH 222 and CHEM 212 are completed.

Advising notes for U0 students

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

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)

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 395	(1)	Quantitative Biology Seminar
CHEM 212*	(4)	Introductory Organic Chemistry 1
COMP 202**	(3)	Foundations of Programming
MATH 222*	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics

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

**Students who have sufficient knowledge of programming should take COMP 250 Introduction to Computer Science rather than COMP 202.

Biology (6 credits)

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

Physics (6 credits)

PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves

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

BIOL 205	(3)	Biology of Organisms

BIOL 206	(3)	Methods in Biology of Organisms
BIOL 304	(3)	Evolution
BIOL 308	(3)	Ecological Dynamics

Field Courses - 3 credits from the following list or any other field course with permission:

BIOL 240	(3)	Monteregian Flora
BIOL 331	(3)	Ecology/Behaviour Field Course
BIOL 334	(3)	Applied Tropical Ecology
BIOL 432	(3)	Limnology

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

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

BIOL 432	(3)	Limnology
BIOL 434	(3)	Theoretical Ecology
BIOL 435	(3)	Natural Selection
BIOL 465	(3)	Conservation Biology
BIOL 509	(3)	Methods in Molecular Ecology
BIOL 510	(3)	Advances in Community Ecology
BIOL 515	(3)	Advances in Aquatic Ecology
BIOL 540	(3)	Ecology of Species Invasions
BIOL 594	(3)	Advanced Evolutionary Ecology
BIOL 596*	(1)	Advanced Experimental Design
BIOL 597*	(2)	Advanced Biostatistics
BIOL 598*	(3)	Advanced Design and Statistics

Stream 2: Physical Biology (21 credits)

BIOL 319	(3)	Introduction to Biophysics
PHYS 329	(3)	Statistical Physics with Biophysical Applications
PHYS 346	(3)	Majors Quantum Physics

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

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 309	(3)	Mathematical Models in Biology
BIOL 313	(3)	Eukaryotic Cell Biology

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

BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development

BIOL 524	(3)	Topics in Molecular Biology
BIOL 530	(3)	Advances in Neuroethology
BIOL 551	(3)	Principles of Cellular Control
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology

Complementary Courses

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

9 credits from the following:

Recommendations for Theoretical Ecology and Ev

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

Note: Students selecting a BIOL course count this toTj/F1 8.11 to2/F1 8.1 this to

18 credits (if 3 credit BIOL course was selected as a research course) or 15 credits (if 6 credit BIOL 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 credits of:

BIOL 206	(3)	Methods in Biology of Organisms

3 credits from the following field courses or any other field course with permission:

BIOL 240	(3)	Monteregian Flora
BIOL 331	(3)	Ecology/Behaviour Field Course
BIOL 334D1	(1.5)	Applied Tropical Ecology
BIOL 334D2	(1.5)	Applied Tropical Ecology
BIOL 432	(3)	Limnology
BIOL 573	(3)	Vertebrate Palaeontology Field Course

At least 9 credits chosen from the following list

BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 304	(3)	Evolution
BIOL 305	(3)	Animal Diversity
BIOL 308	(3)	Ecological Dynamics
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 324	(3)	Ecological Genetics
BIOL 434	(3)	Theoretical Ecology
BIOL 509	(3)	Methods in Molecular Ecology
BIOL 569	(3)	Developmental Evolution
BIOL 594	(3)	Advanced Evolutionary Ecology

Molecular Evolution Stream

At least 15 credits selected as follows:

3 credits

BIOL 202	(3)	Basic Genetics

At least 12 credits selected from the following list:

BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 569	(3)	Developmental Evolution

BIOL 592	(3)	Integrated Bioinformatics

Neurosciences Stream

At least 15 credits selected as follows:

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour

At least 12 credits selected from:

BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 530	(3)	Advances in Neuroethology
BIOL 580	(3)	Genetic Approaches to Neural Systems
NEUR 310	(3)	Cellular Neurobiology
NEUR 507	(3)	Topics in Radionuclide Imaging
NEUR 570	(3)	Human Brain Imaging
PHGY 314	(3)	Integrative Neuroscience
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 552	(3)	Cellular and Molecular Physiology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 502	(3)	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.

Bac

BIOL 499D1	(2)	Honours Seminar in Biology
BIOL 499D2	(2)	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 course to be approved by the Biology Adviser.

Complementary Courses (39 credits)

Honours (9-12 courses)

BIOL 479D1	(4.5)	Honours Research Project 1
BIOL 479D2	(4.5)	Honours Research Project 1

OR

BIOL 480D1	(6)	Honours Research Project 2
BIOL 480D2	(6)	Honours Research Project 2

Core

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 (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.

10.5.12 Bachelor of Science (B.Sc.) - Honours Biology - Quantitative Biology (79 credits)

79 credits

Interdisciplinary research that draws from the natural and physical sciences is an important aspect of modern biology. The Quantitative Biology (QB) Honours 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 through both coursework and a research project. The QB B.Sc. Honours option has two streams: a theoretical ecology and evolutionary biology stream and a physical biology stream. Both streams provide a balance of theory and experimental components that along with a research component will provide outstanding preparation for graduate training. Students must attain a 3.50 CGPA to enter and to complete the Honours program. First Class Honours will be awarded to students in the QB Honours option graduating with a CGPA of 3.75 or greater.

Students may complete this program with a minimum of 74 credits or a maximum of 79 credits depending on whether MATH 222 and CHEM 212 are completed.

Advising notes for U0 students

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

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 (49 credits)

Bio-Physical Sciences Core (31 credits)

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 395	(1)	Quantitative Biology Seminar
CHEM 212*	(4)	Introductory Organic Chemistry 1

Foundations l(4)(4)(4)3m(CHEM 212*)Tj1 0 550 04 1.94MA(CHEM 212*)T80 07 550 04 1.94TH0325+Tm(F)Tj1 0 0

Biology

12 credits from the following:

BIOL 205	(3)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
		Evolution

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 309	(3)	Mathematical Models in Biology
BIOL 313	(3)	Eukaryotic Cell Biology

500-level complementary courses

6 credits from the following:

BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 530	(3)	Advances in Neuroethology
BIOL 551	(3)	Principles of Cellular Control
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology

Complementary Courses (9 credits)

Recommendations for either Theoretical Ecology and Evolutionary Biology or Physical Biology streams

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 350*	(3)	Numerical Computing
COMP 364	(3)	Computer Tools for Life Sciences
MATH 235**	(3)	Algebra 1
MATH 240**	(3)	Discrete Structures
MATH 314	(3)	Advanced Calculus
MATH 317*	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 348	(3)	Euclidean Geometry
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes

* Students may take COMP 350 OR MATH 317.

** MATH 235 or MATH 240 are required for COMP 251.

Recommendations for Physical Biology stream

BIEN 310	(3)	Introduction to Biomolecular Engineering
BIEN 320	(3)	Molecular, Cellular and Tissue Biomechanics
BIEN 340	(3)	Transport Phenomena in Biological Systems 2
BIEN 510	(3)	Engineered Nanomaterials for Biomedical Applications
BIEN 530	(3)	Imaging and Bioanalytical Instrumentation
CHEM 222	(4)	Introductory Organic Chemistry 2

PHYS 242*	(2)	Electricity and Magnetism
PHYS 257	(3)	Experimental Methods 1
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 413	(3)	Physical Basis of Physiology
PHYS 434	(3)	Optics
PHYS 519	(3)	Advanced Biophysics
PHYS 534	(3)	Nanoscience and Nanotechnology

* PHYS 242 is required for PHYS 342 and PHYS 434.

Recommendations for Theoretical Ecology and Evolutionary Biology stream

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

10.5.13 Biology (BIOL) Related Programs and Study Semesters

10.5.13.1 Joint Major in Computer Science and Biology

For more information, see *section 10.9.11: Bachelor of Science (B.Sc.) - Major Computer Science and Biology (74 credits)*.

10.5.13.2 Joint Honours in Computer Science and Biology

For more information, see *section 10.9.15: Bachelor of Science (B.Sc.) - Honours Computer Science and Biology (77 credits)*.

10.5.13.3 Panama Field Study Semester

The program is a joint venture between McGill University and the Smithsonian Tropical Research Institute (STRI) in Panama. For more information, see *Study Abroad & Field Studies > Undergraduate > Field Study Semesters and Off-Campus Courses > Field Study Minor > : Panama Field Study Semester*. You can also visit the following website for details: *www.mcgill.ca/science/undergraduate/internships-field/*.

10.5.13.4 Africa Field Study Semester

The Department of Geography, Faculty of Science, coordinates the 15-credit interdisciplinary Africa Field Study Semester; see *Study Abroad & Field Studies > Undergraduate > Field Study Semesters and Off-Campus Courses > Field Study Minor > : Africa Field Study Semester*. You can also visit the following website for details: *www.mcgill.ca/science/undergraduate/internships-field/*.

10.6 Biotechnology (BIOT)

10.6.1 Location

Stewart Biology Building, Room N7/9B
1205 Dr. Penfield Avenue
Montreal QC H3A 1B1
Telephone: 514-398-4109
Email: *nancy.nelson@mcgill.ca*
Website: *biology.mcgill.ca/undergrad/minorprog_biotech.html*

10.6.2 About Biotechnology

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 re

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 adviser approval.

Biomedicine

ANAT 541	(3)	Cell and Molecular Biology of Aging
EXMD 504	(3)	Biology of Cancer
PATH 300	(3)	Human Disease

Chemical Engineering

CHEE 200	(3)	Chemical Engineering Principles 1
CHEE 204	(3)	Chemical Engineering Principles 2
CHEE 474	(3)	Biochemical Engineering

Chemistry

CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 552	(3)	Physical Organic Chemistry

General

FACC 300	(3)	Engineering Economy

Immunology

ANAT 261	(4)	Introduction to Dynamic Histology
BIOC 503	(3)	Immunochemistry
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 414	(3)	Advanced Immunology
PHGY 513	(3)	Cellular Immunology

Management

ECON 208	(3)	Microeconomic Analysis and Applications
MGCR 211	(3)	Introduction to Financial Accounting
MGCR 341	(3)	Introduction to Finance
MGCR 352	(3)	Principles of Marketing
MGCR 472	(3)	Operations Management

Microbiology

MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 413	(3)	Parasitology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Molecular Biology (Biology)

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 551	(3)	Principles of Cellular Control

Molecular Biology (Biochemistry)

BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
PSYT 455	(3)	Neurochemistry

Physiology

EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHGY 517	(3)	Artificial Internal Organs
PHGY 518	(3)	Artificial Cells

Pollution

CHEE 593	(3)	Industrial Water Pollution Control
CIVE 225	(4)	Environmental Engineering
CIVE 430	(3)	Water Treatment and Pollution Control
CIVE 557	(3)	Microbiology for Environmental Engineering

10.6.6 Biotechnology (BIOT) Related Programs

10.6.6.1 Program for Students in the Faculty of Engineering

See *Faculty of Engineering* > *Undergraduate* > *Browse Academic Units & Programs* > *Minor Programs* > *: Bachelor of Engineering (B.Eng.) - Minor Biotechnology (for Engineering Students) (24 credits)* for details.

10.CHEM Chemistry (CHEM)

Telephone: 514-398-6999
Website: *www.mcgill.ca/chemistry*

Student Advisory Office: Pulp & Paper Building, Room 118A
Website: *www.mcgill.ca/chemistry/current-undergraduate-students/advising*

10.7.2 Office for Science and Society

Assistant Professors

R. Khaliullin; B.S.(INEOS RAS, Moscow), M.S.(Mendeleev Univ., Moscow), Ph.D.(Calif., Berk.)

E. McCalla; B.Sc.(Mt. All.), M.Sc.(McG.), B.Ed.(Nfld.), Ph.D.(Dal.)

M. McKeague; B.Sc., Ph.D.(Car.)

T. Preston; B.Sc.(Tor.), M.Sc.(UWO), Ph.D.(Br. Col.)

C.J. Thibodeaux; B.Sc.(LSU), Ph.D.(Texas)

L. Simine; B.Sc.(Tor.), Ph.D.(Tor.)

CHEE 200	(3)	Chemical Engineering Principles 1
CHEE 204	(3)	Chemical Engineering Principles 2

Complementary Courses (18 credits)

At least one of:

CHEE 220	(3)	Chemical Engineering Thermodynamics
CHEE 314	(3)	Fluid Mechanics

with the remainder chosen from the following:

* Students select either CHEE 494 or CHEE 495

CHEE 230	(3)	Environmental Aspects of Technology
CHEE 315	(3)	Heat and Mass Transfer
CHEE 351	(3)	Separation Processes
CHEE 370	(3)	Elements of Biotechnology
CHEE 380	(3)	Materials Science
CHEE 438	(3)	Engineering Principles in Pulp and Paper Processes
CHEE 452	(3)	Particulate Systems
CHEE 494*	(3)	Research Project and Seminar 1
CHEE 495*	(4)	Research Project and Seminar 2
CHEE 587	(3)	Chemical Processing: Electronics Industry
CHEE 592	(3)	Industrial Air Pollution Control
CHEE 593	(3)	Industrial Water Pollution Control
MATH 314	(3)	Advanced Calculus

10.7.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - General (49 credits)

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120 or CHEM 115, BIOL 111 or BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the DEC with appropriate science and mathematics courses. Note that students who have successfully completed MATH 150 and MATH 151 do not have to take MATH 222.

Required Basic Core Courses (26 credits)

The required courses in this program consist of 26 credits in chemistry and mathematics listed below. The courses marked with an asterisk (*) are omitted from the program of students who ha

CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 381	(3)	Inorganic Chemistry 2
MATH 222**	(3)	Calculus 3

General Option Courses (17 credits)

CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
		Integrated Inorg

CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 332	(3)	Biological Chemistry
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
MATH 222**	(3)	Calculus 3
PHYS 242	(2)	Electricity and Magnetism

Complementary Courses (6 credits)

6 credits of Chemistry (CHEM) courses at the 400 level or higher, or MATH 315 plus 3 credits of Chemistry courses at the 400 level or higher.

10.7.9 Bachelor of Science (B.Sc.) - Major Chemistry - Atmosphere and Environment (63 credits)

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120 or CHEM 115, BIOL 111 or BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the DEC with appropriate science and mathematics courses. Note that students who have successfully completed MATH 150 and MATH 151 do not have to take MATH 222.

Required Courses (57 credits)

The required courses in this program consist of 57 credits in chemistry and mathematics, listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level but the Chemistry courses must be replaced by courses in that discipline if students wish to be eligible for admission to the Ordre des chimistes du Québec. Students from outside Quebec or transfer students should consult the Academic Adviser.

See http://www.mcgill.ca/chemistry/current-undergraduate-students/advising/.

A computer science course, either COMP 202 or COMP 208, is strongly recommended during U1 for students who have no previous introduction to computer programming. Students should contact their adviser on this matter. Completion of Mathematics MATH 222 and MATH 315 during U1 is also strongly recommended.

* Denotes courses with CEGEP equivalents.

** Students who have successfully completed MATH 150 and MATH 151 are not required to take MATH 222.

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 219	(3)	Introduction to Atmospheric Chemistry
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 332	(3)	Biological Chemistry
CHEM 345	(3)	Introduction to Quantum Chemistry

CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (6 credits)

3 credits, one of:

ATOC 214	(3)	Introduction: Physics of the Atmosphere
CHEM 462	(3)	Green Chemistry
CHEM 519	(3)	Advances in Chemistry of Atmosphere
CHEM 532	(3)	Structural Organic Chemistry
MATH 317	(3)	Numerical Analysis

3 credits, one of:

ATOC 315	(3)	Thermodynamics and Convection
CHEM 567	(3)	Chemometrics: Data Analysis
CHEM 575	(3)	Chemical Kinetics
CHEM 597	(3)	Analytical Spectroscopy
EPSC 542	(3)	Chemical Oceanography

10.7.10 Bachelor of Science (B.Sc.) - Major Chemistry - Bio-organic (63 credits)

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120 or CHEM 115, BIOL 111 or BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the DEC with appropriate science and mathematics courses. Note that students who have successfully completed MA 615.52 Tm(mia)Tj 0 0 1 435.05 235.603 1 do nodents

* Denotes courses with CEGEP equivalents.

** Students who have successfully completed MATH 150 and MATH 151 are not required to take MATH 222.

Bio-Physical Sciences Core

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 319	(3)	Introduction to Biophysics
BIOL 395	(1)	Quantitative Biology Seminar
CHEM 212*	(4)	Introductory Organic Chemistry 1
MATH 222**	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
PHYS 329	(3)	Statistical Physics with Biophysical Applications

Chemistry

CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
		Introductory Ph

CHEM 555	(3)	NMR Spectroscopy
CHEM 575	(3)	Chemical Kinetics
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering

10.7.12 Bachelor of Science (B.Sc.) - Major Chemistry - Materials (62 credits)

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120 or CHEM 115, BIOL 111 or BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the DEC with appropriate science and mathematics courses. Note that students who have successfully completed MATH 150 and MATH 151 do not have to take MATH 222.

Required Courses (59 credits)

The required courses in this program consist of 59 credits in chemistry, physics and mathematics, listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level but the Chemistry courses must be replaced by courses in that discipline if students wish to be eligible for admission to the Ordre des chimistes du Québec. Students from outside Quebec or transfer students should consult the Academic Adviser.

Chemistry of Inor

Complementary Courses (3 credits)

3 credits from:

CHEM 514	(3)	Biophysical Chemistry
CHEM 516	(3)	Nuclear and Radiochemistry
CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 533	(3)	Small Molecule Crystallography
CHEM 534	(3)	Nanoscience and Nanotechnology
CHEM 547	(3)	Laboratory Automation
CHEM 555	(3)	NMR Spectroscopy
CHEM 556	(3)	Advanced Quantum Mechanics
CHEM 567	(3)	Chemometrics: Data Analysis
CHEM 577	(3)	Electrochemistry
CHEM 585	(3)	Colloid Chemistry
CHEM 593	(3)	Statistical Mechanics
CHEM 597	(3)	Analytical Spectroscopy

10.7.14 Bachelor of Science (B.Sc.) - Honours Chemistry (71 credits)

Note: Attainment of the Honours degree requires a CGPA of at least 3.00.

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120 or CHEM 115, BIOL 111 or BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the DEC with appropriate science and mathematics courses. Note that students who have successfully completed MATH 150 and MATH 151 do not have to take MATH 222.

Required Courses (53 credits)

The required courses in this program consist of 56 credits in chemistry, physics and mathematics, listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level but the Chemistry courses must be replaced by courses in that discipline if students wish to be eligible for admission to the Ordre des chimistes du Québec. Students from outside Quebec or transfer students should consult the Academic Adviser.

See http://www.mcgill.ca/chemistry/current-undergraduate-students/advising/.

A computer science course, either COMP 202 or COMP 208, is strongly recommended during U1 for students who have no previous introduction to computer programming. Students should contact their adviser on this matter. Completion of Mathematics MATH 222 during U1 is also strongly recommended. Physics PHYS 242 should be completed during U2.

* Denotes courses with CEGEP equivalents.

** Students who have successfully completed MATH 150 and MATH 151 are not required to take MATH 222.

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 332	(3)	Biological Chemistry
CHEM 345	(3)	Introduction to Quantum Chemistry

CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 332	(3)	Biological Chemistry
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory
CHEM 462	(3)	Green Chemistry
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
CHEM 519	(3)	Advances in Chemistry of Atmosphere
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (12 credits)

6 credits of research*:

* Students may take up to 12 Research Project credits but only 6 of these may be used to fulfil the program requirement.

CHEM 470	(6)	Research Project 1
CHEM 480	(3)	Undergraduate Research Project 2

3 credits, one of:

ATOC 214	(3)	Introduction: Physics of the Atmosphere
CHEM 532	(3)	Structural Organic Chemistry
MATH 317	(3)	Numerical Analysis

3 credits, one of:

ATOC 315	(3)	Thermodynamics and Convection
CHEM 567	(3)	Chemometrics: Data Analysis
CHEM 575	(3)	Chemical Kinetics
CHEM 597	(3)	Analytical Spectroscopy
EPSC 542	(3)	Chemical Oceanography

10.7.16 Bachelor of Science (B.Sc.) - Honours Chemistry - Bio-organic (75 credits)

Note: Attainment of the Honours degree requires a CGPA of at least 3.00.

Program Prerequisites

PRE-PROGRAM REQ

DEC with appropriate science and mathematics courses. Note that students who have successfully completed MATH 150 and MATH 151 do not have to take MATH 222.

Required Courses (57 credits)

The required courses in this program consist of 57 credits in chemistry, biology and mathematics, listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level but the Chemistry courses must be replaced by courses in that discipline if students wish to be eligible for admission to the Ordre des chimistes du Québec. Students from outside Quebec or transfer students should consult the Academic Adviser.

See http://www.mcgill.ca/chemistry/current-undergraduate-students/advising/.

