Faculty of Science, including School of Computer Science

Programs, Courses and University Regulations

2023-2024

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

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2023-2024, McGill University

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. Ov

4 About the Faculty of Science (Undergraduate)

4.1 Location

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

The Science Office for Undergraduate Student Advising (SOUSA) is located in Dawson Hall, room 405. SOUSA serves students in the B.Sc. and B.A. &

Associate Dean (Student Affairs)

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 College 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. Students will not be given additional credit toward their degree for any McGill course where the content overlaps substantially with any other course for which they have already received credit, such as for Advanced Standing results.

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

For more information about Advanced Standing, consult: *mcgill.ca/transfercredit*.

6.1.2   Equivalencies for Non-Basic Science Courses

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

If the CEGEP and/or course is not listed on this website, refer to your SOUSA adviser at *mcgill.ca/science/undergraduate/advice/sousa*.

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

Students who are readmitted after interrupting their studies for a period of five consecutive years or more 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 Associate Dean, Student Affairs for Science, in consultation with the appropriate department, may approve a lower minimum for students who had completed 60 credits or more before interrupting their studies.

Students who are readmitted after a period of absence are subject to the program and degree requirements in effect at the time of readmission. The Associate Dean, Student Affairs for Science, in consultation with the department, may approve exemption from any new requirements.

6.2   Residency Requirement

To obtain a B.Sc. degree, students must satisfy the following residency requirements: a minimum of 60 credits of courses used to satisfy the B.Sc. degree requirements must be taken and passed at McGill, e

(subject to departmental approv

6.4.4   Special Designations

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

6.4.4.1   B.Sc. Global Designation

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

6.4.4.2   Internship Program Designation

All B.Sc. programs can include an internship component. For more details, students should refer to *section 12: Science Internships and Field Studies* and *mcgill.ca/science/undergraduate/internships-field/internships*.

6.4.5   Bieler School of Environment

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

6.5   Course Requirements

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

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

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

6.5.1   Course Overlap

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

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

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

Note for Science, and Bachelor of Arts and Science students: Credit for statistics courses offered by fse must ee cal8 230Gw48st fit3 of

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

6.5.2   Courses Outside the Faculties of Arts and of Science

Students in the Faculty of Science should consult the statement of regulations (see below) for taking courses outside the Faculties of Arts and of Science. A list of approved/restricted courses in other faculties can be found in the *The Faculty of Science's Undergraduate Handbook (Section 3.2.2 List of approved and restricted cour*

6.5.4 Courses in English as a Second Language (ESL)

ESL courses are only open to students whose primary language is not English and who have studied for fewer than five years in English-language secondary institutions. Students in the B.Sc. may take a maximum of 12 credits, including academic writing courses for non-anglophones, from the list of ESL courses in the *McGill Writing Centre*.

6.5.5 First-Year Seminars: Registration

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 fewer than that.

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

First-Year Seminars	
CHEM 199	FYS: Why Chemistry?
EPSC 199	FYS: Earth & Planetary Exploration
PSYC 199	FYS: Mind-Body Medicine
PSYT 199	FYS: Mental Illness and the Brain

The First-Year Seminars offered by the Faculty of Arts are also open to Science students. For a complete listing, please consult *Faculty of Arts > Undergraduate > Browse Aca demic Units & Programs > : 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 a student. One credit equals about 45 hours of work. This may be a combination of lecture, laboratory, tutorial, and conference time plus personal study hours. Personal study hours may include required activities, group activities, time spent doing assignments, and preparing and reviewing for a course.

7 Advising

Students who need 96 or fewer credits to complete their degree requirements must consult an academic adviser in their intended department of study to obtain advice and approval of their 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. Students with satisfactory results in International Baccalaureate, French Baccalaureate, Advanced Levels, and Advanced Placement tests may also be exempt from some or all of the Science Freshman courses. **Regardless of how many advanced standing credits received, students are responsible for ensuring their Freshman science program requirements are met.** To facilitate program planning, students must contact their Faculty (SOUSA) adviser for course approval before finalizing their first year courses. For a detailed description of advising and registration procedures, refer to *University Regulations & Resources > Undergraduate > : Undergraduate Advising* and *: Registration*; the *McGill website for newly admitted undergraduate students*; the *SOUSA New Student website*; and your department's website.

Students who need 97–120 credits to complete their degree requirements will normally be registered in a Freshman program until they complete their first year. Students must consult a Faculty adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. For a detailed description of advising and registration procedures as a Freshman student, refer to the *website for newly admitted undergraduate students*, and the SOUSA's *New Student* website.

Advising for all returning students takes place in March for the upcoming academic year. For more information, refer to the *SOUSA website*.

8 Freshman Interest Groups

Freshman Interest Groups (FIGs) are groups of approximately 25 U0 students and U1 students in their first semester, in the B.Sc. or B.A. & Sc., led by a Faculty of Science academic adviser and an upper-year undergraduate student. They meet once every two weeks in the Fall or Winter semester (or weekly for half the semester) to discuss a wide range of topics, such as science in the ne

9   Examinations

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

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

Programs Offered

section 10.1: Bachelor of Science Program Groups, which may include liberal program – Core Science Components, major programs, joint major programs, honours programs, and joint honours programs

section 10.2: Minor Programs

section 10.3: Bachelor of Arts and Science

section 10.4: Internships, Field Studies, and Global Designation

section 10.5: Arts Major and Minor Concentrations Open to Science Students

10.1   Bachelor of Science Program Groups

Science students admitted after September 2009 are limited to choosing liberal, majors, or honours programs within the Science group to which they were admitted, but may continue to choose freely from all available minor programs. Students pursuing a Liberal Science Program – Core Science Component (CSC) may also select a second CSC from any group. See *section 6.4.1: Liberal, Major, and Honours Programs*.

The groups within the B.Sc. are:

- *section 10.1.1: Biological, Biomedical & Life Sciences Group*
- *section 10.1.2: Bio-Physical-Computational Sciences Group*
- *section 10.1.3: Neuroscience Group*
- *section 10.1.4: Physical, Earth, Math & Computer Science Group*

A list of specific programs in each group is available via the above links. To change to a major or honours program in another Science group, students must make an Intra-Faculty Transfer application.

See: *mcgill.ca/science/transfer*.

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 13.4.4: 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)*
- Microbiology and Immunology: *section 13.23.4: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (50 credits)*
- Physiology: *section 13.31.4: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physiology (50 credits)*
- Psychology: *section 13.33.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Psychology (45 credits)*

10.1.1.2 Major Programs

- Anatomy and Cell Biology: *section 13.2.5: Bachelor of Science (B.Sc.) - Major Anatomy and Cell Biology (67 credits)*
- Biochemistry: *section 13.4.5: Bachelor of Science (B.Sc.) - Major Biochemistry (64 credits)*
- Biology: *section 13.5.8: Bachelor of Science (B.Sc.) - Major Biology (59 credits)*
- Biology – Quantitative Biology: *section 13.5.9: Bachelor of Science (B.Sc.) - Major Biology - Quantitative Biology (73 credits)*
- Microbiology and Immunology: *section 13.23.5: Bachelor of Science (B.Sc.) - Major Microbiology and Immunology (66 credits)*
- Pharmacology: *section 13.29.5: Bachelor of Science (B.Sc.) - Major Pharmacology (67 credits)*
- Physiology: *section 13.31.5: Bachelor of Science (B.Sc.) - Major Physiology (65 credits)*
- Psychology: *section 13.33.8: Bachelor of Science (B.Sc.) - Major Psychology (54 credits)*

10.1.1.3 Honours Programs

- Anatomy and Cell Biology: *section 13.2.6: Bachelor of Science (B.Sc.) - Honours Anatomy and Cell Biology (73 credits)*
- Biochemistry: *section 13.4.6: Bachelor of Science (B.Sc.) - Honours Biochemistry (73 credits)*
- Biology: *section 13.5.11: Bachelor of Science (B.Sc.) - Honours Biology (72 credits)*
- Biology – Quantitative Biology: *section 13.5.12: Bachelor of Science (B.Sc.) - Honours Biology - Quantitative Biology (79 credits)*
- Immunology (Interdepartmental): *section 13.18.3: Bachelor of Science (B.Sc.) - Honours Immunology (Interdepartmental) (75 credits)*
- Microbiology and Immunology: *section 13.23.6: Bachelor of Science (B.Sc.) - Honours Microbiology and Immunology (72 credits)*
- Pharmacology – application required, see departmental section for information: *section 13.29.6: Bachelor of Science (B.Sc.) - Honours Pharmacology (76 credits)*
- Ph Physiology: *section 13.31.8: Bachelor of Science (B.Sc.) - Honours Physiolo*

- Chemistry – General option: *section 13.7.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - General (49 credits)*

- Computer Science: *section 13.9.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Computer Science (45 credits)*

- Earth and Planetary Sciences: *section 13.10.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Earth and Planetary Sciences (45 credits)*

- Geography: *section 13.17.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Geography (49 credits)*

- Mathematics: *section 13.22.9: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Mathematics (45 credits)*

- Physics: *section 13.30.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physics (45 credits)*

- Software Engineering: *section 13.9.9: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Software Engineering (49 credits)*

- Statistics: *section 13.22.10: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Statistics (48 credits)*

10.1.4.2 Major Programs

- Atmospheric Science: *section 13.3.6: Bachelor of Science (B.Sc.) - Major Atmospheric Science (62 credits)*

- Chemistry: *section 13.7.8: Bachelor of Science (B.Sc.) - Major Chemistry (59 credits)*

- Chemistry – Bio-organic option: *section 13.7.9: Bachelor of Science (B.Sc.) - Major Chemistry - Bio-organic (63 credits)*

- Chemistry – Biophysical option: *section 13.7.10: Bachelor of Science (B.Sc.) - Major Chemistry: Biophysical Chemistry (66 credits)*

- Computer Science: *section 13.9.10: 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 (65 credits)*

- Earth System Science: *section 13.11.4: Bachelor of Science (B.Sc.) - Major Earth System Science (57 credits)*

- Environment – Atmospheric Environment and Air Quality domain: *: Bachelor of Science (B.Sc.) - Major Environment - Atmospheric Environment and Air Quality (60 credits)*

- Environment – Biodiversity and Conservation domain: *: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Biodiversity and Conservation (63 credits)*

- Environment – Earth Sciences and Economics domain: *: Bachelor of Science (B.Sc.) - Major Envir*

10.1.4.4 Honours Programs

- Applied Mathematics: *section 13.22.15: Bachelor of Science (B.Sc.) - Honours Applied Mathematics (63 credits)*
- Atmospheric Science: *section 13.3.8: Bachelor of Science (B.Sc.) - Honours Atmospheric Science (75 credits)*
- Chemistry: *section 13.7.11: Bachelor of Science (B.Sc.) - Honours Chemistry (71 credits)*
- Chemistry – Bio-organic option: *section 13.7.12: Bachelor of Science (B.Sc.) - Honours Chemistry - Bio-organic (75 credits)*
- Computer Science: *section 13.9.15: Bachelor of Science (B.Sc.) - Honours Computer Science (75 credits)*
- Earth System Science: *section 13.11.5: Bachelor of Science (B.Sc.) - Honours Earth System Science (66 credits)*
- Environment: *: Bachelor of Science (B.Sc.) - Honours Environment (72 credits)*
- Geography: *section 13.17.9: Bachelor of Science (B.Sc.) - Honours Geography (66 credits)*
- Geology: *section 13.10.9: Bachelor of Science (B.Sc.) - Honours Geology (75 credits)*
- Mathematics: *section 13.22.16: Bachelor of Science (B.Sc.) - Honours Mathematics (63 credits)*
- Physics: *section 13.30.13: Bachelor of Science (B.Sc.) - Honours Physics (78 credits)*
- Planetary Sciences: *section 13.10.10: Bachelor of Science (B.Sc.) - Honours Planetary Sciences (78 credits)*
- Probability and Statistics: *section 13.22.17: Bachelor of Science (B.Sc.) - Honours Probability and Statistics (60-63) (63 credits)*
- Software Engineering: *section 13.9.17: Bachelor of Science (B.Sc.) - Honours Software Engineering (75 credits)*

10.1.4.5 Joint Honours Programs

- Mathematics and Computer Science: *section 13.22.19: Bachelor of Science (B.Sc.) - Honours Mathematics and Computer Science (78 credits)*
- Mathematics and Physics: *section 13.30.15: Bachelor of Science (B.Sc.) - Honours Mathematics and Physics (81 credits)*
- Physics and Chemistry: *section 13.30.16: Bachelor of Science (B.Sc.) - Honours Physics and Chemistry (80 credits)*
- Physics and Computer Science: *section 13.30.17: Bachelor of Science (B.Sc.) - Honours Physics and Computer Science (81 credits)*
- Statistics and Computer Science: *section 13.22.18: Bachelor of Science (B.Sc.) - Honours Statistics and Computer Science (79 credits)*

10.2   Minor Programs

Minor Programs

Atmospheric Science: *section 13.3.4: Bachelor of Science (B.Sc.) - Minor Atmospheric Science (18 credits)*

Biology: *section 13.5.6: Bachelor of Science (B.Sc.) - Minor Biology (25 credits)*

Biotechnology: *section 13.6.5: Bachelor of Science (B.Sc.) - Minor Biotechnology (for Science Students) (24 credits)*

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

Chemistry: *section 13.7.5: Bachelor of Science (B.Sc.) - Minor Chemistry (20 credits)*

Cognitive Science: *section 13.8.2: Bachelor of Science (B.Sc.) - Minor Cognitive Science (24 credits)*

Computer Science: *section 13.9.7: Bachelor of Science (B.Sc.) - Minor Computer Science (24 credits)*

Earth System Science: *section 13.11.3: Bachelor of Science - Minor Earth System Science (18 credits)*

Education for Science Students: *section 13.35.4: Bachelor of Science (B.Sc.) - Minor Education for Science Students (18 credits)*

Electrical Engineering: *section 13.30.7: Bachelor of Science (B.Sc.) - Minor Electrical Engineering (24 credits)*

Entrepreneurship for Science Students: *section 13.12.2: Bachelor of Science (B.Sc.) - Minor Entrepr*

Minor Programs

Geology: *section 13.10.5: Bachelor of Science (B.Sc.) - Minor Geology (18 credits)* (*previously named Earth and Planetary Sciences*)

Human Nutrition – see *Faculty of Agricultural & Environmental Sciences > Undergraduate > Browse Academic Programs > Minor Programs > : Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) - Minor Human Nutrition (24 credits)*

Interdisciplinary Life Sciences: *section 13.19.3: Bachelor of Science (B.Sc.) - Minor Interdisciplinary Life Sciences (24 credits)*

Kinesiology: *section 13.20.3: Bachelor of Science (B.Sc.) - Minor Kinesiology (24 credits)*

Management for Non-Management Students: *section 13.21.1: Bachelor of Commerce (B.Com.) - Minor Manag*

Major Concentrations

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Music 36 cr

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

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

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

German Languages: *: Bachelor of Arts (B.A.) - Minor Concentration German Languages (18 credits)*

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

Health Geography: *: Bachelor of Arts (B.A.) - Minor Concentration Health Geography (18 credits)*

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

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

History and Philosophy of Science: *: Bachelor of Arts (B.A.) - Minor Concentration History and Philosophy of Science (18 credits)*

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

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

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

11.3 Undergraduate Poster Showcase

Each year, the Faculty of Science holds an under

- You must have completed at least 27 credits and have at least 12 credits remaining in your degree program.
- Your CGPA must be 2.7 or higher.
- International McGill students are eligible to apply to summer IP and IYS positions (unless otherwise indicated on the job posting). Restrictions apply; interested students should visit the Internships & Field Studies Office's website at *mcgill.ca/science/undergraduate/internships-field* for details.

The program features the *Industrial Practicum* (4 months) and the *Internship Year in Science* (8, 12, 16 months).

