



**Faculty of Science, including School of Computer
Science**

Programs, Courses and University Regulations

2013-2014

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1 About the Faculty of Science

The Faculty of Science aims to be a leader in finding solutions critical to economic and human development, including key questions in the environmental sciences, new materials, and new technologies.

To help us achieve these goals, the Faculty has recruited the best scientific minds of this generation and is committed to ensuring that our undergraduate and graduate students receive an education that prepares them for a lifetime of accomplishment. Not only will these new recruits perform key research work, they will also take on an equally important task: teaching the scientists and leaders of tomorrow. Over the next decade, many of these dynamic young academics will become world leaders in their disciplines. The process has already begun in fields as diverse as neuroscience, astrophysics, green chemistry, and earth system science.

Moreover, we are in the process of boldly transforming the way science is taught, with an increased emphasis on student/professor interaction and outreach. This new approach is reflected in the Faculty's slogan, *Learning Through Discovery*, which emphasizes hands-on research at the undergraduate level and a more personal, one-on-one style between professors and students that traditionally did not begin until the graduate level. In 2005, the Faculty opened its Office for Undergraduate Research in Science and launched a new Freshman Interest Groups program, which allows groups of 10 to 15 Freshman students to meet with a professor weekly.

The Faculty counts undergraduate students as one of its key strengths. The calibre of McGill's undergraduates is very high—they boast the highest average entrance grades in Canada—and the Faculty understands that these brilliant young minds are the key to its future.

2 History of the Faculty of Science

The study of science at McGill goes back almost two centuries, when the lower campus was a rough and muddy cow pasture and the University struggled to establish itself. In 1855, the job of principal was given to a Nova Scotia-born geologist, John William Dawson. When he arrived at McGill, Dawson laid out plans for walks and roads, and at his own expense arranged the planting of trees on the entrance avenue. More importantly, Dawson worked diligently to transform McGill from a poorly equipped provincial college into one of the best scientific institutions in the world. In 1882, he successfully lobbied for the creation of the Royal Society of Canada and brought international renown to McGill.

In the century and a half since Dawson steered the Faculty of Science onto the path of excellence, the Faculty has received numerous honours for its groundbreaking research, including Nobel prizes to seven Science alumni or Faculty members, as well as over 100 fellowships in the Royal Society of Canada. More importantly, McGill's scientists have made the world a better place in which to live and have provided answers to the deepest mysteries facing humanity. Examples of McGill's breakthroughs include the world's first effective anti-retroviral HIV drug, the theory explaining photosynthesis, and the discovery of the fastest-spinning pulsar in the known universe.

McGill's Faculty of Science has a long tradition of discovery and innovation that no other Canadian university, and only a handful of U.S. schools can match. Our long tradition of scientific leadership, and the illustrious roster of McGill researchers who changed the world—Sir Ernest Rutherford, Harriet Brooks, Ronald Melzak, Bernard Belleau, Leo Yaffe, and Vicky Kaspi, to name only a few—are key attributes.

The Faculty of Science's roots are not only strong, but they display a deep commitment to excellence. Whether it's bringing the best scientists in the world to our new Life Sciences Complex, or studying and suggesting ways in which we can help heal the Earth's fragile ecosystem, the Faculty remains committed to Dawson's vision of bringing the best to the world.

3 Programs and Teaching in Science

The Faculty of Science is committed to providing outstanding teaching and research facilities. The Faculty draws on its involvement in cutting-edge research to ensure teaching excellence at the undergraduate level. Professors who spearhead projects that change people's understanding of the world teach regularly at the undergraduate level. Also, research-based independent study courses offer you the opportunity to contribute to your professors' work, rather than just learn about it.

In an effort to supplement classroom learning with real life experience, the Faculty of Science has increased opportunities for undergraduate students to participate in fieldwork. All B.Sc. programs can include an internship component. This is on top of the many undergraduate students the Faculty hires for Work Study projects and other research programs. As a McGill Science student, you have an opportunity to get involved in the structuring of your own education.

The Faculty of Science offers programs leading to the degree of Bachelor of Science (B.Sc.). Admission is selective; fulfilment of the minimum requirements does not guarantee acceptance. Admission criteria are described in the *Undergraduate Admissions Guide*, found at www.mcgill.ca/applying.

There are also two Diploma programs offered in Science. The *Diploma in Environment*, under *Programs, Courses and University Regulations > Faculties & Schools > McGill School of Environment > Undergraduate > : Diploma in Environment (30 credits)*, is a 30-credit program available to holders of a B.Sc. or B.A. or equivalent. The *Diploma in Meteorology* is a one-year program available to holders of a degree in Mathematics, Engineering, Physics, and other appropriate disciplines who wish to qualify for a professional career in Meteorology; see [section 14.3: Atmospheric and Oceanic Sciences \(ATOC\) > section 14.3.9: Diploma in Meteorology \(30 credits\)](#). All credits for these diplomas must be completed at McGill.

The Concurrent B.Sc. and B.Ed. program is designed to provide you with the opportunity to obtain both a B.Sc. and a B.Ed. after a minimum of 135 credits of study. For more information, see [section 14.34: Science or Mathematics for Teachers](#) and [Programs, Courses and University Regulations > Faculties & Schools > Faculty of Education](#).

In addition to the Major program in Software Engineering offered in the Faculty of Science, there is also a Bachelor of Software Engineering program offered jointly with the Faculty of Engineering (refer to [Programs, Courses and University Regulations > Faculties & Schools > Faculty of Engineering > Undergraduate > Academic Programs](#) > : [Department of Electrical and Computer Engineering](#)).

Finally, the Faculties of Arts and Science jointly offer the Bachelor of Arts and Science (B.A. & Sc.), which is described under [Programs, Courses and University Regulations > Faculties & Schools > Bachelor of Arts & Science](#).

4 Revisions – Faculty of Science

Atmospheric and Oceanic Sciences

[section 14.3.10: Atmospheric and Oceanic Sciences \(ATOC\) Related Programs](#)

Biology

[section 14.5.5: Biology \(BIOL\) Faculty](#)

[section 14.5.9: Bachelor of Science \(B.Sc.\) - Major Biology - Quantitative Biology \(73 credits\)](#)

Chemistry

[section 14.7.6: Bachelor of Science \(B.Sc.\) - Minor Chemical Engineering \(24 credits\)](#)

Earth and Planetary Sciences

[section 14.10.2: About Earth and Planetary Sciences](#)

[section 14.10.10: Earth and Planetary Sciences \(EPSC\) Related Programs](#)

Mathematics and Statistics

[section 14.21.12: Bachelor of Science \(B.Sc.\) - Honours Applied Mathematics \(60 credits\)](#)

Pharmacology and Therapeutics

[section 14.28.5: Bachelor of Science \(B.Sc.\) - Major Pharmacology \(65 credits\)](#)

[section 14.28.6: Bachelor of Science \(B.Sc.\) - Honours Pharmacology \(74 credits\)](#)

Physics

[section 14.29.12: Bachelor of Science \(B.Sc.\) - Honours Physics \(78 credits\)](#)

[section 14.29.13: Bachelor of Science \(B.Sc.\) - Honours Mathematics and Physics \(81 credits\)](#)

Redpath Museum

[section 14.33.3: Redpath Museum \(REDM\) Faculty](#)

Science or Mathematics for Teachers

[section 14.34.4: Bachelor of Science \(B.Sc.\) - Minor Education for Science Students \(18 credits\)](#)

5 About the Faculty of Science (Undergraduate)

- McGill's second-largest faculty: 14 schools and departments, including the Redpath Museum, Canada's oldest museum of natural history focusing on teaching, research, and outreach; 20 research centres and institutes
- Students: 4361 undergraduate, 906 graduate, and 131 postdoctoral researchers, for a total of 5398 students
- 265 faculty members, including tenured and tenure-track professors
- Has produced seven Nobel laureates: five were Faculty of Science graduates, while two winners were Science Faculty members.

- Research budget of approximately \$40 million, including \$18 million from the Natural Sciences and Engineering Research Council of Canada, \$5 million from Quebec and increasing annually. Approximately \$150,000 generated annually per professor. Average of four papers per year.
- Faculty renewal: aided by a pool of innovative government initiatives such as the Canada Foundation for Innovation and its Canada Research Chairs program, as well as the Quebec Tax Holiday for technical workers; the Faculty has recruited 160 new professors since 2000.
- Canadian leader in Astrophysics and Cosmology, Climate Change and Extreme Weather, Green Chemistry, Life Sciences (developmental biology and cell information transfer), Earth Systems Science, Biodiversity and Conservation, Nanoscience and Social Neuroscience
- Lead faculty in the establishment of the multidisciplinary **McGill School of Environment** in 2000
- Offers top students an important **Field Studies Program**, which takes students out of the classroom and into the world to conduct research in biodiversity, climate change, volcanology, geology, and marine biology, and to work with native populations, governments, and NGOs in countries as wide-ranging as Africa, Panama, Barbados, the U.S., and Canada—all the way to Axel Heiberg Island, the University's Arctic research station.
- Established 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, Management, and the Montreal Neurological Institute in neuroengineering and brain imaging
- Spearheaded the largest and most recent construction project at McGill, 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 the Stewart Biology buildings.
- Established Canada's first comprehensive **Earth System Science Program** in 2006–2007, to study and research new forms of energy and gain a better understanding of climate change and natural hazards.
- Innovative: the **Tomlinson University Science Teaching Project** conducts groundbreaking university-level science education research, and develops innovative and effective teaching methods for science instructors.
- Inaugurated the **Office for Undergraduate Research** and the **Science Undergraduate Research Awards** to encourage top students to connect with professors during their degree program and pursue research projects in fields of interest, and established the **Freshman Interest Group** program, which provides an opportunity to meet other students, and help young students become more comfortable talking to and interacting with other professors.

5.1 Location

Dawson Hall
853 Sherbrooke Street West
Montreal, Quebec H3A 0G5
Canada

Telephone: 514-398-5442

Faculty website: www.mcgill.ca/science

Science Office for Undergraduate Student Advising (SOUSA): www.mcgill.ca/science/student

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, on the ground floor. SOUSA serves students in the B.Sc. and B.A. & Sc. degrees.

5.2 Administrative Officers

Dean

Martin Grant; B.Sc.(PEI), M.Sc., Ph.D.(Tor.)

Associate Dean (Academic)

Laurie Hendren; B.Sc., M.Sc.(Qu.), Ph.D.(C'nell)

Director of Advising Services

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

Associate Dean (Research and Graduate Education)

Peter Grütter; Ph.D.(Basel) (*James McGill Professor*)

Chief Academic Adviser

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

Assistant to the Dean

Josie D'Amico

5.3 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.

6 Faculty Admission Requirements

For information about admission requirements for the B.Sc., please refer to the *Undergraduate Admissions Guide*, found at www.mcgill.ca/applying.

For information about inter-faculty transfers, refer to *Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > Registration > : Interfaculty Transfer* as well as the relevant information posted on the SOUSA website at www.mcgill.ca/science/student/general/transfer.

7 Faculty Degree Requirements

Each student in the Faculty of Science must be aware of the Faculty regulations as stated in this publication and on the McGill, Science, and SOUSA websites.

While departmental and faculty advisers and staff are always available to give advice and guidance, the ultimate responsibility for completeness and correctness of course selection and registration, for compliance with, and completion of, program and degree requirements, and for the observance of regulations and deadlines, *rests with you*. It is your responsibility to seek guidance from the Science Office for Undergraduate Student Advising (SOUSA) if in any doubt; misunderstanding or misapprehension will not be accepted as cause for dispensation from any regulation, deadline, program, or degree requirement.

To be eligible for a B.Sc. degree, you must fulfil all Faculty and program requirements as indicated below:

Faculty and program requirements

[section 7.1: Minimum Credit Requirement](#)

[section 7.2: Residency Requirement](#)

[Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > Student Records > : Grading and Grade Point Averages \(GPA\)](#)

[section 7.3: Time and Credit Limit for the Completion of the Degree](#)

[section 7.4: About Program Requirements](#)

[section 7.5: Course Requirements](#)

7.1 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.

7.1.1 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, consult: www.mcgill.ca/students/transferecredit.

7.1.2 Equivalencies for Non-Basic Science Courses

Note that equivalencies for some non-basic science courses, such as CHEM 212 and CHEM 222 and PSYC 204, are granted on a per-CEGEP basis. In some cases, a grade greater than the minimum passing grade may be required. For more information about equivalences for non-basic Science courses, please consult: www.mcgill.ca/students/transferecredit/prospective/cegep.

If the CEGEP and/or course is not listed on this website, you should refer to the SOUSA website and follow the instructions for Advanced Standing for students admitted to McGill from CEGEP: www.mcgill.ca/science/student/newstudents/u1/orientation.

7.1.3 Readmission after Interruption of Studies for a Period of Five Consecutive Years or More

If you are readmitted after interrupting your studies for a period of five consecutive years or more, you may be required to complete a minimum of 60 credits and satisfy the requirements of a program. In this case, a new CGPA will be calculated. The Director of Advising Services, in consultation with the appropriate department, may approve a lower minimum for students who had completed 60 credits or more before interrupting their studies.

If you are readmitted after a period of absence, you are subject to the program and degree requirements in effect at the time of readmission. The Director of Advising Services, in consultation with the department, may approve exemption from any new requirements.

7.2 Residency Requirement

To obtain a B.Sc. degree, you must satisfy the following residency requirements: a minimum of 60 credits of courses used to satisfy the B.Sc. degree requirements must be taken and passed at McGill, exclusive of any courses completed as part of the Science Freshman program; see [section 14.1: B.Sc. Freshman Program](#). At least two-thirds of all departmental program requirements (Honours, Major, Core Science Components, or Minor) must normally be completed at McGill not including courses completed in a prior McGill degree. Exceptionally, students in major concentrations or interfaculty or honours programs who pursue an approved Study Away or Exchange program may, with prior approval from both their department and the Director of Advising Services, Faculty of Science, be exempted from the two-thirds rule. In addition, some departments may require that their students complete specific components of their program at McGill.

The residency requirement for diploma programs is 30 credits completed at McGill.

7.3 Time and Credit Limit for the Completion of the Degree

If you need 96 or fewer credits to complete your degree requirements, you are expected to complete your degree in no more than eight terms after your initial registration for the degree.

If you are a student in the Freshman Program, you become subject to these regulations one year after your initial registration. If you want to exceed this time limit, you must seek permission of the Director of Advising Services of the Faculty of Science.

If you are registered in the B.Sc., you are expected to complete the requirements of your program and your degree within 120 credits. You will receive credit for all courses (subject to degree regulations) taken up to and including the semester in which you obtain 120 credits. If you want to remain at McGill beyond that semester, you must also seek permission of the Director of Advising Services, Faculty of Science. Permission for exceeding the time and/or credit limits will normally be granted only for valid academic reasons, such as a change of program (subject to departmental approval) and part-time status. If permission is granted, you will receive credit only for required and complementary courses necessary to complete your program requirements.

7.4 About 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.

7.4.1 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:

7.4.1.1 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 11.2: Minor Programs](#).
- Arts Minor or Major Concentration (18 or 36 credits) – one of the programs listed in [section 11.6: Faculty of Arts Major and Minor Concentration Programs Available 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.

7.4.1.2 Major Programs

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

7.4.1.3 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.

7.4.2 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 11.2: Minor Programs](#); for minor concentrations that are approved for Science students, see [section 11.6: Faculty of Arts Major and Minor Concentration Programs Available to Science Students](#).

7.4.3 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. A minimum of 36 new credits must be completed in the second program.

7.4.4 Concurrent B.Sc. and B.Ed. Program

The Concurrent B.Sc. and B.Ed. program described in [section 14.34: Science or Mathematics for Teachers](#) is designed to provide you with the opportunity to obtain both a B.Sc. and a B.Ed. after a minimum of 135 credits of study.



Note: The Concurrent B.Sc. and B.Ed. program is no longer accepting new students as of Fall 2011.

For more information, see the [B.Sc. and B.Ed. website](#) or contact Pete Barry, email: pete.barry@mcgill.ca.

7.4.5 Internship Year in Science (IYS)

All B.Sc. programs can include an internship component. For more details, students should refer to [section 13.1: Industrial Practicum \(IP\) and Internship Year in Science \(IYS\)](#), [section 11.5: Internship Programs – Industrial Practicum \(IP\) and Internship Year in Science \(IYS\)](#), and www.mcgill.ca/science/student/internships-field.

7.4.6 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 *Programs, Courses and University Regulations > Faculties & Schools > McGill School of Environment*.

7.5 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.

7.5.1 Course Overlap

You will not receive additional credit towards your degree for any course that overlaps in content with a course for which you have already received credit at McGill, at another university, at CEGEP, or for Advanced Placement, Advanced Level, International Baccalaureate, or French Baccalaureate results. It is your responsibility to consult the Science Office for Undergraduate Student Advising (SOUA) 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/students/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.

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

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, 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.
- If you have already received credit for MATH 324 or MATH 357, you 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, you must consult a program adviser to ensure that no significant overlap exists. Where such overlap exists with a course for which you have already received credit, credit for the 500-level course will not be allowed.
- 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.
- PSYC 204 may not be taken if a grade of 75% or better was received in an equivalent course completed at CEGEP.

7.5.2 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 (www.mcgill.ca/science/student/continuingstudents/bsc/outside). You may take courses on the approved list and may not, under any circumstances, take courses on the not-approved list for credit. Requests for permission to take courses that are not on either list should be addressed to the Director of Advising Services.

The regulations are as follows:

- You may take only 6 credits per year, up to 18 credits in all, of courses outside the Faculties of Arts and of Science.
- Courses offered "in the Faculty of Science" or "in the Faculty of Arts" are found under *Programs, Courses and University Regulations > All Courses* (available at www.mcgill.ca/study) when filtered by "Faculty of Science" or by "Faculty of Arts."
- Courses in other faculties that are considered as taught by Science (e.g., BIOT, EXMD, and PHAR) are so designated as offered by the "Faculty of Science" under *Programs, Courses and University Regulations > All Courses* (available at www.mcgill.ca/study).
- Courses in Music are considered as outside the Faculties of Arts and of Science, except MUAR courses, which are considered as Arts courses.
- All courses listed in the Religious Studies (RELG) section are considered as courses in Arts and Science except for courses restricted to B.Th. or S.T.M. students and courses that require permission of the Chair of the B.Th. Committee.

- Students should consult the list of restricted courses outside of the Faculties of Arts and of Science on the SOUSA website (www.mcgill.ca/science/student).
- You must have the necessary prerequisites and permission of the instructor for such courses.
- Credit for computer and statistics courses offered by faculties other than Arts and Science requires the permission of the Director of Advising Services and will be granted only under exceptional circumstances.
- If you use Minerva to register for a course, and it exceeds the specified limitations or it is not approved, the course will be flagged for no credit after the course change period.
- Credit will not be given for any “how to” courses offered by other faculties that are intended to provide you with only practical or professional training in specific applied areas. Examples include courses that teach the use of certain computer packages (databases, spreadsheets, etc.) or computer languages (SQL, COBOL, FORTRAN, etc.), machine shop or electronic shop courses, technical drawing courses, and professional practice courses.
- As a student in the **McGill School of Environment**, you may exceed the 18-credit limit for courses outside the Faculties of Arts and of Science, provided that all such courses are necessary to complete your program of study.
- As a student in the **Major in Software Engineering**, you may exceed the 18-credit limit for courses outside the Faculties of Arts and of Science, provided that all such courses are necessary to complete your program of study.
- As a student in the B.Sc. Liberal Program taking a **Major Concentration in Music**, you may exceed the 18-credit limit for courses outside the Faculties of Arts and of Science, provided that all such courses are necessary to complete your program of study, up to a maximum of 36 Music credits.
- If you registered in the **Minor in Management before September 2007**, you may take 21 credits of courses outside the Faculties of Arts and of Science.
- The 18-credit limit applies to students taking the **Minor in Nutrition**; equivalent courses in Science should be taken instead of courses in the Faculty of Agricultural and Environmental Sciences.

7.5.3 Correspondence, Distance Education, or Web-based Courses

As a Science student, you may obtain transfer credit for correspondence, distance education, or web-based courses if you receive prior approval from the appropriate McGill department for the course content **and** prior approval from the Director of Advising Services, Science, for the method of delivery and evaluation. Courses taught through distance education from institutions other than McGill will only be considered for transfer credits under the following conditions:

- The course is given by a government-accredited, degree-granting institution acceptable to McGill.
- The course counts for credit toward degrees granted at the institution giving the course.
- The combined total of regular course credits and distance education course credits do not exceed the permitted maximum number of credits per term according to Faculty regulations.
- Courses taught through distance education may not be used to complete program requirements, except on an individual basis when serious, documented circumstances warrant it.

7.5.4 Courses in English as a Second Language (ESL)

ESL courses are only open to students whose primary language is not English and who have studied for fewer than five years in English-language secondary institutions. As a student in the B.Sc., you may take a maximum of 12 credits, including academic writing courses for non-anglophones, from the list of ESL courses published at www.mcgill.ca/science/student/continuingstudents/bsc/outside.

7.5.5 Registration for First-Year Seminars

Registration for First-Year Seminars is limited to students in their first year of study at McGill, i.e., newly admitted students in U0 or U1. These courses are designed to provide a closer interaction with professors and better working relations with peers than is available in large introductory courses. These seminars endeavour to teach the latest scholarly developments and expose participants to advanced research methods. Registration is on a first-come, first-served basis. The maximum number of students in any seminar is 25, although some are limited to even fewer than that.

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
PSYC 199	FYS: Mind-Body Medicine
PSYT 199	FYS: Mental Illness and the Brain

The First-Year Seminars offered by the Faculty of Arts are also open to Science students. For a complete listing, please consult *Programs, Courses and University Regulations > Faculty of Arts > Undergraduate > Academic Programs > : First-Year Seminars*.

7.5.6 Course Credit Weight

The credit assigned to a particular course should reflect the amount of effort it demands of you. Normally, one credit will represent three hours total work per week for one term—including a combination of lecture hours, other contact hours, such as laboratory periods, tutorials, and problem periods, as well as personal study time.

8 Advising

If you need 96 or fewer credits to complete your degree requirements, you must consult an academic adviser in your proposed department of study to obtain advice and approval of your course selection. Quebec students with a Diploma of Collegial Studies in Science have normally taken the equivalent of, and are therefore exempt from, the 100-level basic science courses in Biology, Chemistry, Mathematics, and Physics. Such students may also be exempt from some 200-level courses. If you are a student with satisfactory results in International Baccalaureate, French Baccalaureate, Advanced Levels, and Advanced Placement tests, you may also be exempt from some or all of the Science Freshman courses. To facilitate program planning, you must present your transcript(s) and letter of admission. For a detailed description of advising and registration procedures, you should refer to *Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > : Undergraduate Advising*, to *Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > : Registration*, and to the website for newly admitted undergraduate students at www.mcgill.ca/newstudents, as well as to the information posted on the SOUSA website at www.mcgill.ca/science/student/newstudents/u1, and the departmental websites.

If you need 97–120 credits to complete your degree requirements, you will normally be registered in a Freshman program until you complete your first year. You must consult a SOUSA adviser in the Science Office for Undergraduate Student Advising to obtain advice and approval of your course selection. For a detailed description of advising and registration procedures as a Freshman student, you should refer to the website for newly admitted undergraduate students at www.mcgill.ca/newstudents, and to the information on the SOUSA website at www.mcgill.ca/science/student/newstudents/u0.

Advising for all returning students takes place in March for the upcoming academic year. For more information, you should refer to the information on the SOUSA website, www.mcgill.ca/science/student/continuingstudents.

9 Freshman Interest Groups

Freshman Interest Groups (FIGs) are groups of approximately 15 U0 students and U1 students in their first semester, in the B.Sc. or B.A. & Sc., led by a professor in the Faculty of Science or Faculty of Medicine and an upper-year undergraduate student. They meet once every two weeks in the Fall semester to discuss a wide range of topics, such as science in the news, program choices, undergraduate research opportunities, or just aspects of life in Montreal. The purpose of a FIG is to ease the transition to McGill and Montreal and to provide you an opportunity to interact with a professor and with other U0 students in a small group. FIGs carry no credit and there is no charge. For more information and to see how to register, refer to www.mcgill.ca/science/student/fig.

10 Examinations

Students should refer to *Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > : Examinations: General Information* for information about final examinations and deferred examinations. Note that for the Faculty of Science, *Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > : Final Examinations: University Regulations Concerning Final Examinations* applies to courses up to and including the 500 level.

The exam schedules are posted on the McGill website, www.mcgill.ca/students/exams, normally one month after the start of classes for the Tentative Exam Schedule, and two months after the start of classes for the Final Examination Schedule.

Students are warned not to make travel arrangements to leave Montreal prior to the scheduled end of any examination period.

11 Overview of Programs Offered

Programs Offered

section 11.1: Bachelor of Science Program Groups, which may include Liberal Program – Core Science Components, Major Programs, Joint Major Programs, Honours Programs, and Joint Honours Programs

section 11.2: Minor Programs

section 7.4.4: Concurrent B.Sc. and B.Ed. Program (Note: The Concurrent B.Sc. and B.Ed. program is no longer accepting new students as of Fall 2011.)

Programs Offered

section 11.4: Bachelor of Arts and Science

section 7.4.5: Internship Year in Science (IYS)

section 13: Science Internships and Field Studies

section 11.6: Faculty of Arts Major and Minor Concentration Programs Available to Science Students

11.1 Bachelor of Science Program Groups

Science students admitted after September 2009 are limited to choosing liberal, majors, or honours programs within the Science group to which they were admitted, but may continue to choose freely from all available minor programs. Students pursuing a Liberal Science Program – Core Science Component (CSC) may also select a second CSC from any group. See *section 7.4.1: Liberal, Major, and Honours Programs*.

The groups within the B.Sc. are:

- Biological, Biomedical & Life Sciences
- Microbiology & Immunology
- Neuroscience
- Physical, Earth, Math & Computer Science
- Concurrent B.Sc./B.Ed. (Note that as of September 2011, no new students are being admitted to this group.)

For a list of specific programs in each group, see:

- *section 11.1.1: Biological, Biomedical & Life Sciences Group*
- *section 11.1.2: Microbiology and Immunology Group*
- *section 11.1.3: Neuroscience Group*
- *section 11.1.4: Physical, Earth, Math & Computer Science Group*
- *section 11.3: Concurrent B.Sc. and B.Ed. Program (Science or Mathematics for Teachers)* (Note that as of September 2011, no new students are being admitted to this group.)

To change to a major or honours program in another Science group, students must make an Intra-Faculty Transfer application.

See: www.mcgill.ca/science/student/general/transfer.

11.1.1 Biological, Biomedical & Life Sciences Group**11.1.1.1 Liberal Program – Core Science Components**

- Anatomy and Cell Biology: *section 14.2.4: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Anatomy and Cell Biology (48 credits)*
- Biochemistry: *section 14.4.5: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biochemistry (47 credits)*
- Biology: *section 14.5.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biology (47 credits)*
- Physiology: *section 14.30.4: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physiology (50 credits)*
- Psychology: *section 14.32.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Psychology (45 credits)*

11.1.1.2 Major Programs

- Anatomy and Cell Biology: *section 14.2.5: Bachelor of Science (B.Sc.) - Major Anatomy and Cell Biology (67 credits)*
- Biochemistry: *section 14.4.6: Bachelor of Science (B.Sc.) - Major Biochemistry (67 credits)*
- Biology: *section 14.5.8: Bachelor of Science (B.Sc.) - Major Biology (59 credits)*
- Biology – Quantitative Biology: *section 14.5.9: Bachelor of Science (B.Sc.) - Major Biology - Quantitative Biology (73 credits)*
- Pharmacology: *section 14.28.5: Bachelor of Science (B.Sc.) - Major Pharmacology (65 credits)*
- Physiology: *section 14.30.5: Bachelor of Science (B.Sc.) - Major Physiology (65 credits)*
- Psychology: *section 14.32.8: Bachelor of Science (B.Sc.) - Major Psychology (54 credits)*

11.1.1.3 Joint Major Programs

- Biology and Mathematics: [section 14.5.10: Bachelor of Science \(B.Sc.\) - Major Biology and Mathematics \(76 credits\)](#)
- Computer Science and Biology: [section 14.9.11: Bachelor of Science \(B.Sc.\) - Major Computer Science and Biology \(73 credits\)](#)
- Physiology and Mathematics: [section 14.30.6: Bachelor of Science \(B.Sc.\) - Major Physiology and Mathematics \(77 credits\)](#)
- Physiology and Physics: [section 14.30.7: Bachelor of Science \(B.Sc.\) - Major Physiology and Physics \(80 credits\)](#)

11.1.1.4 Honours Programs

- Anatomy and Cell Biology: [section 14.2.6: Bachelor of Science \(B.Sc.\) - Honours Anatomy and Cell Biology \(73 credits\)](#)
- Biochemistry: [section 14.4.7: Bachelor of Science \(B.Sc.\) - Honours Biochemistry \(76 credits\)](#)
- Biology: [section 14.5.11: Bachelor of Science \(B.Sc.\) - Honours Biology \(75 credits\)](#)
- Pharmacology – application required, see departmental section for information: [section 14.28.6: Bachelor of Science \(B.Sc.\) - Honours Pharmacology \(74 credits\)](#)
- Physiology: [section 14.30.8: Bachelor of Science \(B.Sc.\) - Honours Physiology \(75 credits\)](#)
- Psychology: [section 14.32.9: Bachelor of Science \(B.Sc.\) - Honours Psychology \(60 credits\)](#)

11.1.2 Microbiology and Immunology Group**11.1.2.1 Liberal Program – Core Science Component**

- Microbiology and Immunology – application required, see [section 14.22: Microbiology and Immunology \(MIMM\)](#) for information, and [section 14.22.4: Bachelor of Science \(B.Sc.\) - Liberal Program - Core Science Component Microbiology and Immunology \(49 credits\)](#)

11.1.2.2 Major Program

- Microbiology and Immunology – application required, see [section 14.22: Microbiology and Immunology \(MIMM\)](#) for information, and [section 14.22.5: Bachelor of Science \(B.Sc.\) - Major Microbiology and Immunology \(68 credits\)](#)

11.1.2.3 Honours Programs

- Immunology (Interdepartmental) – application required, see [section 14.17: Immunology](#) for information, and [section 14.17.3: Bachelor of Science \(B.Sc.\) - Honours Immunology \(Interdepartmental\) \(75 credits\)](#)
- Microbiology and Immunology – application required, see [section 14.22: Microbiology and Immunology \(MIMM\)](#) for information, and [section 14.22.6: Bachelor of Science \(B.Sc.\) - Honours Microbiology and Immunology \(74 credits\)](#)

11.1.3 Neuroscience Group**11.1.3.1 Major Program**

- Neuroscience – application required, see [section 14.25: Neuroscience](#) for information, and [section 14.25.4: Bachelor of Science \(B.Sc.\) - Major Neuroscience \(65 credits\)](#)

11.1.3.2 Honours Program

- Neuroscience – application required, see [section 14.25: Neuroscience](#) for information, and [section 14.25.5: Bachelor of Science \(B.Sc.\) - Honours Neuroscience \(74 credits\)](#)

11.1.4 Physical, Earth, Math & Computer Science Group**11.1.4.1 Liberal Program – Core Science Components**

- Atmospheric Science: [section 14.3.5: Bachelor of Science \(B.Sc.\) - Liberal Program - Core Science Component Atmospheric and Oceanic Sciences \(48 credits\)](#)
- Chemistry – Biological option: [section 14.7.7: Bachelor of Science \(B.Sc.\) - Liberal Program - Core Science Component Chemistry - Biological \(47 credits\)](#)
- Chemistry – General option: [section 14.7.8: Bachelor of Science \(B.Sc.\) - Liberal Program - Core Science Component Chemistry - General \(49 credits\)](#)

- Chemistry – Physical option: *section 14.7.9: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - Physical (47 credits)*
- Computer Science: *section 14.9.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Computer Science (45 credits)*
- Earth and Planetary Sciences: *section 14.10.6: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Earth and Planetary Sciences (45 credits)*
- Geography: *section 14.16.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Geography (49 credits)*
- Mathematics: *section 14.21.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Mathematics (45 credits)*
- Physics: *section 14.29.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physics (48 credits)*
- Software Engineering: *section 14.9.9: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Software Engineering (49 credits)*
- Statistics: *section 14.21.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Statistics (45 credits)*

11.1.4.2 Major Programs

- Atmospheric Science: *section 14.3.6: Bachelor of Science (B.Sc.) - Major Atmospheric Science (61 credits)*
- Chemistry: *section 14.7.10: Bachelor of Science (B.Sc.) - Major Chemistry (59 credits)*
- Chemistry – Atmosphere and Environment option: *section 14.7.11: Bachelor of Science (B.Sc.) - Major Chemistry - Atmosphere and Environment (63 credits)*
- Chemistry – Bio-organic option: *section 14.7.12: Bachelor of Science (B.Sc.) - Major Chemistry - Bio-organic (63 credits)*
- Chemistry – Materials option: *section 14.7.13: Bachelor of Science (B.Sc.) - Major Chemistry - Materials (62 credits)*
- Computer Science: *section 14.9.10: Bachelor of Science (B.Sc.) - Major Computer Science (63 credits)*
- Computer Science – Computer Games option: *section 14.9.12: Bachelor of Science (B.Sc.) - Major Computer Science - Computer Games (67 credits)*
- Earth and Planetary Sciences: *section 14.10.7: Bachelor of Science (B.Sc.) - Major Earth and Planetary Sciences (66 credits)*
- Earth System Science: *section 14.11.4: Bachelor of Science (B.Sc.) - Major Earth System Science (57 credits)*
- Environment – Atmospheric Environment and Air Quality domain: *section 14.12.4: Bachelor of Science (B.Sc.) - Major Environment - Atmospheric Environment and Air Quality (60 credits)*
- Environment – Biodiversity and Conservation domain: *section 14.12.5: 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: *section 14.12.6: Bachelor of Science (B.Sc.) - Major Environment - Earth Sciences and Economics (66 credits)*
- Environment – Ecological Determinants of Health domain – Cellular: *section 14.12.7: 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: *section 14.12.8: 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: *section 14.12.9: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Environmetrics (63 credits)*
- Environment – Food Production and Environment domain: *section 14.12.10: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Food Production and Environment (63 credits)*
- Environment – Land Surface Processes and Environmental Change domain: *section 14.12.11: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Land Surface Processes and Environmental Change (63 credits)*
- Environment – Renewable Resource Management domain: *section 14.12.12: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Renewable Resource Management (63 credits)*
- Environment – Water Environments and Ecosystems domain – Biological: *section 14.12.13: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Water Environments and Ecosystems - Biological (60 credits)*
- Environment – Water Environments and Ecosystems domain – Physical: *section 14.12.14: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Water Environments and Ecosystems - Physical (63 credits)*
- Geography: *section 14.16.8: Bachelor of Science (B.Sc.) - Major Geography (58 credits)*
- Mathematics: *section 14.21.9: Bachelor of Science (B.Sc.) - Major Mathematics (54 credits)*
- Physics: *section 14.29.9: Bachelor of Science (B.Sc.) - Major Physics (60 credits)*
- Software Engineering: *section 14.9.13: Bachelor of Science (B.Sc.) - Major Software Engineering (63 credits)*

11.1.4.3 Joint Major Programs

- Atmospheric Science and Physics: *section 14.3.7: Bachelor of Science (B.Sc.) - Major Atmospheric Science and Physics (67 credits)*
- Biology and Mathematics: *section 14.5.10: Bachelor of Science (B.Sc.) - Major Biology and Mathematics (76 credits)*
- Computer Science and Biology: *section 14.9.11: Bachelor of Science (B.Sc.) - Major Computer Science and Biology (73 credits)*
- Mathematics and Computer Science – see Mathematics and Statistics: *section 14.21.10: Bachelor of Science (B.Sc.) - Major Mathematics and Computer Science (72 credits)*
- Physics and Computer Science – see Physics: *section 14.29.11: Bachelor of Science (B.Sc.) - Major Physics and Computer Science (66 credits)*

- Physics and Geophysics: [section 14.29.10: Bachelor of Science \(B.Sc.\) - Major Physics and Geophysics \(69 credits\)](#)
- Physiology and Mathematics: [section 14.30.6: Bachelor of Science \(B.Sc.\) - Major Physiology and Mathematics \(77 credits\)](#)
- Physiology and Physics: [section 14.30.7: Bachelor of Science \(B.Sc.\) - Major Physiology and Physics \(80 credits\)](#)
- Statistics and Computer Science: [section 14.21.11: Bachelor of Science \(B.Sc.\) - Major Statistics and Computer Science \(72 credits\)](#)

11.1.4.4 Honours Programs

- Applied Mathematics: [section 14.21.12: Bachelor of Science \(B.Sc.\) - Honours Applied Mathematics \(60 credits\)](#)
- Atmospheric Science: [section 14.3.8: Bachelor of Science \(B.Sc.\) - Honours Atmospheric Science \(73 credits\)](#)
- Chemistry: [section 14.7.14: Bachelor of Science \(B.Sc.\) - Honours Chemistry \(71 credits\)](#)
- Chemistry – Bio-organic option: [section 14.7.16: Bachelor of Science \(B.Sc.\) - Honours Chemistry - Bio-organic \(75 credits\)](#)
- Chemistry – Atmosphere and Environment option: [section 14.7.15: Bachelor of Science \(B.Sc.\) - Honours Chemistry - Atmosphere and Environment \(75 credits\)](#)
- Chemistry – Materials: [section 14.7.17: Bachelor of Science \(B.Sc.\) - Honours Chemistry - Materials \(74 credits\)](#)
- Computer Science: [section 14.9.14: Bachelor of Science \(B.Sc.\) - Honours Computer Science \(75 credits\)](#)
- Earth Sciences: [section 14.10.8: Bachelor of Science \(B.Sc.\) - Honours Earth Sciences \(75 credits\)](#)
- Earth System Science: [section 14.11.5: Bachelor of Science \(B.Sc.\) - Honours Earth System Science \(66 credits\)](#)
- Environment: [section 14.12.15: Bachelor of Science \(B.Sc.\) - Honours Environment \(72 credits\)](#)
- Geography: [section 14.16.9: Bachelor of Science \(B.Sc.\) - Honours Geography \(66 credits\)](#)
- Mathematics: [section 14.21.13: Bachelor of Science \(B.Sc.\) - Honours Mathematics \(60 credits\)](#)
- Physics: [section 14.29.12: Bachelor of Science \(B.Sc.\) - Honours Physics \(78 credits\)](#)
- Planetary Sciences: [section 14.10.9: Bachelor of Science \(B.Sc.\) - Honours Planetary Sciences \(81 credits\)](#)
- Probability and Statistics: [section 14.21.15: Bachelor of Science \(B.Sc.\) - Honours Probability and Statistics \(64 credits\)](#)
- Software Engineering: [section 14.9.15: Bachelor of Science \(B.Sc.\) - Honours Software Engineering \(75 credits\)](#)

11.1.4.5 Joint Honours Programs

- Mathematics and Computer Science: [section 14.21.14: Bachelor of Science \(B.Sc.\) - Joint Honours Mathematics and Computer Science \(75 credits\)](#)
- Mathematics and Physics: [section 14.29.13: Bachelor of Science \(B.Sc.\) - Honours Mathematics and Physics \(81 credits\)](#)
- Physics and Chemistry: [section 14.29.14: Bachelor of Science \(B.Sc.\) - Honours Physics and Chemistry \(80 credits\)](#)
- Statistics and Computer Science: [section 14.21.16: Bachelor of Science \(B.Sc.\) - Honours Statistics and Computer Science \(79 credits\)](#)

11.2 Minor Programs

Minor Programs

Atmospheric Science, [section 14.3.4: Bachelor of Science \(B.Sc.\) - Minor Atmospheric Science \(18 credits\)](#)

Biology, [section 14.5.6: Bachelor of Science \(B.Sc.\) - Minor Biology \(25 credits\)](#)

Biotechnology, [section 14.6.5: Bachelor of Science \(B.Sc.\) - Minor Biotechnology \(for Science Students\) \(24 credits\)](#)

Chemical Engineering, [section 14.7.6: Bachelor of Science \(B.Sc.\) - Minor Chemical Engineering \(24 credits\)](#)

Chemistry, [section 14.7.5: Bachelor of Science \(B.Sc.\) - Minor Chemistry \(18 credits\)](#)

Cognitive Science, [section 14.8.2: Bachelor of Science \(B.Sc.\) - Minor Cognitive Science \(24 credits\)](#)

Computer Science, [section 14.9.7: Bachelor of Science \(B.Sc.\) - Minor Computer Science \(24 credits\)](#)

Earth System Science, [section 14.11.3: Bachelor of Science - Minor Earth System Science \(18 credits\)](#)

Education for Science Students, [section 14.34.4: Bachelor of Science \(B.Sc.\) - Minor Education for Science Students \(18 credits\)](#)

Electrical Engineering, [section 14.29.7: Bachelor of Science \(B.Sc.\) - Minor Electrical Engineering \(24 credits\)](#)

Environment, [section 14.12.3: Bachelor of Science \(Agricultural and Environmental Sciences\) \(B.Sc.\(Ag.Env.Sc.\)\) or Bachelor of Science \(B.Sc.\) - Minor Environment \(18 credits\)](#)

Field Study, [section 14.14.1: Field Studies - Minor Field Studies \(18 credits\)](#)

Minor Programs

Finance for Non-Management Students, *section 14.20.1: Minor Finance (For Non-Management Students) (18 credits)*

General Science, *section 14.15.3: Bachelor of Science (B.Sc.) - Minor General Science (18 credits)*

Geochemistry, *section 14.10.5: Bachelor of Science (B.Sc.) - Minor Geochemistry (18 credits)*

Geography, *section 14.16.5: Bachelor of Science (B.Sc.) - Minor Geography (18 credits)*

Geographic Information Systems and Remote Sensing, *section 14.16.6: Bachelor of Science (B.Sc.) - Minor Geographic Information Systems and Remote Sensing (18 credits)*

Geology, *section 14.10.4: Bachelor of Science (B.Sc.) - Minor Geology (18 credits) (previously named Earth and Planetary Sciences)*

Human Nutrition – see *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Agricultural and Environmental Sciences > Undergraduate > Academic Programs > : Minor Human Nutrition (24 credits)*

Interdisciplinary Life Sciences, *section 14.18.3: Bachelor of Science (B.Sc.) - Minor Interdisciplinary Life Sciences (24 credits)*

Kinesiology, *section 14.19.3: Bachelor of Science (B.Sc.) - Minor Kinesiology (24 credits)*

Management for Non-Management Students, *section 14.20.2: Minor Management (For Non-Management Students) (18 credits)*

Marketing for Non-Management Students, *section 14.20.3: Minor Marketing (For Non-Management Students) (18 credits)*

Mathematics, *section 14.21.5: Bachelor of Science (B.Sc.) - Minor Mathematics (24 credits)*

Musical Applications of Technology – see *Programs, Courses and University Regulations > Faculties & Schools > Schulich School of Music > Undergraduate > : Minor Musical Applications of Technology (18 credits)*

Musical Science and Technology – see *Programs, Courses and University Regulations > Faculties & Schools > Schulich School of Music > Undergraduate > : Minor Musical Science and Technology (18 credits)*

Natural History, *section 14.33.4: Bachelor of Science (B.Sc.) - Minor Natural History (24 credits)*

Neuroscience, *section 14.25.3: Bachelor of Science (B.Sc.) - Minor Neuroscience (25 credits)*

Operations Management for Non-Management Students, *section 14.20.4: Minor Operations Management (For Non-Management Students) (18 credits)*

Pharmacology, *section 14.28.4: Bachelor of Science (B.Sc.) - Minor Pharmacology (24 credits)*

Physics, *section 14.29.6: Bachelor of Science (B.Sc.) - Minor Physics (18 credits)*

Psychology, *section 14.32.6: Bachelor of Science (B.Sc.) - Minor Psychology (24 credits)*

Statistics, *section 14.21.6: Bachelor of Science (B.Sc.) - Minor Statistics (24 credits)*

Technological Entrepreneurship for Science Students – application required, see *program listing: section 14.35.3: Bachelor of Science (B.Sc.) - Minor Technological Entrepreneurship for Science Students (18 credits) (Please note that this Minor is currently under review.)*

**Notes:**

1. The Minor in Chemical Engineering is only available to students in Chemistry.
2. The Minor in Electrical Engineering is only available to students in the Major program in Physics.
3. The Minor in General Science is only available to students in B.Sc. Liberal programs.

11.3 Concurrent B.Sc. and B.Ed. Program (Science or Mathematics for Teachers)

Note: The Concurrent B.Sc. and B.Ed. program is no longer accepting new students as of Fall 2011.

Concurrent B.Sc. and B.Ed. Programs (see *section 14.34: Science or Mathematics for Teachers*)

Major in Mathematics for Teachers – *section 14.34.13: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Mathematics for Teachers (135 credits)*

Major Concentration in Biology with a Minor in Chemistry for Teachers – *section 14.34.5: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Chemistry for Teachers (135 credits)* or *section 14.34.6: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Chemistry for Teachers (135 credits)*

Concurrent B.Sc. and B.Ed. Programs (see [section 14.34: Science or Mathematics for Teachers](#))

Major Concentration in Biology with a Minor in Physics for Teachers – [section 14.34.7: Concurrent Bachelor of Science \(B.Sc.\) and Bachelor of Education \(B.Ed.\) - Major Concentration Biology - Cell/Molecular with Minor Physics for Teachers \(135 credits\)](#) or [section 14.34.8: Concurrent Bachelor of Science \(B.Sc.\) and Bachelor of Education \(B.Ed.\) - Major Concentration Biology - Organismal with Minor Physics for Teachers \(135 credits\)](#)

Major Concentration in Chemistry with a Minor in Biology for Teachers – [section 14.34.9: Concurrent Bachelor of Science \(B.Sc.\) and Bachelor of Education \(B.Ed.\) - Major Concentration Chemistry with Minor Biology for Teachers \(135 credits\)](#)

Major Concentration in Chemistry with a Minor in Physics for Teachers – [section 14.34.10: Concurrent Bachelor of Science \(B.Sc.\) and Bachelor of Education \(B.Ed.\) - Major Concentration Chemistry with Minor Physics for Teachers \(135 credits\)](#)

Major Concentration in Physics with a Minor in Biology for Teachers – [section 14.34.11: Concurrent Bachelor of Science \(B.Sc.\) and Bachelor of Education \(B.Ed.\) - Major Concentration Physics with Minor Biology for Teachers \(135 credits\)](#)

Major Concentration in Physics with a Minor in Chemistry for Teachers – [section 14.34.12: Concurrent Bachelor of Science \(B.Sc.\) and Bachelor of Education \(B.Ed.\) - Major Concentration Physics with Minor Chemistry for Teachers \(135 credits\)](#)

11.4 Bachelor of Arts and Science

Please see *Programs, Courses and University Regulations > Faculties & Schools > [Bachelor of Arts and Science](#)* for details.

11.5 Internship Programs – Industrial Practicum (IP) and Internship Year in Science (IYS)

The Faculty of Science offers an internship program which features the Industrial Practicum (4 months) and the Internship Year in Science (8, 12, 16 months). Participating in an internship offers you the chance to add a practical element to your studies, to solidify your career goals, to gain some valuable experience, and to earn money.

It will also give you the opportunity to enhance your degree: if you complete two IPs or participate in an IYS, the name of your program will change to include the word internship (e.g., Bachelor of Science – Internship Program – Biology).

To learn more about the Science internship programs, visit www.mcgill.ca/science/student/internships-field.

11.6 Faculty of Arts Major and Minor Concentration Programs Available to Science Students

For more information, please see the relevant departmental entries under *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Arts > [Undergraduate](#)*.