A computer science course, either COMP 202 or COMP 208, is strongly recommended during U1 for students who have no previous introduction to computer programming. Students should contact their adviser on this matter. Completion of Mathematics MATH 222 during U1 is also strongly recommended.

* Denotes courses with CEGEP equivalents.

** Students who have successfully completed MATH 150 and MATH 151 are not required to take MATH 222.

Bsl0 0 1 165.864 Batter	(3)	Molecular Biology

CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 470	(6)	Research Project 1
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
PHYS 242	(2)	Electricity and Magnetism

Complementary Courses

(9-10 credits)

3 credits of:

CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 381	(3)	Inorganic Chemistry 2

6-7 credits of:

		Molecular Biology of the Gene

* Denotes courses with CEGEP equivalents.

** Students who have successfully completed MATH 150 and MATH 151 are not required to take MATH 222.

*** Students may take up to 12 Research Project credits but only 6 of these may be used to fulfil the program requirement.

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 332	(3)	Biological Chemistry
CHEM 334	(3)	Advanced Materials
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory
CHEM 470***	(6)	Research Project 1
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
CHEM 574	(3)	Introductory Polymer Chemistry
MATH 222**	(3)	Calculus 3
PHYS 242	(2)	Electricity and Magnetism

Complementary Cour

Note: Attainment of the Honours degree requires a CGPA of at least 3.00.

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120 or CHEM 115, BIOL 111 or BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the DEC with appropriate science and ma .ent6.721 Tm(. Qushe) 1 or their equi

Students complete a minimum of 9 credits each in two areas.

Computer Science and Mathematics

COMP 206	(3)	Introduction to Software Systems
COMP 230	(3)	Logic and Computability
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theory of Computation
COMP 417	(3)	Introduction Robotics and Intelligent Systems
COMP 424	(3)	Artificial Intelligence
COMP 527	(3)	Logic and Computation
COMP 531	(3)	Advanced Theory of Computation
MATH 318	(3)	Mathematical Logic

Linguistics

LING 201	(3)	Introduction to Linguistics
LING 330	(3)	Phonetics
LING 331	(3)	Phonology 1
LING 355	(3)	Language Acquisition 1
LING 371	(3)	Syntax 1
LING 419	(3)	Linguistic Theory and its Foundations
LING 440	(3)	Morphology
LING 455	(3)	Second Language Syntax
LING 571	(3)	Syntax 2
LING 590	(3)	Language Acquisition and Breakdown

Philosophy

PHIL 210	(3)	Introduction to Deductive Logic 1
PHIL 304	(3)	Chomsky
PHIL 306	(3)	Philosophy of Mind
		Intermediate Logic

PSYC 340	(3)	Psychology of Language
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development

10.9 Computer Science (COMP)

10.9.1 Location

Main Office
McConnell Engineering Building, Room 318
3480 University Street
Montreal QC H3A 0E9
Telephone: 514-398-7071
Fax: 514-398-3883

Undergraduate Student Affairs Office
McConnell Engineering Building, Room 320
3480 University Street
Montreal QC H3A 0E9
Telephone: 514-398-7071 ext. 00739
Fax: 514-398-3883

Email: *ugrad-sec@cs.mcgill.ca*
Website: *www.cs.mcgill.ca*

10.9.2 About Computer Science

Computer Science covers the theory and practice behind the design and implementation of computer and information systems. Fundamental to computer science are questions about how to describe, process, manage, and analyze information and computation. A fundamental building block is the study of algorithms. An algorithm presents a detailed sequence of actions solving a particular task. A computer program is the implementation of an algorithm in a specific programming language, which enables a computer to execute the algorithm. Software generally refers to a computer program or a set of related computer programs.

Based on the building blocks of computational thinking and programming, computer science is split into many different areas. Examples are:

- The study of algorithms and data structures
- Programming languages and methodology
- Theory of computation
- Software engineering (the design of large software systems)
- Computer architecture (the structure of the hardware)
- Communication between computers
- Operating systems (the software that shields users from the underlying hardware)
- Database systems (software that handles large amounts of data efficiently)
- Artificial intelligence (algorithms inspired by human information processing)
- Computer vision (algorithms that let computers see and recognize their environment)
- Computer graphics
- Robotics (algorithms that control robots)
- Computational biology (algorithms and methods that address problems inspired by biology)

Computer science also plays an important role in many other fields, including Biology, Physics, Engineering, Business, Music, and Neuroscience, where it is necessary to process and reason about large amounts of data. Computer Science is strongly related to mathematics, linguistics, and engineering.

A degree in Computer Science offers excellent job prospects. As the use of computers and specialized software plays a crucial role in business, science, and our personal life, computer science graduates are in high demand. Computer scientists find jobs in software development, consulting, research, and project management. As computer scientists often develop the software for a specific application domain (e.g., business, engineering, medicine), they must be prepared and willing to get to know their application area.

The School of Computer Science offers a wide range of programs. Most programs start with the same set of basic courses allowing students to decide on their exact program once they get a basic understanding of the discipline. Within the Faculty of Science, there are:

- Major, Honours, Liberal, and Minor programs in Computer Science;
- Major, Honours, and Liberal programs in Software Engineering;
- Major in Computer Science: Computer Games Option;
- Major and Honours in Mathematics and Computer Science (see *section 10.22: Mathematics and Statistics (MATH)*);
- Major and Honours in Statistics and Computer Science (see *section 10.22: Mathematics and Statistics (MATH)*);
- Major and Honours in Physics and Computer Science (see *section 10.30: Physics (PHYS)*);
- Major and Honours in Computer Science and Biology (see *section 10.5: Biology (BIOL)*).

The School also offers a Major Concentration and Minor concentrations in Computer Science, and a Major Concentration in Software Engineering through the Faculty of Arts (see *Faculty of Arts* > *Undergraduate* > *Browse Academic Units & Programs* > *: Computer Science (COMP)*), or as part of a Bachelor of Arts and Science (see *Bachelor of Arts & Science* > *Undergraduate* > *Browse Academic Units & Programs* > *: Computer Science (COMP)*).

The School's courses are available as electives to Engineering students. Engineering students interested in a minor in Computer Science should consult *Faculty of Engineering* > *Undergraduate* > *Browse Academic Units & Programs* > *Minor Programs* > *: Computer Science Courses and Minor Program*.

Most course instructors are faculty members of the School that do research in the areas they teach. The School favours interactive teaching practices where students get to know their professors and have the opportunity to do cutting-edge research. Some graduate courses in Computer Science are available to suitably qualified senior undergraduates. The School offers large computing labs in the Lorne Trottier Building, which is dedicated to undergraduate students.

All students planning to enter Computer Science programs are strongly encouraged to make an appointment with an academic adviser through the School's Undergraduate Student Affairs Office (see *www.cs.mcgill.ca/academic/undergrad/advising*).

10.9.3 Internship Opportunities

Students who want to get practical experience in industry before graduation are encouraged to participate in one of the following internship programs:

- The **Internship Year in Science** (IYS) is offered for a duration of 8, 12, or 16 months. It will be reflected on the student's transcript and is included in the program name (Bachelor of Science – Internship Program).
- The **Industrial Practicum** (IP) has a duration of four months and is usually carried out starting in May. It will appear as a 0-credit, Pass/F

Emeritus Professors

Assistant Professors

COMP 273	(3)	Introduction to Computer Systems
MATH 240	(3)	Discrete Structures

10.9.8 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Computer Science (45 credits)

This program provides an introduction to the principles of computer science and ofm pro

10.9.9 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Software Engineering (49 credits)

This program covers a core of programming and software engineering courses and allows students to select courses that aim at practical aspects of software development.

Required Courses (36 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202 and can replace it with additional computer science complementary course credits.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures

Complementary Courses (13 credits)

3 credits selected from:

COMP 330	(3)	Theory of Computation
COMP 360	(3)	Algorithm Design

10 credits from:

COMP 322	(1)	Introduction to C++
COMP 409	(3)	Concurrent Programming
COMP 421	(3)	Database Systems
COMP 520	(4)	Compiler Design
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
COMP 535	(4)	Computer Networks 1
ECSE 326	(3)	Software Requirements Engineering
ECSE 437	(3)	Software Delivery
ECSE 539	(4)	Advanced Software Language Engineering

Or any COMP courses at the 300 level or above (excluding COMP 364 and COMP 396.)

10.9.10 Bachelor of Science (B.Sc.) - Major Computer Science (63 credits)

This program is the standard Major program offered by the School of Computer Science. It provides a broad introduction to the principles of computer science and offers ample opportunity to acquire in-depth knowledge of several sub-disciplines. At the same time, its credit requirements allow students to take an additional minor.

Students may complete this program with a minimum of 60 credits or a maximum of 63 credits depending if they are exempt from taking COMP 202.

Required Courses (38 credits)

Students may complete this program with a minimum of 63 credits and maximum of 74 credits depending upon whether they take COMP 202/204, CHEM 212, MATH 222, and COMP 462 versus COMP 561.

Program prerequisites: U0 (freshman) students should take: 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.

Students who do not have a background in computer programming at the level of COMP 202 or COMP 204 must take one of these courses. COMP 204 is considered equivalent to COMP 202 as a prerequisite for COMP 206 and COMP 250.

Required Courses (46 credits)

36-46 credits:

Bio-Physical Sciences Core

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 395	(1)	Quantitative Biology Seminar
CHEM 212*	(4)	Introductory Organic Chemistry 1
COMP 202**	(3)	Foundations of Programming
MATH 222*	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 323	(3)	Probability

Computer Science and Mathematics

COMP 204**	(3)	Computer Programming for Life Sciences
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
MATH 240	(3)	Discrete Structures

Biology

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

Required Joint Courses

COMP 401	(3)	Project in Biology and Computer Science

* Students with CEGEP-level credit for the equivalents of MATH 222 and/or CHEM 212 (see 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 may take either COMP 202 or COMP 204, but not both. Students who have sufficient knowledge in a programming language are not required to take these courses.

Complementary Courses

27-28 credits

3-4 credits from the following:

COMP 462	(3)	Computational Biology Methods
COMP 561	(4)	Computational Biology Methods and Research

3-6 from the following:

MATH 315	(3)	Ordinary Differential Equations
MATH 324	(3)	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.

Note: All COMP courses at the 400 level or above (except COMP 400, 401, 402, 499, 462, and 561).

COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 307	(2)	Principles of Web Development
COMP 310	(3)	Operating Systems
COMP 322	(1)	Introduction to C++
COMP 330	(3)	Theory of Computation
COMP 350	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design
COMP 361D1*	(3)	Software Engineering Project
COMP 361D2*	(3)	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:

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
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 316	(3)	Biomembranes and Organelles
BIOL 319	(3)	Introduction to Biophysics
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 395	(1)	Quantitative Biology Seminar
BIOL 416	(3)	Genetics of Mammalian Development
BIOL 434	(3)	Theoretical Ecology
BIOL 435	(3)	Natural Selection
BIOL 509	(3)	Methods in Molecular Ecology
BIOL 514	(3)	Neurobiology Learning and Memory

BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 568	(3)	Topics on the Human Genome
BIOL 569	(3)	Developmental Evolution
BIOL 575	(3)	Human Biochemical Genetics
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 310	(3)	Cellular Neurobiology

10.9.12 Bachelor of Science (B.Sc.) - Major Computer Science - Computer Games (67 credits)

This program is a specialization within Computer Science. It fulfils all the basic requirements of the Major Computer Science. Complementary courses focus on topics that are important to understanding the technology behind computer games and to gaining experience in software development and design needed for computer game development.

Students may complete this program with a minimum of 62 credits or a maximum of 67 credits depending if they are exempt from taking COMP 202 and their choice of complementary courses.

Required Courses (50 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202 and can replace it with additional computer science complementary course credits.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 308	(1)	Computer Systems Lab
COMP 310	(3)	Operating Systems
COMP 322	(1)	Introduction to C++
COMP 330	(3)	Theory of Computation
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
COMP 557	(3)	Fundamentals of Computer Graphics
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures
MATH 323	(3)	Probability

Complementary Courses (17 credits)

Students complete a minimum of 15 or a maximum of 17 complementary credits selected as follows:

3 credits selected from:

COMP 350	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design

6-8 credits selected from:

COMP 424	(3)	Artificial Intelligence
COMP 521	(4)	Modern Computer Games
COMP 522	(4)	Modelling and Simulation
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
COMP 551	(4)	Applied Machine Learning
COMP 559	(4)	Fundamentals of Computer Animation

6 credits selected from:

COMP 409	(3)	Concurrent Programming
COMP 421	(3)	Database Systems
COMP 535	(3)	Computer Networks 1

10.9.13 Bachelor of Science (B.Sc.) - Major Software Engineering (63 credits)

This program provides a broad introduction to the principles of computer science and covers in depth the design and development of software systems. Students may complete this program with a maximum of 63 credits or a minimum of 60 credits if they are exempt from taking COMP 202.

Required Courses

36-39 credits

* Students who have sufficient knowledge in a programming language do not need to take COMP 202.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
ECSE 429	(3)	Software Validation
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures

Complementary Courses (24 credits)

9 credits selected from Groups A and B, with at least 3 credits selected from each:

15 credits selected from Groups C and D, with at least 9 credits selected from Group C, and at least 3 credits selected from Group D.

Group A:

MATH 222	(3)	Calculus 3
MATH 323	(3)	Probability
MATH 324	(3)	Statistics

Group B:

COMP 330	(3)	Theory of Computation
COMP 360	(3)	Algorithm Design

Group C: Software Engineering Specialization

* Students may select either COMP 409 or ECSE 420, but not both.

COMP 409*	(3)	Concurrent Programming
COMP 523	(3)	Language-based Security
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
ECSE 326	(3)	Software Requirements Engineering
ECSE 420*	(3)	Parallel Computing
ECSE 424	(3)	Human-Computer Interaction
ECSE 437	(3)	Software Delivery
ECSE 539	(4)	Advanced Software Language Engineering

Group D: Applications

COMP 350	(3)	Numerical Computing
COMP 417	(3)	Introduction Robotics and Intelligent Systems
COMP 421	(3)	Database Systems
COMP 424	(3)	Artificial Intelligence
COMP 512	(4)	Distributed Systems
COMP 520	(4)	Compiler Design
COMP 521	(4)	Modern Computer Games
COMP 522	(4)	Modelling and Simulation
COMP 535	(4)	Computer Networks 1
COMP 551	(4)	Applied Machine Learning
COMP 557	(4)	Fundamentals of Computer Graphics
COMP 558	(3)	Fundamentals of Computer Vision

10.9.14 Bachelor of Science (B.Sc.) - Honours Computer Science (75 credits)

Students may complete this program with a minimum of 72 credits or a maximum of 75 credits depending if they are exempt from taking COMP 202.

Honours students must maintain a CGPA of at least 3.00 during their studies and at graduation.

Required Courses (48 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202.

** Students take either MATH 340 or MATH 350.

COMP 310	(3)	Operating Systems
COMP 322	(1)	Introduction to C++
COMP 330	(3)	Theory of Computation
COMP 350	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design
COMP 361D1^	(3)	Software Engineering Project
COMP 361D2^	(3)	Software Engineering Project

All COMP courses at the 400 level or above except COMP 400, 401, 402, 462, 561.

*** Students with credit for COMP 251 cannot take COMP 252, and must instead include at least 6 credits at the 400-level or above, 3 credits of which must be at the 500-level.

^ Students must take both COMP 361D1 and COMP 361D2 or neither.

Biology Block

9-12 credits from the following, with 3-6 credits at the 400 level or above:

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
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 316	(3)	Biomembranes and Organelles
BIOL 319	(3)	Introduction to Biophysics
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
dRp4 8d	(3)	Laboratory in Neurobiology

BIOL 575	(3)	Human Biochemical Genetics
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 310	(3)	Cellular Neurobiology

10.9.16 Bachelor of Science (B.Sc.) - Honours Software Engineering (75 credits)

This program provides a more challenging and research-oriented version of the Major Software Engineering program.

Students may complete this program with a maximum of 75 credits or a minimum of 72 credits if they are exempt from taking COMP 202.

Honours students must maintain a CGPA of at least 3.00 during their studies and at graduation.

Required Courses

39-42 credits

* Students who have sufficient knowledge in a programming language do not need to take COMP 202.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
COMP 400	(4)	Project in Computer Science
ECSE 429	(3)	Software Validation
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures

Complementary Courses (33 credits)

At least 9 credits must be from Groups A and B, with at least 3 credits from each:

At least 18 credits must be from Groups C and D, with at least 9 credits from Group C and at least 6 credits from Group D.

At least 12 credits must be from COMP courses at the 500 level or above.

Group A:

MATH 222	(3)	Calculus 3
MATH 323	(3)	Probability
MATH 324	(3)	Statistics

Group B:

COMP 330	(3)	Theory of Computation
COMP 360	(3)	Algorithm Design

Group C: Software Engineering Specialization

* Students may select either COMP 409 or ECSE 420, but not both.

COMP 409*	(3)	Concurrent Programming
COMP 523	(3)	Language-based Security
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
ECSE 326	(3)	Software Requirements Engineering
ECSE 420*	(3)	Parallel Computing
ECSE 424	(3)	Human-Computer Interaction
ECSE 437	(3)	Software Delivery
ECSE 539	(4)	Advanced Software Language Engineering

Group D: Applications

COMP 350	(3)	Numerical Computing
COMP 417	(3)	Introduction Robotics and Intelligent Systems
COMP 421	(3)	Database Systems
COMP 424	(3)	Artificial Intelligence
COMP 512	(4)	Distributed Systems
COMP 520	(4)	Compiler Design
COMP 521	(4)	Modern Computer Games
COMP 522	(4)	Modelling and Simulation
COMP 535	(4)	Computer Networks 1
COMP 551	(4)	Applied Machine Learning
COMP 557	(4)	Fundamentals of Computer Graphics
COMP 558	(3)	Fundamentals of Computer Vision

10.9.17 Computer Science (COMP) Related Programs

10.9.17.1 Major and Honours in Mathematics and Computer Science

For more information, see *section 10.22: Mathematics and Statistics (MATH)*. Honours students must consult an Honours adviser in both departments.

10.9.17.2 Major and Honours in Statistics and Computer Science

For more information, see *section 10.22: Mathematics and Statistics (MATH)*. Honours students must consult an Honours adviser in both departments.

10.9.17.3 Major and Honours in Physics and Computer Science

For more information, see *section 10.30: Physics (PHYS)*. Honours students must consult an Honours adviser in both departments.

10.9.17.4 Minor in Cognitive Science

Students following Major or Honours programs in Computer Science may want to consider the Minor in Cognitive Science. For more information, see *section 10.8: Cognitive Science*.

10.10 Earth and Planetary Sciences (EPSC)

10.10.1 Location

Frank Dawson Adams Building, Room 238
3450 University Street
Montreal QC H3A 0E8
Telephone: 514-398-6767
Fax: 514-398-4680
Email: *kristy.thornton@mcgill.ca*
Website: *www.mcgill.ca/eps*

10.10.2 About Earth and Planetary Sciences

Emeritus Professors

Andrew J. Hynes; B.Sc.(Tor.), Ph.D.(Cant.)

Robert F. Martin; B.Sc.(Ott.), M.S.(Penn. St.), Ph.D.(Stan.)

Colin W. Stearn; B.Sc.(McM.), M.S., Ph.D.(Yale), F.R.S.C.

Professors

Don Baker; A.B.(Chic.), Ph.D.(Penn. St.)

Eric Galbraith; B.Sc. (McG.), Ph.D. (Br. Col.)

Galen Halverson; B.A.(Mont.), M.A., Ph.D.(Harv.) (*T.H. Clark Chair in Sedimentary and Petroleum Geology*)

Olivia G. Jensen; B.Sc., M.Sc., Ph.D.(Br. Col.)

Alfonso Mucci; B.Sc., M.Sc.(Montr.), Ph.D.(Miami)

John Stix; A.B.(Dart.), M.Sc., Ph.D.(Tor.)

A.E. (Willy) Williams-Jones; B.Sc., M.Sc.(Natal), Ph.D.(Qu.) (*W*

EPSC 233	(3)	Earth and Life History

9 credits selected from the list below and other 300-level and higher courses in Earth and Planetary Sciences may be substituted with permission.

EPSC 231	(3)	Field School 1
EPSC 303	(3)	Structural Geology
EPSC 334	(3)	Invertebrate Paleontology
EPSC 350	(3)	Tectonics
EPSC 452	(3)	Mineral Deposits
EPSC 542	(3)	Chemical Oceanography
EPSC 561	(3)	Ore-forming Processes

10.10.6 Bachelor of Science (B.Sc.) - Minor Geochemistry (18 credits)

Required Courses (9 credits)

EPSC 201	(3)	Understanding Planet Earth
EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology

Complementary Courses (9 credits)

9 credits selected from:

EPSC 220	(3)	Principles of Geochemistry
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 542	(3)	Chemical Oceanography
EPSC 561	(3)	Ore-forming Processes
EPSC 570	(3)	Cosmochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

10.10.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Earth and Planetary Sciences (45 credits)

The B.Sc. (Liberal) program in Earth and Planetary Sciences provides the graduate with a solid core of knowledge of Geology, Geophysics, Earth Systems Science, and Planetary Science while allowing for a broadening of the student's educational experience with courses from the other sciences or the arts. The program is flexible, allowing students to assemble a truly interdisciplinary degree.

