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The web version is the most current version of this publication.

Not all courses are offered every year and changes can be made after publication. Always check the Minerv

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13.5.5

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 - at 88.9%, 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. b 303.83 Tm(ays in whic.11 Tm(wson)3ll9itment to e)Tj1 0 0 1 364.1ncluding Nobel prizes83 Tm(w L0 9izes83 0

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 13.34: Science or Mathematics for Teachers* and the *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 *Faculty of Engineering > 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 *Bachelor of Arts & Science*.

4 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: 3,908 undergraduate, 862 graduate, and 111 postdoctoral researchers, for a total of 4,881 students.
- Average entering grade is 89%, highest at McGill.
- 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 & Extreme Weather, Green Chemistry, Life Sciences (developmental biology & 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, marine biology, and to work with native populations, governments and NGOs in countries as wide-ranging as Africa, Panama, Barbados, the US, 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 2006-07, 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 provide an opportunity to meet other students, and help young students become more comfortable talking to and interacting with other professors.

4.1 Location

Dawson Hall
853 Sherbrooke Street West
Montreal, Quebec H3A 2T6
Canada

Telephone: 514-398-4210
Faculty website: *www.mcgill.ca/science*
Science Office for Undergraduate Student Advising (SOUSA): *www.mcgill.ca/science/sousa*

The Science Office for Undergraduate 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. The SOUSA Office serves students in the B.Sc. and B.A. & Sc. degrees.

4.2 Administrative Officers

Martin Grant; B.Sc.(PEI), M.Sc., Ph.D.(Tor.)	**Dean**
Laurie Hendren; B.Sc., M.Sc.(Qu.), Ph.D.(C'nell) (*on sabbatical leave 2010-2011*)	**Associate Dean (Academic)**
Nick de Takacsy; B.Sc., M.Sc.(Montr), Ph.D.(McG.) *2010-2011*	**Special Adviser, Faculty of Science**
Nicole Allard; B.A.(W. Ont.), M.A.(Guelph), M.Ed.(McG.)	**Director of Advising Services**
Peter Grütter; Ph.D.(Basel) (*James McGill Professor*)	**Associate Dean (Research and Graduate Education)**
Pete Barry; B.Sc.(C'dia), M.Sc.(McG.)	**Chief Academic Adviser**
Josie D'Amico	**Assistant to the Dean**

4.3 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 .

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.

5 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/undergrad*.

For information about inter-faculty transfers, refer to *University Regulations and Information* > *Inter-Faculty Transfer* as well as the relevant information posted on the SOUSA website at *www.mcgill.ca/science/F2 oSaTj0 G0 g/F1 8.1 Tf1 0 0 1 520.412 698.435 Tm(.mTjET42.52 321.316 3569.48 321.316 3l569.48 32143*

Faculty and program requirements

section 6.4: About Program Requirements

section 6.5: Course Requirements

6.1 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.

6.1.1 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 towards 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 standings 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/student-records/transfercredits*.

6.1.2 Equivalencies for Non-Basic Science Courses

Note that equivalencies for some non-basic science courses, such as CHEM 212 and 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/student-records/transfercredits/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/sousa*.

6.1.3 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.

6.2 Residency Requirement

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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.

6.4.5 Internship Year in Science (IYS)

All B.Sc. programs can include an internship component. For more details, students should refer to *section 12.1: Industrial Practicum (IP) and Internship Year in Science (IYS)*, *section 10.5: Internship Programs - Industrial Practicum (IP) and Internship Year in Science (IYS)* and *www.mcgill.ca/science/internships-field/internships*.

McGill School of Environment

The regulations are as follows:

- Courses in other faculties that are considered as taught by Science (e.g., BIOT, EXMD, and PHAR) are so designated under the *Faculty of Science* section of this publication.
- Courses in Music are considered as outside the Faculties of Arts and of Science, except MUAR courses, which are considered as Arts courses.
- Courses in other faculties can be taken as elective courses or as part of a program as specified in this publication.
- You may take only 6 credits per year, up to 18 credits in all, of courses outside the Faculties of Arts and of Science.
- You must have the necessary prerequisites and permission of the instructor for such courses.
- Credit for courses in Education and Continuing Education requires the permission of the Director of Advising Services, Science.
- 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's 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 take as many courses outside the Faculties of Arts and of Science as are necessary to complete your program of study. You may also take up to 18 credits of approved courses outside the Faculties of Arts and Science beyond the requirements of your major.
- 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.

6.5.3 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 towards 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.

6.5.4 Courses in English as a Second Language (ESL)

ESL courses are open to Science students under the regulations specified by the English and French Language Centre; see *Faculty of Arts > English as a Second Langauge (ESLN)*.

6.5.5 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.

CHEM 199	FYS: Why Chemistry?

The First-Year Seminars offered by the Faculty of Arts are also open to Science students. For a complete listing, please consult *Faculty of Arts > First-Year Seminars*.

6.5.6 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.

7 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 *University Regulations and Information > Registration* and to *University Regulations and Information > Undergraduate Advising*; *Welcome to McGill*, which you will receive upon acceptance from Enrolment Services; as well as information posted on the SOUSA website, *www.mcgill.ca/science/sousa* 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 *Welcome to McGill*, which you will receive upon acceptance from Enrolment Services, as well as the information on the SOUSA website, *www.mcgill.ca/science/sousa*.

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/sousa*.

8 Freshman Interest Groups

Freshman Interest Groups (FIGs) are groups of approximately 15 U0 students and U1 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*.

9 Examinations

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

The exam schedules are posted on the McGill website, *www.mcgill.ca/students*, 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.

10 Overview of Programs Offered

Science Program Groups, *section 10.1: Faculty of Science Program Groups*, which may include Liberal Program - Core Science Components, Major Programs, Joint Major Programs and Honours Programs.

Joint Honours Programs,*: Joint Honours Programs*

Minor Programs, *section 10.2: Minor Programs*

Concurrent B.Sc. and B.Ed. Program, *section 6.4.4: Concurrent B.Sc. and B.Ed. Program*

Bachelor of Arts and Science, *section 10.4: Bachelor of Arts and Science*

Internship Year in Science (IYS), *section 6.4.5: Internship Year in Science (IYS)*

Science Internships and Field Studies, *section 12: Science Internships and Field Studies*

Faculty of Arts Major and Minor Concentration Programs Available to Science Students, *section 10.6: Faculty of Arts Major and Minor Concentration Programs Available to Science Students*

10.1 Faculty of Science Program Groups

Science students admitted after September 2009 are limited to choosing majors or honours programs within the Science group to which they were admitted, but may continue to choose freely from all available minor 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.

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

- *section 10.1.1: Biological, Biomedical & Life Sciences Group*
- *section 10.1.2: Microbiology and Immunology Group*
- *section 10.1.3: Neuroscience Group*
- *section 10.1.4: Physical, Earth, Math & Computer Science Group*
- *section 10.3: Concurrent B.Sc. and B.Ed. Program (Science or Mathematics for Teachers)*

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

See: *http://www.mcgill.ca/science/sousa/bsc/transfer/intra*.

10.1.1 Biological, Biomedical & Life Sciences Group

10.1.1.1 Liberal Program - Core Science Components

- Anatomy and Cell Biology, *section 13.2.4: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Anatomy and Cell Biology (48 credits)*
- Biochemistry, *section 13.4.5: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biochemistry (47 credits)*
- Biology, *section 13.5.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biology (47 credits)*
- Physiology, *section 13.30.4: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physiology (50 credits)*
- Psychology, *section 13.32.6: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Psychology (45 credits)*

- Physiology and Physics, *section 13.30.7: Bachelor of Science (B.Sc.) - Major Physiology and Physics (80 credits)*

10.1.1.4 Honours Programs

- Anatomy and Cell Biology, *section 13.2.6: Bachelor of Science (B.Sc.) - Honours Anatomy and Cell Biology (73 credits)*
- Biochemistry, *section 13.4.7: Bachelor of Science (B.Sc.) - Honours Biochemistry (76 credits)*
- Biology, *section 13.5.10: Bachelor of Science (B.Sc.) - Honours Biology (75 credits)*
- Pharmacology - application required, see departmental section for information, *section 13.28.6: Bachelor of Science (B.Sc.) - Honours Pharmacology (74 credits)*
- Physiology, *section 13.30.8: Bachelor of Science (B.Sc.) - Honours Physiology (75 credits)*
- Psychology, *section 13.32.8: Bachelor of Science (B.Sc.) - Honours Psychology (60 credits)*

Microbiology and Immunology Gr

10.1.4.2 Major Programs

- Atmospheric Science, *section 13.3.6: Bachelor of Science (B.Sc.) - Major Atmospheric Science (61 credits)*
- Atmospheric Science (Atmospheric Chemistry option), *section 13.3.7: Bachelor of Science (B.Sc.) - Major Atmospheric Science - Atmospheric Chemistry (61 credits)*
- Chemistry, *section 13.7.10: Bachelor of Science (B.Sc.) - Major Chemistry (59 credits)*
- Chemistry (Bio-organic option), *section 13.7.12: Bachelor of Science (B.Sc.) - Major Chemistry - Bio-organic (63 credits)*
- Chemistry (Atmosphere and Environment option), *section 13.7.11: Bachelor of Science (B.Sc.) - Major Chemistry - Atmosphere and Environment (63 credits)*
- Chemistry (Materials option), *section 13.7.13: Bachelor of Science (B.Sc.) - Major Chemistry - Materials (62 credits)*
- Computer Science, *section 13.9.11: Bachelor of Science (B.Sc.) - Major Computer Science (63 credits)*
- Computer Science (Computer Games option), *section 13.9.13: Bachelor of Science (B.Sc.) - Major Computer Science - Computer Games (67 credits)*
- Earth and Planetary Sciences, *section 13.10.7: Bachelor of Science (B.Sc.) - Major Earth and Planetary Sciences (66 credits)*
- Earth System Science, *section 13.11.3: Bachelor of Science (B.Sc.) - Major Earth System Science (57 credits)*
- Environment (Atmospheric Environment and Air Quality domain) - see *McGill School of Environment > Bachelor of Science (B.Sc.) - Major Environment - Atmospheric Environment and Air Quality (60 credits)*
- Environment (Biodiversity and Conservation domain) - see *McGill School of Environment > 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) - see *McGill School of Environment > Bachelor of Science (B.Sc.) - Major Environment - Earth Sciences and Economics (66 credits)*
- Environment (Ecological Determinants of Health domain - Cellular) - see *McGill School of Environment > Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - E.004296Tj1 0 0 1 2i804 477.54 Tmlogical Determinants of Hea*