11.6.1 Major Concentrations**Major Concentrations**

African Studies, : [Bachelor of Arts \(B.A.\) - Major Concentration African Studies \(36 credits\)](#)

Anthropology, : [Bachelor of Arts \(B.A.\) - Major Concentration Anthropology \(36 credits\)](#)

Art History, : [Bachelor of Arts \(B.A.\) - Major Concentration Art History \(36 credits\)](#)

Canadian Studies, : [Bachelor of Arts \(B.A.\) - Major Concentration Canadian Studies \(36 credits\)](#)

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 \(36 credits\)](#)

Geography (Urban Systems), : [Bachelor of Arts \(B.A.\) - Major Concentration Geography \(Urban Systems\) \(36 credits\)](#)

German Language and Literature, : [Bachelor of Arts \(B.A.\) - Major Concentration German Studies - Language and Literature \(36 credits\)](#)

German Literature and Culture, : [Bachelor of Arts \(B.A.\) - Major Concentration German Studies - Literature and Culture \(36 credits\)](#)

German Studies, Contemporary, : [Bachelor of Arts \(B.A.\) - Major Concentration Contemporary German Studies \(36 credits\)](#)

Major Concentrations

- 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)*
- Middle East Studies**, : *Bachelor of Arts (B.A.) - Major Concentration Middle East Studies (36 credits)*
- Music** (available to students in B.Sc. Liberal only), : *Bachelor of Arts (B.A.) - Major Concentration Music (36 credits)*
- North American Studies**, : *Bachelor of Arts (B.A.) - Major Concentration North American Studies (36 credits)*
- Philosophy**, : *Bachelor of Arts (B.A.) - Major Concentration Philosophy (36 credits)*
- Philosophy and Western Religions**, : *Bachelor of Arts (B.A.) - Major Concentration Philosophy and Western Religions (36 credits)*
- Political Science**, : *Bachelor of Arts (B.A.) - Major Concentration Political Science (36 credits)*
- Québec Studies**, : *Bachelor of Arts (B.A.) - Major Concentration Quebec Studies / La concentration Majeur en Études sur le Québec (36 credits)*
- Russian**, : *Bachelor of Arts (B.A.) - Major Concentration Russian (36 credits)*
- Scriptures and Interpretation** – see Religious Studies, : *Bachelor of Arts (B.A.) - Major Concentration Scriptures and Interpretations (36 credits)*
- Sociology**, : *Bachelor of Arts (B.A.) - Major Concentration Sociology (36 credits)*
- Women's Studies**, : *Bachelor of Arts (B.A.) - Major Concentration Women's Studies (36 credits)*
- World Religions** – see Religious Studies, : *Bachelor of Arts (B.A.) - Major Concentration World Religions (36 credits)*

11.6.2 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)*
- Art History**, : *Bachelor of Arts (B.A.) - Minor Concentration Art History (18 credits)*
- Canada/Québec** – see Political Science, : *Bachelor of Arts (B.A.) - Minor Concentration Political Science: Canada/Québec (18 credits)*
- Canadian Ethnic and Racial Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration Canadian Ethnic and Racial Studies (18 credits)*
- Canadian Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration Canadian Studies (18 credits)*
- Catholic Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration Catholic 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)*
- Comparative Politics** – see Political Science, : *Bachelor of Arts (B.A.) - Minor Concentration Comparative Politics (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)*
- 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)*

Minor Concentrations

- 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)*
- Geographical Information Systems** - see Geography, : *Bachelor of Arts (B.A.) - Minor Concentration Geographic Information Systems (18 credits)*
- Geography**, : *Bachelor of Arts (B.A.) - Minor Concentration Geography (18 credits)*
- German Language**, : *Bachelor of Arts (B.A.) - Minor Concentration German Language (18 credits)*
- German Literature**, : *Bachelor of Arts (B.A.) - Minor Concentration German Literature (18 credits)*
- German Literature and Culture in Translation**, : *Bachelor of Arts (B.A.) - Minor Concentration German Literature and Culture in Translation (18 credits)*
- Hispanic Languages**, : *Bachelor of Arts (B.A.) - Minor Concentration Hispanic Languages (18 credits)*
- Hispanic Literature and Culture**, : *Bachelor of Arts (B.A.) - Minor Concentration Hispanic Literature and Culture (18 credits)*
- History**, : *Bachelor of Arts (B.A.) - Minor Concentration History (18 credits)*
- History and Philosophy of Science**, : *Bachelor of Arts (B.A.) - Minor Concentration History and Philosophy of Science (18 credits)*
- International Development Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration International Development Studies (18 credits)*
- International Relations** – see Political Science, : *Bachelor of Arts (B.A.) - Minor Concentration International Relations (18 credits)*
- Islamic Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration Islamic Studies (18 credits)*
- Italian Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration Italian Studies (18 credits)*
- Jewish Law**, : *Bachelor of Arts (B.A.) - Minor Concentration Jewish Law (18 credits)*
- Jewish Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration Jewish Studies (18 credits)*
- Langue et littérature françaises – Critique littéraire**, : *Baccalauréat ès Arts (B.A.) - Concentration mineure langue et littérature françaises - Critique littéraire (18 crédits)*
- Langue et littérature françaises – Études et pratiques littéraires**, : *Baccalauréat ès Arts (B.A.) - Concentration mineure langue et littérature françaises - Études et pratiques littéraires (18 crédits)*
- Langue et littérature françaises – Langue française**, : *Baccalauréat ès Arts (B.A.) - Concentration mineure langue et littérature françaises - Langue française (18 crédits)*
- Langue et littérature françaises – Langue française et traduction**, : *Baccalauréat ès Arts (B.A.) - Concentration mineure langue et littérature françaises - Langue française et traduction (18 crédits)*
- Langue et littérature françaises – Traduction**, : *Baccalauréat ès Arts (B.A.) - Concentration mineure langue et littérature françaises - Traduction (18 crédits)*
- Linguistics**, : *Bachelor of Arts (B.A.) - Minor Concentration Linguistics (18 credits)*
- Middle East Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration Middle East Studies (18 credits)*
- Middle East Languages**, : *Bachelor of Arts (B.A.) - Minor Concentration Middle East Languages (18 credits)*
- Music**, : *Bachelor of Arts (B.A.) - Minor Concentration Music (18 credits)*
- North American Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration North American Studies (18 credits)*
- Philosophy**, : *Bachelor of Arts (B.A.) - Minor Concentration Philosophy (18 credits)*
- Philosophy and Western Religions**, : *Bachelor of Arts (B.A.) - Minor Concentration Philosophy and Western Religions (18 credits)*
- Political Science**, : *Bachelor of Arts (B.A.) - Minor Concentration Political Science (18 credits)*
- Political Economy** – see Political Science, : *Bachelor of Arts (B.A.) - Minor Concentration Political Economy (18 credits)*
- Political Theory** – see Political Science, : *Bachelor of Arts (B.A.) - Minor Concentration Political Theory (18 credits)*
- Politics, Law and Society** – see Political Science, : *Bachelor of Arts (B.A.) - Minor Concentration Politics, Law and Society (18 credits)*
- Québec Studies**, : *Bachelor of Arts (B.A.) - Minor Concentration Quebec Studies / La concentration Mineur en Études sur le Québec (18 crédits)*
- Religion and Globalization** – see Religious Studies, : *Bachelor of Arts (B.A.) - Minor Concentration Religion and Globalization (18 credits)*
- Russian**, : *Bachelor of Arts (B.A.) - Minor Concentration Russian (18 credits)*
- Russian Culture**, : *Bachelor of Arts (B.A.) - Minor Concentration Russian Culture (18 credits)*

Minor Concentrations

Scriptural Languages – see Religious Studies, : *Bachelor of Arts (B.A.) - Minor Concentration Scriptural Languages (18 credits)*

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

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

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

South Asia – see Political Science, : *Bachelor of Arts (B.A.) - Minor Concentration South Asia (18 credits)*

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

World Religions – see Religious Studies, : *Bachelor of Arts (B.A.) - Minor Concentration World Religions (18 credits)*

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

12 Undergraduate Research Opportunities

Because McGill is a research-intensive university, research informs the curriculum. There are many opportunities for talented students to take part in research during their undergraduate studies, whether at McGill, in affiliated hospitals, at other universities, or 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 12.1: Research Project Courses*
- *section 12.1.1: "396" Undergraduate Research Project Courses*
- *section 12.2: Undergraduate Student Research Awards* – NSERC USRA, NSERC Industrial USRA, SURA, FRSQ USRA
- *section 12.3: Undergraduate Research Conference*
- *section 12.4: Other opportunities*
- Dean's Multidisciplinary Undergraduate Research List – see description elsewhere in *Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > Graduation > : Graduation Honours: Faculty of Science Dean's Multidisciplinary Undergraduate Research List*

The **Office for Undergraduate Research in Science (OURS)** coordinates several of the aforementioned programs, and can help students find out about other opportunities. Visit the OURS website at www.mcgill.ca/science/research/ours to find out more.

Because internships and field study programs may include a research component, please also see:

- *section 13.1: Industrial Practicum (IP) and Internship Year in Science (IYS)*
- *section 13.2: Field Study and Study Abroad*

12.1 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, see the research course list online at www.mcgill.ca/science/research/ours/researchcourses or browse the course listings at www.mcgill.ca/students/courses/calendars/keyword.

12.1.1 "396" Undergraduate Research Project Courses

"396" undergraduate research project courses are offered by most departments and schools—ANAT 396, ATOC 396, BIOC 396, BIOL 396, etc.—plus COGS 396 and NSCI 396. They are elective courses, which can be taken outside your own department, and can be taken after one term of undergraduate studies. Note that for Microbiology and Immunology, MIMM 396 is for *microbiology* projects whereas MIMM 397 is for *immunology*; otherwise, for all practical purposes MIMM 397 should be treated as a "396" course. There is also a BASC 396 course for B.A. & Sc. students.

Students can consult a list of past projects and currently available projects on the Science website at www.mcgill.ca/science/research/ours/396, or they can devise a new project in consultation with a McGill professor and submit the required paperwork online.

12.2 Undergraduate Student Research Awards

There are several award programs that fund undergraduate student research projects at McGill (and sometimes off-campus), usually in the summer. Please see the following:

- [section 12.2.1: NSERC Undergraduate Student Research Awards](#)
- [section 12.2.2: NSERC Industrial Undergraduate Student Research Awards](#)
- [section 12.2.3: SURA: Science Undergraduate Research Awards](#)
- [section 12.2.4: FRSQ Undergraduate Student Research Awards](#)

Please also consult the Office for Undergraduate Research in Science website at www.mcgill.ca/science/research/ours for any new programs that may have been added.

12.2.1 NSERC Undergraduate Student Research Awards

The Natural Sciences and Engineering Research Council of Canada Undergraduate Student Research Awards (NSERC USRA) in Universities program supports 16 consecutive weeks of paid full-time research under the supervision of a professor who holds an NSERC grant. It is an excellent way to prepare for graduate studies or a future career in science. This program is offered at other universities across Canada, and a travel allowance from NSERC is available.

To apply, students must first identify a proposed supervisor who holds an NSERC grant. Students should apply at the university where they wish to hold the award. Applicants must be Canadian citizens or Permanent Residents of Canada. See www.mcgill.ca/science/research/ours/nserc for more information.

12.2.2 NSERC Industrial Undergraduate Student Research Awards

In cooperation with a company, students can also apply for an Industrial NSERC Award to provide salary support and gain industrially relevant experience. Students apply for these awards through one or more companies (not through McGill). For more information on forms, student eligibility, and company eligibility, please visit the NSERC website www.nserc.ca and look for the *Industrial Undergraduate Student Research Awards*.

12.2.3 SURA: Science Undergraduate Research Awards

Science Undergraduate Research Awards—SURAs—are for both Canadian and international McGill students registered in a science undergraduate program. SURAs are broadly similar to the NSERC USRA; two differences are, on the student side, that *international students may apply*, and on the supervisor side, while they must still hold a research grant, the grant may be from one of the other funding agencies, namely CRC, NSERC, CIHR, SSHRC, FQRNT, or FRSQ (not only NSERC).

See www.mcgill.ca/science/research/ours/sura for details.

12.2.4 FRSQ Undergraduate Student Research Awards

This program is meant to stimulate interest in research on the part of students registered in an undergraduate program in Health Sciences or other disciplines offering specialization in health sciences, including social sciences, natural sciences, and engineering. For more information, see www.mcgill.ca/gps/funding/students-postdocs/students/frsq-usra.

12.3 Undergraduate Research Conference

Each fall, the Faculty of Science holds an Undergraduate Research Conference to celebrate the research accomplishments of our undergraduate students. The conference also includes a public lecture by a Nobel laureate or other luminary on a topic related to scientific discovery.

Students who wish to present their research posters should contact their departments in the preceding winter or summer, since *departments* nominate participants for the conference.

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 see www.mcgill.ca/science/research/ours/urc.

12.4 Other opportunities

Science internships and field study programs may have a research component or focus. Please see their descriptions under [section 11.5: Internship Programs – Industrial Practicum \(IP\) and Internship Year in Science \(IYS\)](#) and [section 13.2: Field Study and Study Abroad](#) in this publication.

Individual departments and researchers offer many other research opportunities. These may be paid or unpaid, for academic credit or not for credit. Some of these opportunities are formal programs and are described in other sections of this publication ([section 12.1: Research Project Courses](#), [section 12.1.1: "396" Undergraduate Research Project Courses](#), and [section 12.2: Undergraduate Student Research Awards](#)) or on the Office for Undergraduate Research in

Science website (www.mcgill.ca/science/research/ours); however, many opportunities arise as a result of students talking with their professors. For advice on approaching professors, and more generally on how to get involved in research, see www.mcgill.ca/science/research/ours/how.

In addition to opportunities available at McGill, there are several external opportunities at other institutions. Many of these are catalogued at www.mcgill.ca/science/research/ours/opportunities. You may also want to look for additional opportunities funded or offered by the relevant research agencies, institutions, and universities of interest: for example, a provincial cancer research society, a national science funding agency, or a national psychological association.

13 Science Internships and Field Studies

The *Science Internships & Field Studies Office* promotes field studies and internship opportunities to interested students seeking hands-on experience. The office coordinates the field study semesters offered through the Faculty of Science and provides internship opportunities to students who are in Science programs at McGill. Whether you decide to participate in a field study semester or apply classroom theory to practice, the *Science Internships & Field Studies Office* will offer you assistance in your decision.

13.1 Industrial Practicum (IP) and Internship Year in Science (IYS)

These programs are open to all Science undergraduate students. An internship is a career-related, professionally supervised, paid work term and done during your undergraduate degree in a field related to your studies. Internships may have a basis in research. To be eligible to apply:

- You must be a full-time undergraduate student in Science before and after the IP or the IYS is completed.
- You must have completed at least 27 credits and should have at least 12 credits remaining in your degree program.
- Your CGPA must be 2.7 or higher.
- International students are eligible to apply to all IYS positions (unless otherwise indicated in the job posting) and to summer IPs (provided the student has an off-campus work permit).

For more information on IP and IYS, please see [section 7.4.5: Internship Year in Science \(IYS\)](#) and www.mcgill.ca/science/internships-field/internships.

13.2 Field Study and Study Abroad

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

14 Academic 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 Neuroscience.

14.1 B.Sc. Freshman Program

If you need 97–120 credits (four years) to complete your degree requirements, you must register in the Science Freshman program, which is designed to provide the basic science foundation for your subsequent three-year Liberal, Major, or Honours program. For a detailed description of the Science Freshman program, you should consult [section 14.1.1: Bachelor of Science \(B.Sc.\) - Freshman Program \(30 credits\)](#) and the Science Freshman Student information available on the SOUSA website, www.mcgill.ca/science/student/newstudents/u0.

If you have completed the Diploma of Collegial Studies, Advanced Placement exams, Advanced Levels, the International Baccalaureate, the French Baccalaureate, or McGill placement examinations, you may receive exemption and/or credit for all or part of the basic science courses in biology, chemistry, mathematics, and physics. Similarly, if you have completed courses at other universities or colleges, you may receive exemptions and/or credits. You should consult www.mcgill.ca/students/transferecredit for more information.

14.1.1 Bachelor of Science (B.Sc.) - Freshman Program (30 credits)

Students who need 97-120 credits to complete their degree requirements will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/student/newstudents/u0>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science Courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses to satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program should be aware of the department specific requirements when selecting their courses. Detailed advising information is available at <http://www.mcgill.ca/science/student/newstudents/u0/bscfreshman/specific>.
4. The maximum number of courses per term, required, complementary, and elective, is five.
5. Some medical and dental schools have specific freshman course requirements. Check the admission requirements of the school(s) to which you intend to apply.

List of approved Freshman Science Courses

Select the approved courses according to the instructions above.

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133**	(3)	Linear Algebra and Geometry

MATH 134***	(3)	Enriched Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

* CHEM 115 is not open to students who are taking or have taken CHEM 110 or CHEM 120.

* CHEM 120 is not open to students who have taken CHEM 115.

** Not open to students who are taking or taken MATH 134.

*** MATH 134 is an enriched version of MATH 133. MATH 134 may be used instead of MATH 133 to: (1) provide a course prerequisite; and (2) satisfy program requirements.

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus 1
MATH 150	(4)	Calculus A

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.

14.2 Anatomy and Cell Biology (ANAT)

14.2.1 Location

Strathcona Anatomy and Dentistry Building, Room 1/60
3640 University Street
Montreal, Quebec H3A 0C7

Telephone: 514-398-6335

Website: www.mcgill.ca/anatomy

14.2.2 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. Students should choose their major based on their interest and also consider the Interdisciplinary Minor in Life Sciences. A B.Sc. in Anatomy and Cell Biology provides an excellent preparation for technical and administrative positions in laboratories of universities, research institutions, hospitals, 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 new cryo-electron microscope facility in the Department is unique and represents a cutting edge technology to apply fundamental discoveries to therapeutic applications.

Inquiries about programs should be directed to the Department of Anatomy and Cell Biology.

14.2.3 Anatomy and Cell Biology (ANAT) Faculty

Chair

Craig Mandato

Emeritus Professors

Gary C. Bennett; B.A., B.Sc.(Sir G. Wms.), M.Sc., Ph.D.(McG.)

Yves Clermont; B.Sc.(Montr.), Ph.D.(McG.), F.R.C.S.

Dennis G. Osmond; C.M., B.Sc., M.B., Ch.B., D.Sc.(Brist.), M.R.C.S., L.R.C.P., F.R.S.C.

H. Warshawsky; B.Sc.(Sir G. Wms.), M.Sc., Ph.D.(McG.)

Professors

Chantal Autexier; B.Sc.(C' dia), Ph.D.(McG.)

Philip Barker; B.Sc.(S. Fraser), Ph.D.(Alta.) (*joint appt. with Neurology & Neurosurgery*)

Alain Beaudet; M.Sc., Ph.D., M.D.(Montr.) (*joint appt. with Neurology & Neurosurgery*)

James R. Brawer; B.S.(Tufts), Ph.D.(Harv.)

Samuel David; Ph.D.(Manit.) (*joint appt. with Neurology & Neurosurgery*)

Louis Hermo; B.A.(Loyola), M.Sc., Ph.D.(McG.)

Timothy Kennedy; B.Sc.(McM.), M.Phil., Ph.D.(Col.) (*joint appt. with Neurology & Neurosurgery*)

Nathalie Lamarche-Vane; B.Sc., Ph.D.(Montr.)

Marc D. McKee; B.Sc., M.Sc., Ph.D.(McG.) (*joint appt. with Dentistry*)

Peter McPherson; B.Sc.(Manit.), Ph.D.(Iowa) (*joint appt. with Neurology and Neurosurgery*)

Sandra C. Miller; B.Sc.(Sir G. Wms.), M.Sc., Ph.D.(McG.)

Carlos R. Morales; DVM.(U.N., Argentina), Ph.D.(McG.)

Barry I. Posner; M.D.(Manit.), F.R.C.P.(C) (*joint appt. with Medicine*)

Dieter Reinhardt; M.S.(Kaiserslautern), Ph.D.(Munich) (*joint appt. with Dentistry*)

Alfredo Ribeiro-da-Silva; M.D., Ph.D.(Oporto) (*joint appt. with Pharmacology and Therapeutics*)

Wayne Sossin; S.B.(MIT), Ph.D.(Stan.) (*joint appt. with Neurology & Neurosurgery*)

Stefano Stifani; Ph.D.(Rome), Ph.D.(Alta.) (*joint appt. with Neurology & Neurosurgery*)

Dominique Walker; B.Sc., Ph.D.(Geneva) (*joint appt. with Psychiatry*)

Associate Professors

Orest W. Blaschuk; B.Sc.(Winn.), M.Sc.(Manit.), Ph.D.(Tor.) (*joint appt. with Surgery*)

Eugene Daniels; M.Sc., Ph.D.(Manit.)

Elaine Davis; B.Sc., M.Sc.(W. Ont.), Ph.D.(McG.)

Associate Professors

M.F. Lalli; B.Sc., M.Sc.(Bowling Green), Ph.D.(McG.)
Craig Mandato; B.Sc., Ph.D.(Wat.)
John F. Presley; B.A., Ph.D.(Texas)
Hojatollah Vali; B.Sc., M.Sc., Ph.D.(Munich) (*joint appt. with Earth and Planetary Sciences*)

Assistant Professors

Fiona Bedford; B.Sc.(Birm.), Ph.D.(Lond.)
Isabelle Rouiller; Ph.D.(UK)

Associate Members

John J.M. Bergeron (*Medicine*)
Albert Berghuis (*Biochemistry*)
Colin Chalk (*Neurology & Neurosurgery*)
Jean-François Cloutier (*Neurology & Neurosurgery*)
Claudio Cuello (*Pharmacology & Therapeutics*)
Giovanni DiBattista (*Medicine*)
Alyson Fournier (*Neurology & Neurosurgery*)
Janet Henderson (*Medicine*)
Robert Scott Kiss (*Biochemistry*)
Bartha Knoppers (*Human Genetics*)
Svetlana Komarova (*Dentistry*)
Andrea Leblanc (*Neurology & Neurosurgery*)
Peter Metrakos (*Department of Surgery*)
Tommy Nilsson (*Medicine*)
Edward S. Ruthazer (*Neurology & Neurosurgery*)
Michael Sacher (*Biology*)
Philippe Seguela (*Neurology & Neurosurgery*)
Peter Siegel (*Medicine & Biochemistry*)
Thomas Stroh (*Neurology & Neurosurgery*)
Jacalyn Vogel (*Biology*)
Xiang-Jiao Yang (*Medicine*)

Adjunct Professors

Michel Cayouette; Ph.D.(Laval)
Frederic Charron; B.Sc.(Montr.), Ph.D.(McG.)
Miroslaw Cygler; M.Sc., Ph.D.(Lodz, Poland)
Daniel Cyr; B.Sc., M.Sc.(C' dia), Ph.D.(Manit.)
Michel Desjardins; M.Sc., Ph.D.(Montr.)
Jacques Drouin; B.Sc., D.Sc.(Laval)
David Hipfner; B.Sc., Ph.D.(Qu.)
Artur Kania; Ph.D.(Baylor)
André Nantel; B.Sc., M.Sc.(Laval), Ph.D.(Chapel Hill)
Alexei Pshezhetsky; Ph.D.(Russia)
Joseph Schrag; M.Sc., Ph.D.(Ill.)

Adjunct Professors

Atilla Sik; M.Sc., Ph.D.(Hungary)

Faculty Lecturer

Ayman Behiery; M.B., Ch.B.(Cairo)

14.2.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Anatomy and Cell Biology (48 credits)

Students may complete this program with a minimum of 47 credits or a maximum of 48 credits depending on their choice of complementary courses.

Required Courses (32 credits)

* Students who have taken the equivalent of CHEM 212 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
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

One of the following statistics courses:

MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

Complementary Courses (16 credits)

Students complete a minimum of 15 or a maximum of 16 complementary course credits selected as follows:

List A

9 credits selected from:

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Basis of Embryology
ANAT 565	(3)	Diseases-Membrane Trafficking
NEUR 310	(3)	Cellular Neurobiology

List B

6-7 credits selected from:

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Basis of Embryology

ANAT 565	(3)	Diseases-Membrane Trafficking
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 Oncogenes
BIOL 320	(3)	Evolution of Brain and Behaviour
EXMD 504	(3)	Biology of Cancer
NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease

14.2.5 Bachelor of Science (B.Sc.) - Major Anatomy and Cell Biology (67 credits)

Required Courses (43 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
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 following statistics courses:

BIOL 373	(3)	Biometry
MATH 203*	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

Complementary Courses (24 credits)

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

12 credits selected from:

ANAT 321	(3)	Circuitry of the Human Brain
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ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Basis of 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
MIMM 314	(3)	Intermediate Immunology
NEUR 310	(3)	Cellular Neurobiology

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

ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Basis of Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 432	(9)	Honours Research Project
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 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 314	(3)	Molecular Biology of Oncogenes
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
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 01
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
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)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 451	(3)	Advanced Neurophysiology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Cellular Immunology
PHGY 515	(3)	Physiology of Blood 1
PHGY 516	(3)	Physiology of Blood 2
PHGY 517	(3)	Artificial Internal Organs
PHGY 518	(3)	Artificial Cells
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

14.2.6 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 following statistics courses:

BIOL 373	(3)	Biometry
MATH 203*	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

Complementary Courses (21 credits)

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

18 credits selected from:

* Note: Students may take either ANAT 321 OR ANAT 323.

ANAT 321*	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 323*	(3)	Neuroanatomy
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Basis of 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
MIMM 314	(3)	Intermediate Immunology
NEUR 310	(3)	Cellular Neurobiology

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

ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Basis of Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 432	(9)	Honours Research Project
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 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 314	(3)	Molecular Biology of Oncogenes
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
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 01
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 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
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)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 451	(3)	Advanced Neurophysiology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Cellular Immunology
PHGY 515	(3)	Physiology of Blood 1
PHGY 516	(3)	Physiology of Blood 2
PHGY 517	(3)	Artificial Internal Organs
PHGY 518	(3)	Artificial Cells
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

14.3 Atmospheric and Oceanic Sciences (ATOC)

14.3.1 Location

Burnside Hall, Room 945
805 Sherbrooke Street West
Montreal, Quebec H3A 0B9

Telephone: 514-398-3764

Fax: 514-398-6115

Email: undergraduateinfo@meteo.mcgill.ca

Website: www.mcgill.ca/meteo

14.3.2 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 possible changes in global climate caused by the changing chemical composition of the atmosphere. The approach is always quantitative. 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 warms the air above it by radiation and convection, and how the atmosphere and ocean interact to shape the weather and climate. A comprehensive understanding requires both viewpoints, and these are reflected in the curriculum.

The Department of Atmospheric and Oceanic Sciences offers four main programs in Atmospheric Science: Honours, Major, Minor, and a Joint Major in Atmospheric Science and Physics. The Honours program is meant for students with high standing. It is based on courses similar to those in the Major program, but provides the opportunity to take advanced optional courses. The Major program, although somewhat less intensive, satisfies the requirements for a professional career as a meteorologist, and like the Honours program equips the student to undertake postgraduate study in meteorology, atmospheric science, and related sciences (physical oceanography) at any of the leading universities. The Department also offers a special one-year Diploma program to B.Sc. or B.Eng. graduates.

A degree in Atmospheric Science can lead to a professional career in government service or private industry. The Meteorological Service of Canada has traditionally been the main employer of graduating students, but certain provincial governments and environmental consulting and engineering firms also employ graduates trained in atmospheric science. Positions in teaching and research are available to graduates with M.Sc. and Ph.D. degrees. Students interested in any of the undergraduate programs should consult the undergraduate adviser, Room 946, Burnside Hall.

14.3.3 Atmospheric and Oceanic Sciences (ATOC) Faculty

Chair

John R. Gyakum

Emeritus Professors

Jacques F. Derome; M.Sc.(McG.), Ph.D.(Mich.), F.R.S.C.

Henry G. Leighton; M.Sc.(McG.), Ph.D.(Alta.)

Lawrence A. Mysak; B.Sc.(Alta.), M.Sc.(Adel.), A.M., Ph.D.(Harv.), F.R.S.C.

Iszta I. Zawadzki; B.Sc.(Buenos Aires), M.Sc., Ph.D.(McG.), F.R.S.C.

Professors

Parisa Ariya; B.Sc., Ph.D.(York) (*James McGill Professor*) (*joint appt. with Chemistry*)

John R. Gyakum; B.Sc.(Penn.), M.Sc., Ph.D.(MIT)

Man Kong (Peter) Yau; S.B., S.M., Sc.D.(MIT)

Associate Professors

Peter Bartello; M.Sc., Ph.D.(McG.) (*joint appt. with Mathematics and Statistics*)

Frédéric Fabry; B.Sc., M.Sc., Ph.D.(McG.) (*joint appt. with McGill School of Environment*)

Pavlos Kollias; B.Sc., M.Sc.(Athens), Ph.D.(Miami) (*Canada Research Chair, Tier 2*)

David Straub; B.Sc., M.Sc.(SW Louisiana), Ph.D.(Wash.)

Bruno Tremblay; B.Sc.(McG.), M.Sc.(Car.), Ph.D.(McG.)

Assistant Professors

Yi Huang; B.Sc., M.Sc.(Pekin), Ph.D.(Princ.)

Daniel Kirshbaum; Ph.D.(Wash.)

Jaime Palter; B.Sc., Ph.D.(Duke)

Adjunct Professors

Ashu Dastoor; Ph.D.(Indian IT)

Luc Fillion; Ph.D.(McG.)

Pierre Gauthier; Ph.D.(McG.)

Hai Lin; Ph.D.(McG.)

Damon Matthews; Ph.D.(Vic., BC)

Seok-Woo Son; Ph.D.(Penn.)

Associate Member

Michel Bourqui; Ph.D.(ETH Zurich)

14.3.4 Bachelor of Science (B.Sc.) - Minor Atmospheric Science (18 credits)

This Minor may be taken in conjunction with any program in the Faculty of Science.

Required Courses (15 credits)

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

Either of the following courses:

ATOC 219	(3)	Introduction to Atmospheric Chemistry
CHEM 219	(3)	Introduction to Atmospheric Chemistry

Complementary Course (3 credits)

3 credits from the following:

ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 357	(3)	Atmospheric and Oceanic Science Laboratory

14.3.5 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 credits selected from:

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

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

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

ATOC 309	(3)	Weather Radars and Satellites
ATOC 419	(3)	Advances in Chemistry of Atmosphere
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
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 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)	Computers in 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

14.3.6 Bachelor of Science (B.Sc.) - Major Atmospheric Science (61 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)	Computers in Engineering
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (37 credits)

36-37 credits

Note: All students are encouraged to consult with the Undergraduate Adviser for help selecting from among the complementary courses. As general recommendations (but not programmatic requirements), students wishing to comply with Environment Canada recommendations for careers in operational meteorology are advised to take ATOC 215, 309, 512, 513, 540, 541, and 546. Students interested in atmospheric chemistry, aerosols, and cloud physics are advised to take ATOC 219, 309, 419, 521, 525, 540 and CHEM 223, 253. Suggested minors include math, physics, chemistry, computer science, earth and planetary science, and geography.

3-6 credits selected from:

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

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

21-25 credits selected from the following (at least 12 credits must come from ATOC):

ATOC 309	(3)	Weather Radars and Satellites
ATOC 419	(3)	Advances in Chemistry of Atmosphere
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
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 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
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 320	(3)	Elementary Earth Physics
EPSC 340	(3)	Earth and Planetary Inference
EPSC 542	(3)	Chemical Oceanography
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 203	(3)	Principles of Statistics 1
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MATH 423	(3)	Regression and Analysis of Variance
MATH 555*	(4)	Fluid Dynamics
PHYS 241	(3)	Signal Processing
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432*	(3)	Physics of Fluids

* Students may take PHYS 432 OR MATH 555.

14.3.7 Bachelor of Science (B.Sc.) - Major Atmospheric Science and Physics (67 credits)

This Major provides a solid basis for postgraduate study in meteorology, atmospheric physics, or related fields, as well as the necessary preparation for embarking on a professional career as a meteorologist directly after the B.Sc.

The program is jointly administered by the Department of Physics and the Department of Atmospheric and Oceanic Sciences. Students should consult undergraduate advisers in both departments.

Required Courses (64 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 315	(3)	Thermodynamics and Convection
ATOC 412	(3)	Atmospheric Dynamics
ATOC 540	(3)	Synoptic Meteorology 1

ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
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 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 446	(3)	Majors Quantum Physics

Complementary Course (3 credits)

Students select one of the following courses:

PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 439	(3)	Majors Laboratory in Modern Physics

14.3.8 Bachelor of Science (B.Sc.) - Honours Atmospheric Science (73 credits)

72-73 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)	Computers in Engineering
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (46 credits)

45-46 credits

Note: All students are encouraged to consult with the undergraduate adviser for help selecting from among the complementary courses. As general recommendations (but not programmatic requirements), students wishing to comply with Environment Canada recommendations for careers in operational meteorology are advised to take ATOC 215, 309, 512, 513, 540, 541, and 546. Students interested in atmospheric chemistry, aerosols, and cloud physics are advised to take ATOC 219, 309, 419, 521, 525, 540 and CHEM 223, 253. Suggested minors include math, physics, chemistry, computer science, earth and planetary science, and geography.

27 credits at the 200 to 300 level

3-6 credits selected from:

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

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

3 credits selected from:

CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
MATH 319	(3)	Introduction to Partial Differential Equations

9-12 credits selected from:

ATOC 309	(3)	Weather Radars and Satellites
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 362	(2)	Advanced Organic Chemistry Laboratory
CHEM 367	(3)	Instrumental Analysis 1
MATH 203	(3)	Principles of Statistics 1
MATH 317	(3)	Numerical Analysis
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
PHYS 241	(3)	Signal Processing
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves

18-19 credits at the 400 to 500 level, selected from the following (at least 12 credits must come from ATOC):

ATOC 419	(3)	Advances in Chemistry of Atmosphere
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
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 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
CHEM 575	(3)	Chemical Kinetics
EPSC 542	(3)	Chemical Oceanography
MATH 423	(3)	Regression and Analysis of Variance
MATH 555*	(4)	Fluid Dynamics
PHYS 432*	(3)	Physics of Fluids
PHYS 551	(3)	Quantum Theory
PHYS 559	(3)	Advanced Statistical Mechanics

* Students may take PHYS 432 OR MATH 555.

14.3.9 Diploma in 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 419 or CHEM 419.

ATOC 309	(3)	Weather Radars and Satellites
ATOC 315	(3)	Thermodynamics and Convection
ATOC 419*	(3)	Advances in Chemistry of Atmosphere

CHEM 419* (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

14.3.10 Atmospheric and Oceanic Sciences (ATOC) Related Programs

14.3.10.1 Internship Year in Science (IYS)

Revision, August 2013. Start of revision.

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 11.5: Internship Programs – Industrial Practicum \(IP\) and Internship Year in Science \(IYS\)](#).

The following programs are also available with an internship component:

- Major in Atmospheric Science;
- Honours in Atmospheric Science.

Revision, August 2013. End of revision.

14.3.10.2 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 14.11: Earth System Science \(ESYS\)](#).

14.4 Biochemistry (BIOC)

14.4.1 Location

McIntyre Medical Building, 9th Floor
3655 Promenade Sir-William-Osler
Montreal, Quebec H3G 1Y6

Christine Laberge, Student Affairs Officer
Telephone: 514-398-2423
Email: christine.laberge@mcgill.ca
Website: www.mcgill.ca/biochemistry

14.4.2 About Biochemistry

Biochemistry is the application of chemical, genetic, and biophysical approaches to the study of biological processes at the cellular and molecular level. We are interested in, for example, mechanisms of brain function; cellular differentiation; energy utilization by animals and microorganisms; and in the molecular basis of inheritance and disease. The researcher seeks to determine how specific molecules such as proteins, nucleic acids, lipids, vitamins, and hormones function in various cellular processes. Particular emphasis is placed on the regulation of reactions in living cells. The knowledge and methods developed by researchers are applied in all fields of medicine, in agriculture, and in many chemical and health-related industries. Biochemistry is unique in providing basic theoretical training, as well as basic practical laboratory training and research in both enzymology and genetic engineering, which are the two basic components in the rapidly expanding field of Biotechnology.

There are three programs offered by the Department of Biochemistry: Major, Honours, and Liberal. The Major and Honours programs provide a sound background for students who wish to have a professional career in biochemistry, and can lead to postgraduate studies and research careers in hospital, university, or industrial laboratories. The Liberal program is less specialized, offering students opportunities to select courses in other fields of interest.

During the first year, each program provides basic training in organic, physical, and analytical chemistry, as well as in biology and physiology. The Honours and Major programs become more specialized in biochemistry during the following two years, with additional work in chemistry and biology.

Students interested in pursuing an *ad hoc* Joint Major or Joint Honours degree between Biochemistry and a second discipline may consult with our Chief Academic Adviser, Dr. Albert Berghuis (albert.berghuis@mcgill.ca).

The increasing involvement of complex technology in modern society requires personnel trained in both chemistry and biology. With the advent of biotechnology, the combination of chemistry, molecular biology, enzymology, and genetic engineering found in the biochemistry program provides the essential background and training. The researcher is in an advantageous position to fulfil this role and assume a wide variety of positions in industry and the health field. These positions include: research and development in the chemical and pharmaceutical industries; testing and research in government and hospital laboratories; and management. Many graduates pursue higher degrees in research and attain academic positions in universities and colleges.

14.4.3 Adviser

New students interested in Biochemistry should refer to our website for information regarding orientation and program advising: www.mcgill.ca/biochemistry/undergraduates/advising.

Returning students must schedule an advising appointment directly with the academic adviser assigned to them in their first year in Biochemistry.

14.4.4 Biochemistry (BIOC) Faculty

Chair

David Y. Thomas

Associate Chair

Kalle Gehring

Emeritus Professors

Rhoda Blostein; B.Sc., M.Sc., Ph.D.(McG.), F.R.S.C. (*joint appt. with Medicine*)

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

Robert E. MacKenzie; B.Sc.(Agr.)(McG.), M.N.S., Ph.D.(C'nell.)

Edward A. Meighen; B.Sc.(Alta.), Ph.D.(Calif., Berk.)

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

Theodore L. Sourkes; M.Sc.(McG.), Ph.D.(C'nell), F.R.S.C.

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

Professors

Nicole Beauchemin; B.Sc., M.Sc., Ph.D.(Montr.) (*joint appt. with Oncology and Medicine*)

Albert Berghuis; B.Sc., M.Sc.(Rijks Univ. Groningen, The Netherlands), Ph.D.(Br. Col.) (*Canada Research Chair in Structural Biology*)

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

Kalle Gehring; B.A.(Brown), M.Sc.(Mich.), Ph.D.(Calif., Berk.) (*Chercheur National du FRSQ*)

Vincent Giguère; B.Sc., Ph.D.(Laval) (*joint appt. with Oncology and Medicine*)

Philippe Gros; B.Sc., M.Sc.(Montr.), Ph.D.(McG.), F.R.S.C. (*James McGill Professor*)

Roderick McInnes; B.Sc., M.D.(Dal.), Ph.D.(McG.) (*Canada Research Chair in Neurogenetics*) (*joint appt. with Human Genetics*)

Professors

William Muller; B.Sc., Ph.D.(McG.) (*Canada Research Chair in Molecular Oncology*)

Alain Nepveu; B.Sc., M.Sc.(Montr.), Ph.D.(Sher.) (*James McGill Professor*) (*joint appt. with Oncology and Medicine*)

Morag Park; B.Sc., Ph.D.(Glasgow), F.R.S.C. (*Diane & Sal Guerrero Chair in Cancer Genetics*) (*James McGill Professor*) (*joint appt. with Oncology and Medicine*)

Jerry Pelletier; B.Sc., Ph.D.(McG.) (*James McGill Professor*)

Gordon C. Shore; B.Sc.(Guelph), Ph.D.(McG.)

Joseph Shuster; B.Sc.(McG.), Ph.D.(Calif.), M.D.(Alta.)

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

Nahum Sonenberg; M.Sc., Ph.D.(Weizmann Inst.), F.R.S.C., F.R.S. (*James McGill Professor*)

David Y. Thomas; B.Sc.(Brist.), M.Sc., Ph.D.(Univ. Coll., Lond.), F.R.S.C. (*Canada Research Chair in Molecular Genetics*)

Michel L. Tremblay; B.Sc., M.Sc.(Sher.), Ph.D.(McM.), F.R.S.C. (*James McGill Professor*) (*Jeanne & Jean-Louis Levesque Chair in Cancer Research*)

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

Associate Professors

Maxime Bouchard; B.Sc., Ph.D.(Laval) (*Canada Research Chair in Kidney Disease*)

Thomas Duchaine; B.Sc., Ph.D.(Montr.) (*Chercheur Boursier du FRSQ*)

Imed Gallouzi; Maitrise, DEA, Ph.D.(Montpellier, France) (*Canada Research Chair in Cellular Information Systems*)

Bhushan Nagar; B.Sc., Ph.D.(Tor.) (*Canada Research Chair in the Structural Biology of Signal Transduction*)

Arnim Pause; B.Sc., M.Sc.(U. Konstanz, Germ.), Ph.D.(McG.) (*Canada Research Chair in Molecular Oncology*)

Jason C. Young; B.Sc.(Tor.), Ph.D.(McM.) (*Canada Research Chair in Molecular Chaperones*)

Assistant Professors

Uri David Akavia; B.Sc., M.Sc., Ph.D.(Tel Aviv)

Josée Dostie; B.Sc.(Sher.), Ph.D.(McG.) (*CIHR New Investigators Award; Chercheur Boursier du FRSQ*)

Sidong Huang; B.A. (Boston), Ph.D.(Calif.)

Martin Schmeing; B.Sc.(McG.), Ph.D.(Yale)

Julie St-Pierre; B.Sc., M.Sc.(Laval), Ph.D.(Camb.)

Jose Teodoro; B.Sc.(W. Ont.), Ph.D.(McG.) (*CIHR New Investigators Award; Chercheur Boursier du FRSQ*)

Associate Members

Karine Auclair (*Chemistry*)

Edward A. Fon (*Neurology and Neurosurgery*)

Jacques Genest (*Medicine*)

Matthias Götte (*Microbiology and Immunology*)

Michael Hallett (*Bioinformatics*)

Qutayba Hamid (*Medicine and Pathology Meakins-Christie Labs*)

Robert Scott Kiss (*Medicine*)

Gergely Lukacs (*Physiology*)

Vassilios Papadopoulos (*Medicine*)

Janusz Rak (*Pediatrics*)

Reza Salavati (*Parasitology*)

Maya Saleh (*Medicine*)

Erwin Schurr (*Ct. for Study of Host Resistance, MGH*)

Peter Siegel (*Medicine*)

Associate MembersYoula Tsantrizos (*Chemistry*)Bernard Turcotte (*Medicine*)Simon Wing (*Medicine*)Xiang-Jiao Yang (*Medicine*)**Adjunct Professors**Mirek Cygler (*Biochemistry, Sask.*)Jacques Drouin (*IRCM*)Anny Fortin (*Dafra Pharma*)Tarik Möröy (*IRCM*)Donald Nicholson (*Merck Frosst*)Enrico Purisima (*NRC/BRI*)René Roy (*UQAM*)**14.4.5 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biochemistry (47 credits)****U1 Required Courses (20 credits)**

* Students with CEGEP-level credit for CHEM 212 and/or CHEM 222 should replace these courses with elective courses.

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2

U1 Complementary Courses (6 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.

6 credits selected from:

BIOL 205	(3)	Biology of Organisms
MIMM 211	(3)	Introductory Microbiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

U2 Required Courses (15 credits)

BIOC 300D1	(3)	Laboratory in Biochemistry
BIOC 300D2	(3)	Laboratory in Biochemistry
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
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
COMP 202	(3)	Foundations of Programming
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

14.4.6 Bachelor of Science (B.Sc.) - Major Biochemistry (67 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
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

U1 Complementary Courses (6 credits)

6 credits selected from:

BIOL 205	(3)	Biology of Organisms
MIMM 211	(3)	Introductory Microbiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

U2 Required Courses (23 credits)

ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOC 300D1	(3)	Laboratory in Biochemistry
BIOC 300D2	(3)	Laboratory in Biochemistry
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules

CHEM 214	(3)	Physical Chemistry/Biological Sciences 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 362	(2)	Advanced Organic Chemistry Laboratory

U2 Complementary Courses (3 credits)

3 credits selected from:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 202	(3)	Foundations of Programming
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
PSYC 204	(3)	Introduction to Psychological Statistics

U3 Required Courses (6 credits)

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

U3 Complementary Courses (6 credits)

At least 3 credits selected from:

BIOC 404	(3)	Biophysical Chemistry
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Immunochemistry
PSYT 455	(3)	Neurochemistry

The remainder, if any, to be selected from the following list:

BIOC 570	(3)	Biochemistry of Lipoproteins
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
CHEM 382	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 532	(3)	Structural Organic Chemistry
CHEM 552	(3)	Physical Organic Chemistry
CHEM 572	(3)	Synthetic Organic Chemistry
EXMD 502	(3)	Advanced Endocrinology 01
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses & Hormones

14.4.7 Bachelor of Science (B.Sc.) - Honours Biochemistry (76 credits)

Admission to the Honours program will not be granted until U2. Students who wish to enter the Honours program in U2 should follow the U1 Major program. Those who satisfactorily complete the U1 Major program with a GPA of at least 3.20 and a mark of B- or better in every required course are eligible for admission to the Honours program.

Students seeking admission to the Honours program must obtain permission from the Departmental Student Affairs Officer, Christine Laberge (christine.laberge@mcgill.ca), during the Add/Drop period in September of their second year.

Promotion to U3 year is based on satisfactory completion of U2 courses with a GPA of at least 3.20 and a mark of B- or better in every required course. In borderline cases, the marks received in BIOC 311 and BIOC 312 will be of particular importance for continuation in the U3 Honours year.

For graduation in the Honours program, students must complete a minimum of 90 credits, pass all required courses with no grade less than B-, and achieve a CGPA of at least 3.20.

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
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

U1 Complementary Courses (6 credits)

6 credits selected from:

BIOL 205	(3)	Biology of Organisms
MIMM 211	(3)	Introductory Microbiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

U2 Required Courses (23 credits)

ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOC 300D1	(3)	Laboratory in Biochemistry
BIOC 300D2	(3)	Laboratory in Biochemistry
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
CHEM 214	(3)	Physical Chemistry/Biological Sciences 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 362	(2)	Advanced Organic Chemistry Laboratory

U2 Complementary Courses (3 credits)

3 credits selected from:

BIOL 309	(3)	Mathematical Models in Biology
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BIOL 373	(3)	Biometry
COMP 202	(3)	Foundations of Programming
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
PSYC 204	(3)	Introduction to Psychological Statistics

U3 Required Courses (15 credits)

BIOC 404	(3)	Biophysical Chemistry
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 462	(6)	Research Laboratory in Biochemistry

U3 Complementary Courses (6 credits)

At least 3 credits selected from:

BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 491	(6)	Independent Research
BIOC 503	(3)	Immunochemistry
PSYT 455	(3)	Neurochemistry

The remainder, if any, to be selected from the following list:

BIOC 570	(3)	Biochemistry of Lipoproteins
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
CHEM 382	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 532	(3)	Structural Organic Chemistry
CHEM 552	(3)	Physical Organic Chemistry
CHEM 572	(3)	Synthetic Organic Chemistry
EXMD 502	(3)	Advanced Endocrinology 01
EXMD 503	(3)	Advanced Endocrinology 02
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses & Hormones

14.4.8 Biochemistry (BIOC) Related Programs

14.4.8.1 Interdepartmental Honours in Immunology

For more information, see [section 14.17: 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 (ciro.piccirillo@mcgill.ca, 514-934-1934 extension 45135), or Dr. Monroe Cohen, Physiology (monroe.cohen@mcgill.ca, 514-398-4342).

14.5 Biology (BIOL)

14.5.1 Location

Stewart Biology Building, Room W4/7
1205 avenue Docteur Penfield
Montreal, Quebec H3A 1B1

Telephone: 514-398-6400
Fax: 514-398-5069
Website: <http://biology.mcgill.ca>

14.5.2 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 a Liberal program, a Major program, Joint Majors with Computer Science and with Mathematics, an Honours program, a Minor program, a Minor concentration in Science for Arts students, a Biology Major option in Quantitative Biology, as well as major and minor concentrations in the B.A. & Sc.

The programs in Biology offer students an opportunity to gain knowledge in more than one area of biology and they provide a broader training than the more specialized programs in Biochemistry, Microbiology, Physiology, or Anatomy and Cell Biology. Many of our graduates continue on to M.D. programs and successful careers in health care. A B.Sc. degree in Biology also prepares students for a wide range of employment opportunities, including entry to professional schools in veterinary science, dentistry, agriculture, nursing, education, and library science. It provides a solid background for students who are interested in careers related to environmental protection, wildlife management, biotechnology, and the pharmaceutical industry. A B.Sc. degree in Biology often leads to postgraduate studies at the M.Sc. and Ph.D. levels, and then on to research careers in universities, research institutes, hospitals, and industrial or governmental laboratories.

The Department of Biology has well-equipped teaching laboratories located in the Stewart Biology Building, and research labs located in the Stewart Biology Building and the Bellini Life Sciences Building. Much of the Department's research space has been renovated or newly constructed in the last several years thanks to extensive support from the Canadian Foundation for Innovation, the *Ministère de la développement économique, innovation, et exploration du Québec*, and the generosity of private benefactors. Our undergraduates are encouraged to take advantage of these facilities by pursuing independent research projects, either as 3-, 6-, and 9-credit stand-alone courses or as part of the Honours program. Department members carry out research in areas of molecular biology, cell biology, ecology, animal behaviour, developmental biology, bioinformatics, neurobiology, marine biology, plant biology, and evolution. The Department also includes many associate faculty members, many of whom are located in McGill-affiliated teaching hospitals or in departments of the Faculty of Medicine, and others who are affiliated with the Redpath Museum, the McGill School of Environment, and remote sites such as the Smithsonian Tropical Research Institute (STRI) in Panama and the Bellairs Research Institute in Barbados. Field courses are given at STRI and Bellairs, at the nearby Gault Nature Reserve, and also at the Huntsman Marine Science Centre in New Brunswick. The Department is also a very active contributor to the Africa Field Study Semester.

The *Biology Department Undergraduate Programs 2013–2014* booklet (“Blue Book”) describes in detail the content of each course and the level at which it is given, the aims and methods used, lectures, references, grading procedures, and other important information. The “Blue Book” also contains more information on registration, counselling, committee structure, and the research interests and facilities that are provided in the Department. It is available at <http://biology.mcgill.ca/undergrad/bluebook.html>.

Inquiries about undergraduate programs should be directed to the Student Affairs Office, Room W3/25, Stewart Biology Building, telephone 514-398-4109.



Note to those interested in the B.A. & Sc. program: Two major concentrations in Biology as well as two minor concentrations in Biology (Organismal and Cell/Molecular Options) are available to students pursuing the B.A. & Sc. degree. These major concentrations are described in *Programs, Courses and University Regulations > Faculties & Schools > Bachelor of Arts and Science > Undergraduate > : Biology (BIOL)*.

14.5.3 Preprogram Requirements

Requirements for the Major and Honours programs in Biology are two courses in elementary Biology, two courses in general Chemistry, two courses in Mathematics (as per the Freshman requirements), and two courses in Physics (mechanics and electromagnetism). Students entering into the B.A. & Sc., the Liberal program and the Biology Science Minor have the same biology, chemistry, and mathematics requirements. The physics requirements will vary according to their future direction. Note that satisfying the minimum Freshman mathematics requirements may not necessarily qualify for medical or dental school admissions requirements.

Students planning to take one of the joint majors or the Quantitative Biology Major option should consult the Undergraduate Adviser in Room W3/25, Stewart Biology Building, telephone 514-398-4109 to ensure they are taking the appropriate prerequisites.

14.5.4 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.



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.

14.5.4.1 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, others on evolutionary origins.

Key courses: BIOL 304, BIOL 305, BIOL 306, BIOL 307, BIOL 320, BIOL 331, or BIOL 334D1/BIOL 334D2 or another field course with a significant behavioural component, BIOL 373, BIOL 507.

Other suggested courses: BIOL 377, BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2.

Most courses from the fields of behaviour, ecology, and evolutionary biology will be relevant for this concentration. Some courses that focus on a particular taxonomic group such as birds (Natural Resource Sciences WILD 420), amphibians and reptiles (BIOL 427), and marine mammals (BIOL 335) include a significant amount of information on behaviour.

14.5.4.2 Biological Diversity and Systematics

The study of biological diversity deals with the maintenance, emergence, and history of the inexhaustible variety of different kinds of organisms. It is deeply concerned with the particular characteristics of different organisms and therefore emphasizes the detailed study of particular groups and forms the basis of comparative biology. Our knowledge of diversity is organized through the study of systematics, which seeks to understand the history of life and the phylogenetic and genetic relationships of living things. Appreciation and knowledge of diversity and systematics are essential in ecology and evolutionary biology and underlie all work in resource utilization and conservation biology.

Key courses: BIOL 304, BIOL 305, BIOL 373.

Other suggested courses: BIOL 240, BIOL 310, BIOL 320, BIOL 324, BIOL 331, BIOL 334D1/BIOL 334D2, BIOL 335, BIOL 350/ENTO 350, BIOL 352, BIOL 355, BIOL 377, BIOL 418, BIOL 427, BIOL 428, BIOL 429, BIOL 463, BIOL 465, BIOL 466 or BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, BIOL 515, BIOL 540, BIOL 555D1/BIOL 555D2, BIOL 569, BIOL 571, BIOL 573, BIOL 594, REDM 400, REDM 405.

Macdonald campus: ENTO 440, ENVB 313, PLNT 358, WILD 307, WILD 350, WILD 420, WILD 424.

14.5.4.3 Conservation Biology Concentration

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

Key courses: BIOL 308, BIOL 310, BIOL 373, BIOL 465, plus at least one of the following field courses: BIOL 331 or BIOL 334D1/BIOL 334D2 or BIOL 428 or BIOL 429 or BIOL 553.

Other suggested courses: BIOL 304, BIOL 305, BIOL 307, BIOL 324, BIOL 335, BIOL 350/ENTO 350, BIOL 355, BIOL 377, BIOL 413, BIOL 427, BIOL 434, BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, BIOL 510, BIOL 515, BIOL 540, BIOL 590, BIOL 594, ECON 225, ECON 326, GEOG 370, GEOG 470, REDM 400.