Required Courses (21 credits)

EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
EPSC 231	(3)	Field School 1
EPSC 233	(3)	Earth and Life History
EPSC 303	(3)	Structural Geology
EPSC 320	(3)	Elementary Earth Physics

Complementary Courses (24 credits)

3 credits, one of:

EPSC 331	(3)	Field School 2
EPSC 341	(3)	Field School 3

plus 21 credits chosen from the following:

Note: Courses at the 300 or higher level in other departments in the Faculties of Science and Engineering may also be used as complementary credits, with the permission of the Director of undergraduate studies.

EPSC 334	(3)	Invertebrate Paleontology
EPSC 340	(3)	Earth and Planetary Inference
EPSC 350	(3)	Tectonics
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 530	(3)2Tm41	Volcanology
EPSC 542	(3)	Chemical Oceanography
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Processes of Igneous Petrology
EPSC 549	(3)	Hydrogeology
EPSC 550	(3)	Selected Topics 1
EPSC 551	(3)	Selected Topics 2
EPSC 552	(3)	Selected Topics 3

1 70.52 317.7 Tm(EPSC 571 9 Tm(1 70.52 317.7 0 0 16221.949 317.7 Tm(Sel2Tm41)Tj1Ad232.301 600.66 5.SC l2Tm41)Tj1a1 1 251 Ore-forming Processes

EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
EPSC 231	(3)	Field School 1
EPSC 233	(3)	Earth and Life History
EPSC 240	(3)	Geology in the Field
EPSC 303	(3)	Structural Geology
EPSC 320	(3)	Elementary Earth Physics
EPSC 340	(3)	Earth and Planetary Inference
MATH 222	(3)	Calculus 3

Complementary Courses (36 credits)

15 credits of advanced earth science

EPSC 334	(3)	Invertebrate Paleontology
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits

3 credits of field school

EPSC 331	(3)	Field School 2
EPSC 341	(3)	Field School 3

3 credits of environmental and ore-forming processes

EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

15 credits of other specializations can be drawn from the categories above or from:

EPSC 350	(3)	Tectonics
EPSC 435	(3)	Applied Geophysics
EPSC 470D1	(3)	Undergraduate Thesis Research
EPSC 470D2	(3)	Undergraduate Thesis Research
EPSC 482	(3)	Research in Earth and Planetary Sciences
EPSC 501	(3)	Crystal Chemistry
EPSC 503	(3)	Advanced Structural Geology
EPSC 520	(3)	Earthquake Physics and Geology

EPSC 530	(3)	Volcanology
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Processes of Igneous Petrology
EPSC 550	(3)	Selected Topics 1
EPSC 551	(3)	Selected Topics 2
EPSC 552	(3)	Selected Topics 3
EPSC 567	(3)	Advanced Volcanology

Other ATOC, EPSC, ESYS, GEOG, MATH and MIME courses may also be used, with the permission of the Director of undergraduate studies, if they meet the academic requirements of professional orders in most Canadian provinces.

10.10.9 Bachelor of Science (B.Sc.) - Honours Geology (75 credits)

The program curriculum is designed to provide a rigorous foundation in the fundamental earth science disciplines and in the advanced subjects relevant to fundamental and applied research in exploration for energy resources or industrial and ore minerals, and in environmental geosciences. The program meets the academic requirements shared by the professional orders for geologists and environmental geoscientists in most Canadian provinces. It is intended to provide an excellent preparation for graduate work in the earth sciences but offers enough flexibility to prepare for a wide range of careers in industry and teaching.

Required Courses (42 credits)

EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
EPSC 231	(3)	Field School 1
EPSC 233	(3)	Earth and Life History
EPSC 240	(3)	Geology in the Field
EPSC 303	(3)	Structural Geology
EPSC 320	(3)	Elementary Earth Physics
EPSC 340	(3)	Earth and Planetary Inference
EPSC 480D1	(3)	Honours Research Thesis
EPSC 480D2	(3)	Honours Research Thesis
MATH 222	(3)	Calculus 3
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (33 credits)

15 credits of advanced earth science

EPSC 334	(3)	Invertebrate Paleontology
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits

3 credits of field school

EPSC 331	(3)	Field School 2
EPSC 341	(3)	Field School 3

3 credits of environmental and ore-forming processes

EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

12 credits of other specializations can be drawn from the categories above or from:

EPSC 350	(3)	Tectonics
EPSC 435	(3)	Applied Geophysics
EPSC 501	(3)	Crystal Chemistry
EPSC 503	(3)	Advanced Structural Geology
EPSC 510	(3)	Geodynamics
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 530	(3)	Volcanology
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Processes of Igneous Petrology
EPSC 550	(3)	Selected Topics 1
EPSC 551	(3)	Selected Topics 2
EPSC 552	(3)	Selected Topics 3
EPSC 567	(3)	Advanced Volcanology

Courses from other departments may also be used, with the permission of the Director of undergraduate studies, when they meet the academic requirements of professional orders in most Canadian provinces.

10.10.10 Bachelor of Science (B.Sc.) - Honours Planetary Sciences (78 credits)

The program curriculum is designed to provide a rigorous foundation in physical sciences and the flexibility to create an indi

EPSC 320	(3)	Elementary Earth Physics
EPSC 340	(3)	Earth and Planetary Inference
EPSC 350	(3)	Tectonics
EPSC 423	(3)	Igneous Petrology
EPSC 480D1	(3)	Honours Research Thesis
EPSC 480D2	(3)	Honours Research Thesis
EPSC 510	(3)	Geodynamics
EPSC 570	(3)	Cosmochemistry
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
PHYS 340	(3)	Majors Electricity and Magnetism

Complementary Courses (12 credits)

10.10.11 Earth and Planetary Sciences (EPSC) Related Programs

10.10.11.1 Joint Major in Physics and Geophysics

For more information, see *section 10.30: Physics (PHYS)*.

10.10.11.2 Earth System Science Interdepartmental Major

This program is offered by the Departments of

10.11.3 Bachelor of Science - Minor Earth System Science (18 credits)

The Minor in Earth System Science (ESYS) is offered jointly by the following departments:

Atmospheric and Oceanic Sciences (ATOC)

Earth and Planetary Sciences (EPSC)

Geography (GEOG)

Required Courses (12 credits)

ESYS 200	(3)	Earth System Processes
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
ESYS 500	(3)	Earth System Applications

Complementary Courses (6 credits)

Two courses from 2 of 3 ESYS Departments (EPSC, ATOC, or GEOG), 300 level or higher, in consultation with the ESS student adviser.

10.11.4 Bachelor of Science (B.Sc.) - Major Earth System Science (57 credits)

The Major in Earth System Science (ESYS) is offered jointly by the following departments:

Atmospheric and Oceanic Sciences (ATOC)

Earth and Planetary Sciences (EPSC)

Geography (GEOG)

Earth System Science (ESYS) views Earth as a single integrated system that provides a unifying context to examine the interrelationships between all components of the Earth system. The approach concentrates on the nature of linkages among the biological, chemical, human, and physical subsystems of the Earth. Earth System Science primarily involves studying the cycling of matter and energy through the atmosphere, biosphere, cryosphere, exosphere, and hydrosphere. It examines the dynamics and interrelationships among these processes at time scales that range from billions of years to days, and seeks to understand how these interrelationships have changed over time.

Required Courses (24 credits)

COMP 202	(3)	Foundations of Programming
ENVR 201	(3)	Society, Environment and Sustainability
ESYS 200	(3)	Earth System Processes
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
ESYS 500	(3)	Earth System Applications
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3

Complementary Courses (33 credits)

One of the following two courses:

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 219	(3)	Introduction to Atmospheric Chemistry

One of the following two courses:

EPSC 210	(3)	Introductory Mineralogy
EPSC 220	(3)	Principles of Geochemistry

One of the following two courses:

GEOG 306	(3)	Raster Geo-Information Science
GEOG 308	(3)	Principles of Remote Sensing

One of the following two courses:

ENVR 200	(3)	The Global Environment
GEOG 203	(3)	Environmental Systems

One of the following two courses:

BIOL 215	(3)	Introduction to Ecology and Evolution
ENVR 202	(3)	The Evolving Earth

One of the following courses:

ANTH 339	(3)	Ecological Anthropology
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health
GEOG 300	(3)	Human Ecology in Geography
GEOG 310	(3)	Development and Livelihoods
GEOG 382	(3)	Principles Earth Citizenship
GEOG 406	(3)	Human Dimensions of Climate Change

15 credits from the following course list, with at least 3 credits from each of subject codes ATOC, EPSC, and GEOG. At least 9 of the 15 credits must be at the 400 level or higher.

Note: Courses at the 300 level or higher in other departments in the Faculties of Science and Engineering may also be used as complementary credits, with the permission of an academic adviser. Please see the list posted on the Departmental web page.

ATOC 215	(3)	Oceans, Weather and Climate
		Weather Radars and Ew6((3))Tj1 0 0 1 70.52 mate3)(3)A3)3)3)

BIOL 432	(3)	Limnology
BIOL 434	(3)	Theoretical Ecology
BIOL 441	(3)	Biological Oceanography
BIOL 465	(3)	Conservation Biology
BIOL 540	(3)	Ecology of Species Invasions
BIOL 573	(3)	Vertebrate Palaeontology Field Course
BREE 217	(3)	Hydrology and Water Resources
BREE 319	(3)	Engineering Mathematics
BREE 509	(3)	Hydrologic Systems and Modelling
BREE 510	(3)	Watershed Systems Management
BREE 51(3)	(3)	Soil Hydrologic Modelling

GEOG 495	(3)	Field Studies - Physical Geography
GEOG 499	(3)	Subarctic Field Studies
GEOG 501	(3)	Modelling Environmental Systems
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
MATH 314	(3)	Advanced Calculus
MATH 315*	(3)	Ordinary Differential Equations
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 323	(3)	Probability
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 423	(3)	Regression and Analysis of Variance
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes
MATH 525	(4)	Sampling Theory and Applications
NRSC 540	(3)	Socio-Cultural Issues in Water
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432	(3)	Physics of Fluids

* MATH 315 is a required course for the B.Sc. Honours Earth System Science.

10.11.5 Bachelor of Science (B.Sc.) - Honours Earth System Science (66 credits)

The Honours in Earth System Science (ESYS) is offered jointly by the following departments:

Atmospheric and Oceanic Sciences (ATOC)

Earth and Planetary Sciences (EPSC)

Geography (GEOG)

A rigorous foundation in earth system science and the flexibility to create an individualized program in preparation for careers in industry, teaching, and research. It is also intended to provide an excellent preparation for graduate work in earth system science. A CGPA of 3.20 or higher is required for registration in and graduation from this program.

"First Class Honours" is awarded to students who obtain a minimum cumulative grade point average of 3.70, a minimum program GPA of 3.20, and a minimum grade of B+ in ESYS 300, ESYS 301, and ESYS 500.

Required Courses (33 credits)

COMP 202	(3)	Foundations of Programming
ENVR 201	(3)	Society, Environment and Sustainability
ESYS 200	(3)	Earth System Processes
ESYS 300	(3)	Investigating the Earth System

ESYS 301	(3)	Earth System Modelling
ESYS 480D1	(3)	Honours Research Project
ESYS 480D2	(3)	Honours Research Project
ESYS 500	(3)	Earth System Applications
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (33 credits)

One of the following two courses:

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 219	(3)	Introduction to Atmospheric Chemistry

15 credits from the following course list, with at least 3 credits from each of subject codes ATOC, EPSC, and GEOG. At least 9 of the 15 credits must be at the 400 level or higher.

Note: Courses at the 300 level or higher in other departments in the Faculties of Science and Engineering may also be used as complementary credits, with the permission of an academic adviser. Please see the list posted on the Departmental web page.

ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 315	(3)	Thermodynamics and Convection
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
	(3)	Ecological Dynamics

EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 530	(3)	Volcanology
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes
EPSC 567	(3)	Advanced Volcanology
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar
GEOG 272	(3)	Earth's Changing Surface
GEOG 305	(3)	Soils and Environment
GEOG 307	(3)	Socioeconomic Applications of GIS
GEOG 321	(3)	Climatic Environments
GEOG 322	(3)	Environmental Hydrology
GEOG 350	(3)	Ecological Biogeography
GEOG 351	(3)	Quantitative Methods
GEOG 372	(3)	Running Water Environments
GEOG 470	(3)	Wetlands
GEOG 495	(3)	Field Studies - Physical Geography
GEOG 499	(3)	Subarctic Field Studies
GEOG 501	(3)	Modelling Environmental Systems
GEOG 5379nj.72d4V	(3)	Global Biogeochemistry

10.14 Experimental Medicine (EXMD)

10.14.1 Location

Division of Experimental Medicine
Department of Medicine
1001 Decarie Boulevard
Montreal QC H4A 3J1
Canada
Telephone: 514-934-1934, ext. 34699, 34700 or 36465
Email: *experimental.medicine@mcgill.ca*
Website: *www.mcgill.ca/expmed*

10.14.2 About Experimental Medicine

Experimental Medicine is a Division of the Department of Medicine. There are no B.Sc. programs in Experimental Medicine, but the EXMD courses listed below are considered as courses taught by the Faculty of Science.

The AFSS provides one term of integrated field study in East Africa, with emphasis on environmental conservation, culture change, and sustainable development. Students investigate challenges of sustaining biological diversity and social justice in African environments subject to cultural change, economic development, and environmental stress. Cultural and ecological variation is examined in highland, montane, rangeland, desert, riverine, salt- and fresh-water lake, coastal, and urban settings.

Africa Field Study Semester - Required Courses

6 credits

Students select one course titled "Research in Society and Development in Africa" and one course titled "Research in Ecology and Development in Africa" from the courses below.

ANTH 451	(3)	Research in Society and Development in Africa
BIOL 451	(3)	Research in Ecology and Development in Africa
GEOG 451	(3)	Research in Society and Development in Africa
	(3)	Research in Ecology and Development in Africa

Students select one 3-credit course titled "Water Resources in Barbados" and one 6-credit course titled "Sustainable Development Plans" from the list below.

AGRI 452	(3)	Water Resources in Barbados
AGRI 519	(6)	Sustainable Development Plans
CIVE 452	(3)	Water Resources in Barbados
CIVE 519	(6)	Sustainable Development Plans
URBP 519	(6)	Sustainable Development Plans

Barbados Interdisciplinary Tropical Studies Field Semester (15 credits)

The Barbados Interdisciplinary Tropical Studies (BITS) Field Semester is an activity-filled, hands-on experience for students with an interest in international studies with a Caribbean flavour.

McGill Arctic Field Study Semester

Required Courses (15 credits)

9 credits

ATOC 373	(3)	Arctic Climate and Climate Change
EPSC 373	(3)	Arctic Geology
GEOG 373	(3)	Arctic Geomorphology

and 6 credits from

ATOC 473	(6)	Artic Field Research
EPSC 473	(6)	Arctic Field Research
GEOG 473	(6)	Arctic Field Research

Minor Field Studies - Complementary Course

In consultation with their departmental adviser and/or the Field Study Minor adviser, students who have completed one of the field study semesters described above may select a 3-credit complementary course to complete the requirements for the Minor and ask for it to be added to their academic records.

10.16 General Science

10.16.1 Location

Interdisciplinary Programs Adviser
Ryan Bouma
Telephone: 514-398-7330
Email: *ryan.bouma@mcgill.ca*

10.16.2 About the General Science Minor

The Minor in General Science is only open to students in a B.Sc. Liberal program. Students interested in completing this Minor must consult with the Adviser for this program. See the program description in *section 10.16.3: Bachelor of Science (B.Sc.) - Minor General Science (18 credits)* for more information.

10.16.3 Bachelor of Science (B.Sc.) - Minor General Science (18 credits)

The Minor General Science is restricted to students in the B.Sc. Liberal program and may be used for the breadth component in this option. Students should consult their program adviser for their core science component and the Interdisciplinary Programs Adviser when selecting courses for this Minor.

Complementary Courses (18 credits)

Courses are to be chosen according to the following guidelines:

All courses must be offered by the Faculty of Science and must be at or above the 200 level*.

All courses must be different from the student's core science component courses.

Two options:

9 credits at the 300 level or above and at least 9 credits outside the student's core science component subject.

or

12 credits at the 300 lev

10.17 Geography (GEOG)

10.17.1 Location

Burnside Hall, Room 705

Associate Professors

S. Breau; M.A.(Laval), Ph.D.(Calif.-LA)

G.L. Chmura; M.Sc.(Rhode Is.), Ph.D.(LSU)

B. Forest; A.B.(Chic.), Ph.D.(Calif.-LA)

M. Kalacska; M.Sc., Ph.D.(Alta.)

M.F. Lapointe; M.Sc.(McG.), Ph.D.(Br. Col.)

B. Lehner; M.Sc.(Freiburg), Ph.D.(Frankfurt)

K. Manaugh;B.A.(Naropa), M.U.P., Ph.D.(McG.)

T.C. Meredith; M.Sc., Dip.Cons.(Lond.), Ph.D.(Camb.)

S. Moser; Ph.D.(NUS)

B. Robinson; B.Sc.(Georgia Tech.), M.Eng., MCP(MIT), Ph.D.(Wisc. Madison)

R. Sengupta; M.Sc., Ph.D.(Ill.) (*joint appt. with McGill School of Environment*)

R. Sieber; M.P.A.(W. Mich.), Ph.D.(Rutg.) (*joint appt. with McGill School of Environment*)

I.B. Strachan; B.Sc.(Tor.), M.Sc., Ph.D.(Qu.) (*cross appt. with Natural Resource Sciences*)

J. Unruh; B.A.(Kansas), M.S.(Wisc. Madison), Ph.D.(Ariz.)

Assistant Professors

Y. le Polain de Waroux; Ph.D.(Louvain)

G. MacDonald; M.Sc., Ph.D.(McG.)

G. McKenzie; B.A.(Br. Col.), M.Sc.A.(Melb.), Ph.D.(Calif., Santa Barbara)

M. Riva; M.Sc., Ph.D.(Montr.) (*joint appt. with the Institute for Health and Social Policy*)

GEOG 272	(3)	Earth's Changing Surface

9 credits at a 300 and 400 level from any Geography course.

10.17.6 Bachelor of Science (B.Sc.) - Minor Geographic Information Systems and Remote Sensing (18 credits)

The Geographic Information Systems (GIS) and Remote Sensing Minor program provides B.Sc. students with the fundamentals of geospatial tools and technologies.

Required Courses (6 credits)

COMP 202	(3)	Foundations of Programming
GEOG 201	(3)	Introductory Geo-Information Science

Complementary Courses (12 credits)

3 credits selected from:

GEOG 306	(3)	Raster Geo-Information Science
GEOG 307	(3)	Socioeconomic Applications of GIS

6 credits selected from:

GEOG 308	(3)	Principles of Remote Sensing
GEOG 384*	(3)	Principles of Geospatial Web
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 535	(3)	Remote Sensing and Interpretation

3 credits selected from:

ANTH 511	(3)	Computational Approaches to Prehistory
ATOC 309	(3)	Weather Radars and Satellites
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering
COMP 250	(3)	Introduction to Computer Science
ESYS 300	(3)	Investigating the Earth System
GEOG 306*	(3)	Raster Geo-Information Science
GEOG 307*	(3)	Socioeconomic Applications of GIS
GEOG 308*	(3)	Principles of Remote Sensing
GEOG 384*	(3)	Principles of Geospatial Web
GEOG 506*	(3)	Advanced Geographic Information Science
GEOG 535*	(3)	Remote Sensing and Interpretation

* may be taken in either list of complementary courses, but credits from one group may not be doubled-counted in the other.

10.17.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Geography (49 credits)

This is the Core Science Component in Geography for the B.Sc. Liberal. Required courses provide a foundation in Geography (which takes a holistic approach to environmental sciences, distinguished by its incorporation of human and climatic elements). By completing these courses, students will be armed with the prerequisites for 300-level courses in Geography. Our set of complementary courses provides students with necessary analytical skills and a broad background in physical geography. The 300-level courses in the complementary set prepare students for advanced study at the 400 and 500 level.

Required Courses (13 credits)

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 203	(3)	Environmental Systems
GEOG 272	(3)	Earth's Changing Surface
GEOG 290	(1)	Local Geographical Excursion
GEOG 351	(3)	Quantitative Methods

Complementary Courses (36 credits)

3 credits of statistics*

* Note: Credit given for statistics courses is subject to certain restrictions. Students in Science should consult the "Course Overlap" information in the "Course Requirements" section for the Faculty of Science.