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- Atmospheric Science, *section 13.3.9: Bachelor of Science (B.Sc.) - Honours Atmospheric Science (70 credits)*
- Atmospheric Science (Atmospheric Chemistry option), *section 13.3.10: Bachelor of Science (B.Sc.) - Honours Atmospheric Science - Atmospheric Chemistry (70 credits)*
- Chemistry, *section 13.7.14: Bac*

Human Nutrition – see *Faculty of Agricultural and Environmental Sciences > School of Dietetics and Human Nutrition > Minor Human Nutrition (24 credits)*

Interdisciplinary Life Sciences, *section 13.18.3: Bac*

10.4 Bachelor of Arts and Science

Please see the *Bachelor of Arts and Science* section of this publication for details.

10.5 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/internships-field/internships*.

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

For more information, please see the relevant departmental entries under the *Faculty of Arts* section.

10.6.1 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)*

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, *: Bachelor of Arts (B.A.) - Concentration majeure langue et littérature françaises - Études et pratiques littéraires (36 crédits)*

Langue et littérature françaises - Traduction, *: Bachelor of 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)*

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, *: Bachelor of Arts (B.A.) - Concentration mineure langue et littérature françaises - Critique littéraire (18 crédits)*

Langue et littérature françaises - Études et pratiques littéraires, *: Bachelor of Arts (B.A.) - Concentration mineure langue et littérature françaises - Études et pratiques littéraires (18 crédits)*

Langue et littérature françaises - Langue française, *: Bachelor of Arts (B.A.) - Concentration mineure langue et littérature françaises - Langue française (18 crédits)*

Langue et littérature françaises - Langue française et traduction, *: Bachelor of Arts (B.A.) - Concentration mineure langue et littérature françaises - Langue française et traduction (18 crédits)*

Langue et littérature françaises - Traduction, *: Bachelor of 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 credits)*

Russian - see Russian and Slavic Studies, *: Bachelor of Arts (B.A.) - Minor Concentration Russian (18 credits)*

Russian Culture - see Russian and Slavic Studies, *: Bachelor of Arts (B.A.) - Minor Concentration Russian Culture (18 credits)*

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)*

11 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 11.1: Department Research Projects*

11.3 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 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/ours/urc*.

11.4 Other opportunities

Science internships and field study programs may have a research component or focus. Please see their descriptions under *section 10.5: Internship Programs - Industrial Practicum (IP) and Internship Y*

2. Many students will complete more than 7 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 www.mcgill.ca/science/sousa/bsc/freshman.

4. The maximum number of courses per term, required, complementary and elective, is five.

taken, but some restrictions apply. Consult the SOUSA website at http://www.mcgill.ca/science/sousa/bsc/course/outside for more information about taking courses from other faculties.

13.2 Anatomy and Cell Biology (ANAT)

13.2.1 Location

Strathcona Anatomy and Dentistry Building
3640 University Street, Room 1/60
Montreal, Quebec H3A 2B2

Telephone: 514-398-6335
Website: *www.mcgill.ca/anatomy*

13.2.2 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

Professors

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 appoint. with Medicine*)

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

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

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

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

Associate Professors

Adjunct Professors

Michel Cayouette; Ph.D.(Laval)

F. Charron; B.Sc.(Montr.), Ph.D.(McG.)

E. Chevet; Ph.D.(Paris)

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.)

Marko Horb; Ph.D.(SUNY)

Artur Kania; Ph.D.(Baylor)

Bartha Knoppers; Ph.D.(France)

André Nantel; B.Sc., M.Sc.(Laval), Ph.D.(Chapel Hill)

Maureen O'Conner-McCourt; Ph.D.(Alta.)

Alexei Pshezhetsky; Ph.D.(Russia)

Joseph Schrag; M.Sc., Ph.D.(Ill.)

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

Pierre Thibault; Ph.D.(Montr.)

Faculty Lecturer

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

13.2.4 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
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
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
EXMD 504	(3)	Biology of Cancer
MIMM 314	(3)	Immunology
NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease

13.2.5 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
ANA	(3)	Introductory Molecular and Cell Biology

MIMM 314	(3)	Immunology
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
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
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
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 455	(3)	Neurochemistry
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 370	(3)	Human Genetics Applied
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 468	(6)	Independent Research Project 3
BIOL 514	(3)	Neurobiology Learning and Memory
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 544	(3)	Genetic Basis of Life Span
BIOL 551	(3)	Molecular Biology: Cell Cycle
BIOL 572	(3)	Molecular Evolution
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
EXMD 509	(3)	Gastrointestinal Physiology and Pathology
EXMD 510	(3)	Bioanalytical Separation Methods
EXMD 512D1	(3)	Recent Progress in AIDS Research

84.271 332.56 Tm(AIDS Research)Tj1 0 02 0 S Research

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 500	(3)	Advances: Neurobiology of Mental Disorders

13.2.6 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 3.00 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 314	(3)	Immunology
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:

ANAT 321	(3)	Circuitry of the Human Brain
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
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
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 455	(3)	Neurochemistry
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 370	(3)	Human Genetics Applied
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 468	(6)	Independent Research Project 3
BIOL 514	(3)	Neurobiology Learning and Memory

BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 544	(3)	Genetic Basis of Life Span
BIOL 551	(3)	Molecular Biology: Cell Cycle
BIOL 572	(3)	Molecular Evolution
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
EXMD 509	(3)	Gastrointestinal Physiology and Pathology
EXMD 510	(3)	Bioanalytical Separation Methods
EXMD 512D1	(3)	Recent Progress in AIDS Research
EXMD 512D2	(3)	Recent Progress in AIDS Research
MIMM 314	(3)	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
MIMM 387	(3)	Applied Microbiology and Immunology
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
		Bacterial Pathogenesi09

PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience Advanced Neurophysiology

Either of the following courses:

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

Complementary Course (3 credits)

One of the following courses:

ATOC 412	(3)	Atmospheric Dynamics
ATOC 540	(3)	Synoptic Meteorology 1

13.3.5 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Atmospheric and Oceanic Sciences (46 credits)

Required Courses (37 credits)

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

13.3.6 Bachelor of Science (B.Sc.) - Major Atmospheric Science (61 credits)

Required Courses (46 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 215OC 215	(3)	Oceans, Weather and Climate

ATOC 515	(3)	Turbulence in Atmosphere and Oceans
CHEM 307	(3)	Analytical Chemistry of Pollutants
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 542	(3)	Chemical Oceanography
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 423	(3)	Regression and Analysis of Variance
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

13.3.8 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)	Water in the Atmosphere
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 434	(3)	Optics
PHYS 439	(3)	Majors Laboratory in Modern Physics

13.3.9 Bachelor of Science (B.Sc.) - Honours Atmospheric Science (70 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 (52 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)	Water in the Atmosphere
ATOC 480	(3)	Honours Research Project
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 546	(1)	Current Weather Discussion
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

3-6 credits ordinarily selected from the courses below:

* Students may take either ATOC 419 or CHEM 419

** Students may tak

MATH 222	(3)	Calculus 3
	(3)	Linear Algebra

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2

Complementary Courses (12 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)	Water in the Atmosphere
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 332 or MATH 555.

ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 530	(3)	Paleoclimate Dynamics
GEOG 522	(3)	Advanced Environmental Hydrology
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 332*	(3)	Physics of Fluids
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves

13.3.12 Atmospheric and Oceanic Sciences (ATOC) Related Programs

13.3.12.1 Internship Year in Science (IYS)

IYS is a pregraduate work experience program available to eligible students and normally taken between their U2 and U3 years. For more information, see *section 10.5: 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

A Science Major Concentration in Earth, Atmosphere and Ocean Sciences is available to students pursuing the B.A. & Sc. degree. This Major Concentration is described in the Bachelor of Arts and Science section of this publication; see *section 13.10: Earth, Atmosphere and Ocean Sciences* for details.

13.3.12.2 Earth System Science Interdepartmental Major

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

Students in the Department of Atmospheric & Oceanic Sciences interested in this program should contact Professor Bruno Tremblay (*mailto:bruno.tremblay@mcgill.ca*). For more information, see *section 13.11: Earth System Science Interdepartmental Major (ESYS)*.

Emeritus Professors

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

Associate Members

Vassilios Papadopoulos (*MUHC*)

Ianusz Rak (*Pediatrics*)

Reza Salavati (*Parasitology*)

Maya Saleh (*Medicine*)

Erwin Schurr (*Exp. Medicine, RVH*)

Charles Scriver (*Pediatrics, MCH*)

Peter Siegel (*Medicine*)

Bernard Turcotte (*Exp. Medicine, RVH*)

Simon Wing (*Medicine*)

Xiang-Jiao Yang (*Molecular Oncology, RVH*)

Adjunct Professors

Prabhat Arya (*NRC, Ottawa*)

Mirek Cygler (*B.R.I.*)

Jacques Drouin (*IRCM*)

Anny Fortin (*Dafra Pharma*)

Tarik Möröy (*IRCM*)

Donald Nicholson (*Merck*)

Maureen D. O'Connor-McCourt (*B.R.I.*)

Enrico Purisima (*B.R.I.*)

Martine Raymond (*I.R.I.C. Montr.*)

René Roy (*UQAM*)

Alex

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 or U2 as part of the breadth component of the program.