Macdonald campus: NRSC 437, PLNT 358, WILD 350, WILD 415, WILD 420, WILD 421.

14.5.4.4 Concentrations Available Within the Area of Ecology

Ecology is the study of the interactions between organisms and environment that affect distribution, abundance, and other characteristics of the organisms. A strong analytical and quantitative orientation is common to all areas of ecology, and thus students wishing to specialize in these areas are strongly encouraged to develop their background in statistical analysis, computing, and mathematical modeling. Many of the ecology courses feature a strong analytical component, and students will find that background preparation in this area is very useful, if not essential. Ecology depends heavily on field research, and thus BIOL 331 and/or other field courses should be considered as vital to all concentrations in this area.

14.5.4.4.1 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/BIOL 334D2, BIOL 350/ENTO 350, BIOL 373, COMP 202, COMP 273.

Other suggested courses: BIOL 307, BIOL 324, BIOL 377, BIOL 418, BIOL 427, BIOL 428, BIOL 429, BIOL 432, BIOL 434, BIOL 441, BIOL 465, BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, BIOL 510, BIOL 515, BIOL 540, BIOL 571, BIOL 590, BIOL 594, GEOG 302, REDM 405.

Macdonald campus: PLNT 460.

14.5.4.4.2 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 of the courses (Biological Oceanography) a laboratory component, that stress the techniques used to study aquatic ecology. In addition, the concentration includes a field course in ecology. There is also a variety of courses in aquatic disciplines offered in other departments that complement the aquatic ecology courses offered in Biology.

Key courses: BIOL 305, BIOL 308, BIOL 331 or another field course, BIOL 373, BIOL 418, BIOL 432 (or ENVB 315), BIOL 441, BIOL 465, BIOL 515, COMP 202, COMP 273.

Other suggested courses: BIOL 307, BIOL 429, BIOL 434, BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, BIOL 540, BIOL 590, GEOG 305, GEOG 306, GEOG 308, GEOG 322, REDM 405.

14.5.4.4.3 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 the fields, or for employment in aquatic biology and oceanography.

Key courses: BIOL 305, BIOL 308, BIOL 335, BIOL 373, BIOL 441, BIOL 515.

Other suggested courses: ATOC 512, ATOC 550, BIOL 331, BIOL 334D1/BIOL 334D2, BIOL 418, BIOL 429, BIOL 432, BIOL 434, BIOL 465, BIOL 540, BIOL 590, EPSC 542.

For students intending to proceed to graduate work, one independent studies course (BIOL 466 or BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2) 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.

14.5.4.5 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 435, BIOL 463, BIOL 466 or BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, BIOL 555D1/BIOL 555D2, BIOL 569, BIOL 570, BIOL 571, BIOL 573, BIOL 585, BIOL 594.

Other suggested courses in Organismal Biology: BIOL 240, BIOL 335, BIOL 350/ENTO 350, BIOL 355, BIOL 427, BIOL 428, BIOL 463.

Macdonald campus: PLNT 358, WILD 420.

Genetics and Development: BIOL 300, BIOL 303.

Ecology and Behaviour: BIOL 309, BIOL 429, BIOL 434, BIOL 507, BIOL 515, BIOL 590, REDM 405.

14.5.4.6 Human Genetics Concentration

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

Key courses: BIOL 301, BIOL 370, BIOL 373, BIOL 416, BIOL 520, BIOL 568, BIOL 575.

Other suggested courses: BIOC 311, BIOL 314, BIOL 377, BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, CHEM 203 or CHEM 204, and CHEM 214, CHEM 222, MIMM 314.

14.5.4.7 Molecular Genetics and Development Concentration

The discoveries that have fuelled the ongoing biomedical and biotechnology revolution have been derived from the fusion of a number of fields of biological investigation, including molecular biology, genetics, cellular and developmental biology, and biochemistry. A substantial amount of this research has been conducted upon model eukaryotic organisms, such as yeast, the fruit fly (*Drosophila*), the nematode (*C. elegans*), and the mustard weed (*Arabidopsis*). In the molecular genetics and development concentration, students will obtain a comprehensive understanding of how these “model eukaryotes” have advanced our knowledge of the mechanisms responsible for cellular function and organismal development. Graduates from this concentration will be well prepared to pursue higher degrees in the fields of basic biology, biotechnology, and biomedicine or to assume a wide variety of positions in government, universities, and medical 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 416, BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, BIOL 518, BIOL 520, BIOL 524, BIOL 544.

14.5.4.8 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 507, BIOL 514, BIOL 530, BIOL 532, BIOL 588.

Other suggested courses: ANAT 321, ANAT 322, BIOL 300, BIOL 303, BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, 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.

14.5.5 Biology (BIOL) Faculty

Revision, August 2013. Start of revision.

Chair

Graham A.C. Bell

Emeritus Professors

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)

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

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

John B. Lewis; B.Sc., M.Sc., Ph.D.(McG.)

Professors

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

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

Lauren Chapman; B.Sc.(Alta.), Ph.D.(McG.) (*Canada Research Chair in Respiratory Ecology and Aquatic Conservation*)

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

Andrew Gonzalez; B.Sc.(Nott.), Ph.D.(Imperial Coll., Lond.) (*Canada Research Chair in Biodiversity Science*)

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

Paul F. Lasko; A.B.(Harv.), Ph.D.(MIT) (*James McGill Professor*) (*Associate Member in Anatomy & Cell Biology*)

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

Louis Lefebvre; B.Sc., M.A., Ph.D.(Montr.) (*on sabbatical*)

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

Catherine Potvin; B.Sc., M.Sc.(Montr.), Ph.D.(Duke)

Neil M. Price; B.Sc.(New Br.), Ph.D.(Br. Col.)

Professors

Daniel J. Schoen; B.Sc., M.Sc.(Mich.), Ph.D.(Calif.) (*Macdonald Professor of Botany*)

Associate Professors

Ehab Abouheif; M.Sc.(C'dia), Ph.D.(Duke) (*Canada Research Chair in Evolutionary Developmental Biology*)

Thomas Bureau; B.Sc.(Calif.), Ph.D.(Texas) (*William Dawson Scholar*)

Melania Cristescu; B.Sc., M.Sc.(Ovidius Univ. Constanta, Romania), Ph.D.(Guelph)

Joseph A. Dent; B.Sc., Ph.D.(Colo.)

François Fagotto; Ph.D.(Neuchâtel) (*Canada Research Chair in Cell Biology*)

Gregor Fussmann; Dipl.(Berlin), Ph.D.(Max Planck Institute)

Irene Gregory-Eaves; B.Sc.(Vic., BC), M.Sc., Ph.D.(Qu.)

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

Paul Harrison; B.Sc.(NUI), Ph.D.(Lond.)

Andrew Hendry; B.Sc.(Vic., BC), M.Sc., Ph.D.(Wash.) (*joint appt. with Redpath Museum*)

Rudiger Krahe; Dipl.(Alexander Univ.), Ph.D.(Humboldt)

Brian Leung; B.Sc.(Br. Col.), Ph.D.(Car.)

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

Simon Reader; B.A.(Camb.), Ph.D.(Camb.)

Richard Roy; B.Sc.(Bishop's), Ph.D.(Laval)

Frieder Schoeck; Dipl.(Erhagen), Ph.D.(Max Planck Institute)

Jacalyn Vogel; M.Sc.(E. Ill.), Ph.D.(Kansas) (*Canadian Pacific Chair in Biotechnology*)

Tamara Western; B.Sc.(Dal.), Ph.D.(Br. Col.)

Monique Zetka; B.Sc., Ph.D.(Br. Col.)

Assistant Professors

Gary Brouhard; M.S.E., Ph.D.(Mich.) (*Associate Member in Physics*)

David Dankort; B.Sc., Ph.D.(McM.)

Jonathan Davies; M.Sc.(Cape Town), Ph.D.(Imperial Coll., Lond.)

Michael Hendricks; B.A.(Bowdoin), Ph.D.(Sing.) (*Effective Sept. 1, 2013*)

Nam-Sung Moon; B.Sc., Ph.D.(McG.)

Rodrigo Reyes Lamothe; M.Sc.(C'dia), Ph.D.(Oxf.)

Jon Sakata; B.A.(C'nell), Ph.D.(Texas-Austin, Institute for Neuroscience)

Alanna Watt; B.Sc.(C'dia), Ph.D.(Brandeis)

Sarah Woolley; B.Sc.(Duke), Ph.D.(Texas-Austin)

Hugo Zheng; M.Sc.(Helsinki), Ph.D.(Oxf. Brookes) (*on sabbatical*)

Associate Members

Anatomy and Cell Biology: Craig Mandato

Anthropology: Colin Chapman

Biochemistry: Maxime Bouchard

Centre for Research in Neuroscience: Sal Carbonetto, Yong Rao, Donald Van Meyel

MCH: Feige Kaplan, Rima Rozen

Medical Genetics, Chair: David Rosenblatt

MNI: Kenneth Hastings, Stefano Stifani

Physics: Paul Francois

Associate Members

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

RVH: Hugh J. Clarke, Daniel Dufort, Teruko Taketo

Adjunct Professors

Centre National de la Recherche Scientifique (CNRS): Michel Loreau

Concordia University: Malcolm S. Whiteway

IRCM: Frédéric Charron, David Hipfner, Artur Kania, Marie Kmita

Picchio International Inc.: Francesco Bellini

STRI: Eldredge Bermingham, Rachel Collin, Hector Guzman, Edward Allen Herre, Haris Lessios, William Owen McMillan, Mark Torchin

Université de Montréal: Pierre Drapeau

Revision, August 2013. End of revision.

14.5.6 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, W3/25, 514-398-4109, email: nancy.nelson@mcgill.ca.

6 credits of overlap are allowed between the Minor and the primary program.

Required Courses (15 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution

Complementary Courses (10 credits)

Students complete a minimum of 9 or a maximum of 10 complementary course credits depending on their choice of complementary courses.

To include:

CHEM 212*	(4)	Introductory Organic Chemistry 1
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Plus an additional two courses from the Biology department's course offerings, at the 300 level or above.

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

14.5.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biology (47 credits)

Students may complete this program with a minimum of 45 credits or a maximum of 47 credits depending on their choice of complementary courses.

Required Courses (19 credits)

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

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 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.

14.5.8 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.

U1 Required Courses (18 credits)

BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 202 (3) Basic Genetics
BIOL 205 (3) Biology of Organisms
BIOL 206 (3) Methods in Biology of Organisms
BIOL 215 (3) Introduction to Ecology and Evolution

U2 or U3 Required Course (4 credits)

BIOL 301 (4) Cell and Molecular Laboratory

Complementary Courses (37 credits)

Students complete a minimum of 36 credits or maximum of 37 credits selected as follows:

U1 Complementary Course

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

CHEM 212* (4) Introductory Organic Chemistry 1

U2 or U3 Complementary Courses

12 credits selected from:

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

Other Complementary Courses

21-24 credits selected in consultation with the Program Adviser. All courses must be at the 300 level or higher; they are to include Biology courses of which at most three courses may be substituted, given the Adviser's consent, with science courses offered by other departments. Unless required by the Major, prerequisites for these courses must be taken as electives.

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

Revision, August 2013. Start of revision.

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

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 (42 credits)

Biology (17 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 395	(1)	Quantitative Biology Seminar 1
BIOL 495	(1)	Quantitative Biology Seminar 2

Chemistry (4 credits)

3-4 credits:

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
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Computer Science (3 credits)

3 credits from:

COMP 202	(3)	Foundations of Programming
COMP 250	(3)	Introduction to Computer Science

Math

9-12 credits from

MATH 222*	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability

* For students who have NOT taken MATH 150 and MATH 151.

Physics (6 credits)

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

Course Requirements for Quantitative Biology Streams (22 credits)

21 or 22 credits from one of the following two streams:

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

Biology

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

9 credits chosen from the following list, of which 6 credits must be at the 400 level or above:

BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 324	(3)	Ecological Genetics
BIOL 373	(3)	Biometry
BIOL 434	(3)	Theoretical Ecology
BIOL 510	(3)	Advances in Community Ecology
BIOL 594	(3)	Advanced Evolutionary Ecology

Stream 2: Physical Biology (22 credits)

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 319	(3)	Introduction to Biophysics
PHYS 333	(3)	Thermal and Statistical 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 either Theoretical Ecology and Evolutionary Biology or Physical Biology streams

BIOL 466	(3)	Independent Research Project 1
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 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)	Topics in Geometry
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes

* Students may take COMP 350 OR MATH 317.

Recommendations for Physical Biology stream

CHEM 222	(4)	Introductory Organic Chemistry 2
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
CHEM 514	(3)	Biophysical Chemistry
PHYS 242*	(2)	Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 413	(3)	Physical Basis of Physiology
PHYS 434	(3)	Optics
PHYS 446	(3)	Majors Quantum Physics
PHYS 534	(3)	Nanoscience and Nanotechnology

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

Recommendations for Theoretical Ecology and Evolutionary Biology stream

MATH 204	(3)	Principles of Statistics 2
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MATH 242	(3)	Analysis 1
MATH 324	(3)	Statistics
MATH 340	(3)	Discrete Structures 2
MATH 423	(3)	Regression and Analysis of Variance
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
PHYS 333*	(3)	Thermal and Statistical Physics

* PHYS 333 is now required for the Physical Biology stream

Revision, August 2013. End of revision.

14.5.10 Bachelor of Science (B.Sc.) - Major Biology and Mathematics (76 credits)

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

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 program.

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

Required Courses (34 credits)

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

** Students who have sufficient knowledge in a programming language should take COMP 250 (3 credits) "Introduction to Computer Science" rather than COMP 202.

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

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 215	(3)	Introduction to Ecology and Evolution
CHEM 212*	(4)	Introductory Organic Chemistry 1
COMP 202**	(3)	Foundations of Programming
MATH 222	(3)	Calculus 3
MATH 223***	(3)	Linear Algebra
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 247***	(3)	Honours Applied Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability

Complementary Courses (42 credits)

For the 42 credits, students complete 24 credits of BINF, 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 toward their 24 credits of BINF, BIOL, NEUR, PHGY, PSYC courses while students selecting a MATH course count this toward their 18 credits of MATH courses.

3 credits from the following Math or Biology research courses:

BIOL 466	(3)	Independent Research Project 1
BIOL 467	(3)	Independent Research Project 2
MATH 410	(3)	Majors Project

Of the remaining complementary courses, at least 6 credits must be at the 400 level or above.

Math Courses

15 credits (if MATH 410 was selected as a research course) or 18 credits of MATH courses chosen from Sequence 1 or 2 and from "Remaining Math Courses" as follows:

Sequence 1: Theory

12 credits from the following courses:

* Students may take either MATH 317 or MATH 327.

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

Sequence 2: Statistics

9 credits from the following:

MATH 324	(3)	Statistics
MATH 423	(3)	Regression and Analysis of Variance
MATH 447	(3)	Introduction to Stochastic Processes

Remaining Math Courses

Remaining 3-9 credits of MATH courses may be chosen from any of the two preceding sequences and/or from the following list:

MATH 204	(3)	Principles of Statistics 2
MATH 340	(3)	Discrete Structures 2
MATH 437	(3)	Mathematical Methods in Biology
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications

BIOL, NEUR, PHGY, PHYS, PSYC Courses

21 credits (if BIOL course was selected as a research course) or 24 credits 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
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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

At least 9 credits chosen from the following list, of which 6 credits must be at the 400 level or above:

BIOL 202	(3)	Basic Genetics
BIOL 304	(3)	Evolution
BIOL 308	(3)	Ecological Dynamics
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 324	(3)	Ecological Genetics
BIOL 434	(3)	Theoretical Ecology
BIOL 435	(3)	Natural Selection
BIOL 466	(3)	Independent Research Project 1
BIOL 467	(3)	Independent Research Project 2
BIOL 468	(6)	Independent Research Project 3
BIOL 585	(3)	Game Theory and Evolutionary Dynamics
BIOL 590	(3)	Linking Community and Ecosystem Ecology
BIOL 594	(3)	Advanced Evolutionary Ecology

Molecular Evolution Stream

At least 16 credits selected as follows:

7 credits from:

BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory

At least 9 credits selected from the following list, of which 6 credits must be at the 400 level or above.

* Students may take either BINF 511 or BIOL 592.

BINF 511*	(3)	Bioinformatics for Genomics
BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 319	(3)	Introduction to Biophysics
BIOL 435	(3)	Natural Selection
BIOL 466	(3)	Independent Research Project 1
BIOL 467	(3)	Independent Research Project 2
BIOL 468	(6)	Independent Research Project 3
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
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At least 12 credits selected from:

BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 466	(3)	Independent Research Project 1
BIOL 467	(3)	Independent Research Project 2
BIOL 468	(6)	Independent Research Project 3
BIOL 530	(3)	Advances in Neuroethology
PHGY 314	(3)	Integrative Neuroscience
PHGY 425	(3)	Analyzing Physiological Systems
PSYC 427	(3)	Sensorimotor Behaviour

Remaining BINF, BIOL, NEUR, PHGY, PSYC

For the remaining BINF, BIOL, NEUR, PHGY, PSYC complementary course credits, if any, students top up their credits to the necessary 21-24 credits with any course listed in the above three streams. Other relevant courses may be substituted with the approval of the Program Adviser.

14.5.11 Bachelor of Science (B.Sc.) - Honours Biology (75 credits)

Students may complete this program with a minimum of 71 credits or a maximum of 75 credits depending on their choice of complementary courses.

The Honours program in Biology is designed expressly as a preparation for graduate studies and research, and provides students with an enriched training in biology and some research experience in a chosen area. Acceptance into the Honours program at the end of U2 requires a CGPA of 3.50 and approval of a 9- or 12-credit Independent Studies proposal (see listing of BIOL 479 and BIOL 480 for details). Students also complete a 4-credit Honours Seminar course, BIOL 499. For an Honours degree, a minimum CGPA of 3.50 in the U3 year and adherence to the program as outlined below are the additional requirements.

U1 Required Courses (18 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution

U1 Complementary Course (4 credits)

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
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U2 or U3 Required Courses (7 credits)

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 373	(3)	Biometry

U2 and U3 Complementary Courses (33 credits)

Students who take CHEM 212 in U1 complete 30 credits and those exempted from CHEM 212 complete 33 credits selected as follows:

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

18-21 credits in Biology at the 300 level or higher, of which 9 credits may be from other Science departments, with approval of the Adviser.

U3 Required Courses (4 credits)

BIOL 499D1	(2)	Honours Seminar in Biology
BIOL 499D2	(2)	Honours Seminar in Biology

U3 Complementary Courses (12 credits)

9-12 credits selected from:

BIOL 479D1	(4.5)	Honours Research Project 1
BIOL 479D2	(4.5)	Honours Research Project 1
BIOL 480D1	(6)	Honours Research Project 2
BIOL 480D2	(6)	Honours Research Project 2

14.5.12 Biology (BIOL) Related Programs and Study Semesters**14.5.12.1 Joint Major in Computer Science and Biology**

For more information, see [section 14.9.11: Bachelor of Science \(B.Sc.\) - Major Computer Science and Biology \(73 credits\)](#).

14.5.12.2 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 [Programs, Courses and University Regulations > Faculties & Schools > Field Studies > Undergraduate > : Panama Field Study Semester](#). You can also visit the following website for details: www.mcgill.ca/science/student/internships-field.

14.5.12.3 Africa Field Study Semester

The Department of Geography, Faculty of Science, coordinates the 15-credit interdisciplinary Africa Field Study Semester; see [Programs, Courses and University Regulations > Faculties & Schools > Field Studies > Undergraduate > : Africa Field Study Semester](#). You can also visit the following website for details: www.mcgill.ca/science/student/internships-field.

14.6 Biotechnology (BIOT)**14.6.1 Location**

Sheldon Biotechnology Centre

Lyman Duff Building
3775 University Street
Montreal, Quebec H3A 2B4
Telephone: 514-398-3998

14.6.2 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 regular departmental Major (or Honours or Faculty) program. The Minor emphasizes an area relevant to biotechnology which is complementary to the main program.

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

The course BIOT 505 *Selected Topics in Biotechnology* is considered as a course taught by the Faculty of Science.

14.6.3 General Regulations

To obtain the Minor in Biotechnology, students must:

- satisfy the requirements both for the departmental program and for the Minor;
- complete 24 credits, 18 of which must be exclusively for the Minor program;
- obtain a grade of C or better in the courses presented for the Minor.

14.6.4 Biotechnology (BIOT) Faculty

Program Supervisor

Jacalyn Vogel; M.Sc.(E. Ill.), Ph.D.(Kansas) (*Canadian Pacific Chair in Biotechnology*)

14.6.5 Bachelor of Science (B.Sc.) - Minor Biotechnology (for Science Students) (24 credits)

To obtain the Minor Biotechnology, Science students must:

- a) satisfy both the requirements for the departmental program and for the Minor;
- b) complete 24 credits, 18 of which must be exclusively for the Minor program.*

* Approved substitutions must be made for any of the required courses which are part of the student's main program.

Required Courses (15 credits)

* Students may take either BIOL 201 or BIOC 212.

BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOL 200	(3)	Molecular Biology
BIOL 201*	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOT 505	(3)	Selected Topics in Biotechnology
MIMM 211	(3)	Introductory Microbiology

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

General

FACC 300	(3)	Engineering Economy
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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)	Finance 1
MGCR 352	(3)	Marketing Management 1
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 Oncogenes

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 01
EXMD 503	(3)	Advanced Endocrinology 02
PHAR 562	(3)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2
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

14.6.6 Biotechnology (BIOT) Related Programs**14.6.6.1 Program for Students in the Faculty of Engineering**

See *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Engineering > Undergraduate > Academic Programs > Minor Programs > : [Biotechnology Minor](#)* for details.

14.7 Chemistry (CHEM)**14.7.1 Location**

Otto Maass Chemistry Building
801 Sherbrooke Street West
Montreal, Quebec H3A 0B8

Website: www.chemistry.mcgill.ca

Departmental Office: Room 322
Telephone: 514-398-6999

Student Advisory Office: Room 314
Website: www.chemistry.mcgill.ca/advising/index.htm

14.7.2 Office for Science and Society

The Office for Science and Society is dedicated to the promotion of critical thinking and the presentation of practical scientific information to the public, educators, and students in an accurate and responsible fashion. The Office answers queries from the public as well as from the media, with a view toward establishing scientific accuracy. The Office also offers a variety of educational and interesting presentations on scientific topics and its members contribute to a number of courses under the umbrella of "The World of Chemistry."

Director

Joseph A. Schwarcz; B.Sc., Ph.D.(McG.)

Members

Ariel Fenster; L.Sc., D.E.A.(Paris), Ph.D.(McG.)

David N. Harpp; A.B.(Middlebury), M.A.(Wesl.), Ph.D.(N. Carolina), F.C.I.C. (*William C. Macdonald Professor of Chemistry*)

14.7.3 About Chemistry

Chemistry is both a pure science, offering a challenging intellectual pursuit, and an applied science whose technology is of fundamental importance to the economy and society. Modern chemists seek an understanding of the structure and properties of atoms and molecules to predict and interpret the properties and transformations of matter and the energy changes that accompany those transformations. Many of the concepts of physics and mathematics are basic to chemistry, while chemistry is of fundamental importance to many other disciplines such as the biological and medical sciences, geology, metallurgy, etc.

A degree in chemistry leads to a wide variety of professional vocations. The large science-based industries (petroleum refining, plastics, pharmaceuticals, etc.) all employ chemists in research, development, and quality control. Many federal and provincial departments and agencies employ chemists in research and testing laboratories. Such positions are expected to increase with the currently growing concern for the environment and for consumer protection. A background in chemistry is also useful as a basis for advanced study in other related fields, such as medicine and the biological sciences. For a business career, a B.Sc. in Chemistry can profitably be combined with a master's degree in Business Administration, or a study of law for work as a patent lawyer or forensic scientist.

Chemistry courses at the university level are traditionally divided into four areas of specialization: 1) organic chemistry, dealing with the compounds of carbon; 2) inorganic chemistry, concerned with the chemistry and compounds of elements other than carbon; 3) analytical chemistry, which deals with the identification of substances and the quantitative measurement of their compositions; and 4) physical chemistry, which treats the physical laws, kinetics, and energetics governing chemical reactions, behaviour of materials, and molecular structure. Naturally, there is a great deal of overlap between these different areas, and the boundaries are becoming increasingly blurred. After a general course at the introductory level, courses in organic, inorganic, analytical, and physical chemistry are offered throughout the university years. Since chemistry is an experimental science, laboratory classes accompany most undergraduate courses. In addition, courses are offered in polymer, theoretical, green, nano, and biological chemistry to upper-year undergraduates.

There are two main programs in the Department of Chemistry: Honours and Major. The Honours program is intended primarily for students wishing to pursue graduate studies in chemistry. While the Major program is somewhat less specialized, it is still recognized as sufficient training for a career in chemistry. It can also lead to graduate studies although an additional Qualifying year may be necessary. There are also a number of B.Sc. Liberal and other programs available. Interested students may inquire about these at the Student Advisory Office, Room 314, Otto Mass Chemistry Building, or see www.chemistry.mcgill.ca/advising/index.htm.

14.7.4 Chemistry (CHEM) Faculty

Chair

R. Bruce Lennox (*until May 31, 2013*)

Masad Damha (*as of June 2013*)

Emeritus Professors

Tak-Hang Chan; B.Sc.(Tor.), M.A., Ph.D.(Princ.), F.C.I.C., F.R.S.C. (*Tomlinson Emeritus Professor of Chemistry*)

Adi Eisenberg; B.S.(Worcester Polytech.), M.A., Ph.D.(Princ.), F.C.I.C. (*Otto Maass Professor of Chemistry*)

Byung Chan Eu; B.Sc.(Seoul), Ph.D.(Brown)

Denis F.R. Gilson; B.Sc.(Univ. Coll. Lond.), M.Sc., Ph.D.(Br. Col.), F.C.I.C., F.R.S.C. (UK)

John F. Harrod; B.Sc., Ph.D.(Birm.) (*Tomlinson Emeritus Professor of Chemistry*)

Alan S. Hay; B.Sc., M.Sc.(Alta.), Ph.D.(Ill.), D.Sc.(Alta.), F.R.S., F.N.Y., Acad.Sci. (*Tomlinson Emeritus Professor of Chemistry*)

Robert H. Marchessault; B.Sc.(Loyola), Ph.D.(McG.), D.Sc.(C' dia), F.R.S.C. (*E.B. Eddy Professor of Industrial Chemistry*)

Mario Onyszchuk; B.Sc.(McG.), M.Sc.(W. Ont.), Ph.D.(McG.), Ph.D.(Cant.)

Donald Patterson; M.Sc.(McG.), Doc.(St-Etienne) (*Otto Maass Emeritus Professor of Chemistry*)

Emeritus Professors

Arthur S. Perlin; M.Sc., Ph.D.(McG.), F.R.S.C. (*E.B. Eddy Emeritus Professor of Industrial Chemistry*)

William C. Purdy; B.A.(Amh.), Ph.D.(MIT), F.C.I.C. (*William C. Macdonald Emeritus Professor of Chemistry*)

Leon E. St-Pierre; B.Sc.(Alta.), Ph.D.(Notre Dame), F.C.I.C.

Michael A. Whitehead; B.Sc., Ph.D., D.Sc.(Lond.), F.C.I.C.

Professors

Bruce Arndtsen; B.A.(Car. Coll.), Ph.D.(Stan.) (*William Dawson Scholar*)

D. Scott Bohle; B.A.(Reed College), M.Phil., Ph.D.(Auck.) (*CRC Tier I Chair*)

David H. Burns; B.Sc.(Puget Sound), Ph.D.(Wash.)

Ian S. Butler; B.Sc., Ph.D.(Brist.), F.C.I.C., C.Sci., C.Chem., F.R.S.C. (UK)

Masad J. Damha; B.Sc., Ph.D.(McG.) (*James McGill Professor*)

Derek G. Gray; B.Sc.(Belf.), M.Sc., Ph.D.(Manit.), F.C.I.C. (*NSERC Paprican Chair*)

David N. Harpp; A.B.(Middlebury), M.A.(Wesl.), Ph.D.(N. Carolina), F.C.I.C. (*William C. Macdonald Professor of Chemistry*)

R. Bruce Lennox; B.Sc., M.Sc., Ph.D.(Tor.) (*Tomlinson Professor of Chemistry*)

C.J. Li; B.Sc.(Zhengzhou), M.Sc.(C.A.S.), Ph.D.(McG.) (*CRC Tier I Chair*)

David Ronis; B.Sc.(McG.), Ph.D.(MIT)

Eric D. Salin; B.Sc.(Calif.), Ph.D.(Ore. St.)

Bryan C. Sanctuary; B.Sc., Ph.D.(Br. Col.)

Hanadi Sleiman; B.Sc.(A.U.B.), Ph.D.(Stan.) (*William Dawson Scholar*)

Theo G.M. van de Ven; Kand. Doc.(Utrecht), Ph.D.(McG.) (*NSERC Paprican Chair*)

Associate Professors

Mark P. Andrews; B.Sc., M.Sc., Ph.D.(Tor.)

Parisa Ariya; B.Sc., Ph.D.(York) (*William Dawson Scholar*) (*joint appt. with Atmospheric & Oceanic Sciences*)

Karine Auclair; B.Sc.(UQAC), Ph.D.(Alta.)

Christopher J. Barrett; B.Sc., M.Sc., Ph.D.(Qu.)

Gonzalo Cosa; B.Sc.(Rio Cuarto), Ph.D.(Ott.)

William C. Galley; B.Sc.(McG.), Ph.D.(Calif.)

James Gleason; B.Sc.(McG.), Ph.D.(Virg.)

Ashok K. Kakkar; B.Sc.(Punjab), M.Sc.(H.P.U.), Ph.D.(Wat.)

Patanjali Kambhampati; B.A.(Car. Coll.), Ph.D.(Texas)

Anthony Mittermaier; B.Sc.(Guelph), Ph.D.(Tor.)

Nicolas Moitessier; B.Sc., M.Sc., Ph.D.(Nancy)

Dmitrii Perepichka; B.S., M.Sc., Ph.D.(Ukraine)

Joan F. Power; B.Sc., Ph.D.(C'dia)

Linda Reven; B.A.(Car. Coll.), Ph.D.(Ill.)

Youla Tsantrizos; B.Sc., M.Sc., Ph.D.(McG.)

Paul Wiseman; B.Sc.(St. FX), Ph.D.(W. Ont.) (*joint appt. with Physics*)

Assistant Professors

Amy S. Blum; B.S.(Princ.), M.S., Ph.D.(Wash.)

Tomislav Friš i ; B.Sc.(Zagreb), Ph.D. (U. Iowa)

Jean-Philip Lumb; B. A. (C'nell), Ph.D.(Calif., Berk.)

Audrey Moores; B.Sc., M.Sc., Ph.D.(École Poly., Palaiseau, Fr.) (*Faculty of Science Tier II Chair*)

Assistant ProfessorsBradley Siwick; B.A.Sc., M.Sc., Ph.D.(Tor.) (*joint appt. with Physics*)**Associate Members**James A. Finch (*Mining & Metallurgical Engineering*)P. Grütter (*Physics*)Esther Schirmmacher (*Medicine*)Ralf Schirmmacher (*Medicine*)**Adjunct Professors**

Yvan Guindon; B.Sc., Ph.D.(Montr.), F.C.I.C., F.R.S.C.

Christian Reber; B.Sc., Ph.D.(Berne)

Ivor Wharf; B.Sc., Ph.D.(Lond.), A.R.C.S., D.I.C.

Robert Zamboni; B.Sc., Ph.D.(McG.)

14.7.5 Bachelor of Science (B.Sc.) - Minor Chemistry (18 credits)**Required Courses (18 credits)**

* Denotes courses with CEGEP equivalents.

Substitutions for these by more advanced courses may be made at the discretion of the Adviser.

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

14.7.6 Bachelor of Science (B.Sc.) - Minor Chemical Engineering (24 credits)**Revision, July 2013. Start of revision.**

A Chemical Engineering Minor will be of interest to Chemistry students who wish to study the problems of process engineering and its related subjects. A student completing this Minor will be able to make the important link between molecular sciences and industrial processing. This Minor will not provide Professional Engineering accreditation.

Required Courses (6 credits)

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 CHEE 392 and CHEE 393

** 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 392*	(4)	Project Laboratory 1
CHEE 393*	(5)	Project Laboratory 2
CHEE 438	(3)	Engineering Principles in Pulp and Paper Processes
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

Revision, July 2013. End of revision.

14.7.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - Biological (47 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 have successfully completed them at CEGEP. Students from outside Quebec or transfer students should consult the Academic Adviser.

See <http://www.chemistry.mcgill.ca/advising/inside/advisors.php>.

The Liberal Program: Core Science Component in Chemistry - Biological Option is not certified by the Ordre des chimistes du Québec. Students interested in pursuing a career in Chemistry in Quebec are advised to take an appropriate B.Sc. program in Chemistry.

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 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 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

CHEM 381	(3)	Inorganic Chemistry 2
MATH 222**	(3)	Calculus 3

Biological Option Courses (21 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 382	(3)	Organic Chemistry: Natural Products
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory
CHEM 502	(3)	Advanced Bio-Organic Chemistry

14.7.8 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 have successfully completed them at the CEGEP level. Students from outside Quebec or transfer students should consult the Academic Adviser.

See <http://www.chemistry.mcgill.ca/advising/inside/advisors.php>.

The Liberal Program: Core Science Component Chemistry - General Option is not certified by the Ordre des chimistes du Québec. Students interested in pursuing a career in Chemistry in Quebec are advised to take an appropriate B.Sc. program in Chemistry.

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 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 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 381	(3)	Inorganic Chemistry 2
MATH 222**	(3)	Calculus 3

General Option Courses (20 credits)

CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Molecular Properties and Structure 1

CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory
MATH 315	(3)	Ordinary Differential Equations
PHYS 242	(2)	Electricity and Magnetism

Complementary Course (3 credits)

3 credits from:

CHEM 355	(3)	Molecular Properties and Structure 2
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14.7.9 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - Physical (47 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 have successfully completed them at CEGEP. Students from outside Quebec or transfer students should consult the Academic Adviser.

See <http://www.chemistry.mcgill.ca/advising/inside/advisors.php>.

The Liberal Program: Core Science Component Chemistry - Physical Option is not certified by the Ordre des chimistes du Québec. Students interested in pursuing a career in Chemistry in Quebec are advised to take an appropriate B.Sc. program in Chemistry.

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.

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 381	(3)	Inorganic Chemistry 2
MATH 222**	(3)	Calculus 3

Physical Option Courses (21 credits)

CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
CHEM 365	(2)	Statistical Thermodynamics

CHEM 393	(2)	Physical Chemistry Laboratory 2
COMP 208	(3)	Computers in Engineering
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
PHYS 242	(2)	Electricity and Magnetism

14.7.10 Bachelor of Science (B.Sc.) - Major Chemistry (59 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 (53 credits)

The required courses in this program consist of 53 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.chemistry.mcgill.ca/advising/inside/advisors.php>.

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. 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 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
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 393	(2)	Physical Chemistry Laboratory 2
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations
PHYS 242	(2)	Electricity and Magnetism

Complementary Courses (6 credits)

6 credits of additional Chemistry (CHEM) courses at the 300 level or higher.

14.7.11 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 (54 credits)

The required courses in this program consist of 54 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.chemistry.mcgill.ca/advising/inside/advisors.php>.

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 219	(3)	Introduction to Atmospheric Chemistry
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
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 393	(2)	Physical Chemistry Laboratory 2
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (9 credits)

3 credits, one of:

CHEM 419	(3)	Advances in Chemistry of Atmosphere
CHEM 462	(3)	Green Chemistry

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
ATOC 412	(3)	Atmospheric Dynamics
CHEM 567	(3)	Chemometrics: Data Analysis
CHEM 575	(3)	Chemical Kinetics
CHEM 597	(3)	Analytical Spectroscopy
EPSC 542	(3)	Chemical Oceanography

14.7.12 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 MATH 150 and MATH 151 do not have to take MATH 222.

Required Courses (60 credits)

The required courses in this program consist of 60 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.chemistry.mcgill.ca/advising/inside/advisors.php>.

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.

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry

CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
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 393	(2)	Physical Chemistry Laboratory 2
CHEM 502	(3)	Advanced Bio-Organic Chemistry
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations

Complementary Course (3 credits)

One of:

BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
MIMM 211	(3)	Introductory Microbiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

14.7.13 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.

See <http://www.chemistry.mcgill.ca/advising/inside/advisors.php>.

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. 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 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory

CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
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 393	(2)	Physical Chemistry Laboratory 2
CHEM 574	(3)	Introductory Polymer Chemistry
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations
PHYS 242	(2)	Electricity and Magnetism

Complementary Course (3 credits)

CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 534	(3)	Nanoscience and Nanotechnology
CHEM 571	(3)	Polymer Synthesis
CHEM 585	(3)	Colloid Chemistry

14.7.14 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 53 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.chemistry.mcgill.ca/advising/inside/advisors.php>.

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. 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
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CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
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 393	(2)	Physical Chemistry Laboratory 2
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations
PHYS 242	(2)	Electricity and Magnetism

Complementary Courses (18 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)	Research Project 2

12 credits of additional Chemistry courses as follows:

6 credits of which must be at the 300 level or higher, and

6 credits of which must be at the 400 level or higher.

14.7.15 Bachelor of Science (B.Sc.) - Honours Chemistry - Atmosphere and Environment (75 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 (60 credits)

The required courses in this program consist of 60 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.chemistry.mcgill.ca/advising/inside/advisors.php>.

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 219	(3)	Introduction to Atmospheric Chemistry
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
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 393	(2)	Physical Chemistry Laboratory 2
CHEM 419	(3)	Advances in Chemistry of Atmosphere
CHEM 462	(3)	Green Chemistry
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (15 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)	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

6 credits, two of:

ATOC 315	(3)	Thermodynamics and Convection
ATOC 412	(3)	Atmospheric Dynamics
CHEM 567	(3)	Chemometrics: Data Analysis
CHEM 575	(3)	Chemical Kinetics
CHEM 597	(3)	Analytical Spectroscopy
EPSC 542	(3)	Chemical Oceanography

14.7.16 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 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, 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.chemistry.mcgill.ca/advising/inside/advisors.php>.

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.

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
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 393	(2)	Physical Chemistry Laboratory 2
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (18 credits)

18 credits selected as follows:

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)	Research Project 2

6 credits, two of the following courses:

BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 502	(3)	Advanced Bio-Organic Chemistry
MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

and 6 credits of additional Chemistry courses at the 400 level or higher.

14.7.17 Bachelor of Science (B.Sc.) - Honours Chemistry - Materials (74 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 (65 credits)

The required courses in this program consist of 65 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.chemistry.mcgill.ca/advising/inside/advisors.php>.

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. 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.

*** 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
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CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 345	(3)	Molecular Properties and Structure 1
CHEM 355	(3)	Molecular Properties and Structure 2
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 393	(2)	Physical Chemistry Laboratory 2
CHEM 470***	(6)	Research Project 1
CHEM 574	(3)	Introductory Polymer Chemistry
MATH 222**	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations
PHYS 242	(2)	Electricity and Magnetism

Complementary Courses (9 credits)

9 credits, three of:

* Students take either ANAT 542 or MIME 542.

ANAT 542*	(3)	Transmission Electron Microscopy
CHEM 462	(3)	Green Chemistry
CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 533	(3)	Small Molecule Crystallography
CHEM 534	(3)	Nanoscience and Nanotechnology
CHEM 571	(3)	Polymer Synthesis
CHEM 582	(3)	Supramolecular Chemistry
CHEM 585	(3)	Colloid Chemistry
MIME 260	(3)	Materials Science and Engineering
MIME 542*	(3)	Transmission Electron Microscopy

14.7.18 Chemistry (CHEM) Related Programs

14.7.18.1 Joint Honours in Physics and Chemistry

For more information, see [section 14.29: Physics \(PHYS\)](#).

14.8 Cognitive Science

14.8.1 About Cognitive Science

Cognitive Science is the multidisciplinary study of cognition in humans and machines. The goal is to understand the principles of intelligence and thought with the hope that this will lead to a better understanding of the mind and of learning, and to the development of intelligent devices that constructively extend human abilities.

Students wishing to enrol in the Minor in Cognitive Science must meet with the Interdisciplinary Programs Adviser in the Faculty of Science.

14.8.2 Bachelor of Science (B.Sc.) - Minor Cognitive Science (24 credits)

The Minor Cognitive Science is intended to allow students in the Faculty of Arts or the Faculty of Science to explore the interdisciplinary study of cognition. The goal is to understand the principles of intelligence with the hope that this will lead to a better understanding of the mind and learning.

Students wishing to complete this Minor must meet with the Interdisciplinary Programs Adviser in the Science Office for Undergraduate Student Advising (SOUSA).

Required Course (3 credits)

PSYC 532	(3)	Cognitive Science
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Complementary Courses (21 credits)

Note:

Students must take a minimum of 6 credits at the 400 to 500 level.

Students may not take any courses from their home department(s).

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 360	(3)	Introduction to Semantics
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
PHIL 310	(3)	Intermediate Logic
PHIL 415	(3)	Philosophy of Language
PHIL 474	(3)	Phenomenology
PHIL 506	(3)	Seminar: Philosophy of Mind
PHIL 511	(3)	Seminar: Philosophy of Logic and Mathematics

Psychology

PSYC 213	(3)	Cognition
PSYC 301	(3)	Animal Learning & Theory
PSYC 304	(3)	Child Development
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 340	(3)	Psychology of Language
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development

14.9 Computer Science (COMP)

14.9.1 Location

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

Undergraduate Student Affairs Office
 Lorne Trotter Building, Room 2060
 3630 University Street
 Montreal, Quebec H3A 0C6
 Telephone: 514-398-7071 ext. 00739
 Fax: 514-398-4653

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

14.9.2 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 such as 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), and 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, in consulting, in research, and in 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 a major, an honours, a liberal, and a minor program in Computer Science, a major and a liberal program in Software Engineering, a major in Computer Science: Computer Games Option, a joint major and a joint honours program in Mathematics and Computer Science (see [section 14.21: Mathematics and Statistics \(MATH\)](#)), a joint major and a joint honours program in Statistics and Computer Science (see [section 14.21: Mathematics and Statistics \(MATH\)](#)), a joint major in Physics and Computer Science (see [section 14.29: Physics \(PHYS\)](#)), and a joint major in Computer Science and Biology (see [section 14.5: 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 [Programs, Courses and University Regulations > Faculties & Schools > Faculty of Arts > Undergraduate > Academic Programs > : Computer Science \(COMP\)](#)) or as part of a Bachelor of Arts and Science (see [Programs, Courses and University Regulations > Faculties & Schools > Bachelor of Arts and Science > Undergraduate > Academic 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 [Programs, Courses and University Regulations > Faculties & Schools > Faculty of Engineering > Undergraduate > Academic 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. Students will learn in a small classroom environment, get to know their professors and have 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 Trotter Building, which is dedicated to undergraduate students.

All students planning to enter Computer Science programs are encouraged to make an appointment with an academic adviser through the School's Undergraduate Student Affairs Office.

14.9.3 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 an academic program offered for a duration of 8, 12, or 16 months. It will be reflected on your transcript and is included in your 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/Fail course on your transcript. If you complete two IPs, the name of your program will change to include the word "internship."

For more information on these programs, consult [section 13.1: Industrial Practicum \(IP\) and Internship Year in Science \(IYS\)](#) or www.mcgill.ca/science/student/internships-field.

14.9.4 Research Opportunities

Computer science undergraduates have excellent opportunities to participate in research. Each summer, several awards are available, such as the NSERC Undergraduate Student Research Awards; these offer financial support for a research experience in an academic setting. Other research assistantship and volunteering opportunities in research labs are also available. Students may also take undergraduate research project courses such as COMP 396 *Undergraduate Research Project*, COMP 400 *Honours Project in Computer Science*, and COMP 401 *Project in Biology and Computer Science*. Students who have participated in substantial and broad undergraduate research may qualify for the Dean's Multidisciplinary Undergraduate Research List at graduation time. For more information, consult [Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > Graduation > : Graduation Honours: Faculty of Science Dean's Multidisciplinary Undergraduate Research List](#).

14.9.5 Admissions

Students intending to pursue a major in Computer Science or Software Engineering should have a reasonable mathematical background and should have completed MATH 140 (or MATH 150), MATH 141 (or MATH 151), and MATH 133, or their CEGEP equivalents. These three Mathematics courses should

have been completed with at least an average of B-. A background in computer science is not necessary as students may start their studies with the introductory course COMP 202. However, taking COMP 202 in the Freshman year, or completing an equivalent course in CEGEP, would be an asset and allows students to take more advanced courses earlier in their program.

More information about the admission process and the programs is available at www.cs.mcgill.ca.

14.9.6 Computer Science (COMP) Faculty

Director

Gregory Dudek

Emeritus Professors

Renato De Mori-Bajolin; D.Eng.(Politecnico di Torino, Italy)

Timothy Merrett; B.Sc.(Qu.), D.Phil.(Oxf.)

Monroe Newborn; B.E.E.(R.P.I.), Ph.D.(Ohio St.), F.A.C.M.

Christopher C. Paige; B.Sc.(Syd.), B.Eng.(Syd.), Ph.D.(Lond.), D.Phil.(Lond.)

Gerald Ratzer; B.Sc.(Glas.), M.Sc.(McG.)

Godfried T. Toussaint ; B.Sc.(Tulsa), Ph.D.(Br. Col.)

Sue Whitesides; M.S.E.E.(Stan.), Ph.D.(Wisc.)

Professors

David M. Avis; B.Sc.(Wat.), Ph.D.(Stan.)

Luc P. Devroye; M.S.(Louvain), Ph.D.(Texas) (*James McGill Professor*)

Gregory Dudek; B.Sc.(Qu.), M.Sc., Ph.D.(Tor.) (*James McGill Professor*)

Laurie Hendren; B.Sc., M.Sc.(Qu.), Ph.D.(C' nell) (*Canada Research Chair*) (*Royal Society of Canada Fellow*)

Prakash Panangaden; M.Sc.(IIT, Kanpur), M.S.(Chic.), Ph.D.(Wisc.)

Bruce Reed; B.Sc., Ph.D.(McG.) (*Canada Research Chair*) (*Royal Society of Canada Fellow*)

Kaleem Siddiqi; B.Sc.(Lafayette), M.Sc., Ph.D.(Brown) (*William Dawson Scholar*)

Denis Thérien; B.Sc.(Montr.), M.Sc., Ph.D.(Wat.) (*James McGill Professor*)

Associate Professors

Mathieu Blanchette; B.Sc., M.Sc.(Montr.), Ph.D.(Wash.)

Xiao-Wen Chang; B.Sc., M.Sc.(Nanjing), Ph.D.(McG.)

Claude Crépeau; B.Sc., M.Sc.(Montr.), Ph.D.(MIT)

Nathan Friedman; B.A.(W. Ont.), Ph.D.(Tor.)

Michael Trevor Hallett; B.Sc.(Qu.), Ph.D.(Vic., BC)

Patrick Hayden; B.Sc.(McG.), Ph.D.(Oxf.) (*Canada Research Chair*)

Bettina Kemme; B.Sc., M.Sc.(Erlangen-Nuremberg, Germany), Ph.D.(ETH, Zurich)

Jörg Kienzle; Eng.Dip., Ph.D.(Swiss Fed. IT)

Michael Langer; B.Sc.(McG.), M.Sc.(Tor.), Ph.D.(McG.) (*on leave 2013–2014*)

Xue Liu; B.Sc., M.Sc.(Tsinghua), Ph.D.(Ill.)

Muthucumaru Maheswaran; B.Sc.(Peradeniya), M.Sc., Ph.D.(Purd.)

Brigitte Pientka; B.Sc., M.Sc.(Darmstadt), Ph.D.(Carn. Mell)

Joëlle Pineau; B.Sc.(Wat.), M.Sc., Ph.D.(Carn. Mell)

Doina Precup; B.Sc.(Cluj-Napoca), M.Sc., Ph.D.(Mass.)

Martin Robillard; B.Eng.(École Poly., Montr.), M.Sc., Ph.D.(Br. Col.)

Carl Tropper; B.Sc.(McG.), Ph.D.(Brooklyn Poly.)

Clark Verbrugge; B.A.(Qu.), Ph.D.(McG.)

Associate Professors

Adrian Vetta; B.Sc., M.Sc.(LSE), Ph.D.(MIT)

Assistant Professors

Hamed Hatami; B.Sc.(Sharif Univ. of Technology), M.Sc., Ph.D.(Tor.)

Wenbo He; B.Eng.(Harbin), M.Eng., Ph.D.(Ill.)

Paul Kry; B.Sc.(Wat.), M.Sc., Ph.D.(Br. Col.)

Derek Ruths; B.Sc., M.Sc., Ph.D.(Rice)

J r me Waldisp hl; B.Sc.(Nice and Sophia-Antipolis, France), M.Sc.(Paris VII), Ph.D.( cole Poly., France)

Faculty Lecturer

Joseph Vybihal; B.Sc., M.Sc.(McG.)

Associate Members

Daniel J. Levitin (*Psychology*)

Dirk Schlimm (*Philosophy*)

Raja Sengupta (*Geography*)

F. Bruce Shepherd (*Mathematics*)

Thomas Richard Shultz (*Psychology*)

Ren e Sieber (*Geography*)

Adjunct Professors

Masoumeh Tabaeh Izadi; B.Sc.(Tehran), M.Sc.(King's Coll., Lond.), Ph.D.(McG.)

Theodore Perkins; B.A.(Car.), M.Sc.(Wisc.), Ph.D.(Mass.)

Ioannis Rekleitis; B.Sc.(Athens), M.Sc., Ph.D.(McG.)

Ger Otto Sabidussi

Hans Vangheluwe; B.Sc., M.Sc., D.Sc.(Ghent, Belgium)

14.9.7 Bachelor of Science (B.Sc.) - Minor Computer Science (24 credits)

This Minor is designed for students who want to gain a basic understanding of computer science principles and get an overview of some computer science areas. Basic computer science skills are important in many domains. Thus, the Minor is useful for students majoring in any discipline. It can be taken in conjunction with any program in the Faculties of Science and Engineering (with the exception of other programs in Computer Science).

Students must obtain approval from the adviser of their main program. Students are strongly encouraged to talk to an adviser of the School of Computer Science before choosing the complementary courses. Approval must be given by the School for the particular selection of courses to be credited toward the Minor. This should be done before registering for the final term of studies.

Students may receive credit toward their Computer Science Minor by taking certain approved courses outside the School of Computer Science. These courses must have a high computer science content. A student will not be permitted to receive more than 6 credits from such courses. These courses must be approved by the School of Computer Science in advance. If a student's Major program requires Computer Science courses, up to 6 credits of Computer Science courses may be used to fulfil both Major and Minor requirements.

Required Courses (9 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202, but it must be replaced 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

Complementary Courses (15 credits)

15 credits selected from the courses below and computer science courses at the 300 level or above (except COMP 364, COMP 396, COMP 400).

* Note: COMP 251 is a prerequisite for many of the other complementary courses.