BIOL 373	(3)	Biometry
GEOG 202	(3)	Statistics and Spatial Analysis
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics
SOCI 350	(3)	Statistics in Social Research

9 credits of systematic physical geography

GEOG 305	(3)	Soils and Environment
GEOG 321	(3)	Climatic Environments
GEOG 322	(3)	Environmental Hydrology
		Running W

9 credits on human-environment linkages

GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health
GEOG 303	(3)	Health Geography
GEOG 310	(3)	Development and Livelihoods
GEOG 311	(3)	Economic Geography
GEOG 315	(3)	Urban Transportation Geography

3 credits of field courses:

GEOG 495	(3)	Field Studies - Physical Geography
GEOG 496	(3)	Geographical Excursion
GEOG 499	(3)	Subarctic Field Studies

3 credits of approved advanced courses in Geography, or elsewhere in the Faculty of Science that have been approved by the Program Adviser, including any geography courses from the above complementary lists.

Geography Approved Course List - Major, Honours and Liberal Programs

GEOG 404	(3)	Environmental Management 2
GEOG 501	(3)	Modelling Environmental Systems
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration

10.17.8 Bachelor of Science (B.Sc.) - Major Geography (58 credits)

The BSc Major in Geography provides students with strong training in the theory and tools of physical geography. Students will explore the science of how physical, chemical, and biological processes interact at various spatial and temporal scales to produce distinct environments over the planet, and study different suites of ecosystem services while investigating sustainability challenges for human communities that depend on them. The program includes core training in systematic areas of physical geography (geomorphology, hydrology, soil biogeochemistry, biogeography and climatology), field courses providing hands on exposure to environmental data collection, and courses in quantitative techniques and in GIS and Remote Sensing..

Required Courses (13 credits)

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 203	(3)	Environmental Systems
GEOG 272	(3)	Earth's Changing Surface
GEOG 290	(1)	Local Geographical Excursion
GEOG 351	(3)	Quantitative Methods

Complementary Courses (45 credits)

3 credits of statistics:

Note: Credit given for statistics courses is subject to certain restrictions. Students in Science should consult the "Course Overlap" information in the "Course Requirements" section for the Faculty of Science.

BIOL 373	(3)	Biometry
GEOG 202	(3)	Statistics and Spatial Analysis
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics
SOCI 350	(3)	Statistics in Social Research

9 credits of systematic physical geography:

GEOG 305	(3)	Soils and Environment
GEOG 321	(3)	Climatic Environments
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
GEOG 373	(3)	Arctic Geomorphology
GEOG 470	(3)	Wetlands

3 credits of field courses:

(Field course availability is determined each year in February.)

GEOG 495	(3)	Field Studies - Physical Geography
GEOG 496	(3)	Geographical Excursion
GEOG 499	(3)	Subarctic Field Studies

Students must take a total of 15 credits from the next 2 blocks; they will choose 9 credits from one block and 6 credits from the other block, de 353.621 Tmm one block

GEOG 460	(3)	Research in Sustainability

9 credits on human-environment linkages

GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health
GEOG 303	(3)	Health Geography
GEOG 310	(3)	Development and Livelihoods
GEOG 311	(3)	Economic Geography
GEOG 315	(3)	Urban Transportation Geography

6 credits of approved advanced courses in Geography, or elsewhere in the Faculty of Science that have been approved by the Program Adviser, including any geography courses from the above complementary lists.

Admission to 500-level courses in Geography requires the instructor's permission. It is not advisable to take more than one 500-le

9 credits on human-environment linkages

GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health
GEOG 303	(3)	Health Geography
GEOG 310	(3)	Development and Livelihoods
GEOG 311	(3)	Economic Geography
GEOG 315	(3)	Urban Transportation Geography

3 credits of statistics*, one of:

* Note: Credit given for statistics courses is subject to certain restrictions. Students in Science should consult the "Course Overlap" information in the "Course Requirements" section for the Faculty of Science.

BIOL 373	(3)	Biometry
GEOG 202	(3)	Statistics and Spatial Analysis
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics
SOCI 350	(3)	Statistics in Social Research

9 credits of systematic physical geography:

GEOG 305	(3)	Soils and Environment
GEOG 321	(3)	Climatic Environments
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
GEOG 470	(3)	Wetlands

3 credits of field courses:

GEOG 495	(3)	Field Studies - Physical Geography

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ESYS 200	(3)	Earth System Processes
ESYS 300	(3)	Investigating the Earth System
GEOG 302	(3)	Environmental Management 1
GEOG 360	(3)	Analyzing Sustainability
GEOG 460	(3)	Research in Sustainability

6 credits of approved advanced courses in Geography, or elsewhere in the Faculty of Science that have been approved by the Program Adviser, including any geography courses from the above complementary lists.

Geography Approved Course List - Major, Honours and Liberal Programs

GEOG 404	(3)	Environmental Management 2
GEOG 501	(3)	Modelling Environmental Systems
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration

For more information, see *section 10.11: Earth System Science (ESYS)*.

10.17.10.5 Sustainability, Science and Society – Bachelor of Arts and Science (B.A. & Sc.)

The Interfaculty Program in Sustainability

10.18.3 Bachelor of Science (B.Sc.) - Honours Immunology (Interdepartmental) (75 credits)

IHI is a 75-credit program involving the Departments of Biochemistry; Microbiology and Immunology; and Physiology, and incorporates elements from each of these disciplines. Immunology is a key area of biomedical research and is critical to our understanding of the patho-physiology of many immune-mediated diseases. This program provides an excellent foundation for students interested in pursuing a career in biomedical research and/or medicine.

The program consists of 48 required credits of basic science courses,covering cell and molecular biology; microbiology and immunology; biochemistry; and physiology. There are also 27 complementary credits which allow for specialization in immunology and related disciplines. To graduate from IHI, students must have a minimum CGPA of 3.30 and pass fiv

plus 3 credits selected from the following:

* Students take either PHGY 209 or MIMM 211.

** Students take either CHEM 203 or CHEM 204.

ANAT 214	(3)	Systemic Human Anatomy
ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOL 202	(3)	Basic Genetics
		Biology of Org

MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

U3 Complementary Courses

9 credits of U3 complementary courses chosen in the following manner:

3 credits selected from:

BIOC 503	(3)	Immunochemistry
MIMM 509	(3)	Inflammatory Processes
PHGY 531	(3)	Topics in Applied Immunology

plus 6 credits selected from:

* Students take either ANAT 458 or BIOC 458, but not both.

ANAT 458*	(3)	Membranes and Cellular Signaling
BIOC 404	(3)	Biophysical Methods in Biochemistry
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Immunochemistry
BIOL 520	(3)	Gene Activity in Development
EXMD 504	(3)	Biology of Cancer
MIMM 413	(3)	Parasitology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHGY 488	(3)	Stem Cell Biology
PHGY 531	(3)	Topics in Applied Immunology
PHGY 552	(3)	Cellular and Molecular Physiology

10.19 Interdisciplinary Life Sciences

10.19.1 Location

BIOC 450	(3)	Protein Structure and Function
BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery
CHEM 504	(3)	Drug Design
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	The Business of Science
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
NSCI 201	(3)	Introduction to Neuroscience 2
NUTR 307	(3)	Metabolism and Human Nutrition
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PSYC 211	(3)	Introductory Behavioural Neuroscience
PSYC 311	(3)	Human Cognition and the Brain

PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour

Health Social Science

At least 3 credits from:

ANTH 204	(3)	Anthropology of Meaning
ANTH 227	(3)	Medical Anthropology
ANTH 302	(3)	New Horizons in Medical Anthropology
ANTH 314	(3)	Psychological Anthropology 01
ECON 440	(3)	Health Economics
GEOG 221	(3)	Environment and Health
GEOG 303	(3)	Health Geography
HIST 249	(3)	Health and the Healer in Western History
HIST 335	(3)	Science and Medicine in Canada
		Science and the Enlightenment

PHGY 210	(3)	Mammalian Physiology 2

Complementary Courses (9 credits)

9 credits, three of the following courses:

EDKP 330	(3)	Physical Activity and Health
EDKP 394	(3)	Historical Perspectives
EDKP 396	(3)	Adapted Physical Activity
EDKP 405	(3)	Sport in Society
EDKP 444	(3)	Ergonomics
EDKP 445	(3)	Exercise Metabolism
EDKP 446	(3)	Physical Activity and Ageing
EDKP 447	(3)	Motor Control
EDKP 448	(3)	Exercise and Health Psychology
EDKP 449	(3)	Exercise Pathophysiology 2
EDKP 485	(3)	Exercise Pathophysiology 1
EDKP 495	(3)	Scientific Principles of Training
EDKP 498	(3)	Sport Psychology
EDKP 542	(3)	Environmental Exercise Physiology
EDKP 566	(3)	Advanced Biomechanics Theory

10.21 Management for Science Students

The Desautels Faculty of Management offers four minor programs for non-Management students open for application to students in the Faculty of Science. Please refer to *Desautels Faculty of Management > Undergraduate > Overview of Programs Offered by the Desautels Faculty of Management > : Minors for Non-Management Students* for detailed information about program requirements and applying.

Also available to Science students is the Minor in Entrepreneurship for Science students; see *section 10.12: Entrepreneurship for Science Students*. Students in this Minor are not permitted to take the Desautels Minors in Finance, Management, Marketing, or Operations Management (for Non-Management students).

10.21.1 Bachelor of Commerce (B.Com.) - Minor Finance (For Non-Management Students) (18 credits)

The Minor Finance consists of 18 credits of Management courses and is offered to non-Management students in the Faculties of Arts, Engineering, and Science.

The Minor has been designed to provide students with an understanding of the key concepts in corporate finance as well as investment banking.

Required Courses (9 credits)

FINE 342	(3)	Corporate Finance
FINE 441	(3)	Investment Management
MGCR 341*	(3)	Introduction to Finance

Complementary Courses (9 credits)

9 credits selected from:

FINE 434	(3)	Topics in Finance 1
FINE 435	(3)	Advanced Topics in Finance
FINE 442	(3)	Capital Markets and Institutions
FINE 443	(3)	Applied Corporate Finance
FINE 444	(3)	Principles and Strategies of Securities Trading

FINE 445	(3)	Real Estate Finance
FINE 446	(3)	Behavioural Finance
FINE 447	(3)	Venture Capital and Entrepreneurial Finance
FINE 448	(3)	Financial Derivatives
FINE 449	(3)	Market Risk Models
FINE 451	(3)	Fixed Income Analysis
FINE 452	(3)	Applied Quantitative Finance
FINE 456	(3)	Trading in Financial Securities
FINE 480	(3)	Global Investments
FINE 482	(3)	International Finance 1
FINE 492	(3)	International Corporate Finance

or other appropriate 300- or 400-level FINE courses with the approval of the Program Adviser.

* Prerequisite: MGCR 271, Business Statistics, or another equivalent Statistics course approved by the Program Adviser.

Note: Students should select their Statistics course only after consulting the "Course Overlap" section in the Faculty of Arts, the "Course Overlap" section in the Faculty of Science, and the "Course Overlap" section in the Desautels Faculty of Management to avoid overlapping Statistics courses.

10.21.2 Bachelor of Commerce (B.Com.) - Minor Management (For Non-Management Students) (18 credits)

The Minor Management consists of 18 credits of Management courses and is currently offered to non-Management students in the following Faculties: Arts, Engineering, Science, Agricultural & Environmental Sciences, Music, Religious Studies, and Kinesiology.

This Minor is designed to provide non-management students with the opportunity to obtain basic knowledge in various aspects of management.

Complementary Courses (18 credits)

Selected from categories A, B, and C:

Category A

3 credits selected from:

MGCR 211	(3)	Introduction to Financial Accounting
MGCR 341*	(3)	Introduction to Finance

Category B

9 credits selected from:

MGCR 222	(3)	Introduction to Organizational Behaviour
MGCR 271**	(3)	Business Statistics
MGCR 293***	(3)	Managerial Economics
MGCR 331	(3)	Information Systems
MGCR 352	(3)	Principles of Marketing
MGCR 382	(3)	International Business
MGCR 472*	(3)	Operations Management

Category C

6 credits selected from:

3-6 credits from any 300- or 400-level Management courses for which prerequisites have been met.

0-3 credits may be from a specifically designated course by the student's home faculty.

* Prerequisite: MGCR 271, Business Statistics, or another equivalent Statistics course approved by the Program Adviser.

** 3 credits of statistics: Students who have taken an equivalent Statistics course in another faculty may not count those credits towards the Minor; an additional 3-credit complementary course must be chosen from the course list above.

*** Students who have taken an equivalent Economics course in another faculty may not count those credits toward the Minor; an additional 3-credit complementary course must be chosen from the course list above.

Note: Students should select their Statistics course only after consulting the "Course Overlap" section in the Faculty of Arts, the "Course Overlap" section in the Faculty of Science, and the "Course Overlap" section in the Desautels Faculty of Management to avoid overlapping Statistics courses.

10.21.3 Bachelor of Commerce (B.Com.) - Minor Marketing (For Non-Management Students) (18 credits)

The Minor Marketing consists of 18 credits of Management courses and is currently offered to non-Management students in the Faculties of Arts, Engineering, Science, and the Schulich School of Music.

This Minor is designed to provide students with an understanding of the fundamental concepts in marketing and a framework for applying marketing in a decision-making context. Students will be introduced to the basic concepts in marketing. The use of marketing theory and concepts for decision making will be covered. Marketing research methods for marketing decisions is introduced. Subsequently, students will be able to specialize by choosing from the list of complementary courses.

Required Courses (9 credits)

MGCR 352	(3)	Principles of Marketing
MRKT 354	(3)	Marketing Strategy
MRKT 451	(3)	Marketing Research

Complementary Courses (9 credits)

3 credits:

MGCR 271*	(3)	Business Statistics

6 credits selected from:

MRKT 357	(3)	Marketing Planning 1
MRKT 365	(3)	New Products
MRKT 438	(3)	Brand Management
MRKT 452	(3)	Consumer Behaviour
MRKT 453	(3)	Advertising and Media
MRKT 455	(3)	Sales Management
MRKT 459	(3)	Retail Management
MRKT 483	(3)	International Marketing Management

or other appropriate 300- or 400-level MRKT courses with the approval of the Program Adviser.

* Students who have taken an equivalent Statistics course in another faculty may not count those credits toward the Minor; an additional 3-credit complementary course must be chosen from the course list above.

Note: Students should select their Statistics course only after consulting the "Course Overlap" section in the Faculty of F

MGCR 472	(3)	Operations Management
MGSC 373	(3)	Operations Research 1

Complementary Courses (12 credits)

3 credits

MGCR 271*	(3)	Business Statistics

9 credits selected from:

MGSC 372	(3)	Advanced Business Statistics
MGSC 402	(3)	Operations Strategy
MGSC 403	(3)	Introduction to Logistics Management
MGSC 405	(3)	Quality Management
MGSC 415	(3)	Supplier Management
MGSC 431	(3)	Operations and Supply Chain Analysis
MGSC 479	(3)	Applied Optimization
MGSC 575	(3)	Applied Time Series Analysis Managerial Forecasting
MGSC 578	(3)	Simulation of Management Systems

or other appropriate 300- or 400-level MGSC courses with the approval of the Program Adviser.

* 3 credits of Statistics: Students who have taken an equivalent Statistics course in another faculty may not count those credits toward the Minor; an additional 3-credit complementary course must be chosen from the course list above.

Note: Students should select their Statistics course only after consulting the "Course Overlap" section in the Faculty of Arts, the "Course Overlap" section in the Faculty of Science, and the "Course Overlap" section in the Desautels Faculty of Management to avoid overlapping Statistics courses.

10.22 Mathematics and Statistics (MATH)

10.22.1 Location

Burnside Hall, Room 1005
805 Sherbrooke Street West
Montreal QC H3A 0B9
Telephone: 514-398-3800
Website: *www.mcgill.ca/mathstat*

10.22.2 About Mathematics and Statistics

Mathematics and statistics are omnipresent in today's world of information and technology. Their theories, models, and methods are integral to the way we analyze, understand, and build the world around us. They play a key role in nearly every effort to push the boundaries of science, engineering, medicine, and social sciences, and contribute, in a major way, to solving some of the most pressing human, environmental, and economic problems of our time.

The Department of Mathematics and Statistics is one of the oldest and most distinguished of its kind in Canada. It is home to active, internationally acclaimed, and award-winning researchers in the three principal subdisciplines in the mathematical sciences.

Pure mathematics is concerned with abstract structures and concepts mainly with respect to their intrinsic and technical nature, although many areas in pure mathematics have developed from questions in science and technology. Core areas of expertise in pure mathematics include algebra, analysis, geometry, number theory, and topology.

Applied mathematics develops and utilizes advanced mathematical methods to solve problems in a broad range of applications in science, technology, engineering, computer science, and business. Core areas of expertise in applied mathematics include discrete mathematics, game theory, graph theory, mathematical ph

Statistics is motivated by the need to extract information from data, to quantify uncertainty, and to make predictions about random phenomena. To do this effectively, sophisticated mathematical and probabilistic techniques and computational tools are needed. Core areas of expertise include Bayesian inference, biostatistics, computational statistics, high-dimensional data modeling, multivariate analysis, and survival analysis.

10.22.3 Undergraduate Program Options

Our programs provide a broad and solid mathematical and statistical education that paves the way to many interesting career options in academia, government, and industry. Top students typically get admitted to prestigious graduate schools around the world and often become leaders in their areas of research in academic or industrial settings. Our graduates at all levels are in high demand in government departments, health research centers, banks, insurance and pharmaceutical companies, statistical agencies, and multinational high-technology industries.

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Emeritus Professors

Michael Makkai; M.A., Ph.D.(ELTE) (*Peter Redpath Professor of Pure Mathematics*)

Sherwin Maslowe; B.Sc.(Wayne), M.Sc., Ph.D.(Calif.)

Arak M. Mathai; M.Sc.(Kerala), M.A., Ph.D.(Tor.)

Karl Peter Russell; Vor.Dip.(Hamburg), Ph.D.(Calif.)

Georg Schmidt; B.Sc.(Natal), M.Sc.(S. Af.), Ph.D.(Stan.)

Vanamamalai Seshadri; B.Sc, M.Sc.(Madr.), Ph.D.(Okla.)

George P.H. Styan; M.A., Ph.D.(Col.)

Kwok Kuen Tam; M.A., Ph.D.(Tor.)

John C. Taylor; B.Sc.(Acad.), M.A.(Qu.), Ph.D.(McM.)

Jian-Jun Xu; B.Sc., M.Sc.(Beijing), M.Sc., Ph.D.(Rensselaer Poly.)

Sanjo Zlobec; M.Sc.(Zagreb), Ph.D.(N'western)

Professors

Masoud Asgharian; B.Sc.(SBU, Iran), M.Sc., Ph.D.(McG.)

Peter Bartello; B.Sc.(Tor.), M.Sc., Ph.D.(McG.) (*joint appt. with Atmospheric and Oceanic Sciences*)

Rustum Choksi; B.Sc.(Tor.), M.Sc., Ph.D.(Brown)

Henri Darmon; B.Sc.(McG.), Ph.D.(Harv.), F.R.S.C. (*Distinguished James McGill Professor*)

Christian Genest; B.Sp.Sc.(UQAC), M.Sc.(Montr.), Ph.D.(Br. Col.) (*Canada Research Chair*)

Eyal Z. Goren; B.A., M.S., Ph.D.(Hebrew)

Pengfei Guan; B.Sc.(Zhejiang), M.Sc., Ph.D.(Princ.) (*Distinguished James McGill Professor*)

Jacques C. Hurtubise; B.Sc.(Montr.), D.Phil.(Oxf.) F.R.S.C.

Dmitry Jakobson; B.Sc.(MIT), Ph.D.(Princ.) (*Peter Redpath Professor*)

Vojkan Jaksic; B.S.(Belgrade), Ph.D.(Caltech.)

Niky Kamran; B.Sc., M.Sc.(ULB), Ph.D.(Wat.), F.R.S.C. (*James McGill Professor*)

Adam Oberman; B.S.(Tor.), M.S., Ph.D.(Chic.)

Charles Roth; M.Sc.(McG.), Ph.D.(Hebrew)

David A. Stephens; B.Sc., Ph.D.(Nott.)

John A. Toth; B.Sc., M.Sc.(McM.), Ph.D.(MIT)

Adrian Vetta; B.Sc., M.Sc.(LSE), Ph.D.(MIT) (*joint appt. with Computer Science*)

Daniel T. Wise; B.A.(Yeshiva), Ph.D.(Princ.) (*James McGill Professor*)

David Wolfson; B.Sc., M.Sc.(Natal), Ph.D.(Purd.)

Associate Professors

Louigi Addario-Berry; B.Sc., M.Sc., Ph.D.(McG.)