Internship Program Designation

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

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

12.2 Field Study Semester Programs

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

12.3 B.Sc. Global Designation

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

13 Browse Academic Units and Programs

What is a Major Program?

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

What is an Honours Program?

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

What is a B.Sc. Liberal Program?

This is a flexible and modular program. Students combine a core science component (CSC) in a Science discipline with a breadth component, which may be a minor from a wide variety of areas, a major concentration from the Faculty of Arts, or a second CSC from any groupr

mathematics, and physics. Similarly, students who have completed courses at other universities or colleges may receive exemptions and/or credits. Consult

MATH 150	(4)	Calculus A

Second calculus course, one of:

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

First physics course, one of:

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

Second physics course, one of:

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

Electives

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

13.2   Anatomy and Cell Biology (ANAT)

13.2.1   Location

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

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

The department is equipped to perform protein purification; recombinant DN

13.2.3 Anatomy and Cell Biology (ANAT) Faculty

Chair

Chantal Autexier

Emeritus Professors

Gary C. Bennett; John J.M. Bergeron; James R. Brawer; Louis Hermo; Sandra C. Miller; Dennis G. Osmond; Hershey Warshawsky

Professors

Chantal Autexier; Samuel David (*joint appt. with Neurology and Neurosurgery*); Elaine Davis; Timothy Kennedy (*joint appt. with Neurology and Neurosurgery*); Nathalie Lamarche-Vane; Marc D. McKee (*joint appt. with Dentistry*); Peter McPherson (*joint appt. with Neurology and Neurosurgery*); Carlos R. Morales; Joaquin Ortega; Barry I. Posner (*joint appt. with Medicine and Health Sciences*); Dieter Reinhardt (*joint appt. with Dentistry*); Alfredo Ribeiro-da-Silva (*joint appt. with Pharmacology and Therapeutics*); Wayne Sossin (*joint appt. with Neurology and Neurosurgery*); Stefano Stif

* Students who have taken the equivalent of CHEM 212, CHEM 222, and/or MATH 203 in CEGEP (as defined at

ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Biochemistry of Immune Diseases
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 544	(3)	Genetic Basis of Life Span
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 575	(3)	Human Biochemical Genetics
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BIOT 505	(3)	Selected Topics in Biotechnology
COMP 204	(3)	Computer Programming for Life Sciences
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes

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 of advanced anatomy courses (AAC) selected from:

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

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321**	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 323**	(3)	Clinical Neuroanatomy
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 514	(3)	Advanced Human Anatomy Laboratory
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 542	(3)	Transmission Electron Microscopy of Biological Samples
ANAT 565	(3)	Diseases-Membrane Trafficking
NEUR 310	(3)	Cellular Neurobiology

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

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 323	(3)	Clinical Neuroanatomy
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 542	(3)	Transmission Electron Microscopy of Biological Samples
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function

BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Biochemistry of Immune Diseases
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
		Evolution of Brain and 68 Tm((3))Tj3

PHAR 563	(3)	Endocrine Pharmacology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and 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)	Translational Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.3   Atmospheric and Oceanic Sciences (ATOC)

13.3.1   Location

Burnside Hall, Room 305
805 Sherbrooke Street West
Montreal QC H3A 0B9
Telephone: 514-398-3764
Fax: 514-398-6115
Email: *info.aos@mcgill.ca*
Website: *mcgill.ca/meteo*

13.3.2   About Atmospheric and Oceanic Sciences

The Department of Atmospheric and Oceanic Sciences offers, at the undergraduate level, a broad range of courses in atmospheric chemistry, atmospheric physics, meteorology, ocean and atmosphere dynamics, and climate. The study of atmospheric and oceanic sciences is based largely on physics and applied mathematics. All required courses except those at the introductory level generally have prerequisites or corequisites in physics, mathematics, and atmospheric science.

One of the goals of the discipline is to develop the understanding necessary to improve our ability to predict the weather. Another important area of study focuses on the changes in global climate caused by the changing chemical composition of the atmosphere. The approach to the study of climate change is quantitative in the Department of Atmospheric and Oceanic Sciences. Like other physical sciences, atmospheric and oceanic sciences attempt to create theoretical models of their complex processes as a means of analyzing the motion and composition of the air and seawater, thermodynamic behaviours, and their interaction with radiation and with the other components of the climate system.

From one viewpoint, the atmosphere and ocean may be studied as a large volume of gas or liquid by the methods of fluid mechanics: wind or currents, circulation patterns, turbulence, and energy and momentum exchanges are the ideas employed in this approach. Alternatively, the atmosphere and ocean may be studied from the point of view of their detailed physical processes: how water condenses in the air; how seawater freezes to form sea ice; how cloud droplets make rain; how sunlight warms the surface of the Earth; how heat is exchanged between the ocean and the atmosphere; and how the atmosphere and ocean interact to shape the weather and climate. A comprehensive understanding requires both viewpoints, and these are reflected in the curriculum.

The Department of Atmospheric and Oceanic Sciences offers six programs:

- *section 13.3.4: **Minor** in Atmospheric Science*
- *section 13.3.5: **Liberal Program** - Core Science Component Atmospheric and Oceanic Sciences*
- *section 13.3.6: **Major** in Atmospheric Sciences*
- *section 13.3.7: **Major** in Atmospheric Science and Physics*

- *section 13.3.8:* ***Honours*** *in Atmospheric Science*
- *section 13.3.9:* ***Diploma*** *in Meteorology*

The **Honours** program is meant for students with high standing. It is based on courses similar to those in the Major program, but includes a mandatory research course and provides opportunities to take advanced courses. The **Major** program, although somewhat less intensive, leads to a broad range of career opportunities, including a professional career as a meteorologist, and like the Honours program equips the student to undertake postgraduate study in atmospheric and oceanic sciences at any of the leading universities. The Department also offers a special one-year

PHYS 404**	(3)	Climate Physics

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

**Note: Students may select ATOC 404 or PHYS 404 but not both.

3-9 credits selected from:

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 548	(3)	Mesoscale Meteorology
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics

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

45-48 credits

Required Courses (21 credits)

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

Complementary Courses (24-27 credits)

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

3-6 credits selected from:

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

3 credits selected from:

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

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (36-39 credits)

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

Core (21-22 credits)

3-6 credits selected from:

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

* If chosen, students may take ATOC 219 or CHEM 219.

3 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

| PHYS 350** | (3) | Honours Electricity and Magnetism |
| PHYS 352*** | (3) | Honours Electromagnetic Waves |

* If chosen, students may take either MATH 203 or MATH 324.

** If chosen, students may take either PHYS 340 or PHYS 350.

*** If chosen, students may take either PHYS 342 and PHYS 352.

15-17 credits from one of the following streams:

Weather Analysis and Forecasting Stream (16-17 credits)

13 credits from:

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

3-4 credits selected from:

ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 548	(3)	Mesoscale Meteorology
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids
PHYS 512	(3)	Computational Physics with Applications

+ If chosen, students may take either ATOC 404 or PHYS 404.

++ If chosen, students may take either PHYS 432 or MATH 555.

Climate Science Stream (15 credits)

6 credits from:

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

+ If chosen, students may take either ATOC 404 or PHYS 404.

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

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
EPSC 513	(3)	Climate and the Carbon Cycle
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 323	(3)	Probability
	(3)	Computational Physics with Applications

ATOC 546	(1)	Current Weather Discussion
ATOC 548	(3)	Mesoscale Meteorology
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids
PHYS 512	(3)	Computational Physics with Applications

+ If chosen, students may take either ATOC 404 or PHYS 404.

++ If chosen, students may take either PHYS 432 or MATH 555.

13.3.7 Bachelor of Science (B.Sc.) - Major Atmospheric Science and Physics (69 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 (57 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
		Majors Electricity and Magnetism

Complementary Course (12 credits)

At least 6 of the 12 complementary credits must come from ATOC courses.

ATOC 357	(3)	Atmospheric and Oceanic Science Laboratory
ATOC 404*	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 548	(3)	Mesoscale Meteorology
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 404*	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 449	(3)	Majors Research Project
PHYS 512	(3)	Computational Physics with Applications

* Students cannot take both ATOC 404 and PHYS 404.

13.3.8   Bachelor of Science (B.Sc.) - Honours Atmospheric Science (75 credits)

72-75 credits

The B.Sc.; Honours in Atmospheric Science provides advanced training in atmospheric science, and it includes a research component.

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.

Required Courses (27 credits)

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

Complementary Courses (45-48 credits)

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

Core (24-25 credits) (24 credits)

3-6 credits selected from:

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

* If chosen, students may take either ATOC 219 or CHEM 219.

3 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
MATH 319	(3)	Partial Differential Equations

6-10 credits selected from:

CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
COMP 551	(4)	Applied Machine Learning
MATH 203*	(3)	Principles of Statistics 1
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340**	(3)	Majors Electricity and Magnetism
PHYS 342***	(3)	Majors Electromagnetic Waves
PHYS 350**	(3)	Honours Electricity and Magnetism

PHYS 352***	(3)	Honours Electromagnetic Waves

* If chosen, students may take either MATH 203 or MATH 324.

** If chosen, students may take either PHYS 340 or PHYS 350.

*** If chosen, students may take either PHYS 342 or PHYS 352.

21-23 credits from one of the following four streams:

Weather Analysis and Forecasting Stream (22-23 credits)

16 credits from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 521	(3)	Cloud Physics
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion

6-7 credits selected from:

ATOC 404+	(3)	Climate Physics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 548	(3)	Mesoscale Meteorology
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids
PHYS 512	(3)	Computational Physics with Applications

+ If chosen, students may take either ATOC 404 or PHYS 404.

++ If chosen, students may take either PHYS 432 or MATH 555.

Climate Science Stream (21-22 credits)

15 credits from:

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

PHYS 404+   (3)   Climate Physics

+ If chosen, students may take either ATOC 404 or PHYS 404.

If chosen, students may take either MATH 203 or MATH 324.

6-7 credits (3 credits must be an AT

EPSC 513	(3)	Climate and the Carbon Cycle
MATH 423	(3)	Applied Regression
PHYS 404+	(3)	Climate Physics
PHYS 512	(3)	Computational Physics with Applications

+ If chosen, students may take either ATOC 404 or PHYS 404.

General Stream (21-22 credits)

(at least 15 credits must be ATOC courses) selected from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion

Required Courses (15 credits)

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 521	(3)	Cloud Physics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 54115 credits)	(3)	Synoptic Meteorology 2

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

13.4   Biochemistry (BIOC)

13.4.1   Location

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

13.4.2   About Biochemistry

What is Biochemistry?

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

- *The study of life in its chemical processes*: Biochemistry is both a life science and a chemical science—it explores the chemistry of living organisms and the molecular basis for the changes occurring in living cells. It uses the methods of chemistry, physics, molecular biology, and immunology to study the structure and behaviour of the complex molecules found in biological material and the ways these molecules interact to form cells, tissues, and whole organisms. Biochemistry graduates are interested, for example, in mechanisms of brain function, cellular multiplication and differentiation, communication within and between cells and organs, and the chemical bases of inheritance and disease.

462, and BIOC 491 courses. Students can also take a variety of complementary courses in other biological, biomedical, and chemical disciplines in their second and third years.

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

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

13.4.3 Biochemistry Faculty

Chair

Thomas Duchaine

Emeritus Professors

Nicole Beauchemin, Rhoda Blostein, Philip E. Branton, Peter E. Braun, Robert E. MacKenzie, Walter E. Mushynski, Joseph Shuster, John R. Silvius, Clifford P. Stanners, Maria Zannis-Hadjopoulos, Imed Gallouzi

Professors

Albert Berghuis, Josée Dostie, Thomas Duchaine, Kalle Gehring, Vincent Giguère, Philippe Gros, Alba Guarné, Roderick R. McInnes, William Muller, Bhushan Nagar, Alain Nepveu, Morag Park, Arnim Pause, Jerry Pelletier, Martin Schmeing, Nahum Sonenberg, Jose G. Teodoro, David Y. Thomas, Michel L. Tremblay

Associate Professors

Sidong Huang, Ian Watson

Assistant Professors

Natasha C. Chang, Katie Cockburn, Maxime Denis, Lawrence Kazak, William Pastor, Maria Vera Ugalde

Associate Members

Gary Brouhard, Marc Fabian, Robert S. Kiss, Gergely Lukacs, Luke McCaffrey, Joaquin Ortega, Janusz Rak, Stéphane Richard, Reza Salavati, Erwin Schurr, Peter Siegel, Ivan Topisirovic, Youla S. Tsantrizos, Bernard Turcotte, Josie Ursini-Siegel, Simon Wing, Xiang-Jiao Yang, Natalie Zeytun

Adjunct Professors

Jacques Drouin, Enrico Purisima, Selena Sagan, Julie St-Pierre, Martin Savageau, Robert Joseph Zamboni

13.4.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biochemistry (47 credits)

U1 Required Courses (23 credits)

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

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOC 220	(3)	Laboratory Methods in Biochemistry and Molecular Biology 1
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2

U1 Complementary Courses** (6 credits)

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

6 credits selected from:

BIOL 205	(3)	Functional Biology of Plants and Animals

MIMM 211	(3)	Introductory Microbiology
~~MIMM 314~~	(3)	Introductory Immunology: Elements of Immunity
~~PHGY 209~~	(3)	Mammalian Physiology 1
~~PHGY 210~~	(3)	Mammalian Physiology 2

U2 Required Courses (12 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 320	(3)	Laboratory Methods in Biochemistry and Molecular Biology 2
CHEM 302	(3)	Introductory Organic Chemistry 3

U2 Complementary Courses** (3 credits)

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

3 credits selected from:

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

U3 Complementary Courses (3 credits)

3 credits selected from:

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

Bachelor of Science (B.Sc.) - Major BiocB.Sc.) - nPP3 T o5yc2 299.983 0yy3ea265.864 315.7 Tm(nPP3 T o5yc1 8..589 Tm(ses (3 cred

U1 Complementary Courses (6 credits)

6 credits selected from:

BIOL 205	(3)	Functional Biology of Plants and Animals
MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

U2 Required Courses (20 credits)

ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 320	(3)	Laboratory Methods in Biochemistry and Molecular Biology 2
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
CHEM 267	(3)	Introductory Chemical Analysis
COMP 202	(3)	Foundations of Programming
COMP 204	(3)	Computer Programming for Life Sciences
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
PSYC 204	(3)	Introduction to Psychological Statistics

U3 Required Courses (6 credits)

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

U3 Complementary Courses (6 credits)

3-6 credits selected from:

BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 470	(3)	Lipids and Lipoproteins in Disease
BIOC 491	(6)	Independent Research
BIOC 503	(3)	Biochemistry of Immune Diseases
PSYT 455	(3)	Neurochemistry

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 Cancer
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 532	(3)	Structural Organic Chemistry
CHEM 552	(3)	Physical Organic Chemistry
CHEM 572	(3)	Synthetic Organic Chemistry
EXMD 502	(3)	Advanced Endocrinology 1
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses and Hormones

13.4.6 Bachelor of Science (B.Sc.) - Honours Biochemistry (73 credits)

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

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

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

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

U1 Required Courses (23 credits)

* Note: Students with CEGEP-level credit for the equivalents of CHEM 212 and/or CHEM 222 (see http://www.mcgill.ca/students/courses/plan/transfer/ for accepted equivalents) may not take these courses at McGill and should replace them with elective courses to satisfy the total credit 0 1 67.2 Tm(* Note:n2csl59ir1 0 (

MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

U2 Required Courses (20 credits)

ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 320	(3)	Laboratory Methods in Biochemistry and Molecular Biology 2
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
CHEM 267	(3)	Introductory Chemical Analysis
COMP 202	(3)	Foundations of Programming
COMP 204	(3)	Computer Programming for Life Sciences
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
PSYC 204	(3)	Introduction to Psychological Statistics

U3 Required Courses (15 credits)

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

U3 Complementary Courses (6 credits)

3-6 credits selected from:

BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 470	(3)	Lipids and Lipoproteins in Disease
BIOC 491	(6)	Independent Research
BIOC 503	(3)	Biochemistry of Immune Diseases
PSYT 455	(3)	Neurochemistry

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 Cancer
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 532	(3)	Structural Organic Chemistry
CHEM 552	(3)	Physical Organic Chemistry
CHEM 572	(3)	Synthetic Organic Chemistry
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses and Hormones

13.4.7 Biochemistry (BIOC) Related Programs

13.4.7.1 Interdepartmental Honours in Immunology

For more information, see *section 13.18: Immunology*. This program is offered by the Departments of Biochemistry, Microbiology and Immunology, and Physiology.