COMP 251*	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
MATH 222	(3)	Calculus 3
MATH 240	(3)	Discrete Structures 1

14.9.8 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 offers opportunity to get insight into some of its sub-areas. Having only 45 credits, it allows students to combine it with minor or major concentrations in other disciplines.

Required Courses (21 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202, but it must be replaced 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
MATH 222	(3)	Calculus 3
MATH 240	(3)	Discrete Structures 1

Complementary Courses (24 credits)

3-6 credits from:

MATH 223	(3)	Linear Algebra
MATH 318	(3)	Mathematical Logic
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MATH 340	(3)	Discrete Structures 2

At least 3 credits from:

COMP 330	(3)	Theory of Computation
COMP 350	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design

At least 3 credits from:

COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Development

The remaining complementary courses should be selected from any COMP courses at the 300 level or above except COMP 364, COMP 396, COMP 400 and COMP 431.

Note: Advanced COMP courses have more prerequisites than the required courses for this program. Students have to make sure that they have the appropriate prerequisites when choosing upper-level courses.

14.9.9 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.

Students may complete this program with a minimum of 48 credits or a maximum of 49 credits depending on their choice of complementary courses.

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 Development
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 1

Complementary Courses (13 credits)

3 credits selected from:

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

9-10 credits selected from the courses below:

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	(3)	Computer Networks 1

Or any computer science course at the 300 level or above, excluding COMP 364, COMP 396, and COMP 400.

14.9.10 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 (33 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 Development
COMP 310	(3)	Operating Systems
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1

Complementary Courses (30 credits)

Students should talk to an academic adviser before choosing their complementary courses.

At least 6 credits selected from:

COMP 330	(3)	Theory of Computation
COMP 350	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design

3-9 credits selected from:

* Must include at least one of MATH 323 and MATH 340.

MATH 318	(3)	Mathematical Logic
MATH 323*	(3)	Probability
MATH 324	(3)	Statistics
MATH 340*	(3)	Discrete Structures 2

The remaining credits selected from computer science courses at the 300 level or above (except COMP 364, COMP 396, COMP 400).

Note: Students have to make sure that they have the appropriate prerequisites when choosing upper-level courses.

14.9.11 Bachelor of Science (B.Sc.) - Major Computer Science and Biology (73 credits)

This program will train students in the fundamentals of biology - with a focus on molecular biology - and will give them computational and mathematical skills needed to manage, analyze, and model large biological datasets. Two integrative features of the program are a three-credit joint independent studies course, and a one-credit seminar.

Students may complete this program with a maximum of 73 credits or a minimum of 69 credits. This depends upon the student's choice of required courses and whether or not the student is exempt from taking COMP 202.

Advising notes for UO students:

It is highly recommended that Freshman BIOL, CHEM, MATH, and PHYS courses be selected with an adviser to ensure they meet the core requirements of the COMP-BIO program.

Required Courses (49 credits)**Required Mathematics and Statistics Courses**

6 credits from the following:

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra

Required Computer Science Courses

12-16 credits from:

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

** Students take either COMP 462 or COMP 561.

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

Required Biology Courses

20 credits from:

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 212	(4)	Introductory Organic Chemistry 1

Required Joint Courses

4 credits from:

COMP 401	(3)	Project in Biology and Computer Science
COMP 499	(1)	Undergraduate Bioinformatics Seminar

Complementary Courses (27 credits)

6 credits, ONE of the following pairs of courses as follows:

MATH 203 and MATH 204 or MATH 323 and MATH 324 or BIOL 309 and BIOL 373.

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
MATH 203	(3)	Principles of Statistics 1
MATH 204	(3)	Principles of Statistics 2
MATH 323	(3)	Probability
MATH 324	(3)	Statistics

At least 21 credits selected from the following blocks, with the following requirements:

- at least 9 credits from each of the following two blocks
- at least 9 credits at the 400 level or above

- at least 3 credits at the 400 level or above from each block

Computer Science Block

Note: All COMP courses at the 400 level or above (except COMP 400).

COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Development
COMP 310	(3)	Operating Systems
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
MATH 240	(3)	Discrete Structures 1

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

Biology Block

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 395	(1)	Quantitative Biology Seminar 1
BIOL 435	(3)	Natural Selection
BIOL 495	(1)	Quantitative Biology Seminar 2
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 551	(3)	Principles of Cellular Control
BIOL 568	(3)	Topics on the Human Genome
BIOL 569	(3)	Developmental Evolution
BIOL 583	(3)	Advanced Biometry

14.9.12 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 Development
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 1
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 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

14.9.13 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 (39 credits)

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

** Students may select either COMP 310 or ECSE 427, but not both.

COMP 202*	(3)	Foundations of Programming
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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 Development
COMP 310**	(3)	Operating Systems
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
ECSE 427**	(3)	Operating Systems
ECSE 429	(3)	Software Validation
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1

Complementary Courses (24 credits)

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

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

At least 15 credits selected from the following, with at least 6 credits selected from Software Engineering Specializations, and at least 6 credits selected from Applications Specialties.

Software Engineering Specializations

* 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 420*	(3)	Parallel Computing

Application Specialties

* Students may select either COMP 557 or ECSE 532, but not both.

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	(3)	Computer Networks 1
COMP 557*	(3)	Fundamentals of Computer Graphics
COMP 558	(3)	Fundamentals of Computer Vision
ECSE 424	(3)	Human-Computer Interaction
ECSE 532*	(3)	Computer Graphics

14.9.14 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 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 303	(3)	Software Development
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 350	(3)	Numerical Computing
COMP 362	(3)	Honours Algorithm Design
COMP 400	(3)	Honours Project in Computer Science
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1
MATH 340**	(3)	Discrete Structures 2
MATH 350**	(3)	Graph Theory and Combinatorics

Complementary Courses (27 credits)

6 credits selected from:

MATH 318	(3)	Mathematical Logic
MATH 323	(3)	Probability
MATH 324	(3)	Statistics

The remaining credits selected from computer science courses at the 300 level or above (except COMP 364 and COMP 396). At least 12 credits must be at the 500 level.

14.9.15 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 (42 credits)

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

** Students may select either COMP 310 or ECSE 427, but not both.

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 Development
COMP 310**	(3)	Operating Systems
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
COMP 400	(3)	Honours Project in Computer Science
ECSE 427**	(3)	Operating Systems
ECSE 429	(3)	Software Validation
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1

Complementary Courses (33 credits)

Of the 33 credits, at least 12 credits must be at the 500 level or above. Courses at the 600 level require special permission. Information on the policy and procedures for such permission may be found at: http://www.mcgill.ca/science/sousa/general/course/600-level_courses/.

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

Group A:

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

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

At least 18 credits selected from the following, with at least 6 credits selected from Software Engineering Specializations, and at least 9 credits selected from Applications Specialties.

Software Engineering Specializations

* 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 420*	(3)	Parallel Computing

Application Specialties

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	(3)	Computer Networks 1
COMP 557	(3)	Fundamentals of Computer Graphics
COMP 558	(3)	Fundamentals of Computer Vision
ECSE 424	(3)	Human-Computer Interaction

At least 6 credits selected from any COMP courses at the 500 level or above. These may include courses on the Software Engineering Specializations and Application Specialties lists.

14.9.16 Computer Science (COMP) Related Programs**14.9.16.1 Joint Major in Mathematics and Computer Science**

For more information, see [section 14.21: Mathematics and Statistics \(MATH\)](#).

14.9.16.2 Joint Honours in Mathematics and Computer Science

For more information, see [section 14.21: Mathematics and Statistics \(MATH\)](#). Students must consult an Honours adviser in both departments.

14.9.16.3 Joint Major in Statistics and Computer Science

For more information, see [section 14.21: Mathematics and Statistics \(MATH\)](#).

14.9.16.4 Joint Honours in Statistics and Computer Science

For more information, see [section 14.21: Mathematics and Statistics \(MATH\)](#). Students must consult an Honours adviser in both departments.

14.9.16.5 Joint Major in Physics and Computer Science

For more information, see [section 14.29: Physics \(PHYS\)](#).

14.9.16.6 Minor in Cognitive Science

Students following Major or Honours programs in Computer Science may want to consider the Minor in Cognitive Science.

14.10 Earth and Planetary Sciences (EPSC)

14.10.1 Location

Frank Dawson Adams Building, Room 238
3450 University Street
Montreal, Quebec H3A 0E8

Telephone: 514-398-6767
Fax: 514-398-4680
Email: kristy.thornton@mcgill.ca
Website: www.eps.mcgill.ca

14.10.2 About Earth and Planetary Sciences

Revision, August 2013. Start of revision.

The domain of Earth and Planetary Sciences includes the solid Earth and its hydrosphere and extends to the neighbouring terrestrial planets. It is a multidisciplinary field in which the principles of chemistry, physics, and mathematics are applied to the rich problems of the real world in order to understand how planets like the Earth work; in the past, the present, and the future.

Career opportunities are many and varied for graduates in the Earth and Planetary Sciences. There is presently a demand for graduates with expertise in many disciplines of the Earth Sciences. Our students are recruited for employment in the petroleum and mining industries, and in the environmental sector.

During the summer months, undergraduate students are generally able to obtain employment from industry or government agencies, providing them with both financial benefits and first-hand geoscientific experience. Career opportunities in planetary science are present in universities and research organizations.

The Department has a full-time staff of 17 professors and one faculty lecturer. There are approximately 55 graduate and 50 undergraduate students. Classes are therefore small at all levels, resulting in an informal and friendly atmosphere throughout the Department in which most of the faculty and students interact on a first-name basis. Emphasis is placed equally on quality teaching and research, providing undergraduate students with a rich and exciting environment in which to explore and learn.

The undergraduate curriculum is designed to provide both a rigorous foundation in the physical sciences and the flexibility to create an individualized program in preparation for careers in industry, teaching, or research. In addition to the Major and Honours undergraduate programs, the Department is part of the Earth System Science Interdepartmental program, and also offers a Joint Major in Physics and Geophysics, which provides a rigorous mathematics and physics preparation and a geological background in the geosciences.

The Minor in Geology offers students from other departments the opportunity to obtain exposure to the Earth Sciences, while the Minor in Geochemistry is oriented towards Chemistry Major students who want to see the application of chemistry to problems in Earth and Planetary Sciences.

Students interested in any of the programs should inquire at Room 238, Frank Dawson Adams Building, 514-398-6767, or should consult the Undergraduate Director:

Revision, August 2013. End of revision.

Professor Jeanne Paquette
Frank Dawson Adams Building, Room 214
Email: jeanne.paquette@mcgill.ca
Telephone: 514-398-4402

14.10.3 Earth and Planetary Sciences (EPSC) Faculty

Chair

TBA

Emeritus Professors

Jafar Arkani-Hamed; B.Eng.(Tehran), Ph.D.(MIT)

Wallace H. MacLean; B.Geol.Eng.(Colorado Sch. of Mines), M.Sc.(A.), Ph.D.(McG.)

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

Don M. Francis; B.Sc.(McG.), M.Sc.(Br. Col.), Ph.D.(MIT) (*Dawson Professor of Geology*)

Andrew J. Hynes; B.Sc.(Tor.), Ph.D.(Cant.) (*William E. Logan Professor of 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.)

Associate Professors

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

Jeffrey McKenzie; B.Sc.(McG.), M.Sc., Ph.D.(Syrac.)

Jeanne Paquette; B.Sc., M.Sc.(McG.), Ph.D.(Stony Brook) (*Undergraduate Director*)

Hojatollah Vali; B.Sc., M.Sc., Ph.D.(Munich) (*Director, Electron Microscopy Centre*)

Boswell Wing; A.B.(Harv.), M.A., Ph.D.(Johns Hop.)

Assistant Professors

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

Rebecca Harrington; B.Sc., M.S., Ph.D.(Calif.-LA)

Yajing Liu; B.Sc.(Peking), Ph.D.(Harv.)

Christie Rowe; A.B.(Smith), Ph.D.(Calif.-Santa Cruz) (*Robert Wares Faculty Scholar*)

Vincent van Hinsberg; Propadeuse(Utrecht), Doctorandus(Utrecht), Ph.D.(Brist.) (*Osisko Faculty Scholar*)

Faculty Lecturer

W. Minarik; B.A.(St. Olaf), M.Sc.(Wash.), Ph.D.(Rensselaer Poly.)

Adjunct Professors

M. Riedel

H. Short

B. Sundby

W. Trzeciński

Retired Professor

R. Hesse

14.10.4 Bachelor of Science (B.Sc.) - Minor Geology (18 credits)

The Minor Geology offers students from other departments the opportunity to obtain exposure to the Earth Sciences.

Required Courses (6 credits)

EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology

Complementary Courses (12 credits)

3 credits, one of:

EPSC 201	(3)	Understanding Planet Earth
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EPSC 233	(3)	Earth and Life History
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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 203	(3)	Structural Geology
EPSC 231	(3)	Field School 1
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 1

14.10.5 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)	Isotope Geology
EPSC 542	(3)	Chemical Oceanography
EPSC 561	(3)	Ore-forming Processes 1
EPSC 570	(3)	Cosmochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

14.10.6 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 203	(3)	Structural Geology
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 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 312	(3)	Spectroscopy of Minerals
EPSC 330	(3)	Earthquakes and Earth Structure
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)	Isotope Geology
EPSC 530	(3)	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
EPSC 561	(3)	Ore-forming Processes 1
EPSC 562	(3)	Ore-forming Processes 2
EPSC 567	(3)	Advanced Volcanology
EPSC 570	(3)	Cosmochemistry
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
ESYS 500	(3)	Earth System Applications

14.10.7 Bachelor of Science (B.Sc.) - Major Earth and Planetary Sciences (66 credits)

The program curriculum is designed to provide a rigorous foundation in physical sciences and the flexibility to create an individualized program in preparation for careers in industry, teaching, and research. The program is accepted for professional qualification in most Canadian provinces.

U1 Required Courses (21 credits)

EPSC 203	(3)	Structural Geology
EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
EPSC 231	(3)	Field School 1
EPSC 312	(3)	Spectroscopy of Minerals
MATH 222	(3)	Calculus 3

U1 Complementary Course (3 credits)

3 credits, one of:

EPSC 201	(3)	Understanding Planet Earth
EPSC 233	(3)	Earth and Life History

U2 and/or U3 Required Courses (24 credits)

EPSC 320	(3)	Elementary Earth Physics
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 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits

Complementary Courses (18 credits)

3 credits, one of:

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

plus 15 credits (five courses) chosen from the following:

Note: Other courses at the 300 level or higher in Earth and Planetary Sciences and 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 330	(3)	Earthquakes and Earth Structure
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 470D1	(3)	Undergraduate Thesis Research
EPSC 470D2	(3)	Undergraduate Thesis Research
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotope Geology
EPSC 530	(3)	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
EPSC 561	(3)	Ore-forming Processes 1
EPSC 562	(3)	Ore-forming Processes 2
EPSC 567	(3)	Advanced Volcanology
EPSC 570	(3)	Cosmochemistry
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

14.10.8 Bachelor of Science (B.Sc.) - Honours Earth Sciences (75 credits)

The program curriculum is designed to provide a rigorous foundation in physical sciences and the flexibility to create an individualized program in preparation for careers in industry, teaching, and research. It is intended to provide an excellent preparation for graduate work in the earth sciences. The program is accepted for professional qualification in most Canadian provinces.

Note: Honours students must maintain a CGPA equal to or greater than 3.20.

U1 Required Courses (24 credits)

EPSC 203	(3)	Structural Geology
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 312	(3)	Spectroscopy of Minerals
MATH 222	(3)	Calculus 3

U2 and/or U3 Required Courses (33 credits)

EPSC 320	(3)	Elementary Earth Physics
EPSC 340	(3)	Earth and Planetary Inference
EPSC 350	(3)	Tectonics
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits
EPSC 480D1	(3)	Honours Research Project
EPSC 480D2	(3)	Honours Research Project
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (18 credits)

3 credits, one of:

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

plus 15 credits (five courses) chosen from the following:

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 the Director of undergraduate studies.

EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 334	(3)	Invertebrate Paleontology
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 501	(3)	Crystal Chemistry
EPSC 510	(3)	Geodynamics and Geomagnetism
EPSC 519	(3)	Isotope Geology
EPSC 530	(3)	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
EPSC 561	(3)	Ore-forming Processes 1
EPSC 562	(3)	Ore-forming Processes 2
EPSC 567	(3)	Advanced Volcanology
EPSC 570	(3)	Cosmochemistry
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

14.10.9 Bachelor of Science (B.Sc.) - Honours Planetary Sciences (81 credits)

The program curriculum is designed to provide a rigorous foundation in physical sciences and the flexibility to create an individualized program in preparation for careers in industry, teaching, and research. It is intended to provide an excellent preparation for graduate work in the earth and planetary sciences.

Note: Honours students must maintain a CGPA equal to or greater than 3.20.

U1 Required Courses (27 credits)

EPSC 203	(3)	Structural Geology
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 312	(3)	Spectroscopy of Minerals
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra

U2 and/or U3 Required Courses (42 credits)

EPSC 320	(3)	Elementary Earth Physics
EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 340	(3)	Earth and Planetary Inference
EPSC 350	(3)	Tectonics
EPSC 423	(3)	Igneous Petrology
EPSC 480D1	(3)	Honours Research Project
EPSC 480D2	(3)	Honours Research Project
EPSC 510	(3)	Geodynamics and Geomagnetism
EPSC 570	(3)	Cosmochemistry
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)

3 credits, one of:

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

plus 9 credits (three courses) chosen from the following:

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 the Director of undergraduate studies.

EPSC 334	(3)	Invertebrate Paleontology
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotope Geology
EPSC 530	(3)	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
EPSC 561	(3)	Ore-forming Processes 1

EPSC 562	(3)	Ore-forming Processes 2
EPSC 567	(3)	Advanced Volcanology
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

14.10.10 Earth and Planetary Sciences (EPSC) Related Programs

14.10.10.1 Joint Major in Physics and Geophysics

For more information, see [section 14.29: Physics \(PHYS\)](#).

14.10.10.2 Earth System Science Interdepartmental Major

Revision, August 2013. Start of revision.

This program is offered by the Departments of Atmospheric and Oceanic Sciences; Earth and Planetary Sciences; and Geography. Students in the Department of Earth and Planetary Sciences who are interested in this program should contact: Professor William Minarik (william.minarik@mcgill.ca).

Revision, August 2013. End of revision.

For more information, see [section 14.11: Earth System Science \(ESYS\)](#).

14.11 Earth System Science (ESYS)

14.11.1 Location

Program Adviser
 Dr. William Minarik
 Frank Dawson Adams, Room 215
 Email: william.minarik@mcgill.ca
 Telephone: 514-398-2596

14.11.2 About Earth System Science

The McGill interdepartmental major program in Earth System Science (ESYS) is designed to equip students with the skills and knowledge to address six “Grand Challenges” that are fundamental to our understanding of the way in which the Earth operates. These are:

- Global biogeochemical cycles
- Climate variability and change
- Land use and land cover change
- Energy and resources
- Earth hazards: volcanoes, earthquakes, and hurricanes
- Earth-atmosphere observation, analysis, and prediction

The ESS programs are offered jointly by the Department of Atmospheric and Oceanic Sciences (ATOC), the Department of Earth and Planetary Sciences (EPSC), and the Department of Geography (GEOG).

The individual departments, their disciplines, and specific courses offered by them are described in their respective entries in this publication.

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

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.

14.11.4 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
ATOC 309	(3)	Weather Radars and Satellites
ATOC 315	(3)	Thermodynamics and Convection
ATOC 412	(3)	Atmospheric Dynamics
ATOC 419	(3)	Advances in Chemistry of Atmosphere
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
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 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
BIOL 308	(3)	Ecological Dynamics
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
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 515	(3)	Soil Hydrologic Modelling
BREE 533	(3)	Water Quality Management
ECON 347	(3)	Economics of Climate Change
ECON 405	(3)	Natural Resource Economics
EPSC 212	(3)	Introductory Petrology
EPSC 312	(3)	Spectroscopy of Minerals
EPSC 320	(3)	Elementary Earth Physics
EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 331	(3)	Field School 2
EPSC 334	(3)	Invertebrate Paleontology
EPSC 340	(3)	Earth and Planetary Inference
EPSC 341	(3)	Field School 3
EPSC 350	(3)	Tectonics
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
EPSC 519	(3)	Isotope Geology
EPSC 530	(3)	Volcanology
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes 1
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 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.

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

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

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
ATOC 309	(3)	Weather Radars and Satellites
ATOC 315	(3)	Thermodynamics and Convection
ATOC 412	(3)	Atmospheric Dynamics
ATOC 419	(3)	Advances in Chemistry of Atmosphere
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
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 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
BIOL 308	(3)	Ecological Dynamics
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
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 515	(3)	Soil Hydrologic Modelling
BREE 533	(3)	Water Quality Management
ECON 347	(3)	Economics of Climate Change
ECON 405	(3)	Natural Resource Economics
EPSC 212	(3)	Introductory Petrology
EPSC 312	(3)	Spectroscopy of Minerals
EPSC 320	(3)	Elementary Earth Physics
EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 331	(3)	Field School 2
EPSC 334	(3)	Invertebrate Paleontology
EPSC 340	(3)	Earth and Planetary Inference
EPSC 341	(3)	Field School 3
EPSC 350	(3)	Tectonics
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
EPSC 519	(3)	Isotope Geology
EPSC 530	(3)	Volcanology
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes 1
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 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.

14.12 Environment

14.12.1 Location

Downtown Campus

3534 University Street
 Montreal, Quebec H3A 2A7
 Telephone: 514-398-2827
 Fax: 514-398-1643

Macdonald Campus

Rowles House
 21,111 Lakeshore Road
 Sainte-Anne-de-Bellevue, Quebec H9X 3V9
 Telephone: 514-398-7559
 Fax: 514-398-7846

14.12.2 About Environment

All courses given by the McGill School of Environment (Subject Code ENVR) are considered as courses taught by the Faculty of Science.

Science students who are interested in studying the environment should refer to *Programs, Courses and University Regulations > Faculties & Schools > McGill School of Environment*.

14.12.3 Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Minor Environment (18 credits)

This 18-credit Minor is intended for Faculty of Agricultural and Environmental Science students and Faculty of Science students, but is open to students from other faculties as well, except Arts and Law.

Advising Note:

Consultation with the Program Adviser for approval of course selection to meet program requirements is obligatory. Only courses at the 200 level and above will be approved.

For information about the Minor in Environment, contact:

Ms. Kathy Roulet, MSE Program Adviser

Email: kathy.roulet@mcgill.ca

Telephone: 514-398-4306

Complementary Courses (18 credits)

18 credits of complementary courses are selected as follows:

12 credits of MSE core courses:

Location Note: MSE core courses are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 400	(3)	Environmental Thought

6 credits of environmentally related courses selected with the approval of the Program Adviser (at least 3 credits must be in social sciences). A list of Suggested Courses is given below.

Suggested Course List

The Suggested Course List is divided into two thematic categories: Social Sciences and Policy; and Natural Sciences and Technology.

Most courses listed at the 300 level and higher have prerequisites. You are urged to prepare your program of study with this in mind.

This list is not meant to be exhaustive. You are also encouraged to examine the course lists of the various domains in the Environment program for other courses that might interest you. Courses not on the Suggested Course list may be included in the Minor with the permission of the MSE Program Adviser.

Location Note: When planning your schedule and registering for courses, you should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Social Sciences and Policy

* Note: If WILD 415 is taken, 1 additional credit of complementary courses must be taken.

AGEC 231	(3)	Economic Systems of Agriculture
AGEC 333	(3)	Resource Economics
AGEC 430	(3)	Agriculture, Food and Resource Policy
AGEC 442	(3)	Economics of International Agricultural Development
AGRI 210	(3)	Agro-Ecological History
AGRI 411	(3)	Global Issues on Development, Food and Agriculture
ANTH 206	(3)	Environment and Culture
ANTH 212	(3)	Anthropology of Development
ANTH 339	(3)	Ecological Anthropology
ANTH 512	(3)	Political Ecology
BREE 503	(3)	Water: Society, Law and Policy
CIVE 433	(3)	Urban Planning
ECON 205	(3)	An Introduction to Political Economy
ECON 225	(3)	Economics of the Environment
ECON 326	(3)	Ecological Economics
ECON 347	(3)	Economics of Climate Change
ECON 405	(3)	Natural Resource Economics
ENVB 437	(3)	Assessing Environmental Impact
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 400	(3)	Environmental Thought
GEOG 200	(3)	Geographical Perspectives: World Environmental Problems
GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 221	(3)	Environment and Health
GEOG 300	(3)	Human Ecology in Geography
GEOG 301	(3)	Geography of Nunavut
GEOG 302	(3)	Environmental Management 1
GEOG 303	(3)	Health Geography
GEOG 370	(3)	Protected Areas
GEOG 382	(3)	Principles Earth Citizenship
GEOG 403	(3)	Global Health and Environmental Change
GEOG 408	(3)	Geography of Development

GEOG 410	(3)	Geography of Underdevelopment: Current Problems
GEOG 530	(3)	Global Land and Water Resources
GEOG 551	(3)	Environmental Decisions
MGPO 440	(3)	Strategies for Sustainability
NRSC 221	(3)	Environment and Health
NRSC 540	(3)	Socio-Cultural Issues in Water
PHIL 230	(3)	Introduction to Moral Philosophy 1
PHIL 237	(3)	Contemporary Moral Issues
PHIL 334	(3)	Ethical Theory
PHIL 343	(3)	Biomedical Ethics
PHIL 348	(3)	Philosophy of Law 1
POLI 211	(3)	Comparative Government and Politics
POLI 212	(3)	Government and Politics - Developed World
POLI 227	(3)	Developing Areas/Introduction
POLI 345	(3)	International Organizations
POLI 445	(3)	International Political Economy: Monetary Relations
PSYC 215	(3)	Social Psychology
RELG 270	(3)	Religious Ethics and the Environment
RELG 340	(3)	Religion and the Sciences
RELG 370	(3)	Religion and Human Rights
RELG 376	(3)	Religious Ethics
SOCI 222	(3)	Urban Sociology
SOCI 234	(3)	Population and Society
SOCI 235	(3)	Technology and Society
SOCI 254	(3)	Development and Underdevelopment
SOCI 386	(3)	Contemporary Social Movements
URBP 201	(3)	Planning the 21st Century City
URBP 506	(3)	Environmental Policy and Planning
URBP 530	(3)	Urban Environmental Planning
WILD 415*	(2)	Conservation Law

Natural Sciences and Technology

* Note: You may take LSCI 230 or MIMM 211, but not both; you may take BIOL 432 or ENVB 315, but not both; you may take BREE 217 or GEOG 322, but not both; you may take ENVB 430 or GEOG 201, but not both; you may take BIOL 308 or ENVB 305, but not both.

AGRI 340	(3)	Principles of Ecological Agriculture
AGRI 435	(3)	Soil and Water Quality Management
ANSC 326	(3)	Fundamentals of Population Genetics
ANTH 311	(3)	Primate Behaviour and Ecology
ARCH 375	(2)	Landscape
ARCH 377	(3)	Energy, Environment and Buildings
ARCH 378	(3)	Site Usage
ATOC 215	(3)	Oceans, Weather and Climate
BIOL 240	(3)	Monteregian Flora

BIOL 305	(3)	Animal Diversity
BIOL 308*	(3)	Ecological Dynamics
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 342	(3)	Marine Biology
BIOL 418	(3)	Freshwater Invertebrate Ecology
BIOL 432*	(3)	Limnology
BIOL 436	(3)	Evolution and Society
BIOL 465	(3)	Conservation Biology
BREE 217*	(3)	Hydrology and Water Resources
BREE 322	(3)	Organic Waste Management
BREE 518	(3)	Bio-Treatment of Wastes
BTEC 502	(3)	Biotechnology Ethics and Society
CHEE 230	(3)	Environmental Aspects of Technology
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 462	(3)	Green Chemistry
CIVE 225	(4)	Environmental Engineering
CIVE 323	(3)	Hydrology and Water Resources
CIVE 550	(3)	Water Resources Management
ENTO 340	(3)	Field Entomology
ENVB 210	(3)	The Biophysical Environment
ENVB 301	(3)	Meteorology
ENVB 305*	(3)	Population & Community Ecology
ENVB 315*	(3)	Science of Inland Waters
ENVB 410	(3)	Ecosystem Ecology
ENVB 415	(3)	Ecosystem Management
ENVB 430*	(3)	GIS for Natural Resource Management
ENVR 200	(3)	The Global Environment
ENVR 202	(3)	The Evolving Earth
EPSC 201	(3)	Understanding Planet Earth
EPSC 233	(3)	Earth and Life History
EPSC 425	(3)	Sediments to Sequences
EPSC 549	(3)	Hydrogeology
ESYS 301	(3)	Earth System Modelling
GEOG 200	(3)	Geographical Perspectives: World Environmental Problems
GEOG 201*	(3)	Introductory Geo-Information Science
GEOG 205	(3)	Global Change: Past, Present and Future
GEOG 272	(3)	Earth's Changing Surface
GEOG 308	(3)	Principles of Remote Sensing
GEOG 321	(3)	Climatic Environments
GEOG 322*	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
GEOG 470	(3)	Wetlands

LSCI 230*	(3)	Introductory Microbiology
MICR 331	(3)	Microbial Ecology
MIME 308	(3)	Social Impact of Technology
MIME 320	(3)	Extraction of Energy Resources
MIMM 211*	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
NRSC 333	(3)	Pollution and Bioremediation
NRSC 340	(3)	Global Perspectives on Food
NRSC 510	(3)	Agricultural Micrometeorology
NRSC 514	(3)	Freshwater Ecosystems
PARA 410	(3)	Environment and Infection
PARA 515	(3)	Water, Health and Sanitation
PLNT 304	(3)	Biology of Fungi
PLNT 305	(3)	Plant Pathology
PLNT 358	(3)	Flowering Plant Diversity
PLNT 426	(3)	Plant Ecophysiology
PLNT 460	(3)	Plant Ecology
SOIL 300	(3)	Geosystems
WILD 421	(3)	Wildlife Conservation

14.12.4 Bachelor of Science (B.Sc.) - Major Environment - Atmospheric Environment and Air Quality (60 credits)

The rapid expansion of industrialization has been accompanied by a host of environmental problems, many, if not most, involving the atmosphere. Some problems are of a local nature, such as air pollution in large urban centres, while others are global, or at least reach areas far removed from industrial activities.

The emphasis in this domain is on the mechanisms of atmospheric flow and on atmospheric chemistry. Courses examine how the atmosphere transports pollution, lifting it to great heights into the stratosphere or keeping it trapped near the ground, moving it around the globe or imprisoning it locally, or how it simply cleanses itself of pollution through rainfall. The domain also gives students the training required to understand the important chemical reactions taking place within the atmosphere, as well as the know-how necessary to measure and analyze atmospheric constituents.

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook 2013-2014" available on the MSE website (<http://www.mcgill.ca/mse>).

Program Requirements

Note: Students are required to take a maximum of 31 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes core and required courses.

Location Note: When planning your schedule and registering for courses, you should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment

ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain: Required Courses (18 credits)

18 credits are selected from:

* Note: You may take ATOC 219 or CHEM 219, but not both.

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 215	(3)	Oceans, Weather and Climate
ATOC 219*	(3)	Introduction to Atmospheric Chemistry
ATOC 315	(3)	Thermodynamics and Convection
CHEM 219*	(3)	Introduction to Atmospheric Chemistry
GEOG 308	(3)	Principles of Remote Sensing

Domain: Complementary Courses (21 credits)

21 credits of complementary courses are selected as follows:

6 credits - Analytical Chemistry/Calculus courses

3 credits - Statistics

9 credits - Math or Physical Science

3 credits - Social Science

Analytical Chemistry/Calculus:

One of:

AEMA 202	(3)	Intermediate Calculus
MATH 222	(3)	Calculus 3

and 3 credits from:

Note: CHEM 287 and CHEM 297 must be taken together.

CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory
FDSC 213	(3)	Analytical Chemistry 1

Statistics:

3 credits of Statistics courses or equivalent from:

AEMA 310	(3)	Statistical Methods 1
MATH 203	(3)	Principles of Statistics 1

Math or Physical Science:

9 credits of Math or Physical Science (at least 6 credits of which are at the 300 level or above):

* Note: You may take ATOC 419 or CHEM 419, but not both; you may take AEMA 305 or MATH 315, but not both.

AEMA 305*	(3)	Differential Equations
ATOC 309	(3)	Weather Radars and Satellites
ATOC 412	(3)	Atmospheric Dynamics
ATOC 419*	(3)	Advances in Chemistry of Atmosphere
ATOC 540	(3)	Synoptic Meteorology 1
CHEE 230	(3)	Environmental Aspects of Technology
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 377	(3)	Instrumental Analysis 2
CHEM 419*	(3)	Advances in Chemistry of Atmosphere
CIVE 225	(4)	Environmental Engineering
COMP 208	(3)	Computers in Engineering
GEOG 505	(3)	Global Biogeochemistry
MATH 223	(3)	Linear Algebra
MATH 315*	(3)	Ordinary Differential Equations
NRSC 333	(3)	Pollution and Bioremediation
NRSC 510	(3)	Agricultural Micrometeorology

Social Science:

One of:

ANTH 206	(3)	Environment and Culture
ECON 225	(3)	Economics of the Environment
ECON 347	(3)	Economics of Climate Change
GEOG 302	(3)	Environmental Management 1
GEOG 404	(3)	Environmental Management 2
GEOG 498	(3)	Humans in Tropical Environments
RELG 270	(3)	Religious Ethics and the Environment

14.12.5 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)

This domain (63 credits including core) is open only to students in the B.Sc.(Ag.Env.Sc.) Major in Environment or B.Sc. Major in Environment program.

This domain links the academic study of biological diversity with the applied field of conservation biology. The study of biological diversity, or "biodiversity," lies at the intersection of evolution with ecology and genetics, combining the subdisciplines of evolutionary ecology, evolutionary genetics, and ecological genetics. It has two main branches: the creation of diversity and the maintenance of diversity. Both processes are governed by a general mechanism of selection acting over different scales of space and time. This gives rise to a distinctive set of principles and generalizations that regulate rates of diversification and levels of diversity, as well as the abundance or rarity of different species. Conservation biology constitutes the application of these principles in the relevant social and economic context to the management of natural systems, with the object of preventing the extinction of rare species and maintaining the diversity of communities. As the impact of industrialization and population growth on natural systems has become more severe, conservation has emerged as an important area of practical endeavour.

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook 2012-2013" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Ms. Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 30 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes core and required courses.

Location Note: When planning their schedule and registering for courses, students should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain: Complementary Courses (42 credits)

42 credits of complementary courses are selected as follows:

9 credits - basic courses in the Biological Principles of Diversity, Systematics, and Conservation

3 credits - Ecology

3 credits - Statistics

9 credits - Interface between Science, Policy, and Management

3 credits - Field Courses

6 credits - General Scientific Principles

3 credits - Social Science

6 credits - Organisms and Diversity

Biological Principles of Diversity/Systematics/Conservation:

9 credits are chosen from basic courses in the biological principles of diversity, systematics, and conservation as follows:

One of:

AEBI 212	(3)	Evolution and Phylogeny
BIOL 304	(3)	Evolution

One of:

AEBI 211	(3)	Organisms 2
BIOL 305	(3)	Animal Diversity

One of:

BIOL 465	(3)	Conservation Biology
WILD 421	(3)	Wildlife Conservation

Ecology:

One of:

BIOL 308	(3)	Ecological Dynamics
ENVB 305	(3)	Population & Community Ecology

Statistics:

One of:

AEMA 310	(3)	Statistical Methods 1
BIOL 373	(3)	Biometry

Science, Policy, and Management:

9 credits are chosen from interface between science, policy, and management as follows:

* Note: You may take AGECE 200 or ECON 208, but not both.

AGECE 200*	(3)	Principles of Microeconomics
AGRI 550	(3)	Sustained Tropical Agriculture
ECON 208*	(3)	Microeconomic Analysis and Applications
ECON 225	(3)	Economics of the Environment
GEOG 302	(3)	Environmental Management 1
GEOG 370	(3)	Protected Areas
GEOG 408	(3)	Geography of Development
GEOG 410	(3)	Geography of Underdevelopment: Current Problems

Field Courses

One of:

AGRI 452	(3)	Water Resources in Barbados
BIOL 331	(3)	Ecology/Behaviour Field Course
BIOL 334	(3)	Applied Tropical Ecology
BIOL 553	(3)	Neotropical Environments
GEOG 495	(3)	Field Studies - Physical Geography
GEOG 499	(3)	Subarctic Field Studies
WILD 475	(3)	Desert Ecology

General Scientific Principles

6 credits of general scientific principles selected from the following:

* Note: You may take ENVB 430 or GEOG 306, but not both.

(A second field course from the domain curriculum may also be taken.)

** Note: You may take BIOL 432 or ENVB 315, but not both.

BIOL 324	(3)	Ecological Genetics
BIOL 342	(3)	Marine Biology

BIOL 432**	(3)	Limnology
BIOL 441	(3)	Biological Oceanography
ENVB 313	(3)	Phylogeny and Biogeography
ENVB 315**	(3)	Science of Inland Waters
ENVB 410	(3)	Ecosystem Ecology
ENVB 430*	(3)	GIS for Natural Resource Management
ENVB 437	(3)	Assessing Environmental Impact
GEOG 272	(3)	Earth's Changing Surface
GEOG 306*	(3)	Raster Geo-Information Science
GEOG 321	(3)	Climatic Environments
GEOG 322	(3)	Environmental Hydrology
GEOG 350	(3)	Ecological Biogeography
MICR 331	(3)	Microbial Ecology
PLNT 460	(3)	Plant Ecology
WILD 311	(3)	Ethology
WOOD 420	(3)	Environmental Issues: Forestry

Social Science:

One of:

* Note: If WILD 415 is taken, 1 additional credit of complementary courses must be taken.

AGEC 333	(3)	Resource Economics
ANTH 339	(3)	Ecological Anthropology
ANTH 416	(3)	Environment/Development: Africa
ECON 326	(3)	Ecological Economics
GEOG 404	(3)	Environmental Management 2
GEOG 498	(3)	Humans in Tropical Environments
GEOG 510	(3)	Humid Tropical Environments
URBP 520	(3)	Globalization: Planning and Change
WILD 415*	(2)	Conservation Law

Organisms and Diversity:

6 credits of organisms and diversity selected as follows:

* Note: You may take BIOL 350 or ENTO 350, but not both; you may take BIOL 540 or ENVR 540, but not both.

AGRI 340	(3)	Principles of Ecological Agriculture
ANTH 311	(3)	Primate Behaviour and Ecology
BIOL 335	(3)	Marine Mammals
BIOL 350*	(3)	Insect Biology and Control
BIOL 355	(3)	Trees: Ecology & Evolution
BIOL 427	(3)	Herpetology
BIOL 540*	(3)	Ecology of Species Invasions
ENTO 350*	(3)	Insect Biology and Control
ENTO 352	(3)	Biocontrol of Pest Insects
ENTO 440	(3)	Insect Diversity

ENVR 540*	(3)	Ecology of Species Invasions
PLNT 304	(3)	Biology of Fungi
PLNT 358	(3)	Flowering Plant Diversity
WILD 307	(3)	Natural History of Vertebrates
WILD 350	(3)	Mammalogy
WILD 420	(3)	Ornithology
WILD 424	(3)	Parasitology

14.12.6 Bachelor of Science (B.Sc.) - Major Environment - Earth Sciences and Economics (66 credits)

The resources necessary for human society are extracted from the Earth, used as raw materials in our factories and refineries, and then returned to the Earth as waste. Geological processes produce resources humans depend on, and they also determine the fate of wastes in the environment. Understanding Earth's geologic processes provides us with the knowledge to mitigate many of our society's environmental impacts due to resource extraction and waste disposal. Additionally, economics frequently affects what energy sources power our society and how our wastes are treated. Earth sciences and economics are essential for our understanding of the many mechanisms, both physical and social, that affect Earth's environment.

This domain includes the fundamentals of each discipline. Students learn of minerals, rocks, soils, and waters and how these materials interact with each other and with the atmosphere. Fundamental economic theory and the economic effects of public policy toward resource industries, methods of waste disposal, and the potential effects of global warming on the global economy are also explored.

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 34 credits at the 200 level and a minimum of 15 credits at the 400 level or higher in this program. This includes core and required courses.

Location Note: When planning your schedule and registering for courses, you should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain: Required Courses (21 credits)

ECON 230D1	(3)	Microeconomic Theory
ECON 230D2	(3)	Microeconomic Theory

ECON 405	(3)	Natural Resource Economics
EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
EPSC 355	(3)	Sedimentary Geology

Domain: Complementary Courses (24 credits)

24 credits of complementary courses are selected as follows:

3 credits - Statistics courses

9 credits - List A

12 credits - List B

Statistics:

One of the following Statistics courses or equivalent.

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.

AEMA 310	(3)	Statistical Methods 1
GEOG 202	(3)	Statistics and Spatial Analysis
MATH 203	(3)	Principles of Statistics 1

List A:

9 credits from:

AGEC 333	(3)	Resource Economics
ECON 326	(3)	Ecological Economics
ECON 347	(3)	Economics of Climate Change
ECON 416	(3)	Topics in Economic Development 2
ECON 525	(3)	Project Analysis
ENVB 437	(3)	Assessing Environmental Impact

List B:

12 credits from:

AGRI 435	(3)	Soil and Water Quality Management
ANTH 339	(3)	Ecological Anthropology
BIOL 305	(3)	Animal Diversity
BIOL 553	(3)	Neotropical Environments
ECON 305	(3)	Industrial Organization
ECON 313	(3)	Economic Development 1
ECON 314	(3)	Economic Development 2
ECON 408	(3)	Public Sector Economics 1
ECON 409	(3)	Public Sector Economics 2
EPSC 312	(3)	Spectroscopy of Minerals
EPSC 331	(3)	Field School 2
EPSC 341	(3)	Field School 3
EPSC 425	(3)	Sediments to Sequences

EPSC 435	(3)	Applied Geophysics
EPSC 452	(3)	Mineral Deposits
EPSC 519	(3)	Isotope Geology
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar
GEOG 302	(3)	Environmental Management 1
GEOG 322	(3)	Environmental Hydrology
SOIL 510	(3)	Environmental Soil Chemistry

14.12.7 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)

The Cellular concentration in this domain is open only to students in the B.Sc.(Ag.Env.Sc.) Major Environment or B.Sc. Major Environment program.

This domain considers the interface between the environment and human well-being, with particular focus on the triad that ties human health to the environment through the elements of food and infectious agents. Each of these elements is influenced by planned and unplanned environmental disturbances. For example, agricultural practices shift the balance between beneficial and harmful ingredients of food. Use of insecticides presents dilemmas with regard to the environment, economics, and human health. The distribution of infectious diseases is influenced by the climatic conditions that permit vectors to coexist with humans, by deforestation, by urbanization, and by human interventions ranging from the building of dams to provision of potable water.

In designing interventions that aim to prevent or reduce infectious contaminants in the environment, or to improve food production and nutritional quality, not only is it important to understand methods of intervention, but also to understand social forces that influence how humans respond to such interventions.

Students in the Cellular concentration will explore these interactions in more depth, at a physiological level. Students in the Population concentration will gain a depth of understanding at an ecosystem level that looks at society, land, and population health.

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), consult the "MSE Student Handbook 2012-2013" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Ms. Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 31 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes core and required courses.

Location Note: When planning your schedule and registering for courses, you should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research

ENVR 451 (6) Research in Panama

Domain: Required Course (3 credits)

PARA 410 (3) Environment and Infection

Domain: Complementary Courses (39 credits)

39 credits of the complementary courses are selected as follows:

21 credits - Fundamentals, 3 credits from each category

12 credits - Human Health, maximum of 3 credits from any one category

6 credits - Natural Environment, maximum of 3 credits from any one category

Fundamentals:

21 credits of Fundamentals, 3 credits from each category.

Health, Society, and Environment

* Note: You may take GEOG 221 or NRSC 221, but not both.

GEOG 221* (3) Environment and Health

GEOG 303 (3) Health Geography

NRSC 221* (3) Environment and Health

SOCI 234 (3) Population and Society

SOCI 309 (3) Health and Illness

Toxicology

ANSC 312 (3) Animal Health and Disease

PHAR 303 (3) Principles of Toxicology

Cellular Biology

ANSC 234 (3) Biochemistry 2

BIOL 201 (3) Cell Biology and Metabolism

LSCI 202 (3) Molecular Cell Biology

Genetics

BIOL 202 (3) Basic Genetics

LSCI 204 (3) Genetics

Molecular Biology

BIOL 200 (3) Molecular Biology

LSCI 211 (3) Biochemistry 1

Statistics

One of the following Statistics courses or equivalent:

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.

AEMA 310	(3)	Statistical Methods 1
MATH 203	(3)	Principles of Statistics 1

Nutrition

* Note: NUTR 307 - Video conference Downtown and at the Macdonald campus

ANSC 330	(3)	Fundamentals of Nutrition
NUTR 307*	(3)	Human Nutrition

Human Health:

12 credits chosen from Human Health, maximum of 3 credits from any one category:

Immunology and Pathogenicity

MICR 341	(3)	Mechanisms of Pathogenicity
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PARA 438	(3)	Immunology
PATH 300	(3)	Human Disease

Infectious Disease

ANSC 400	(3)	Eukaryotic Cells and Viruses
MIMM 324	(3)	Fundamental Virology
MIMM 413	(3)	Parasitology
WILD 424	(3)	Parasitology

Nutrition

NUTR 403	(3)	Nutrition in Society
NUTR 512	(3)	Herbs, Foods and Phytochemicals

Drugs and Hormones

ANSC 424	(3)	Metabolic Endocrinology
PHAR 300	(3)	Drug Action

Physiology

ANSC 323	(3)	Mammalian Physiology
PHGY 209	(3)	Mammalian Physiology 1

Natural Environment:

6 credits chosen from the Natural Environment, maximum of 3 credits from any one category:

Hydrology and Climate

* Note: You may take BREE 217 or GEOG 322, but not both.

AGRI 452	(3)	Water Resources in Barbados
BREE 217*	(3)	Hydrology and Water Resources

GEOG 321	(3)	Climatic Environments
GEOG 322*	(3)	Environmental Hydrology
NRSC 510	(3)	Agricultural Micrometeorology

Techniques and Management

BREE 322	(3)	Organic Waste Management
CHEE 230	(3)	Environmental Aspects of Technology
ENVB 437	(3)	Assessing Environmental Impact
GEOG 302	(3)	Environmental Management 1
URBP 507	(3)	Planning and Infrastructure

Pest Management

* Note: You may take BIOL 350 or ENTO 350, but not both.

BIOL 350*	(3)	Insect Biology and Control
ENTO 350*	(3)	Insect Biology and Control
ENTO 352	(3)	Biocontrol of Pest Insects

Pollution Control and Management

BREE 518	(3)	Bio-Treatment of Wastes
NRSC 333	(3)	Pollution and Bioremediation

Ecology

* Note: You may take ENVR 540 or BIOL 540, but not both.

BIOL 432	(3)	Limnology
BIOL 465	(3)	Conservation Biology
BIOL 540*	(3)	Ecology of Species Invasions
BIOL 553	(3)	Neotropical Environments
ENVB 410	(3)	Ecosystem Ecology
ENVR 540*	(3)	Ecology of Species Invasions
MICR 331	(3)	Microbial Ecology
PLNT 304	(3)	Biology of Fungi
PLNT 460	(3)	Plant Ecology

14.12.8 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)

The Population concentration in this domain is open only to students in the B.Sc.(Ag.Env.Sc.) Major Environment or B.Sc. Major Environment program.

This domain considers the interface between the environment and human well-being, with particular focus on the triad that ties human health to the environment through the elements of food and infectious agents. Each of these elements is influenced by planned and unplanned environmental disturbances. For example, agricultural practices shift the balance between beneficial and harmful ingredients of food. Use of insecticides presents dilemmas with regard to the environment, economics, and human health. The distribution of infectious diseases is influenced by the climatic conditions that permit vectors to coexist with humans, by deforestation, by urbanization, and by human interventions ranging from the building of dams to provision of potable water.

In designing interventions that aim to prevent or reduce infectious contaminants in the environment, or to improve food production and nutritional quality, not only is it important to understand methods of intervention, but also to understand social forces that influence how humans respond to such interventions.

Students in the Population concentration will gain a depth of understanding at an ecosystem level that looks at society, land, and population health. Students in the Cellular concentration will explore these interactions in more depth, at a physiological level.

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook 2012-13" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Ms. Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 31 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes core and required courses.

Location Note: When planning your schedule and registering for courses, you should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain: Required Course (3 credits)

PARA 410	(3)	Environment and Infection
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Domain: Complementary Courses (39 credits)

39 credits of complementary courses are selected as follows:

21 credits - Fundamentals, maximum of 3 credits from each category

6 credits - List A categories, maximum of 3 credits from any one category

12 credits - List B categories, maximum of 3 credits from any one category

Fundamentals:

21 credits of fundamentals, 3 credits from each category:

Health and Environment

GEOG 221	(3)	Environment and Health
NRSC 221	(3)	Environment and Health

Health and Society

GEOG 303	(3)	Health Geography
SOCI 234	(3)	Population and Society

SOCI 309 (3) Health and Illness

Toxicology

ANSC 312 (3) Animal Health and Disease

PHAR 303 (3) Principles of Toxicology

Biology

BIOL 200 (3) Molecular Biology

BIOL 201 (3) Cell Biology and Metabolism

LSCI 211 (3) Biochemistry 1

Statistics

One of the following Statistics courses or equivalent:

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.

AEMA 310 (3) Statistical Methods 1

MATH 203 (3) Principles of Statistics 1

Nutrition

*Note: NUTR 307 (Video conference Downtown and at the Macdonald campus)

ANSC 330 (3) Fundamentals of Nutrition

NUTR 207 (3) Nutrition and Health

NUTR 307* (3) Human Nutrition

Advanced Ecology

* Note: You may take ENVR 540 or BIOL 540, but not both.

BIOL 465 (3) Conservation Biology

BIOL 540* (3) Ecology of Species Invasions

BIOL 553 (3) Neotropical Environments

ENVB 410 (3) Ecosystem Ecology

ENVB 506 (3) Quantitative Methods: Ecology

ENVR 540* (3) Ecology of Species Invasions

MICR 331 (3) Microbial Ecology

PLNT 460 (3) Plant Ecology

List A:

6 credits from the following List A categories, maximum of 3 credits from any one category:

Hydrology, Climate, and Agriculture

* Note: You may take BREE 217 or GEOG 322, but not both.

AGRI 340 (3) Principles of Ecological Agriculture

AGRI 452 (3) Water Resources in Barbados

AGRI 550 (3) Sustained Tropical Agriculture

BREE 217*	(3)	Hydrology and Water Resources
GEOG 321	(3)	Climatic Environments
GEOG 322*	(3)	Environmental Hydrology
NRSC 510	(3)	Agricultural Micrometeorology

Decision Making and Social Change

* Note: You may take AGECE 200 or ECON 208, but not both.