Antony R. Humphries; B.A., M.A.(Camb.), Ph.D.(Bath)

Abbas Khalili; B.S., M.S.(IUT, Iran), Ph.D.(Wat.)

Jean-Philippe Lessard; B.Sc.(Sher.), M.Sc.(Montr.), Ph.D.(Georgia Tech.)

Jean-Christophe Nave; B.Sc., Ph.D.(Calif., Santa Barbara)

Johanna Neslehova; B.Sc., M.Sc.(Hamburg), Ph.D.(Oldenburg)

Sergey Norin; M.S.(SPbU), Ph.D.(Georgia Tech.)

Mikael Pichot; B.Sc.(Lyon), M.S., Ph.D.(ENS Lyon)

Russell Steele/F1 8.1 Tf1 6 165.36 Tm(gia)Tj1 0 0 1 2.n. M5.3359 181.08 Tm(at.))Tj1 j/F31 8.1 Tf1 as Tm(Mikael Pichot; B.71453.32 TG.52umurTm(W)Tj1 0 0 5 7

MATH 222	(3)	Calculus 3
MATH 223*	(3)	Linear Algebra
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MATH 423	(3)	Regression and Analysis of Variance

Complementary Courses (9 credits)

9 credits selected from:

CHEM 593	(3)	Statistical Mechanics
GEOG 351	(3)	Quantitative Methods
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
PHYS 362	(3)	Statistical Mechanics
PHYS 559	(3)	Advanced Statistical Mechanics
SOCI 504	(3)	Quantitative Methods 1

No more than 6 credits may be tak

MATH 317, MATH 319, MATH 327, MATH 329, MATH 407, MATH 417, MATH 423, MATH 430, MATH 447, MATH 523, MATH 525.

Required Courses (27 credits)

* Students may select either MATH 249 or MATH 316 but not both.

** Students who have successfully completed a course equivalent to MATH 222 with a grade of C or better may omit MATH 222, but must replace it with 3 credits of complementary courses.

MATH 222**	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 236	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 249*	(3)	Honours Complex Variables
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 316*	(3)	Complex Variables
MATH 323	(3)	Probability

Complementary Courses (18 credits)

18 credits selected from the following list, with at least 6 credits selected from:

MATH 317	(3)	Numerical Analysis
MATH 324	(3)	Statistics
MATH 335	(3)	Computational Algebra
MATH 340	(3)	Discrete Mathematics

the remainder of the 18 credits to be selected from:

MATH 204	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 318	(3)	Mathematical Logic
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 320	(3)	Differential Geometry
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 346	(3)	Number Theory
MATH 348	(3)	Euclidean Geometry
MATH 352	(1)	Problem Seminar
MATH 407	(3)	Dynamic Programming
MATH 410TH 410	(3)	Majors Project

MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis

10.22.10 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Statistics (48 credits)

(45 or 48 credits)

This program provides training in statistics, with a solid mathematical core, and basic training in computing. With strong performance in an appropriate selection of courses, this program can lead to "A.Stat." professional accreditation from the Statistical Society of Canada, which is regarded as the entry level requirement for Statisticians practising in Canada.

Students may complete this program with a minimum of 45 credits or a maximum of 48 credits depending on whether or not they are required to take MATH 203.

Program Prerequisites

Students entering the Core Science Component in Statistics are normally expected to have completed the courses below or their equivalents. Otherwise they will be required to make up any deficiencies in these courses over and above the 45 credits required for the program.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2

In addition, a student who has not completed the equivalent of MATH 203 on entering the program must consult an academic adviser and take MATH 203 in the first semester, increasing the total number of program credits from 45 to 48.

Required Courses (27 credits)

* Students who have successfully completed a course equivalent to MATH 222 with a grade of C or better may omit MATH 222, but must replace it with 3 credits of comple49 4I431 yits requc(1T 1 458.eeents who ha)Tj1 0 0 1 12

At least 6 credits selected from:

* Students can take either MATH 317 or COMP 350, but not both.

COMP 250	(3)	Introduction to Computer Science
COMP 350*	(3)	Numerical Computing
MATH 243	(3)	Analysis 2
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 316	(3)	Complex Variables
MATH 317*	(3)	Numerical Analysis
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 340	(3)	Discrete Mathematics
MATH 350	(3)	Honours Discrete Mathematics
MATH 417	(3)	Linear Optimization
MATH 430	(3)	Mathematical Finance

At least 9 credits selected from:

*Students can take either MATH 410 or MATH 420, but not both.

CCOM 314	(3)	Communicating Science
COMP 551	(4)	Applied Machine Learning
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 410*	(3)	Majors Project
MATH 420*	(3)	Independent Study
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
		Sampling

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2

Guidelines for Selection of Courses in the Major Program

The following informal guidelines should be discussed with the student's adviser.

MATH 318	(3)	Mathematical Logic
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 320	(3)	Differential Geometry
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 346	(3)	Number Theory
MATH 348	(3)	Euclidean Geometry
MATH 352	(1)	Problem Seminar
MATH 407	(3)	Dynamic Programming
MATH 410	(3)	Majors Project
MATH 417	(3)	Linear Optimization
MATH 423	(3)	Regression and Analysis of Variance
MATH 427	(3)	Statistical Quality Control
MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 478	(3)	Computational Methods in Applied Mathematics
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis

If necessary, 6 additional credits in Mathematics or related disciplines selected in consultation with the Adviser.

10.22.12 Bachelor of Science (B.Sc.) - Major Mathematics and Computer Science (72 credits)

Program Prerequisites

Students entering the Joint Major in Mathematics and Computer Science are normally expected to have completed the courses below or their equivalents. Otherwise, they will be required to make up any deficiencies in these courses over and above the 72 credits of courses in the program specification.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2

Required Courses (54 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202 but can replace it with an additional Computer Science complementary course.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation

COMP 360	(3)	Algorithm Design
MATH 222	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 236	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 315	(3)	Ordinary Differential Equations
MATH 317	(3)	Numerical Analysis
MATH 318	(3)	Mathematical Logic
MATH 323	(3)	Probability
MATH 340	(3)	Discrete Mathematics

Complementary Courses (18 credits)

9 credits from the set of courses recommended for a major or honours program in Mathematics.

9 credits selected from Computer Science courses at the 300 level or above (except COMP 364 and COMP 396) and ECSE 508.

10.22.13 Bachelor of Science (B.Sc.) - Major Statistics and Computer Science (72 credits)

This program provides students with a solid training in both computer science and statistics together with the necessary mathematical background. As statistical endeavours involve ever increasing amounts of data, some students may want training in both disciplines.

Program Prerequisites

Students entering the Joint Major in Statistics and Computer Science are normally expected to have completed the courses below or their equivalents. Otherwise they will be required to make up any deficiencies in these courses over and above the 72 credits of required courses.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2

Required Courses (51 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202 but can replace it with an additional Computer Science complementary course.

** Students take either COMP 350 or MATH 317, but not both.

*** Students take either MATH 223 or MATH 236, but not both.

Both courses are equivalent as prerequisites for required and complementary Computer Science courses listed below.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
		Programming Languages and PMA

MATH 242	(3)	Analysis 1
MATH 314	(3)	Advanced Calculus
MATH 317**	(3)	Numerical Analysis
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MATH 423	(3)	Regression and Analysis of Variance

Complementary Courses (21 credits)

12 credits in Mathematics selected from:

* Students take either MATH 340 or MATH 350, but not both.

** MATH 578 and COMP 540 cannot both be taken for program credit.

MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 327	(3)	Matrix Numerical Analysis
MATH 340*	(3)	Discrete Mathematics
MATH 350*	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 410	(3)	Majors Project
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524MA	(4)	Nonparametric Statistics

10.22.14 Bachelor of Science (B.Sc.) - Honours Applied Mathematics (63 credits)

Applied Mathematics is a very broad field and students are encouraged to choose a coherent program of complementary courses. Most students specialize in "continuous" or "discrete" applied mathematics, but there are many sensible combinations of courses, and the following informal guidelines should be discussed with the student's adviser. Also, aside from seeking to develop a sound basis in Applied Mathematics, one of the objectives of the program is to kindle the students' interest in possible areas of application. To develop an appreciation of the diversity of Applied Mathematics, students are advised to develop some depth (e.g., by completing a minor) in a field related to Applied Mathematics such as Atmospheric and Oceanic Sciences, Biology, Biochemistry, Chemistry, Computer Science, Earth and Planetary Sciences, Economics, Engineering, Management, Physics, Physiology, and Psychology.

Students may complete this program with a minimum of 60 credits or a maximum of 63 credits depending if they are exempt from MATH 222.

Program Prerequisites

The minimum requirement for entry into the Honours program is that the student has completed with high standing the following courses below or their equivalents:

Linear Algebra and R1 0 0 1 221.3Mobm(di there are man2ainear)Tj1 0 0 rr their

Complementar

++ Not open to students who have taken MATH 354.

All MATH 500-level courses.

Other courses with the permission of the Department.

10.22.15 Bachelor of Science (B.Sc.) - Honours Mathematics (63 credits)

Students may complete this program with a minimum of 60 credits or a maximum of 63 credits depending if they are exempt from MATH 222.

Program Prerequisites

The minimum requirement for entry into the Honours program is that the student has completed with high standing the following courses below or their equivalents.

MATH 133	(3)	Linear Algebra and Geometry
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

In particular, MATH 150/151 and MATH 140/141/222 are considered equivalent.

Students who have not completed an equivalent of MATH 222 on entering the program must consult an academic adviser and take MATH 222 as a required course in the first semester, increasing the total number of program credits from 60 to 63. Students who have successfully completed MATH 150/1151 are not required to take MATH 222.

Students who transfer to Honours in Mathematics from other programs will have credits for previous courses assigned, as appropriate, by the Department.

To be awarded the Honours degree, the student must have, at time of graduation, a CGPA of at least 3.00 in the required and complementary Mathematics courses of the program, as well as an oTH 150/158hTj1 0 0223G(e MA)Tj1 j1m(e MA)Tj1 0 0 1 501v-62080 0 1 501v-62080 0 1p atell a19 TmSt2 3.00 inC(B.Sc.) - H

MATH 254**	(3)	Honours Analysis 1

** It is strongly recommended that students take MATH 254.

0-6 credits from the following courses for which no Honours equivalent exists:

MATH 204	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 407	(3)	Dynamic Programming
MATH 430	(3)	Mathematical Finance

6-12 credits selected from:

COMP 250++	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
MATH 350	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 377	(3)	Honours Number Theory
		Honours Numerical 1)

In particular, MATH 150/151 and MA

MATH 325	(3)	Honours Ordinary Differential Equations
MATH 350	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 358+	(3)	Honours Advanced Calculus
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis
MATH 398	(3)	Honours Euclidean Geometry
MATH 454	(3)	Honours Analysis 3
MATH 455++	(3)	Honours Analysis 4
MATH 458	(3)	Honours Differential Geometry
MATH 466	(3)	Honours Complex Analysis
MATH 475	(3)	Honours Partial Differential Equations
MATH 478	(3)	Computational Methods in Applied Mathematics
MATH 480	(3)	Honours Independent Study

and any 500-level course offered by the Department of Mathematics and Statistics not listed in Part III below.

Part III: at least 18 credits in probability and statistics selected as follows:

At least 6 credits selected from:

MATH 308	(3)	Fundamentals of Statistical Learning
MATH 524	(4)	Nonparametric Statistics
MATH 547	(4)	Stochastic Processes
MATH 556	(4)	Mathematical Statistics 1
		Mathematical Statistics 2

COMP 424	(3)	Artificial Intelligence
COMP 551	(4)	Applied Machine Learning
MATH 430	(3)	Mathematical Finance
MATH 540	(4)	Life Actuarial Mathematics
MATH 541	(4)	Nonlife Actuarial Models
MATH 594+++	(4)	Topics in Mathematics and Statistics
MATH 598+++	(4)	Topics in Probability and Statistics

10.22.17 Bachelor of Science (B.Sc.) - Honours Statistics and Computer Science (79 credits)

This is a challenging program providing students with a solid training in both computer science and statistics suitable for entry into graduate school in either discipline.

Students may complete this program with a minimum of 76 credits or a maximum of 79 credits depending on whether or not they are exempt from taking COMP 202.

Program Prerequisites

Students entering the Joint Honours in Statistics and Computer Science are normally expected to have completed the courses below or their equivalents. Otherwise, they will be required to make up any deficiencies in these courses over and above the 76-79 credits of courses in the program.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2

Required Courses (46 credits)

* Students who have sufficient knowledge in a programming language are not required to take COMP 202.

** Students take either MATH 251 or MATH 247, but not both.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theory of Computation
COMP 362	(3)	Honours Algorithm Design
MATH 235	(3)	Algebra 1
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Vector Calculus
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 533	(4)	Honours Regression and Analysis of Variance

Complementary Courses (33 credits)

18 credits in Mathematics selected as follows:

3 credits selected from:

MATH 242	(3)	Analysis 1
MATH 254*	(3)	Honours Analysis 1

* It is strongly recommended that students take MATH 254.

3 credits selected from:

MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis

At least 8 credits selected from:

MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2

The remaining Mathematics credits selected from:

** MATH 578 and COMP 540 cannot both be taken for program credit.

MATH 350	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 454	(3)	Honours Analysis 3
MATH 545	(4)	Introduction to Time Series Analysis
MATH 578**	(4)	Numerical Analysis 1
MATH 587	(4)	Advanced Probability Theory 1
MATH 594	()	Topics in Mathematics and Statistics

15 credits in Computer Science selected as follows:

At least 6 credits selected from:

COMP 424	(3)	Artificial Intelligence
COMP 462	(3)	Computational Biology Methods
COMP 526	(3)	Probabilistic Reasoning and AI
COMP 540**	(3)	Matrix Computations
COMP 547	(4)	Cryptography and Data Security
COMP 551	(4)	Applied Machine Learning
COMP 552	(4)	Combinatorial Optimization
COMP 564	(3)	Advanced Computational Biology Methods and Research
COMP 566	(3)	Discrete Optimization 1
COMP 567	(3)	Discrete Optimization 2

The remaining Computer Science credits are selected from COMP courses at the 300 level or above excluding COMP 396.

10.22.18 Bachelor of Science (B.Sc.) - Honours Mathematics and Computer Science (78 credits)

Students may complete this program with a minimum of 72 credits or a maximum of 78 credits depending if they are exempt from COMP 202/204/208 and/or MATH 222.

Program Prerequisites

Students must consult an Honours adviser in both departments to ensure that they have sufficient background to enter the program. The minimum requirements are the following courses or their equivalencies:

MATH 133	(3)	Linear Algebra and Geometry
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

In particular, MATH 150/151 and MATH 140/141/222 are considered equivalent.

To be awarded the Honours degree, the student must have, at time of graduation, a CGPA of at least 3.00 in the required and complementary Mathematics courses of the program, as well as an overall CGPA of at least 3.00.

Required Courses

(36-39 credits)

* Students who have successfully completed MATH 150/151 or an equivalent of MATH 222 on entering the program are not required to take MATH 222.

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 362	(3)	Honours Algorithm Design
MATH 222*	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 251	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 350	(3)	Honours Discrete Mathematics

Complementary Courses

36-39 credits

0-3 credits selected from:

COMP 202**	(3)	Foundations of Programming
COMP 204**	(3)	Computer Programming for Life Sciences
COMP 208**	(3)	Computer Programming for Physical Sciences and Engineering

** Students who have sufficient knowledge of computer programming are not required to take COMP 202/204/208.

3 credits selected from:

MATH 242	(3)	Analysis 1
MATH 254***	(3)	Honours Analysis 1

*** It is strongly recommended that students take MATH 254.

3 credits selected from:

MATH 248	(3)	Honours Vector Calculus
MATH 358	()	Honours Advanced Calculus

18 credits in Mathematics, at least 12 credits selected from:

+ Not open to students who have taken MA

Immunology is the study of the molecular and cellular basis of host resistance and immunity to external agents such as pathogenic microorganisms. Immunologists study the mechanisms by which the body recognizes foreign antigens, generates appropriate antibodies to an enormously diverse spectrum of antigens, and sequesters and kills invading microorganisms. Their discoveries lead to vaccination against disease; transfusions and organ transplants; and treatments for allergies; cancer; autoimmune diseases; and immune-deficiency diseases such as

Assistant Professors

I. King; B.A.(Ohio), M.Sc.(Pitt.), Ph.D.(Roch.)

C. Maurice; M.S., Ph.D.(Montpellier)

M. Richer; B.Sc.(McG.), M.Sc.(Montr.), Ph.D.(Br. Col.)

Associate Members

Dentistry: E. Emami, S. Tran

Epidemiology and Infectious Diseases: M. Behr, A. Dascal, V. Loo

Genetics: E. Schurr

Immunology, Autoimmunity, Host Defense: J. Antel, M. Burnier, I. Colmegna, P. Gros, A. Kristof, J. Mandl, A. Orthwein, J. Rauch, M. Saleh, J. Spicer, C. Tsoukas, S. Vidal

Immunology and Parasitology: B. Brenner, C.T. Costiniuk, M. Ndao, P. Rohrbach, B. Ward, J. Zhang

Microbiology: D. Cuong Vinh, M. Divangahi, C. Liang, D. Nguyen, M. Reed

Molecular Biology: N. Cermakian, S. Hussain, A. Jardim, D. Langlais, A. Mouland, K. Pantopoulos, M. Tremblay, B. Turcotte, J. Xia

Virology: A. Gatignol, A.E. Koromilas, R. Lin, T. Mesplede, J.Teodoro

Immunology and Virology: M-A. Jenabian

Adjunct Professors

A. Bar-Or; B.Sc.(McM.), M.D.,C.M.(McG.)

E. Cohen; B.Sc.(McG.), Ph.D.(Montr.)

A. Descoteaux; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)

J.M. Di Noia; Ph.D.(Buenos Aires)

A. Finzi; Ph.D.(Montr.)

N. Grandvaux; Ph.D.(Grenoble)

C. Krawczyk; Ph.D.(Tor.)

G. Kukolj; Ph.D.(McG.)

P. Lau; Ph.D.(Ott.)

S. Lesage; B.Sc., Ph.D.(McG.)

S.L. Liu; Ph.D.(Wash.)

J. Madrenas; M.D.(Barcelona), M.Sc.(Autonoma, Barcelona), Ph.D.(Alta.)

R. Moutih; Ph.D.(McG.)

C. Paradis-Bleau; M.Sc., Ph.D.(Laval)

A. Petronela; M.Sc., Ph.D.(Paris XI)

K. Pike; Ph.D.(Tor.)

W-K. Suh; Ph.D.(Tor.)

10.23.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (50 credits)

U1 Required Courses (19 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology

MIMM 214	(3)	Introductory Immunology: Elements of Immunity

U1 Complementary Course (3 credits)

3 credits, select one from:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

U1, U2, or U3 Required Course (3 credits)

3 credits, select one from:

BIOL 373	(3)	Biometry
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

U2 Required Courses (16 credits)

MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes

U1, U2 or U3 Complementary Courses (3 credits)

3 credits selected from:

* Students who have taken CHEM 212 or CHEM 222 in CEGEP must replace it with another complementary course.

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458	(3)	Membranes and Cellular Signaling
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458	(3)	Membranes and Cellular Signaling

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
COMP 204	(3)	Computer Programming for Life Sciences
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 496D1	(3)	Microbiology Advanced Research Project
MIMM 496D2	(3)	Microbiology Advanced Research Project
MIMM 497D1	(3)	Immunology Advanced Research Project
MIMM 497D2	(3)	Immunology Advanced Research Project
MIMM 509	(3)	Inflammatory Processes
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

10.23.5 Bachelor of Science (B.Sc.) - Major Microbiology and Immunology (66 credits)

The Major program is designed for students who want to acquire a substantial background in microbiology and immunology and related disciplines (chemistry, biology, biochemistry) which will prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes.

U1 Required Courses (26 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

** Students who have taken CHEM 222 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222**	(4)	Introductory Organic Chemistry 2
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

One of:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

U1, U2, or U3 Required Course (3 credits)

One of:

BIOL 373	(3)	Biometry
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

U2 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Course (3 credits)

MIMM 413	(3)	Parasitology

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Complementary Courses (9 credits)

9 credits selected from:

* Students may select either ANAT 458 or BIOC 458, but not both.

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458*	(3)	Membranes and Cellular Signaling
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology

BIOL 314	(3)	Molecular Biology of Cancer
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 302	(3)	Introductory Organic Chemistry 3
COMP 204	(3)	Computer Programming for Life Sciences
		Introduction to Softw864 646.96 TmycM 302

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

U1, U2, or U3 Required Course (3 credits)

One of:

BIOL 373	(3)	Biometry
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

U2 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Courses (15 credits)

MIMM 413	(3)	Parasitology
MIMM 501D1*	(6)	Honours Research Project in Immunology
MIMM 501D2*	(6)	Honours Research Project in Immunology
MIMM 502D1*	(6)	Honours Research Project in Microbiology
MIMM 502D2*	(6)	Honours Research Project in Microbiology

* Students take either MIMM 501D1 and MIMM 501D2 OR MIMM 502D1 and MIMM 502D2.