3 credits selected from:

BIOL 373	(3)	Biometry
COMP 202	(3)	Introduction to Computing 1
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

13.4.6 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:

		Biology of Org

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)	Introduction to Computing 1
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 455	(3)	Neurochemistry
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Immunochemistry

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

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 352	(3)	Structural Organic Chemistry
CHEM 382	(3)	Organic Chemistry: Natural Products

CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 552	(3)	Physical Organic Chemistry
CHEM 572	(3)	Synthetic Organic Chemistry
EXMD 502	(3)	Advanced Endocrinology 01
MIMM 314	(3)	Immunology
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses & Hormones

13.4.7 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 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
BIOL 373	(3)	Biometry
COMP 202	(3)	Introduction to Computing 1
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 455	(3)	Neurochemistry
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 491F0 8.3 Tf1 0 0 1 67	(6)Trm5330.463 709.84 Tm1 0 0 1 70.52 361.4431rch	Independent Research

MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses & Hormones

13.4.8 Biochemistry (BIOC) Related Programs

13.4.8.1 Interdepartmental Honours in Immunology

For more information, see *section 13.17: Immunology Interdepartmental Honours*. 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 Immunlogy (*ciro.piccirillo@mcgill.ca*, 514-934-1934 extension 45135) or Dr. Monroe Cohen, Physiology (*monroe.cohen@mcgill.ca*, 514-398-4342).

13.5 Biology (BIOL)

13.5.1 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*

13.5.2 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 indi

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 the Bachelor of Arts and Science section of this publication; see *Bachelor of Arts and Science > Biology (BIOL)* for details.

13.5.3 Preprogram Requirements

Requirements for the Major and Honours programs in Biology are 2 courses in elementary Biology, 2 courses in general Chemistry, 2 courses in Calculus and 2 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.

13.5.4 Biology Concentrations

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

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.

13.5.4.1 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 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, most courses from these fields 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 behaviour.

13.5.4.2 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 324, BIOL 331 or BIOL 334D1/BIOL 334D2, BIOL 335, BIOL 350/ENTO 350, BIOL 352, BIOL 355, BIOL 377, BIOL 427, BIOL 428, BIOL 429, BIOL 465, BIOL 466 or BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, BIOL 540, BIOL 555D1/BIOL 555D2, BIOL 569, BIOL 571, BIOL 573, BIOL 594, REDM 400.

Macdonald Campus: AEBI 212, ENTO 440, ENVB 313, PLNT 358, WILD 307, WILD 350, WILD 420, WILD 424.

13.5.4.3 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 prevv

13.5.4.4 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 modelling. 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 fi

13.5.4.7 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 416, BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, BIOL 518, BIOL 520, BIOL 524, BIOL 544.

13.5.4.8 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 which 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 de

Professors

Adjunct Professors

IRCM: Michel Cayouette, Frédéric Charron, Artur Kania, Marie Kmita

NRC Lab: Malcolm S. Whiteway

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

U. of Montreal: Pierre Drapeau, Louis St-Amant

Joint Major in Biology and Mathematics Program Coordinators

Claire de Mazancourt; Bacc.(École des Mines), D.E.A., Ph.D.(Paris VI) (*Biology*)

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

Stephen W. Drury; M.A., Ph.D.(Cant.) (*Mathematics*)

Axel Hundemer; M.Sc., Ph.D.(Munich) (*Mathematics*)

13.5.6 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.

Six 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.

Students select the course below, 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.

CHEM 212*	(4)	Introductory Organic Chemistry 1

13.5.7 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 four credits can be made up with a 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.

13.5.8 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 Courses (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 student's 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.

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

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

Note: Students selecting a BIOL course count this toward their 21 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

Math Courses

15 - 18 credits of MATH courses chosen from Sequence 1 or 2 and from "Remaining Math Courses" as follows:

Sequence 1

12 credits from the following courses:

* Students may take either MATH 317 or MATH 327

** Students may take either MATH 326 or MATH 437

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 437**	(3)	Mathematical Methods in Biology

Sequence 2

9 credits from the following:

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

Remaining Math Courses

Remaining 3 to 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 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications

BIOL, NEUR, PHGY, PHYS, PSYC courses

18 to 21 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:

Stream Required Course

BIOL 206	(3)	Methods in Biology of Organisms

Stream Complementary Courses

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-lev

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

13.5.11 Biology (BIOL) Related Programs and Study Semesters

13.5.11.1 Joint Major in Computer Science and Biology

For more information, see *section 13.9.12: Bachelor of Science (B.Sc.) - Major Computer Science and Biology (73 credits)*

13.5.11.2 Panama Field Study Semester

The program is a joint venture between McGill Uniy n13.54he por 1e

13.6.3 General Regulations

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CHEM 552	(3)	Physical Organic Chemistry

General

MIME 310	(3)	Engineering Economy

Immunology

ANAT 261	(4)	Introduction to Dynamic Histology
BIOC 503	(3)	Immunochemistry
MIMM 314	(3)	Immunology
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)	Molecular Biology: Cell Cycle

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
BIOC 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
CIVE 553	(3)	Stream Pollution and Control

13.6.6 Biotechnology (BIOT) Related Programs

13.6.6.1 Program for Students in the Faculty of Engineering

See *Faculty of Engineering > Biotechnology Minor* for details.

13.7 Chemistry (CHEM)

13.7.1 Location

Otto Maass Chemistry Building
801 Sherbrooke Street West
Montreal, Quebec H3A 2K6

Website: *www.chemistry*

13.7.3 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, behavior 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*.

13.7.4 Chemistry (CHEM) Faculty

Chair

R. Bruce Lennox

Emeritus Professors

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

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

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

Denis F.R. Gilson; B.Sc.(U. 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 Hnson Emeritus311.602 Tm9tt Chemistry

Professors

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.(Oreg.St.)

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

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.(T

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.)

13.7.5 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

13.7.6 Bachelor of Science (B.Sc.) - Minor Chemical Engineering (24 credits)

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 (7 credits)

CHEE 200	(4)	Introduction to Chemical Engineering
CHEE 204	(3)	Chemical Manufacturing Processes

Complementary Courses (17 credits)

at least one of:

CHEE 220	(3)	Chemical Engineering Thermodynamics
CHEE 314	(4)	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	(4)	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

CHEM 382	(3)	Organic Chemistry: Natural Products
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory
CHEM 502	(3)	Advanced Bio-Organic Chemistry

Bachelor of Science (B.Sc.) - Liberal Pr

CHEM 352	(3)	Structural Organic Chemistry
CHEM 355	(3)	Molecular Properties and Structure 2

13.7.9 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 hav

13.7.10 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.

13.7.11 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
		Statis 381.1u2)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
CHEM 307	(3)	Analytical Chemistry of Pollutants
CHEM 352	(3)	Structural Organic Chemistry
MATH 317	(3)	Numerical Analysis

3 credits, one of:

ATOC 315	(3)	Water in the Atmosphere
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

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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
CHEM 490D1	(1.5)	Research Project 3
CHEM 490D2	(1.5)	Research Project 3

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

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

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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
CHEM 490D1	(1.5)	Research Project 3
CHEM 490D2	(1.5)	Research Project 3

6 credits, tw

CH3)

CHBL 201	CHBacal Genets

BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 502	(3)	Advanced Bio-Organic Chemistry
MIMM 211	(3)	Introductory Microbiology
MIMM 314	(3)	Immunology
MIMM 323	(3)	Microbial Physiology
PHGY 201	(3)	Human Physiology: Control Systems
PHGY 202	(3)	Human Physiology: Body Functions
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.

13.7.16 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
CHEM 490D1	(1.5)	Research Project 3
CHEM 490D2	(1.5)	Research Project 3

3 credits, one of:

ATOC 214	(3)	Introduction: Physics of the Atmosphere
CHEM 307	(3)	Analytical Chemistry of Pollutants
CHEM 352	(3)	Structural Organic Chemistry
MATH 317	(3)	Numerical Analysis

6 credits, two of:

ATOC 315	(3)	Water in the Atmosphere
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

13.7.17 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

LING 531	(3)	Phonology 2
LING 555	(3)	Language Acquisition 2
LING 571	(3)	Syntax 2
LING 590	(3)	Language Acquisition and Breakdown

Mathematics

MATH 318	(3)	Mathematical Logic
MATH 328	(3)	Computability and Mathematical Linguistics

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 410	(3)	Advanced Topics in Logic 1
PHIL 415	(3)	Philosophy of Language
PHIL 419	(3)	Epistemology
PHIL 506	(3)	Seminar: Philosophy of Mind
PHIL 507	(3)	Seminar: Cognitive Science

Psychology

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 211	(3)	Introductory Behavioural Neuroscience
PSYC 212	(3)	Perception
PSYC 213	(3)	Cognition
PSYC 301	(3)	Animal Learning & Theory
PSYC 311	(3)	Human Cognition and the Brain
PSYC 353	(3)	Laboratory in Human Perception
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 470	(3)	Memory and Brain

13.9 Computer Science (COMP)

13.9.1 Location

McConnell Engineering Building, Room 318
3480 University Street
Montreal, Quebec, H3A 2A7
Telephone: 514-398-7071
Fax: 514-398-3883

Undergraduate Student Affairs Office
Lorne Trottier Building, Room 2060

3630 University Street
Montreal, Quebec, H3A 2B2
Telephone: 514-398-7071 ext. 00739
Fax: 514-398-4653

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

13.9.2 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 so that a computer can execute the algorithm. Software generally refers to a computer program or a set of related computer programs.