AGECE 200*	(3)	Principles of Microeconomics
AGECE 242	(3)	Management Theories and Practices
BTEC 502	(3)	Biotechnology Ethics and Society
ECON 208*	(3)	Microeconomic Analysis and Applications
EDER 461	(3)	Society and Change
GEOG 302	(3)	Environmental Management 1
GEOG 404	(3)	Environmental Management 2
PHIL 343	(3)	Biomedical Ethics
URBP 520	(3)	Globalization: Planning and Change

Development and History

AGRI 210	(3)	Agro-Ecological History
ANTH 212	(3)	Anthropology of Development
HIST 292	(3)	History and the Environment
SOCI 254	(3)	Development and Underdevelopment

List B:

12 credits from the following List B categories, maximum of 3 credits from any one category:

Techniques and Management

* Note: You may take ENVB 430 or GEOG 201, but not both.

CHEE 230	(3)	Environmental Aspects of Technology
ENVB 430*	(3)	GIS for Natural Resource Management
ENVB 437	(3)	Assessing Environmental Impact
GEOG 201*	(3)	Introductory Geo-Information Science
URBP 507	(3)	Planning and Infrastructure

Immunology and Infectious Disease

ANSC 400	(3)	Eukaryotic Cells and Viruses
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 324	(3)	Fundamental Virology
MIMM 413	(3)	Parasitology
PARA 438	(3)	Immunology
WILD 424	(3)	Parasitology

Nutrition and Agriculture

* Note: NUTR 512 (Video conference Downtown and at the Macdonald campus)

AGRI 411	(3)	Global Issues on Development, Food and Agriculture
NUTR 403	(3)	Nutrition in Society
NUTR 501	(3)	Nutrition in Developing Countries
NUTR 512*	(3)	Herbs, Foods and Phytochemicals

Populations and Place

CANS 407	(3)	Regions of Canada
GEOG 300	(3)	Human Ecology in Geography
GEOG 498	(3)	Humans in Tropical Environments
PSYC 533	(3)	International Health Psychology

Pollution and Pest Management

BIOL 350	(3)	Insect Biology and Control
BREE 322	(3)	Organic Waste Management
ENTO 352	(3)	Biocontrol of Pest Insects
NRSC 333	(3)	Pollution and Bioremediation

Genetics

BIOL 202	(3)	Basic Genetics
LSCI 204	(3)	Genetics

14.12.9 Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Environmetrics (63 credits)

This domain (63 credits including core) is open only to students in the B.Sc.(Ag.Env.Sc.) Major in Environment or B.Sc. Major in Environment program.

In view of the crucial need for sound study design and appropriate statistical methods for analyzing environmental changes and their impacts on humans and various life forms and their ecological relationships, this program is intended to provide students with a strong background in the use of statistical methods of data analysis in environmental sciences.

Graduates will be capable of effectively participating in the design of environmental studies and adequately analyzing data for use by the environmental community. Accordingly, the list of courses for the Environmetrics Domain is composed primarily of statistics courses and mathematically oriented courses with biological and ecological applications. The list is completed by general courses that refine the topics introduced in the MSE core courses by focusing on the ecology of living organisms, soil sciences or water resources, and impact assessment. These courses should allow the students to understand their interlocutors and be understood by them in their future job. Students can further develop their background in applied or mathematical statistics and their expertise in environmental sciences by taking complementary courses along each of two axes: statistics and mathematics, and environmental sciences. An internship is also offered to students to provide them with preliminary professional experience.

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook 2012-2013" (available on the MSE website at <http://www.mcgill.ca/mse>), or contact Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Prerequisites and equivalent courses are common with Math courses, so check with your adviser when choosing your courses. Be especially careful with Statistics courses, as you will receive no credit (and no warning!) for a course that is considered equivalent to one you have already taken. 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.

Statistics courses BIOL 373 OR AEMA 310 can be taken in U1, but do not take them if you want to follow Option 1 (below), as they overlap with MATH 324.

Program Requirements

Note: Students are required to take a maximum of 30 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes core and required courses.

Location Note: When planning their schedule and registering for courses, students should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course if you want to take it on the Downtown campus, and in Section 051 of an ENVR course if you want to take it on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain: Required Courses (6 credits)

AEMA 403	(3)	Environmetrics Stage
AEMA 414	(3)	Temporal and Spatial Statistics 01

Domain - Complementary Courses (36 credits)

36 credits of complementary courses are selected as follows:

12 credits - Fundamentals

3 credits - Basic Environmental Science

6 credits - Statistics, one of two options

15 credits - List 1 and List 2

Fundamentals:

12 credits of Fundamentals, 3 credits from each category.

Ecology

BIOL 308	(3)	Ecological Dynamics
ENVB 305	(3)	Population & Community Ecology

Impact

ENVB 437	(3)	Assessing Environmental Impact
MIME 308	(3)	Social Impact of Technology

Modelling

BIOL 309	(3)	Mathematical Models in Biology
ENVB 506	(3)	Quantitative Methods: Ecology

GIS Techniques

ENVB 430	(3)	GIS for Natural Resource Management
GEOG 201	(3)	Introductory Geo-Information Science

Basic Environmental Science:

One of:

BREE 217	(3)	Hydrology and Water Resources
CIVE 323	(3)	Hydrology and Water Resources
ENVB 210	(3)	The Biophysical Environment
GEOG 305	(3)	Soils and Environment
GEOG 322	(3)	Environmental Hydrology
GEOG 350	(3)	Ecological Biogeography

Statistics:

6 credits of Statistics are selected from one of the following two options.

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. Several Statistics courses overlap (especially with MATH 324) and cannot be taken together. These rules do not apply to B.Sc.(Ag.Env.Sc.) students.

Option 1

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

Option 2

One of:

AEMA 310	(3)	Statistical Methods 1
BIOL 373	(3)	Biometry

And one of:

AEMA 411	(3)	Experimental Designs 01
CIVE 555	(3)	Environmental Data Analysis
GEOG 351	(3)	Quantitative Methods
SOCI 461	(3)	Quantitative Data Analysis

A total of 15 credits are chosen from the following two lists.

List 1

3 credits minimum of statistics and mathematics chosen from:

* Note: or equivalent courses to BREE 252 or BREE 319.

BIOL 434	(3)	Theoretical Ecology
BREE 252*	(3)	Computing for Engineers
BREE 319*	(3)	Engineering Mathematics

GEOG 501	(3)	Modelling Environmental Systems
MATH 223	(3)	Linear Algebra
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 423	(3)	Regression and Analysis of Variance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 525	(4)	Sampling Theory and Applications
SOCI 504	(3)	Quantitative Methods 1
SOCI 505	(3)	Quantitative Methods 2
SOCI 580	(3)	Social Research Design and Practice

List 2

3 credits minimum of environmental sciences chosen from:

AGRI 452	(3)	Water Resources in Barbados
AGRI 550	(3)	Sustained Tropical Agriculture
BIOL 331	(3)	Ecology/Behaviour Field Course
BIOL 553	(3)	Neotropical Environments
ENVB 313	(3)	Phylogeny and Biogeography
GEOG 300	(3)	Human Ecology in Geography
GEOG 302	(3)	Environmental Management 1
GEOG 404	(3)	Environmental Management 2
GEOG 494	(3)	Urban Field Studies
GEOG 499	(3)	Subarctic Field Studies
NRSC 333	(3)	Pollution and Bioremediation
PLNT 460	(3)	Plant Ecology
WILD 401	(4)	Fisheries and Wildlife Management
WOOD 420	(3)	Environmental Issues: Forestry

14.12.10 Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Food Production and Environment (63 credits)

This domain (63 credits including core) is open only to students in the B.Sc.(Ag.Env.Sc.) Major in Environment or B.Sc. in Environment program.

The business of food production is an area of human activity with a large and intimate interaction with the environment. Modern agriculturalists must strike a delicate balance between trying to provide food for themselves, their families, and urban dwellers and trying to minimize environmental damage. When negative effects due to agricultural activities do occur, they are not usually the classic point-source effects that we have come to associate with industry or large cities. Rather, the effects are over extremely large land areas cumulating, perhaps, in pollution of river systems or lakes some distance away. As world populations grow, and as diets change, potentially negative interactions between agricultural systems and other facets of the environment will become more frequent. In the same way, urban sprawl will make conflicts between agriculture and urbanites more common.

With a judicious choice of courses, graduates of this domain may be eligible to apply for membership in the Ordre des agronomes du Québec (OAQ) and the Agricultural Institute of Canada (AIC).

Program Prerequisites or Corequisites

All students in this program MUST take these pre- or corequisite courses, or their equivalents. These courses are taken as follows:

Location Note: When planning their schedule and registering for courses, students should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

One of the following courses or CEGEP equivalent (e.g., CEGEP objective 00XU):

BIOL 112	(3)	Cell and Molecular Biology
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LSCI 211 (3) Biochemistry 1

One of the following courses or CEGEP equivalent (e.g., CEGEP objective 00XV):

CHEM 212 (4) Introductory Organic Chemistry 1

FDSC 230 (4) Organic Chemistry

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook 2012-2013" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Ms. Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 34 credits at the 200 level and a minimum of 15 credits at the 400 level or higher in this program. This includes core and required courses, but does not include the domain prerequisites or corequisites listed above.

Location Note: When planning their schedule and registering for courses, students should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain: Required Courses (9 credits)

AEBI 210	(3)	Organisms 1
AGRI 210	(3)	Agro-Ecological History
PLNT 300	(3)	Cropping Systems

Domain: Complementary Courses (33 credits)

33 credits of complementary courses selected as follows:

15 credits - Basic Sciences

12 credits - Applied Sciences

6 credits - Social Sciences/Humanities

Basic Sciences:

15 credits of Basic Sciences selected as follows:

One of the following Statistics courses or equivalent:

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.

AEMA 310	(3)	Statistical Methods 1
MATH 203	(3)	Principles of Statistics 1

One of:

AGRI 340	(3)	Principles of Ecological Agriculture
ANSC 250	(3)	Principles of Animal Science

One of:

BIOL 202	(3)	Basic Genetics
LSCI 204	(3)	Genetics

One of:

ENVB 210	(3)	The Biophysical Environment
GEOG 305	(3)	Soils and Environment

One of:

BIOL 308	(3)	Ecological Dynamics
ENVB 305	(3)	Population & Community Ecology

Applied Sciences:

12 credits of Applied Sciences from the following:

* Note: You may take BREE 217 or GEOG 322, but not both; you may take FDSC 200 or NUTR 207, but not both.

AGRI 411	(3)	Global Issues on Development, Food and Agriculture
AGRI 435	(3)	Soil and Water Quality Management
AGRI 550	(3)	Sustained Tropical Agriculture
BIOL 465	(3)	Conservation Biology
BIOL 553	(3)	Neotropical Environments
BREE 217*	(3)	Hydrology and Water Resources
BREE 322	(3)	Organic Waste Management
BREE 518	(3)	Bio-Treatment of Wastes
ENVB 437	(3)	Assessing Environmental Impact
FDSC 200*	(3)	Introduction to Food Science
FDSC 535	(3)	Food Biotechnology
GEOG 302	(3)	Environmental Management 1
GEOG 322*	(3)	Environmental Hydrology
MICR 331	(3)	Microbial Ecology
NRSC 333	(3)	Pollution and Bioremediation

NUTR 207*	(3)	Nutrition and Health
NUTR 403	(3)	Nutrition in Society
PARA 410	(3)	Environment and Infection
PHAR 303	(3)	Principles of Toxicology
PLNT 434	(3)	Weed Biology and Control
SOIL 315	(3)	Soil Nutrient Management
SOIL 445	(3)	Agroenvironmental Fertilizer Use
SOIL 510	(3)	Environmental Soil Chemistry
WILD 401	(4)	Fisheries and Wildlife Management

Social Sciences/Humanities:

6 credits in Social Sciences and Humanities are selected as follows:

* Note: You may take AGECE 200 or ECON 208, but not both; you may take AGECE 333 or ECON 405, but not both.

** Note: If WILD 415 is taken, 1 additional credit of complementary courses must be taken.

AGECE 200*	(3)	Principles of Microeconomics
AGECE 320	(3)	Intermediate Microeconomic Theory
AGECE 333*	(3)	Resource Economics
AGECE 430	(3)	Agriculture, Food and Resource Policy
AGECE 442	(3)	Economics of International Agricultural Development
ECON 208*	(3)	Microeconomic Analysis and Applications
ECON 225	(3)	Economics of the Environment
ECON 405*	(3)	Natural Resource Economics
GEOG 404	(3)	Environmental Management 2
GEOG 410	(3)	Geography of Underdevelopment: Current Problems
GEOG 498	(3)	Humans in Tropical Environments
GEOG 510	(3)	Humid Tropical Environments
SOCI 254	(3)	Development and Underdevelopment
SOCI 565	(3)	Social Change in Panama
WILD 415**	(2)	Conservation Law

14.12.11 Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment-Land Surface Processes and Environmental Change (63 credits)

This domain (63 credits including core) is open only to students in the B.Sc.(Ag.Env.Sc.) Major in Environment or B.Sc. Major in Environment programs.

The thin soil layer on the planet's land surfaces controls the vital inputs of water, nutrients, and energy to terrestrial and freshwater aquatic ecosystems. Widespread occurrences around the globe of desertification, soil erosion, deforestation, and land submergence over water reservoirs indicate that this dynamic system is under increasing pressure from population growth and changes in climate and land uses. Production of key greenhouse gases (water vapour, CO₂, and methane) is controlled by complex processes operating at the land surface, involving climate change feedbacks that need to be fully understood, given current global warming trends.

The program introduces students to the interacting physical and biogeochemical processes at the atmosphere-lithosphere interface, which fashion land surface habitats and determine their biological productivity and response to anthropogenic or natural environmental changes. Through an appropriate selection of courses, students can prepare for graduate training in emerging research areas such as earth system sciences, environmental hydrology, and landscape ecology.

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook 2012-2013" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Ms. Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 30 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes Core and Required courses.

Location Note: Core Required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain Required Course (3 credits)

GEOG 203	(3)	Environmental Systems
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Domain: Complementary Courses (39 credits)

39 credits of complementary courses are selected as follows:

9 credits - 3 credits from each category of Statistics, GIS and Remote Sensing Techniques, Weather and Climate

9 credits of fundamental land surface processes

3 credits of environment and resource management

3 credits of field course

3 credits of social science

12 credits total of advanced studies chosen from List A: Particular Environments and List B: Surface Processes

Statistics

One of the following Statistics courses or equivalent:

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.

AEMA 310	(3)	Statistical Methods 1
GEOG 202	(3)	Statistics and Spatial Analysis
MATH 203	(3)	Principles of Statistics 1

GIS and Remote Sensing Techniques

One of:

ENVB 430	(3)	GIS for Natural Resource Management
GEOG 201	(3)	Introductory Geo-Information Science

GEOG 308 (3) Principles of Remote Sensing

Weather and Climate

One of:

ATOC 215 (3) Oceans, Weather and Climate

ENVB 301 (3) Meteorology

Fundamental Land Surface Processes:

9 credits of fundamental land surface processes chosen as follows:

GEOG 321 (3) Climatic Environments

And/or one of:

GEOG 272 (3) Earth's Changing Surface

SOIL 300 (3) Geosystems

And/or one of:

GEOG 305 (3) Soils and Environment

SOIL 326 (3) Soils in a Changing Environment

And/or one of:

BREE 217 (3) Hydrology and Water Resources

GEOG 322 (3) Environmental Hydrology

Environment and Resource Management:

One of:

* Note: You may take BIOL 308 or ENVB 305, but not both.

AGRI 435 (3) Soil and Water Quality Management

AGRI 452 (3) Water Resources in Barbados

AGRI 550 (3) Sustained Tropical Agriculture

BIOL 308* (3) Ecological Dynamics

BIOL 465 (3) Conservation Biology

CHEE 230 (3) Environmental Aspects of Technology

CIVE 225 (4) Environmental Engineering

ENVB 305* (3) Population & Community Ecology

ENVB 437 (3) Assessing Environmental Impact

ESYS 301 (3) Earth System Modelling

GEOG 302 (3) Environmental Management 1

GEOG 404 (3) Environmental Management 2

WILD 421 (3) Wildlife Conservation

WOOD 420 (3) Environmental Issues: Forestry

WOOD 441 (3) Integrated Forest Management

Field Course:

One of:

BIOL 553	(3)	Neotropical Environments
GEOG 495	(3)	Field Studies - Physical Geography
GEOG 496	(3)	Geographical Excursion
GEOG 499	(3)	Subarctic Field Studies
WILD 475	(3)	Desert Ecology

Social Science:

One of:

AGEC 333	(3)	Resource Economics
ANTH 339	(3)	Ecological Anthropology
ECON 225	(3)	Economics of the Environment
ECON 326	(3)	Ecological Economics
ECON 405	(3)	Natural Resource Economics
GEOG 221	(3)	Environment and Health
GEOG 408	(3)	Geography of Development
GEOG 498	(3)	Humans in Tropical Environments
NRSC 221	(3)	Environment and Health
SOCI 565	(3)	Social Change in Panama
URBP 520	(3)	Globalization: Planning and Change

12 credits total of advanced studies chosen from the following two lists:

List A - Particular Environments:

3-9 credits of advanced study of Particular Environments:

* Note: You may take BIOL 432 or ENVB 315, but not both.

BIOL 432*	(3)	Limnology
ENVB 315*	(3)	Science of Inland Waters
ENVB 410	(3)	Ecosystem Ecology
GEOG 350	(3)	Ecological Biogeography
GEOG 372	(3)	Running Water Environments
GEOG 470	(3)	Wetlands
GEOG 536	(3)	Geocryology
GEOG 550	(3)	Historical Ecology Techniques
PLNT 358	(3)	Flowering Plant Diversity
PLNT 460	(3)	Plant Ecology

List B - Surface Processes:

3-9 credits advanced study of Surface Processes:

ATOC 315	(3)	Thermodynamics and Convection
BREE 509	(3)	Hydrologic Systems and Modelling

EPSC 549	(3)	Hydrogeology
EPSC 580	(3)	Aqueous Geochemistry
GEOG 501	(3)	Modelling Environmental Systems
GEOG 505	(3)	Global Biogeochemistry
GEOG 537	(3)	Advanced Fluvial Geomorphology
NRSC 333	(3)	Pollution and Bioremediation
SOIL 331	(3)	Soil Physics
SOIL 510	(3)	Environmental Soil Chemistry

14.12.12 Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Renewable Resource Management (63 credits)

This domain (63 credits including core) is open only to students in the B.Sc.(Ag.Env.Sc.) Major in Environment or B.Sc. Major in Environment program.

Renewable resource management is an emerging field that focuses on the ecosystem structures and processes required to sustain the delivery, to humanity, of ecosystem goods and services such as food, clean water and air, essential nutrients, and the provision of beauty and inspiration. Renewable resource management recognizes humans as integral components of ecosystems and is used to develop goals that are consistent with sustainability and ecosystem maintenance.

The Renewable Resource Management domain provides students with an understanding of: 1) the interactions between physical and biological factors that determine the nature and dynamics of populations and entities in the natural environment; 2) the ways in which ecosystems can be managed to meet specific goals for the provision of goods and services; 3) the economic and social factors that determine how ecosystems are managed; 4) the ways in which management of natural resources can affect the capability of natural ecosystems to continue to supply human needs in perpetuity; and 5) the approaches and technologies required to monitor and analyze the dynamics of natural and managed ecosystems.

Program Prerequisites or Corequisites

All students in this program MUST take the following pre- or corequisite courses:

One of the following biology courses or CEGEP equivalent (e.g., CEGEP objective 00XU):

BIOL 112	(3)	Cell and Molecular Biology
LSCI 211	(3)	Biochemistry 1

One of the following chemistry courses or CEGEP equivalent (e.g., CEGEP objective 00XV):

CHEM 212	(4)	Introductory Organic Chemistry 1
FDSC 230	(4)	Organic Chemistry

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook 2012-2013" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Ms. Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 30 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes core and required courses, but does not include the domain prerequisites or corequisites listed above.

Location Note: When planning their schedule and registering for courses, students should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability

ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain: Complementary Courses (42 credits)

42 credits of complementary courses are selected as follows:

9 credits - Basic Principles of Ecosystem Processes and Diversity

6 credits - 3 credits from each category of Statistics and GIS

6 credits - Advanced Ecosystem Components

6 credits - Advanced Ecological Processes

6 credits - Social Processes

9 credits - Ecosystem Components or Management of Ecosystems

Basic Principles of Ecosystem Processes:

9 credits of basic principles of ecosystem processes and diversity are selected as follows:

One of:

AEBI 210	(3)	Organisms 1
AEBI 211	(3)	Organisms 2
BIOL 305	(3)	Animal Diversity

One of:

BIOL 308	(3)	Ecological Dynamics
ENVB 305	(3)	Population & Community Ecology

One of:

ENVB 210	(3)	The Biophysical Environment
GEOG 305	(3)	Soils and Environment

Statistics

One of:

AEMA 310	(3)	Statistical Methods 1
BIOL 373	(3)	Biometry

GIS Methods

One of:

ENVB 430	(3)	GIS for Natural Resource Management
GEOG 201	(3)	Introductory Geo-Information Science

Advanced Ecosystem Components:

6 credits of advanced ecosystem components selected from:

BIOL 553	(3)	Neotropical Environments
GEOG 372	(3)	Running Water Environments
PLNT 358	(3)	Flowering Plant Diversity
SOIL 326	(3)	Soils in a Changing Environment
WILD 307	(3)	Natural History of Vertebrates

Advanced Ecological Processes:

6 credits of advanced ecological processes selected from:

* Note: You may take BIOL 432 or ENVB 315, but not both; you can take BREE 217 or GEOG 322, but not both.

BIOL 432*	(3)	Limnology
BIOL 465	(3)	Conservation Biology
BREE 217*	(3)	Hydrology and Water Resources
ENVB 315*	(3)	Science of Inland Waters
ENVB 410	(3)	Ecosystem Ecology
GEOG 322*	(3)	Environmental Hydrology
MICR 331	(3)	Microbial Ecology
NRSC 333	(3)	Pollution and Bioremediation
PLNT 460	(3)	Plant Ecology

Social Processes:

6 credits of social processes selected as follows:

* If WILD 415 is taken, 1 additional credit of complementary courses must be taken.

** Note: You may take AGECE 333 and ECON 405, but not both.

AGECE 242	(3)	Management Theories and Practices
AGECE 333**	(3)	Resource Economics
ANTH 339	(3)	Ecological Anthropology
CANS 407	(3)	Regions of Canada
ECON 405**	(3)	Natural Resource Economics
GEOG 382	(3)	Principles Earth Citizenship
GEOG 498	(3)	Humans in Tropical Environments
RELG 270	(3)	Religious Ethics and the Environment
SOCI 565	(3)	Social Change in Panama
URBP 520	(3)	Globalization: Planning and Change
WILD 415*	(2)	Conservation Law

Ecosystem Components or Management of Ecosystems:

9 credits of ecosystem components or management of ecosystems selected from:

AGRI 435	(3)	Soil and Water Quality Management
AGRI 452	(3)	Water Resources in Barbados
AGRI 550	(3)	Sustained Tropical Agriculture
ENVB 437	(3)	Assessing Environmental Impact
GEOG 302	(3)	Environmental Management 1
GEOG 404	(3)	Environmental Management 2
PLNT 300	(3)	Cropping Systems
SOIL 335	(3)	Soil Ecology and Management
WILD 401	(4)	Fisheries and Wildlife Management
WOOD 441	(3)	Integrated Forest Management

14.12.13 Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment -Water Environments and Ecosystems - Biological (60 credits)

This concentration (60 credits including core) is open only to students in the B.Sc.(Ag.Env.Sc.) Major in Environment or B.Sc. Major in Environment program.

To educate students in both the ecological and physical facets of the water environment, this domain offers two concentrations, with students choosing one or the other.

Those electing the Biological concentration will focus on the mechanisms regulating the different forms of life in water bodies. They will acquire, as well, a good understanding of the physical mechanisms controlling water properties. Students interested in studying the transport and transformation mechanisms of water on the planet, from rivers to the oceans and atmosphere, will select the Physical concentration. They will acquire, as well, a solid background in the biological processes taking place in water bodies.

Graduates of this domain are qualified to enter the work force or to pursue advanced studies in fields such as marine biology, geography, physical oceanography, and atmospheric science.

Suggested First Year (U1) Courses

For suggestions of courses to take in your first year (U1), you can consult the "MSE Student Handbook 2012-2013" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Ms. Kathy Roulet, Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 30 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes core and required courses.

Location Note: When planning your schedule and registering for courses, you should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research

ENVR 451 (6) Research in Panama

Domain: Required Courses (6 credits)

ATOC 214 (3) Introduction: Physics of the Atmosphere

ATOC 215 (3) Oceans, Weather and Climate

Domain: Complementary Courses (33 credits)

33 credits of complementary courses are selected as follows:

6 credits - Hydrology/Water Resources, Population/Community and Ecology

3 credits - Math and Statistics

3 credits - Field Course

3 credits - Social Sciences and Policy

18 credits chosen in total from List A and List B

Hydrology/Water Resources, Population/Community and Ecology:

6 credits selected as follows:

One of:

BREE 217 (3) Hydrology and Water Resources

GEOG 322 (3) Environmental Hydrology

And one of:

BIOL 308 (3) Ecological Dynamics

ENVB 305 (3) Population & Community Ecology

Math and Statistics:

One of:

* Note: AEMA 310 or equivalent

AEMA 202 (3) Intermediate Calculus

AEMA 310* (3) Statistical Methods 1

MATH 203 (3) Principles of Statistics 1

MATH 222 (3) Calculus 3

Field Course:

3 credits selected from the following courses or an equivalent Aquatic Field course:

AGRI 452 (3) Water Resources in Barbados

BIOL 331 (3) Ecology/Behaviour Field Course

GEOG 495 (3) Field Studies - Physical Geography

Social Sciences and Policy:

One of:

AGEC 333 (3) Resource Economics

ANTH 339 (3) Ecological Anthropology

ECON 225	(3)	Economics of the Environment
ECON 326	(3)	Ecological Economics
GEOG 404	(3)	Environmental Management 2
GEOG 498	(3)	Humans in Tropical Environments
POLI 345	(3)	International Organizations
SOCI 565	(3)	Social Change in Panama
URBP 520	(3)	Globalization: Planning and Change

18 credits chosen in total from List A and List B as follows:

List A

9-12 credits chosen from:

* Note: you may take BIOL 540 or ENVR 540, but not both; you may take ENVB 210 or GEOG 305, but not both; you may take BIOL 432 or ENVB 315, but not both.

AGRI 435	(3)	Soil and Water Quality Management
BIOL 342	(3)	Marine Biology
BIOL 432*	(3)	Limnology
BIOL 441	(3)	Biological Oceanography
BIOL 465	(3)	Conservation Biology
BIOL 540*	(3)	Ecology of Species Invasions
BIOL 553	(3)	Neotropical Environments
BIOL 570	(3)	Advanced Seminar in Evolution
ENTO 535	(3)	Aquatic Entomology
ENVB 210*	(3)	The Biophysical Environment
ENVB 315*	(3)	Science of Inland Waters
ENVR 540*	(3)	Ecology of Species Invasions
GEOG 305*	(3)	Soils and Environment
GEOG 350	(3)	Ecological Biogeography
MICR 331	(3)	Microbial Ecology
NRSC 333	(3)	Pollution and Bioremediation
PARA 410	(3)	Environment and Infection
WILD 401	(4)	Fisheries and Wildlife Management

List B

6-9 credits chosen from:

* Note: you may take ATOC 219 or CHEM 219, but not both; you may take ATOC 419 or CHEM 419, but not both; you may take ENVB 430 or GEOG 201, but not both; CHEM 287 and CHEM 297 must be taken together.

ATOC 219*	(3)	Introduction to Atmospheric Chemistry
ATOC 419*	(3)	Advances in Chemistry of Atmosphere
CHEM 219*	(3)	Introduction to Atmospheric Chemistry
CHEM 287*	(2)	Introductory Analytical Chemistry
CHEM 297*	(1)	Introductory Analytical Chemistry Laboratory
CHEM 419*	(3)	Advances in Chemistry of Atmosphere
ENVB 430*	(3)	GIS for Natural Resource Management

EPSC 220	(3)	Principles of Geochemistry
GEOG 201*	(3)	Introductory Geo-Information Science
GEOG 308	(3)	Principles of Remote Sensing
GEOG 372	(3)	Running Water Environments
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques

14.12.14 Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Water Environments and Ecosystems - Physical (63 credits)

This concentration (60 credits including core) is open only to students in the B.Sc.(Ag.Env.Sc.) Major in Environment or B.Sc. Major in Environment program.

To educate students in both the ecological and physical facets of the water environment, this domain offers two concentrations, with students choosing one or the other.

Students interested in studying the transport and transformation mechanisms of water on the planet, from rivers to the oceans and atmosphere, will select the Physical concentration. They will acquire, as well, a solid background in the biological processes taking place in water bodies. Those electing the Biological concentration will focus on the mechanisms regulating the different forms of life in water bodies. They will acquire, as well, a good understanding of the physical mechanisms controlling water properties.

Graduates of this domain are qualified to enter the work force or to pursue advanced studies in fields such as marine biology, geography, physical oceanography, and atmospheric science.

Suggested First Year (U1) Courses

For suggestions on courses to take in your first year (U1), you can consult the "MSE Student Handbook 2012-2013" available on the MSE website (<http://www.mcgill.ca/mse>), or contact Ms. Kathy Roulet, the Program Adviser (kathy.roulet@mcgill.ca).

Program Requirements

Note: Students are required to take a maximum of 30 credits at the 200 level and a minimum of 12 credits at the 400 level or higher in this program. This includes core and required courses.

Location Note: When planning your schedule and registering for courses, you should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Core: Required Courses (18 credits)

Location Note: Core required courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Core: Complementary Course - Senior Research Project (3 credits)

Note: Only 3 credits will be applied to the program; extra credits will count as electives.

AGRI 519	(6)	Sustainable Development Plans
ENVR 401	(3)	Environmental Research
ENVR 451	(6)	Research in Panama

Domain: Required Courses (12 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 215	(3)	Oceans, Weather and Climate
ATOC 315	(3)	Thermodynamics and Convection
GEOG 372	(3)	Running Water Environments

Domain: Complementary Courses (30 credits)

30 credits of complementary courses are selected as follows:

6 credits - Hydrology/Water Resources, Population, Community and Ecology

3 credits - Statistics or Calculus

3 credits - Field course

12 credits chosen from List A

6 credits chosen from List B

Hydrology/Water Resources, Population/Community and Ecology

6 credits selected as follows:

One of:

BREE 217	(3)	Hydrology and Water Resources
GEOG 322	(3)	Environmental Hydrology

And one of:

BIOL 308	(3)	Ecological Dynamics
ENVB 305	(3)	Population & Community Ecology

Statistics or Calculus:

One of:

* Note: AEMA 310 or equivalent.

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.

AEMA 202	(3)	Intermediate Calculus
AEMA 310*	(3)	Statistical Methods 1
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3

Field Course:

3 credits selected from the following courses or an equivalent Aquatic Field course:

AGRI 452	(3)	Water Resources in Barbados
GEOG 495	(3)	Field Studies - Physical Geography

List A:

12 credits chosen from:

AGRI 435	(3)	Soil and Water Quality Management
ATOC 309	(3)	Weather Radars and Satellites

ATOC 568	(3)	Ocean Physics
BREE 416	(3)	Engineering for Land Development
CIVE 323	(3)	Hydrology and Water Resources
EPSC 549	(3)	Hydrogeology
GEOG 201	(3)	Introductory Geo-Information Science
GEOG 308	(3)	Principles of Remote Sensing
GEOG 537	(3)	Advanced Fluvial Geomorphology
NRSC 510	(3)	Agricultural Micrometeorology
URBP 520	(3)	Globalization: Planning and Change

And/or one of:

AEMA 305	(3)	Differential Equations
MATH 315	(3)	Ordinary Differential Equations

And/or one of:

BREE 506	(3)	Advances in Drainage Management
BREE 509	(3)	Hydrologic Systems and Modelling

And/or one of:

ENVB 210	(3)	The Biophysical Environment
GEOG 305	(3)	Soils and Environment

And/or one of:

ENVB 430	(3)	GIS for Natural Resource Management
GEOG 306	(3)	Raster Geo-Information Science

List B:

6 credits chosen from:

* Note: You can take BIOL 432 or ENVB 315, but not both.

BIOL 342	(3)	Marine Biology
BIOL 432*	(3)	Limnology
BIOL 441	(3)	Biological Oceanography
BIOL 465	(3)	Conservation Biology
BIOL 553	(3)	Neotropical Environments
ENVB 315*	(3)	Science of Inland Waters
GEOG 350	(3)	Ecological Biogeography
GEOG 505	(3)	Global Biogeochemistry
WILD 401	(4)	Fisheries and Wildlife Management

14.12.15 Bachelor of Science (B.Sc.) - Honours Environment (72 credits)

This program is open only to students in the B.Sc. Major Environment. To be eligible for Honours, students must satisfy the requirements set by their B.Sc. degree.

In addition, students must satisfy the following:

1. Students apply for the Honours program in March of their U2 year. See the Program Adviser for details.
2. Applicants must have a minimum Program GPA (GPA of all required and complementary courses for the program in Environment taken at McGill) of 3.3 to enter the Honours program.
3. Students must earn a B grade (3.0) or higher for the Honours Research course (ENVR 495).
4. Students are required to achieve a minimum overall CGPA of 3.0 at graduation, and a minimum Program GPA of 3.3 to obtain Honours.

Students in the B.Sc. Honours programs complete the core and domain courses (60 to 66 credits) according to their chosen domain as well as the 6 credits of Honours required courses.

At the completion of your Honours research, you are expected to present your results at an Honours Symposium, and are required to submit a copy of your final report to the MSE Program Adviser.

Honours Required Courses (6 credits)

Note: you take either ENVR 495D1 and ENVR 495D2 (6 credits over consecutive terms) or ENVR 495N1 and ENVR 495N2 (6 credits over non-consecutive terms).

ENVR 495D1	(3)	Honours Research
ENVR 495D2	(3)	Honours Research
ENVR 495N1	(3)	Honours Research
ENVR 495N2	(3)	Honours Research

14.12.16 Diploma in Environment (30 credits)

The Diploma in Environment is designed for students with an undergraduate degree who wish to enrich or reorient their training, supplementing their specialization with additional undergraduate-level course work in Environment.

The diploma requires 30 credits of full-time or part-time studies at McGill; it may be started in either January or September. The diploma is a one-year program if taken full-time.

Students holding a B.Sc. or a B.A. degree or equivalent in good standing will be permitted to register for the diploma through the Faculty of Agricultural and Environmental Sciences, the Faculty of Arts, or the Faculty of Science, provided they are otherwise acceptable for admission to the University.

Advising Note:

Consultation with the Program Adviser for approval of course selection to meet program requirements is obligatory. All courses must be at the 200 level and above, and completed with a grade of C or better.

Location Note:

When planning your schedule and registering for courses, you should verify where each course is offered because courses for this program are taught at both McGill's Downtown campus and at the Macdonald campus in Sainte-Anne-de-Bellevue.

Required Courses (18 credits)

Location Note: The ENVR courses are offered on both campuses. You should register in Section 001 of an ENVR course that you plan to take on the Downtown campus, and in Section 051 of an ENVR course that you plan to take on the Macdonald campus.

ENVR 200	(3)	The Global Environment
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 202	(3)	The Evolving Earth
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 301	(3)	Environmental Research Design
ENVR 400	(3)	Environmental Thought

Complementary Courses (12 credits)

12 credits of complementary courses are selected as follows:

3 credits - must be taken with the approval of the Program Adviser in an area outside of the student's previous degree (e.g., those with a B.A. or equivalent degree must take at least 3 credits in the natural sciences; those with a B.Sc. or equivalent degree must take at least 3 credits in the social sciences). A list of Suggested Courses is given below.

9 credits - must be taken in an area of focus chosen by the student with the approval of the Program Adviser. At least 6 credits must be taken at the 400 level or higher. A list of Suggested Courses is given below.

Suggested Course List

The Suggested Course List is divided into two thematic categories: Social Sciences and Policy; and Natural Sciences and Technology.

Most courses listed at the 300 level and higher have prerequisites. You are urged to prepare your program of study with this in mind.

This list is not meant to be exhaustive. You are also encouraged to examine the course lists of the various domains in the Environment program for other courses that might interest you. Courses not on the Suggested Course List may be included in the diploma with the permission of the Program Adviser.

Social Sciences and Policy

* Note: If WILD 415 is taken, 1 additional credit of complementary courses must be taken.

AGEC 231	(3)	Economic Systems of Agriculture
AGEC 333	(3)	Resource Economics
AGEC 430	(3)	Agriculture, Food and Resource Policy
AGEC 442	(3)	Economics of International Agricultural Development
AGRI 210	(3)	Agro-Ecological History
AGRI 411	(3)	Global Issues on Development, Food and Agriculture
ANTH 206	(3)	Environment and Culture
ANTH 212	(3)	Anthropology of Development
ANTH 339	(3)	Ecological Anthropology
ANTH 512	(3)	Political Ecology
BREE 503	(3)	Water: Society, Law and Policy
CIVE 433	(3)	Urban Planning
ECON 205	(3)	An Introduction to Political Economy
ECON 225	(3)	Economics of the Environment
ECON 326	(3)	Ecological Economics
ECON 347	(3)	Economics of Climate Change
ECON 405	(3)	Natural Resource Economics
ENVB 437	(3)	Assessing Environmental Impact
ENVR 201	(3)	Society, Environment and Sustainability
ENVR 203	(3)	Knowledge, Ethics and Environment
ENVR 400	(3)	Environmental Thought
GEOG 200	(3)	Geographical Perspectives: World Environmental Problems
GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 221	(3)	Environment and Health
GEOG 300	(3)	Human Ecology in Geography
GEOG 301	(3)	Geography of Nunavut
GEOG 302	(3)	Environmental Management 1
GEOG 303	(3)	Health Geography
GEOG 370	(3)	Protected Areas
GEOG 382	(3)	Principles Earth Citizenship

GEOG 403	(3)	Global Health and Environmental Change
GEOG 408	(3)	Geography of Development
GEOG 410	(3)	Geography of Underdevelopment: Current Problems
GEOG 530	(3)	Global Land and Water Resources
GEOG 551	(3)	Environmental Decisions
MGPO 440	(3)	Strategies for Sustainability
NRSC 221	(3)	Environment and Health
NRSC 540	(3)	Socio-Cultural Issues in Water
PHIL 230	(3)	Introduction to Moral Philosophy 1
PHIL 237	(3)	Contemporary Moral Issues
PHIL 334	(3)	Ethical Theory
PHIL 343	(3)	Biomedical Ethics
PHIL 348	(3)	Philosophy of Law 1
POLI 211	(3)	Comparative Government and Politics
POLI 212	(3)	Government and Politics - Developed World
POLI 227	(3)	Developing Areas/Introduction
POLI 345	(3)	International Organizations
POLI 445	(3)	International Political Economy: Monetary Relations
PSYC 215	(3)	Social Psychology
RELG 270	(3)	Religious Ethics and the Environment
RELG 340	(3)	Religion and the Sciences
RELG 370	(3)	Religion and Human Rights
RELG 376	(3)	Religious Ethics
SOCI 222	(3)	Urban Sociology
SOCI 234	(3)	Population and Society
SOCI 235	(3)	Technology and Society
SOCI 254	(3)	Development and Underdevelopment
SOCI 386	(3)	Contemporary Social Movements
URBP 201	(3)	Planning the 21st Century City
URBP 506	(3)	Environmental Policy and Planning
URBP 530	(3)	Urban Environmental Planning
WILD 415*	(2)	Conservation Law

Natural Sciences and Technology

* Note: You may take LSCI 230 or MIMM 211, but not both; you may take BIOL 432 or ENVB 315, but not both; you may take ENVB 430 or GEOG 201, but not both; you may take BREE 217 or GEOG 322, but not both.

AGRI 340	(3)	Principles of Ecological Agriculture
AGRI 435	(3)	Soil and Water Quality Management
ANSC 326	(3)	Fundamentals of Population Genetics
ANTH 311	(3)	Primate Behaviour and Ecology
ARCH 375	(2)	Landscape
ARCH 377	(3)	Energy, Environment and Buildings
ARCH 378	(3)	Site Usage

ATOC 215	(3)	Oceans, Weather and Climate
BIOL 240	(3)	Monteregian Flora
BIOL 305	(3)	Animal Diversity
BIOL 308	(3)	Ecological Dynamics
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 342	(3)	Marine Biology
BIOL 418	(3)	Freshwater Invertebrate Ecology
BIOL 432*	(3)	Limnology
BIOL 436	(3)	Evolution and Society
BIOL 465	(3)	Conservation Biology
BREE 217*	(3)	Hydrology and Water Resources
BREE 322	(3)	Organic Waste Management
BREE 518	(3)	Bio-Treatment of Wastes
BTEC 502	(3)	Biotechnology Ethics and Society
CHEE 230	(3)	Environmental Aspects of Technology
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 462	(3)	Green Chemistry
CIVE 225	(4)	Environmental Engineering
CIVE 323	(3)	Hydrology and Water Resources
CIVE 550	(3)	Water Resources Management
ENTO 340	(3)	Field Entomology
ENVB 210	(3)	The Biophysical Environment
ENVB 301	(3)	Meteorology
ENVB 305	(3)	Population & Community Ecology
ENVB 315*	(3)	Science of Inland Waters
ENVB 410	(3)	Ecosystem Ecology
ENVB 415	(3)	Ecosystem Management
ENVB 430*	(3)	GIS for Natural Resource Management
ENVR 200	(3)	The Global Environment
ENVR 202	(3)	The Evolving Earth
EPSC 201	(3)	Understanding Planet Earth
EPSC 233	(3)	Earth and Life History
EPSC 425	(3)	Sediments to Sequences
EPSC 549	(3)	Hydrogeology
ESYS 301	(3)	Earth System Modelling
GEOG 200	(3)	Geographical Perspectives: World Environmental Problems
GEOG 201*	(3)	Introductory Geo-Information Science
GEOG 205	(3)	Global Change: Past, Present and Future
GEOG 272	(3)	Earth's Changing Surface
GEOG 308	(3)	Principles of Remote Sensing
GEOG 321	(3)	Climatic Environments
GEOG 322*	(3)	Environmental Hydrology

GEOG 372	(3)	Running Water Environments
GEOG 470	(3)	Wetlands
LSCI 230*	(3)	Introductory Microbiology
MICR 331	(3)	Microbial Ecology
MIME 308	(3)	Social Impact of Technology
MIME 320	(3)	Extraction of Energy Resources
MIMM 211*	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
NRSC 333	(3)	Pollution and Bioremediation
NRSC 340	(3)	Global Perspectives on Food
NRSC 510	(3)	Agricultural Micrometeorology
NRSC 514	(3)	Freshwater Ecosystems
PARA 410	(3)	Environment and Infection
PARA 515	(3)	Water, Health and Sanitation
PLNT 304	(3)	Biology of Fungi
PLNT 305	(3)	Plant Pathology
PLNT 358	(3)	Flowering Plant Diversity
PLNT 426	(3)	Plant Ecophysiology
PLNT 460	(3)	Plant Ecology
SOIL 300	(3)	Geosystems
WILD 421	(3)	Wildlife Conservation

14.13 Experimental Medicine (EXMD)

14.13.1 Location

Lady Meredith House, Room 101
1110 Pine Avenue West
Montreal, Quebec H3A 1A3

Telephone: 514-398-3466

Email: experimental.medicine@mcgill.ca

Website: www.medicine.mcgill.ca/expmed

14.13.2 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.

Experimental Medicine Courses

EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 01
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology

Experimental Medicine Courses

EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
EXMD 509	(3)	Gastrointestinal Physiology and Pathology
EXMD 510	(3)	Bioanalytical Separation Methods
EXMD 511	(3)	Joint Venturing with Industry

14.14 Field Study

For details about the available Field Study Semesters, see *Programs, Courses and University Regulations > Faculties & Schools > Field Studies* .

14.14.1 Field Studies - Minor Field Studies (18 credits)

Students participating in any one of the field study semesters, i.e., the Africa Field Study Semester, the Barbados Field Study Semester, the Barbados Interdisciplinary Tropical Studies (BITS) Field Study Semester, or the Panama Field Study Semester may complete the 18-credit Minor in Field Studies.

The Minor consists of the 15 credits of a field study semester plus three additional complementary credits chosen by the student in consultation with their departmental adviser and/or the Field Study Minor adviser.

For students in the B.Sc. Liberal Program, the Field Studies Minor can serve as the breadth component.

Program descriptions for each of the field study semesters are provided below.

Note: The field study semesters are not degree programs. Credits may be counted toward McGill degrees with the permission of program advisers. Students who complete a field study semester may consult the Field Study Minor adviser about completing the Minor program as part of their McGill degree.

Africa Field Study Semester (15 credits)

The Africa Field Study Semester (AFSS) is run through McGill's Canadian Field Study in Africa Program (CFSIA).

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
NRSC 451	(3)	Research in Ecology and Development In Africa

Africa Field Study Semester - Complementary Courses

9 credits from:

* Note: Courses marked with an asterisk ("*") are offered on a rotational basis, at least 3 credits annually.

ANTH 411	(3)	Primate Studies & Conservation
ANTH 416	(3)	Environment/Development: Africa
BIOL 428	(3)	Biological Diversity in Africa
BIOL 429	(3)	East African Ecology
GEOG 404*	(3)	Environmental Management 2
GEOG 408	(3)	Geography of Development
GEOG 423	(3)	Dilemmas of Development

HIST 413	(3)	Independent Research
NRSC 405	(3)	Natural History of East Africa
NUTR 403*	(3)	Nutrition in Society
REDM 405	(3)	Natural History of East Africa
WILD 420*	(3)	Ornithology

Barbados Field Study Semester (15 credits)

The Barbados Field Study Semester (BFSS) provides one term of integrated field study for students with an interest in global issues related to natural resource use as affected by socio-economic, management, urban, and physical constraints. Offered at the Bellairs Research Institute in Barbados, this program challenges students to be more effective environmental decision makers, policy makers, and managers. There is a growing need for professionals with such skills at all levels of government, within NGOs, and in the private sector. The overall goal of the BFSS is to equip future leaders to address the complexity of issues associated with the formulation and implementation of organizational strategies compatible with the societal goal of sustainable use and development of our natural resources.

The BFSS is intended for senior undergraduate students from across the University. Students must apply to participate in the program. Selection will be based on the student's Academic Standing and demonstrated interests and involvement in international issues related to natural resource use.

Barbados Field Study Semester - Required Courses

6 credits

URBP 507	(3)	Planning and Infrastructure
URBP 520	(3)	Globalization: Planning and Change

Barbados Field Study Semester - Complementary Courses

9 credits

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. The focus is on sustainable agri-food, nutrition, and energy production on a tropical island with a tourist-based economy. It is offered annually (in the Summer). It consists of two 2-hour orientation sessions conducted on the Macdonald campus and at the Bellairs Research Institute in Barbados, followed by three 3-credit and one 6-credit project courses at Bellairs Research Institute. This program integrates intensive course work with group project work and contributes to the formation of professionals with planning, managing, decision-making, and communication skills. The program addresses a global need for experienced professionals capable of interacting with various levels of government, non-governmental organizations, and the private sector. BITS welcomes applications from senior undergraduate students from across the University.

Barbados Interdisciplinary Tropical Studies Field Semester - Required Courses

15 credits

AEBI 421	(3)	Tropical Horticultural Ecology
AEBI 423	(3)	Sustainable Land Use
AEBI 425	(3)	Tropical Energy and Food
AEBI 427	(6)	Barbados Interdisciplinary Project

Panama Field Study Semester (15 credits)

This program is offered in Panama with the support of the Smithsonian Tropical Research Institute (STRI).

Hands-on experience is gained through research projects organized around multidisciplinary environmental issues. The nature of these projects will centre on practical environmental problems/questions important for Panama. Students will form teams that will work with Panamanian institutions (NGO, governmental, or research).

There is a one- or two-day period of transition and 13 weeks of course attendance in Panama. Field trips will be integrated into each of the courses offered.

Panama Field Study Semester - Required Courses

9 credits

BIOL 553	(3)	Neotropical Environments
ENVR 451	(6)	Research in Panama

Panama Field Study Semester - Complementary Courses

6 credits

Complementary courses change from year to year. Students will register for the 6 credits offered the Winter of their participation in the field study semester.

Winter 2014 complementary courses:

AGRI 550	(3)	Sustained Tropical Agriculture
GEOG 498	(3)	Humans in Tropical Environments

Winter 2015 complementary courses:

GEOG 404	(3)	Environmental Management 2
HIST 510	(3)	Environmental History of Latin America (Field)

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.

14.15 General Science**14.15.1 Location**

Interdisciplinary Programs Adviser
Wendy Brett, Adviser
Telephone: 514-398-7330
Email: wendy.brett@mcgill.ca

14.15.2 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 14.15.3: Bachelor of Science \(B.Sc.\) - Minor General Science \(18 credits\)](#) for more information.

14.15.3 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 level or above and at least 6 credits outside the student's core science component subject.

* Note: All Undergraduate research project courses with the 396 or 397 course number cannot be used toward the Minor General Science.

14.16 Geography (GEOG)

14.16.1 Location

Burnside Hall, Room 705
805 Sherbrooke Street West
Montreal, Quebec H3A 0B9

Telephone: 514-398-4951 or 514-398-4111

Fax: 514-398-7437

Website: www.mcgill.ca/geography

14.16.2 About Geography

The Department of Geography offers programs in both Arts and Science. All B.A. programs in Geography (including Urban Systems) can be found under *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Arts > Undergraduate > Academic Programs > : Geography (GEOG)*.

Geography is a broad, holistic discipline; both a natural and a social science because it examines people and their environment and serves as a bridge between physical and cultural processes. Human Geography (a social science, thus B.A. programs) is concerned especially with the political, economic, social, and cultural processes and resource practices that create spatial patterns and define particular places. Physical Geography (B.Sc. programs) integrates disciplines such as climatology, geomorphology, geology, biology, hydrology, ecology, soil science, and even marine science. Whether considering greenhouse gas emissions, the spread of disease, or threats to biodiversity, in all cases geographers are interested in where things happen, why, and with what consequences.

Our graduates go on to careers in environmental consulting, social agencies, or non-governmental organizations. Skills in Geographic Information Science (GIS) are very marketable. Students are well prepared for graduate work in social sciences, urban planning, and environmental studies at leading schools.

14.16.3 Prerequisites

There are no departmental prerequisites for entrance to the B.Sc. Geography programs. Students who have completed college or pre-university geography courses fully equivalent to those in the first year of university may, with an adviser's approval, substitute other courses as part of their program.

A Science Major Concentration in Geography – Physical Geography option is available to students pursuing the B.A. & Sc. degree. This Major concentration is described in *Programs, Courses and University Regulations > Faculties & Schools > Bachelor of Arts and Science > Undergraduate > Academic Programs > : Geography (GEOG)*.