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Complementary Course (3 credits)

3 credits selected from:

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458	(3)	Membranes and Cellular Signaling
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 404	(3)	Biophysical Methods in Biochemistry
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids

BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 520	(3)	Gene Activity in Development
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 302	(3)	Introductory Organic Chemistry 3
COMP 204	(3)	Computer Programming for Life Sciences
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes
PATH 300	(3)	Human Disease
PHAR3)	(3)	Drug Action

Email: *ciro.piccirillo@mcgill.ca*

10.24 Music for Science Students

10.24.1 Location

Strathcona Music Building
555 Sherbrooke Street West
Montreal QC H3A 1E3
Telephone: 514-398-4535
Fax: 514-398-1540
Website: *www.mcgill.ca/music*

10.24.2 About Music

The Schulich School of Music offers some programs that are open to students in the Faculty of Science. For more information, see *Schulich School of Music*

Required Courses (9 credits)

BIOL 200	(3)	Molecular Biology
NSCI 200	(3)	Introduction to Neuroscience 1
NSCI 201	(3)	Introduction to Neuroscience 2

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 ANAT 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.

ANAT 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 212*	(3)	Molecular Mechanisms of Cell Function

PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
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PHYS 102+++	(4)	Introductory Physics - Electromagnetism
PHYS 131***	(4)	Mechanics and Waves
PHYS 142+++	(4)	Electromagnetism and Optics

Core Required Courses (20 credits)

Note: Students who have successfully completed an equivalent of CHEM 212 in CEGEP or elsewhere must replace these credits with a 3-credit elective course to satisfy the total credit requirement for the Neuroscience Major.

BIOL 200	(3)	Molecular Biology
CHEM 212	(4)	Introductory Organic Chemistry 1
NSCI 200	(3)	Introduction to Neuroscience 1
NSCI 201	(3)	Introduction to Neuroscience 2
NSCI 300	(3)	Neuroethics
NSCI 400D1	(.5)	Neuroscience Seminar

BIOL 202	(3)	Basic Genetics
PHGY 311	(3)	Channels, Synapses and Hormones

3 credits from:

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

6 credits from:

ANAT 321	(3)	Circuitry of the Human Brain
PSYC 302	(3)	The Psychology of Pain
PSYC 317	(3)	Genes and Behaviour
PSYC 342	(3)	Hormones and Behaviour

Other Complementary Courses

(21-23 credits)

3-16 credits from:

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 389	(3)	Laboratory in Neurobiology
NSCI 410	(6)	Independent Research 1
NSCI 420D1	(4.5)	Independent Research 2
NSCI 420D2	(4.5)	Independent Research 2

The remainder of the credits should be taken from the following lists. At least 15 of the 21-23 credits must be at the 400- or 500-level, which could include the above NSCI 410 or NSCI 420D1/NSCI 420D2 research courses:

200- and 300-level courses:

* Students take either BIOL 201 OR BIOC 212, but not both.

** Students take either COMP 206 or COMP 250, but not both.

ANAT 321	(3)	Circuitry of the Human Brain
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 311	(3)	Metabolic Biochemistry
BIOL 201*	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 320	(3)	Evolution of Brain and Behaviour
CHEM 222	(4)	Introductory Organic Chemistry 2
COMP 206**	(3)	Introduction to Software Systems
COMP 250**	(3)	Introduction to Computer Science
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

MIMM 314	(3)	Intermediate Immunology
NEUR 310	(3)	Cellular Neurobiology
PHAR 300	(3)	Drug Action
PHGY 210	(3)	Mammalian Physiology 2
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience
PSYC 213	(3)	Cognition
PSYC 302	(3)	The Psychology of Pain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour

400- and 500-level courses:

***Students may take either BIOL 514 or PSYC 514, but not both.

BIOL 514***	(3)	Neurobiology Learning and Memory
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BMDE 519	(3)	Biomedical Signals and Systems
COMP 546	(4)	Computational Perception
MATH 437	(3)	Mathematical Methods in Biology
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
NEUR 503	(3)	Computational Neuroscience

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PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514***	(3)	Neurobiology of Learning and Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 529	(3)	Music Cognition
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

10.26.5 Bachelor of Science (B.Sc.) - Honours Neuroscience (74 credits)

The Honours program is intended for students who are interested in laboratory-based research and in acquiring a foundation in each of the 3 streams of the Neuroscience Major Program (cell and molecular; neurophysiology and computational; and cognition and behaviour). Students are admitted to the program after one year in a major.

Applicants must have taken a minimum of 27 graded credits in their U1 year, must have a CGPA of at least 3.5, and must have obtained minimum grades of B+ in both NSCI 200 and NSCI 201, as well as a minimum grade of C in BIOL 200, BIOC 212 or BIOL 201, and CHEM 212. Additional requirements for applying are provided on the Neuroscience website: (www.mcgill.ca/neuroscience). Meeting the minimum requirements does not guarantee admission to the Honours Neuroscience program.

To graduate from the program, students must have a CGPA of 3.30 and a minimum grade of B+ in NCSI 300, NCSI 400, and NCSI 430D1/D2.

"First Class Honours" is awarded to students who obtain a minimum cumulative grade point average of 3.70, a minimum program GPA of 3.30, and a minimum grade of B+ in NSCI 300, NSCI 400, and NSCI 430.

Required Courses (38 credits)

Note: Students who have successfully completed an equivalent of CHEM 212 in CEGEP or elsewhere must replace these credits with a 3-credit elective course to satisfy the total credit requirement for Honours Neuroscience.

BIOC 311	(3)	Metabolic Biochemistry
BIOL 200	(3)	Molecular Biology
CHEM 212	(4)	Introductory Organic Chemistry 1
NSCI 200	(3)	Introduction to Neuroscience 1
NSCI 201	(3)	Introduction to Neuroscience 2
NSCI 300	(3)	Neuroethics
NSCI 400D1	(.5)	Neuroscience Seminar
NSCI 400D2	(.5)	Neuroscience Seminar
NSCI 430D1	(4.5)	Honours Research Project
NSCI 430D2	(4.5)	Honours Research Project

COMP 204	(3)	Computer Programming for Life Sciences

3 credits from:

BIOL 373	(3)	Biometry
MATH 324	(3)	Statistics
PSYC 305	(3)	Statistics for Experimental Design

3 credits from:

Note: Students who have successfully completed an equivalent to MATH 222 at CEGEP or elsewhere, must replace these credits with a 3-credit elective course to satisfy the total credit requirement for Honours Neuroscience.

BIOL 309	(3)	Mathematical Models in Biology
MATH 222	(3)	Calculus 3

3 credits from:

ANAT 321	(3)	Circuitry of the Human Brain
BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

The remaining 21 credits should be taken from the following lists. At least 15 of the 21 credits must be taken at the 400- or 500-level.

200- and 300-level courses:

*Students may take either COMP 206 or COMP 250, but not both.

BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
		Cell and Molecular Laboratory

(3) Cognition

PSYT 500 (3) Advances: Neurobiology of Mental Disorders

10.27 Nutrition (NUTR)

10.27.1 Location

School of Human Nutrition
Macdonald-Stewart Building, Room MS2-045
21,111 Lakeshore Road
Sainte-Anne-de-Bellevue QC H9X 3V9
Website: *www.mcgill.ca/nutrition*

10.27.2 About Nutrition

The School of Human Nutrition offers a **Minor in Human Nutrition** which can be taken by Science students; see *Faculty of Agricultural and Environmental Sciences* > *Undergraduate* > *Overview of Programs Offered* > *: Bachelor of Science in Nutritional Sciences – B.Sc.(Nutr.Sc.) (Overview)*.

NUTR 307 is considered as a course taught by the Faculty of Science.

10.28 Pathology (PATH)

10.28.1 Location

Department of Pathology
Duff Medical Building, B wing
3775 University Street
Montreal QC H3A 2B4
Telephone: 514-398-3045
Website: *www.mcgill.ca/pathology*

10.28.2 About Pathology

Pathology is a branch of medical science that involves the study and diagnosis of disease through the examination of surgically removed organs, tissues (biopsy samples), bodily fluids, and in some cases the whole body (autopsy). Aspects of a bodily specimen that may be considered include its gross anatomical make up, appearance of the cells using immunological markers, and chemical signatures in the cells. Pathology also includes the related scientific study of disease processes whereby the causes, mechanisms, and extent of disease are examined. Areas of study include cellular adaptation to injury, necrosis (death of living cells or tissues), inflammation, wound healing, and neoplasia (abnormal new growth of cells). Pathologists specialize in a wide range of diseases including cancer and the vast majority of cancer diagnoses are made by pathologists. The cellular pattern of tissue samples are observed under a microscope to help determine if a sample is cancerous or non-cancerous (benign). Pathologists also employ genetic studies and gene markers in the assessment of various diseases. Investigators in a pathology department may be utilizing information and experimental techniques originally developed in almost any area of modern biology and, in return, may contribute new knowledge of benefit to many other disciplines. Research on disease may target any of the organ systems, in normal and abnormal conditions, and studies may be conducted from a structural, biochemical or functional perspective at any level, from the intact organism down to specific components of the individual cell. There are no B.Sc. programs in Pathology, students who are interested in studying pathology can apply for Master or Ph.D program. For more information on Pathology programs please visit *www.mcgill.ca/pathology/programs/programs*. Please note that the undergraduate course PATH 300 *Human Disease* is considered as taught by the Faculty of Science.

10.29 Pharmacology and Therapeutics (PHAR)

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Website: *www.mcgill.ca/pharma*

10.29.2 About Pharmacology and Therapeutics

Pharmacology is the science that deals with all aspects of drugs and their interactions with living organisms. Thus, it involves the physical and chemical properties of drugs, their biochemical and physiological effects, mechanisms of action, pharmacokinetics, and therapeutic and other uses. Since the word "drug" encompasses all chemical substances that produce an effect on living cells, pharmacology is evidently a very extensive subject.

Pharmacology is a multidisciplinary science. It has developed its own set of principles and methods to study the mode of the action of drugs, but it has also utilized many techniques and approaches from various disciplines including biochemistry, physiology, anatomy, and molecular biology, as well as others. Pharmacology encompasses a number of different areas such as:

- pharmacogenomics;
- molecular biology;
- bioinformatics;
- neuropharmacology;
- reproductive pharmacology;
- endocrine pharmacology;
- receptor pharmacology;
- cardiovascular pharmacology;
- toxicology;
- developmental pharmacology;
- autonomic pharmacology;
- biochemical pharmacology;
- therapeutics.

Training in pharmacology is conducted at both the undergraduate and graduate levels. Because of its breadth, students may be attracted to the subject from a variety of viewpoints; this includes those completing a bachelor's degree in any number of basic science disciplines, such as biology, zoology, chemistry, physics, biochemistry, microbiology, anatomy, and physiology. At the undergraduate level, seven lecture courses are offered. A course involving research projects in pharmacology is also available to provide students with the opportunity to get first-hand experience in a pharmacology research laboratory. These courses provide students with knowledge concerning the actions of drugs on living systems and insight into approaches to basic pharmacological research.

10.29.3 Pharmacology and Therapeutics (PHAR) Faculty

Chair

Gerhard Multhaup

Emeritus Professors

Radan Capek; M.D., Ph.D.(Prague)

Hans H. Zingg; M.D., Ph.D.(McG.)

Professors

Daniel Bernard; Ph.D.(Johns Hop.)

Derek Bowie; B.Sc., Ph.D.(Lond.)

Paul B.S. Clarke; M.A.(Cant.), Ph.D.(Lond.)

A. Claudio Cuello; M.D.(Buenos Aires), M.A., D.Sc.(Oxf.), F.R.S.C.

Barbara Hales; M.Sc.(Phil. Coll. of Pharm. and Science), Ph.D.(McG.)

Terence Hébert; M.Sc.(Windsor), Ph.D.(Tor.)

Dusica Maysinger; Ph.D.(USC)

Anne McKinney; Ph.D.(Ulster)

Gerhard Multhaup; Ph.D.(Cologne)

Alfredo Ribeiro-da-Silva; M.D., Ph.D.(Oporto)

Bernard Robaire; B.A.(Calif.), Ph.D.(McG.)

H. Uri Saragovi; Ph.D.(Miami)

Professors

Moshe Szyf; M.Sc., Ph.D.(Hebrew)

Jacquetta Trasler; M.D.,C.M., Ph.D.(McG.)

Associate Professors

Jason Chaim Tanny; Ph.D.(Harv.)

Assistant Professors

Bastien Castagner; Ph.D.(Col.)

Maureen McKeague; Ph.D.(Carleton)

Lisa-Marie Munter; Ph.D.(Berlin)

Jean-François Trempe; D.Phil.(Oxf.)

Associate Members

Moulay Alaoui-Jamali; Ph.D.(Sorbonne)

Carolyn Baglole; M.Sc.(PEI), Ph.D.(Calg.)

Luda Diatchenko; M.D., Ph.D.(RNRMU)

Serge Gauthier; M.D.(Montr.)

Timothy Geary; Ph.D.(Mich.)

Bertrand Jean-Claude; M.Sc.(Moncton), Ph.D.(McG.)

Brigitte Keiffer; Ph.D.(Louis Pasteur)

Sarah Kimmins; Ph.D.(Dal.)

Stephane Laporte; Ph.D.(Sher.)

Stanley Nattel; B.Sc., M.D., C.M.(McG.)

Cristian O'Flaherty; Ph.D.(McG.)

Pedro Rosa-Neto; M.D.(Lisbon), Ph.D.(Aarhus)

Simon Rousseau; Ph.D.(Laval)

Laura Stone; Ph.D.(Minn.)

Marc Ware; M.D.(Univ. West Indies, Kingston)

Edith A. Zorychta; B.Sc.(St. FX), M.Sc., Ph.D.(McG.)

Adjunct Professors

Bruce Allen; Ph.D.(Br. Col.)

Sylvain Chemtob; M.D.(Montr.), Ph.D.(McG.)

Yves De Koninck; Ph.D.(McG.)

Greg FitzHarris; Ph.D. (UCL; UK)

Jean-Sebastien Joyal; M.D., Ph.D.(McG.)

Thomas Sanderson; Ph.D.(Br. Col.)

Affiliate Members

Mathieu Boucher; Ph.D.(Montr.)

Lionel Breton; Ph.D.(Paris V)

Lorella Garofalo; Ph.D.(McG.)

John Gillard; Ph.D.(Tasmania)

Joseph Mancini; M.Sc., Ph.D.(McG.)

Karen Meerovitch; Ph.D.(McG.)

10.29.4 Bachelor of Science (B.Sc.) - Minor Pharmacology (24 credits)

The Minor Pharmacology is intended for students registered in a complementary B.Sc. prAoUinor Pha who areded fre in complefocusn comtroduction to specialized0 0

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PSYC 204	(3)	Introduction to Psychological Statistics

3 credits, one of (usually in Year 3):

PHAR 503	(3)	Drug Discovery and Development 1

EXMD 509**	(3)	Gastrointestinal Physiology and Pathology
EXMD 511	(3)	Joint Venturing with Industry
HGEN 400**	(3)	Genetics in Medicine
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 466+	(3)	Viral Pathogenesis
NEUR 310	(3)	Cellular Neurobiology
PARA 410	(3)	Environment and Infection
PATH 300	(3)	Human Disease
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets
PHAR 599D1	(3)	Pharmacology Research Project
PHAR 599D2	(3)	Pharmacology Research Project
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 425***	(3)	Analyzing Physiological Systems
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PPHS 501	(3)	Population Health and Epidemiology
PSYC 302	(3)	The Psychology of Pain
PSYC 305**	(3)	Statistics for Experimental Design
PSYC 311	(3)	Human Cognition and the Brain
PSYC 317**	(3)	Genes and Behaviour
PSYC 318**	(3)	Behavioural Neuroscience 2
PSYT 301	(3)	Issues in Drug Dependence
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
REDM 410	(3)	Writing Research Articles

Note: * Students may take either ANAT 458 or BIOC 458

** Access to these courses is not guaranteed

*** Open to students who have the Prerequisites

+ Access to these courses is not guaranteed. Open to students who have the Pre-requisites

10.29.6 Bachelor of Science (B.Sc.) - Honours Pharmacology (76 credits)

The Honours program is designed as a preparation for graduate studies and research. In addition to the strong training provided by the Major program, it requires students to have direct research experience in a chosen area during their final year of study. Acceptance into the Honours program takes place in the Winter term of U2 and requires a CGPA of 3.50. Students who wish to enter the Honours program should follow the Major program; those who satisfactorily complete the first three terms with a CGPA of at least 3.50 and a mark of B+ or higher in core Pharmacology courses (PHAR 300, PHAR 301, and PHAR 303) are eligible for admission. Applications can be obtained from the office of the Department of Pharmacology in the McIntyre Medical Building or on the Departmental website.

U1 Required Courses (24 credits)

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
PHAR 200	(1)	Introduction to Pharmacology 1
PHAR 201	(1)	Introduction to Pharmacology 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

* Students who have taken the equivalent of CHEM 212, CHEM 222,and/or MATH 203 in CEGEP (as defined at: http://www.mcgill.ca/students/transfercredit/prospective/cegep) are exempt and may not take these courses at McGill. Students must replace these credits with appropriate complementary course credits to satisfy the total credit requirements for their degree.

U2 Required Courses (16 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOL 301	(4)	Cell and Molecular Laboratory
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology

U3 Required Courses (6 credits)

PHAR 598D1	(3)	Honours Pharmacology Research Project
PHAR 598D2	(3)	Honours Pharmacology Research Project

Complementary Courses (30 credits)

15 credits selected as follows:

3 credits, one of (highly recommended in Year 1):

ANAT 212	(3)	Molecular Mechanisms of Cell Function
BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

3 credits, one of (usually in Year 2):

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

3 credits, one of (usually in Year 2):

BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
MATH 203*	(3)	Principles of Statistics 1

PSYC 204	(3)	Introduction to Psychological Statistics

3 credits, one of (usually in Year 3):

PHAR 503	(3)	Drug Discovery and Development 1
PHAR 505	(3)	Structural Pharmacology

3 credits, one of (usually in Year 3):

PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology

15 credits selected from the following upper-level science courses:

Committee approval is required to substitute an upper-level science course not in the list below.

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381***	(3)	Experimental Embryology
ANAT 458*	(3)	Membranes and Cellular Signaling
BIEN 510	(3)	Engineered Nanomaterials for Biomedical Applications
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOC 470**	(3)	Lipids and Lipoproteins in Disease
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 370	(3)	Human Genetics Applied
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 462***	(3)	Green Chemistry
CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery
CHEM 504	(3)	Drug Design
CHEM 522	(3)	Stereochemistry
CHEM 552	(3)	Physical Organic Chemistry
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 504	(3)	Biology of Cancer
EXMD 509**	(3)	Gastrointestinal Physiology and Pathology

EXMD 511	(3)	Joint Venturing with Industry
HGEN 400**	(3)	Genetics in Medicine
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 466+	(3)	Viral Pathogenesis
NEUR 310	(3)	Cellular Neurobiology
PARA 410	(3)	Environment and Infection
PATH 300	(3)	Human Disease
PHAR 390	(3)	Laboratory in Pharmacology
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 425***	(3)	Analyzing Physiological Systems
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PPHS 501	(3)	Population Health and Epidemiology
PSYC 302	(3)	The Psychology of Pain
PSYC 305**	(3)	Statistics for Experimental Design
PSYC 311	(3)	Human Cognition and the Brain
PSYC 317**	(3)	Genes and Behaviour
PSYC 318**	(3)	Behavioural Neuroscience 2
PSYT 301	(3)	Issues in Drug Dependence
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
REDM 410	(3)	Writing Research Articles

Note: * Students may take either ANAT 458 or BIOC 458

** Access to these courses is not guaranteed

*** Open to students who have the Pre-requisites

+ Access to these courses is not guaranteed. Open to students who have the Pre-requisites

10.30 Physics (PHYS)

10.30.1 Location

Rutherford Physics Building, Room 108
3600 University Street
Montreal QC H3A 2T8

Telephone: 514-398-6477
Fax: 514-398-8434
Email: *chairsec.physics@mcgill.ca*
Website: *www.physics.mcgill.ca*

10.30.2 About Physics

Physics is in many ways the parent of the other natural sciences and its discoveries and laws continually affect their development. Its range and scope extend in space and time from subnuclear particles to the universe itself. The subfields of physics such as mechanics, thermodynamics, electricity, atomic physics, and quantum mechanics, to mention but a few, permeate all other scientific disciplines. People trained in physics are employed in industry, government, and educational systems where they find many challenges as teachers, researchers, administrators, and in the rapidly developing area of scientific business.