Based on the building blocks of algorithms and programs, 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 that imitate 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, Ph

13.9.5 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 adv

Assistant Professors

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

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

Xue Liu; B.Sc., M.Sc.(Tsinghua), Ph.D.(Ill.) (*on leave 2010*)

Muthucumaru Maheswaran; B.Sc.(Peradeniya), M.Sc., Ph.D.(Purd.) (*on sabbatical 2010-2011*)

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

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

Mohit Singh; B.Tech.(Indian IT), Ph.D.(Carn. Mell)

Jérôme Waldispühl; B.Sc.(Nice and Sophia-Antipolis (France)), M.Sc.(Paris VII), Ph.D.(École 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*)

Renée Sieber (*Geography*)

Adjunct Professors

Stefan Brands

Renato De Mori

Ted Perkins

Ioannis Rekleitis

Ger Otto Sabidussi

Pascal Tesson

13.9.7 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 towards the Minor. This should be done before registering for the final term of studies.

Students may receive credit towards 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 six 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 six 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.

** Students may take either COMP 203 or COMP 250 but not both.

COMP 202*	(3)	Introduction to Computing 1
COMP 203**	(3)	Introduction to Computing 2

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, COMP 431).

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

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

13.9.8 Bachelor of Science (B.Sc.) - Minor Computational Molecular Biology (24 credits)

Computational molecular biology is the sub-discipline of bioinformatics that is located at the intersection of computer science and molecular biology. The focus of this area is on techniques for managing and analyzing molecular sequence data. This program will provide undergraduate students in the biological sciences with the skills from computer science to solve computational problems arising in molecular biology and genomics and will provide students with the necessary skills to build software tools from these algorithms.

The Minor Computational Molecular Biology is NOT open to students in Computer Science or Joint Computer Science programs.

Required Courses (24 credits)

COMP 202	(3)	Introduction to Computing 1
COMP 203	(3)	Introduction to Computing 2
COMP 251	(3)	Data Structures and Algorithms
COMP 360	(3)	Algorithm Design Techniques
COMP 462	(3)	Computational Biology Methods
COMP 563	(3)	Molecular Evolution Theory
COMP 564	(3)	Computational Gene Regulation
MATH 240	(3)	Discrete Structures 1

13.9.9 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)	Introduction to Computing 1
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Data Structures and Algorithms
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)	Theoretical Aspects: Computer Science
COMP 350	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design Techniques

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.

13.9.10 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 this p6(Probability)Tj1 0 0 1 165.864 6p7e1 Tf3onent Softwar2 35

3 credits selected from:

COMP 330	(3)	Theoretical Aspects: Computer Science
COMP 360	(3)	Algorithm Design Techniques

9 - 10 credits selected from the courses below:

* Students take either COMP 435 or COMP 535, but not both.

COMP 322	(1)	Introduction to C++
COMP 409	(3)	Concurrent Programming
COMP 421	(3)	Database Systems
COMP 435*	(3)	Basics of Computer Networks
COMP 520	(4)	Compiler Design
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Object-Oriented 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 431.

13.9.11 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 maximum of 63 credits or a minimum of 60 credits if they are exempt from taking COMP 202.

Required Courses (30 credits)

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

COMP 202*	(3)	Introduction to Computing 1
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Data Structures and Algorithms
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 310	(3)	Operating Systems
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1

Complementary Courses (33 credits)

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

At least 6 credits selected from:

COMP 330	(3)	Theoretical Aspects: Computer Science
COMP 350	(3)	Numerical Computing

COMP 360	(3)	Algorithm Design Techniques

At least 3 credits selected from:

COMP 303	(3)	Software Development
COMP 304	(3)	Object-Oriented Design

3 - 9 credits selected from:

* Must include at least one of the 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, COMP 431) and ECSE 508.

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

13.9.12 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. Three integrative features of the program are a three-credit joint independent studies course, co-supervised by a Biology professor and a Computer Science professor; a one-credit seminar; and a three-credit course BIOL 495 "Integrative Computing in Biology".

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.

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)	Introduction to Computing 1
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Data Structures and Algorithms
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

7 credits from:

BIOL 495	(4)	Integrative Computing in Biology
COMP 401	(3)	Project in Biology and Computer Science
COMP 499	(1)	Undergraduate Bioinformatics Seminar

460.4202

Complementar

BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 435	(3)	Natural Selection
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 568	(3)	Topics on the Human Genome
BIOL 569	(3)	Developmental Evolution
BIOL 572	(3)	Molecular Evolution
BIOL 583	(3)	Advanced Biometry

13.9.13 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)	Introduction to Computing 1
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Data Structures and Algorithms
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)	Theoretical Aspects: Computer Science
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

Group A:

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

Group B:

COMP 330	(3)	Theoretical Aspects: Computer Science
COMP 360	(3)	Algorithm Design Techniques

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)	Object-Oriented 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

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

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 (45 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)	Introduction to Computing 1
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(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)	Theoretical Aspects: Computer Science
COMP 350	(3)	Numerical Computing
COMP 362	(3)	Honours Algorithm Design
COMP 400	(3)	Technical Project and Report
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 (30 credits)

At least 3 credits selected from:

COMP 303	(3)	Software Development
COMP 304	(3)	Object-Oriented Design

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, COMP 396, COMP 400, COMP 431) and ECSE 508. At least 12 credits must be at the 500-level.

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

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

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

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

Required Courses (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)	Introduction to Computing 1
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science

COMP 251	(3)	Data Structures and Algorithms
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)	Technical Project and Report
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- or 700-level require special permission. Information on the policy and procedures for such permission may be found at the website: http://www.mcgill.ca/science/sousa/bsc/course/graduate/.

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)	Theoretical Aspects: Computer Science
COMP 360	(3)	Algorithm Design Techniques

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)	Object-Oriented 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

13.10.2 About Earth and Planetary Sciences

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 14 professors and one faculty lecturer. There are approximately 40 graduate and 35 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 Inter-departmental 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.

A Science Major Concentration in Earth, Atmosphere and Ocean Sciences is available to students pursuing the B.A. & Sc. degree. This Major Concentration is described in the Bachelor of Arts and Science section of this publication; see *Bachelor of Arts and Science > Earth, Atmosphere and Ocean Sciences* for details.

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:

Professor Jeanne Paquette
Frank Dawson Adams Building, Room 214
Email: *jeanne.paquette@mcgill.ca*
Telephone: 514-398-4402

13.10.3 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.(Appl.), Ph.D.(McG.)

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

Eric W. Mountjoy; B.A.Sc.(Br. Col.), Ph.D.(Tor.) (*William E. Logan Emeritus Professor of Geology*)

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.(Harv.), Ph.D.(Harv.) (*T.H. Clark Chair in Sedimentary and Petroleum Geology*)

Jeanne Paquette; B.Sc., M.Sc.(McG.), Ph.D.(Stonybrook) (*Undergraduate Director*)

Hojatollah Vali; B.Sc., M.Sc., Ph.D.(Munich) (*Director, Electron Microscopy Centre*)

Assistant Professors

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

Sarah Hall; B.A.(Hamilton), Ph.D.(Calif.-Santa Cruz)

Jeffrey McKenzie; B.Sc.(McG.), M.Sc., Ph.D.(Syr.)

Boswell Wing;

EPSC 542	(3)	Chemical Oceanography
EPSC 561	(3)	Ore-forming Processes 1

13.10.5 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 545	(3)	Low-Temperature Geochemistry
EPSC 561	(3)	Ore-forming Processes 1
EPSC 570	(3)	Cosmochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

13.10.6 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.

(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 423	(3)	Igneous Petrology
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits
EPSC 455	(3)	Sedimentary Geology

Complementary Courses (18 credits)

3 credits, one of:

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

EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 334	(3)	Invertebrate Paleontology
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 451	(3)	Hydrothermal Mineral Deposits
EPSC 501	(3)	Crystal Chemistry
EPSC 510	(3)	Geodynamics and Geomagnetism
EPSC 519	(3)	Isotope Geology
EPSC 525	(3)	Subsurface Mapping
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 570	(3)	Cosmochemistry
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

13.10.9 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

13.10.10 Earth and Planetary Sciences (EPSC) Related Programs

13.10.10.1 Joint Major in Physics and Geophysics

See *section 13.29: Physics (PHYS)*.

13.11 Earth System Science Interdepartmental Major (ESYS)

13.11.1 Location

Program Adviser
Professor Jeffrey McKenzie
Frank Dawson Adams, Room 131C
Email: *jeffrey.mckenzie@mcgill.ca*
Telephone: 514-398-3833

13.11.2 About Earth System Science Interdepartmental Major

The McGill 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 Major is offered jointly by the Department of Atmospheric and Oceanic Sciences (ATOC), the Department of Earth and Planetary Sciences (EPSC), and of

GEOG 203	(3)	Environmental Systems
GEOG 308	(3)	Principles of Remote Sensing
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3

Complementary Courses (21 credits)

3 credits, one of the following courses:

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

18 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 18 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)	Water in the Atmosphere
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 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 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
BREE 319	(3)	Engineering Mathematics
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 341	(3)	Field School 3

EPSC 350	(3)	Tectonics
EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 451	(3)	Hydrothermal Mineral Deposits
EPSC 452	(3)	Mineral Deposits
EPSC 455	(3)	Sedimentary Geology
EPSC 519	(3)	Isotope Geology
EPSC 525	(3)	Subsurface Mapping
EPSC 530	(3)	Volcanology
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
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 306	(3)	Raster Geo-Information Science
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 380	(3)	Adaptive Environmental Management
GEOG 495	(3)	Field Studies - Physical Geography
GEOG 499	(3)	Subarctic Field Studies
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 522	(3)	Advanced Environmental Hydrology
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)	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 332	(3)	Physics of Fluids
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves

13.12 Environment

13.12.1 Location

Downtown Campus
3534 University Street
Montreal, Quebec, H3A 2A7
Telephone: 514-398-2827
Fax: 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

13.12.2 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 the *McGill School of Environment* section where they will find information concerning the Minor Program in Environment, the B.Sc. Major Program in Environment and the B.Sc. Honours Program in Environment.