14.16.4 Geography (GEOG) Faculty

Chair

T.R. Moore

Emeritus Professors

W. Armstrong

S.H. Olson

Professors

P.G. Brown; B.A.(Haver.), M.A., Ph.D.(Col.) (*joint appt. with McGill School of Environment and Natural Resource Sciences*)

O.T. Coomes; B.Sc.(Vic., BC), M.A.(Tor.), Ph.D.(Wisc.)

Professors

T.R. Moore; B.Sc.(Swansea), Ph.D.(Aberd.)
 W.H. Pollard; B.A., M.Sc.(Guelph), Ph.D.(Ott.)
 N.T. Roulet; B.Sc., M.Sc.(Trent), Ph.D.(McM.) (*James McGill Professor*)
 G.W. Wenzel; M.A.(Manit.), Ph.D.(McG.)

Associate Professors

S. Breau; B.A.(Moncton), M.A.(Laval), Ph.D.(Calif.-LA)
 G.L. Chmura; B.S.(Mass.), M.S.(Rhode Is.), Ph.D.(L.S.U.)
 B. Forest; A.B.(Chic.), M.A., Ph.D.(Calif.-LA)
 M.F. Lapointe; B.Sc., M.Sc.(McG.), Ph.D.(Br. Col.)
 B. Lehner; Dip. Hydrol.(Freiburg), Ph.D.(Frankfurt)
 T.C. Meredith; B.E.S.(Wat.), M.Sc., Dip.Cons.(Lond.), Ph.D.(Camb.)
 N. Ramankutty; B.E.(P.S.G. Coll. of Tech.), M.S.(Ill.), Ph.D.(Wisc.)
 N.A. Ross; B.A., M.A.(Qu.), Ph.D.(McM.)
 R. Sengupta; B.Sc.(Bombay), M.Sc.(IIT, Mumbai), M.S., Ph.D.(S. Ill.-Carbondale) (*joint appt. with McGill School of Environment*)
 R.E. Sieber; B.Sc.(Mich. St.), 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*)
 S. Turner; B.Soc.Sci., M.Soc.Sc.(Waikato), Ph.D.(Hull)
 J. Unruh; B.A.(Kansas), M.S.(Wisc.), Ph.D.(Ariz.)

Assistant Professors

L. Berrang Ford; B.Sc.(Guelph), M.Sc.(Oxf.), Ph.D.(Guelph)
 J. Ford; B.A., M.Sc.(Oxf.), Ph.D.(Guelph)
 M. Kalácska; B.Sc., M.Sc., Ph.D.(Alta.)
 N. Oswin; B.A. Hons.(Tor.), M.A.(Dal.), Ph.D.(Br. Col.)
 J. Rhemtulla; B.Sc.(McG.), M.Sc.(Alta.), Ph.D.(Wisc. Madison) (*joint appt. with McGill School of Environment*)

14.16.5 Bachelor of Science (B.Sc.) - Minor Geography (18 credits)

The Minor Geography is expandable into the B.Sc. Major Geography.

The Minor Geography is designed to provide students in the Faculty of Science with an overview of basic elements of geography at the introductory and advanced level.

This Minor permits no overlap with any other programs.

Required Courses (12 credits)

GEOG 203	(3)	Environmental Systems
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World
GEOG 302	(3)	Environmental Management 1

Complementary Courses (6 credits)

6 credits of Geography courses at the 300 and 400 level.

14.16.6 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 (12 credits)

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 306	(3)	Raster Geo-Information Science
GEOG 307	(3)	Socioeconomic Applications of GIS
GEOG 308	(3)	Principles of Remote Sensing

Complementary Courses (6 credits)

3 credits selected from:

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 202	(3)	Foundations of Programming
COMP 208	(3)	Computers in Engineering
COMP 250	(3)	Introduction to Computer Science
ESYS 300	(3)	Investigating the Earth System
GEOG 506*	(3)	Advanced Geographic Information Science
GEOG 535*	(3)	Remote Sensing and Interpretation

* GEOG 506 or GEOG 535 may be taken in either list of complementary courses, but credits from one group may not be double-counted in the other.

14.16.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Geography (49 credits)**Required Courses (22 credits)**

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 203	(3)	Environmental Systems
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World
GEOG 272	(3)	Earth's Changing Surface
GEOG 290	(1)	Local Geographical Excursion
GEOG 302	(3)	Environmental Management 1
GEOG 351	(3)	Quantitative Methods

Complementary Courses (27 credits)

One course (3 credits) from the following statistics* courses.

* 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

One course (3 credits) from the following GIS/Remote Sensing courses:

GEOG 306	(3)	Raster Geo-Information Science
GEOG 307	(3)	Socioeconomic Applications of GIS
GEOG 308	(3)	Principles of Remote Sensing

Four courses (12 credits) from the following:

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

One course (3 credits) from the following 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

Two additional courses (6 credits) from the list of approved Geography courses below, including at least one at the 400 level or above.

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 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

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

The Major is designed to provide a coverage of the main elements of physical geography.

Required Courses (22 credits)

GEOG 201	(3)	Introductory Geo-Information Science
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GEOG 203	(3)	Environmental Systems
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World
GEOG 272	(3)	Earth's Changing Surface
GEOG 290	(1)	Local Geographical Excursion
GEOG 302	(3)	Environmental Management 1
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

3 credits of GIS techniques:

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

12 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:

(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

15 credits from approved courses in Geography, or elsewhere in the Faculty of Science, or in the Faculty of Engineering; at least 9 credits of which are to be taken outside Geography. Students may also include any courses that are not already counted towards the GIS techniques or the systematic physical geography requirements. Admission to 500-level courses in Geography requires the instructor's permission. It is not advisable to take more than one 500-level course in a term.

Advising Note: See the Geography website for the list of approved courses in the Faculty of Science. Some courses require the permission of the Department and from the Associate Dean of Science, Student Affairs.

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 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

14.16.9 Bachelor of Science (B.Sc.) - Honours Geography (66 credits)

The Honours program is designed to provide specialized systematic training in physical geography. In addition to the Faculty requirement that Honours students maintain a minimum CGPA of at least 3.00, students who enter a Geography Honours program on or after September 2006 must have a program GPA of 3.30.

Honours students are encouraged to participate in 500-level seminars with graduate students, but it is not advisable to take more than one per term.

Required Courses (24 credits)

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 203	(3)	Environmental Systems
GEOG 272	(3)	Earth's Changing Surface
GEOG 302	(3)	Environmental Management 1
GEOG 351	(3)	Quantitative Methods
GEOG 381	(3)	Geographic Thought and Practice
GEOG 491D1	(3)	Honours Research
GEOG 491D2	(3)	Honours Research

Complementary Courses (42 credits)

6 credits of introductory courses, two of:

GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World

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

3 credits of GIS techniques:

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

12 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
GEOG 496	(3)	Geographical Excursion
GEOG 499	(3)	Subarctic Field Studies

15 credits from approved courses in Geography, or elsewhere in the Faculty of Science or the Faculty of Engineering; at least 9 credits of which are to be taken outside Geography. Students may also include any courses that are not already counted towards the GIS techniques or the systematic physical geography requirements. Admission to 500-level courses in Geography requires the instructor's permission. It is not advisable to take more than one per term.

Advising Note: See the Geography website for the list of approved courses in the Faculty of Science. Some courses require the permission of the Department and from the Associate Dean of Science, Student Affairs.

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 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

14.16.10 Geography (GEOG) Related Programs and Study Semesters

14.16.10.1 African Field Study Semester

The Department of Geography, Faculty of Science, coordinates the 15-credit interdisciplinary African Field Study Semester; see www.mcgill.ca/africa.

14.16.10.2 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 www.mcgill.ca/pfss.

14.16.10.3 Earth System Science Interdepartmental Major

For more information, see [section 14.11: Earth System Science \(ESYS\)](#).

BIOL 200	(3)	Molecular Biology
BIOL 201*	(3)	Cell Biology and Metabolism
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
MIMM 211**	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHGY 209**	(3)	Mammalian Physiology 1

U2 Required Courses

13 credits from the following:

ANAT 261	(4)	Introduction to Dynamic Histology
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
MIMM 314	(3)	Intermediate Immunology

U3 Required Courses

15 credits from the following:

MIMM 414	(3)	Advanced Immunology
PHGY 419D1	(4.5)	Immunology Research Project
PHGY 419D2	(4.5)	Immunology Research Project
PHGY 513	(3)	Cellular Immunology

Complementary Courses (27 credits)**U1 Complementary Courses**

6 credits chosen for U1 complementary courses in the following manner.

3 credits selected from:

BIOL 373	(3)	Biometry
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

plus 3 credits selected from the following:

* Students take CHEM 287 and CHEM 297.

** Students take either PHYG 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
BIOL 205	(3)	Biology of Organisms
BIOL 304	(3)	Evolution
CHEM 203***	(3)	Survey of Physical Chemistry
CHEM 204***	(3)	Physical Chemistry/Biological Sciences 1
CHEM 287*	(2)	Introductory Analytical Chemistry

CHEM 297*	(1)	Introductory Analytical Chemistry Laboratory
COMP 202	(3)	Foundations of Programming
COMP 250	(3)	Introduction to Computer Science
MATH 204	(3)	Principles of Statistics 2
MIMM 211**	(3)	Introductory Microbiology
MIMM 212	(2)	Laboratory in Microbiology
PHGY 209**	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

U2 Complementary Courses

12 credits chosen as follows:

6 credits selected from:

Students may select

* BIOC 300D1 and BIOC 300D2 or

** MIMM 386D1 and MIMM 386D2 or

*** PHGY 212 and PHGY 213 and BIOL 301

BIOC 300D1*	(3)	Laboratory in Biochemistry
BIOC 300D2*	(3)	Laboratory in Biochemistry
BIOL 301***	(4)	Cell and Molecular Laboratory
MIMM 386D1**	(3)	Laboratory in Microbiology and Immunology
MIMM 386D2**	(3)	Laboratory in Microbiology and Immunology
PHGY 212***	(1)	Introductory Physiology Laboratory 1
PHGY 213***	(1)	Introductory Physiology Laboratory 2

plus 6 credits, selected from:

* Students take either BIOL 309 or MATH 315, but not both.

ANAT 365	(3)	Cellular Trafficking
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309*	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
CHEM 302	(3)	Introductory Organic Chemistry 3
MATH 222	(3)	Calculus 3
MATH 315*	(3)	Ordinary Differential Equations
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 & 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 Chemistry
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
MIMM 413	(3)	Parasitology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHGY 531	(3)	Topics in Applied Immunology
PHGY 552	(3)	Cellular and Molecular Physiology

14.18 Interdisciplinary Life Sciences

14.18.1 Location

Interdisciplinary Programs Adviser
 Wendy Brett, Adviser
 Telephone: 514-398-7330
 Email: wendy.brett@mcgill.ca

14.18.2 About the Interdisciplinary Life Sciences Minor

The Interdisciplinary Life Sciences Minor allows students to obtain exposure to Life Sciences and life science related areas. Students must consult with the Adviser to review course selection.



Please note: Students studying in Anatomy and Cell Biology; Biochemistry; Microbiology and Immunology; and Physiology are not permitted to complete this Minor.

14.18.3 Bachelor of Science (B.Sc.) - Minor Interdisciplinary Life Sciences (24 credits)

The Interdisciplinary Life Sciences Minor will allow students from the earth, physical, math, and computational science areas to broaden their studies with some basic life sciences, health social science, and empirical technological science. The Minor is 24 credits and allows students flexibility in their course selections. Students must take 9 credits from an extensive list of basic life science courses, 3 credits from an extensive list of health and social science courses, and 3 credits from an empirical and technological science list. The remaining 9 credits may be taken from courses listed in any of the three categories.

This Minor is not open to students taking a major, honours, or core science component in the following units: Anatomy and Cell Biology, Biochemistry, Microbiology and Immunology, and Physiology.

Interested students should contact the Interdisciplinary Programs Adviser.

Complementary Courses (24 credits)

The 24 credits required for this program must satisfy the following criteria:

At least 18 credits must be new credits that are not used to satisfy any other program.

At least 18 credits must be outside the student's main discipline.

Depth requirement:

at least 6 credits must be at the 300 level or above.

Breadth requirement:

at least 9 credits must be taken from the Basic Life Sciences List,

at least 3 credits from the Health Social Sciences List,

at least 3 credits from the Empirical Science and Technology List.

The remaining 9 credits may be selected from any of the lists.

Basic Life Sciences

At least 9 credits from:

* Students take either ANAT 212 or BIOC 212, but not both.

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 321	(3)	Circuitry of the Human Brain
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Basis of Embryology
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 311	(3)	Metabolic Biochemistry
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 Oncogenes
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 Design and Development 1
CHEM 504	(3)	Drug Design and Development 2
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)	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 & 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
HIST 350	(3)	Science and the Enlightenment
HIST 381	(3)	Colonial Africa
HIST 396	(3)	Disease in Africa Since 1960
HIST 424	(3)	Gender, Sexuality & Medicine
HIST 447	(3)	The Natural History of America
HSEL 308	(3)	Issues in Women's Health
HSEL 309	(3)	Women's Reproductive Health
PHIL 237	(3)	Contemporary Moral Issues
PHIL 343	(3)	Biomedical Ethics
POLI 417	(3)	Health Care in Canada
PSYC 215	(3)	Social Psychology
PSYC 304	(3)	Child Development
PSYC 333	(3)	Personality and Social Psychology
PSYC 412	(3)	Developmental Psychopathology
PSYC 413	(3)	Cognitive Development
PSYC 414	(3)	Social Development
SOCI 225	(3)	Medicine and Health in Modern Society
SOCI 309	(3)	Health and Illness
SOCI 310	(3)	Sociology of Mental Disorder
SOCI 338	(3)	Introduction to Biomedical Knowledge
SOCI 365	(3)	Health and Development
SOCI 390	(3)	Gender and Health
SOCI 515	(3)	Medicine and Society
SOCI 525	(3)	Health Care Systems in Comparative Perspective
SOCI 538	(3)	Selected Topics in Sociology of Biomedical Knowledge

Empirical Science and Technology

At least 3 credits from:

* Students who have already received credit for MATH 324 will NOT receive credit for GEOG 202, MATH 203, PSYC 204, BIOL 373, MATH 204, or PSYC 305.

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

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 202	(3)	Foundations of Programming
COMP 364	(3)	Computer Tools for Life Sciences
COMP 462	(3)	Computational Biology Methods
GEOG 202	(3)	Statistics and Spatial Analysis
MATH 203	(3)	Principles of Statistics 1
MATH 204	(3)	Principles of Statistics 2

MATH 323	(3)	Probability
MATH 324*	(3)	Statistics
PSYC 204	(3)	Introduction to Psychological Statistics
PSYC 305	(3)	Statistics for Experimental Design

14.19 Kinesiology for Science Students

14.19.1 Location

Department of Kinesiology and Physical Education
Currie Gymnasium
475 Pine Avenue West
Montreal, Quebec H2W 1S4

Telephone: 514-398-4184

Fax: 514-398-4186

Email: kin.physed@mcgill.ca

Website: www.mcgill.ca/edu-kpe

14.19.2 About Kinesiology for Science Students

Students planning a career in the health sciences, whether as a health professional or a biomedical researcher, will find courses in Kinesiology to be of interest from both theoretical and applied perspectives. There is a focus on the benefits of physical activity for health and well-being, as well as appropriate prescription of exercise in the treatment of various diseases, injuries, and disabilities. Courses deal with both prevention and rehabilitation.

14.19.3 Bachelor of Science (B.Sc.) - Minor Kinesiology (24 credits)

The Minor Kinesiology is designed to provide students in B.Sc. programs with basic but comprehensive knowledge of scientific bases of human physical activity and its relationship with health and well-being.

Students registered in the Minor Kinesiology may not take additional courses outside the Faculties of Arts and of Science.

Required Courses (15 credits)

EDKP 206	(3)	Biomechanics of Human Movement
EDKP 261	(3)	Motor Development
EDKP 395	(3)	Exercise Physiology
PHGY 209	(3)	Mammalian Physiology 1
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

14.20 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 *Programs, Courses and University Regulations > Faculties & Schools > Desautels Faculty of Management* for detailed information about program requirements and applying.

Also available to Science students is the Minor in Technological Entrepreneurship for Science students; see [section 14.35: Technological Entrepreneurship for Science Students](#). (Please note that this Minor is currently under revision.)

14.20.1 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)	Finance 2
FINE 441	(3)	Investment Management
MGCR 341*	(3)	Finance 1

Complementary Courses (9 credits)

9 credits selected from:

FINE 442	(3)	Capital Markets and Institutions
FINE 443	(3)	Applied Corporate Finance
FINE 445	(3)	Real Estate Finance
FINE 448	(3)	Financial Derivatives
FINE 449	(3)	Market Risk Models
FINE 451	(3)	Fixed Income Analysis
FINE 480	(3)	Global Investments
FINE 482	(3)	International Finance 1
FINE 492	(3)	International Finance 2
FINE 541N1	(1.5)	Applied Investments
FINE 541N2	(1.5)	Applied Investments
FINE 547	(3)	Advanced Finance Seminar

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.

14.20.2 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)	Finance 1

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)	Marketing Management 1
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.

14.20.3 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)	Marketing Management 1
MRKT 354	(3)	Marketing Management 2
MRKT 451	(3)	Marketing Research

Complementary Courses (9 credits)

3 credits selected from:

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 Management
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 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.

14.20.4 Minor Operations Management (For Non-Management Students) (18 credits)

Mentors: Please consult the Bachelor of Commerce website at: <http://www.mcgill.ca/desautels/programs/bcom/academics/courseinfo>

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

It provides non-Management students with the opportunity to pursue a career that involves decision making at the operational level. Graduates will be able to find employment in consulting, manufacturing, supply chain, distribution, retail operations, healthcare management and environmental management for profit and non-profit corporations. This Minor has been designed to provide students with an understanding of the key concepts in operations management theory and practice.

Required Courses (6 credits)

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

Complementary Courses (12 credits)

3 credits selected from:

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 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.

14.21 Mathematics and Statistics (MATH)

14.21.1 Location

Burnside Hall, Room 1005
805 Sherbrooke Street West
Montreal, Quebec H3A 0B9

Telephone: 514-398-3800

Fax: 514-398-3899

Website: www.math.mcgill.ca

14.21.2 About Mathematics and Statistics

Mathematics has evolved to a discipline that is mainly characterized by its method of proof, its concern for a progressive broadening of its concepts, and by the search for mathematical entities and operations that represent aspects of reality. It is a subject that is pursued by many for its own sake, and regarded as part of the mainstream of human culture. Mathematics pervades modern society with an impact which, already immense, is rapidly growing.

The two principal divisions of mathematics are pure mathematics and applied mathematics. The pure mathematician is interested in abstract mathematical structures and in mathematics as an intellectual enterprise. The primary concern may not be with its utilitarian aspects or with the current needs of science and technology, although many problems in pure mathematics have developed from the sciences.

The applied mathematician is more interested in how mathematics can be used to study some aspects of the world. Mathematicians are engaged in the creation, study, and application of advanced mathematical methods relevant to scientific problems. Statistical science and methodology today is concerned with phenomena in which there is a background of uncertainty arising from inherent variability and the investigator is obliged to arrive at decisions from limited data. A key tool in statistics is probability.

Some of the fields in which pure mathematicians work are algebra, analysis, geometry, topology, number theory, and foundations. Applied mathematics, which once referred to the application of mathematics to such disciplines as mechanics and fluid dynamics, has currently assumed a much broader meaning and embraces such diverse fields as communication theory, theory of optimization, theory of games, and numerical analysis.

Mathematics offers many vocational possibilities. Such fields as teaching, computing, applied statistics, and actuarial science offer opportunities for B.Sc. graduates. Opportunities to do original research in pure and applied mathematics are available in universities and research institutions. Employment is to be found in financially or technologically oriented business firms. The Department of Mathematics and Statistics through its various programs attempts to provide courses to suit the diverse interests within mathematics and statistics.

The Honours program demands of the student a talent for abstraction in addition to a high level of competence in the use of mathematical tools. This program is intended for students who plan to work in an area where mathematical innovations may be needed. It is almost essential for students contemplating a career in mathematical research.

The Major program involves the same subjects as the Honours program, but is less demanding in terms of abstraction. It is designed primarily for students who will need mathematical tools in their work but whose creative activity will involve applications of mathematics to other areas. Within the framework of the Mathematics Major, various combinations of courses are suggested to meet the needs of different students. These include course suggestions for secondary school teachers, careers in management, and for careers in industry, government, or actuarial sciences.

It is possible for Major students to include a number of Honours courses in their programs. This will be an advantage for those students who plan to use their mathematics in graduate studies.

Students interested in a Mathematics program linked to other disciplines are advised to consider the B.Sc. Liberal program with a core component in Mathematics or Statistics, or our joint programs with Computer Science, Physiology, and Physics.

In planning their programs, students are advised to seriously consider developing some depth in another discipline—preferably one for which mathematics has some relevance and use. Mathematics has been closely linked to areas such as computer science, physics, and engineering, but has recently come to play an increasingly important role in fields such as biology, linguistics, management, and psychology. Students should consider completing the requirements for minor programs such as those available in Cognitive Science, Computer Science, and Statistics.

Students considering programs in Mathematics and Statistics should contact the Department to arrange for academic advising.

The student's attention is called to the fact that a B.Com. degree with a Major in Mathematics is available from the Desautels Faculty of Management. In addition, the Schulich School of Music offers the B.Mus. degree with Honours in Theory with Mathematics option.

14.21.3 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 an academic program offered for a duration of 8, 12, or 16 months. It is reflected on the transcript and included in the program name (Bachelor of Science – Internship program). Eligible students usually take this program between their U2 and U3 years.
- 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/Fail course on your transcript.

For more information on these programs, consult [section 13.1: Industrial Practicum \(IP\) and Internship Year in Science \(IYS\)](#).



Note: Students entering a program listed below that has MATH 222 (Calculus 3) as a required course and who have successfully completed a course equivalent to MATH 222 with a grade of C or better may omit MATH 222 (Calculus 3) from the program, but must replace it with 3 credits of elective courses.

14.21.4 Mathematics and Statistics (MATH) Faculty

Chair

Jacques Hurtubise

Emeritus Professors

Michael Barr; A.B., Ph.D.(Penn.) (*Peter Redpath Emeritus Professor of Pure Mathematics*)

William G. Brown; M.A.(Col.), B.A., Ph.D.(Tor.)

Marta Bunge; M.A., Ph.D.(Penn.)

Ian Connell; B.Sc., M.Sc.(Manit.), Ph.D.(McG.)

Kohur GowriSankaran; B.A., M.A.(Madr.), Ph.D.(Bom.)

Paul Koosis; B.A., Ph.D.(Calif., Berk.)

Joachim Lambek; M.Sc., Ph.D.(McG.), F.R.S.C. (*Peter Redpath Emeritus Professor of Pure Mathematics*)

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

Sherwin A. Maslowe; B.Sc.(Wayne State), 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.)

V. 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.)

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

Professors

William J. Anderson; B.Eng., Ph.D.(McG.)

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

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

Stephen W. Drury; M.A., Ph.D.(Cant.)

Christian Genest; B.Sp.Sc.(UQAC), M.Sc.(UQAM), 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.) (*Canada Research Chair*)

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

Professors

Dmitry Jakobson; B.Sc.(MIT), Ph.D.(Princ.) (*William Dawson Scholar*)
 Vojkan Jaksic; B.S.(Belgrade), Ph.D.(Calif. Tech.)
 Niky Kamran; B.Sc., M.Sc.(Brussels), Ph.D.(Wat.), F.R.S.C. (*James McGill Professor*)
 Charles Roth; M.Sc.(McG.), Ph.D.(Hebrew)
 F. Bruce Shepherd; B.Sc.(Vic., Tor.), M.Sc., Ph.D.(Wat.) (*James McGill Professor*)
 David A. Stephens; B.Sc., Ph.D.(Nott.) (*James McGill Professor*)
 John A. Toth; B.Sc., M.Sc.(McM.), Ph.D.(MIT)
 Daniel T. Wise; B.A.(Yeshiva), Ph.D.(Princ.)
 David Wolfson; M.Sc.(Natal), Ph.D.(Purd.)
 JianJu Xu; B.Sc., M.Sc.(Beijing), M.Sc., Ph.D.(Renss.)

Associate Professors

Masoud Asgharian; B.Sc.(Shahid Beheshti), M.Sc., Ph.D.(McG.)
 Peter Bartello; B.Sc.(Tor.), M.Sc., Ph.D.(McG.) (*joint appt. with Atmospheric and Oceanic Sciences*)
 Antony Humphries; B.A., M.A.(Camb.), Ph.D.(Bath)
 Wilbur Jonsson; M.Sc.(Manit.), Dr.Rer.Nat.(Tübingen)
 Ivo Klemes; B.Sc.(Tor.), Ph.D.(Calif. Tech.)
 James G. Loveys; B.A.(St. Mary's), M.Sc., Ph.D.(S. Fraser)
 Johanna Neslehova; Vor.Dip.(Prague), Dip.(Hamburg), Ph.D.(Oldenburg)
 Adam Oberman; B.S.(Tor.), M.S., Ph.D.(Chic.)
 Neville G.F. Sancho; B.Sc., Ph.D.(Belf.)
 Robert Seiringer; M.Sc., Ph.D.(Vienna) (*William Dawson Scholar*)
 Russell Steele; B.S., M.S.(Carn. Mell), Ph.D.(Wash.)
 Adrian Vetta; B.Sc., M.Sc.(LSE), Ph.D.(MIT) (*joint appt. with Computer Science*)

Assistant Professors

Louigi Addario-Berry; B.Sc., M.Sc., Ph.D.(McG.)
 Abbas Khalili; B.S., M.S.(Esfahan), Ph.D.(Wat.)
 Jean-Christophe Nave; M.Sc., Ph.D.(Calif., Santa Barbara)
 Sergey Norin; M.S.(St.-Petersburg), Ph.D.(Georgia Tech.)
 Mikael Pichot; B.Sc.(Lyon), M.S., Ph.D.(École Normale-Lyon)
 Gantumur Tsogtgerel; B.Sc.(Mongolia), M.Sc.(Netherlands), Ph.D.(Utrecht)
 Johannes Walcher; Dip., Ph.D.(ETH) (*joint appt. with Physics*) (*Canada Research Chair*)

Associate Members

Xiao-Wen Chang (*Computer Science*)
 Luc P. Devroye (*Computer Science*)
 P.R.L. Dutilleul (*Plant Science*)
 Eliot Fried (*Mechanical Engineering*)
 Leon Glass (*Physiology*)
 George Haller (*Mechanical Engineering*)
 James A. Hanley (*Epidemiology & Biostatistics*)
 Hamed Hatami (*Computer Science*)
 Lawrence Joseph (*Epidemiology & Biostatistics*)

Associate Members

Anmar Khadra (*Physiology*)
 Michael Mackey (*Physiology*)
 Erica E.M. Moodie (*Epidemiology & Biostatistics*)
 Lawrence A. Mysak (*Atmospheric & Oceanic Sciences*)
 Christopher Conway Paige (*Computer Science*)
 Prakash Panangaden (*Computer Science*)
 Robert W. Platt (*Pediatrics*)
 James O. Ramsay (*Psychology*)
 George Alexander Whitmore (*Management*)
 Christina Wolfson (*Epidemiology & Biostatistics*)

Adjunct Professors

Vasek Chvatal; M.A.(Charles U., Prague), Ph.D.(Wat.)
 Martin J. Gander; M.S.(ETH), M.S., Ph.D.(Stan.)
 Andrew Granville; B.A., CASM(Camb.), Ph.D.(Qu.)
 Adrian Iovita; B.S.(Bucharest), Ph.D.(Boston)
 Olga Kharlampovich; M.A.(Ural State), Ph.D.(Leningrad), Dr.Sc.(Steklov Institute)
 Ming Mei; B.Sc., M.Sc.(Jiangxi Normal Univ.), Ph.D.(Kanazawa)
 Alexei Miasnikov; M.Sc.(Novosibirsk), Ph.D., Dr.Sc.(Leningrad)
 M. Ram Murty; B.Sc.(Car.), Ph.D.(MIT), F.R.S.C.
 Vladimir Remeslennikov; M.Sc.(Perm, Russia), Ph.D.(Novosibirsk)
 Robert A. Seely; B.Sc.(McG.), Ph.D.(Cant.)
 Alain C. Vandal; B.Sc., M.Sc.(McG.), Ph.D.(Auck.)
 Thomas Wihler; M.S., Ph.D.(ETH)

Faculty Lecturers

Jose A. Correa; M.Sc.(Wat.), Ph.D.(Car.)
 Axel Hundemer; M.Sc., Ph.D.(Munich)
 Armel Djivede Kelome; M.Sc.(Benin), M.Sc.(McG.), Ph.D.(Georgia Tech.)

14.21.5 Bachelor of Science (B.Sc.) - Minor Mathematics (24 credits)

The Minor may be taken in conjunction with any primary program in the Faculty of Science (other than programs in Mathematics). Students should declare their intention to follow the Minor Mathematics at the beginning of the penultimate year and should obtain approval for the selection of courses to fulfil the requirements for the Minor from the Departmental Chief Adviser (or delegate).

It is strongly recommended that students in the Minor program take MATH 323. The remaining credits may be freely chosen from the required and complementary courses for majors and honours students in Mathematics, with the obvious exception of courses that involve duplication of material. Alternatively, up to 6 credits may be allowed for appropriate courses from other departments.

Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program. However, with an approved choice of substantial courses, the overlap restriction may be relaxed to 9 credits for students whose primary program requires 60 credits or more, and to 12 credits when the primary program requires 72 credits or more.

Required Courses (9 credits)

* MATH 223 may be replaced by MATH 235 and MATH 236. In this case, the complementary credit requirement is reduced by 3 credits.

MATH 222	(3)	Calculus 3
MATH 223*	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (15 credits)

15 credits selected from the required and complementary courses for majors and honours students in Mathematics, with MATH 323 strongly recommended; alternatively, up to 6 credits may be allowed for appropriate courses from other departments.

14.21.6 Bachelor of Science (B.Sc.) - Minor Statistics (24 credits)

The Minor may be taken in conjunction with any primary program in the Faculty of Science. Students should declare their intention to follow the Minor Statistics at the beginning of the penultimate year and must obtain approval for the selection of courses to fulfil the requirements for the Minor from the Departmental Chief Adviser (or delegate).

All courses counted towards the Minor must be passed with a grade of C or better. Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program. However, with an approved choice of substantial courses, the overlap restriction may be relaxed to 9 credits for students whose primary program requires 60 credits or more, and to 12 credits when the primary program requires 72 credits or more.

Required Courses (15 credits)

* MATH 223 may be replaced by MATH 235 and MATH 236. In this case the complementary credit requirement is reduced by 3 credits.

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 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
SOCI 505	(3)	Quantitative Methods 2

No more than 6 credits may be taken outside the Department of Mathematics and Statistics.

Further credits (if needed) may be freely chosen from the required and complementary courses for majors and honours students in Mathematics, with the obvious exception of courses that involve duplication of material.

14.21.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Mathematics (45 credits)**Program Prerequisites**

Students entering the Core Science Component in Mathematics 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
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MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2

Guidelines for Selection of Courses

The following informal guidelines should be discussed with the student's adviser. Where appropriate, Honours courses may be substituted for equivalent Major courses. Students planning to pursue graduate studies are encouraged to make such substitutions.

Students interested in computer science are advised to choose courses from the following: MATH 317, MATH 318, MATH 327, MATH 328, MATH 335, MATH 340, MATH 407, MATH 417 and to complete the Computer Science Minor.

Students interested in probability and statistics are advised to take MATH 204, MATH 324, MATH 407, MATH 423, MATH 447, MATH 523, MATH 525.

Students interested in applied mathematics should take MATH 317, MATH 319, MATH 324, MATH 326, MATH 327, MATH 407, MATH 417.

Students considering a career in secondary school teaching are advised to take MATH 318, MATH 328, MATH 338, MATH 339, MATH 346, MATH 348.

Students interested in careers in business, industry or government are advised to select courses from the following list:

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 elective 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 Structures 2

the remainder of the 18 credits to be selected from:

MATH 204	(3)	Principles of Statistics 2
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)	Topics in Geometry
MATH 352	(1)	Problem Seminar
MATH 407	(3)	Dynamic Programming
MATH 410	(3)	Majors Project
MATH 417	(3)	Mathematical Programming
MATH 423	(3)	Regression and Analysis of Variance
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

14.21.8 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Statistics (45 credits)

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

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 elective 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 314	(3)	Advanced Calculus
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MATH 423	(3)	Regression and Analysis of Variance

Complementary Courses (18 credits)

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

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

MATH 249*	(3)	Honours Complex Variables
MATH 315	(3)	Ordinary Differential Equations

MATH 316*	(3)	Complex Variables
MATH 317	(3)	Numerical Analysis
MATH 335	(3)	Computational Algebra
MATH 340	(3)	Discrete Structures 2
MATH 427	(3)	Statistical Quality Control

at least 7 credits selected from:

MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications

the remainder of the 18 credits to be selected from:

MATH 204	(3)	Principles of Statistics 2
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)	Topics in Geometry
MATH 352	(1)	Problem Seminar
MATH 407	(3)	Dynamic Programming
MATH 410	(3)	Majors Project
MATH 417	(3)	Mathematical Programming
MATH 430	(3)	Mathematical Finance

14.21.9 Bachelor of Science (B.Sc.) - Major Mathematics (54 credits)

Program Prerequisites

Students entering the Major program 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 54 credits of required courses.

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. Where appropriate, Honours courses may be substituted for equivalent Major courses. Students planning to pursue graduate studies are encouraged to make such substitutions.

Students interested in computer science are advised to choose courses from the following: MATH 317, MATH 318, MATH 327, MATH 328, MATH 335, MATH 340, MATH 407, MATH 417 and to complete the Computer Science Minor.

Students interested in probability and statistics are advised to take MATH 204, MATH 324, MATH 407, MATH 423, MATH 447, MATH 523, MATH 525.

Students interested in applied mathematics should take MATH 317, MATH 319, MATH 324, MATH 326, MATH 327, MATH 407, MATH 417.

Students considering a career in secondary school teaching are advised to take MATH 318, MATH 328, MATH 338, MATH 339, MATH 346, MATH 348.

Students interested in careers in business, industry or government are advised to select courses from the following list:

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)

Note: Students who have done well in MATH 235 and MATH 242 should consider entering the Honours stream by registering in MATH 251 and MATH 255 instead of MATH 236 and MATH 243.

* 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 elective 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 (27 credits)

27 credits selected as follows:

21 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 Structures 2
MATH 427	(3)	Statistical Quality Control

the remainder of the 21 credits to be selected from:

MATH 204	(3)	Principles of Statistics 2
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)	Topics in Geometry
MATH 352	(1)	Problem Seminar

MATH 407	(3)	Dynamic Programming
MATH 410	(3)	Majors Project
MATH 417	(3)	Mathematical Programming
MATH 423	(3)	Regression and Analysis of Variance
MATH 430	(3)	Mathematical Finance
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

6 additional credits in Mathematics or related disciplines selected in consultation with the Adviser.

14.21.10 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 Structures 2

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, COMP 396, COMP 400, COMP 431) and ECSE 508.

14.21.11 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.

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 330	(3)	Theory of Computation
COMP 350**	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design
MATH 222	(3)	Calculus 3
MATH 223***	(3)	Linear Algebra
MATH 235	(3)	Algebra 1
MATH 236***	(3)	Algebra 2
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 327	(3)	Matrix Numerical Analysis
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MATH 340*	(3)	Discrete Structures 2
MATH 350*	(3)	Graph Theory and Combinatorics
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 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis
MATH 578**	(4)	Numerical Analysis 1

9 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 564	(3)	Computational Gene Regulation
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 (except COMP 396, COMP 400, and COMP 431) and ECSE 508.

14.21.12 Bachelor of Science (B.Sc.) - Honours Applied Mathematics (60 credits)

Revision, June 2013. Start of revision.

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.

Required Courses (42 credits)

* COMP 250 may be preceded by COMP 202.

** Students select either MATH 251 or MATH 247, but not both.

COMP 250*	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
MATH 235	(3)	Algebra 1
MATH 242	(3)	Analysis 1
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced Calculus
MATH 251**	(3)	Honours Algebra 2

MATH 255	(3)	Honours Analysis 2
MATH 325	(3)	Honours Ordinary Differential Equations
MATH 350	(3)	Graph Theory and Combinatorics
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 375	(3)	Honours Partial Differential Equations
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 470	(3)	Honours Research Project

Complementary Courses (18 credits)

Advising Notes:

Students interested in continuous applied mathematics are urged to choose these as part of their Complementary Courses: MATH 354 and MATH 355, and are advised to choose additional courses from MATH 387, MATH 397, MATH 555, MATH 560, MATH 574, MATH 578, MATH 579, MATH 580, MATH 581.

Students interested in discrete applied mathematics are advised to choose from these as part of their Complementary Courses: COMP 362, COMP 490, MATH 370, MATH 371, MATH 407, MATH 547, MATH 487, MATH 550, MATH 552, MATH 560.

3 credits selected from:

MATH 249	(3)	Honours Complex Variables
MATH 366	(3)	Honours Complex Analysis

at least 3 credits selected from:

MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis

and the remainder of credits selected from:

COMP 362	(3)	Honours Algorithm Design
MATH 352	(1)	Problem Seminar
MATH 354	(3)	Honours Analysis 3
MATH 355	(3)	Honours Analysis 4
MATH 370	(3)	Honours Algebra 3
MATH 371	(3)	Honours Algebra 4
MATH 377	(3)	Honours Number Theory
MATH 380	(3)	Honours Differential Geometry
MATH 480	(3)	Honours Independent Study
MATH 487	(3)	Honours Mathematical Programming
MATH 488	(3)	Honours Set Theory
MATH 490	(3)	Honours Mathematics of Finance

All MATH 500-level courses.

No more than 6 credits from the following courses for which no Honours equivalent exists:

MATH 204	(3)	Principles of Statistics 2
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MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 348	(3)	Topics in Geometry
MATH 407	(3)	Dynamic Programming

Other courses with the permission of the Department.

Revision, June 2013. End of revision.

14.21.13 Bachelor of Science (B.Sc.) - Honours Mathematics (60 credits)

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. In addition, a student who has not completed the equivalent of MATH 222 must take it in the first term without receiving credits toward the credits required in the Honours program.

Students who transfer to Honours in Mathematics from other programs will have credits for previous courses assigned, as appropriate, by the Department.

To remain in an Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GPA in the required and complementary Mathematics courses of the program, as well as an overall CGPA of 3.00.

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

Required Courses (48 credits)

* MATH 314 may be substituted for MATH 248 if MATH 222 had to be taken in the Fall.

MATH 235	(3)	Algebra 1
MATH 242	(3)	Analysis 1
MATH 248*	(3)	Honours Advanced Calculus
MATH 251	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 325	(3)	Honours Ordinary Differential Equations
MATH 354	(3)	Honours Analysis 3
MATH 355	(3)	Honours Analysis 4
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 366	(3)	Honours Complex Analysis
MATH 370	(3)	Honours Algebra 3
MATH 371	(3)	Honours Algebra 4
MATH 375	(3)	Honours Partial Differential Equations
MATH 380	(3)	Honours Differential Geometry
MATH 470	(3)	Honours Research Project

Complementary Courses (12 credits)

12 credits selected from:

MATH 350	(3)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar

MATH 376	(3)	Honours Nonlinear Dynamics
MATH 377	(3)	Honours Number Theory
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis
MATH 480	(3)	Honours Independent Study
MATH 487	(3)	Honours Mathematical Programming
MATH 488	(3)	Honours Set Theory

all MATH 500-level courses.

Honours-level courses from related disciplines:

* COMP 250 may be preceded by COMP 202.

COMP 250*	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures

no more than 6 credits from the following courses for which no Honours equivalent exists:

MATH 204	(3)	Principles of Statistics 2
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 348	(3)	Topics in Geometry
MATH 407	(3)	Dynamic Programming

Students may select other courses with the permission of the Department.

14.21.14 Bachelor of Science (B.Sc.) - Joint Honours Mathematics and Computer Science (75 credits)

Students may complete this program with a minimum of 72 credits or a maximum of 75 credits depending on whether or not they are exempt from taking COMP 202.

Program Prerequisites

Students must consult an Honours adviser in both departments. Students entering the Joint Honours 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 72-75 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 (45 credits)

* Students who have sufficient knowledge in a programming language are not required 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 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 235	(3)	Algebra 1
MATH 242	(3)	Analysis 1
MATH 248	(3)	Honours Advanced Calculus
MATH 251	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 350	(3)	Graph Theory and Combinatorics

Complementary Courses (30 credits)

18 credits in Mathematics, at least 12 credits selected from:

* Students with appropriate background in probability may substitute MATH 587 for MATH 356 and must then also register for MATH 355.

MATH 354	(3)	Honours Analysis 3
MATH 355	(3)	Honours Analysis 4
MATH 356*	(3)	Honours Probability
MATH 370	(3)	Honours Algebra 3
MATH 371	(3)	Honours Algebra 4
MATH 387	(3)	Honours Numerical Analysis

The remaining credits should be selected from honours courses given by the Department of Mathematics and Statistics.

12 credits in Computer Science, selected from Computer Science courses at the 300 level or above excluding COMP 364, COMP 396 and COMP 431. ECSE 508 may also be taken.

14.21.15 Bachelor of Science (B.Sc.) - Honours Probability and Statistics (64 credits)

Required Courses (46 credits)

* COMP 250 may be preceded by COMP 202.

** Students select either MATH 251 or MATH 247, but not both.

COMP 250*	(3)	Introduction to Computer Science
MATH 235	(3)	Algebra 1
MATH 242	(3)	Analysis 1
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced Calculus
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 354	(3)	Honours Analysis 3
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 470	(3)	Honours Research Project
MATH 523	(4)	Generalized Linear Models
MATH 533	(4)	Honours Regression and Analysis of Variance
MATH 556	(4)	Mathematical Statistics 1

MATH 557 (4) Mathematical Statistics 2

Complementary Courses (18 credits)

At least 3 credits from:

MATH 355 (3) Honours Analysis 4
 MATH 587 (4) Advanced Probability Theory 1
 MATH 598 (4) Topics in Probability & Statistics

The remaining credits selected from:

MATH 325 (3) Honours Ordinary Differential Equations
 MATH 350 (3) Graph Theory and Combinatorics
 MATH 352 (1) Problem Seminar
 MATH 366 (3) Honours Complex Analysis
 MATH 375 (3) Honours Partial Differential Equations
 MATH 380 (3) Honours Differential Geometry
 MATH 387 (3) Honours Numerical Analysis
 MATH 397 (3) Honours Matrix Numerical Analysis
 MATH 480 (3) Honours Independent Study
 MATH 490 (3) Honours Mathematics of Finance
 MATH 524 (4) Nonparametric Statistics
 MATH 525 (4) Sampling Theory and Applications
 MATH 545 (4) Introduction to Time Series Analysis
 MATH 547 (4) Stochastic Processes
 MATH 550 (4) Combinatorics
 MATH 589 (4) Advanced Probability Theory 2

With at most 3 credits from the following courses for which no Honours equivalent exists:

MATH 204 (3) Principles of Statistics 2
 MATH 407 (3) Dynamic Programming
 MATH 427 (3) Statistical Quality Control

14.21.16 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 (49 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 242	(3)	Analysis 1
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced 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 (30 credits)

15 credits in Mathematics selected as follows:

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)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar
MATH 354	(3)	Honours Analysis 3
MATH 355	(3)	Honours Analysis 4
MATH 545	(4)	Introduction to Time Series Analysis

MATH 578** (4) Numerical Analysis 1

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 552	(4)	Combinatorial Optimization
COMP 564	(3)	Computational Gene Regulation
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 and COMP 431.

14.21.17 Mathematics and Statistics (MATH) Related Programs

14.21.17.1 Joint Major in Biology and Mathematics

For more information, see [section 14.5: Biology \(BIOL\)](#) > [section 14.5.10: Bachelor of Science \(B.Sc.\) - Major Biology and Mathematics \(76 credits\)](#).

14.21.17.2 Joint Major in Physiology and Mathematics

For more information, see [section 14.30: Physiology \(PHGY\)](#) > [section 14.30.6: Bachelor of Science \(B.Sc.\) - Major Physiology and Mathematics \(77 credits\)](#).

14.21.17.3 Joint Honours Program in Mathematics and Physics

For more information, see [section 14.29: Physics \(PHYS\)](#) > [section 14.29.13: Bachelor of Science \(B.Sc.\) - Honours Mathematics and Physics \(81 credits\)](#).

14.22 Microbiology and Immunology (MIMM)

14.22.1 Location

Lyman Duff Medical Sciences Building, Room 511
3775 University Street
Montreal, Quebec H3A 2B4

Telephone: 514-398-3915

Fax: 514-398-7052

Email: office.microimm@mcgill.ca

Website: www.mcgill.ca/microimm

14.22.2 About Microbiology and Immunology

Microbiology is the study of microorganisms such as bacteria, viruses, unicellular eukaryotes, and parasites. Microorganisms play an important role in human and animal disease, food production (bread, cheese, wine), decay and spoilage, contamination and purification of water and soil. Microbiologists study these tiny, self-replicating machines to understand the basic principles of life: growth, metabolism, cell division, control of gene expression, response to environmental stimuli. Microbiologists are also concerned with controlling or harnessing microorganisms for the benefit of people, by isolating antibiotics or producing vaccines to protect against disease, and by developing and perfecting microorganisms for industrial uses.

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, allergies, cancer, autoimmune diseases and immune-deficiency diseases such as AIDS. Antibodies may soon be used in conjunction with antibiotics or chemical agents as specific “magic bullets” to diagnose disease and attack microbes and cancers.

The disciplines of microbiology and immunology are natural partners in research, and both fields use the modern methods of cell biology, molecular biology, and genetics to study basic life processes. The members of the Department of Microbiology and Immunology perform research on microbial physiology and genetics, microbial pathogenesis, molecular virology, cellular and molecular immunology, and parasitology. Students registered in the Department therefore are exposed to these related areas and receive an excellent background in basic biology and chemistry as well as in the more applied areas of biotechnology and medicine.

Many opportunities exist for careers in basic or applied microbiology and immunology, medical microbiology, environmental microbiology, and biotechnology. They include positions in industry (pharmaceutical and biotechnology), hospitals, universities, and government (environment, public health, and energy). A degree in microbiology also provides an excellent basis for entering professional and postgraduate programs in medicine, dentistry, the veterinary sciences, research, and education.



Notes on admission to Microbiology and Immunology programs:

Please note that enrolment in Microbiology and Immunology programs is limited to a total of 120 students per year. Students seeking admission to the Liberal, Majors, and Honours programs must have completed BIOL 112, CHEM 110, CHEM 120, MATH 139 or MATH 140, MATH 141, PHYS 101, and PHYS 102 or their equivalent with an overall average of at least B+ (75%).

Students transferring from other programs may be admitted with a B+ average up to the maximum program capacity of 120 students. Applicants not admitted will be placed on a waiting list and will be considered should vacancies occur. Application deadline for U0 or transfer students from other departments and faculties is the third Monday in April. Students who want to transfer to Microbiology and Immunology should consider taking MIMM 211, or equivalent, as a complementary course.

An undergraduate handbook, containing detailed course descriptions, a listing of faculty research interests, and information on careers in microbiology and immunology, is available from the Student Affairs Office in Room 511 of the Lyman Duff Building and at www.mcgill.ca/microimm.

All students (U1, U2, U3) must attend an advising session. Please check www.mcgill.ca/microimm for dates.

14.22.3 Microbiology and Immunology (MIMM) Faculty

Chair

Dr. Joaquin Madrenas

Professors

James W. Coulton; B.Sc.(Tor.), M.Sc.(Calg.), Ph.D.(W. Ont.)

Albert Berghuis; M.Sc.(The Netherlands), Ph.D.(Br. Col.)

Matthias Götte; Ph.D.(Max Planck)

Joaquin Madrenas; M.Sc., Ph.D.(Alta.), M.D.(Barcelona)

Greg Matlashewski; B.Sc.(C'dia), Ph.D.(Ott.)

Robert A. Murgita; B.Sc.(Maine), M.S.(Vermont), Ph.D.(McG.)

Martin Olivier; B.Sc.(Montr.), Ph.D.(McG.)

Mark A. Wainberg; B.Sc.(McG.), M.Sc., Ph.D.(Col.)

Associate Professors

Dalius J. Briedis; B.A., M.D.(Johns Hop.)

Benoit Cousineau; B.Sc., M.Sc., Ph.D.(Montr.)

Sylvie Fournier; Ph.D.(Montr.)

Samantha Gruenheid; B.Sc.(Br. Col.), Ph.D.(McG.)

Hervé Le Moual; Ph.D.(Montr.)

Gregory T. Marczynski; B.Sc., Ph.D.(Ill.)

Ciriaco Piccirillo; B.Sc., Ph.D.(McG.)

Donald Sheppard; M.D.(Tor.)

Assistant Professors

Jorg Friz; Ph.D.(Vienna)

Irah King; B.Sc.(Ohio St.), M.Sc.(Pitt. St.), Ph.D.(Roch.)

Connie Krawczyk; B.Sc.(Guelph), Ph.D.(Tor.)

Associate Members

Biochemistry: Philip Gros, Michel Tremblay

Epidemiology and Infectious Diseases: Marcel Behr, Andre Dascal, Vivian Loo, Mark Miller, Michael Reed

Immunology, Autoimmunity, Host Defense: Jack Antel, Amit Bar-Or, Miguel Burnier, Nicholas V. Christou, Arnold Kristof, Marianna Newkirk, Joyce Rauch, Maya Saleh, Christos Tsoukas

Immunology and Parasitology: Paula Ribeiro, Petra Rohrbach, Brian Ward, Momar Ndao, Ji Zhang

Microbiology: Maziar Divangahi, Chen Liang, Jay Nadeau, Dao Nguyen

Molecular Biology: Nicolas Cermakian, Subah Hussain, Armando Jardim, Andrew Mouland, Kostas Pantopoulos, Bernard Turcotte

Virology: Anne Gatignol, Antonis Koromilas, Rongtuan Lin, Jose Teodoro

Adjunct Professors

Jacques Archambault; B.Sc.(Montr.), Ph.D.(Tor.)

Albert Descoteaux; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)

Andres Finzi; B.Sc., M.Sc., Ph.D.(Montr.)

George Kukolj; B.Sc., Ph.D.(McG.)

Peter Lau; Ph.D.(Ott.)

Byong Lee; B.Sc.(Kangwon), M.Sc., Ph.D.(Laval)

Shan-Lu Liu; M.D.(China), Ph.D.(Wash.)

Andrew Makrigiannis; B.Sc., Ph.D.(Dal.)

Woong-Kyung Suh; B.Sc., M.Sc.(Seoul), Ph.D.(Tor.)