The two main undergraduate programs in physics at McGill are the Honours and the Major. The **Honours** program is highly specialized and the courses are very demanding. This program is appropriate for students who wish to make an in-depth study of the subject in preparation for graduate work and an academic or professional career in physics. The three multidisciplinary honours programs—in Mathematics and Physics, in Physics and Chemistry, and in Physics and Computer Science—are even more specialized and demanding. They are intended for students who wish to develop a strong basis in both physics and the other discipline and are intended as preparation for graduate work and a professional or academic career. Although these programs have a bias for theoretical work, they are broad enough and strong enough to prepare students for further study in either experimental physics or respectively mathematics, chemistry, or computer science.

The **Major** program, on the other hand, offers a broad training in classical and modern physics and yet leaves room for the student to take a meaningful sequence of courses in other areas. It is intended primarily for students who wish to pursue careers in fields for which physics provides a basis. However, this program also provides a preparation for graduate studies.

It is possible for students to transfer from the Major program to the Honours program after the first year of studies; see *section 10.30.9: Bachelor of Science (B.Sc.) - Major Physics (63 credits)*.

There are also a number of other **major** programs, offered jointly with other departments:

- Atmospheric Sciences and Physics;
- Physics and Computer Science;
- Physics and Geophysics;
- Physiology and Physics;

and **minor** programs:

- Electrical Engineering, available only to students in the Physics Major;
- Minor in Physics.

The **Concentration** program allows students a greater focus in biological physics. There is also a core Physics component of the **Liberal Science** program, for students less interested in a specialized education.

Students from outside of the Province of Quebec will ordinarily register in the **Science Freshman** program. Physics offers two sequences of courses for this program, described below.

The list of pre- and corequisites is not absolute. In many cases, permission of the Department may be sought to have a specific prerequisite waived. The procedure is to ask the professor in charge of the course to review the request for such a waiver. The prerequisites of the 100-level courses are described in the following section entitled Science Freshman program.

Students interested in any of the Physics programs should contact the *Department* for an adviser.

A Science

- Honours Program in Ph

Professors

A. Maloney; B.S., M.S.(Stan.), Ph.D.(Harv.)

N. Provatas; Ph.D.(McG.) (*Canada Research Chair*)

K. Ragan; B.Sc.(Alta.), Ph.D.(Geneva) (*Macdonald Professor of Physics*)

D.H. Ryan; B.A., Ph.D.(Dub.)

P. Wiseman; B.Sc.(St. FX), Ph.D.(UWO) (*joint appt. with Chemistry*)

Associate Professors

H. Cynthia Chiang; B.Sc.(Ill.-Urbana-Champaign), Ph.D.(Caltech)

L. Childress; B.A., Ph.D.(Harv.) (*Canada Research Chair*)

B. Coish; B.Sc.(Manit.), M.Sc.(McM.), Ph.D.(Basel)

D. Cooke; B.Sc.(St. FX), Ph.D.(Alta.)

N. Cowan; B.Sc.(McG.), Ph.D.(Wash.) (*joint appt. with Earth and Planetary Sciences*)

A. Cumming; B.A.(Camb.), Ph.D.(Calif., Berk.)

K. Dasgupta; M.Sc.(IIT Delhi), Ph.D.(TIFR, India)

P. Francois; Ph.D.(Paris VII)

M. Hilke; B.Sc., M.Sc., Ph.D.(Geneva)

S. Leslie; B.Sc.(Br. Col.), Ph.D.(Calif., Berk.)

T. Pereg-Barnea; B.Sc.(Jerus.), M.Sc, Ph.D.(Br. Col.)

W. Reisner; B.A.(Reed), Ph.D.(Princ.)

S. Robertson; B.Sc.(Calg.), M.Sc., Ph.D.(Vic., BC) (*Affiliated I.P.P. Scientist*)

R. Rutledge; B.Sc.(USC), Ph.D.(MIT)

J. Sankey; Ph.D.(Cornell) (*Canada Research Chair*)

J. Sievers; Ph.D.(Caltech)

B. Siwick; B.A.Sc., M.Sc., Ph.D.(Tor.) (*Canada Research Chair*) (*joint appt. with Chemistry*)

B. Vachon; B.Sc.(McG.), Ph.D.(Vic., BC)

A. Warburton; B.Sc.(Vic., BC), M.Sc., Ph.D.(Tor.)

T. Webb; B.Sc.(Tor.), M.Sc.(McM.), Ph.D.(Tor.)

Assistant Professors

K. Agarwal; B.Tech(IIT Kanpur), Ph.D.(Harv.)

T. Brunner; Dip., Ph.D.(TUM)

S. Caron-Huot; B.Sc.(Laval), M.Sc., Ph.D.(McG.)

D. Haggard; B.A.(St. John's), M.Sc.(SF State), Ph.D.(Wash.)

E. Lee; B.Sc., M.Sc.(Tor.), M.A., Ph.D.(Calif., Berk.)

A. Liu; B.A.(Princ.), Ph.D.(MIT)

Associate Members

G. Bub (*Physiology*)

M. Chacron (*Physiology*)

S. Devic (*Oncology*)

S. Enger (*Oncology*)

K. Gehring (*Biochemistry*)

P. Kambhampati (*Chemistry*)

A. Khadra (*Physiology*)

Associate Members

J. Kildea (*Medical Physics*)

D. Rassier (*Kinesiology*)

D. Ronis (*Chemistry*)

J. Seuntjens (*Medical Physics*)

T. Szkopek (*Electrical and Computer Engineering*)

Adjunct Professors

O. Hernandez,A. Najafi-Yazdi, B. Palmieri, M. Pearson, V. Tabard-Cossa, W. Witczak-Krempa

Curator (Rutherford Museum and McPherson Collection)

J. Barrette

10.30.6 Bachelor of Science (B.Sc.) - Minor Physics (18 credits)

The 18-credit Minor permits no overlap with any other programs. It contains no Mathematics courses, although many of the courses in it have Math pre- or corequisites. It will, therefore, be particularly appropriate to students in Mathematics, but it is also available to any Science student with the appropriate mathematical background.

Students in certain programs (e.g., the Major Chemistry) will find that there are courses in the Minor that are already part of their program, or that they may not take for credit because of a substantial overlap of material with a course or courses in their program. After consultation with an adviser, such students may complete the Minor by substituting any other physics course(s) from the Major or Honours Physics programs.

Required Course (3 credits)

PHYS 257	(3)	Experimental Methods 1

Complementary Courses (15 credits)

15 credits to be selected as follows:

One of:

PHYS 230	(3)	Dynamics of Simple Systems
PHYS 251	(3)	Honours Classical Mechanics 1

One of:

PHYS 232	(3)	Heat and Waves
PHYS 253	(3)	Thermal Physics

One of:

PHYS 241	(3)	Signal Processing
PHYS 258	(3)	Experimental Methods 2

One of:

PHYS 224	(3)	Physics of Music
PHYS 228	(3)	Energy and the Environment
PHYS 260	(3)	Modern Physics and Relativity
PHYS 320	(3)	Introductory Astrophysics

One of:

PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 350	(3)	Honours Electricity and Magnetism

10.30.7 Bachelor of Science (B.Sc.) - Minor Electrical Engineering (24 credits)

[Program registration done by Student Affairs Office]

The Minor program does not carry professional recognition. Only students who satisfy the requirements of the Major Physics are eligible for this Minor. Students registered for this option cannot count PHYS 241 toward the requirements of the Major in Physics, and should replace this course by another Physics or Mathematics course. Students who select ECSE 334rd t3eigPe.e3jor Ph

Required Courses (36 credits)

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 346	(3)	Majors Quantum Physics

Complementary Courses (9 credits)

9 credits selected from:

PHYS 328	(3)	Electronics
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 434	(3)	Optics
PHYS 439	(3)	Majors Laboratory in Modern Physics
PHYS 447	(3)	Applications of Quantum Mechanics

10.30.9 Bachelor of Science (B.Sc.) - Major Physics (63 credits)

60-63 credits

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology

MATH 133 and either MATH 140/141 or MATH 150/151.

MATH 133	(3)	Linear Algebra and Geometry

MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

Required Courses

(48-51 credits)

* Students who have successfully completed MATH 150/151 or an equivalent of MATH 222 on entering the program are not required to take MATH 222, reducing the total number of program credits from 63 to 60.

** Students coming into the program with sufficient knowledge of computer programming may replace COMP 208 with PHYS 512 or another 3-credit COMP course at the 200 level or above after consulting with an adviser.

COMP 208**	(3)	Computer Programming for Physical Sciences and Engineering
MATH 222*	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 346	(3)	Majors Quantum Physics
PHYS 447	(3)	Applications of Quantum Mechanics
PHYS 449	(3)	Majors Research Project

Complementary Courses (12 credits)

3 credits from:

PHYS 329	(3)	Statistical Physics with Biophysical Applications
PHYS 333	(3)	Thermal and Statistical Physics

9 credits from:

PHYS 319	(3)	Introduction to Biophysics
PHYS 320	(3)	Introductory Astrophysics
PHYS 321	(3)	Data Science and Observational Astrophysics
PHYS 328	(3)	Electronics
PHYS 404	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 439	(3)	Majors Laboratory in Modern Physics

Physics Research Project

Complementary Courses

(18-19 credits)

3 credits selected from:

COMP 202	(3)	Foundations of Programming
COMP 250	(3)	Introduction to Computer Science

3 credits selected from:

PHYS 328	(3)	Electronics
PHYS 331	(3)	Topics in Classical Mechanics

3 credits selected from:

PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 439	(3)	Majors Laboratory in Modern Physics

3 credits selected from:

CHEM 514	(3)	Biophysical Chemistry
MATH 437	(3)	Mathematical Methods in Biology
PHGY 425	(3)	Analyzing Physiological Systems
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 447	(3)	Applications of Quantum Mechanics

6 to 7 credits selected from:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 316	(3)	Biomembranes and Organelles
BIOL 551	(3)	Principles of Cellular Control

10.30.11 Bachelor of Science (B.Sc.) - Major Physics and Geophysics (69 credits)

This joint program in Physics and Geophysics provides a firm basis for graduate work in geophysics and related fields as well as a sound preparation for those who wish to embark on a career directly after the B.Sc.

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves

PHYS 142	(4)	Electromagnetism and Optics

One of:

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology

MATH 133 and either MATH 140/141 or MATH 150/151.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

Required Courses (57 credits)

	lus 2	Field School 1

COMP 302	(3)	Programming Languages and Paradigms
COMP 350	(3)	Numerical Computing
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing

U3 Required Courses (21 credits)

COMP 360	(3)	Algorithm Design
MATH 323	(3)	Probability
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 346	(3)	Majors Quantum Physics
PHYS 489	(3)	Special Project

10.30.13 Bachelor of Science (B.Sc.) - Honours Physics (78 credits)

Students entering this program for the first time should have high standing in mathematics and physics. In addition, a student who has not completed the equivalent of MATH 222 must take it in the first term without receiving credit toward the 78 credits required in the Honours program.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (unless it is improved to a C or higher in a supplementary examination or by retaking the course), may not register in the Honours program the following year, or graduate with the Honours degree, except with the permission of the Department.

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology

MATH 133 and either MATH 140/141 or MATH 150/151.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

U1 Required Courses (27 credits)

MATH 247	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Vector Calculus
MATH 249	(3)	Honours Complex Variables
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 260	(3)	Modern Physics and Relativity

U2 Required Courses (24 credits)

MATH 475	(3)	Honours Partial Differential Equations
PHYS 253	(3)	Thermal Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 359	(3)	Honours Laboratory in Modern Physics 1
PHYS 362	(3)	Statistical Mechanics
PHYS 457	(3)	Honours Quantum Physics 2

U3 Required Courses (6 credits)

PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 551	(3)	Quantum Theory

U3 Complementary Courses (21 credits)

6 credits selected from:

Note: PHYS 459D1 and PHYS 459D2 are taken together.

PHYS 459D1	(3)	Honours Research Thesis
PHYS 459D2	(3)	Honours Research Thesis
PHYS 469	(3)	Honours Laboratory in Modern Physics 2
PHYS 479	(3)	Physics Research Project

15 credits selected from the list below (students may substitute one or more courses with any 3-credit course approved by the Department of Physics):

PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 479	(3)	Physics Research Project
PHYS 512	(3)	Computational Physics with Applications
PHYS 514	(3)	General Relativity
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics
PHYS 557	(3)	Nuclear Physics

PHYS 558	(3)	Solid State Physics
PHYS 559	(3)	Advanced Statistical Mechanics
PHYS 562	(3)	Electromagnetic Theory
PHYS 567	(3)	Particle Physics

10.30.14 Bachelor of Science (B.Sc.) - Honours Physics: Biological Physics (82 credits)

The B.Sc. Honours Physics: Biological Physics program keeps a strong core of foundational physics and specializes through courses in biology, mathematics, physiology, computer science, and chemistry. The Honours program offers a more rigorous preparation, with additional research experience, for students with a strong interest in biophysics. In the final year, students will have an opportunity to carry out a research project within a biophysics lab in the department. This program provides a very strong foundation for students wishing to pursue graduate studies in biophysics, as well as for research careers in industrial, hospital, or academic laboratory settings.

Required Courses (63 credits)

Bio-Physical Sciences Core (24 credits)

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 395	(1)	Quantitative Biology Seminar
CHEM 212*	(4)	Introductory Organic Chemistry 1
MATH 247	(3)	Honours Applied Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
PHYS 319	(3)	Introduction to Biophysics
PHYS 329	(3)	Statistical Physics with Biophysical Applications

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

Biology and Mathematics (6 credits)

BIOL 202	(3)	Basic Genetics
MATH 248	(3)	Honours Vector Calculus

Physics (33 credits)

PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 253	(3)	Thermal Physics
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 346	(3)	Majors Quantum Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 459D1	(3)	Honours Research Thesis
PHYS 459D2	(3)	Honours Research Thesis
PHYS 519	(3)	Advanced Biophysics

Complementary Courses

(18-19 credits)

3 credits selected from:

COMP 202	(3)	Foundations of Programming
COMP 250	(3)	Introduction to Computer Science

3 credits selected from:

PHYS 328	(3)	Electronics
PHYS 351	(3)	Honours Classical Mechanics 2

3 credits selected from:

PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 359	(3)	Honours Laboratory in Modern Physics 1

3 credits selected from:

CHEM 514	(3)	Biophysical Chemistry
MATH 437	(3)	Mathematical Methods in Biology
PHGY 425	(3)	Analyzing Physiological Systems
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 447	(3)	Applications of Quantum Mechanics

6 to 7 credits selected from:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 316	(3)	Biomembranes and Organelles
BIOL 551	(3)	Principles of Cellular Control

10.30.15 Bachelor of Science (B.Sc.) - Honours Mathematics and Physics (81 credits)

This is a specialized and demanding program intended for students who wish to develop a strong basis in both Mathematics and Physics in preparation for graduate work and a professional or academic career. Although the program is optimized for theoretical physics, it is broad enough and strong enough to prepare students for further study in either experimental physics or mathematics.

The minimum requirement for entry into the program is completion with high standing of the usual CEGEP courses in physics and in mathematics, or the Physics Program Prerequisites as explained below. In addition, a student who has not completed the equivalent of MATH 222 must take it in the first term without receiving credit toward the 81 credits required in the Honours program.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (unless the student improves the grade to a C or higher through a supplemental exam or by retaking the course), may not register in the Honours program the following year, or graduate with the Honours degree, except with the permission of both departments. The student will have two advisers, one from Mathematics and the other from Physics.

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology

MATH 133 and either MATH 140/141 or MATH 150/151.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

U1 Required Courses (27 credits)

MATH 235	(3)	Algebra 1
MATH 248	(3)	Honours Vector Calculus
MATH 249	(3)	Honours Complex Variables
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 260	(3)	Modern Physics and Relativity

U2 Required Courses (24 credits)

MATH 255	(3)	Honours Analysis 2
MATH 475	(3)	Honours Partial Differential Equations
PHYS 253	(3)	Thermal Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 362	(3)	Statistical Mechanics

PHYS 359	(3)	Honours Laboratory in Modern Physics 1

Complementary Courses (18 credits)

U1 Complementary Course (3 credits)

MATH 247	(3)	Honours Applied Linear Algebra
MATH 251	(3)	Honours Algebra 2

U2 Complementary Courses (3 credits)

MATH 242	(3)	Analysis 1
MATH 254**	(3)	Honours Analysis 1

** It is strongly recommended that students take MATH 254.

U3 Complementary Courses (12 credits)

12 credits are selected as follows:

3 credits from:

MATH 455	(3)	Honours Analysis 4
MATH 456	(3)	Honours Algebra 3

6 credits selected from:

PHYS 432	(3)	Physics of Fluids
PHYS 479	(3)	Physics Research Project
PHYS 512	(3)	Computational Physics with Applications
PHYS 514	(3)	General Relativity
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics
PHYS 551	(3)	Quantum Theory
PHYS 557	(3)	Nuclear Physics
PHYS 558	(3)	Solid State Physics
PHYS 559	(3)	Advanced Statistical Mechanics
PHYS 562	(3)	Electromagnetic Theory
PHYS 567	(3)	Particle Physics

3 credits in Honours Mathematics.

10.30.16 Bachelor of Science (B.Sc.) - Honours Physics and Chemistry (80 credits)

This is a specialized and demanding program intended primarily, although not exclusively, for students with a theoretical bias who are interested in working in fields of study at the crossroads of physical chemistry and physics. The program will prepare students for either theoretical or experimental graduate work in departments where there is an emphasis on such cross-disciplinary areas as condensed matter physics, chemical physics, or material science.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (unless the student improves the grade to a C or above by taking a supplemental exam or retaking the course), may not register in this Honours program the following year, or graduate with the Honours degree, except with permission of both departments.

The student will have two advisers, one from Chemistry and the other from Physics.

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology

MATH 133 and either MATH 140/141 or MATH 150/151.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

Required Courses (68 credits)

CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
CHEM 556	(3)	Advanced Quantum Mechanics
CHEM 574	(3)	Introductory Polymer Chemistry
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering
MATH 247	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Vector Calculus
MATH 249	(3)	Honours Complex Variables
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 457	(3)	Honours Quantum Physics 2
PHYS 558	(3)	Solid State Physics

Complementary Courses (12 credits)

(with at least 3 credits in Chemistry and 3 credits in Physics)

3 credits selected from:

CHEM 593	(3)	Statistical Mechanics
PHYS 559	(3)	Advanced Statistical Mechanics

9 credits selected from the list below:

CHEM 480D1	(1.5)	Undergraduate Research Project 2
CHEM 480D2	(1.5)	Undergraduate Research Project 2
CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 575	(3)	Chemical Kinetics
CHEM 585	(3)	Colloid Chemistry
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 434	(3)	Optics
PHYS 469	(3)	Honours Laboratory in Modern Physics 2
PHYS 479	(3)	Physics Research Project
PHYS 562	(3)	Electromagnetic Theory

10.30.17 Bachelor of Science (B.Sc.) - Honours Physics and Computer Science (81 credits)

** NEW PROGRAM **

This program provides essential background in p.244 409.611 Ts4Tm(Chemistry g25l)Tj9es1 0 0 1 7r Sc(wiaithern Ph)Tj1 0 9.35724.091 377.462ern PhHuej9e(Hm((v

10.30.18.2 Major in Physiology and Physics

See *section 10.31: Physiology (PHGY)*. This program provides a firm basis for graduate work in bio-physics and other interdisciplinary fields involving the physical and biological sciences.

10.31 Physiology (PHGY)

10.31.1 Location

McIntyre Medical Sciences Building, Room 1021
3655 Promenade Sir-William-Osler
Montreal QC H3G 1Y6
Telephone: 514-398-4316
Website: *www.mcgill.ca/physiology*

10.31.2 About Physiology

Physiology has its roots in many of the basic sciences including biology, chemistry, mathematics, and physics, and overlaps with other biomedical sciences such as anatomy, biochemistry, pathology, pharmacology, psychology, and biomedical engineering. Physiology is one of the prime contributors of basic scientific knowledge to the clinical medical sciences.

Members of the Department of Physiology at McGill are engaged in studies dealing with molecules, single cells, or entire systems in a variety of vertebrates, including humans. A wide range of interest and expertise is represented, including:

- cardiovascular;
- respiratory;
- gastrointestinal and renal physiology;
- the physiology of exercise;
- neurophysiology;
- endocrinology;
- immunology;
- biophysics;
- biomathematics.

Some faculty members have formal or informal links with the departments of mathematics, physics, electrical engineering, and chemistry, and with clinical departments (medicine, sur

Please Note: Complementary courses are not electives.

Associate Professors

Suresh Krishna; Ph.D. (New York University)

Anmar Khadra; B.Sc.(C'dia), M.Sc., Ph.D.(Wat.)

Reza Sharif-Naeini; B.Sc.(Montr.), M.Sc., Ph.D.(McG.)

Ursula Stochaj; Ph.D.(Cologne)

Associate Professor (Part-time)

Nicole Bernard; B.Sc.(McG.), Ph.D.(Duke)

Assistant Professors

Arjun Krishnaswamy; B.Sc. Ph.D.(McG.)