13.13 Experimental Medicine (EXMD)

13.13.1 Location

Lady Meredith House, Room 101
Email: *experimental.medicine@mcgill.ca*
Website: *www.medicine.mcgill.ca/EXPMED*

13.13.2 About Experimental Medicine

Experimental Medicine is a division of the Department of Medicine. There are no B.Sc. programs in Experimental Medicine, b

EXMD 510	(3)	Bioanalytical Separation Methods
EXMD 511	(3)	Joint Venturing with Industry

13.14 Field Study

For details about the Minor Program in Field Study, see *Field Studies and Study Abroad > Field Study Minor*.

13.15 General Science Minor

13.15.1 Location

Interdisciplinary Programs Adviser
Wendy Brett
Email: *wendy.brett@mcgill.ca*
Telephone: 514-398-7330

13.15.2 About General Science

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 Advisor for this program. See the program description in *section 13.15.3: Bachelor of Science (B.Sc.) - Minor General Science (18 credits)* for more information.

13.15.3 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 General Science Minor.

Geograph

13.16.2 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 *Faculty of Arts > 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 that 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.

13.16.3 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 Option is available to students pursuing the B.A. & Sc. degree. This Major Concentration is described in the Bachelor of Arts and Science section of this publication; see *Bachelor of Arts and Science > Geography (GEOG)* for details.

13.16.4 Geography (GEOG) Faculty

Chair

T.R. Moore (*until August 2010*)

New Chair - TBA

Emeritus Professor

B.J. Garnier; M.A.(Camb.)

Professors

P.G. Brown; B.A.(Haver.), M.A., Ph.D.(Col.) (*joint appoint. with McGill School of Environment and Natural Resource Sciences*)

T.R. Moore; B.Sc.(Swansea), Ph.D.(Aberd.) (*on leave Fall and Winter 2010-11*)

N.T. Roulet; B.Sc., M.Sc.(Trent), Ph.D.(McM.) (*James McGill Professor*) (*on leave Fall 2010*)

G.W. Wenzel; M.A.(Manit.), Ph.D.(McG.)

Associate Professors

G.L. Chmura; B.S.(Mass.), M.S.(R.I.), Ph.D.(L.S.U.)

O.T. Coomes; B.Sc.(Vic., BC), M.A.(Tor.), Ph.D.(Wisc.)

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

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

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

W.H. Pollard; B.A., M.Sc.(Guelph), Ph.D.(Ott.)

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 appoint. with McGill School of Environment*)

R.E. Sieber; B.Sc.(Mich. St.), M.P.A.(W. Mich.), Ph.D.(Rutgers) (*joint appoint. with McGill School of Environment*)

I.B. Strachan; B.Sc.(Tor.), M.Sc., Ph.D.(Qu.) (*cross appoint. 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)

Assistant Professors

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

J. Ford; B.A., M.Sc.(Oxf.), Ph.D.(Guelph)

M. Kalácska; B.Sc., M.Sc., Ph.D.(Alta.)

B. Lehner; Dip. Hydrol.(Freiburg), Ph.D.(Frankfurt)

N. Oswin; B.A. Hons.(Tor.), M.A.(Dal.), Ph.D.(Br. Col.)

N. Ramankutty; B.E.(P.S.G. Coll. of Tech.), M.S.(Ill.), Ph.D.(Wisc.)

J. Rhemtulla; B.Sc.(McG.), M.Sc.(Alta.), P.h.D.(Wisc. Madison)

13.16.5 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.

13.16.6 Bachelor of Science (B.Sc.) - Minor Geographic Information Systems (18 credits)

The Minor Geographic Information Systems (GIS) is designed to provide students in the Faculty of Science who have an interest in GIS with a basic, but comprehensive, knowledge of concepts and methods relating to the analysis of geospatial data.

Required Courses (15 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
GEOG 506	(3)	Advanced Geographic Information Science

Complementary Course (3 credits)

One course to be chosen from:

* Note prerequisites

ATOC 309	(3)	Weather Radars and Satellites
COMP 420	(3)	Secondary Storage Algorithms and Data Structures
COMP 557*	(3)	Fundamentals of Computer Graphics
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 551	(3)	Environmental Decisions
URBP 505	(3)	Geographic Information Systems

Bac

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 522	(3)	Advanced Environmental Hydrology
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 535	(3)	Remote Sensing and Interpretation
		G 0 m2Hlogy

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 497	(3)	Ecology of Coastal Waters
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 522	(3)	Advanced Environmental Hydrology
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

13.16.9 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 3.3.

Honours students are encouraged to participate in 500-level seminars with graduate students, but it is not advisable to take more than one in a 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 497	(3)	Ecology of Coastal Waters
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 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.

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 522	(3)	Advanced Environmental Hydrology
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

13.16.10 Geography (GEOG) Related Programs and Study Semesters

13.16.10.1 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*.

13.16.10.2 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*.

13.16.10.3 Earth System Science Interdepartmental Major

For more information, see *section 13.11: Earth System Science Interdepartmental Major (ESYS)*

Apply to Dr. C. Piccirillo, Microbiology and Immunology, Room L11.132-44, Montreal General Hospital, 1650 Cedar Avenue, Montreal, QC, H3G 1A4;*ciro.piccirillo@mcgill.ca*; 514-398-2872 **or** Dr. Monroe Cohen, Physiology, Room 1136, McIntyre Medical Sciences Building, 3655 Drummond Street, Montreal, QC, H3G 1Y6; *monroe.cohen@mcgill.ca*; 514-398-4342.

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

Students must obtain a U1 GPA or a U2 CGPA of 3.30 for admission to this enrolment-limited program. U1 students should inform one of the program coordinators of their intent to enter the Honours Immunology (Interdepartmental) Program during their U1 Winter term and confirm their intention in writing by April 1. U2 or U3 students can apply for admission at any time.

For graduation in the Honours program, the student must complete a minimum of 90 credits, and achieve a CGPA of not less than 3.30. The immunology courses (BIOC 503, MIMM 314, MIMM 414, MIMM 509, PHGY 419D1/D2, PHGY 513, PHGY 531) must all be passed with a grade not less than B.

Required Courses (48 credits)

U1 Required Courses

20 credits selected as follows:

* Students select either BIOC 212 or BIOL 201.

** Students select either CHEM 203 or CHEM 204.

*** Students select either PHGY 209 or MIMM 211.

BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOL 200	(3)	Molecular Biology
BIOL 201*	(3)	Cell Biology and Metabolism
CHEM 203**	(3)	Survey of Physical Chemistry
CHEM 204**	(3)	Physical Chemistry/Biological Sciences 1
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
MIMM 211***	(3)	Introductory Microbiology
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)	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.

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

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 BIOC 458 or ANAT 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 Design and Development 1
PHAR 504	(3)	Drug Design and Development 2
PHGY 531	(3)	Topics in Applied Immunology
PHGY 552	(3)	Cellular and Molecular Physiology

13.18 Interdisciplinary Life Sciences Minor

13.18.1 Location

Interdisciplinary Programs Advisor
W

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 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 314	(3)	Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	Applied Microbiology and Immunology
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 Design and Development 1
PHAR 504	(3)	Drug Design 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: Health/Disease
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
PHIL 443	(3)	Topics in 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 422	(3)	Health Care Providers
SOCI 515	(3)	Medicine and Society
SOCI 525	(3)	Health Care Systems in Comparative Perspective

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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 553	(3)	Physical Activity Assessments
EDKP 566	(3)	Advanced Biomechanics Theory

13.20 Management Minor Programs

The Desautels Faculty of Management offers four programs for non-Management students open for application to students in the Faculty of Science. Please refer to the *Desautels Faculty of Management* section of this publication for detailed information about program requirements and applying.

- Finance for Non-Management Students; see *Desautels Faculty of Management > Minor Finance (For Non-Management Students) (18 credits).*
- Management for Non-Management Students; see *Desautels Faculty of Management > Minor Management (For Non-Management Students) (18 credits).*

  As of the 2008-09 academic year, the *Minor in Management* for Science students was retired. 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.
- Marketing for Non-Management Students; see *Desautels Faculty of Management > Minor Marketing (For Non-Management Students) (18 credits).*
- Operations Management for Non-Management Students; see *Desautels Faculty of Management > Minor Operations Management (For Non-Management Students) (18 credits).*

Also available to Science students is the Minor in Technological Entrepreneurship for Science students; see *section 13.35: Technological Entrepreneurship for Science Students*. (*Please note that this Minor is currently under revision.*)

13.21 Mathematics and Statistics (MATH)

13.21.1 Location

Burnside Hall, Room 1005
805 Sherbrooke Street West
Montreal, Quebec, H3A 2K6

Telephone: 514-398-3800
Fax: 514-398-3899
Website: *www.math.mcgill.ca*

13.21.2 About Mathematics and Statistics

Emeritus Professors

Michael Barr; A.B., Ph.D.(Penn.) (*Peter Redpath Emeritus Professor of Pure Mathematics*)

Marta Bunge; M.A., Ph.D.(Penn.)

Jal R. Choksi; B.A.(Cant.), Ph.D.(Manc.)

Ian Connell; B.Sc., M.Sc.(Manit.), Ph.D.(McG.)

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*)

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 Russel; 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.)

William G. Brown; M.A.(Col.), B.A., Ph.D.(Tor.)