Students interested in the program should contact:

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

OR

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

13.5 Biology (BIOL)

13.5.1 Location

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

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 individual molecules within it;
-

- two courses in general chemistry;
- two courses in mathematics (as per the Freshman science requirements);
- one or two courses in physics (mechanics and electromagnetism), depending on your choice of upper year courses.

Students entering ntudents ent 682.56 0354Y Sc.,82.56Lib

Professors

Ehab Abouheif; Graham A.C. Bell; Lauren Chapman; Melania Cristescu; Gregor Fussmann; Andrew Gonzalez (*on sabbatical*); Irene Gregory-Eaves; Frédéric Guichard; Siegfried Hekimi; Andrew Hendry, *joint appt. with Redpath Museum*; Rees Kassen; Paul F. Lasko; Laura Nilson; Catherine Potvin; Neil M. Price (*on sabbatical*); Richard Roy; Daniel J. Schoen; Hugo Zheng

Associate Professors

Gary Brouhard (*on sabbatical*); Thomas E. Bureau; David Dankort; Joseph A. Dent; Anna Hargreaves (*on sabbatical*); Paul Harrison; Michael Hendricks; Brian Leung; Nam-Sung Moon; Simon Reader (*on sabbatical*); Rodrigo Reyes-Lamothe, (*on sabbatical*); Jon Sakata; Frieder Schoeck; Jacalyn Vogel; Alanna Watt; Steph Weber (*on sabbatical*); Tamara Western; Sarah Woolley; Monique Zetka

Assistant Professors

Abigail Gerhold; Mélanie Guigueno; Arnold Hayer; Tomoko Ohyama; Lars Iversen; Laura Pollock; Fiona Soper; Jennifer Sunday

Associate Members

BioEngineering: Adam Hendricks

Centre for Research in Neuroscience: Donald Van Meyel

Glen site: Hugh J. Clarke; Daniel Dufort; David Rosenblatt; Teruko Taketo

MNI: Kenneth Hastings

Physics: Paul Francois

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

Adjunct Professors

BELLUS Health Inc.: Francesco Bellini

Canadian Mountain Network: Norma Kassi

IRCM: David Hipfner

STRI: Andrew Altieri; Hector Guzman; WW

CHEM 212*   (4)   Introductory Organic Chemistry 1

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 Biology Adviser.

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

The Liberal Program - Core Science Component Biology is a flexible program focusing on the fundamentals of biology. Topics include a range of biological concepts spanning molecules and cells to organisms and ecosystems, including development, behaviour and evolution.

BIOL 205	(3)	Functional Biology of Plants and Animals
BIOL 206	(3)	Methods in Biology
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 216	(3)	Biology of Behaviour
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 302	(3)	Fundamentals of Genetics and Genomics
BIOL 311	(3)	Advanced Methods in Organismal Biology
COMP 204	(3)	Computer Programming for Life Sciences

Complementary Courses (27-28 credits)

Core 12-13 credits

3 or 4 credits selected from CHEM block:

CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 212*	(4)	Introductory Organic Chemistry 1

* If a student has already taken CHEM 212 or its equivalent, the credits can be made up with CHEM 204, or CHEM 222, or a 3- or 4-credit Biology complementary course to be approved by the Biology Adviser.

9 credits (3 credits from each of Blocks A, B and C):

Block A-Ecology and Evolution:

BIOL 304	(3)	Evolution
BIOL 305	(3)	Animal Diversity
BIOL 308	(3)	Ecological Dynamics

Block B-Molecular and Cellular:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 313	(3)	Eukaryotic Cell Biology

Block C-Neuro/Behaviour:

BIOL 306	(3)	Neural Basis of Behaviour
BIOL 307	(3)	Behavioural Ecology

Other (15 credits)

15 credits other Biology courses at the 300-500 levels, of which 6 credits must be at the 400-500 levels; may include up to 6 credits of research, and may include up to 6 credits of other non-BIOL science courses subject to Adviser approval.

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

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

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

Advising notes for U0 students

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

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

Required Cour

BIOL 432	(3)	Limnology

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

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

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

Stream 2: Physical Biology (21 credits)

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

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

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

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

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

Complementary Courses

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

9 credits from the following:

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

BIOL 466	(3)	Independent Research Project 1
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 350*	(3)	Numerical Computing
COMP 364	(3)	Computer Tools for Life Sciences
MATH 235**	(3)	Algebra 1
MATH 240**	(3)	Discrete Structures
MATH 314	(3)	Advanced Calculus
MATH 317*	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 348	(3)	Euclidean Geometry
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes

* Students may take COMP 350 OR MATH 317.

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

Recommendations for Physical Biology stream

BIEN 310	(3)	Introduction to Biomolecular Engineering
BIEN 320	(3)	Molecular, Cellular and Tissue Biomechanics
BIEN 340	(3)	Transport Phenomena in Biological Systems 2
BIEN 510	(3)	Engineered Nanomaterials for Biomedical Applications
BIEN 530	(3)	Imaging and Bioanalytical Instrumentation
CHEM 222	(4)	Introductory Organic Chemistry 2
PHYS 242*	(2)	Electricity and Magnetism
PHYS 257	(3)	Experimental Methods 1
	(3)BIEN 530	Majors Electromagnetic Waves

BIOL 467	(3)	Independent Research Project 2
BIOL 468	(6)	Independent Research Project 3
MATH 410	(3)	Majors Project

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

Math Courses

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

Stream 1: Theory

12 credits from the following courses:

* Students may take either MATH 317 or MATH 327.

MATH 314	(3)	Advanced Calculus
MATH 317*	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327*	(3)	Matrix Numerical Analysis

Stream 2: Statistics

9 credits from the following:

MATH 324	(3)	Statistics
MATH 423	(3)	Applied Regression
MATH 447	(3)	Introduction to Stochastic Processes

Remaining Math Courses

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

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

BIOL, NEUR, PHGY, PHYS, PSYC Courses

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

Note: Some courses in the streams may have prerequisites.

Ecology and Evolutionary Ecology Stream

At least 15 credits selected as follows:

3 credits of:

BIOL 206	(3)	Methods in Biology

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

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

At least 9 credits chosen from the following list

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

Molecular Evolution Stream

At least 15 credits selected as follows:

3 credits

BIOL 202	(3)	Basic Genetics

At least 12 credits selected from the following list:

BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 569	(3)	Developmental Evolution
BIOL 592	(3)	Integrated Bioinformatics

Neurosciences Stream

At least 15 credits selected as follows:

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour

At least 12 credits selected from:

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

Remaining BIOL, NEUR, PHGY, PSYC

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

13.5.11   Bachelor of Science (B.Sc.) - Honours Biology (72 credits)

The Honours program in Biology is intended for students who are interested in gaining a concentrated research experience. A broad range of fundamental biological concepts spanning molecules and cells to organisms and ecosystems, including development, behaviour and evolution is supplemented with research in a chosen area. Potential areas of focus include: (1) molecular, cellular and developmental biology, (2) conservation, ecology and evolution, and (3) neurobiology and behaviour.

Acceptance into the Honours program at the end of U2 requires a CGPA of 3.50 and approval of a 9- or 12-credit Independent Studies proposal (see listing of BIOL 479D1/BIOL 479D2, BIOL 480D1/BIOL 480D2 for details). For an Honours degree, a minimum CGPA of 3.50 at Graduation and adherence to the program as outlined below are the additional requirements.

First Class Honours will be awarded to students graduating with a CGPA of 3.75 or better, and having successfully completed the Honours program

Required Courses (35 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
		Functional Biology of Plants and

3 or 4 credits selected from CHEM block:

| CHEM 204 | (3) | Physical Chemistry/Biological Sciences 1 |
| CHEM 212* | (4) | Introductory Organic Chemistry 1 |

* If a student has already taken CHEM 212 or its equivalent, the credits can be made up with CHEM 204, CHEM 222, or a 3- or 4-credit Biology complementary course to be approved by the Biology Adviser.

9 credits (3 credits from each of Block A, Block B and Block C):

Block A- Ecology and Evolution:

BIOL 304	(3)	Evolution
BIOL 305	(3)	Animal Diversity
BIOL 308	(3)	Ecological Dynamics

Block B- Molecular and Cellular:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 313	(3)	Eukaryotic Cell Biology

Block C-Neuro/Behaviour:

| BIOL 306 | (3) | Neural Basis of Behaviour |
| BIOL 307 | (3) | Behavioural Ecology |

Honours Block (9-12 credits)

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

OR

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

Other (12-15 credits)

15 credits of Biology courses at the 300-500 levels if taking BIOL 479D1/D2, or 12 credits if taking BIOL 480D1/D2. With permission of the Biology Adviser, up to 6 credits may be taken from other science department courses (300-500 levels). Up to 3 credits of previous independent research courses may be included. Must include 6 credits of 400-500 levels.

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

79 credits

Interdisciplinary research that draws from the natural and physical sciences is an important aspect of modern biology

Advising notes for U0 students

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

This program is recommended for U1 students achieving a CGP

PHYS 253**	(3)	Thermal Physics

* Students take PHYS 230 or PHYS 251.

** Students take PHYS 232 or PHYS 253.

Course Requirements for Quantitative Biology Streams

21 credits from one of the following two streams:

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

Biology

12 credits from the following:

BIOL 205	(3)	Functional Biology of Plants and Animals
BIOL 206	(3)	Methods in Biology
BIOL 304	(3)	Evolution
BIOL 308	(3)	Ecological Dynamics

Field Courses

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

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

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

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

BIOL 432	(3)	Limnology
BIOL 434	(3)	Theoretical Ecology

13.6   Biotechnology (BIOT)

13.6.1   Location

McIntyre Medical Building
3655 Promenade Sir-William-Osler, Room 1325
Montreal, QC H3G 1Y6

13.6.2   About Biotechnology

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

The **Minor in Biotechnology** is offered by the Faculties of Engineering and of Science, and students combine the minor with the regular departmental major, or honours, or liberal program. The minor emphasizes an area relevant to biotechnology which is complementary to the main program.

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

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

13.6.3   General Regulations

To obtain the Minor in Biotechnology, students must:

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

13.6.4   Biotechnology (BIOT) Minor Program

Program Supervisor

Audrey Moores

Maass Chemistry Building
801 Sherbrooke St. West Montreal, QC, H3A 0B8
Telephone: 514-398-4654
Email: *audrey.moores@mcgill.ca*

Program Adviser

Chantal Grignon

Life Sciences Building
3649 Sir William Osler, Montreal, QC, H3G 0B1
Telephone: 514-398-3622
Email: *chantal.grignon@mcgill.ca*

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

To obtain the Minor Biotechnology, Science students must:

a) satisfy both the requirements for the departmental program and for the Minor;

b) complete 24 credits, 18 of which must be exclusively for the Minor program.*

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

Required Courses (15 credits)

* Students may take either BIOL 201 or BIOC 212.

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

Complementary Courses (9 credits)

9 credits selected from courses outside the department of the student's main program. Students may select three courses from one of the lists below, or may choose three alternate courses with adviser approval.

Biomedicine

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

Chemical Engineering

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

Chemistry

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

General

FACC 300	(3)	Engineering Economy

Immunology

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

Management

ECON 208	(3)	Microeconomic Analysis and Applications
MGCR 211	(3)	Introduction to Financial Accounting
MGCR 341	(3)	Introduction to Finance

| MGCR 352 | (3) | Principles of Marketing |
| MGCR 372 | (3) | Operations Management. |

Microbiology

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

Molecular Biology (Biology)

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

Molecular Biology (Biochemistry)

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

Physiology

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

Pollution

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

13.6.6   Biotechnology (BIOT) Related Programs

13.6.6.1 Program for Students in the Faculty of Engineering

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

13.7   Chemistry (CHEM)

13.7.1   Location

Otto Maass Chemistry Building
801 Sherbrooke Street West
Montreal QC H3A 0B8
Departmental Office: Room 322
Telephone: 514-398-6999
Website: *mcgill.ca/chemistry*

Student advising: *mcgill.ca/chemistry/current-undergraduate-students/advising*.

13.7.2   Office for Science and Society

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

There are two main programs in the Department of Chemistry: Honours and Major. 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 118A, Pulp & Paper Building, or see *mcgill.ca/chemistry/current-undergraduate-students/advising*.

13.7.4 Chemistry Faculty

Chair

D. Perepichka

Director of Graduate Studies

N. Moitessier

Emeritus Professors

T.H. Chan; B.C. Eu; D.G. Gray; E.D. Salin; M.A. Whitehead.; I.S. Butler

Professors

M.P. Andrews; P. Ariya; B.A. Arndtsen; K. Auclair; C.J. Barrett; D.S. Bohle; G. Cosa; M.J. Damha; D.N. Harpp; A. Kakkar; R.B. Lennox; C.J. Li; N. Luedtke; J. Mauzeroll; N. Moitessier; D. Perepichka; H. Sleiman; J.L. Gleason; Y.S. Tsantrizos; T.G.M. van de Ven; P. Wiseman; A. Moores.; P. Kambhampati; A. Mittermaier

Associate Professors

A.S. Blum; J.-P. Lumb; T. Preston; M. Harrington; L. Reven; B. Siwick.; R. Khaliullin

Assistant Professors

CHEM 381	(3)	Inorganic Chemistry 2
CHEM 462	(3)	Green Chemistry

** Any level 300-500 CHEM course can be substituted for courses within this list.

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

The B.Sc.; Minor in Chemical Engineering is designed for Chemistry students who wish to study the problems of process engineering and its related subjects, and the important link between molecular sciences and industrial processing. This Minor will not provide requirements for registration as a licensed (professional) engineer.

Required Courses (18 credits)

CHEE 200	(3)	Chemical Engineering Principles 1
CHEE 204	(3)	Chemical Engineering Principles 2
CHEE 220	(3)	Chemical Engineering Thermodynamics
CHEE 314	(3)	Fluid Mechanics
CHEE 315	(3)	Heat and Mass Transfer
CHEE 351	(3)	Separation Processes

Complementary Courses (6 credits)

6 credits selected from any undergraduate courses offered by Chemical Engineering, excluding the following courses: CHEE 363, CHEE 456, CHEE 494, CHEE 495 and CHEE 496.

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Basic Core Courses (26 credits)

The required courses in this program consist of 26 credits in chemistry and mathematics listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level. Students from outside Quebec or transfer students should consult the Academic Adviser.

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

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

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MATH 222**	(3)	Calculus 3

General Option Courses (17 credits)

CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 392	(3)	Experimental Chemistry 1
PHYS 242	(2)	Electricity and Magnetism

Complementary Course (6 credits)

6 credits from:

CHEM 355	(3)	Applications of Quantum Chemistry
MATH 315	(3)	Ordinary Differential Equations

Chemistry courses at the 300+ level.

13.7.8   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.mcgill.ca/chemistry/current-undergraduate-students/advising/.

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

* Denotes courses with CEGEP equivalents.

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 332	(3)	Biological Chemistry
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics

CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 392	(3)	Experimental Chemistry 1
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
MATH 222**	(3)	Calculus 3
PHYS 242	(2)	Electricity and Magnetism

Complementary Courses (6 credits)

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

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Courses (57 credits)

The required courses in this program consist of 60 credits in chemistry, biology and mathematics, listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level but the Chemistry courses must be replaced by courses in that discipline if students wish to be eligible for admission to the Ordre des chimistes du Québec. Students from outside Quebec or transfer students should consult the Academic Adviser.