Judith Mandl; B.Sc.(Warw.), Ph.D.(Emory)

Anastasia Nijnik; M.Biochem., Ph.D.(Oxf.)

Masha Prager-Khoutorsky; B.Sc., Ph.D.(Hebrew)

Daniela Quail; B.Sc., Ph.D.(UWO)

Melissa Vollrath; B.Sc.(Wisc.), Ph.D.(BCM)

Associate Members

Anaesthesia: Steven Backman

Biomedical Engineering: Robert Kearney, Satya Prakash

Biomedical Ethics: Jennifer Fishman

Kinesiology and Physical Education: Dilson Rassier

Mathematics: Anthony Humphries

Medicine: Nicole Bernard, Volker Blank, Mark Blostein, Andrey Cybulsky, Geoffrey Hendy, Louise Larose, Anne-Marie Lauzon, Serge Lemay, James Martin, Barry Posner, Shafaat Rabbani, Simon Rousseau, Mary Stevenson, Tomoko Takano, Elena Torban, Simon Wing

Microbiology and Immunology: Jörg Fritz

Neurology and Neurosurgery: Jack Antel, Massimo Avoli, Daniel Guitton, Christopher Pack, David Ragsdale, Ed Ruthazerj1 0 0 1 448.5j1 0 0 1 379.051 355 Tm(vid Ra

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

PHGY 459D2*	(3)	Physiology Seminar
PHGY 461D1**	(4.5)	Experimental Physiology
PHGY 461D2**	(4.5)	Experimental Physiology
PHGY 488	(3)	Stem Cell Biology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Cellular Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 531	(3)	Topics in Applied Immunology
PHGY 550	(3)	Molecular Physiology of Bone
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

10.31.5 Bachelor of Science (B.Sc.) - Major Physiology (65 credits)

The Major program includes, in addition to some intensive studies in Physiology, a strong core content of related biomedical sciences. Admission to the Major program will be in U2, upon completion of the U1 required courses, and in consultation with the student's adviser.

If not previously taken, CHEM 212 "Introductory Organic Chemistry 1" must be completed in addition to the 64-65 program credits.

Students may complete this program with a minimum of 64 credits or a maximum of 65 credits depending on their choice of complementary courses.

U1 Required Courses (18 credits)

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 222	(4)	Introductory Organic Chemistry 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

U2 and U3 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOL 301	(4)	Cell and Molecular Laboratory
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

PHGY 488	(3)	Stem Cell Biology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Cellular Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 531	(3)	Topics in Applied Immunology
PHGY 550	(3)	Molecular Physiology of Bone
	(3)	Cellular and Molecular Physiology

BIOL 468	(6)	Independent Research Project 3
BIOL 518	(3)	Advanced Topics in Cell Biology

REDM 410	(3)	Writing Research Articles

10.31.6 Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (79 credits)

Required Courses (70 credits)

Bio-Physical Sciences Core

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 395	(1)	Quantitative Biology Seminar
MATH 222	(3)	Calculus 3
MATH 223*	(3)	Linear Algebra
MATH 247*	(3)	Honours Applied Linear Algebra
MATH 315**	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
MATH 325**	(3)	Honours Ordinary Differential Equations

* Students may take either MATH 223 or MATH 247.

** Students may take either MATH 315 or MATH 325.

Physiology and Mathematics Core

BIOL 309	(3)	Mathematical Models in Biology
BMDE 519	(3)	Biomedical Signals and Systems
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 248***	(3)	Honours Vector Calculus
MATH 314***	(3)	Advanced Calculus
MATH 317	(3)	Numerical Analysis
MA	(3)	Introduction to Partial Differential Equations

3 credits, one of:

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience

3 credits, one of:

PHYS 413	(3)	Physical Basis of Physiology
PHYS 519	(3)	Advanced Biophysics

10.31.7 Bachelor of Science (B.Sc.) - Major Physiology and Physics (82 credits)

This program provides a firm foundation in physics, mathematics, and physiology. It is appropriate for students interested in applying methods of the physical sciences to problems in physiology and allied biological sciences.

Required Courses (76 credits)

Bio-Physical Sciences Core

ysics	(4)	Introduction to Physical Molecular and Cell Biology

PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 346	(3)	Majors Quantum Physics

*** Students may take either MATH 248 or MATH 314.

Complementary Courses (6 credits)

3 credits, one of:

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience

3 credits, one of:

PHYS 413	(3)	Physical Basis of Physiology
PHYS 519	(3)	Advanced Biophysics

10.31.8 Bachelor of Science (B.Sc.) - Honours Physiology (75 credits)

All admissions to the Honours program will be in U2, and the student must have a U1 GPA of 3.30, with no less than a B in PHGY 209 and PHGY 210. Admission to U3 requires a U2 CGPA of 3.20 with no less than a B in U2 Physiology courses. Decisions for admission to U3 will be heavily influenced by student standing in U2 courses.

The Department reserves the right to restrict the number of entering students in the Honours program. Students who do not maintain Honours standing may transfer their registration to the Major program in Physiology.

The deadline to apply to the Honours program is August 23, 2019. Application forms are available online at physiology.med@mcgill.ca or a hard copy can be picked up at McIntyre 1021. Please contact Sonia Viselli, Student Affairs Officer (sonia.viselli@mcgill.ca; 514-398-3689) for more information. An email will be sent to acknowledge receipt of your application.

Graduation: To graduate from the Honours Physiology program, the student will have a CGPA of 3.20 with a mark no less than a B in all Physiology courses.

If not previously taken, CHEM 212 Introductory Organic Chemistry 1 must be completed in addition to the 75 program credits.

Required Courses (60 credits)

ANAT 261	(4)	Introduction to Dynamic Histology
BIOC 311	(3)	Metabolic Biochemistry
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics

PHGY 351	(3)	Research Techniques: Physiology
PHGY 359D1	(.5)	Tutorial in Physiology
PHGY 359D2	(.5)	Tutorial in Physiology
PHGY 459D1	(3)	Physiology Seminar
PHGY 459D2	(3)	Physiology Seminar
PHGY 461D1	(4.5)	Experimental Physiology
PHGY 461D2	(4.5)	Experimental Physiology

Complementary Courses (15 credits)

9 credits selected as follows:

3 credits, one of:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

3 credits, one of:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science
PSYC 305	(3)	Statistics for Experimental Design

3 credits, one of:

BIOC 312	(3)	Biochemistry of Macromolecules
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

6 credits selected from the Upper-Level Physiology (ULP) course list as follows:

BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology

PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Cellular Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 531	(3)	Topics in Applied Immunology
PHGY 550	(3)	Molecular Physiology of Bone
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

10.31.9 Physiology (PHGY) Related Programs

10.31.9.1 Interdepartmental Honours in Immunology

For more information, see *section 10.18: Immunology*. This program is offered by the Departments of Biochemistry, Microbiology and Immunology, and Physiology.

Students interested in the program should contact:

Dr. Monroe Cohen
Physiology
Telephone: 514-398-4342
Email: *monroe.cohen@mcgill.ca*

OR

Dr. C. Piccirillo
Microbiology and Immunology
Telephone: 514-Dino51ino2l.chone: 514-DeFC313 449.141 Tm(elxm tC nhone: nfo46 7.52 369.021 Tm(Email:)Tj0 0 1 rg0 0 1 RG/F2 8.1 Tf1 0 0 1 16 7.52 369.0

Courses	
PSYT 400D1/PSYT 400D2	Research Project in Psychiatry
PSYT 455	Neurochemistry
PSYT 500	Advances: Neurobiology of Mental Disorders
PSYT 502	Brain Evolution and Psychiatry
PSYT 503	Mental Health Services and Policy
PSYT 504	Issues in Forensic Mental Health
PSYT 515	Advanced Studies in Addiction

10.33 Psychology (PSYC)

10.33.1 Location

2001 McGill College, Room 740
Montreal QC H3A 1G1
Telephone: 514-398-6100
Fax: 514-398-4896
Email: *info@psych.mcgill.ca*
Website: *www.mcgill.ca/psychology*

10.33.2 About Psychology

The Department of Psychology offers programs in both Arts and Science. All B.A. programs in Psychology can be found in *Faculty of Arts* > *Undergraduate* > *Browse Academic Units & Programs* > *: Psychology (PSYC)*.

Psychology is the scientific study of mind and behaviour. It is both a **social** and a **biological** science.

- As a **social science**, psychology examines the social nature of human beings and the influence that culture, group membership, and relationships have on individual personality, thought, and behaviour.
- As a **biological science**, psychology seeks to identigy ps ha

Students who are interested in psychology as a career must pursue graduate studies. Persons who hold graduate degrees in Psychology, usually the Ph.D., may find employment in universities, research institutes, hospitals, community agencies, government departments, large corporations, or may act as self-employed consultants. At the graduate level, psychology has many specialized branches including social psychology, physiological psychology, experimental psychology, clinical psychologye

Emeritus Professors

D.J. Levitin; A.B.(Stan.), M.S., Ph.D.(Ore.) (*James McGill Professor*)

A.A.J. Marley; B.Sc.(Birm.), Ph.D.(Penn.)

R. Melzack; B.Sc., M.Sc., Ph.D.(McG.) (*E.P. Taylor Emeritus Professor of Psychology*)

D.S. Moskowitz; B.S.(Kirkland), M.A., Ph.D.(Conn.)

Y. Oshima-Takane; B.A.(TWCU.), M.A.(Tokyo), Ph.D.(McG.)

R.O. Pihl; B.A.(La

Assistant Professors

J. Britt; B.A.(Colo.), Ph.D(Balt.)

C. Falk; B.Sc.(Wisc. Madison), M.A., Ph.D.(Br. Col)

at least 3, but no more than 6, credits selected from:

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

18-21 credits selected from Psychology courses at the 300 level or above.

10.33.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Psychology (45 credits)

This Core Science Component Psychology requires the completion of 45 credits in Psychology, all of which need to be passed with a minimum grade of C. A prerequisite to the program is PSYC 100 or equivalent. Students completing a Liberal Program with a Core Science Component Psychology must also complete at least one breadth component in a second area.

Recommended Background

It is expected that most students who enter the Liberal program in Psychology will have taken introductory psychology, biology, and statistics at the collegial level. Recommended CEGEP courses include Psychology 350-101 or 350-102 or equivalent; Biology CEGEP objective 00UK, 00XU or equivalent; and Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-level statistics course to be exempt from PSYC 204. In the first year, those students who have not taken the recommended collegial-level statistics course, or those who have obtained a grade below 75%, must take Psychology PSYC 204. Those who have not taken Introductory Psychology in CEGEP must take PSYC 100.

Required Course (3 credits)

PSYC 204	(3)	Introduction to Psychological Statistics

Complementary Courses (42 credits)

9 credits from:

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

List A

6 credits in Psychology from List A (Behavioural Neuroscience, Cognition and Quantitive Methods).

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	The Psychology of Pain
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 329	(3)	Introduction to Auditory Cognition
PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour

PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	The Psychology of Pain
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 329	(3)	Introduction to Auditory Cognition
PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour
PSYC 352	(3)	Cognitive Psychology Laboratory
PSYC 353	(3)	Laboratory in Human Perception
PSYC 403	(3)	Modern Psychology in Historical Perspective
PSYC 406	(3)	Psychological Tests
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 451	(3)	Human Factors Research and Techniques
PSYC 470	(3)	Memory and Brain
PSYC 501	(3)	Auditory Perception
PSYC 502	(3)	Psychoneuroendocrinology
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of Learning and Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 529	(3)	Music Cognition
PSYC 531	(3)	Structural Equation Models
PSYC 536	(3)	Correlational Techniques
PSYC 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication and Consciousness
PSYC 541	(3)	Multilevel Modelling
PSYC 545	(3)	Topics in Language Acquisition
PSYC 561	(3)	Methods: Developmental Psycholinguistics
PSYC 562	(3)	Measurement of Psychological Processes

List B

6 credits in Psychology from List B (Social, Health, and Developmental Psychology).

PSYC 304	(3)	Child Development
PSYC 3163)	(3)	Psychology of Deafness

PSYC 328	(3)	Health Psychology
PSYC 331	(3)	Inter-Group Relations
PSYC 332	(3)	Introduction to Personality
PSYC 333	(3)	Personality and Social Psychology
PSYC 337	(3)	Introduction to Psychopathology
PSYC 351	(3)	Research Methods in Social Psychology
PSYC 408	(3)	Principles and Applications of Psychotherapy
PSYC 409	(3)	Positive Psychology
PSYC 412	(3)	Developmental Psychopathology
PSYC 414	(3)	Social Development
PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations
PSYC 512	(3)	Advanced Personality Seminar
PSYC 528	(3)	Vulnerability to Depression and Anxiety
PSYC 530	(3)	Applied Topics in Deafness
PSYC 533	(3)	International Health Psychology
PSYC 535	(3)	Advanced Topics in Social Psychology

6 credits at the 300 level or above.

Program Prerequisites

Admission to Honours is selective. Students with a cumulative grade point average (CGPA) of 3.00 or better are eligible to apply; however, since enrolment

PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
		Beha

PSYC 337	(3)	Introduction to Psychopathology
PSYC 351	(3)	Research Methods in Social Psychology
PSYC 408	(3)	Principles and Applications of Psychotherapy
PSYC 409	(3)	Positive Psychology
PSYC 412	(3)	Developmental Psychopathology
PSYC 414	(3)	Social Development
PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 475	(3)	Neuroscience of Social Psychology
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations
PSYC 512	(3)	Advanced Personality Seminar
PSYC 528	(3)	Vulnerability to Depression and Anxiety
PSYC 530	(3)	Applied Topics in Deafness
PSYC 533	(3)	International Health Psychology
PSYC 535	(3)	Advanced Topics in Social Psychology

9 credits at the 300 level or above selected from:

Anatomy and Cell Biology (ANAT), Biochemistry (BIOC), Biology (BIOL), Chemistry (CHEM), Computer Science (COMP), Mathematics (MATH), Physiology (PHGY), Psychiatry (PYST), Psychology (PSYC).

10.34 Redpath Museum (REDM)

10.34.1 Location

Redpath Museum
859 Sherbrooke Street West
Montreal QC H3A 0C4
Telephone: 514-398-4086 ext. 3188
Fax: 514-398-3185
Email: *redpath.museum@mcgill.ca*
Website: *www.mcgill.ca/redpath*

10.34.2 About the Redpath Museum

The Redpath Museum fosters the study of the history and diversity of the natural world. Its mandate includes biological, geological, and cultural diversity, and science education. It conducts academic teaching and research activities and also provides academic services to other units. The Redpath Museum offers a B.Sc. **Minor** program in Natural History. REDM courses listed below are considered as ones taught by the Faculty of Science.

Redpath Museum Courses	
REDM 396	Undergraduate Research Project
REDM 400	Science and Museums

Redpath Museum Courses	
REDM 405	Natural History of East Africa
REDM 511	Advanced Museum-Based Science

10.34.3 Redpath Museum Faculty

Director

Hans C.E. Larsson

Emeritus Professor

Robert L. Carroll; B.Sc.(Mich.), Ph.D.(Harv.), F.R.S.C., F.L.S.

Professors

David M. Green; B.Sc.(Br. Col.), M.Sc., Ph.D.(Guelph), F.L.S.

Andrew Hendry; B.Sc.(Vic., BC), M.Sc., Ph.D.(Wash.) (*joint appt. with Biology*)

Anthony Ricciardi; B.Sc.(Agr.), M.Sc., Ph.D.(McG.) (*joint appt. with McGill School of Environment*)

Associate Professors

Hans C.E. Larsson; B.Sc.(McG.), Ph.D.(Chic.)

Virginie Millien; Maîtrise(Paris VI), DEA, Ph.D.(Montp.)

Assistant Professor

Rowan Barrett; B.Sc.(Guelph), M.Sc.(McG.), Ph.D.(Br. Col.) (*CRC Tier 2 Chair in Biodiversity Science*)

Associate Members

Biology: Graham A.C. Bell, Lauren Chapman

Chemistry: David N. Harpp (*Tomlinson Chair in University Science Teaching*)

Earth & Planetary Sciences: Jeanne Paquette

McGill School of Environment: Colin Chapman

Adjunct Professors

Robert Holmes, Henry M. Reiswig, Michael Woloch

10.34.4 Bachelor of Science (B.Sc.) - Minor Natural History (24 credits)

The Minor Natural History involves the exploration of the natural world via specimen-based studies, object-oriented investigations and field studies.228 lh3401 Tatire uj/F

ESYS 300	(3)	Investigating the Earth System
GEOG 203	(3)	Environmental Systems
GEOG 272	(3)	Earth's Changing Surface
GEOG 470	(3)	Wetlands
GEOG 550	(3)	Historical Ecology Techniques

List D: Field Studies

* Note: 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 Adviser.

BIOL 331	(3)	Ecology/Behaviour Field Course
BIOL 334	(3)	Applied Tropical Ecology
BIOL 335	(3)	Marine Mammals
BIOL 573	(3)	Vertebrate Palaeontology Field Course
ENTO 340	(3)	Field Entomology
EPSC 231	(3)	Field School 1
NRSC 405*	(3)	Natural History of East Africa
REDM 405*	(3)	Natural History of East Africa
WILD 475	(3)	Desert Ecology

10.35 Science or Mathematics for Teachers

10.35.1 Location

Dawson Hall, Room 405
853 Sherbrooke Street West
Montreal QC H3A 0G5
Email: *pete.barry@mcgill.ca*
Website: *www.mcgill.ca/scienceforteachers*

10.35.2 About Science or Mathematics for Teachers

The training and certification of school teachers has traditionally been the responsibility of the Faculty of Education and requires the completion of a Bachelor of Education, subject to regulations set by the Government of Quebec. The Faculties of Education and of Science offer the **Minor** in Education for Science Students for students in the B.Sc. who wish to combine Science or Mathematics with Education at McGill. The **Minor** allows Science students to develop or explore an interest in Education without committing themselves to completing a B.Ed. degree. Science students who have taken this Minor will have completed some of the necessary credits for the B.Ed. degree should they wish to enrol in that program. For details, see *section 10.35.4: Bachelor of Science (B.Sc.) - Minor Education for Science Students (18 credits)*.

The traditional **Bachelor of Education**, Secondary Program, Science and Technology, or Secondary Program, Mathematics is available within the Faculty of Education; see *Faculty of Education > Undergraduate > Browse Academic Units & Programs > Department of Integrated Studies in Education > : Overview of Programs (Integrated Studies in Education)*. Additionally, the **Master of Arts in Teaching and Learning** (MATL) is available in the Faculty of Education (see *Faculty of Education > Graduate > Browse Academic Units & Programs > : Integrated Studies in Education*).

10.35.3 Science or Mathematics for Teachers Faculty

Minor in Education for Science Students

Program Adviser: Jenna Prigioniero
Faculty of Education
Telephone: 514-398-7042
Website: *www.mcgill.ca/isa*

10.35.4 Bachelor of Science (B.Sc.) - Minor Education for Science Students (18 credits)

This Minor allows Science students to develop or explore an interest in Education without committing themselves to completing a B.Ed. degree. Science students who have taken this Minor in Education will have completed some of the credits for the B.Ed. degree should they wish to enrol in that program. Students graduating with a B.Sc. should also consider the Master of Arts in Teaching and Learning (http://www.mcgill.ca/dise/grad/) if they are interested in obtaining a teaching license.

This minor program requires an application due to limited enrolment space. Please see http://www.mcgill.ca/isa/faculty-advising/minor-programs for procedures and deadlines.

For more information please contact:

Internships & Student Affairs Office, Faculty of Education

General Information: 514-398-7042

Website: http://www.mcgill.ca/isa

Required Courses (6 credits)

EDEC 260	(3)	Philosophical Foundations
EDPE 300	(3)	Educational Psychology

Complementary Courses (12 credits)

3 credits from:

EDEC 233	(3)	Indigenous Education
EDEC 248	(3)	Equity and Education
EDEC 249	(3)	Global Education and Social Justice

3 credits from:

EDEC 247	(3)	Policy Issues in Quebec Education
EDEM 220	(3)	Contemporary Issues in Education

6 credits from:

* Note: Students select either EDES 335 or EDES 353.

EDEC 262	(3)	Media, Technology and Education
EDES 335*	(3)	Teaching Secondary Science 1
EDES 353*	(3)	Teaching Secondary Mathematics 1
EDPE 304	(3)	Measurement and Evaluation
EDPI 341	(3)	Instruction in Inclusive Schools

6 credits from the list below:

* Note: Students select either EDES 335 or EDES 353.

EDEC 262	(3)	Media, Technology and Education
EDES 335*	(3)	Teaching Secondary Science 1
EDES 353*	(3)	Teaching Secondary Mathematics 1
EDPE 304	(3)	Measurement and Evaluation
EDPI 341	(3)	Instruction in Inclusive Schools