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

Stephen W. Drury; M.A., Ph.D.(Cant.)

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

Kohur GowriSankaran; B.A., M.A.(Madr.), Ph.D.(Bom.)

Pengfei Guan; B.Sc.(Zhejiang), M.Sc., Ph.D.(Prin.)

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

Dmitry Jakobson; B.Sc.(MIT), Ph.D.(Prin.) (*William Dawson Scholar*)

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

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

Olga Kharlampovich; M.A.(Ural State), Ph.D.(Leningrad), Dr.Sc.(Steklov Institute)

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

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.)

John A. Toth; B.Sc., M.Sc.(McM.), Ph.D.(MIT) (*William Dawson Scholar*)

Daniel T. Wise; B.A.(Yeshiva), Ph.D.(Prin.)

David W

Adjunct Professors

Robert A. Seely; B.Sc.(McG.), Ph.D.(Cant.)

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.)

13.21.5 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 six credits may be allowed for appropriate courses from other departments.

Generally no more than six 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 nine 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 three.

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.

13.21.6 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 six 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 nine 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 three.

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 447	(3)	Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications
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.

13.21.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Mathematics (45 credits)

Program Prerequisites

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 328	(3)	Computability and Mathematical Linguistics
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 339	(3)	Foundations 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)	Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications

13.21.8 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 three 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 339	(3)	Foundations of Mathematics Number

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

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 328	(3)	Computability and Mathematical Linguistics
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 339	(3)	Foundations 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)	Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications

6 additional credits in Mathematics or related disciplines selected in consultation with the adviser.

13.21.10 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)	Introduction to Computing 1
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Data Structures and Algorithms
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theoretical Aspects: Computer Science
COMP 360	(3)	Algorithm Design Techniques
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.

13.21.11 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)	Introduction to Computing 1
COMP 206	(3)	Introduction to Software Systems

COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Data Structures and Algorithms
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theoretical Aspects: Computer Science
COMP 350**	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design Techniques
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
MATH 340*	(3)	Discrete Structures 2
MATH 350*	(3)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar
MATH 410	(3)	Majors Project
MATH 447	(3)	Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 578**	(4)	Numerical Analysis 1

9 credits in Computer Science selected as follows:

At least 6 credits selected from:

COMP 423	(3)	Data Compression
COMP 424	(3)	Artificial Intelligence
COMP 462	(3)	Computational Biology Methods
COMP 490	(3)	Introduction to Probabilistic Analysis of Algorithms
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.

13.21.12 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, towards 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)	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 339	(3)	Foundations of Mathematics
MATH 348	(3)	Topics in Geometry
MATH 407	(3)	Dynamic Programming
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Stochastic Processes

Students may select other courses with the permission of the Department.

13.21.13 Bachelor of Science (B.Sc.) - Honours Applied Mathematics (60 credits)

Applied mathematics is a very broad field and students are encouraged to choose a coherent program of complementary courses. Most students specialize in "continuous" or "discrete" applied mathematics, but there are many sensible combinations of courses, and the following informal guidelines should be discussed with the student's advisor. 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.

COMP 250*	(3)	Introduction to Computer Science
COMP 252	(3)	Algorithms and Data Structures
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 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 447, 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

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MATH 348 (3) Topics in Geometry

MATH 525	(4)	Sampling Theory and Applications
		Combinatorics

MATH 354	(3)	Honours Analysis 3
MATH 355	(3)	Honours Analysis 4
MATH 356*	(3)	Honours Probability
MATH 370	(3)	Honours Algebra 3

678.4 Tm((3))Tj1 0 0 1 64.662 Honours Algebra 4 Tm(( )Tj1 0 0 1 251.42T.m 370

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 578**	(4)	Numerical Analysis 1

15 credits in Computer Science selected as follows:

At least 6 credits selected from:

COMP 423	(3)	Data Compression
		Artificial Intelligence

13.21.17 Mathematics and Statistics (MATH) Related Programs

13.21.17.1 Joint Major in Biology and Mathematics

For more information, see *section 13.5: Biology (BIOL) > Bachelor of Science (B.Sc.) - Major Biology and Mathematics (76 credits)*.

13.21.17.2 Joint Major in Physiology and Mathematics

For more information, see *section 13.30: Physiology (PHGY) > Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (77 credits)*.

13.21.17.3 Joint Honours Program in Mathematics and Physics

For more information, see *section 13.29: Physics (PHYS) > Bachelor of Science (B.Sc.) - Honours Mathematics and Physics (81 credits)*.

13.22 Microbiology and Immunology (MIMM)

13.22.1 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*

13.22.2 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 on the web at *www.mcgill.ca/microimm*.

All students (U1, U2, U3) must attend an advising session. Please check *www.mcgill.ca/microimm* for dates.

13.22.3 Microbiology and Immunology (MIMM) Faculty

Chair

Malcolm Baines (*Acting Chair*)

Professors

Zafer Ali-Khan; B.Sc.(Bilar), M.Sc.(Karachi), Ph.D.(Tulane)

Malcolm G. Baines; B.Sc., M.Sc., Ph.D.(Qu.)

James W. Coulton; B.Sc.(Tor

Associate Members

Virology: Shan Cen

Adjunct Professors

J. Archambault; B.Sc.(Montr), Ph.D.(Tor.)

Vibhuti Dave; M.Sc., Ph.D.(Bombay)

Albert Descoteaux; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)

Elias Haddad; B.Sc., M.Sc.(Beirut), Ph.D.(McG.)

Taff Jones; B.Sc., Ph.D.(Univ. Coll., Lond.)

George Kukolj; B.Sc., Ph.D.(McG.)

Peter Lau; Ph.D.(Ott.)

Andrew Makrigiannis; B.Sc., Ph.D.(Dal.)

Allan M. Matte; B.Sc., M.Sc.(Guelph), Ph.D.(Sask.)

Clement Rioux; B.Sc., M.Sc.(Laval), Ph.D.(Guelph)

Rafick-P. Sekaly; B.A.(Stanislas), B.Sc., M.Sc.(Montr.), Ph.D.(Lausanne)

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

13.22.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (48 credits)

U1 Required Courses (15 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	(2)	Laboratory in Microbiology

U1 Complementary Course (3 credits)

3 credits, select one from:

BIOC 212	(3)	Molecular Mechanisms of Cell Function

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)	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)	Applied Microbiology and Immunology
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 (6 credits)

6 credits selected from:

Students may take either ANAT 458 or BIOC 458 but not both.

Students may take either CHEM 203 or CHEM 204 but not both.

** 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)	Applied Microbiology and Immunology
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

13.22.5 Bachelor of Science (B.Sc.) - Major Microbiology and Immunology (67 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 (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	(2)	Laboratory in Microbiology

one of:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 201	(3)	Cell Biology and Metabolism

one of:

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

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)	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 302	(3)	Introductory Organic Chemistry 3
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	Applied Microbiology and Immunology
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

13.22.6 Bachelor of Science (B.Sc.) - Honours Microbiology and Immunology (73 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 ex

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 455	(3)	Neurochemistry
BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 520	(3)	Gene Activity in Development
BIOT 505	(3)	Selected Topics in Biotechnology
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
PHAR 562	(3)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2

13.22.7 Microbiology and Immunology (MIMM) Related Programs

13.22.7.1 Interdepartmental Honours in Immunology

For more information, see *section 13.17: Immunology Interdepartmental Honours*.

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; email: *ciro.piccirillo@mcgill.ca*.

13.23 Music

13.23.1 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*

13.23.2 About Music

For more information, see *Schulich School of Music*.

13.23.3 Music Faculty

Department of Music Research Chair

Lloyd Whitesell

Department of Performance Chair

André Roy

Adviser (B.A./B.Sc. Music programs)

B. Minorgan
514-398-4535, ext. 6333

13.23.4 Music Related Programs

13.23.4.1 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 *Schulich School of Music > Minor in Musical Applications of Technology*, or the Minor in Musical Science and Technology, see *Schulich School of Music > Minor in Musical Science and Technology*. 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 offi

13.25.2 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 man

BIOC 455	(3)	Neurochemistry
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 310	(3)	Cellular Neurobiology
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 451	(3)	Advanced Neurophysiology

Neurophysiology

ANAT 322	(3)	Neuroendocrinology
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 514	(3)	Neurobiology Learning and Memory
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 451	(3)	Advanced Neurophysiology
PHGY 520	(3)	Ion Channels
PHGY 556	(3)	Topics in Systems Neuroscience
PSYC 427	(3)	Sensorimotor Behaviour

Neuropsychology

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
		Neural T 322

13.25.4 Bachelor of Science (B.Sc.) - Major Neuroscience (68 credits)

This interdisciplinary Major program in Neuroscience is a focused program for students interested in how the nervous system functions. Research in neuroscience is highly interdisciplinary in nature, and borrows principles from a number of subjects including: biology, biochemistry, immunology, physiology, psychology, as well as mathematics, physics and computer science. To ensure that students have the appropriate foundation, they are required to take 32 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 upper-level complementary courses to obtain more specialized training in areas of neuroscience that best suit their interest.ain more

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)	Introduction to Computing 1

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, may substitute another 3-credit course for MATH 222.

Streams

15 credits selected from one of the following streams:

A. Cell and Molecular Stream

15 credits selected as follows:

* 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 202	(3)	Basic Genetics
MIMM 314	(3)	Immunology
PHGY 311	(3)	Channels, Synapses & Hormones

B. Neurophysiology/Neural Computation Stream

15 credits selected as follows:

9 credits from:

* Students take either BIOL 201 OR BIOC 212, but not both.

ANAT 321	(3)	Circuitry of the Human Brain
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOL 201*	(3)	Cell Biology and Metabolism
PHGY 311	(3)	Channels, Synapses & Hormones

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, may substitute another 3-credit course for MATH 222.