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

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

* Denotes courses with CEGEP equivalents.

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

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 392	(3)	Experimental Chemistry 1
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
CHEM 502	(3)	Advanced Bio-Organic Chemistry

| MATH 222** | (3) | Calculus 3 |
| PHYS 242 | (2) | Electricity and Magnetism |

Complementary Course (6 credits)

6 credits from:

BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 365	(2)	Statistical Thermodynamics
MATH 315	(3)	Ordinary Differential Equations
MIMM 211	(3)	Introductory Microbiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

13.7.10   Bachelor of Science (B.Sc.) - Major Chemistry: Biophysical Chemistry (66 credits)

This program trains students in the fundamentals of chemistry and develops the physical science, computational, and mathematical skills needed for advanced biophysical chemistry research in the biomedical and biotechnology industries. The program features integrative, interdisciplinary courses in bio-physical sciences.

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 MA

CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
		Inorg

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

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

* Denotes courses with CEGEP equivalents.

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

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

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

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

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

* Denotes courses with CEGEP equivalents.

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

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 392	(3)	Experimental Chemistry 1
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
CHEM 502	(3)	Advanced Bio-Organic Chemistry
MATH 222**	(3)	Calculus 3
PHYS 242	(2)	Electricity and Magnetism

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)	Undergraduate Research Project 2

9 credits from the following:

BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 365	(2)	Statistical Thermodynamics
MATH 315	(3)	Ordinary Differential Equations
MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology

MIMM 323	(3)	Microbial Physiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

and 3 credits of additional Chemistry courses at the 400 level or higher.

13.7.13 Bachelor of Science (B.Sc.) - Honours Chemistry: Biophysical Chemistry (75 credits)

This program trains students in the fundamentals of chemistry and develops the physical science, computational, and mathematical skills needed for advanced biophysical chemistry research in the biomedical and biotechnology industries. The program features integrativ

CHEM 470	(6)	Research Project 1
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
PHYS 242	(2)	Electricity and Magnetism

Complementary Courses

(9-10 credits)

3 credits of:

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

6-7 credits of:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 316	(3)	Biomembranes and Organelles
BIOL 551	(3)	Principles of Cellular Control
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 381	(3)	Inorganic Chemistry 2
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 514	(3)	Biophysical Chemistry
CHEM 520	(3)	Methods in Chemical Biology
CHEM 555	(3)	Magnetic Resonance Spectroscopy
CHEM 575	(3)	Chemical Kinetics
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering

13.7.14   Chemistry (CHEM) Related Programs

13.7.14.1 Joint Honours in Physics and Chemistry

For more information, see *section 13.30: Physics (PHYS)*.

13.8   Cognitive Science

13.8.1   About Cognitive Science

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

Students wishing to enrol in the **Minor in Cognitive Science** must meet with the *Cognitive Science Program Adviser* in the Faculty of Science. Please refer to *mcgill.ca/cogsci* for advising information.

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

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

Students wishing to complete this Minor should contact the Cognitive Science Program Adviser if there are any questions about the requirements at https://www.mcgill.ca/science/undergraduate/advice/sousa.

Required Course (3 credits)

PSYC 433	(3)	Cognitive Science

Complementary Courses (21 credits)

Note:

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

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

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

Computer Science and Mathematics

COMP 206	(3)	Introduction to Software Systems
COMP 230	(3)	Logic and Computability
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theory of Computation
COMP 527	(3)	Logic and Computation
MATH 240	(3)	Discrete Structures
MATH 318	(3)	Mathematical Logic

Linguistics

Any course at the 300, 400 or 500 level from the department of Linguistics, or:

LING 201	(3)	Introduction to Linguistics
LING 210	(3)	Introduction to Speech Science
LING 260	(3)	Meaning in Language

Philosophy

PHIL 210	(3)	Introduction to Deductive Logic 1
PHIL 221	(3)	Introduction to History and Philosophy of Science 2
PHIL 306	(3)	Philosophy of Mind
PHIL 310	(3)	Intermediate Logic
PHIL 311	(3)	Philosophy of Mathematics
PHIL 341	(3)	Philosophy of Science 1
PHIL 411	(3)	Topics in Philosophy of Logic and Mathematics
PHIL 415	(3)	Philosophy of Language
PHIL 441	(3)	Philosophy of Science 2
PHIL 474	(3)	Phenomenology

Psychology

PSYC 212	(3)	Perception
PSYC 213	(3)	Cognition
PSYC 301	(3)	Animal Learning and Theory
PSYC 304	(3)	Child Development
PSYC 310	(3)	Intelligence

| PSYC 311 | (3) | Human Cognition and the Brain |
| PSYC 315 | (3) | Computational Psychology |

A de

13.9.6 Computer Science Faculty

Director

M. Blanchette

Emeritus Professors

D. Avis; R. De Mori; T.H. Merrett; M.M. Newborn; C. Paige; D. Thérien; C. Tropper

Professors (Post-Retirement)

N. Friedman; C. Tropper; G.F.G. Ratzer

Professors

L. Devroye; G. Dudek; B. Kemme; J. Kienzle; X. Liu; P. Panangaden; B. Pientka; B. Reed; M. Robillard; K. Siddiqi; A. Vetta

Associate Professors

M. Blanchette; X.-W. Chang; J. Cheung; C. Crépeau; C. Dubach; H. Hatami; P. Kry; M. Langer; M. Maheswaran; D. Meger; J. Pineau; D. Precup; D. Ruths; C. Verbrugge; J. Waldispuhl

Assistant Professors

O. Balmau; J. Guo; Y.Li; H.C. Lin; E. Patitsas; R. Rabbany; M. Ravanbakhsh; S. Reddy; B. Richards; R. Robere; D. Rolnick

Faculty Lecturers

G. Alberini; D. Beccerra; J. Errington; F. M'hiri; M. ElSaadawy; J. Vybihal

Associate Members

L. Addario-Berry (*Math & Stats*); S. Baillet (*Neurology and Neurosurgery*); P. Bashivan (*Physiology*); D. Bzdok (*Biological and Biomedical Engineering*); L. Collins (*Neurology and Neurosurgery*); J. Ding (*Medicine*); B. Fung (*Information Studies*); S. Gravel (*Human Genetics*); D. Nowrouzezahrai (*Electrical and Computer Engineering*); T. O'Donnell (*Linguistics*); P. Savadjiev (*Diagnostic Radiology*); D. Schlimm (*History and Philosophy of Mathematics*); M. Sonderegger (*Linguistics*); T Shultz (*Psychology*); Y. Yang (*Mathemtics and Statistics*)

Adjunct Professors

S. Andrews; D. Bahdanaum; M.G. Bellemare; X. Chen; F. Diaz; K. Dziugaite; G. Grant;

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

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

This program provides an introduction to the principles of computer science and offers opportunity to get insight into some of its sub-areas. Having only 45 credits, it allows students to combine it with minor or major concentrations in other disciplines.

Required Courses (18 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202, but it must be replaced with an additional computer science complementary course.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
MATH 240	(3)	Discrete Structures

Complementary Courses (27 credits)

3 credits from each of the groups A, B, C, and D.

Group A

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

Group B

MATH 223	(3)	Linear Algebra
MATH 318	(3)	Mathematical Logic
MATH 340	(3)	Discrete Mathematics

Group C

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

Group D

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

An additional 3 credits may be selected from Group A or B.

The remaining complementary credits must be selected from any COMP courses at the 300 level or above except COMP 364 and COMP 396.

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

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

Required Courses (36 credits)

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

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

Complementary Courses (13 credits)

3 credits selected from:

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

10 credits from:

COMP 322	(1)	Introduction to C++
COMP 409	(3)	Concurrent Programming
COMP 421	(3)	Database Systems
COMP 520	(4)	Compiler Design
		Formal VV

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

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

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

Required Courses (33 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures

Complementary Courses (30 credits)

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

At least 6 credits selected from:

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

3-9 credits selected from:

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

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

At least 6 credits at the 400-level or above.

Nuote:Students wa
The remaining credits selected from computer science courses at the 300 level or abov

Required Courses (39-42 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 424	(3)	Artificial Intelligence
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures
MATH 323	(3)	Probability
MATH 324	(3)	Statistics

Complementary Courses (24-26 credits)

Group A:

6 credits selected from:

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

Group B:

3 credits selected from:

COMP 310	(3)	Operating Systems
COMP 421	(3)	Database Systems

Group C:

3 or 4 credits selected from:

COMP 451	(3)	Fundamentals of Machine Learning
COMP 551	(4)	Applied Machine Learning

Group D:

3 credits selected from:

COMP 345	(3)	From Natural Language to Data Science
COMP 370	(3)	Introduction to Data Science

Group E:

3 or 4 credits selected from:

COMP 417	(3)	Introduction Robotics and Intelligent Systems
COMP 445	(3)	Computational Linguistics
COMP 511	(4)	Network Science
COMP 514	(4)	Applied Robotics
COMP 545	(4)	Natural Language Understanding with Deep Learning
COMP 549	(3)	Brain-Inspired Artificial Intelligence
COMP 550	(3)	Natural Language Processing
COMP 558	(4)	Fundamentals of Computer Vision
COMP 562	(4)	Theory of Machine Learning
COMP 565	(4)	Machine Learning in Genomics and Healthcare
COMP 579	(4)	Reinforcement Learning
COMP 585	(4)	Intelligent Software Systems
ECSE 552	(4)	Deep Learning
ECSE 557	(3)	Introduction to Ethics of Intelligent Systems

Group F:

6 credits of COMP courses at the 300 level or above (except COMP 396).

13.9.12   Bachelor of Science (B.Sc.) - Major Computer Science and Biology (74 credits)

This program will focus on the fundamentals of biology and will give them computational and mathematical skills needed to manage, analyze, and model large biological datasets. Integrative features of the program include interdisciplinary introductory and seminar courses in bio-physical sciences, and a joint independent studies project.

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

COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
MATH 240	(3)	Discrete Structures

Biology

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

Required Joint Courses

| COMP 401 | (3) | Project in Biology and Computer Science |

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

** Students may take either COMP 202 or COMP 204, but not both. Students who have sufficient knowledge in a programming language are not required to take these courses.

Complementary Courses

27-28 credits

3-4 credits from the following:

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

3-6 from the following:

| MATH 315 | (3) | Ordinary Differential Equations |
| MATH 324 | (3) | Statistics |

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

Computer Science Block

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

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

| COMP 273 | (3) | Introduction to Computer Systems |
| | | Programming Languages and 0 262.444 TmSere1..ageeh u0 le |

Biology Block

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

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 308	(3)	Ecological Dynamics
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 316	(3)	Biomembranes and Organelles
BIOL 319	(3)	Introduction to Biophysics
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 395	(1)	Quantitative Biology Seminar
BIOL 416	(3)	Genetics of Mammalian Development
BIOL 434	(3)	Theoretical Ecology
BIOL 435	(3)	Natural Selection
BIOL 509	(3)	Methods in Molecular Ecology
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 568	(3)	Topics on the Human Genome
BIOL 569	(3)	Developmental Evolution
BIOL 575	(3)	Human Biochemical Genetics
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 310	(3)	Cellular Neurobiology

13.9.13 Bachelor of Science (B.Sc.) - Major Computer Science - Computer Games (65 credits)

This program is a specialization within Computer Science. It fulfils all the basic requirements of the Major Computer Science. The program focuses 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 65 credits depending on whether they are exempt from taking COMP 202.

Required Courses

(46-49 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
COMP 322	(1)	Introduction to C++
COMP 330	(3)	Theory of Computation
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
COMP 557	(4)	Fundamentals of Computer Graphics
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures
MATH 323	(3)	Probability

Complementary Courses (16 credits)

3 credits selected from:

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

At least 7 credits selected from:

COMP 308	(1)	Computer Systems Lab
COMP 424	(3)	Artificial Intelligence
COMP 521	(4)	Modern Computer Games
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
COMP 551	(4)	Applied Machine Learning
COMP 559	(4)	Fundamentals of Computer Animation

At least 6 credits selected from:

COMP 409	(3)	Concurrent Programming
COMP 421	(3)	Database Systems
COMP 535	(4)	Computer Networks 1

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

This program provides a broad introduction to the principles of computer science and covers in depth the design and development of software systems.

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

Required Courses

36-39 credits

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

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

Complementary Courses (24 credits)

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

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

Group A:

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

Group B:

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

Group C: Software Engineering Specialization

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

COMP 409*	(3)	Concurrent Programming
COMP 523	(3)	Language-based Security
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
COMP 555	(4)	Information Privacy
ECSE 326	(3)	Software Requirements Engineering
ECSE 420*	(3)	Parallel Computing
ECSE 424	(3)	Human-Computer Interaction
ECSE 437	(3)	Software Delivery

ECSE 539	(4)	Advanced Software Language Engineering

Group D: Applications

COMP 350	(3)	Numerical Computing
COMP 417	(3)	Introduction Robotics and Intelligent Systems
COMP 421	(3)	Database Systems
COMP 424	(3)	Artificial Intelligence
COMP 512	(4)	Distributed Systems
COMP 520	(4)	Compiler Design
COMP 521	(4)	Modern Computer Games
COMP 535	(4)	Computer Networks 1
COMP 551	(4)	Applied Machine Learning
COMP 557	(4)	Fundamentals of Computer Graphics
COMP 558	(4)	Fundamentals of Computer Vision
COMP 585	(4)	Intelligent Software Systems

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

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

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

Required Courses (48 credits)

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

** Students take either MATH 340 or MATH 350.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems

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6 credits selected from:

MATH 318	(3)	Mathematical Logic
MATH 323	(3)	Probability
MATH 324	(3)	Statistics

The remaining credits selected from computer science courses at the 300 level or above (except COMP 364 and COMP 396) and ECSE 539. At least 12 credits must be at the 500 level.

13.9.16   Bachelor of Science (B.Sc.) - Honours Computer Science and Biology (77 credits)

This program focuses on the fundamentals of biology with a focus on molecular biology, and gives them computational and mathematical skills needed to manage, analyze, and model large biological datasets. Compared to the Joint Major counterpart, this program requires additional research credits and a larger number of advanced courses. Students must maintain a minimum CGPA of 3.5. To graduate with First Class Honours, the CGPA must be at least 3.75.

Students may complete this program with a minimum of 67 and a maximum of 77 credits, depending upon whether they take COMP 202/204, CHEM 212, MATH 222.

Program Prerequisites: U0 (freshman) students should take: BIOL 111-112, CHEM 110-120, MATH 133, MATH 140-141 or MATH 150-151, PHYS 101-102 or PHYS 131-142. Note that MATH 150-151 provides equivalence for required course MATH 222.