Dan Ziberstein; B.Sc., M.Sc., Ph.D.(Hebrew)

Affiliated Centre

Centre for Host Resistance
Montreal General Hospital
1650 Cedar Avenue
Montreal, Quebec H3G 1A4
Telephone: 514-398-8038

Director: E. Skamene

14.22.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (49 credits)**U1 Required Courses (18 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 (15 credits)

MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 386D1	(3)	Laboratory in Microbiology and Immunology
MIMM 386D2	(3)	Laboratory in Microbiology and 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 314	(3)	Molecular Biology of Oncogenes
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
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 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

14.22.5 Bachelor of Science (B.Sc.) - Major Microbiology and Immunology (68 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 (21 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 386D1	(3)	Laboratory in Microbiology and Immunology
MIMM 386D2	(3)	Laboratory in Microbiology and Immunology

U3 Required Courses (9 credits)

MIMM 413	(3)	Parasitology
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 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 314	(3)	Molecular Biology of Oncogenes
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
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
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

14.22.6 Bachelor of Science (B.Sc.) - Honours Microbiology and Immunology (74 credits)

The Honours program is designed to offer, in addition to the substantial background given by the Major program, a significant research experience in a laboratory within the Department during the U3 year. Students are prepared for this independent research project by following an advanced laboratory course in U2. This program is intended to prepare students for graduate study in microbiology and immunology or related fields, but could also be chosen by students intending to enter medical research after medical school, or intending to enter the job market in a laboratory research environment.

Students intending to apply to Honours must follow the Major program in U1 and U2 and must obtain a CGPA of at least 3.50 at the end of their U2 year. For graduation in Honours, students must pass all required courses with a C or better, and achieve a sessional GPA of at least 3.30 in the U3 year.

U1 Required Courses (25 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 (21 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 386D1	(3)	Laboratory in Microbiology and Immunology
MIMM 386D2	(3)	Laboratory in Microbiology and Immunology

U3 Required Courses (21 credits)

MIMM 413	(3)	Parasitology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

MIMM 502D1	(6)	Honours Research Project in Microbiology
MIMM 502D2	(6)	Honours Research Project in Microbiology

Complementary Course (3 credits)

3 credits selected from:

ANAT 458	(3)	Membranes and Cellular Signaling
BIOC 404	(3)	Biophysical Chemistry
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458	(3)	Membranes and Cellular Signaling
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
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
PHAR 562	(3)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2
PSYT 455	(3)	Neurochemistry

14.22.7 Microbiology and Immunology (MIMM) Related Programs**14.22.7.1 Interdepartmental Honours in Immunology**

For more information, see [section 14.17: Immunology](#).

This program is offered by the departments of Biochemistry, Microbiology and Immunology, and Physiology.

Students interested in immunology may choose between this Honours program and the Honours program of the Department of Microbiology and Immunology.

Details of this program may also be obtained from Professor Piccirillo in the Department of Microbiology and Immunology, Room L11.132, Montreal General Hospital; Telephone: 514-934-1934, ext. 45135; ciro.piccirillo@mcgill.ca.

14.23 Music**14.23.1 Location**

Strathcona Music Building
555 Sherbrooke Street West
Montreal, Quebec H3A 1E3

Telephone: 514-398-4535
Fax: 514-398-8061
Website: www.mcgill.ca/music

14.23.2 About Music

For more information, see *Programs, Courses and University Regulations > Faculties & Schools > [Schulich School of Music](#)*.

14.23.3 Music Faculty

Department of Music Research Chair

Christoph Neidhöfer; Dipl.(Musikhochschule Basel), Ph.D.(Harv.)

Department of Performance Chair

Jean Lesage; Concours, Diplôme d'études supérieures(Cons. de Montréal)

Adviser (B.A./B.Sc. Music programs)

Sara Laimon; B.Mus.(Br. Col.), M.Mus.(Yale), D.M.A.(SUNY, Stony Brook)
Telephone: 514-398-1882

Diana Toni Dutz; B.Mus.(W. Ont.), Grad.Dip.(C'dia)
Telephone: 514-398-6337

14.23.4 Music Related Programs

14.23.4.1 Minor in Musical Applications of Technology and Minor in Musical Science and Technology

Science students may apply for admission to either the Minor in Musical Applications of Technology, see *Programs, Courses and University Regulations > Faculties & Schools > Schulich School of Music > Undergraduate > Programs of Study > : Minor Musical Applications of Technology (18 credits)*, or the Minor in Musical Science and Technology, see *Programs, Courses and University Regulations > Faculties & Schools > Schulich School of Music > Undergraduate > Programs of Study > : Minor Musical Science and Technology (18 credits)*. Enrolment in Music Technology programs is highly restricted. Application forms will be available from the Department of Music Research in the Schulich School of Music from February 1 and must be completed and returned to that office by May 15 of each academic year. Late applications will not be accepted and no students will be admitted in January. Successful applicants will be notified by June 1. Registration will be limited to available lab space.

14.23.4.1.1 Science Minor in Music Technology (24 credits)

This program was retired as of the 2008–2009 academic year. Students currently registered in the program should consult with their program adviser and refer to the Calendar for the academic year in which they began the program for guidance about program requirements. Science students are eligible to take the Arts Minor Concentration in Music; see *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Arts > Undergraduate > Academic Programs > : Music (MUAR)*. Music courses listed as MUAR (see Faculty of Arts courses) are considered to be Arts courses. All other Music courses are considered by the Faculty of Science to be courses outside of Arts and Science (see [section 7.5.2: Courses Outside the Faculties of Arts and Science](#) for the relevant regulations).

14.24 Neurology and Neurosurgery (NEUR)

14.24.1 Location

Montreal Neurological Institute and Hospital
3801 University Street, Room 141
Montreal, Quebec H3A 2B4

14.24.2 About Neurology and Neurosurgery

There are no B.Sc. programs in Neurology and Neurosurgery, but the course NEUR 310 *Cellular Neurobiology*, which is part of the Minor in Neuroscience, is a course taught by the Faculty of Science.

14.25 Neuroscience

14.25.1 Location

Director of Neuroscience

Professor Monroe Cohen
 Department of Physiology
 McIntyre Medical Sciences Building, Room 1150
 3655 Promenade Sir-William-Osler
 Montreal, Quebec H3G 1Y6

Interdisciplinary Programs Adviser

Wendy Brett, Adviser
 Telephone: 514-398-7330
 Email: wendy.brett@mcgill.ca
 Website: www.mcgill.ca/neuroscience

14.25.2 About Neuroscience

Neuroscience is a multidisciplinary science devoted to the understanding of the nervous system. The brain is one of the most complex systems in the universe, and understanding how it functions is among the most challenging questions in science. Scientists are investigating the brain at many levels, from the molecules at synapses to complex forms of behaviour, and use methods of inquiry that are drawn from a number of disciplines, including molecular and cellular biology, physiology, behavioural sciences and cognitive psychology, computer science, and artificial intelligence. In addition, scientists are investigating the nervous system of many different animals, from simple invertebrates to humans. These wide-ranging investigations are providing a clearer understanding of how neurons work; how they communicate with one another; how they are organized into local or distributed networks; how the connections between neurons are established and change with experience; how neuronal function is influenced by pharmacological agents, and during disease states. As a result, we are gaining deeper insights into the neural basis of mental activity, as well as developing new therapeutic approaches to alleviate neurological and psychological diseases.



Please note: New students are required to attend an information session held at the end of August. Please consult the neuroscience website in early August for the date and location.

14.25.3 Bachelor of Science (B.Sc.) - Minor Neuroscience (25 credits)

This Minor is intended to provide students with a basic understanding of how the nervous system functions. The Minor is composed of 25 credits: 13 required and 12 complementary. For the 12 complementary credits, at least 6 must be at the 400 or 500 level and not from the student's home department. All course selections for the Minor must be approved by the program's adviser, Wendy Brett (Email: wendy.brett@mcgill.ca; Office: Dawson Hall, Rm 405). A maximum of 6 credits can be counted for both the student's primary program and for the Minor in Neuroscience.

Required Courses (13 credits)

Note: Students who have successfully completed an equivalent of CHEM 212 in CEGEP or elsewhere prior to starting at McGill must replace these credits with a 3-credit elective course to satisfy the total credit requirement for the Neuroscience Minor.

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

Complementary Courses (12 credits)

12 credits selected as follows:

- At least 6 of the 12 credits have to be at the 400 or 500 level.
- At least 6 of the 400- or 500-level credits have to be from outside the student's home department.

0-6 credits from the following list of 200- and 300-level courses:

Notes:

* Students may select ANAT 212 or BIOC 212 or BIOL 201.

** Students may select either BIOL 306 or PHGY 314.

ANAT 212*	(3)	Molecular Mechanisms of Cell Function
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BIOC 212*	(3)	Molecular Mechanisms of Cell Function
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
BIOL 389	(3)	Laboratory in Neurobiology
LING 390	(3)	Neuroscience of Language
NEUR 310	(3)	Cellular Neurobiology
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 314**	(3)	Integrative Neuroscience
PSYC 302	(3)	The Psychology of Pain
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 342	(3)	Hormones and Behaviour

6-12 credits from the following list of 400- and 500-level courses, and not from the student's home department:

*** Students may select either BIOL 514 or PSYC 514.

BIOL 514***	(3)	Neurobiology Learning and Memory
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 501	(3)	Auditory Perception
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 514***	(3)	Neurobiology of Learning and Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 532	(3)	Cognitive Science
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
PSYT 505	(3)	Neurobiology of Schizophrenia

14.25.4 Bachelor of Science (B.Sc.) - Major Neuroscience (65 credits)

The Major program in Neuroscience is a focused program for students interested in how the nervous system functions. It is highly interdisciplinary and borrows principles and methodologies from a number of fields including: biology, biochemistry, physiology, psychology, as well as mathematics, physics, computer science, and immunology. To ensure that students have the appropriate foundation, they are required to take 29 credits in lower-level courses from physiology, biology, mathematics, computer science, psychology, and ethics. While flexible, the program offers students a concentrated selection of 15 credits to be taken from one of three areas of current scientific activities in the neurosciences: Cell/Molecular, Neurophysiology/Computation, or Cognition/Behaviour. In addition, students select 21 credits from a wide array of complementary courses to obtain more specialized training in areas of neuroscience that best suit their interest.

Note that enrolment in the Neuroscience Major is limited.

Program Prerequisites

Notes on admission to the Neuroscience Major program: Enrolment in the Neuroscience Major is limited to a total of 50 students per year. U0 students seeking admission to this program should consult the neuroscience website for admissions requirements and have completed the courses listed below or equivalent.

* Students complete one of MATH 139, MATH 140 OR MATH 150 but not both.

** Students complete one of either MATH 141 OR MATH 151 but not both.

*** Students complete one of either PHYS 101 OR PHYS 131 but not both.

+++ Students complete one of either PHYS 102 OR PHYS 142 but not both.

BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
MATH 139*	(4)	Calculus 1 with Precalculus
MATH 140*	(3)	Calculus 1
MATH 141**	(4)	Calculus 2
MATH 150*	(4)	Calculus A
MATH 151**	(4)	Calculus B
PHYS 101***	(4)	Introductory Physics - Mechanics
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
NSCI 400D2	(.5)	Neuroscience Seminar
PSYC 311	(3)	Human Cognition and the Brain

Complementary Courses (45 credits)

9 core credits selected as follows:

3 credits from:

BIOL 373	(3)	Biometry
PSYC 305	(3)	Statistics for Experimental Design

3 credits completed by taking the course below or an equivalent in Computer Science.

COMP 202	(3)	Foundations of Programming
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3 credits from:

BIOL 309	(3)	Mathematical Models in Biology
MATH 222**	(3)	Calculus 3

** 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 the Neuroscience Major.

Streams

15 credits selected from one of the following streams:

A. Cell and Molecular Stream

15 credits selected as follows:

9 credits as follows:

BIOC 311	(3)	Metabolic Biochemistry
BIOL 202	(3)	Basic Genetics
PHGY 311	(3)	Channels, Synapses & Hormones

3 credits from:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

3 credits from:

MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHAR 300	(3)	Drug Action

B. Neurophysiology/Neural Computation Stream

15 credits selected as follows:

6 credits as follows:

ANAT 321	(3)	Circuitry of the Human Brain
PHGY 311	(3)	Channels, Synapses & Hormones

3 credits from:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

3 credits from:

BIOL 309	(3)	Mathematical Models in Biology
COMP 206	(3)	Introduction to Software Systems
MATH 222**	(3)	Calculus 3

** 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 the Neuroscience Major.

C. Cognitive/Behavioural Stream

15 credits selected as follows:

9 credits as follows:

ANAT 321	(3)	Circuitry of the Human Brain
PSYC 213	(3)	Cognition
PSYC 318	(3)	Behavioural Neuroscience 2

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

3 credits from:

LING 390	(3)	Neuroscience of Language
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/NSCID2 research courses:

200- and 300-level courses:

* Students take either BIOL 201 OR BIOC 212, but not both.

BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 311	(3)	Metabolic Biochemistry
BIOL 201*	(3)	Cell Biology and Metabolism
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
LING 390	(3)	Neuroscience of Language
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 & Hormones
PHGY 314	(3)	Integrative Neuroscience
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 MATH 437 OR PHYS 413, but not both.

BIOL 514	(3)	Neurobiology Learning and Memory
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BMDE 519	(3)	Biomedical Signals and Systems
MATH 437**	(3)	Mathematical Methods in Biology
MIMM 414	(3)	Advanced Immunology

MIMM 509	(3)	Inflammatory Processes
NEUR 550	(3)	Free Radical Biomedicine
PHAR 562	(3)	General Pharmacology 1
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 513	(3)	Cellular Immunology
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHYS 413**	(3)	Physical Basis of Physiology
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 501	(3)	Auditory Perception
PSYC 502	(3)	Psychoneuroendocrinology
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 532	(3)	Cognitive Science
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
PSYT 505	(3)	Neurobiology of Schizophrenia
REDM 410	(3)	Writing Research Articles

14.25.5 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; cognition and behaviour). Students are admitted to the program after one year in a major.

The program is composed of 74 credits: 44 credits are required, including a 9-credit independent research project, and 30 credits are complementary. Because it is a limited-enrolment program, the entrance requirements for the Honours program are more stringent. Applicants must have taken a minimum of 27 graded credits in their U1 year, must have a CGPA of at least 3.50 and 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 (44 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 Honours Program.

ANAT 321	(3)	Circuitry of the Human Brain
BIOC 311	(3)	Metabolic Biochemistry
BIOL 200	(3)	Molecular Biology
CHEM 212*	(4)	Introductory Organic Chemistry 1
COMP 202	(3)	Foundations of Programming

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
PHGY 311	(3)	Channels, Synapses & Hormones
PSYC 311	(3)	Human Cognition and the Brain
PSYC 318	(3)	Behavioural Neuroscience 2

Complementary Courses (30 credits)

3 credits from:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

3 credits from:

BIOL 373	(3)	Biometry
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 the Neuroscience Major.

BIOL 309	(3)	Mathematical Models in Biology
MATH 222**	(3)	Calculus 3

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:

BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 389	(3)	Laboratory in Neurobiology
CHEM 222	(4)	Introductory Organic Chemistry 2
COMP 206	(3)	Introduction to Software Systems
LING 390	(3)	Neuroscience of Language
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 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 342	(3)	Hormones and Behaviour

400- and 500-level courses:

*** Students may take either MATH 437 OR PHYS 413, but not both.

BIOL 514	(3)	Neurobiology Learning and Memory
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BMDE 519	(3)	Biomedical Signals and Systems
MATH 437***	(3)	Mathematical Methods in Biology
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
NEUR 550	(3)	Free Radical Biomedicine
PHAR 562	(3)	General Pharmacology 1
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 513	(3)	Cellular Immunology
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHYS 413***	(3)	Physical Basis of Physiology
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 501	(3)	Auditory Perception
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 532	(3)	Cognitive Science
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
PSYT 505	(3)	Neurobiology of Schizophrenia

REDM 410 (3) Writing Research Articles

14.26 Nutrition (NUTR)

14.26.1 Location

School of Dietetics and Human Nutrition
Macdonald-Stewart Building, Room MS2-039
21,111 Lakeshore Road
Sainte-Anne-de-Bellevue, Quebec H9X 3V9

14.26.2 About Nutrition

The School of Dietetics and Human Nutrition offers a Minor in Human Nutrition which can be taken by Science students; see *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Agricultural and Environmental Sciences > Undergraduate > Academic Programs > Bachelor of Science in Nutritional Sciences – B.Sc.(Nutr.Sc.) (Overview)*.

NUTR 307 is considered as a course taught by the Faculty of Science and is offered simultaneously on both campuses.

14.27 Pathology (PATH)

14.27.1 Location

Department of Pathology
Duff Medical Building
3775 University Street
Montreal, Quebec H3A 2B4

14.27.2 About Pathology

There are no B.Sc. programs in Pathology, but the course PATH 300 *Human Disease* is considered as one taught by the Faculty of Science.

14.28 Pharmacology and Therapeutics (PHAR)

14.28.1 Location

McIntyre Medical Building, Room 1325
3655 Promenade Sir-William-Osler
Montreal, Quebec H3G 1Y6

Telephone: 514-398-3623
Website: www.mcgill.ca/pharma

14.28.2 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, it is evident that pharmacology is 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, and 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 the student 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.

14.28.3 Pharmacology and Therapeutics (PHAR) Faculty

Chair

Gerhard Multhaup

Emeritus Professors

Radan Capek; M.D., Ph.D.(Prague)

Brian Collier; B.Sc., Ph.D.(Leeds)

Theodore Sourkes; Ph.D.(C'neil)

Hans H. Zingg; M.D., Ph.D.(McG.)

Professors

Guillermina Almazan; Ph.D.(McG.)

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.)

Dusica Maysinger; Ph.D.(USC)

Peter J. McLeod; M.D.(Manit.), F.R.C.P.(C.)

Gerhard Multhaup; Ph.D.(Cologne, Germany)

Alfredo Ribeiro-da-Silva; M.D., Ph.D.(Oporto)

Bernard Robaire; B.A.(Calif.), Ph.D.(McG.)

H. Uri Saragovi; Ph.D.(Miami)

Moshe Szyf; M.Sc., Ph.D.(Hebrew)

Jacquetta Trasler; M.D.,C.M., Ph.D.(McG.)

Associate Professors

Daniel Bernard; Ph.D.(Johns Hop.)

Derek Bowie; B.Sc., Ph.D.(Lond.)

Terence Hébert; M.Sc.(Windsor), Ph.D.(Tor.)

Anne McKinney; Ph.D.(Ulster)

Stanley Nattel; B.Sc., M.D.,C.M.(McG.)

Ante L. Padjen; M.D., M.Sc., D.Sc.(Zagreb)

Edith A. Zorychta; B.Sc.(St. FX), M.Sc., Ph.D.(McG.)

Assistant Professors

Lisa-Marie Munter; Ph.D.(Berlin, Germany)

Jason Chaim Tanny; Ph.D.(Harv.)

Associate Members

Moulay Alaoui-Jamali; Ph.D.(Sorbonne)

Martine Culty; Ph.D.(INSERM, Grenoble)

Giovanni Di Battista; B.Sc., Ph.D.(Montr.)

Associate Members

Lesley Fellows; M.D.(McG.), Ph.D.(Oxf.)
 Pierre Fiset; M.D.(Laval), F.R.C.P.S.(C)
 Serge Gauthier; M.D.(Montr.)
 Timothy Geary; Ph.D.(Mich.)
 Bertrand Jean-Claude; M.Sc.(Moncton), Ph.D.(McG.)
 Sarah Kimmins; Ph.D.(Dal.)
 Stephane Laporte; Ph.D.(Sher.)
 Cristian O'Flaherty; Ph.D.(McG.)
 Vassilios Papadopoulos; Ph.D.(Université Pierre et Marie Curie)
 Roger Prichard; B.Sc., Ph.D.(N.S.W.)
 Simon Rousseau; Ph.D.(Laval)
 Yoram Shir; M.D.(Israel), Ph.D.(Johns Hop.)
 Laura Stone; Ph.D.(Minn.)
 Marc Ware; M.D.(Univ. West Indies, Kingston, Jamaica)
 Tak Pan Wong; Ph.D.(McG.)

Adjunct Professors

Bruce Allen; Ph.D.(Br. Col.)
 Martin Bruno; Ph.D.(McG.)
 Sylvain Chemtob; M.D.(Montr.), Ph.D.(McG.)
 Yves De Koninck; Ph.D.(McG.)
 Lorella Garofalo; Ph.D.(McG.)
 Jennifer M.A. Laird; Ph.D.(Brist.)
 Joseph Mancini; M.Sc., Ph.D.(McG.)
 Karen Meerovitch; Ph.D.(McG.)
 Greg Miller; Ph.D.(W. Ont.)
 Thomas Sanderson; Ph.D.(Br. Col.)

14.28.4 Bachelor of Science (B.Sc.) - Minor Pharmacology (24 credits)

The Minor Pharmacology is intended for students registered in a complementary B.Sc. program who are interested in a focused introduction to specialized topics in pharmacology to prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes. Students should declare their intent to enter the Minor in Pharmacology at the beginning of their U2 year. They must consult with, and obtain the approval of, the Coordinator for the Minor Program in the Department of Pharmacology and Therapeutics. (Please contact the coordinator: Dr. Terry Hébert; terence.hebert@mcgill.ca; 514-398-1398).

All courses in the Minor program must be passed with a minimum grade C or better. Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program.

Required Courses (12 credits)

PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 562	(3)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2

Complementary Courses (12 credits)

12 credits selected as follows:

3 credits, one of:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism

3 credits, one of:

PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

6 credits, chosen from:

* PHAR 504 can be taken with PHAR 503 only.

PHAR 303	(3)	Principles of Toxicology
PHAR 503*	(3)	Drug Discovery and Development 1
PHAR 504*	(3)	Drug Discovery and Development 2
PHAR 558	(3)	Pharmacology Selected Topics
PHAR 599	(6)	Pharmacology Research Project

14.28.5 Bachelor of Science (B.Sc.) - Major Pharmacology (65 credits)

This program incorporates extensive studies in Pharmacology with a strong component of related biomedical sciences, providing a solid preparation for employment opportunities or for entry into graduate or professional training programs. Students must consult an adviser upon entering the program and at the beginning of U2 to verify courses and progress. Additional consultation at regular intervals is encouraged.

U1 Required Courses (22 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
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 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 (12 credits)

PHAR 503	(3)	Drug Discovery and Development 1
PHAR 558	(3)	Pharmacology Selected Topics
PHAR 562	(3)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2

Complementary Courses (15 credits)

15 credits selected as follows:

3 credits selected from (usually 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 selected from (usually in Year 2):

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

3 credits selected from (usually in Year 2):

BIOL 373	(3)	Biometry
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

Revision, July 2013. Start of revision.

6 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.

PHAR 599D1 and PHAR 599D2 are taken together.

* Note: Students may take either ANAT 458 or BIOC 458.

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
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 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials

CHEM 382	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Design and Development 1
CHEM 504	(3)	Drug Design and Development 2
CHEM 522	(3)	Stereochemistry
CHEM 552	(3)	Physical Organic Chemistry
EPIB 501	(3)	Population Health and Epidemiology
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 504	(3)	Biology of Cancer
EXMD 511	(3)	Joint Venturing with Industry
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 599D1	(3)	Pharmacology Research Project
PHAR 599D2	(3)	Pharmacology Research Project
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 520	(3)	Ion Channels
PSYC 302	(3)	The Psychology of Pain
PSYC 311	(3)	Human Cognition and the Brain
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

Revision, July 2013. End of revision.

14.28.6 Bachelor of Science (B.Sc.) - Honours Pharmacology (74 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 (22 credits)

* Students with prior credit for CHEM 212 may take an elective in place of this course.

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
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

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 (18 credits)

* PHAR 599D1 and PHAR 599D2 are taken together.

PHAR 503	(3)	Drug Discovery and Development 1
PHAR 558	(3)	Pharmacology Selected Topics
PHAR 562	(3)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2
PHAR 599D1*	(3)	Pharmacology Research Project
PHAR 599D2*	(3)	Pharmacology Research Project

Complementary Courses (18 credits)

18 credits selected as follows:

3 credits selected from (usually 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 selected from (usually in Year 2):

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

3 credits selected from (usually in Year 2):

BIOL 373	(3)	Biometry
MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

Revision, July 2013. Start of revision.

9 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.

* Note: Students may take either ANAT 458 or BIOC 458.

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
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 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 382	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Design and Development 1
CHEM 504	(3)	Drug Design and Development 2
CHEM 522	(3)	Stereochemistry
CHEM 552	(3)	Physical Organic Chemistry
EPIB 501	(3)	Population Health and Epidemiology
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 504	(3)	Biology of Cancer
EXMD 511	(3)	Joint Venturing with Industry
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 504	(3)	Drug Discovery and Development 2
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 520	(3)	Ion Channels
PSYC 302	(3)	The Psychology of Pain
PSYC 311	(3)	Human Cognition and the Brain
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

Revision, July 2013. End of revision.

14.29 Physics (PHYS)

14.29.1 Location

Rutherford Physics Building, Room 108
3600 University Street
Montreal, Quebec H3A 2T8

Telephone: 514-398-6477

Fax: 514-398-8434

Email: secretariat@physics.mcgill.ca

Website: www.physics.mcgill.ca

14.29.2 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 two joint honours programs, one in Mathematics and Physics and the other in Physics and Chemistry, 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 two 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 or chemistry. High standing in CEGEP or Freshman-year mathematics and physics is a requirement for admission to these honours programs.

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 14.29.9: Bachelor of Science \(B.Sc.\) - Major Physics \(60 credits\)](#).

There are also a number of other major programs: Atmospheric Sciences and Physics, Physics and Computer Science, Physics and Geophysics, and Physiology and Physics, offered jointly with other departments, and a minor program in Electrical Engineering, available only to students in the Physics Major program. In addition, there is a minor in Physics and a core Physics component of the Liberal Science program, for students less interested in a specialized education.

For those interested in a career as a high school science teacher, the concurrent program leading to both a B.Sc. and a B.Ed. degree provides several physics options. These combine physics courses from the Major and Minor programs with courses from either Biology or Chemistry and with Education courses. (For details, see [section 14.34: Science or Mathematics for Teachers](#).)

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: they are 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 major concentration in physics is available to students pursuing the B.A. & Sc. degree. This Major concentration is described in *Programs, Courses and University Regulations > Faculties & Schools > Bachelor of Arts and Science > Undergraduate > Academic Programs > : Physics (PHYS)*.

14.29.3 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 13.1: Industrial Practicum \(IP\) and Internship Year in Science \(IYS\)](#).

The following programs are also available with an internship component:

- Major in Physics
- Honours in Physics
- Joint Honours Program in Physics and Chemistry
- Joint Honours Program in Physics and Mathematics
- Joint Major Program in Atmospheric Science and Physics

- Joint Major Program in Physics and Computer Science
- Joint Major Program in Physics and Geophysics

14.29.4 Science Freshman Program

Students entering McGill with a Quebec CEGEP profile in Science will normally begin their programs in Physics with courses at the 200 level.

Students without this profile should normally take courses PHYS 131 and PHYS 142 if they have previously taken physics at the high school level and should be taking differential calculus concurrently with PHYS 131 and integral calculus concurrently with PHYS 142. Those students who have not previously taken physics at the high school level and who intend to do programs in the Biological Sciences may instead take courses PHYS 101 and PHYS 102. All students are expected to have reasonable fluency in algebra, geometry, and trigonometry at the high school level. If this is not the case, then MATH 112 should be taken concurrently with PHYS 101. Those for whom this is not necessary are advised to take MATH 139 concurrently with PHYS 101.

14.29.5 Physics (PHYS) Faculty

Chair

C. Gale

Emeritus Professors

Subal Das Gupta; B.A., M.Sc.(Calc.), Ph.D.(McM.) (*William C. Macdonald Emeritus Professor of Physics*)

Nicholas DeTakaesy; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)

Harry C.S. Lam; B.Sc.(McG.), Ph.D.(MIT)

Tommy S.K. Mark; B.Sc., M.Sc., Ph.D.(McG.) (*William C. Macdonald Emeritus Professor of Physics*)

Douglas G. Stairs; B.Sc., M.Sc.(Qu.), Ph.D.(Harv.) (*William C. Macdonald Emeritus Professor of Physics*)

John O. Strom-Olsen; B.A., M.S., Ph.D.(Cant.)

Martin J. Zuckermann; M.A., D.Phil.(Oxf.), F.R.S.C. (*William C. Macdonald Emeritus Professor of Physics*)

Post-Retirement Appointments

Z. Altounian; B.Sc., M.Sc.(Cairo), Ph.D.(McM.)

Jean Barrette; B.Sc., M.Sc., Ph.D.(Montr.)

John E. Crawford; B.A., M.A.(Tor.), Ph.D.(McG.)

Professors

Robert Brandenberger; Dipl., A.M., Ph.D.(Harv.) (*Canada Research Chair*)

James M. Cline; B.Sc.(Calif.), M.Sc., Ph.D.(Calif. Tech.)

François Corriveau; B.Sc.(Laval), M.Sc.(Br. Col.), Docteur Sc.Nat.(Zurich)

Charles Gale; B.Sc.(Ott.), M.Sc., Ph.D.(McG.) (*James McGill Professor*)

Martin Grant; B.Sc.(PEI), M.Sc., Ph.D.(Tor.), F.R.S.C. (*James McGill Professor*)

Peter Grutter; Dipl., Ph.D.(Basel) (*James McGill Professor*)

Hong Guo; B.Sc.(Sichuan), M.Sc., Ph.D.(Pitt.), F.R.S.C. (*James McGill Professor*)

David Hanna; B.Sc.(McG.), M.A., Ph.D.(Harv.) (*William C. Macdonald Professor of Physics*)

Sangyong Jeon; B.Sc.(Seoul), M.Sc., Ph.D.(Wash.)

Victoria Kaspi; B.Sc.(McG.), M.A., Ph.D.(Princ.) (*Canada Research Chair*) (*Lorne Trottier Chair in Astrophysics and Cosmology*)

Shaun Lovejoy; B.A.(Cant.), Ph.D.(McG.)

Nikolas Provas; B.Sc., M.Sc., Ph.D. (McG.)

Kenneth J. Ragan; B.Sc.(Alta.), D.Sc.(Geneva) (*William C. Macdonald Professor of Physics*)

Dominic H. Ryan; B.A., Ph.D.(Trin. Coll.)

Mark Sutton; B.Sc., M.Sc., Ph.D.(Tor.) (*Ernest Rutherford Professor of Physics*)

Associate Professors

Aashish Clerk; B.Sc.(Tor.), Ph.D.(C'nell) (*Canada Research Chair*)
 Andrew Cumming; B.A.(Camb.), Ph.D.(Calif., Berk.)
 Keshav Dasgupta; B.Sc., M.Sc.(Indian IT), Ph.D.(Tata)
 Matt Dobbs; B.Sc.(McG.), Ph.D.(Vic., BC) (*Canada Research Chair*)
 Guillaume Gervais; B.Sc.(Sher.), M.Sc.(McM.), Ph.D.(North. Univ.)
 Michael Hilke; B.Sc., M.Sc., Ph.D.(Geneva)
 Gil Holder; B.Sc., M.Sc.(Qu.), Ph.D.(Chic.) (*Canada Research Chair*)
 Alex Maloney; B.Sc., M.Sc.(Stan.), Ph.D.(Harv.) (*William Dawson Scholar*)
 Guy Moore; B.Sc.(Calif.), Ph.D.(Princ.)
 Steve Robertson; B.Sc.(Calg.), M.Sc., Ph.D.(Vic., BC)
 Bob Rutledge; B.Sc.(USC), Ph.D.(MIT)
 Brigitte Vachon; B.Sc.(McG.), Ph.D.(Vic., BC) (*Canada Research Chair*)
 Andreas Warburton; B.Sc.(Vic., BC), M.Sc., Ph.D.(Tor.)
 Paul Wiseman; B.Sc.(St. FX), Ph.D.(W. Ont.) (*joint appt. with Chemistry*)

Assistant Professors

Lilian Childress; B.A., Ph.D.(Harv.)
 William Coish; B.Sc.(Manit.), M.Sc.(McM.), Ph.D.(Basel)
 David Cooke; B.Sc.(St. FX), Ph.D.(Alta.)
 Paul Francois; B.Sc.(Polytechnique, France), M.Sc., Ph.D.(École normale supérieure)
 Sabrina Leslie; B.Sc.(Br. Col.), Ph.D.(Calif., Berk.)
 Tamar Pereg-Barnea; B.Sc.(Hebrew), M.Sc., Ph.D.(Br. Col.)
 Walter Reisner; B.Sc.(Reed), Ph.D.(Princ.)
 Jack Sankey; B.Sc.(Minn.), M.Sc., Ph.D.(C'nell)
 Brad Siwick; B.A.Sc., M.Sc., Ph.D.(Tor.) (*Canada Research Chair*)
 Johannes Walcher; Dipl., Ph.D.(ETH Zurich)
 Tracy Webb; B.Sc.(Tor.), M.Sc.(McM.), Ph.D.(Tor.)

Lecturer

F. Buchinger; Dipl.(Mainz), Ph.D.(Joh. Gutenberg U.)

Associate Members

M. Chacron (*Physiology*)
 M.A. El Naqa (*Biomedical Engineering*)
 K. Gehring (*Biochemistry*)
 P. Hayden (*Computer Science*)
 P. Kambhampati (*Chemistry*)
 M. Mackey (*Physiology*)
 Z. Mi (*Electrical and Computer Engineering*)
 J. Nadeau (*Biomedical Engineering*)
 G.B. Pike (*MNI & Biomedical Engineering*)
 E. Podgorsak (*Radiation Oncology*)
 D. Rassier (*Kinesiology & Physical Education*)
 D. Ronis (*Chemistry*)

Associate MembersJ. Seuntjens (*Medical Physics*)T. Szkopek (*Electrical & Computer Engineering*)**Curator (Rutherford Museum and McPherson Collection)**

Jean Barrette; B.Sc., M.Sc., Ph.D.(Montr.)

14.29.6 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
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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 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 260	(3)	Modern Physics and Relativity
PHYS 271	(3)	Introduction to Quantum Physics

One of:

PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 350	(3)	Honours Electricity and Magnetism

14.29.7 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 334 in the Minor cannot count PHYS 328 toward the requirements of the Major in Physics, and should replace this course by another Physics or Mathematics course.

Required Courses (12 credits)

ECSE 200	(3)	Electric Circuits 1
ECSE 210	(3)	Electric Circuits 2
ECSE 303	(3)	Signals and Systems 1
ECSE 330	(3)	Introduction to Electronics

Complementary Courses (12 credits)

3 credits from the following and 9 credits of ECSE courses at the 200, 300, or 400 level subject to approval by the Department of Electrical and Computer Engineering.

ECSE 305	(3)	Probability and Random Signals 1
ECSE 334	(3)	Introduction to Microelectronics

14.29.8 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physics (48 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 (39 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 436	(3)	Modern Physics
PHYS 446	(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

14.29.9 Bachelor of Science (B.Sc.) - Major Physics (60 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

U1 Required Courses (21 credits)

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
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

U2 Required Courses (24 credits)

MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 328	(3)	Electronics
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves

U3 Required Courses (15 credits)

PHYS 434	(3)	Optics
PHYS 436	(3)	Modern Physics
PHYS 439	(3)	Majors Laboratory in Modern Physics
PHYS 446	(3)	Majors Quantum Physics
PHYS 449	(3)	Majors Research Project

It is possible for students to transfer from the Major to the Honours program after the U1 year if they have passed all U1 Required courses and MATH 314 and MATH 315 with a C or better, and obtained a GPA of 3.5 or better in these courses. The written permission of an adviser is required for this change of program.

Note: The missing MATH 249 and PHYS 260 from the U1 Honours Year should be taken in U2.

14.29.10 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

U1 Required Courses (30 credits)

EPSC 203	(3)	Structural Geology
EPSC 210	(3)	Introductory Mineralogy
EPSC 231	(3)	Field School 1
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2

U2 Required Courses (18 credits)

EPSC 320	(3)	Elementary Earth Physics
EPSC 350	(3)	Tectonics
MATH 315	(3)	Ordinary Differential Equations
MATH 319	(3)	Introduction to Partial Differential Equations
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism

U2 or U3 Required Courses (6 credits)

EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 510	(3)	Geodynamics and Geomagnetism

U3 Required Courses (15 credits)

PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432	(3)	Physics of Fluids

PHYS 446 (3) Majors Quantum Physics

14.29.11 Bachelor of Science (B.Sc.) - Major Physics and Computer Science (66 credits)

The Major Physics and Computer Science is designed to give motivated students the opportunity to combine the two fields in a way that will distinguish them from the graduates of either field by itself. The two disciplines complement each other, with physics providing an analytic problem-solving outlook and basic understanding of nature, while computer science enhances the ability to make practical and marketable applications, in addition to having its own theoretical interest. Graduates of this program may be able to present themselves as being more immediately useful than a pure physics major, but with more breadth than just a programmer. They will be able to demonstrate their combined expertise in the Special Project course which is the centrepiece of the final year of the program.

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 (21 credits)

COMP 250	(3)	Introduction to Computer Science
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2

U2 Required Courses (24 credits)

COMP 206	(3)	Introduction to Software Systems
COMP 251	(3)	Algorithms and Data Structures
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 446	(3)	Majors Quantum Physics
PHYS 489	(3)	Special Project

14.29.12 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 Advanced 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 375	(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)	Honours Research Project

Revision, July 2013. Start of revision.

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)	Honours Research Project
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
PHYS 580	(3)	Introduction to String Theory

Revision, July 2013. End of revision.

14.29.13 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 Advanced 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 (27 credits)

MATH 242	(3)	Analysis 1
MATH 255	(3)	Honours Analysis 2
MATH 375	(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 457	(3)	Honours Quantum Physics 2

U3 Required Courses (12 credits)

MATH 354	(3)	Honours Analysis 3
MATH 380	(3)	Honours Differential Geometry
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 359	(3)	Honours Laboratory in Modern Physics 1

U1 Complementary Course (3 credits)

MATH 247	(3)	Honours Applied Linear Algebra
MATH 251	(3)	Honours Algebra 2

U3 Complementary Courses (12 credits)

12 credits are selected as follows:

3 credits from:

MATH 355	(3)	Honours Analysis 4
MATH 370	(3)	Honours Algebra 3

Revision, July 2013. Start of revision.

6 credits selected from:

PHYS 432	(3)	Physics of Fluids
PHYS 479	(3)	Honours Research Project
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
PHYS 580	(3)	Introduction to String Theory

Revision, July 2013. End of revision.

3 credits in Honours Mathematics.

14.29.14 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

U1 Required Courses (30 credits)

CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
MATH 247	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced 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

U2 Required Courses (24 credits)

CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 355	(3)	Molecular Properties and Structure 2
CHEM 365	(2)	Statistical Thermodynamics
COMP 208	(3)	Computers in Engineering
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 457	(3)	Honours Quantum Physics 2

U3 Required Courses (14 credits)

CHEM 393	(2)	Physical Chemistry Laboratory 2
CHEM 556	(3)	Advanced Quantum Mechanics
CHEM 574	(3)	Introductory Polymer Chemistry
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 558	(3)	Solid State Physics

U3 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)	Research Project 2
CHEM 480D2	(1.5)	Research Project 2
CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 575	(3)	Chemical Kinetics
CHEM 585	(3)	Colloid Chemistry
MATH 375	(3)	Honours Partial Differential Equations
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 434	(3)	Optics
PHYS 469	(3)	Honours Laboratory in Modern Physics 2
PHYS 479	(3)	Honours Research Project
PHYS 562	(3)	Electromagnetic Theory

14.29.15 Physics (PHYS) Related Programs**14.29.15.1 Joint Major in Atmospheric Science and Physics**

See [section 14.3: Atmospheric and Oceanic Sciences \(ATOC\)](#). This program provides a firm basis for graduate work in atmospheric science and related fields as well as a sound preparation for those who wish to embark on a career directly after the B.Sc. Students should consult undergraduate advisers in both departments.

14.29.15.2 Joint Major in Physiology and Physics

See [section 14.30: Physiology \(PHGY\)](#). This program provides a firm basis for graduate work in bio-physics and other interdisciplinary fields involving the physical and biological sciences.

14.30 Physiology (PHGY)**14.30.1 Location**

McIntyre Medical Sciences Building, Room 1021
3655 Promenade Sir-William-Osler
Montreal, Quebec H3G 1Y6

Telephone: 514-398-4316

Fax: 514-398-7452

Website: www.medicine.mcgill.ca/physio

14.30.2 About Physiology

Physiology has its roots in many of the basic sciences including biology, chemistry, mathematics, and physics. Physiology overlaps with other biomedical sciences such as anatomy, biochemistry, pathology and pharmacology, and with psychology and biomedical engineering, and 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 man. A wide range of interest and expertise is represented, including cardiovascular, respiratory, gastrointestinal and renal physiology, the physiology of exercise, neurophysiology, endocrinology, immunology, biophysics, and biomathematics. Some faculty members have formal or informal links with the departments of mathematics, physics, electrical engineering, and chemistry, and with clinical departments (medicine, surgery, pediatrics, neurology, obstetrics, psychiatry, anesthesia), reflecting and reinforcing the close ties between physiology and other disciplines.

Graduates at the B.Sc. level have found rewarding careers in teaching, in secondary schools and CEGEPs, government service, and laboratory technical assistance, such as in pharmaceutical houses, hospitals, and institutions of higher learning. Moreover, physiology provides an excellent background for medicine, dentistry or other postgraduate work, in such fields as physiology, experimental medicine, pharmacology, biochemistry, or physiological psychology.

The programs offered in Physiology differ in their orientation but they all have a common core of material covering cardiovascular, respiratory, gastrointestinal and renal physiology, neurophysiology, endocrinology, and immunology. The specified U1 courses are identical for all programs except the Joint Major programs in Physiology and Physics, Physiology and Mathematics, and the Joint Honours program in Immunology, and thus afford the student maximal flexibility before deciding on a particular program to follow in U2 and U3.

Academic advising is compulsory. All new students to the Department, Freshman and CEGEP, must see an adviser upon entering the program. Contact the Student Affairs Officer at 514-398-3689 for more information.

Returning students are required to consult with their advisers during the advising period for returning students, and regularly throughout the year. It is important that graduating students have their record checked by their adviser at the beginning of their final year.



PLEASE NOTE: Complementary courses are not electives.

The difference between complementary courses and required courses is that complementary courses are defined as offering an element of choice, however small that choice may be. Students may choose from the two (or more) courses specified within complementary course segments of a program description, but **ONLY** from those. For further information, refer to *Programs, Courses and University Regulations > University Regulations and Resources > Undergraduate > Registration > : Course Information and Regulations*.

14.30.3 Physiology (PHGY) Faculty**Chair**

John Orłowski

Emeritus Professors

Thomas M.S. Chang; B.Sc., M.D., C.M., Ph.D.(McG.), F.R.C.P.(C)

Kresmir Krnjevic; O.C., B.Sc., Ph.D., M.B., Ch.B.(Edin.), F.R.S.C

Wayne Lapp; M.S.A.(Tor.), Ph.D.(McG.)

Mortimer Levy; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C) (*joint appt. with Medicine*)

Emeritus Professors

George Mandl; B.Sc.(C'dia), Ph.D.(McG.)
 G. Melvill Jones; B.A., M.A., M.B., B.Ch., M.D.(Cant.)
 J. Milic-Emili; M.D.(Milan)
 C. Polosa; M.D., Ph.D.
 Douglas G.D. Watt; M.D., Ph.D.(McG.)

Professors

Monroe W. Cohen; B.Sc., Ph.D.(McG.)
 Ellis J. Cooper; B.Eng.(Sir G. Wms.), M.Sc.(Sur.), Ph.D.(McM.)
 Kathleen Cullen; B.Sc.(Brown), Ph.D.(Chic.)
 Leon Glass; B.S.(Brooklyn), Ph.D.(Chic.) (*Isadore Rosenfeld Professor of Cardiology*)
 Phil Gold; C.C., B.Sc., M.Sc., Ph.D., M.D., C.M.(McG.), F.R.C.P.(C.), F.R.S.C. (*Douglas G. Cameron Professor of Medicine*) (*joint appt. with Medicine*)
 David Goltzman; B.Sc., M.D., C.M.(McG.) (*Antoine G. Massabki Professor of Medicine*) (*joint appt. with Medicine*)
 John Hanrahan; Ph.D.(Br. Col.)
 Gergely Lukacs; M.D., Ph.D.(Budapest)
 Michael Mackey; B.A., Ph.D.(Wash.) (*Joseph Morley Drake Professor of Physiology*)
 Sheldon Magder; M.D.(Tor.) (*joint appt. with Medicine*)
 Jacapo P. Mortola; M.D.(Milan)
 John Orłowski; B.Sc.(McG.), M.Sc., Ph.D.(Qu.) (*James McGill Professor*)
 Premysl Ponka; M.D., Ph.D.(Prague)
 Alvin Shrier; B.Sc.(C'dia), Ph.D.(Dal.) (*Hosmer Professor of Applied Physiology*)
 John White; B.Sc., M.Sc.(Car.), Ph.D.(Harv.)

Assistant Professors

Claire Brown; B.Sc.(St. Mary's) Ph.D.(W. Ont.)
 Russell Jones; Ph.D.(Tor.)
 Anmar Khadra; B.Sc.(C'dia), M.Sc., Ph.D.(Wat.)
 Anastasiya Nyzhnyk; M.Biochem., Ph.D.(Oxf.)
 Reza Sharif-Naeini; B.Sc.(Montr.), M.Sc., Ph.D.(McG.)

Associate Professors

Maurice Chacron; Ph.D.(Ott.)
 Erik Cook; Ph.D.(Baylor College, Houston)
 Mladen Glavinovic; B.Sc.(Zagreb), M.Sc.(Tor.), Ph.D.(McG.)
 Michael Guevara; B.Sc., M.Eng., Ph.D.(McG.)
 Pejmun Haghighi; Ph.D.(McG.)
 Julio Martinez-Trujillo; Ph.D.(Tübingen)
 Ursula Stochaj; Ph.D.(Cologne)
 Ann Wechsler; B.A.(Tor.), M.Sc., Ph.D.(McG.)

Associate Professor (Part-time)

Nicole Bernard; B.Sc.(McG.), Ph.D.(Duke)

Associate Members

Anaesthesia: Steven Backman

Associate Members

Biomedical Engineering: Robert E. Kearney, Satya Prakash

Dentistry: Fernando Cervero

Electrical and Computer Engineering: Sam Musallam

Kinesiology and Physical Education: Dilson Rassier

Medicine: Volker Blank, Mark Blostein, Andrey Cybulsky, Raymonde Gagnon, Geoffrey Hendy, Louise Larose, Anne Marie Lauzon, Serge Lemay, James Martin, Mariana Newkirk, Barry Posner, Shafaat Rabbani, Mary Stevenson, Tomoko Takano, Elena Torban, Simon Wing, Hans Zingg

Microbiology and Immunology: Jörg Fritz

Neurology and Neurosurgery: Jack Antel, Massimo Avoli, Daniel Guitton, Christopher Pack, David Ragsdale, Ed Ruthazer, Amir Shmuel, Melissa Vollrath

Ophthalmology: Curtis Baker

Otolaryngology: Bernard Segal

Pediatrics: Charles Rohlicek

Pharmacology: Terence Hebert

Psychiatry: Nicolas Cermakian, Bernardo Dubrovsky,

Research in Neuroscience: Charles Bourque, Sal T. Carbonetto

Adjunct Professor

Roy Caplan, Montreal

14.30.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physiology (50 credits)**Required Courses (38 credits)**

* Students who have taken CHEM 212 and/or CHEM 222 in CEGEP are exempted and must replace these credits with an elective course(s).

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

Complementary Courses (12 credits)

12 credits selected as follows:

3 credits selected from:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

3 credits selected from:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry

Upper-Level Physiology (ULP) Courses

6 credits selected from the Upper-Level Physiology (ULP) course list as follows:

All Physiology courses 400 level and above.

Note:

The 6-credit course PHGY 459D1/D2 equals 3 credits of ULP and 3 credits of electives.

The 9-credit course PHGY 461D1/D2 equals 3 credits of ULP and 6 credits of electives.

ANAT 541	(3)	Cell and Molecular Biology of Aging
BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 01
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 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
PHGY 524	(3)	Chronobiology
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

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

Complementary Courses (28 credits)

12-13 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

3 credits, one of:

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

3-4 credits, one of:

ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology

Upper Level Physiology (ULP) Courses

9 credits selected from the Upper-Level Physiology (ULP) course list as follows:

All Physiology courses 400 level and above.

Note:

The 6-credit course PHGY 459D1/D2 equals 3 credits of ULP and 3 credits of electives.

The 9-credit course PHGY 461D1/D2 equals 3 credits of ULP and 6 credits of electives.

ANAT 541	(3)	Cell and Molecular Biology of Aging
BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 01
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 413	(3)	Parasitology

MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
PHGY 524	(3)	Chronobiology
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

Upper Level Science (ULS) Courses

6 credits selected from the Upper-Level Science (ULS) course list as follows:

Note:

For Anatomy, Chemistry, Neurology, and Neurosurgery: select from all courses 300 level and above and the ULS courses listed below.

For Biochemistry, Computer Science, Microbiology and Immunology, Mathematics, Physics, and Pathology: select from all courses 300 level and above.

For Biology, Experimental Medicine, Pharmacology, and Psychology: select from the ULS courses listed below:

ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 309	(3)	Mathematical Models in Biology
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 324	(3)	Ecological Genetics
BIOL 370	(3)	Human Genetics Applied
BIOL 373	(3)	Biometry
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 416	(3)	Genetics of Mammalian Development
BIOL 468	(6)	Independent Research Project 3
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
CHEM 214	(3)	Physical Chemistry/Biological Sciences 2
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 01
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
EXMD 510	(3)	Bioanalytical Separation Methods
NEUR 310	(3)	Cellular Neurobiology
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 562	(3)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2
PHAR 599	(6)	Pharmacology Research Project
PSYC 302	(3)	The Psychology of Pain
PSYC 311	(3)	Human Cognition and the Brain
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

14.30.6 Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (77 credits)

U1 Required Courses (14 credits)

BIOL 200	(3)	Molecular Biology
BIOL 309	(3)	Mathematical Models in Biology
MATH 222	(3)	Calculus 3
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

One of:

MATH 223	(3)	Linear Algebra
MATH 247	(3)	Honours Applied Linear Algebra

U1 Complementary Courses (15 credits)

3 credits, one of:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

6 credits selected as follows:

PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

3 credits, one of:

MATH 248	(3)	Honours Advanced Calculus
MATH 314	(3)	Advanced Calculus

3 credits, one of:

MATH 315	(3)	Ordinary Differential Equations
MATH 325	(3)	Honours Ordinary Differential Equations

U2 Required Courses (24 credits)

MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 323	(3)	Probability
MATH 326	(3)	Nonlinear Dynamics and Chaos
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

U2 or U3 Required Courses (6 credits)

MATH 437	(3)	Mathematical Methods in Biology
PHYS 413	(3)	Physical Basis of Physiology

U3 Required Courses (18 credits)

BMDE 519	(3)	Biomedical Signals and Systems
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 324	(3)	Statistics
PHGY 461D1	(4.5)	Experimental Physiology
PHGY 461D2	(4.5)	Experimental Physiology

14.30.7 Bachelor of Science (B.Sc.) - Major Physiology and Physics (80 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.