C. Cognitive/Behavioural Stream

15 credits selected as follows:

3 credits:

PSYC 318	(3)	Behavioural Neuroscience 2

12 credits from:

* Students take either BIOL 306 OR PHGY 314, but not both.

BIOL 306*	(3)	Neural Basis of Behaviour
LING 390	(3)	Neuroscience of Language
PHGY 314*	(3)	Integrative Neuroscience
PSYC 317	(3)	Genes and Behaviour
PSYC 342	(3)	Hormones and Behaviour
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 470	(3)	Memory and Brain

Upper Level

21 credits selected as follows:

At least 18 of the 21 credits must be 400- or 500-level courses.

3-9 credits - One course MUST be taken from the following list:

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 389	(3)	Laboratory in Neurobiology
NSCI 410	(6)	Independent Research 1
NSCI 420	(9)	Independent Research 2

12 - 18 credits from the following list:

200- and 300-level courses:

BIOC 311	(3)	Metabolic Biochemistry
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 306	(3)	Neural Basis of 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
NEUR 310	(3)	Cellular Neurobiology
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 314	(3)	Integrative Neuroscience
PHIL 306	(3)	Philosophy of Mind
PHIL 341	(3)	Philosophy of Science 1
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour

* or equivalent 300- or 400-level Computer Science course.

400- and 500-level courses:

BIOC 455	(3)	Neurochemistry
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
PHAR 563	(3)	General Pharmacology 2
PHGY 451	(3)	Advanced Neurophysiology
PHGY 513	(3)	Cellular Immunology
PHGY 520	(3)	Ion Channels
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 470	(3)	Memory and Brain
PSYC 505	(3)	The Psychology of Pain
PSYC 526	(3)	Advances in Visual Perception
PSYC 532	(3)	Cognitive Science
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

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.

A Science Major Concentration in Biomedical Sciences is available to students pursuing the B.A. & Sc. degree. This Major Concentration is described under the *Bachelor of Arts and Science* section of this publication; see *Bachelor of Arts and Science > Biomedical Sciences*.

Note: This program was retired at the end of the 2008-09 academic year and no new students were accepted as of June 2009.

13.28.3 Pharmacology and Therapeutics (PHAR) Faculty

Chair

Hans H. Zingg

Emeritus Professors

Brian Collier; B.Sc., Ph.D.(Leeds)

Theodore Sourkes; Ph.D.(C

Assistant Professors

Greg Miller; Ph.D.(W. Ont.)

Jason Chaim Tanny; Ph.D.(Harv.)

Associate Members

Moulay Alaoui-Jamali; Ph.D.(Sorbonne)

Gerald Batist; M.D.,C.M.(McG.)

Martine Culty; Ph.D.(Fr.)

Giovanni Di Battista; B.Sc., Ph.D.(Montr.)

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.)

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 credi relected as follo ws:

312 credi, one of:

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism

312 credi, one of:

PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

612 credi, chosen from:

* PHAR 504 can be taken with PHAR 503 only.

PHAR 303	(3)	Principles of Toxicology
PHAR 503*	(3)	Drug Design and Development 1
PHAR 504*	(3)	Drug Design and Development 2
PHAR 558	(3)	Pharmacology Selected Topics
PHAR 599	(6)	Pharmacology Research Project

13.28.5 Bachelor of Science (B.Sc.) - Major Pharmacology (65 credits)

This program incorporates extensive studies in Pharmacology with a strong component of related biomedical sciencei, 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 (19 credits)

BIOL 200	(3)	Molecular Biology
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 (19 credits)

BIOC 311	(3)	Metabolic Biochemistry

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 502	(3)	Advanced Bio-Organic Chemistry
CHEM 504**	(3)	Drug Design and Development 2
EXMD 504	(3)	Biology of Cancer
EXMD 511	(3)	Joint Venturing with Industry
MIMM 314	(3)	Immunology
MIMM 387	(3)	Applied Microbiology and Immunology
MIMM 414	(3)	Advanced Immunology
NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 504**	(3)	Drug Design 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 311	(3)	Human Cognition and the Brain

13.28.6 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 3.30. 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 3.30 and a mark of B or higher in core Pharmacology courses 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 (19 credits)

* Students with prior credit for CHEM 212 may take an elective in place of this course.

BIOL 200	(3)	Molecular Biology
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 (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOL 202	(3)	Basic Genetics
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 Design 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:

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:

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

3 credits selected from:

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

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.

** Note: Students may take either CHEM 504 or PHAR 504.

ANAT 321	(3)	Circuitry of the Human Brain
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 455	(3)	Neurochemistry
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 502	(3)	Advanced Bio-Organic Chemistry
CHEM 504**	(3)	Drug Design and Development 2
EXMD 504	(3)	Biology of Cancer
EXMD 511	(3)	Joint Venturing with Industry
MIMM 314	(3)	Immunology
MIMM 387	(3)	Applied Microbiology and Immunology
MIMM 414	(3)	Advanced Immunology
NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 504**	(3)	Drug Design 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 311	(3)	Human Cognition and the Brain

13.29 Physics (PHYS)

13.29.1 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*

13.29.2 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 Ph

Emeritus Professors

Subal Das Gupta; B.A., M.Sc.(Calc.), Ph.D.(McM.) (*William C. Macdonald Emeritus Professor of Physics*)

Nicholas DeTakacsy; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)

Harry C.S. Lam; B.Sc.(McG.), Ph.D.(MIT)

M.P. Langleben; B.Sc., M.Sc., Ph.D.(McG.), F.R.S.C.

Jonathan K.P. Lee; B.Eng., M.Sc., Ph.D.(McG.)

Tommy S.K. Mark; B.Sc., M.Sc., Ph.D.(McG.) (*William C. Macdonald Emeritus Professor of Physics*)

Robert B. Moore; B.Eng., M.Sc., Ph.D.(McG.)

Popat M. Patel; B.Sc., M.Sc.(Manc.), Ph.D.(Harv.)

Assistant Professors

Matt Dobbs; B.Sc.(McG.), Ph.D.(Vic., BC) (*Canada Research Chair*)

Guillaume Gervais, B.Sc.(Sherb.), M.Sc.(McM.), Ph.D.(North. Univ.)

Gil Holder; B.Sc., M.Sc.(Qu.), Ph.D.(Chic.) (*Canada Research Chair*)

Maria Kilfoil; B.Sc.(New Br.), M.Sc., Ph.D.(Nfld.)

Alex Maloney; B.Sc., M.Sc.(Stan.), Ph.D.(Harv.)

Walter Reisner; B.Sc.(Reed), Ph.D.(Prin.)

Bob Rutledge; B.Sc.(USC), Ph.D.(MIT)

Brad Siwick; B.A.Sc., M.Sc., Ph.D.(Tor.) (*Canada Research Chair*)

Tracy Webb; B.Sc.(Tor.), M.Sc.(McM.), Ph.D.(Tor.)

Lecturers

Z. Altounian; B.Sc., M.Sc.(Cairo), Ph.D.(McM.)

F. Buchinger; Dipl.(Mainz), Ph.D.(Joh. Gutenberg U.)

Associate Members

G. Brouhard (*Biology*)

M. Chacron (*Physiology*)

K. Gehring (*Biochemistry*)

P. Hayden (*Computer Science*)

M. Mackey (*Physiology*)

J. Nadeau (*Biomedical Engineering*)

E. Podgorsak (*Radiation Oncology*)

D. Rassier (*Kinesiology & Physical Education*)

D. Ronis (*Chemistry*)

J. Seuntjens (*Medical Physics*)

T. Szkopek (*Electrical & Computer Engineering*)

F. Verhaegen (*Oncology & Medical Physics*)

Curator (Rutherford Museum and McPherson Collection)

Jean Barrette; B.Sc., M.Sc., Ph.D.(Montr.)

13.29.6 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

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 225	(3)	Musical Acoustics
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

13.29.7 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 towards 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 towards 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 Sig. 1
ECSE 334	(3)	Introduction to Microelectronics

13.29.8 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

13.29.9 Bachelor of Science (B.Sc.) - Major Physics (60 credits)

Program Prerequisites

Students entering Physics programs from the Freshman Program must have successfully completed the ust ha

Majors Electromagnetic

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 332	(3)	Physics of Fluids
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 446	(3)	Majors Quantum Physics

13.29.11 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 hav(must ha)Tj1 0.12his present themselv

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)	Data Structures and Algorithms
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 Techniques
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

13.29.12 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 (in both the final examination and supplemental examination if taken), 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 357	(3)	Honours Quantum Physics 1
PHYS 359	(3)	Honours Laboratory in Modern Physics 1
PHYS 362	(3)	Statistical Mechanics
PHYS 451	(3)	Honours Classical Mechanics 2
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

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 332	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 479	(3)	Honours Research Project
PHYS 514	(3)	General Relativity
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
		Introduction to String Theory

U3 Complementary Courses (12 credits)

12 credits are selected as follows:

3 credits from:

MATH 355	(3)	Honours Analysis 4 Honours

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
	(2)	Introductory Physical Chemistry 2

9 credits selected from the list below:

Note: CHEM 480D1/CHEM 480D2 and CHEM 490D1/CHEM490D2 are taken together.

CHEM 480D1	(1.5)	Research Project 2
CHEM 480D2	(1.5)	Research Project 2
CHEM 490D1	(1.5)	Research Project 3
CHEM 490D2	(1.5)	Research Project 3
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 434	(3)	Optics
PHYS 451	(3)	Honours Classical Mechanics 2
PHYS 469	(3)	Honours Laboratory in Modern Physics 2
PHYS 479	(3)	Honours Research Project
PHYS 562	(3)	Electromagnetic Theory

13.29.15 Physics (PHYS) Related Programs

13.29.1.51

Graduates at the B.Sc. level have found rew

Assistant Professors

Russell Jones; Ph.D.(Tor.)