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

Required Courses

43-53 credits:

Bio-Physical Sciences Core

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

Computer Science and Mathematics

COMP 204**	(3)	Computer Programming for Life Sciences
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252***	(3)	Honours Algorithms and Data Structures
COMP 561	(4)	Computational Biology Methods and Research
MATH 240	(3)	Discrete Structures

Biology

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

Joint Courses

| COMP 402D1 | (3) | Honours Project in Computer Science and Biology |
| COMP 402D2 | (3) | Honours Project in Computer Science and Biology |

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

** Students may take either COMP 202 or COMP 204, but not both. Students who hav

BIOL 319	(3)	Introduction to Biophysics
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 395	(1)	Quantitative Biology Seminar
BIOL 416	(3)	Genetics of Mammalian Development
BIOL 434	(3)	Theoretical Ecology
BIOL 435	(3)	Natural Selection
BIOL 509	(3)	Methods in Molecular Ecology
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 568	(3)	Topics on the Human Genome
BIOL 569	(3)	Developmental Evolution
BIOL 575	(3)	Human Biochemical Genetics
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 310	(3)	Cellular Neurobiology

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

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

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

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

Required Courses

39-42 credits

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

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

| MATH 223 | (3) | Linear Algebra |
| MATH 240 | (3) | Discrete Structures |

Complementary Courses (33 credits)

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

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

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

Group A:

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

Group B:

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

Group C: Software Engineering Specialization

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

COMP 409*	(3)	Concurrent Programming
COMP 523	(3)	Language-based Security
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
COMP 555	(4)	Information Privacy
ECSE 326	(3)	Software Requirements Engineering
ECSE 420*	(3)	Parallel Computing
ECSE 424	(3)	Human-Computer Interaction
ECSE 437	(3)	Software Delivery
ECSE 539	(4)	Advanced Software Language Engineering

Group D: Applications

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

Frank Dawson Adams Building, Room 238
Telephone: 514-398-6767
Website: *mcgill.ca/eps/studies/undergraduate*

or should consult the Undergraduate Director:

Professor Jeanne Paquette
Frank Dawson Adams Building, Room 214
Telephone: 514-398-4402
Email: *jeanne*

EPSC 334	(3)	Invertebrate Paleontology
EPSC 350	(3)	Tectonics
EPSC 452	(3)	Mineral Deposits
EPSC 561	(3)	Ore-forming Processes

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

The Minor in Geochemistry focuses on the chemistry of Earth's lithosphere, its reactivity in contact with the atmosphere and/or the hydrosphere, and the chemistry of extra-terrestrial materials.

The appropriate background in chemistry is required: (CHEM 110 and CHEM 120, or their equivalent) and calculus (MATH 139 and MATH 141, or their equivalent).

Required Courses (9 credits)

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

Complementary Courses (9 credits)

9 credits selected from:

EPSC 220	(3)	Principles of Geochemistry
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 549	(3)	Hydrogeology
EPSC 570	(3)	Cosmochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

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

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

Required Courses (21 credits)

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

Complementary Courses (24 credits)

3 credits, one of:

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

plus 21 credits chosen from the following:

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

EPSC 334	(3)	Invertebrate Paleontology
EPSC 340	(3)	Earth and Planetary Inference
EPSC 350	(3)	Tectonics
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 530	(3)	Volcanology
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Igneous Petrogenetic Mechanisms
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
EPSC 567	(3)	Advanced Volcanology
EPSC 570	(3)	Cosmochemistry
EPSC 590	(3)	Applied Geochemistry Seminar
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
ESYS 500	(3)	Earth System Applications

13.10.8 Bachelor of Science (B.Sc.) - Major Geology (66 credits)

The program curriculum provides a rigorous foundation in the fundamental earth science subjects and in the advanced subjects relevant to exploration for energy resources, industrial and ore minerals, and to environmental geosciences. The program meets the academic requirements shared by the professional orders for geologists and environmental geoscientists in most Canadian provinces. It also offers students the opportunity to take courses or acquire experience

EPSC 320	(3)	Elementary Earth Physics
EPSC 340	(3)	Earth and Planetary Inference
MATH 222	(3)	Calculus 3

Complementary Cour

(3)   Advanced Volcanology

EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes
EPSC 590	(3)	Applied Geochemistry Seminar

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

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

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

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

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

Required Courses (66 credits)

EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
EPSC 231	(3)	Field School 1
EPSC 233	(3)	Earth and Life History
EPSC 240	(3)	Geology in the Field
	(3)	Structural Geology

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315A2il-dnbu1 snf	(3)	Ordinary Differential Equations

13.10.11.3 Earth System Science Interdepartmental Honours

This program is offered by the Departments of Atmospheric and Oceanic Sciences; Earth and Planetary Sciences; and Geography. Students in the Department of Earth and Planetary Sciences who are interested in this program should contact Professor William Minarik (*william.minarik@mcgill.ca*).

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

13.11 Earth System Science (ESYS)

13.11.1 Location

Program Adviser
Dr. William Minarik
Frank Dawson Adams, Room 215
Telephone: 514-398-2596
Email: *william.minarik@mcgill.ca*
Website: *ess.mcgill.ca*

13.11.2 About Earth System Science

The McGill interdepartmental **Major** program in Earth System Science (ESYS) is designed to equip students with the skills and knowledge to address six "Grand Challenges" that are fundamental to our understanding of the way in which the Earth operates. These Grand Challenges are being tackled with scientific and technological innovation and interdisciplinary research, creating bountiful employment opportunities for ESYS graduates in industry, research institutions, and go

ESYS 500   (3)   Earth System Applications

Complementary Courses (6 credits)

Tw

GEOG 308	(3)	Remote Sensing for Earth Observation
GEOG 314	(3)	Geospatial Analysis
GEOG 428	(4)	Earth System Geographic Information Science

3 credits from the following:

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

3 credits from the following:

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

3 credits from the following:

ANTH 339	(3)	Ecological Anthropology
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health
GEOG 300	(3)	Human Ecology in Geography
GEOG 310	(3)	Development and Livelihoods

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

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

ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
ATOC 404	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
BIOL 308	(3)	Ecological Dynamics
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 432	(3)	Limnology

BIOL 434	(3)	Theoretical Ecology	
BIOL 441	(3)	Biological Oceanography	
BIOL 465	(3)	Conservation Biology	
BIOL 540	(3)	Ecology of Species Invasions	
BIOL 573	(3)	Vertebrate Palaeontology Field Course	
BREE 217	(3)	Hydrology and Water Resources	
BREE 319	(3)	Engineering Mathematics	
BREE 509	(3)	Hydrologic Systems and Modelling.	
BREE 510	(3)	Watershed Systems Management	
BREE 515	(3)	Soil Hydrologic Modelling	
BREE 533	(3)	Water Quality Management	
ECON 347	(3)	Economics of Climate Change	
ECON 405	(3)	Natural Resource Economics	
EPSC 212	(3)	Introductory Petrology	
EPSC 320	(3)	Elementary Earth Physics	
EPSC 331	(3)	Field School 2	
EPSC 334	(3)	Invertebrate Paleontology	
EPSC 340	(3)	Earth and Planetary Inference	
EPSC 341	(3)	Field School 3	
EPSC 350	(3)	Tectonics	
EPSC 355	(3)	Sedimentary Geology	
EPSC 423	(3)	Igneous Petrology	
EPSC 425	(3)	Sediments to Sequences	
EPSC 445	(3)	Metamorphic Petrology	
EPSC 452	(3)	Mineral Deposits	
EPSC 519	(3)	Isotopes in Earth and Environmental Science	
EPSC 525	(3)	Microbiology of the Earth System	
EPSC 530	(3)	Volcanology	
EPSC 549	(3)	Hydrogeology	
EPSC 561	(3)	Ore-forming Processes	
EPSC 567	(3)	Advanced Volcanology	
EPSC 590	(3)	Applied Geochemistry Seminar	
GEOG 272	(3)	Earth's Changing Surface	
GEOG 305	(3)	Soils and Environment	
GEOG 321	(3)	Climatic Environments	
GEOG 322	(3)	Environmental Hydrology	
GEOG 351	(3)	Quantitative Methods	
GEOG 372	(3)	Running Water Environments	
GEOG 401	(3)	Socio-Environmental Systems: Theory and Simulation	
GEOG 414	(3)	Advanced Geospatial Analysis	
GEOG 470	(3)	Wetlands	
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 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
MATH 314	(3)	Advanced Calculus
MATH 315*	(3)	Ordinary Differential Equations
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 323	(3)	Probability
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 423	(3)	Applied Regression
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes
MATH 525	(4)	Sampling Theory and Applications
		Topics in Classical Mechanics

| MATH 222 | (3) | Calculus 3 |
| MATH 315 | (3) | Ordinary Differential Equations |

Complementary Courses (39 credits)

3 credits from the following:

| EPSC 340 | (3) | Earth and Planetary Inference |
| MATH 203 | (3) | Principles of Statistics 1 |

3 credits from the following:

| COMP 202 | (3) | Foundations of Programming |
| COMP 208 | (3) | Computer Programming for Physical Sciences and Engineering |

3 credits from the following:

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

3 credits from the following:

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

3 credits from the following:

GEOG 308	(3)	Remote Sensing for Earth Observation
GEOG 314	(3)	Geospatial Analysis
GEOG 428	(4)	Earth System Geographic Information Science

3 credits from the following:

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

3 credits from the following:

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

3 credits from the following:

ANTH 339	(3)	Ecological Anthropology
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health
GEOG 300	(3)	Human Ecology in Geography

GEOG 310	(3)	Development and Livelihoods

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

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

ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
ATOC 404	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
		Wav

EPSC 350	(3)	Tectonics
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 525	(3)	Microbiology of the Earth System
EPSC 530	(3)	Volcanology
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes
EPSC 567	(3)	Advanced Volcanology
EPSC 590	(3)	Applied Geochemistry Seminar
GEOG 272	(3)	Earth's Changing Surface
GEOG 305	(3)	Soils and Environment
GEOG 321	(3)	Climatic Environments
GEOG 322	(3)	Environmental Hydrology
GEOG 351	(3)	Quantitative Methods
GEOG 372	(3)	Running Water Environments
GEOG 401	(3)	Socio-Environmental Systems: Theory and Simulation
GEOG 414	(3)	Advanced Geospatial Analysis
GEOG 470	(3)	Wetlands
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 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
MATH 314	(3)	Advanced Calculus
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 323	(3)	Probability
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 423	(3)	Applied Regression
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes
MATH 525	(4)	Sampling Theory and Applications
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism

PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 404	(3)	Climate Physics
		Ph

13.14   Experimental Medicine (EXMD)

13.14.1   Location

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

13.14.2   About Experimental Medicine

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

Experimental Medicine Courses		
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 501	(3)	Clinical Applications of Regenerative Medicine
EXMD 502	(3)	Advanced Endocrinology 01
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 505	(3)	Directed Readings in Regenerative Medicine
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 511	(3)	Joint Venturing with Industry

13.15   Field Study

For details about the available Field Study Semesters, see *Field Study Programs* .

13.15.1   Field Studies - Minor Field Studies (18 credits)

Students participating in any one of the field study semesters, i.e., the Africa Field Study Semester, the Barbados Field Study Semester, the Barbados Interdisciplinary Tropical Studies (BITS) Field Study Semester, McGill Arctic Field Study Semester, or the Panama Field Study Semester may complete the 18-credit Minor in Field Studies.

The Minor consists of the 15 credits of a field study semester plus three additional complementary credits chosen by the student in consultation with their departmental adviser and/or the Field Study Minor adviser.

For students in the B.Sc. Liberal Program, the Field Studies Minor can serve as the breadth component.

Program descriptions for each of the field study semesters are provided below.

Note: The field study semesters are not degree programs. Credits may be counted toward McGill degrees with the permission of program advisers. Students who complete a field study semester may consult the Field Study Minor adviser about completing the Minor program as part of their McGill degree.

Africa Field Study Semester (15 credits)

The Africa Field Study Semester (AFSS) is run through McGill's Canadian Field Study in Africa Program (CFSIA).

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

Africa Field Study Semester - Required Courses

6 credits

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

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

Africa Field Study Semester - Complementary Courses

9 credits from:

* Note: Courses marked with an asterisk ("*") are offered on a rotational basis, at least 3 credits annually.

ANTH 411	(3)	Primate Studies and Conservation
ANTH 416	(3)	Environment/Development: Africa
BIOL 428	(3)	Biological Diversity in Africa
BIOL 429	(3)	East African Ecology
GEOG 404*	(3)	Environmental Management 2
GEOG 408	(3)	Geography of Development
GEOG 423	(3)	Dilemmas of Development
HIST 498	(3)	Independent Research
NRSC 405	(3)	Natural History of East Africa
NUTR 404	(3)	Nutrition Field Studies in East Africa
REDM 405	(3)	Natural History of East Africa
WILD 420*	(3)	Ornithology

Barbados Field Study Semester (15 credits)

The Barbados Field Study Semester (BFSS) offers a unique opportunity to study at McGill University's campus in the tropics, the Bellairs Research Institute in Barbados. The focus of this field study semester is the study of sustainability science, with emphasis on the Caribbean, which includes: a different climate and culture, field research, and conducting an applied research project. Project work is conducted with local partners and focuses on sustainability in Barbados.

Barbados Field Study Semester - Required Courses

15 credits

ATOC 341	(3)	Caribbean Climate and Weather
BIOL 343	(3)	Biodiversity in the Caribean
FSCI 444	(6)	Barbados Research Project
GEOG 340	(3)	Sustainability in the Caribbean

Barbados Interdisciplinary Tropical Studies Field Semester (15 credits)

The Barbados Interdisciplinary Tropical Studies (BITS) Field Semester is an activity-filled, hands-on experience for students with an interest in international studies with a Caribbean flavour. The focus is on sustainable agri-food, nutrition, and energy production on a tropical island with a tourist-based economy. It is offered annually (in the Summer). It consists of two 2-hour orientation sessions conducted on the Macdonald campus and at the Bellairs Research Institute in Barbados, followed by three 3-credit and one 6-credit project courses at Bellairs Research Institute. This program integrates intensive course

work with group project work and contrib

GEOG 473   (6)   Arctic Field Research

Minor Field Studies - Complementary Course

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

13.16   General Science

13.16.1   Location

Interdisciplinary Programs Adviser
Curtis Sharman
Email: *curtis.sharman@mcgill.ca*

13.16.2   About the General Science Minor

The Minor in General Science is only open to students in a B.Sc. Liberal program. Students interested in completing this Minor must consult with the Adviser for this program. See the program description in *section 13.16.3: Bachelor of Science (B.Sc.) - Minor General Science (18 credits)* for more information.

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

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

Complementary Courses (18 credits)

Courses are to be chosen according to the following guidelines:

All courses must be offered by the F

Geography also administers the B. A. & Sc. interfaculty programs in Sustainability, Science and Society in partnership with the Bieler School of Environment. These programs are described in *Bachelor of Arts & Science > Undergraduate > Browse Academic Units & Programs > : Sustainability, Science and Society*.

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 is concerned with the political, economic, social, and cultural processes and resource practices that create spatial patterns and define particular places.

FACULTY OF SCIENCE, INCLUDING SCHOOL OF COMPUTER SCIENCE

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health

9 credits from any Geography course at the 300 level or above.

13.17.6 Bachelor of Science (B.Sc.) - Minor GIS & Remote Sensing (18 credits)

The Minor GIS & Remote Sensing program provides B.Sc. students with the fundamentals of geospatial tools and technologies.

Required Course (6 credits)

| GEOG 201 | (3) | Introductory Geo-Information Science |
| GEOG 314 | (3) | Geospatial Analysis |

Complementary Courses (12 credits)

3 credits selected from:

| COMP 202 | (3) | Foundations of Programming |
| GEOG 333 | (3) | Introduction to Programming for Spatial Sciences |

3 credits selected from:

ATOC 309*	(3)	Weather Radars and Satellites
GEOG 308*	(3)	Remote Sensing for Earth Observation
GEOG 414*	(3)	Advanced Geospatial Analysis

6 credits selected from:

ATOC 309*	(3)	Weather Radars and Satellites
COMP 250	(3)	Introduction to Computer Science
ESYS 300	(3)	Investigating the Earth System
GEOG 202	(3)	Statistics and Spatial Analysis
GEOG 308*	(3)	Remote Sensing for Earth Observation
GEOG 384*	(3)	Principles of Geospatial Web
GEOG 414*	(3)	Advanced Geospatial Analysis
GEOG 428	(4)	Earth System Geographic Information Science
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 535	(3)	Remote Sensing and Interpretation

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

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

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

Required Courses (13 credits)

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

Complementary Courses (36 credits)

3 credits of statistics*

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

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

9 credits of systematic physical geography

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

Students must take a total of 9 credits from the next 2 blocks; they will choose 6 credits from one block and 3 credits from the other, depending on their training focus.