U1 Required Courses (17 credits)

* The corequisite BIOL 200, BIOL 201 is waived for this program.

MATH 222	(3)	Calculus 3
PHGY 212*	(1)	Introductory Physiology Laboratory 1
PHGY 213*	(1)	Introductory Physiology Laboratory 2
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 257	(3)	Experimental Methods 1

PHYS 258 (3) Experimental Methods 2

U2 Required Courses (21 credits)

MATH 326 (3) Nonlinear Dynamics and Chaos
PHGY 311 (3) Channels, Synapses & Hormones
PHGY 312 (3) Respiratory, Renal, & Cardiovascular Physiology
PHGY 313 (3) Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314 (3) Integrative Neuroscience
PHYS 328 (3) Electronics
PHYS 339 (3) Measurements Laboratory in General Physics

U2 or U3 Required Courses (6 credits)

MATH 437 (3) Mathematical Methods in Biology
PHYS 413 (3) Physical Basis of Physiology

U3 Required Courses (21 credits)

BMDE 519 (3) Biomedical Signals and Systems
PHGY 461D1 (4.5) Experimental Physiology
PHGY 461D2 (4.5) Experimental Physiology
PHYS 333 (3) Thermal and Statistical Physics
PHYS 340 (3) Majors Electricity and Magnetism
PHYS 446 (3) Majors Quantum Physics

U1 Complementary Courses (9 credits)

3 credits, one of:

MATH 223 (3) Linear Algebra
MATH 247 (3) Honours Applied Linear Algebra

6 credits selected as follows:

** The corequisite BIOL 200, BIOL 201 is waived for this program.

PHGY 209 (3) Mammalian Physiology 1
PHGY 210** (3) Mammalian Physiology 2

U2 Complementary Courses (6 credits)

3 credits, one of:

MATH 315 (3) Ordinary Differential Equations
MATH 325 (3) Honours Ordinary Differential Equations

3 credits, one of:

MATH 248	(3)	Honours Advanced Calculus
MATH 314	(3)	Advanced Calculus

14.30.8 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 May 21. Application forms are available online at physiology.med@mcgill.ca or a hard copy can be picked up at McIntyre 1021. An e-mail 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
BIOL 301	(4)	Cell and Molecular Laboratory
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 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
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

3 credits, one of:

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

Upper-Level Physiology (ULP) Courses

6 credits selected from the Upper-Level Physiology (ULP) course list as follows:

All Physiology courses 400 level and above.

ANAT 541	(3)	Cell and Molecular Biology of Aging
BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 01
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 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
PHGY 524	(3)	Chronobiology
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

14.30.9 Physiology (PHGY) Related Programs

14.30.9.1 Interdepartmental Honours in Immunology

For more information, see [section 14.17: 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, ciro.piccirillo@mcgill.ca, 514-398-2872; or Dr. Monroe Cohen, Physiology, monroe.cohen@mcgill.ca, 514-398-4342.

14.31 Psychiatry (PSYT)

14.31.1 Location

1033 Pine Avenue West, Room 105
Montreal, Quebec H3A 1A1
Telephone: 514-398-4176
Website: www.med.mcgill.ca/psychiatry

14.31.2 About Psychiatry

There are no B.Sc. programs in Psychiatry, but the PSYT courses listed below are administered by the Faculty of Science and are open to Arts and Science students and to graduate students.

Courses

PSYT 199	FYS: Mental Illness and the Brain
PSYT 301	Issues in Drug Dependence
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 505	Neurobiology of Schizophrenia
PSYT 515	Advanced Studies in Addiction

14.32 Psychology (PSYC)

14.32.1 Location

Stewart Biology Building, Room W8/1
1205 Dr. Penfield Avenue
Montreal, Quebec H3A 1B1

Telephone: 514-398-6100
Fax: 514-398-4896
Email: info@psych.mcgill.ca
Website: www.psych.mcgill.ca

14.32.2 About Psychology

The Department of Psychology offers programs in both Arts and Science. All B.A. programs in Psychology can be found under *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Arts > Undergraduate > Academic 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 studies social interactions. As a biological science, it regards humans as the product of evolution and so studies them in biological perspective, comparing and contrasting human behaviour with that of other species.

The data of psychology are collected within the psychological laboratory by the use of experimental methods in the study of behaviour, and outside the laboratory by systematic observation of the behaviour of humans and animals. The aim is to formulate general principles of perception, learning, motivation, cognition, and social psychology that are relevant to different aspects of human life. Experimentation, laboratory techniques, observational procedures, measurement, and statistical methods are important tools of the psychologist.

Psychology has many interdisciplinary aspects. The study of psychological problems often involves knowledge drawn from other disciplines such as biology, physiology, linguistics, sociology, philosophy, and mathematics. For this reason, a student with varied interests can frequently find a place for these in psychology.

Psychology is a young science so that explanations of the processes underlying observed phenomena are often theoretical and speculative. The major objectives of psychological study are to reduce the discrepancy between theory and fact and to provide better answers about why humans think and behave as they do.

Although a number of undergraduate courses in psychology have applied implications, applied training is not the purpose of the undergraduate curriculum. Its purpose is to introduce the student to an understanding of the basic core of psychological knowledge, theory, and method, regardless of questions of practical application.

The B.Sc. or B.A. with a major or honours degree in psychology is not a professional qualification. It does not qualify the individual to carry on professional work in psychology. In the province of Quebec, the minimum requirement for membership in the Order of Psychologists, the professional association governing the work of psychologists in the province, is a doctoral degree. However, the Order also has a number of undergraduate course requirements that you should consult in planning your degree if you ultimately hope to apply for membership in the Order of Psychologists of Quebec. Please see their website: www.ordrepsy.qc.ca/en/psychologue/obligations/laws-and-regulations.sn. All students planning to practise in the province of Quebec will also be examined on their proficiency in French before being admitted to the professional association. Undergraduate courses in psychology may prove of considerable value

to students planning careers in professional fields other than psychology. These include, but are not restricted to, medicine, education, social work, human communication sciences, or business and industry.

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 psychology, child psychology, industrial psychology, community psychology, educational psychology, and others.

Requirements for admission to graduate studies in Psychology vary from one university to another and from one country to another. Nonetheless, both the Honours and Major degrees in Psychology may qualify the student for admission to many graduate schools, provided that sufficiently high grades are obtained and, in some cases, that research experience has been obtained. During the U2 year, undergraduate students are strongly advised to verify the admission requirements of various graduate programs. This is to ensure that sufficient time is available for students to complete all necessary requirements for admission to their preferred graduate programs.

The essential differences between the Honours and the Major program are an emphasis on research methodology courses and practice in the Honours program, and that higher academic standards are required of Honours students. Honours students also have an opportunity to work in small groups closely with staff members.

14.32.3 Information Meetings for New Students

All new students entering the Psychology undergraduate program are required to attend an information meeting prior to registration. Students who have been accepted into a Bachelor of Science program in Psychology **must** attend one of these meetings. Newly admitted students from CEGEPs should attend the information session in June. There will be an identical information session in August for all other students and for any CEGEP students who could not attend the earlier meeting. Please check the Psychology Department website for the specific dates at: www.psych.mcgill.ca/ugrad/ugradm.htm. Students accepted into a Bachelor of Arts program must attend a different information meeting. (For details, see *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Arts > Undergraduate > Academic Programs > : Psychology (PSYC)*.) At this meeting, Paola Carvajal, the Academic Adviser, will explain the requirements of the Department's programs. Incoming students will have an opportunity to ask questions and receive advice on how to plan their courses. After this meeting, students will make appointments for individual advising sessions and fill out their Study Plan form for registration.

Entering students must bring their letter of acceptance and a copy of their collegial transcript(s). They will also need access to this publication and a preliminary Class Schedule before their individual advising session. Students will also find the *Psychology Department Handbook* helpful. It contains more detailed descriptions of Psychology courses and provides guidelines for how students might pursue particular areas of interest. The handbook is available on the Department website: www.psych.mcgill.ca/ugrad/ugradm.htm.

Students entering the Psychology program in January are strongly encouraged to visit the Academic Adviser, Paola Carvajal, in early December to clarify their course selections.

14.32.4 Psychology (PSYC) Faculty

Chair

David C. Zuroff

Emeritus Professors

Albert S. Bregman; M.A.(Tor.), Ph.D.(Yale)

Don C. Donderi; B.A., B.Sc.(Chic.), Ph.D.(C'nell)

Virginia I. Douglas; B.A.(Qu.), M.A., M.S.W., Ph.D.(Mich.)

Keith B.J. Franklin; B.A., M.A.(Auck.), Ph.D.(Lond.)

A.A.J. Marley; B.Sc.(Birm.), Ph.D.(Penn.)

Ronald Melzack; B.Sc., M.Sc., Ph.D.(McG.), F.R.S.C. (*E.P. Taylor Emeritus Professor of Psychology*)

Peter M. Milner; B.Sc.(Leeds), M.Sc., Ph.D.(McG.)

James O. Ramsay; B.Ed.(Alta.), Ph.D.(Princ.)

Yoshio Takane; B.L., M.A.(Tokyo), Ph.D.(N. Carolina)

Norman M. White; B.A.(McG.), M.S., Ph.D.(Pitt.)

Professors

Frances E. Aboud; B.A.(Tor.), M.A., Ph.D.(McG.)

Mark Baldwin; B.A.(Tor.), M.A., Ph.D.(Wat.)

Irving M. Binik; B.A.(NYU), B.H.L.(Jewish Theological Seminary), M.A., Ph.D.(Penn.)

Blaine Ditto; B.S.(Iowa), Ph.D.(Ind.)

Fred H. Genesee; B.A.(W. Ont.), M.A., Ph.D.(McG.)

Professors

Richard F. Koestner; B.A., Ph.D.(Roch.)
 Daniel J. Levitin; A.B.(Stan.), M.S., Ph.D.(Ore.) (*James McGill Professor*)
 John Lydon; B.A.(Notre Dame), M.A., Ph.D.(Wat.)
 Jeffrey S. Mogil; B.Sc.(Tor.), Ph.D.(Calif.-LA) (*E.P. Taylor Professor of Psychology and Canada Research Chair in Genetics of Pain*)
 Debbie S. Moskowitz; B.S.(Kirkland), M.A., Ph.D.(Conn.)
 Karim Nader; B.Sc., Ph.D.(Tor.) (*James McGill Professor*)
 Yuriko Oshima-Takane; B.A.(Tokyo Women's Christian Univ.), M.A.(Tokyo), Ph.D.(McG.)
 David J. Ostry; B.A.Sc., M.A.Sc., Ph.D.(Tor.)
 Caroline Palmer; B.Sc.(Mich.), M.Sc.(Rutg.), Ph.D.(C' nell) (*Canada Research Chair in Cognitive Neuropsychology of Performance*)
 Michael Petrides; B.Sc., M.Sc.(Lond.), Ph.D.(Cant.) (*joint appt. with Neurology and Neurosurgery*)
 Robert O. Pihl; B.A.(Lawrence), Ph.D.(Ariz.)
 Barbara B. Sherwin; B.A., M.A., Ph.D.(C'dia) (*Canada Research Chair on Hormones, Brain and Cognition*)
 Thomas R. Shultz; B.A.(Minn.), Ph.D.(Yale)
 Michael J.L. Sullivan; B.A.(McG.), M.A., Ph.D.(C'dia) (*Canada Research Chair in Behavioural Health*)
 Donald M. Taylor; B.A., M.A., Ph.D.(W. Ont.)
 David C. Zuroff; B.A.(Harv.), M.A., Ph.D.(Conn.)

Associate Professors

A.G. Baker; B.A.(Br. Col.), M.A., Ph.D.(Dal.)
 Evan S. Balaban; B.A.(Mich. St.), Ph.D.(Rockefeller)
 Heungsun Hwang; B.A.(Chung-Ang Univ.), Ph.D.(McG.) (*William Dawson Scholar*)
 Baerbel Knaeuper; Dipl., Dr. phil.(U. of Mannheim), Dr. phil. habil.(Free Univ., Berlin)
 Morton J. Mendelson; B.Sc.(McG.), A.M., Ph.D.(Harv.)
 Gillian A. O'Driscoll; B.A.(Welles.), M.A., Ph.D.(Harv.)
 Kristine Onishi; B.A.(Brown), M.A., Ph.D.(Ill.)
 Maria Pompeiano; M.D., Ph.D.(Pisa)
 Zeev Rosberger; B.Sc.(McG.), M.A., Ph.D.(C'dia) (*part-time*)
 Debra Titone; B.A.(NYU), M.A., Ph.D.(SUNY, Binghamton) (*Canada Research Chair in Cognitive Neuroscience of Language and Memory*)

Assistant Professors

Jennifer A. Bartz; B.A.(C'dia), M.A., Ph.D.(McG.)
 Ian F. Bradley; B.Sc., M.Sc.(Tor.), Ph.D.(Wat.) (*part-time*)
 Yogita Chudusama; B.Sc., Ph.D.(Cardiff Univ.)
 Melanie Dirks; B.A.(McM.), M.S., M.Phil., Ph.D.(Yale)
 Jelena Ristic; B.A., M.A., Ph.D.(Br. Col.)
 Hsiu-Ting Yu; B.S.(Taiwan), M.S., M.A., Ph.D.(Ill.-Urbana-Champaign)

Lecturers

Rhonda Amsel; B.Sc., M.Sc.(McG.)
 Paola Carvajal; B.Sc.(C'dia), M.A.(McG.)

Associate Members

Clinical Research Institute of Montreal: Terence J. Coderre
 Douglas Hospital: Jorge Armony, Suzanne King, Martin Lepage, Jens Pruessner, Maria Natasha Rajah, Howard Steiger

Associate Members

Jewish General Hospital: David Dunkley, Phyllis Zerkowitz

Montreal Neurological Institute: Alain Dagher, Lesley Fellows, Daniel Guitton, Marilyn Jones-Gotman, Brenda Milner, Edward Ruthazer, Wayne Sossin, Viviane Sziklas, Robert Zatorre

Psychiatry: Marco Leyton, Amir Raz

Schulich School of Music: Stephen McAdams

Vision Research Unit (Ophthalmology): Curtis Baker, Robert Hess, Frederick A.A. Kingdom, Kathleen Mullen

Adjunct Professors

M. Bruck; B.A.(Wheaton), M.A., Ph.D.(McG.)

S. Burstein; B.Sc.(McG.), M.A., Ph.D.(Wat.)

P. Delise; B.Sc., M.Ps., Ph.D.(Montr.)

S. Harnard; B.A.(McG.), M.A.(McG.), M.A., Ph.D.(Princ.)

Z. Pleszewski; M.A., Ph.D.(Poznan)

P. Zelazo; B.A.(Amer. Int'l. Coll.), M.S.(N. Carolina), Ph.D.(Wat.)

Part-time Appointments

Jennifer Coelho; B.Sc.(Br. Col.), M.A., Ph.D.(Tor.)

Frank Elgar; B.A., M.Sc., Ph.D.(Dal.)

Elizabeth Foley; B.Sc.(Tor.), Ph.D.(McG.)

Judith LeGallais; B.A., M.A., Ph.D.(McG.)

14.32.5 Admission Requirements to the Bachelor of Science (B.Sc.) – Honours Psychology

Applications can be obtained from the Undergraduate Office of the Department of Psychology, Room N7/9A, Stewart Biology Building. The applications must be completed and returned to the Undergraduate Office by August 1 for September admission. Candidates will be advised of the Department's decision via email before classes begin in September.

Students should note that awarding of the Honours degree will depend on both cumulative grade point average and a minimum grade of B on PSYC 380D1/PSYC 380D2 and PSYC 482. "First Class Honours" is awarded to students who obtain a minimum cumulative grade point average of 3.50, a minimum program GPA of 3.50, and a minimum grade of A- in the required Honours courses, namely PSYC 380D1/PSYC 380D2 and PSYC 482. "Honours" is awarded to students with a minimum cumulative grade point average of 3.00, a minimum program GPA of 3.00, and a minimum grade of B in the required Honours courses, namely PSYC 380D1/PSYC 380D2 and PSYC 482. Moreover, the awarding of the Honours degree normally requires completion of two full years of study, U2 and U3, in the Honours program. Students with particularly strong academic records may be admitted for the U3 year only on the basis of their marks and research experience. These students must complete all Honours program requirements.

For more information, see [section 14.32.9: Bachelor of Science \(B.Sc.\) - Honours Psychology \(60 credits\)](#).

14.32.6 Bachelor of Science (B.Sc.) - Minor Psychology (24 credits)

A minor program in Psychology is available to students registered in any B.Sc. program other than Psychology. This program is intended to complement a student's primary field of study by providing a focused introduction to specialized topics in psychology.

A separate minor concentration exists for students registered in a program in the Faculty of Arts.

The Minor program for Science students requires the completion of 24 credits, of which no more than 6 may overlap with the primary program. All courses in the Minor program must be passed with a minimum grade of C. A prerequisite to the program is PSYC 204 or equivalent.

Complementary Courses (24 credits)

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.

14.32.7 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
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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 Quantitative Methods).

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning & 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 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 Behaviour
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 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 532	(3)	Cognitive Science
PSYC 536	(3)	Correlational Techniques
PSYC 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication & 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 316	(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: Abnormal Psychology 1
PSYC 338	(3)	Introduction: Abnormal Psychology 2
PSYC 351	(3)	Research Methods in Social Psychology
PSYC 408	(3)	Principles of Cognitive Behaviour Therapy
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
PSYC 530	(3)	Applied Topics in Deafness
PSYC 533	(3)	International Health Psychology
PSYC 535	(3)	Advanced Topics in Social Psychology

15 credits in Psychology at the 300 level or above.

6 credits in Psychology at the 400 or 500 level.

14.32.8 Bachelor of Science (B.Sc.) - Major Psychology (54 credits)

Students majoring in Psychology must obtain a minimum grade of C in all 54 credits of the program. A grade lower than C may be made up by taking another equivalent course (if there is one), by successfully repeating the course, or by successfully writing a supplemental examination (if there is one).

Recommended Background

It is expected that most students who enter the Major 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. 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 the recommended collegial-level biology must take BIOL 111 or BIOL 112, and those who have not taken Introductory Psychology in college must take PSYC 100.

U1 Required Courses (12 credits)

Note: PSYC 100 may be taken as a corequisite with these basic courses.

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

U1 or U2 Required Course (3 credits)

PSYC 305	(3)	Statistics for Experimental Design
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Complementary Courses (39 credits)

List A

6 credits in Psychology from List A (Behavioural Neuroscience, Cognition and Quantitative Methods).

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning & 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 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 Behaviour
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 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 532	(3)	Cognitive Science
PSYC 536	(3)	Correlational Techniques
PSYC 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication & 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 316	(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: Abnormal Psychology 1
PSYC 338	(3)	Introduction: Abnormal Psychology 2
PSYC 351	(3)	Research Methods in Social Psychology
PSYC 408	(3)	Principles of Cognitive Behaviour Therapy
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
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.

9 credits in Psychology at the 400 or 500 level.

12 credits at the 300 level or above in any of the following disciplines: Psychology (PSYC), Anatomy and Cell Biology (ANAT), Biology (BIOL), Biochemistry (BIOC), Chemistry (CHEM), Computer Science (COMP), Mathematics (MATH), Physiology (PHGY), Psychiatry (PSYT).

14.32.9 Bachelor of Science (B.Sc.) - Honours Psychology (60 credits)

Honours in Psychology prepares students for graduate study, and so emphasizes practise in the research techniques which are used in graduate school and professionally later on. Students are normally accepted into Honours at the beginning of their U2 year, and the two-year sequence of Honours courses continues through U3.

Recommended Background

It is expected that most students who enter the Honours 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. 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 the recommended collegial-level biology must take BIOL 111 or BIOL 112, and those who have not taken Introductory Psychology in CEGEP must take PSYC 100.

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 is limited, the usual CGPA for admission to this program is 3.50. Students must complete 27 graded credits in their U1 academic year to be eligible to apply to the Honours program.

Students must complete the following courses in their U1 year to be eligible to apply to the Honours program: PSYC 204, PSYC 211, PSYC 212, PSYC 213, and PSYC 215. Students are advised to complete PSYC 305 in their U1 year. Once in the Honours program, the student must obtain a GPA of 3.00 in the U2 year in order to continue in the program for U3. Honours students are encouraged to take at least 27 graded credits per academic year. This is also usually the minimum number of credits required to be eligible for fellowships and awards.

U1 Required Courses (12 credits)

Note: PSYC 100 may be taken as a corequisite with these basic courses.

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

U1 or U2 Required Course (3 credits)

PSYC 305 (3) Statistics for Experimental Design

U2 Required Courses (9 credits)

PSYC 380D1 (4.5) Honours Research Project Seminar

PSYC 380D2 (4.5) Honours Research Project Seminar

U3 Required Course (3 credits)

PSYC 482 (3) Advanced Honours Seminar

Complementary Courses (33 credits)

12 credits to be selected from the list below and any Psychology course at the 500 level.

PSYC 403 (3) Modern Psychology in Historical Perspective

PSYC 483 (3) Seminar in Experimental Psychopathology

PSYC 495 (6) Psychology Research Project 2

PSYC 496 (6) Senior Honours Research 1

PSYC 497 (6) Senior Honours Research 2

PSYC 498D1 (4.5) Senior Honours Research

PSYC 498D2 (4.5) Senior Honours Research

List A

6 credits in Psychology from List A (Behavioural Neuroscience, Cognition, and Quantitative Methods).

NSCI 201 (3) Introduction to Neuroscience 2

PSYC 301 (3) Animal Learning & 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 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 Behaviour

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 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 532	(3)	Cognitive Science
PSYC 536	(3)	Correlational Techniques
PSYC 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication & 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 316	(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: Abnormal Psychology 1
PSYC 338	(3)	Introduction: Abnormal Psychology 2
PSYC 351	(3)	Research Methods in Social Psychology
PSYC 408	(3)	Principles of Cognitive Behaviour Therapy
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
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).

14.33 Redpath Museum (REDM)

14.33.1 Location

Redpath Museum
859 Sherbrooke Street West
Montreal, Quebec H3A 0C4

Telephone: 514-398-4086 ext. 3188

Fax: 514-398-3185

Website: www.mcgill.ca/redpath

14.33.2 About the Redpath Museum

The Redpath Museum exists to foster 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 399	Science Writing
REDM 400	Science and Museums
REDM 405	Natural History of East Africa
REDM 410	Writing Research Articles

14.33.3 Redpath Museum (REDM) Faculty

Revision, August 2013. Start of revision.

Director

David M. Green

Emeritus Professor

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

Professor

David M. Green; B.Sc.(Br. Col.), M.Sc., Ph.D.(Guelph), F.L.S.

Associate Professors

Andrew Hendry; B.Sc.(Vic., BC), M.Sc., Ph.D.(Wash.) (*joint appt. with Biology*)

Hans C.E. Larsson; B.Sc.(McG.), Ph.D.(Chic.) (*CRC Tier 2 Chair in Paleontology*)

Associate Professors

Anthony Ricciardi; B.Sc.(Agr.), M.Sc., Ph.D.(McG.) (*joint appt. with McGill School of Environment*)

Assistant Professors

Rowan D.H. Barrett; B.Sc.(Guelph), M.Sc.(McG.), Ph.D.(Br. Col.)

Virginie Millien; Maîtrise(Paris VI), DEA, Ph.D.(Montpellier II)

Faculty Lecturer

Linda Cooper; B.A.(C'dia), M.A.(McM.)

Associate Members

Biology: Graham A.C. Bell, Lauren J. Chapman

Earth & Planetary Sciences: Jeanne Paquette

McGill School of Environment: Colin A. Chapman

Tomlinson Project in University Level Science Education (T-PULSE): Nicholas de Takacsy

Adjunct Professors

Robert Holmes

Henry M. Reiswig

Michael Woloch

Revision, August 2013. End of revision.

14.33.4 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. Museum collections are used to provide hands-on experience with real objects and specimens. The required course brings students to the Redpath Museum and other McGill natural science museums and exposes them to natural history methodologies and the value of specimen-based studies. Complementary course lists are drawn from a variety of disciplines to emphasize breadth and integration with the inclusion of specimen- or object-based courses and field courses in zoology, botany, and earth and environmental sciences. To ensure breadth, students are required to choose courses from among these lists. A compulsory field course component rounds out the program.

Required Course (3 credits)

REDM 400 (3) Science and Museums

Complementary Courses (21 credits)

Students select 21 credits from among four course lists (A (Zoology), B (Botany), C (Earth and Environmental Sciences), and D (Field Courses)) with the following specifications.

- At least 3 credits and no more than 9 credits from each of Lists A, B, and C.
- At least 3 credits from List D.
- No more than 3 credits from any one list may be at the 200 level.

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

List A: Zoology

* Note: BIOL 205 and BIOL 215 may be applied to either List A or List B.

** Note: Students may take either ENTO 330 or one of the cross-listed courses BIOL 350 and ENTO 350 as these courses have similar content.

AEBI 211	(3)	Organisms 2
ANTH 312	(3)	Zooarchaeology
BIOL 205*	(3)	Biology of Organisms
BIOL 215*	(3)	Introduction to Ecology and Evolution
BIOL 305	(3)	Animal Diversity

BIOL 350**	(3)	Insect Biology and Control
BIOL 352	(3)	Vertebrate Evolution
BIOL 418	(3)	Freshwater Invertebrate Ecology
BIOL 427	(3)	Herpetology
BIOL 463	(3)	Mammalian Evolution
ENTO 330**	(3)	Insect Biology
ENTO 350**	(3)	Insect Biology and Control
ENTO 440	(3)	Insect Diversity
ENTO 535	(3)	Aquatic Entomology
EPSC 334	(3)	Invertebrate Paleontology
WILD 307	(3)	Natural History of Vertebrates
WILD 350	(3)	Mammalogy
WILD 420	(3)	Ornithology

List B: Botany

* Note: BIOL 205 and BIOL 215 may be applied to either List A or List B.

AEBI 210	(3)	Organisms 1
BIOL 205*	(3)	Biology of Organisms
BIOL 215*	(3)	Introduction to Ecology and Evolution
BIOL 240	(3)	Monteregian Flora
BIOL 355	(3)	Trees: Ecology & Evolution
PLNT 304	(3)	Biology of Fungi
PLNT 353	(3)	Plant Structure and Function
PLNT 358	(3)	Flowering Plant Diversity
PLNT 460	(3)	Plant Ecology

List C: Earth and Environmental Sciences

BIOL 540	(3)	Ecology of Species Invasions
ENVR 200	(3)	The Global Environment
ENVR 202	(3)	The Evolving Earth
EPSC 210	(3)	Introductory Mineralogy
EPSC 233	(3)	Earth and Life History
ESYS 200	(3)	Earth System Processes
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

14.34 Science or Mathematics for Teachers

14.34.1 Location

Dawson Hall, Room 405
853 Sherbrooke Street West
Montreal, Quebec H3A 0G5

Fax: 514-398-2157

Email: pete.barry@mcgill.ca

Website: www.mcgill.ca/scienceforteachers

14.34.2 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 have introduced several programs for students who wish to combine Science or Mathematics with Education at McGill. These include the Minor in Education for Science Students, and the Concurrent B.Sc. and B.Ed. The traditional Bachelor of Education, Secondary Program, Science and Technology, or Secondary Program, Mathematics is also available within the Faculty of Education; see *Programs, Courses and University Regulations > Faculties & Schools > Faculty of Education > Undergraduate > Department of Integrated Studies in Education > : Overview of Programs (Integrated Studies in Education)*.

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 a substantial number of the necessary credits for the B.Ed. degree should they wish to enrol in that program. The Minor also allows the possibility of transferring into the Concurrent B.Sc. and B.Ed. For details, see [section 14.34.4: Bachelor of Science \(B.Sc.\) - Minor Education for Science Students \(18 credits\)](#).

The Concurrent B.Sc. and B.Ed. is intended as a very rigorous but rewarding alternative to taking the B.Sc. and the B.Ed. in sequence. It is specifically designed to prepare teacher/scientists and is aligned with the requirements of the Quebec MERST. It has been designed to provide students with the opportunity to attain both a B.Sc. degree and a B.Ed. degree at the same time. It is highly structured and closely integrated so as to satisfy the academic requirements of both degrees.

To be admitted, candidates must satisfy the admission requirements of both faculties. Normally, students will be admitted to both components of the Concurrent B.Sc. and B.Ed. simultaneously. It is possible for students to apply for transfer into this program at any time during their B.Sc. or B.Ed. program. However, because this is a concurrent program, both degrees must be granted at the same convocation. After admission, students should contact one of the coordinators to discuss course selection and scheduling.

Students in the Concurrent B.Sc. and B.Ed. may apply to transfer to either a conventional B.Sc. or a conventional B.Ed. program. To do so, they must submit a Faculty Transfer Application to the appropriate Student Affairs Office. The decision will be based on their grades in the relevant component of the Concurrent program. Students who do transfer to a conventional program may not transfer back to the Concurrent program.

The two components of the Concurrent B.Sc. and B.Ed. are the B.Ed. Secondary Program (120 credits) and one of the B.Sc. programs for teachers (90 credits, or 120 credits for students who have not completed the basic sciences). They are combined in such a way that students complete 135 or 165 credits to fulfil all the requirements for graduation for both the B.Ed. and the B.Sc. These combinations are created exceptionally and exclusively for the Concurrent B.Sc. and B.Ed. For more detailed information about the Concurrent program, particularly how some elements are double-counted so as to satisfy the requirements of both the Faculty of Education and the Faculty of Science, see the program website: www.mcgill.ca/scienceforteachers.

Details of the nine different combinations, including an identification of the elements that are double-counted, are found at the links below. Eight combinations for Science have been specifically designed to align with the teachable subject areas in Education. Each incorporates one Major concentration and one Minor. Note that Major concentrations are not the same as Major programs. The Mathematics combination includes the Major, not the Major concentration, in Mathematics.

- *section 14.34.5: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Chemistry for Teachers (135 credits)*
- *section 14.34.6: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Chemistry for Teachers (135 credits)*
- *section 14.34.7: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Physics for Teachers (135 credits)*
- *section 14.34.8: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Physics for Teachers (135 credits)*
- *section 14.34.9: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Biology for Teachers (135 credits)*
- *section 14.34.10: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Physics for Teachers (135 credits)*
- *section 14.34.13: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Mathematics for Teachers (135 credits)*
- *section 14.34.11: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Biology for Teachers (135 credits)*
- *section 14.34.12: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Chemistry for Teachers (135 credits)*

14.34.3 Science or Mathematics for Teachers Faculty

Concurrent B.Sc. and B.Ed.

Coordinator – Science
Pete Barry
Telephone: 514-398-3202

Coordinator – Education
G. Seiler (*on leave*)
Telephone: 514-398-7106

Minor in Education for Science Students

Program Adviser
Joan Barrett
Student Affairs Office, Faculty of Education
General Information: 514-398-7042
Website: www.mcgill.ca/edu-sao/current/minorseducation

14.34.4 Bachelor of Science (B.Sc.) - Minor Education for Science Students (18 credits)

Revision, August 2013. Start of revision.

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 a substantial number of the necessary credits for the B.Ed. degree should they wish to enrol in that program. Students graduating with a B.Sc. should consider the Master of Arts in Teaching and Learning (<http://www.mcgill.ca/dise/progs/matl>) if they are interested in obtaining a teaching license.

For more information please contact:

Joan Barrett
Student Affairs Office, Faculty of Education
General Information: 514-398-7042
Website: <http://www.mcgill.ca/edu-sao/current/minorseducation>

Required Course (3 credits)

EDPE 300 (3) Educational Psychology

Complementary Courses (15 credits)

9 credits selected from:

One of:

EDEC 233	(3)	First Nations and Inuit Education
EDEC 248	(3)	Multicultural Education
EDEC 249	(3)	Global Education and Social Justice

One of:

EDEC 260	(3)	Philosophical Foundations
EDEC 261	(3)	Philosophy of Catholic Education

One of:

EDEC 247	(3)	Policy Issues in Quebec Education
EDEM 220	(3)	Contemporary Issues in Education

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 309	(3)	Diverse Learners

Revision, August 2013. End of revision.

14.34.5 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Chemistry for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Chemistry for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Biology - Cell/Molecular with Minor Chemistry is one of the nine variations of the program and allows students to focus their Science degree in Cell/Molecular Biology with a subspecialization in Chemistry.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of Major Concentration Biology - Cell/Molecular
- 18 credits of Minor Chemistry
- 15 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/specific/.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus I
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices (Secondary)
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)

EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
EDEC 261*	(3)	Philosophy of Catholic Education

Major Concentration Biology - Cell/Molecular (36 credits)

The Major Concentration Biology - Cell/Molecular is a planned sequence of courses designed to permit a degree of specialization in cell/molecular biology.

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

Required Courses

25 credits selected as follows:

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
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology

Complementary Courses

At least 11 credits selected from:

BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 370	(3)	Human Genetics Applied
BIOL 373	(3)	Biometry
BIOL 413	(1)	Directed Reading

BIOL 568	(3)	Topics on the Human Genome
BIOL 575	(3)	Human Biochemical Genetics

or other appropriate course at the 300 level or higher with the permission of an adviser.

Minor Chemistry (18 credits)

Required Courses

18 credits selected as follows:

* Note: denotes courses with CEGEP equivalents.

Substitutions for these by more advanced courses may be made at the discretion of the Adviser.

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

Additional Science Courses

15 credits selected as follows:

12 credits:

BIOL 210	(3)	Perspectives of Science
CHEM 381	(3)	Inorganic Chemistry 2
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3

plus 3 credits, one of:

CHEM 180	(3)	World of Chemistry: Environment
CHEM 181	(3)	World of Chemistry: Food
CHEM 182	(3)	World of Chemistry: Technology
CHEM 183	(3)	World of Chemistry: Drugs

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.34.6 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Chemistry for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Chemistry for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs." and "Quebec Teacher Certification".

The Major Concentration Biology - Organismal with Minor Chemistry is one of the nine variations of the program and allows students to focus their Science degree in Organismal Biology with a subspecialization in Chemistry.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of Major Concentration Biology - Organismal

- 18 credits of Minor Chemistry

- 15 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at <http://www.mcgill.ca/science/sousa/bsc/freshman>.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science

CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus 1
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education

EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices (Secondary)
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
EDEC 261*	(3)	Philosophy of Catholic Education

Major Concentration Biology - Organismal (36 credits)

The Major Concentration Biology - Organismal is a planned sequence of courses designed to permit a degree of specialization in organismal biology.

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

Required Courses

24 credits

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution

BIOL 304	(3)	Evolution
BIOL 308	(3)	Ecological Dynamics

Complementary Courses

12 credits selected from:

BIOL 303	(3)	Developmental Biology
BIOL 305	(3)	Animal Diversity
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 307	(3)	Behavioural Ecology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 331	(3)	Ecology/Behaviour Field Course
BIOL 342	(3)	Marine Biology
BIOL 350	(3)	Insect Biology and Control
BIOL 373	(3)	Biometry
BIOL 427	(3)	Herpetology
BIOL 435	(3)	Natural Selection
BIOL 441	(3)	Biological Oceanography
BIOL 465	(3)	Conservation Biology

or other appropriate course at the 300 level or higher with the permission of an adviser.

Minor Chemistry (18 credits)**Required Courses**

18 credits selected as follows:

* Note: denotes courses with CEGEP equivalents.

Substitutions for these by more advanced courses may be made at the discretion of the Adviser.

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

Additional Science Courses (15 credits)

15 credits selected as follows:

12 credits:

BIOL 210	(3)	Perspectives of Science
CHEM 381	(3)	Inorganic Chemistry 2
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3

plus 3 credits, one of:

CHEM 180	(3)	World of Chemistry: Environment
CHEM 181	(3)	World of Chemistry: Food
CHEM 182	(3)	World of Chemistry: Technology
CHEM 183	(3)	World of Chemistry: Drugs

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.34.7 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Physics for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Physics for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Biology - Cell/Molecular with Minor Physics is one of the nine variations of the program and allows students to focus their Science degree in Cell/Molecular Biology with a subspecialization in Physics.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of Major Concentration Biology - Cell/Molecular

- 18 credits of Minor Physics

- 15 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/specific/.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus 1
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices (Secondary)
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
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EDEC 261* (3) Philosophy of Catholic Education

Major Concentration Biology - Cell/Molecular (36 credits)

The Major Concentration Biology - Cell/Molecular is a planned sequence of courses designed to permit a degree of specialization in cell/molecular biology.

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

Required Courses*

29 credits selected as follows:

* Students who have already taken CHEM 212 or its equivalent will choose another appropriate complementary course, to be approved by the Adviser. Regardless of the substitution, students must take at least 36 credits in this program.

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
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
CHEM 212*	(4)	Introductory Organic Chemistry 1

Complementary Courses

At least 7 credits selected from:

BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 370	(3)	Human Genetics Applied
BIOL 373	(3)	Biometry
BIOL 413	(1)	Directed Reading
BIOL 568	(3)	Topics on the Human Genome
BIOL 575	(3)	Human Biochemical Genetics

or other appropriate course at the 300 level or higher with the permission of an adviser.

Minor Physics (18 credits)

Required Course

3 credits

PHYS 257	(3)	Experimental Methods 1
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Complementary Courses

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 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 260	(3)	Modern Physics and Relativity
PHYS 271	(3)	Introduction to Quantum Physics

One of:

PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 350	(3)	Honours Electricity and Magnetism

Additional Science Courses (15 credits)

BIOL 210	(3)	Perspectives of Science
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.34.8 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Physics for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Physics for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Biology - Organismal with Minor Physics is one of the nine variations of the program and allows students to focus their Science degree in Organismal Biology with a subspecialization in Physics.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

70 credits of Science Component consisting of:

- 37 credits of Major Concentration Biology - Organismal

- 18 credits of Minor Physics

- 15 credits of Additional Science Courses

5 credits of Electives, of which at least 2 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/specific/.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming

ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus 1
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman Year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education

EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices (Secondary)
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
EDEC 261*	(3)	Philosophy of Catholic Education

Major Concentration Biology - Organismal (37 credits)

The Major Concentration Biology - Organismal is a planned sequence of courses designed to permit a degree of specialization in organismal biology.

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

Required Courses*

28 credits selected as follows:

* Students who have already taken CHEM 212 or its equivalent will choose another appropriate complementary course, to be approved by the Adviser. Regardless of the substitution, students must take at least 36 credits in this program.

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution

BIOL 304	(3)	Evolution
BIOL 308	(3)	Ecological Dynamics
CHEM 212*	(4)	Introductory Organic Chemistry 1

Complementary Courses

9 credits selected from:

BIOL 303	(3)	Developmental Biology
BIOL 305	(3)	Animal Diversity
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 307	(3)	Behavioural Ecology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 331	(3)	Ecology/Behaviour Field Course
BIOL 342	(3)	Marine Biology
BIOL 350	(3)	Insect Biology and Control
BIOL 352	(3)	Vertebrate Evolution
BIOL 373	(3)	Biometry
BIOL 427	(3)	Herpetology
BIOL 435	(3)	Natural Selection
BIOL 441	(3)	Biological Oceanography
BIOL 465	(3)	Conservation Biology

or other appropriate course at the 300 level or higher with the permission of an adviser.

Minor Physics (18 credits)**Required Course**

3 credits

PHYS 257	(3)	Experimental Methods 1
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Complementary Courses

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 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 260	(3)	Modern Physics and Relativity
PHYS 271	(3)	Introduction to Quantum Physics

One of:

PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 350	(3)	Honours Electricity and Magnetism

Additional Science Courses (15 credits)

BIOL 210	(3)	Perspectives of Science
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus

Electives (5 credits)

5 credits, of which at least 2 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.34.9 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Biology for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Biology for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Chemistry with Minor Biology is one of the nine variations of the program and allows students to focus their Science degree in Chemistry with a subspecialization in Biology.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of the Major Concentration Chemistry

- 24 credits of the Minor Biology

- 9 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science Courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/specific/.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus 1
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices (Secondary)
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation

EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
EDEC 261*	(3)	Philosophy of Catholic Education

Major Concentration Chemistry (36 credits)

The Major Concentration Chemistry is not certified by the Ordre des Chimistes du Québec. Students interested in pursuing a career in Chemistry in Quebec are advised to take an appropriate B.Sc. program in Chemistry.

The Major concentration is a planned sequence of courses designed to permit a degree of specialization in this discipline.

Required Courses*

18 credits

* Note: Required courses taken at CEGEP or elsewhere that are not credited toward the Concurrent B.Sc. and B.Ed. must be replaced by courses from the Complementary Course List equal to or exceeding their credit value. Regardless of the substitution, students must take at least 36 credits in this program.

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

Complementary Courses

18 credits selected from:

CHEM 219	(3)	Introduction to Atmospheric Chemistry
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 367	(3)	Instrumental Analysis 1
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 382	(3)	Organic Chemistry: Natural Products

CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 571	(3)	Polymer Synthesis
CHEM 582	(3)	Supramolecular Chemistry
CHEM 591	(3)	Bioinorganic Chemistry

Minor Biology (24 credits)**Required Courses**

15 credits

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution

Complementary Courses

9 credits selected from the Biology Department's course offerings, at the 300 level or above.

Additional Science Courses (9 credits)

BIOL 210	(3)	Perspectives of Science
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.34.10 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Physics for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Physics for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Chemistry with Minor Physics is one of the nine variations of the program and allows students to focus their Science degree in Chemistry with a subspecialization in Physics.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of the Major Concentration Chemistry

- 18 credits of the Minor Physics

- 15 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/specific/.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus 1
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices (Secondary)
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)

EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
EDEC 261*	(3)	Philosophy of Catholic Education

Major Concentration Chemistry (36 credits)

The Major Concentration Chemistry is not certified by the Ordre des Chimistes du Québec. Students interested in pursuing a career in Chemistry in Quebec are advised to take an appropriate B.Sc. program in Chemistry.

The Major concentration is a planned sequence of courses designed to permit a degree of specialization in this discipline.

Required Courses*

18 credits selected as follows:

* Note: Required courses taken at CEGEP or elsewhere that are not credited toward the Concurrent B.Sc. and B.Ed. must be replaced by courses from the Complementary Course List equal to or exceeding their credit value. Regardless of the substitution, students must take at least 36 credits in this program.

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

Complementary Courses

18 credits selected from:

CHEM 219	(3)	Introduction to Atmospheric Chemistry
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 367	(3)	Instrumental Analysis 1

CHEM 381	(3)	Inorganic Chemistry 2
CHEM 382	(3)	Organic Chemistry: Natural Products
CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 571	(3)	Polymer Synthesis
CHEM 582	(3)	Supramolecular Chemistry
CHEM 591	(3)	Bioinorganic Chemistry

Minor Physics (18 credits)**Required Course**

3 credits

PHYS 257	(3)	Experimental Methods 1
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Complementary Courses

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 214	(3)	Introductory Astrophysics
PHYS 260	(3)	Modern Physics and Relativity
PHYS 271	(3)	Introduction to Quantum Physics

One of:

PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 350	(3)	Honours Electricity and Magnetism

Additional Science Courses (15 credits)

BIOL 210	(3)	Perspectives of Science
MATH 203	(3)	Principles of Statistics 1

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.34.11 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Biology for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Biology for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Physics with Minor Biology is one of the nine variations of the program and allows students to focus their Science degree in Physics with a subspecialization in Biology.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of Major Concentration Physics

- 24 credits of Minor Biology

- 9 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/specific/.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus 1
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices (Secondary)
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
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EDEC 261* (3) Philosophy of Catholic Education

Major Concentration Physics (36 credits)

The Major Concentration Physics is a planned sequence of courses designed to permit a degree of specialization in this discipline.

Required Courses*

30 credits selected as follows:

* Note: Required courses taken at CEGEP or elsewhere that are not credited toward the Concurrent B.Sc. and B.Ed. must be replaced by courses from the Complementary Course List equal to or exceeding their credit value. Regardless of the substitution, students must take at least 36 credits in this program.

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 257	(3)	Experimental Methods 1
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 446	(3)	Majors Quantum Physics

Complementary Courses

6 credits selected from:

PHYS 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 241	(3)	Signal Processing
PHYS 258	(3)	Experimental Methods 2
PHYS 334	(3)	Advanced Materials
PHYS 534	(3)	Nanoscience and Nanotechnology

or any 300- or 400-level course approved by an adviser.

Minor Biology (24 credits)

24-25 credits for the Minor Biology selected as follows:

15 credits of required courses

9-10 credits of complementary courses

Required Courses

15 credits

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution

Complementary Courses

9-10 credits of complementary courses, CHEM 212 and 6 selected from the Biology Department's course offerings, at the 300 level or above.

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

CHEM 212* (4) Introductory Organic Chemistry 1

Additional Science Courses (9 credits)

9 credits selected as follows:

6 credits:

BIOL 210 (3) Perspectives of Science

MATH 203 (3) Principles of Statistics 1

plus 3 credits, one additional Physics (PHYS) course approved by the Physics Department.

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.34.12 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Chemistry for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Chemistry for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Physics with Minor Chemistry is one of the nine variations of the program and allows students to focus their Science degree in Physics with a subspecialization in Chemistry.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of the Major Concentration Physics

- 18 credits of the Minor Chemistry

- 15 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/specific/.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus 1
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices (Secondary)
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
EDEC 261*	(3)	Philosophy of Catholic Education

Major Concentration Physics (36 credits)

The Major Concentration Physics is a planned sequence of courses designed to permit a degree of specialization in this discipline.

Required Courses*

30 credits

* Note: Required courses taken at CEGEP or elsewhere that are not credited toward the Concurrent B.Sc. and B.Ed. must be replaced by courses from the Complementary Course List equal to or exceeding their credit value. Regardless of the substitution, students must take at least 36 credits in this program.

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 257	(3)	Experimental Methods 1
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 446	(3)	Majors Quantum Physics

Complementary Courses

6 credits selected from:

PHYS 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 241	(3)	Signal Processing
PHYS 258	(3)	Experimental Methods 2
PHYS 334	(3)	Advanced Materials
PHYS 534	(3)	Nanoscience and Nanotechnology

or any 300- or 400-level course approved by an adviser.

Minor Chemistry (18 credits)

Required Courses

18 credits selected as follows:

* denotes courses with CEGEP equivalents.

Substitutions for these by more advanced courses may be made at the discretion of the Adviser.

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 287	(2)	Introductory Analytical Chemistry
CHEM 297	(1)	Introductory Analytical Chemistry Laboratory

Additional Science Courses (15 credits)

15 credits selected as follows:

9 credits

BIOL 210	(3)	Perspectives of Science
CHEM 381	(3)	Inorganic Chemistry 2
MATH 203	(3)	Principles of Statistics 1

plus 3 credits, one of:

CHEM 180	(3)	World of Chemistry: Environment
CHEM 181	(3)	World of Chemistry: Food
CHEM 182	(3)	World of Chemistry: Technology
CHEM 183	(3)	World of Chemistry: Drugs

plus 3 credits, one additional Physics (PHYS) course approved by the Physics Department.

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.34.13 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Mathematics for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Mathematics for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Mathematics is one of the nine variations of the program and allows students to focus their Science degree in Mathematics.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

54 credits of Science Component consisting of:

- 54 credits of the Major Mathematics

21 credits of Electives, of which at least 18 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website <http://www.mcgill.ca/scienceforteachers/>.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at <http://www.mcgill.ca/science/sousa>. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

Students normally complete 30 credits which must include at least seven courses from the list of Approved Freshman Science Courses, selected as follows:

General Math and Science Breadth

Six of the Freshman courses must satisfy one of the following:

Option 1) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS;

or

Option 2) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

Science Complementary

The seventh course is chosen from the list of Approved Freshman Science Courses.

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.
2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.
3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/specific/.
4. The maximum number of courses per term, required, complementary, and elective, is five.

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

MATH 139	(4)	Calculus 1 with Precalculus
MATH 140	(3)	Calculus I
MATH 150	(4)	Calculus A

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/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Courses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 350	(3)	Classroom Practices (Secondary)
EDES 353	(3)	Teaching Secondary Mathematics 1
EDES 453	(3)	Teaching Secondary Mathematics 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)

EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	First Nations and Inuit Education
EDEC 248*	(3)	Multicultural Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

EDEC 260*	(3)	Philosophical Foundations
EDEC 261*	(3)	Philosophy of Catholic Education

Major Mathematics (54 credits)

Program Prerequisites

Students entering the Major program 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 54 credits for the program.

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

Required Courses

27 credits

Where appropriate, Honours courses may be substituted for equivalent Major courses.

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

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

27 credits selected with the following specifications:

12 credits specifically required of students in the Concurrent B.Sc. and B.Ed. Major Mathematics:

COMP 202	(3)	Foundations of Programming
MATH 324	(3)	Statistics
MATH 338	(3)	History and Philosophy of Mathematics
MATH 348	(3)	Topics in Geometry

at least 3 credits from:

MATH 317	(3)	Numerical Analysis
MATH 335	(3)	Computational Algebra
MATH 340	(3)	Discrete Structures 2

12 credits from:

It is highly recommended that students include MATH 318 and MATH 346 in their complementary courses.

MATH 204	(3)	Principles of Statistics 2
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 346	(3)	Number Theory
MATH 352	(1)	Problem Seminar
MATH 407	(3)	Dynamic Programming
MATH 410	(3)	Majors Project
MATH 417	(3)	Mathematical Programming
MATH 423	(3)	Regression and Analysis of Variance
MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications

In consultation with an adviser, 3 of the 12 credits may be selected from other MATH courses or related disciplines.

Electives (21 credits)

21 credits of electives, of which at least 18 credits must be Science Electives chosen in consultation with the Science Adviser.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

14.35 Technological Entrepreneurship for Science Students**14.35.1 Location**

Desautels Faculty of Management
1001 Sherbrooke Street West, Suite 110
Montreal, Quebec H3A 1G5

14.35.2 About Technological Entrepreneurship for Science Students

Please note that this program is currently under review. Students should register for the Minor in Management (for Non-Management students).

This Minor is geared toward Science students with an interest in entrepreneurship and key business topics. The set of six courses will introduce them to concepts and skills needed to effectively complement the technical expertise obtained. These concepts and skills form the basis of successful companies in the high technology sector, be they start-ups, small, or medium sized.

14.35.3 Bachelor of Science (B.Sc.) - Minor Technological Entrepreneurship for Science Students (18 credits)

(Please note that this program is currently under review.)

This Minor is geared to Science students with an interest in entrepreneurship and key business topics. The set of six courses will introduce you to concepts and skills needed to effectively complement the technical expertise obtained. These concepts and skills form the basis of successful companies in the high technology sector, be they start-ups, small or medium-sized.

Acceptance to the program is both competitive and restricted. Application procedures will be announced in September. Please consult Ron Critchley, Student Adviser, Desautels Faculty of Management Student Affairs Office, Bronfman 110, for details.

Students registered in the Minor Technological Entrepreneurship for Science Students may not take additional courses outside the Faculties of Arts and of Science.

To obtain the Minor, all courses must be completed with a grade of C or better.