Julio Martinez-Trujillo; Ph.D.(Tübingen)

Associate Professors

Riaz Farookhi; B.Sc., M.Sc.(MIT), Ph.D.(Tufts)

Mladen Glavinovic; B.Sc.(Zagreb), M.Sc.(Tor.), Ph.D.(McG.)

Michael Guevara; B.Sc., M.Eng., Ph.D.(McG.)rAu 1 70.52 636.9id91

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.

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 551	(3)	Molecular Biology: Cell Cycle
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 509	(3)	Gastrointestinal Physiology and Pathology
EXMD 510	(3)	Bioanalytical Separation Methods
NEUR 310	(3)	Cellular Neurobiology
PHAR 503	(3)	Drug Design and Development 1
PHAR 504	(3)	Drug Design and Development 2
PHAR 562	(3)	General Pharmacology 1
PHAR 563	(3)	General Pharmacology 2
PHAR 599	(6)	Pharmacology Research Project
PSYC 311	(3)	Human Cognition and the Brain
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour
PSYC 353	(3)	Laboratory in Human Perception
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 505	(3)	The Psychology of Pain
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.30.6 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:

Either PHGY 209 and PHGY 210 or PHGY 201 and PHGY 202.

PHGY 201	(3)	Human Physiology: Control Systems
PHGY 202	(3)	Human Physiology: Body Functions
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

13.30.7 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

Majors Electricity and Magnetism

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

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13.32.2 About Psychology

The Department of Psychology offers programs in both Arts and Science. All B.A. programs in Psychology can be found under *Faculty of Arts* > *Psychology (PSYC)*.

Psychology is the scienti

13.32.4 Psychology (PSYC) Faculty

Chair
K. Franklin

Associate Professors

Gillian A. O'Driscoll; B.A.(Welles.), M.A., Ph.D.(Harv.) (

In all cases, PSYC 308 and NSCI 201 should be considered interchangeable with respect to prerequisite, exemption, etc., requirements. Students who have taken PSYC 308 should not take NSCI 201.

NSCI 201*	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning & Theory
PSYC 310	(3)	Human Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 329	(3)	Introduction to Auditory Cognition
PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour
PSYC 352	(3)	Cognitive Psychology Laboratory
PSYC 353	(3)	Laboratory in Human Perception
PSYC 403	(3)	Modern Psychology in Historical Perspective
PSYC 406	(3)	Psychological Tests
		Special T

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 343	(3)	Language Learning in Children
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 416	(3)	Topics in Child Development
PSYC 429	(3)	Health Psychology
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 511	(3)	Infant Competence
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.

13.32.7 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, 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)	Human Intelligence
PSYC 215	(3)	Social Psychology

U1 or U2 Required Course (3 credits)

PSYC 305	(3)	Statistics for Experimental Design

Complementary Courses (39 credits)

List A

6 credits in Psychology from List A (Behavioural Neuroscience, Cognition and Quantitive Methods).

* Advising Notes Regarding PSYC 308 and NSCI 201:

PSYC 308 is not currently offered but can be substituted with the equivalent course NSCI 201.

In all cases, PSYC 308 and NSCI 201 should be considered interchangeable with respect to prerequisite, exemption, etc., requirements.

Students who have taken PSYC 308 should not take NSCI 201.

NSCI 201*	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning & Theory
PSYC 310	(3)	Human Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 329	(3)	Introduction to Auditory Cognition
PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour
PSYC 352	(3)	Cognitive Psychology Laboratory
PSYC 353	(3)	Laboratory in Human Perception
PSYC 403	(3)	Modern Psychology in Historical Perspective
PSYC 406	(3)	Psychological Tests
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 427	(3)	Sensorimotor 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 505	(3)	The Psychology of Pain
PSYC 510	(3)	Statistical Analysis of Tests
PSYC 514	(3)	Neurobiology of Learning and Memory

Neurochen43 Tm(PSYC 505)Tj1 on

PSYC 529	(3)	Music Cognition
PSYC 531	(3)	Structural Equation Models
PSYC 532	(3)	Cognitive Science
		Correlational Techniques

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 abovPHGY), Py atiatry4(PSYT)41 Tw/F01 060 1 67.52 718-0.07Tm22.54B.Sc.) - Honour0 1 169.239 230.244Tm22.5460 at the)0 1 169.239 43

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 Quantitive Methods).

* Advising Notes Regarding PSYC 308 and NSCI 201:

PSYC 308 is not currently offered but can be substituted with the equivalent course NSCI 201.

In all cases, PSYC 308 and NSCI 201 should be considered interchangeable with respect to prerequisite, exemption, etc., requirements.

Students who have taken PSYC 308 should not take NSCI 201.

NSCI 201*	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning & Theory
PSYC 310	(3)	Human Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 329	(3)	Introduction to Auditory Cognition
PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour
PSYC 352	(3)	Cognitive Psychology Laboratory
PSYC 353	(3)	Laboratory in Human Perception
PSYC 403	(3)	Modern Psychology in Historical Perspective
PSYC 406	(3)	Psychological Tests
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 427	(3)	Sensorimotor 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 505	(3)	The Psychology of Pain
PSYC 510	(3)	Statistical Analysis of Tests
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 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 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 343	(3)	Language Learning in Children
	(3)	Research Methods in Social Psychology

Admission Requirements to the Bac

Associate Professors

Anthony Ricciardi; B.Sc.(Agr.), M.Sc., Ph.D.(McG.) (*joint appoint. with MSE*)

Assistant Professors

Claire de Mazancourt; Bacc.(École des Mines), DEA, Ph.D.(Paris VI)

Brian Leung; B.Sc.(Br. Col.), Ph.D.(Car.) (*joint appoint. with Biology & MSE*)

Virginie Millien; Maîtrise(Paris VI), DEA, Ph.D.(Montpellier II)

Curator

Karen E. Samonds; B.S., B.A.(Mass.), M.Phil., M.A., Ph.D.(Stony Brook) (*joint appoint. with Anatomy & Dentistry*)

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

Adjunct Professors

Hans Hofmann

Robert Holmes

Hendry M. Reiswig

Michael Woloch

13.33.4 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 maixmum 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 341	(3)	History of Life
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

13.34 Science or Mathematics for Teachers

13.34.1 Location

Rutherford Physics Building
3600 University Street
Montreal, Quebec H3A 2T8

Fax: 514-398-8434
Email: *bscbed@physics.mcgill.ca*
Website: *www.mcgill.ca/scienceforteachers*

13.34.2 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 *Ministère de l'Éducation, du Loisir et du Sport* (MELS) regulations. The Faculties of Education and of Science have introduced a number of 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 *Faculty of 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 13.34.4: 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 *Ministère de l'Éducation, du Loisir et du Sport*. 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 relev

9 credits selected as follows:

3 credits, one of:

EDEC 233	(3)	First Nations and Inuit Education
EDEC 248	(3)	Multicultural Education

3 credits, one of:

EDEC 260	(3)	Philosophical Foundations
EDEC 261	(3)	Philosophy of Catholic Education

3 credits, 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)	Exceptional Students

13.34.5 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Chemistry for Teachers (135 credits)

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 cd28eof the B.Ei0c4c1 129.324 253.3w77.70 (or 165 credits) to ful

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 7 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 7 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)	Introduction to Computing 1
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/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/bsc/course/outside for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component consists 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 Language Requirement
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)	Exceptional Students

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
		Molecular Biology of the Gene

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

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 7 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 7 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/freshmang3Courses list, 8063dvised to ih. fiv

List of Approved Freshman Science Courses

Select the approved courses according to the instructions aboveg3Courses list, 806313.344 Tm(Note:)Tj1 0 0 1 67.52 198.764 Tm(CHEM 115 (not open to students wh

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:

		Introductory Physics - Mechanics

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)	Exceptional Students
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/Sociobiology
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.

13.34.7 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Physics for Teachers (135 credits)

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 Ph

60 credits of Education Component consists 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 Language Requirement
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)	Exceptional Students
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*

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.

(3)	Molecular Biology

Thermal Physics

- 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 7 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 7 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)	Introduction to Computing 1
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:

	(4)	Introductory Physics - Mechanics

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)	Exceptional Students
EDPI 341	(3)	Instruction in Inclusive Schools

Complementary Courses

Animal Diversity

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

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

or

Option 2) 3 courses from MA

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/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/bsc/course/outside for more information about taking courses from other faculties.

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 307	(3)	Analytical Chemistry of Pollutants
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.

13.34.10 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Physics for Teachers (135 credits)

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 uuw5

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 7 courses from the Approved Freshman Science Courses list, particularly those who wish to leav

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/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/bsc/course/outside for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education courses:

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 Language Requirement
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)	Exceptional Students
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)

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 307	(3)	Analytical Chemistry of Pollutants
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

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 225	(3)	Musical Acoustics
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.

13.34.11 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Biology for Teachers (135 credits)

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 de

*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 Language Requirement
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)	Exceptional Students
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 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 225	(3)	Musical Acoustics
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)

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.

60 credits of Education Component consists 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 Language Requirement
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)
		T

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 225	(3)	Musical Acoustics
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:

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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.

13.34.13 Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Mathematics for Teachers (135 credits)

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. F

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 7 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)	Introduction to Computing 1
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/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/bsc/course/outside for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component consists 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 Language Requirement
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)	Exceptional Students
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 o

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 328	(3)	Computability and Mathematical Linguistics
MATH 329	(3)	Theory of Interest
MATH 339	(3)	Foundations of Mathematics
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)	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.

Technological Entrepreneurship for Science Stud6465(612 credits m62.68 Tm((3f 337.788 l8-50 8.3 Tf160 0 1 80.407 326.102

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.