3 or 6 credits of environmental analysis/techniques

GEOG 308	(3)	Remote Sensing for Earth Observation
GEOG 314	(3)	Geospatial Analysis
GEOG 384	(3)	Principles of Geospatial Web
GEOG 414	(3)	Advanced Geospatial Analysis

3 or 6 credits (In Environment, Earth System and Sustainability Sciences)

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

GEOG 460	(3)	Research in Sustainability

9 credits on human-environment linkages

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

3 credits of field courses:

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

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

Geography Approved Course List - Major, Honours and Liberal Programs

GEOG 401	(3)	Socio-Environmental Systems: Theory and Simulation
GEOG 404	(3)	Environmental Management 2
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
		Geocryologce

ESYS 200	(3)	Earth System Processes
ESYS 300	(3)	Investigating the Earth System
GEOG 302	(3)	Environmental Management 1
GEOG 360	(3)	Analyzing Sustainability
GEOG 460	(3)	Research in Sustainability

9 credits on human-environment linkages

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

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

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

Geography Approved Course List - Major, Honours and Liberal Programs

GEOG 401	(3)	Socio-Environmental Systems: Theory and Simulation
GEOG 404	(3)	Environmental Management 2
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration

13.17.9 Bachelor of Science (B.Sc.) - Honours Geography (66 credits)

The Honours program provides specialize systematic training in physical geography. In addition to the Faculty of Science 3.00 CGPA requirement, students in a Geography Honours program must maintain a program GPA of 3.30 and complete a 6-credit Honours thesis.

Required Courses (21 credits)

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 203	(3)	Environmental Systems
GEOG 272	(3)	Earth's Changing Surface
		Quantitativ

GEOG 491D1	(3)	Honours Research
GEOG 491D2	(3)	Honours Research

Complementary Courses (45 credits)

9 credits on human-environment linkages

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

3 credits of statistics*, one of:

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

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

9 credits of systematic physical geography:

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

3 credits of field courses:

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

Students must take a total of 15 credits from the next 2 blocks; they will choose 9 credits from one block and 6 credits from the other block, depending on their training focus

6 or 9 credits of environmental analysis/techniques

GEOG 308	(3)	Remote Sensing for Earth Observation
GEOG 314	(3)	Geospatial Analysis
GEOG 384	(3)	Principles of Geospatial Web

GEOG 414	(3)	Advanced Geospatial Analysis
GEOG 428	(4)	Earth System Geographic Information Science

6 or 9 credits (In Environment, Earth Science and Sustainability sciences)

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

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

Geography Approved Course List - Major, Honours and Liberal Programs

GEOG 401	(3)	Socio-Environmental Systems: Theory and Simulation
GEOG 404	(3)	Environmental Management 2
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration

13.17.10 Geography (GEOG) Related Programs and Study Semesters

The following programs, as well as several other opportunities for field study, are offered by the Faculty of Science. For further information, refer to *mcgill.ca/mcgillabroad/students-going-abroad/plan-and-prepare/field-study-semester* or the *Science Internship & Field Studies Office*.

13.17.10.1 Africa Field Study Semester

The Africa program introduces students to East Africa specifically with a view to increasing their understanding of the goals, circumstances, challenges, and opportunities of people living in the areas visited. For more information, see *mcgill.ca/africa*.

13.17.10.2 Barbados Field Study Semester

The Barbados program is offered on McGill's Caribbean campus at the Bellairs Research Institute. Students participating in the BFSS learn about the Sustainable Development Goals (SDGs) of the United Nations, with a focus on the sustainable development of Barbados and Small Island Developing States (SIDS). For more information, see *mcgill.ca/bfss*.

13.17.10.3 Panama Field Study Semester

The Panama program is a joint venture between McGill University and the Smithsonian Tropical Research Institute (STRI) and addresses Latin America's social and tropical environmental issues. For more information, see *mcgill.ca/pfss*.

13.17.10.4 Arctic Field Study Semester

The primary mission of the McGill Arctic Field Studies is to train a future generation of northern specialists and leaders who are able to understand and address the rapidly changing polar environment in a scientifically and culturally responsible manner. For more information, see *mcgill.ca/arctic*.

13.17.10.5 Earth System Science Interdepartmental Major

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

Students in the Department of Geography interested in this program should contact:

William (Bill) Minarik
Telephone: 514-398-2596
Email: *william.minarik@mcgill.ca*

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

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

The Interfaculty Program in Sustainability, Science and Society as well as the Honours in Sustainability, Science and Society is open only to students in the B.A. & Sc. degree.

Students in the Department of Geography interested in this program should contact:

Michelle Maillet
Email: *advisor.geog@mcgill.ca*

For more information about these programs, see *Bachelor of Arts & Science* > *Undergraduate > Browse Academic Units & Programs > : Sustainability, Science, and Society*.

13.18   Immunology

13.18.1   Location

McGill University Health Centre – Glen Site
1001 Decarie Boulevard, Bloc E, Office EM23248
Montreal QC H3G 1A4

or

McIntyre Medical Sciences Building, Room 1136
3655 Promenade Sir-William-Osler
Montreal QC H3G 1Y6

13.18.2   About Immunology

Three departments offer the **Honours** program in Immunology, combining elements of each:

- *section 13.4: Biochemistry (BIOC)*
- *section 13.23: Microbiology and Immunology (MIMM)*
- *section 13.31: Physiology (PHGY)*

The program is a demanding one which will prepare students for graduate work in immunology.

Students who do not maintain Honours standing must transfer their registration to a program in one of the three participating departments.

Apply to:

Dr. Monroe Cohen
Physiology
McIntyre Medical Sciences Building, Room 1136
3655 Promenade Sir-Willam-Osler, Montreal QC H3G 1Y6
Telephone: 514-398-4342
Email: *monroe.cohen@mcgill.ca*

or

Dr. C. Piccirillo
Microbiology and Immunology
McGill University Health Centre – Glen Site
1001 Decarie Boulevard, Bloc E, Office EM23248
Montreal QC H3G 1A4
Telephone: 514-934-1934, ext. 76143
Email: *ciro.piccirillo@mcgill.ca*.

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

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

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

Complementary Courses (27 credits)

U1 Complementary Courses

6 credits chosen 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 either PHGY 209 or MIMM 211.

** Students take either CHEM 203 or CHEM 204.

ANAT 214	(3)	Systemic Human Anatomy
ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Functional Biology of Plants and Animals
BIOL 304	(3)	Evolution
CHEM 203**	(3)	Survey of Physical Chemistry
CHEM 204**	(3)	Physical Chemistry/Biological Sciences 1
COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science
MATH 204	(3)	Principles of Statistics 2
MIMM 211**	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
PHGY 209**	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

U2 Complementary Courses

12 credits chosen as follows:

6 credits selected from:

Students may take

* BIOC 2205.864n(AN)Tj1 0 0 1 81.933 535.582 Tm(A)T46.e35.OC 2205.864n(AN)Tj.943637.392 552 Tm38482 Tm2 Tm385e35.OC 2205.864n(AN)Tj1 1 137.392

* Students take either BIOL 309 or MATH 315, but not both.

ANAT 365	(3)	Cellular Trafficking
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309*	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Cancer
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 and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and 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)	Biochemistry of Immune Diseases
MIMM 509	(3)	Inflammatory Processes
PHGY 531yy Processes(3on	(3)	Topics in Applied Immunology

PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHGY 488	(3)	Stem Cell Biology
PHGY 531	(3)	Topics in Applied Immunology
PHGY 552	(3)	Cellular and Molecular Physiology

13.19 Interdisciplinary Life Sciences

13.19.1 Location

Interdisciplinary Programs Advisor
Curtis Sharman
Email: *curtis.sharman@mcgill.ca*

13.19.2 About the Interdisciplinary Life Sciences Minor

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 311	(3)	Metabolic Biochemistry
BIOC 450	(3)	Protein Structure and Function
BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	The Business of Science
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
NSCI 201	(3)	Introduction to Neuroscience 2
NUTR 307	(3)	Metabolism and Human Nutrition
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology

PHGY 313	(3)	Blood, Gastrointestinal, and 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
	(3)	Health Economics

At least 3 credits from:

* Students who have already received credit for MATH 324 will NOT receive credit for GEOG 202, MATH 203, PSYC 204, BIOL 373, MATH 204, or PSYC 305.

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

EDKP 395	(3)	Exercise Physiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

Complementary Courses (9 credits)

9 credits, three of the following courses:

EDKP 330	(3)	Physical Activity and Public 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)	Neuromuscular and Inflammatory Pathophysiology
EDKP 485	(3)	Cardiopulmonary Exercise Pathophysiology
EDKP 495	(3)	Scientific Principles of Training
EDKP 498	(3)	Sport Psychology
EDKP 542	(3)	Environmental Exercise Physiology
EDKP 566	(3)	Advanced Biomechanics Theory

13.21   Management for Science Students

The Desautels Faculty of Management offers a minor program *: Bachelor of Commerce (B.Com.) - Minor Management (For Non-Management Students) (18 credits)* open for application to students in the Faculty of Science. Please refer to *Desautels Faculty of Management > Undergraduate > Overview of Programs Offer*

| MGCR 352 | (3) | Principles of Marketing |
| MGCR 372* | (3) | Operations Management. |

Furthermore, the Desautels Faculty of Management offers the B.Com. degree with a Major in Mathematics.

Students considering programs in Mathematics and Statistics are encouraged to *contact the Department of Mathematics and Statistics* to arrange for *academic advising*.

13.22.4 Research Opportunities

During their undergraduate degree, students in the Department of Mathematics and Statistics are encouraged to engage in research. The two main opportunities are:

- Funded summer research projects allowing students to engage in state-of-the art research with faculty members
- Opportunities for hands-on experience with data analysis offered through the *Statistical Consulting Service*

13.22.5 Internship Opportunities

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

- The **Internship Year in Science** (IYS) is an option offered for a duration of 8, 12, or 16 months. It is reflected on the transcript and included in the program name (Bachelor of Science – Internship Program). Eligible students usually take this program between their U2 and U3 years.
- The **Industrial Practicum** (IP) has a duration of four months and is usually carried out starting in May. It will appear as a 0-credit, Pass/Fail course on your transcript.

For more information on these opportunities, consult *mcgill.ca/science/undergraduate/internships-field*.

13.22.6 Mathematics and Statistics Faculty

Interim Chair
Rustum Choski

Graduate Program Director
Jérôme Vétois

Undergraduate Program Director
Armel Djivede Kelome

Emeritus Professors
William J. Anderson; Michael Barr; Peter Bartello; William G. Brown; Ian Connell; Stephen Drury; Kohur N. GowriSankaran; Paul Koosis; Michael Makkai; Sherwin Maslowe; Arak M. Mathai; Karl Peter Russell; Georg Schmidt; George P.H. Styan; Kwok Kuen Tam; John C. Taylor; David Wolfson; Jian-Jun Xu; Sanjo Zlobec

Professors
Louigi Addario-Berry; Masoud Asgharian; Rustum Choksi; Henri Darmon; Christian Genest; Eyal Z. Goren; Pengfei Guan; Jacques C. Hurtubise; Dmitry Jakobson; Vojkan Jaksic; Joel Kamnitzer; Niky Kamran; Eric D. Kolaczyk; Jean-Philippe Lessard; Johanna Neslehova; Adam Oberman; Charles Roth; David A. Stephens; John A. Toth; Adrian Vetta; Daniel T. Wise

Associate Professors
Patrick Allen; Linan Chen; Tim Hoheisel; Antony R. Humphries; Abbas Khalili; Jessica Lin; Jean-Christophe Nave; Sergey Norin; Elliot Paquette; Mikael Pichot; Piotr Przytycki; Marcin Sabok; Russell Steele; Anush Tserunyan; Gantumur Tsogtgerel; Jérôme Vétois; Archer Yang

Assistant Professors
Medhi Dadoug;Courtney Paquette; Brent Pym

Associate Members
Simon Caron-Huot; Xiao-Wen Chang; Luc Devroye; Pierre R. L. Dutilleul; Leon Glass; James A. Hanley; Hamed Hatami; Anmar Khadra; Xue Liu; Michael Mackey; Erica E.M. Moodie; Prakash Panangaden; Robert W. Platt; Alexandra Schmidt; Kaleem Siddiqi; Christina Wolfson

Adjunct Professors
Syed E. Ahmed; Andrew Granville; Alexis Hannart; Adrian Iovita; Dimitris Koukoulopoulos; Michael Lipnowski; Ming Mei; Claude-Alain Pillet; Iosif Polterovich; Armen Shirikyan

13.22.7 Bachelor of Science (B.Sc.) - Minor Mathematics (24 credits)

The Minor may be taken in conjunction with any primary program in the Faculty of Science (other than programs in Mathematics). Students should declare their intention to follow the Minor Mathematics at the beginning of the penultimate year and should obtain approval for the selection of courses to fulfil the requirements for the Minor from the Departmental Chief Adviser (or delegate).

It is strongly recommended that students in the Minor program take MATH 323. The remaining credits may be freely chosen from the required and complementary courses for majors and honours students in Mathematics, with the obvious exception of courses that involve duplication of material. Alternatively, up to 6 credits may be allowed for appropriate courses from other departments.

Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program. However, with an approved choice of substantial courses, the overlap restriction may be relaxed to 9 credits for students whose primary program requires 60 credits or more, and to 12 credits when the primary program requires 72 credits or more.

Required Courses (9 credits)

* MATH 223 may be replaced by MATH 235 and MATH 236. In this case, the complementary credit requirement is reduced by 3 credits.

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

Complementary Courses (15 credits)

15 credits selected from the required and complementary courses for majors and honours students in Mathematics, with MATH 323 strongly recommended; alternatively, up to 6 credits may be allowed for appropriate courses from other departments.

13.22.8 Bachelor of Science (B.Sc.) - Minor Statistics (27 credits)

(24-27 credits)

Students may complete this program with a minimum of 24 credits or a maximum of 27 credits.

The Minor may be taken in conjunction with any primary program in the Faculty of Science (other than those with a main component in Statistics). Students should declare their intention to follow the Minor Statistics at the beginning of the penultimate year and must obtain approval for the selection of courses to fulfil the requirements for the Minor from the Departmental Chief Adviser (or delegate).

All courses counted towards the Minor must be passed with a grade of C or better. Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program. However, with an approved choice of substantial courses, the overlap restriction may be relaxed to 9 credits for students whose primary program requires 60 credits or more, and to 12 credits when the primary program requires 72 credits or more.

Required Courses (15 credits)

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MATH 423	(3)	Applied Regression

Complementary Courses (9-12 credits)

9-12 credits selected from:Tj1 0 0 1 82.67 148.265 :Tj21w.s82.6449 179.75lec6 c:Tj1 0 0 1 82.67 148.28222

COMP 551	(4)	Applied Machine Learning
GEOG 351	(3)	Quantitative Methods
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 558	(4)	Design of Experiments
MATH 559	(4)	Bayesian Theory and Methods
MATH 562	(4)	Theory of Machine Learning
PHYS 362	(3)	Statistical Mechanics
PHYS 559	(3)	Advanced Statistical Mechanics
SOCI 504	(3)	Quantitative Methods 1

No more than 6 credits from the above list of complementary courses may be taken outside the Department of Mathematics and Statistics.

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

Program Prerequisites

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

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

Guidelines for Selection of Courses

The following informal guidelines should be discussed with the student's adviser. Where appropriate, Honours courses may be substituted for equivalent Major courses. Students planning to pursue graduate studies are encouraged to make such substitutions.

Students interested in computer science are advised to choose courses from the following: MATH 317, MATH 318, MATH 327, MATH 328, MATH 335, MATH 340, MATH 417 and to complete the Computer Science Minor.

Students interested in probability and statistics are advised to take MATH 204, MATH 324, MATH 423, MATH 447, MATH 523, MATH 525.

Students interested in applied mathematics should take MATH 317, MATH 319, MATH 324, MATH 326, MATH 327, MATH 417.

Students considering a career in secondary school teaching are advised to take MATH 318, MATH 328, MATH 338, MATH 339, MATH 346, MATH 348.

Students interested in careers in business, industry or government are advised to select courses from the following list:

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

Required Courses (27 credits)

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

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

MATH 222**	(3)	Calculus 3

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

Complementary Courses (18 credits)

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

MATH 317	(3)	Numerical Analysis
MATH 324	(3)	Statistics
MATH 335	(3)	Groups, Tilings and Algorithms
MATH 340	(3)	Discrete Mathematics

the remainder of the 18 credits to be selected from:

MATH 204	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 318	(3)	Mathematical Logic
MATH 319	(3)	Partial Differential Equations
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 346	(3)	Number Theory
MATH 348	(3)	Euclidean Geometry
MATH 352	(1)	Problem Seminar
MATH 378	(3)	Nonlinear Optimization
MATH 410	(3)	Majors Project
MATH 417	(3)	Linear Optimization
MATH 423	(3)	Applied Regression
MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 451	()	Introduction to General Topology
MATH 463	(3)	Convex Optimization
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications

MATH 545	(4)	Introduction to Time Series Analysis

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

(45 or 48 credits)

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

Students may complete this program with a minimum of 45 credits or a maximum of 48 credits.

Program Prerequisites

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

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

Required Courses (27 credits)

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

** Students who have sufficient knowledge in a programming language do not need to take COMP 202, but must replace it by either COMP 250 or COMP 350.

***MATH 236 is an equivalent prerequisiste to MATH 223 for required and complementary Computer Science courses listed below.

+ Students hav

MATH 315	(3)	Ordinary Differential Equations
MATH 316	(3)	Complex Variables
MATH 317*	(3)	Numerical Analysis
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 340	(3)	Discrete Mathematics
MATH 350	(3)	Honours Discrete Mathematics
MATH 378	(3)	Nonlinear Optimization
MATH 417	(3)	Linear Optimization
MATH 430	(3)	Mathematical Finance
MATH 463	(3)	Convex Optimization

At least 9 credits selected from:

*If chosen, students can take at most one of MATH 410, MATH 420, MATH 527D1/D2, and WCOM 314.

COMP 551	(4)	Applied Machine Learning
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 410*	(3)	Majors Project
MATH 420*	(3)	Independent Study
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 527D1*	(3)	Statistical Data Science Practicum
MATH 527D2*	(3)	Statistical Data Science Practicum
MATH 545	(4)	Introduction to Time Series Analysis
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 558	(4)	Design of Experiments
MATH 559	(4)	Bayesian Theory and Methods
MATH 598	(4)	Topics in Probability and Statistics
WCOM 314*	(3)	Communicating Science

13.22.11 Bachelor of Science (B.Sc.) - Major Mathematics (54 credits)

Program Prerequisites

Students entering the Major program are normally expected to have completed the courses below or their equivalents. Otherwise, they will be required to make up any deficiencies in these courses over and above the 54 credits of required 2 Tm(xpe))Tj1 0 0 1208.2l024.08 Tm(Linm(v)Tj1 0 0 41 828.2l024.08 Algebra(er C

Guidelines for Selection of Courses in the Major Program

The following informal guidelines should be discussed with the student's adviser. Where appropriate, Honours courses may be substituted for equivalent Major courses. Students planning to pursue graduate studies are encouraged to make such substitutions.

Students interested in computer science are advised to choose courses from the following: MATH 317, MATH 318, MATH 327, MATH 335, MATH 340, MATH 417 and to complete the Computer Science Minor.

Students interested in probability and statistics are advised to take MATH 204, MATH 324, MATH 423, MATH 447, MATH 523, MATH 525.

Students interested in applied mathematics should take MATH 317, MATH 319, MATH 324, MATH 326, MATH 327, MATH 417.

Students considering a career in secondary school teaching are advised to take MATH 318, MATH 338, MATH 346, MATH 348.

Students interested in careers in business, industry or government are advised to select courses from the following list:

MATH 317, MATH 319, MATH 327, MATH 329, MA

MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 346	(3)	Number Theory
MATH 348	(3)	Euclidean Geometry
MATH 352	(1)	Problem Seminar
MATH 378	(3)	Nonlinear Optimization
MATH 410	(3)	Majors Project
MATH 417	(3)	Linear Optimization
MATH 423	(3)	Applied Regression
MATH 427	(3)	Statistical Quality Control
MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 451	()	Introduction to General Topology
MATH 463	(3)	Convex Optimization
MATH 478	(3)	Computational Methods in Applied Mathematics
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis

If necessary, 6 additional credits in Mathematics or related disciplines selected in consultation with the Adviser.

13.22.12 Bachelor of Science (B.Sc.) - Major Statistics (54 credits)

The program provides training in statistics, with a solid mathematical core, and basic training in computing. With satisfactory performance in an appropriate selection of courses, this program can lead to the professional accreditation A. Stat from the Statistical Society of Canada, which is regarded as the entry level requirement for a Statistician practicing in Canada. The students may complete this program with 54-57 credits.

Program Prerequisites

Students entering the Major in Statistics program are normally expected to have completed the courses below or their equivalents. Otherwise they will be required to make up any deficiencies in these courses over and above the 54 credits of program courses.

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

In addition, a student that has not completed the equivalent of MATH 203 upon entering the program must consult an academic adviser. If a student is advised to take MATH 203, this course has to be taken as a complementary course in the first semester, increasing the total number of program credits from 54 to 57.

Students are strongly advised to complete all required courses and all Part I complementary courses by the end of U2, except for MATH 423 and MATH 523.

Students interested in the professional accreditation should consult an academic adviser.

Where appropriate, Honours courses may be substituted for equivalent Major courses. Students planning to pursue graduate studies are encouraged to make such substitutions, and to take MATH 556 and MATH 557 as complementary courses.

Required Courses (34 credits)

* Students must take MATH 204 before taking MATH 324.

** 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 MATH 314.

*** MATH 236 is an equivalent prerequisite to MATH 223 for required and complementary Computer Science courses listed below.

MATH 204*	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
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 323	(3)	Probability
MATH 324*	(3)	Statistics
MATH 423	(3)	Applied Regression
MATH 523	(4)	Generalized Linear Models

Complementary Courses (20-23 credits)

0-3 credits selected from:

| MATH 203 | (3) | Principles of Statistics 1 |

Part I: 6 credits selected from:

* If chosen, students take either MATH 317 or COMP 350, but not both.

COMP 208	(3)	Computer Programming for Physical Sciences and Engineering
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 350*	(3)	Numerical Computing
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 316	(3)	Complex Variables
MATH 317*	(3)	Numerical Analysis
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 340	(3)	Discrete Mathematics
MATH 350	(3)	Honours Discrete Mathematics
MATH 378	(3)	Nonlinear Optimization
MATH 417	(3)	Linear Optimization
MATH 430	(3)	Mathematical Finance
MATH 463	(3)	Convex Optimization

Part II: 14 credits selected from:

* If chosen, students can at most one of MATH 410, MATH 420, MATH 527D1/D2, and WCOM 314.

+ If chosen, students can tak

MATH 410*	(3)	Majors Project
MATH 420*	(3)	Independent Study
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 527D1*	(3)	Statistical Data Science Practicum
MATH 527D2*	(3)	Statistical Data Science Practicum
MATH 545	(4)	Introduction to Time Series Analysis
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 558	(4)	Design of Experiments
MATH 559	(4)	Bayesian Theory and Methods
MATH 598	(4)	Topics in Probability and Statistics
WCOM 314*	(3)	Communicating Science

13.22.13 Bachelor of Science (B.Sc.) - Major Mathematics and Computer Science (72 credits)

The B.Sc.; Major in Mathematics and Computer Science emphasizes fundamental skills in mathematics and computer science, while exploring the interaction between the two fields.

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.

** Student cannot replace TH 141

Ordinary Dif

* 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, bce

MATH 525	(4)	Sampling Theory and Applications
MATH 527D1++	(3)	Statistical Data Science Practicum
MATH 527D2++	(3)	Statistical Data Science Practicum
MATH 545	(4)	Introduction to Time Series Analysis
MATH 558	(4)	Design of Experiments
MATH 559	(4)	Bayesian Theory and Methods
MATH 578**	(4)	Numerical Analysis 1
MATH 598	(4)	Topics in Probability and Statistics

9 credits in Computer Science selected as follows:

At least 6 credits selected from:

COMP 424	(3)	Artificial Intelligence
COMP 462	(3)	Computational Biology Methods
COMP 540**	(4)	Matrix Computations
COMP 547	(4)	Cryptography and Data Security
COMP 551	(4)	Applied Machine Learning
COMP 564	(3)	Advanced Computational Biology Methods and Research
COMP 5671 0 0 1 165 cerical	(3)	Discrete Optimization 1

To be awarded the Honours degree, the student must have, at time of graduation, a CGPA of at least 3.00 in the required and complementary Mathematics courses of the program, as well as an overall CGPA of at least 3.00.

Required Courses

(39-42 credits)

* Students with limited programming experience should take COMP 202 or COMP 204 or COMP 208 or equivalent before COMP 250.

** Students select either MATH 251 or MATH 247, but not both.

*** Students who have successfully completed MATH 150/151 or an equivalent of MATH 222 on entering the program are not required to take MATH 222.

COMP 250*	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
MATH 222***	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 325	(3)	Honours Ordinary Differential Equations
MATH 350	(3)	Honours Discrete Mathematics
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 358	(3)	Honours Advanced Calculus
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 470	(3)	Honours Research Project
MATH 475	(3)	Honours Partial Differential Equations

Complementary Courses (21 credits)

3 credits selected from:

MATH 242	(3)	Analysis 1
MATH 254+	(3)	Honours Analysis 1

+ It is strongly recommended that students take MATH 254.

Advising Notes:

Students interested in continuous applied mathematics are urged to choose these as part of their Complementary Courses: MATH 454, MATH 455 and MATH 478, and are advised to choose additional courses from MATH 387, MATH 397, MATH 555, 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 456, MATH 457, MATH 517, MATH 547, MATH 550, MATH 552.

3 credits selected from:

MATH 249	(3)	Honours Complex Variables
MATH 466	(3)	Honours Complex Analysis

at least 3 credits selected from:

MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis

0-6 credits from the following courses for which no Honours equivalent exists.

MATH 204	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 430	(3)	Mathematical Finance
MATH 451	()	Introduction to General Topology
MATH 478	(3)	Computational Methods in Applied Mathematics

and the remainder of credits selected from:

COMP 362	(3)	Honours Algorithm Design
MATH 352	(1)	Problem Seminar
MATH 365	(3)	Honours Groups, Tilings and Algorithms
MATH 377	(3)	Honours Number Theory
MATH 398	(3)	Honours Euclidean Geometry
MATH 454++	(3)	Honours Analysis 3
MATH 455	(3)	Honours Analysis 4
MATH 456	(3)	Honours Algebra 3
MATH 457	(3)	Honours Algebra 4
MATH 458	(3)	Honours Differential Geometry
MATH 462	(3)	Honours Mathematics for Machine Learning
MATH 480	(3)	Honours Independent Study
MATH 488	(3)	Honours Set Theory

++ Not open to students who have taken MATH 354.

To be awarded the Honours degree, the student must have, at time of graduation, a CGPA of at least 3.00 in the required and complementary Mathematics courses of the program, as well as an overall CGPA of at least 3.00.

Required Courses (48 credits)

45-48 credits

+ Students who have successfully completed MATH 150/151 or an equivalent of MATH 222 on entering the program are not required to take MATH 222.

* Not open to students who have taken MATH 354.

MATH 222+	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 251	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 325	(3)	Honours Ordinary Differential Equations
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 358	(3)	Honours Advanced Calculus
MATH 454*	(3)	Honours Analysis 3
MATH 455	(3)	Honours Analysis 4
MATH 456	(3)	Honours Algebra 3
MATH 457	(3)	Honours Algebra 4
MATH 458	(3)	Honours Differential Geometry
MATH 466	(3)	Honours Complex Analysis
MATH 470	(3)	Honours Research Project
MATH 475	(3)	Honours Partial Differential Equations

Complementary Courses (15 credits)

3 credits selected from:

MATH 242	(3)	Analysis 1
MATH 254**	(3)	Honours Analysis 1

** It is strongly recommended that students take MATH 254.

0-6 credits from the following courses for which no Honours equivalent exists:

MATH 204	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 378	(3)	Nonlinear Optimization
MATH 430	(3)	Mathematical Finance
MATH 451	()	Introduction to General Topology
MATH 463	(3)	Convex Optimization

6-12 credits selected from:

COMP 250++	(3)	Introduction to Computer Science

COMP 252	(3)	Honours Algorithms and Data Structures
MATH 350	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 365	(3)	Honours Groups, Tilings and Algorithms
MATH 376	(3)	Honours Nonlinear Dynamics
		Honours Number

COMP 250*	(3)	Introduction to Computer Science
MATH 208	(3)	Introduction to Statistical Computing
MATH 222***	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 470	(3)	Honours Research Project
MATH 533	(4)	Regression and Analysis of Variance

Complementary Courses (32 credits)

Advising notes:

- Students wishing to pursue mathematical statistics in graduate school are advised to take MATH 587 and recommended to take honours mathematics courses as complementary courses in Part II, in particular MATH 358, MATH 454 (preferably prior to MATH 587), and MATH 455.

- Students wishing to pursue applied statistics and/or careers as statisticians in industry or government are advised to take MATH 523, MATH 524, MATH 547, at least one of MATH 525 and MATH 558, and as many courses as possible from Part III of the list of Complementary Courses below. Students interested in obtaining the A-Stat accreditation from the Statistical Society of Canada should discuss their course selection with the academic adviser.

-Students with interest in probability are advised to choose from the following as part of their Complementary Courses: MATH 547, MATH 587, MATH 589.

- Students with interest in actuarial science are advised to choose from the following as part of their Complementary Courses: MATH 329, MATH 430, MATH 524, MATH 545, MATH 547.

- Students with interest in data science and machine learning are advised to choose from the following as part of their Complementary Courses: COMP 206, COMP 251, COMP 370, COMP 424, COMP 551, MATH 308, MATH 350, MATH 378, MATH 462 and MATH 517,MATH 562, and MATH 563.

Part I: 3 credits selected from:

* It is strongly recommended that students take MATH 254.

MATH 242	(3)	Analysis 1
MATH 254*	(3)	Honours Analysis 1

Part II: 6-11 credits in mathematics and computer science selected from:

+ Students can select either MATH 248 or MATH 358, but not both.

++ Students may obtain credit for both MATH 455 and MATH 587.

COMP 206	(3)	Introduction to Software Systems
COMP 252	(3)	Honours Algorithms and Data Structures
MATH 248+	(3)	Honours Vector Calculus
MATH 325	(3)	Honours Ordinary Differential Equations
MATH 350	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 358+	(3)	Honours Advanced Calculus
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis
MATH 398	(3)	Honours Euclidean Geometry

MATH 454	(3)	Honours Analysis 3
MATH 455++	(3)	Honours Analysis 4
MATH 458	(3)	Honours Differential Geometry
MATH 466	(3)	Honours Complex Analysis
MATH 475	(3)	Honours Partial Differential Equations
MATH 478	(3)	Computational Methods in Applied Mathematics
MATH 480	(3)	Honours Independent Study
MATH 527D1	(3)	Statistical Data Science Practicum
MATH 527D2	(3)	Statistical Data Science Practicum

and any 500-level course offered by the Department of Mathematics and Statistics not listed in P

COMP 588	(4)	Probabilistic Graphical Models
MATH 430	(3)	Mathematical Finance
MATH 462	(3)	Honours Mathematics for Machine Learning
MATH 562	(4)	Theory of Machine Learning
MATH 594+++	(4)	Topics in Mathematics and Statistics
MATH 598+++	(4)1470	Topics in Probability and Statistics

13.22.18 Bachelor of Science (B.Sc.) - Honours Statistics and Computer Science (79 credits)

This is a challenging program providing students with a solid training in both computer science and statistics suitable for entry into graduate school in either discipline.

Students may complete this program with a minimum of 76 credits or a maximum of 79 credits depending on whether or not they are exempt from taking COMP 202.

Program Prerequisites

Students entering the Joint Honours in Statistics and Computer Science are normally expected to have completed the courses below or their equivalents. Otherwise, they will be required to make up any deficiencies in these courses over and above the 76-79 credits of courses in the program.

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

Required Courses (46 credits)

Published Sept o be 25 04 e 29 t 14 m 28 l 50 (mi)6 programming language are not required to take COMP 202.

** Students take either MATH 251 or MATH 247, but not both.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems

| MATH 242 | (3) | Analysis 1 |
| MATH 254* | (3) | Honours Analysis 1 |

* It is strongly recommended that students take MATH 254.

3 credits selected from:

| MATH 387 | (3) | Honours Numerical Analysis |
| MATH 397 | (3) | Honours Matrix Numerical Analysis |

At least 8 credits selected from:

MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 527D1	(3)	Statistical Data Science Practicum
MATH 527D2	(3)	Statistical Data Science Practicum
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 558	(4)	Design of Experiments
MATH 559	(4)	Bayesian Theory and Methods

The remaining Mathematics credits selected from:

** MATH 578 and COMP 540 cannot both be taken for program credit.

MATH 350	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 454	(3)	Honours Analysis 3
MATH 462	(3)	Honours Mathematics for Machine Learning
MATH 545	(4)	Introduction to Time Series Analysis
MATH 563	(4)	Honours Convex Optimization
MATH 578**	(4)	Numerical Analysis 1
MATH 587	(4)	Advanced Probability Theory 1
MATH 594	(4)	Topics in Mathematics and Statistics

15 credits in Computer Science selected as follows:

At least 6 credits selected from:

COMP 424	(3)	Artificial Intelligence
COMP 462	(3)	Computational Biology Methods
COMP 540**	(4)	Matrix Computations
COMP 547	(4)	Cryptography and Data Security
COMP 551	(4)	Applied Machine Learning
COMP 552	(4)	Combinatorial Optimization
COMP 564	(3)	Advanced Computational Biology Methods and Research

| COMP 566 | (3) | Discrete Optimization 1 |
| COMP 567 | (3) | Discrete Optimization 2 |

The remaining Computer Science credits are selected from COMP courses at the 300 level or above excluding COMP 396.

3 credits selected from:

| MATH 242 | (3) | Analysis 1 |
| MATH 254*** | (3) | Honours Analysis 1 |

*** It is strongly recommended that students take MATH 254.

3 credits selected from:

| MATH 248 | (3) | Honours Vector Calculus |
| MATH 358 | (3) | Honours Advanced Calculus |

18 credits in Mathematics, at least 9 credits selected from:

+ Not open to students who have taken MATH 354.

| MATH 356 | (3) | Honours Probability |
| | | Honours Se |

Website: *mcgill.ca/microimm*

13.23.2 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; and 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, and response to environmental stimuli. Microbiologists are also concerned with0 0 1 420en

13.23.4   Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (50 credits)

U1 Required Courses (19 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

U1 Complementary Course (3 credits)

3 credits, select one from:

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

U1, U2, or U3 Required Course (3 credits)

3 credits, select one from:

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

U2 Required Courses (16 credits)

MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology

MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes

U1, U2 or U3 Complementary Courses (3 credits)

3 credits selected from:

* Students who have taken CHEM 212 or CHEM 222 in CEGEP must replace it with another complementary course.

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458	(3)	Membranes and Cellular Signaling
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
COMP 204	(3)	Computer Programming for Life Sciences
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	The Business of Science
MIMM 390	(3)	SEA-PHAGES: Phage Discovery
MIMM 391	(3)	SEA-PHAGES: Genome Annotation
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 496D1	(3)	Microbiology Advanced Research Project
MIMM 496D2	(3)	Microbiology Advanced Research Project
MIMM 497D1	(3)	Immunology Advanced Research Project
MIMM 497D2	(3)	Immunology Advanced Research Project
MIMM 509	(3)	Inflammatory Processes
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease

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

13.23.5 Bachelor of Science (B.Sc.) - Major Microbiology and Immunology (66 credits)

The Major program is designed for students who want to acquire a substantial background in microbiology and immunology and related disciplines (chemistry, biology, biochemistry) which will prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes.

U1 Required Courses (26 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

** Students who have taken CHEM 222 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222**	(4)	Introductory Organic Chemistry 2
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

One of:

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

U1, U2, or U3 Required Course (3 credits)

One of:

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

U2 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Course (3 credits)

MIMM 413	(3)	Parasitology

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Complementary Courses (9 credits)

9 credits selected from:

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

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458*	(3)	Membranes and Cellular Signaling
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 302	(3)	Introductory Organic Chemistry 3
COMP 204	(3)	Computer Programming for Life Sciences
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	The Business of Science
MIMM 390	(3)	SEA-PHAGES: Phage Discovery
MIMM 391	(3)	SEA-PHAGES: Genome Annotation
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 496D1	(3)	Microbiology Advanced Research Project
MIMM 496D2	(3)	Microbiology Advanced Research Project
MIMM 497D1	(3)	Immunology Advanced Research Project
MIMM 497D2	(3)	Immunology Advanced Research Project
MIMM 509	(3)	Inflammatory Processes
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

13.23.6 Bachelor of Science (B.Sc.) - Honours Microbiology and Immunology (72 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 (26 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

** Students who have taken CHEM 222 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222**	(4)	Introductory Organic Chemistry 2
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

One of:

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

U1, U2, or U3 Required Course (3 credits)

One of:

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

U2 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Courses (15 credits)

MIMM 413	(3)	Parasitology
MIMM 501D1*	(6)	Honours Research Project in Immunology
MIMM 501D2*	(6)	Honours Research Project in Immunology

| MIMM 502D1* | (6) | Honours Research Project in Microbiology |
| MIMM 502D2* | (6) | Honours Research Project in Microbiology |

* Students take either MIMM 501D1 and MIMM 501D2 or MIMM 502D1 and MIMM 502D2.

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Complementary Courses (3 credits)

3 credits selected from:

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458	(3)	Membranes and Cellular Signaling
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 404	(3)	Biophysical Methods in Biochemistry
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids

BIOC 45(3))Tj1 0 0 1 70.52m(3)BIOC 45(3))Tj\MembranesandCe(lular Si7gna5inng)Tj1 0 0 1e)

(3)   Neuropharmacology

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

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Diana (Dino) Dutz; B.Mus.(UWO), Grad.Dip.(C'dia)
Telephone: 514-398-6337
Email: *studentaffairs.music@mcgill.ca*

13.24.4 Music Related Programs

13.24.4.1 Minor in Musical Applications of Technology and Minor in Musical Science and Technology

Science students may apply for admission to:

- **Minor in Musical Applications of Technology** – see *Schulich School of Music > Undergraduate > Browse Academic Units & Programs > Department of Music Research: Composition; Music Education; Music History; Theory; Faculty Program > : Bachelor of Music (B.Mus.) - Minor Musical Applications of Technology (18 credits)*
- **Minor in Musical Science and Technology** – see *Schulich School of Music > Undergraduate > Browse Academic Units & Programs > Department of Music Research: Composition; Music Education; Music History; Theory; Faculty Program > : Bachelor of Music (B.Mus.) - Minor Musical Science and Technology (18 credits)*

Enrolment in Music Technology programs is highly restricted. Interested applicants must submit an *online application* via the Schulich School of Music website by the assigned deadline of each academic year. Late applications will not be accepted and no students will be admitted in January. Successful applicants will be notified by email before the end of June. Registration will be limited to available lab space.

13.25   Neurology and Neurosurgery (NEUR)

13.25.1 Location

Montreal Neurological Institute and Hospital
3801 University Street, Room 140
Montreal QC H3A 2B4
Website: *mcgill.ca/neuro*

13.25.2 About Neurology and Neurosurgery

There are no B.Sc. programs in Neurology and Neurosurgery, but the course NEUR 310 *Cellular Neurobiology*, which is part of the Minor in Neuroscience, is taught by the Faculty of Science.

Students wishing to obtain more information about Neurology and Neurosurgery can refer to the Faculty of Medicine and Health Sciences'

Website 2: *mcgill.ca/neuroscience*
Telephone: 514-398-4342

Neuroscience Program Adviser
Curtis Sharman
Email: *curtis.sharman@mcgill.ca*
Website: *mcgill.ca/neuroscience*
Telephone: 514-398-5442

13.26.2 About Neuroscience

Neuroscience is a multidisciplinary science devoted to understanding the nervous system. The brain is one of the most complex systems in the universe, and understanding how it functions is among the most challenging questions in science. Scientists are investigating the brain at many levels, from the molecules at synapses to complex forms of behaviour, and use methods of inquiry that are drawn from a number of disciplines, including molecular and cellular biology, physiology, behavioural sciences and cognitive psychology, computer science, and artificial intelligence. In addition, scientists are investigating the nervous systems of many different animals, from simple invertebrates to humans. These wide-ranging investigations are providing a clearer understanding of how neurons work; how they communicate with one another; how they are organized into local or distributed networks; how the connections between neurons are established and change with experience; and how neuronal function is influenced by pharmacological agents and during disease states.

CHEM 212	(4)	Introductory Organic Chemistry 1
NEUR 310	(3)	Cellular Neurobiology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314**	(3)	Integrative Neuroscience
PSYC 302	(3)	The Psychology of Pain
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour

6-15 credits from the following list of 400- and 500-level courses:

BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 415	(3)	Electroencephalography (EEG) Laboratory in Psychology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 514	(3)	Neurobiology of Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
PSYT 505	(3)	Neurobiology of Schizophrenia

13.26.4 Bachelor of Science (B.Sc.) - Major Neuroscience (65 credits)

The Neuroscience Major is a focused program for students interested in how the nervous system functions. It is highly interdisciplinary and borrows principles and methodologies from a number of fields including: biology, biochemistry, physiology, psychology, mathematics, physics, computer science, and immunology. To ensure that they have the appropriate foundation, students are required to take 29 credits in lower-level courses from physiology, biology, mathematics, computer science, psychology, and ethics. The program offers students a concentrated selection of 15 credits to be taken from one of three areas of current scientific activities in the neurosciences: Cell/Molecular, Neurophysiology/Computation, or Cognition/Behaviour. In addition, students select 21 credits from a wide array of complementary courses to obtain more specialized training in areas of neuroscience that best suit their interests.

Enrolment in the Neuroscience Major is limited to a total of 50 students per year. U0 students seeking admission to this program should consult the neuroscience website for admissions requirements and should have completed the courses listed below or their equivalents.

Program Prerequisites

Students may complete this program with a minimum of 65 or a maximum of 67 credits.

Notes on admission to the Neuroscience Major program: Enrolment in the Neuroscience Major is limited to a total of 50 students per year. U0 students seeking admission to this program should consult the neuroscience website for admissions requirements and should have completed the courses listed below or equivalent.

* Students complete one of MATH 139, MATH 140 OR MA

| COMP 202 | (3) | Foundations of Programming |
| COMP 204 | (3) | Computer Programming for Life Sciences |

3 credits from:

Note: Students who have successfully completed an equivalent to MATH 222 at CEGEP or elsewhere, must replace these credits with a 3-credit elective course to satisfy the total credit requirement for the Neuroscience Major.

| BIOL 309 | (3) | Mathematical Models in Biology |
| MATH 222 | (3) | Calculus 3 |

ANAT 321	(3)	Circuitry of the Human Brain
BIOL 309	(3)	Mathematical Models in Biology
COMP 206**	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra

C. Cognitive/Behavioural Stream

6 credits as follows:

PSYC 213	(3)	Cognition
PSYC 318	(3)	Behavioural Neuroscience 2

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

6 credits from:

ANAT 321	(3)	Circuitry of the Human Brain
PSYC 302	(3)	The Psychology of Pain
PSYC 317	(3)	Genes and Behaviour
PSYC 342	(3)	Hormones and Behaviour

Other Complementary Courses

21-23 credits chosen as follows:

3-16 credits from:

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 389	(3)	Laboratory in Neurobiology
NSCI 410D1	(3)	Independent Research 1
NSCI 410D2	(3)	Independent Research 1
NSCI 420D1	(4.5)	Independent Research 2
NSCI 420D2	(4.5)	Independent Research 2

5-20 of the credits should be taken from the following lists. At least 15 of the 21-23 credits must be at the 400- or 500-level, which could include the above NSCI 410D1/NSCID2 or NSCI 420D1/NSCI 420D2 research courses:

200- and 300-level courses:

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

** Students take either COMP 206 or COMP 250, but not both.

ANAT 321	(3)	Circuitry of the Human Brain
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 311	(3)	Metabolic Biochemistry
BIOL 201*	(3)	Cell Biology and Metabolism

BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 307	(3)	Behavioural Ecology
BIOL 320	(3)	Evolution of Brain and Behaviour
CHEM 222	(4)	Introductory Organic Chemistry 2
COMP 206**	(3)	Introduction to Software Systems
COMP 250**	(3)	Introduction to Computer Science
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
NEUR 310	(3)	Cellular Neurobiology
PHAR 300	(3)	Drug Action
PHGY 210	(3)	Mammalian Physiology 2
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience
PSYC 213	(3)	Cognition
PSYC 302	(3)	The Psychology of Pain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 319	(3)	Computational Models - Cognition
PSYC 342	(3)	Hormones and Behaviour

400- and 500-level courses:

BIOL 414	(3)	Invertebrate Brain Circuits and Behaviours
BIOL 506	(3)	Neurobiology of Learning
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BMDE 519	(3)	Biomedical Signals and Systems
COMP 546	(4)	Computational Perception
MATH 437	(3)	Mathematical Methods in Biology
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
NEUR 503	(3)	Computational Neuroscience
NEUR 507	(3)	Topics in Radionuclide Imaging

NEUR 550	(3)	Free Radical Biomedicine
PHAR 562	(3)	Neuropharmacology
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 513	(3)	Translational Immunology
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 443	(3)	Affective Neuroscience
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 502	(3)	Psychoneuroendocrinology
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 529	(3)	Music Cognition
		Neurochemistry

NSCI 400D2	(.5)	Neuroscience Seminar
NSCI 430D1	(4.5)	Honours Research Project
NSCI 430D2	(4.5)	Honours Research Project
PHGY 311	(3)	Channels, Synapses and Hormones
PSYC 311	(3)	Human Cognition and the Brain
PSYC 318	(3)	Behavioural Neuroscience 2

Complementary Courses (36 credits)

3 credits from:

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

3 credits from:

| COMP 202 | (3) | Foundations of Programming |
| COMP 204 | (3) | Computer Programming for Life Sciences |

3 credits from:

BIOL 373	(3)	Biometry
MATH 324	(3)	Statistics
PSYC 305	(3)	Statistics for Experimental Design

3 credits from:

Note: Students who hav

BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 389	(3)	Laboratory in Neurobiology
CHEM 222	(4)	Introductory Organic Chemistry 2
COMP 206*	(3)	Introduction to Software Systems
COMP 250*	(3)	Introduction to Computer Science
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
NEUR 310	(3)	Cellular Neurobiology
PHAR 300	(3)	Drug Action
PHGY 210	(3)	Mammalian Physiology 2
PHGY 314	(3)	Integrative Neuroscience
PSYC 213	(3)	Cognition
PSYC 302	(3)	The Psychology of Pain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 319	(3)	Computational Models - Cognition
PSYC 342	(3)	Hormones and Behaviour

400- and 500-level courses:

BIOL 414	(3)	Invertebrate Brain Circuits and Behaviours
BIOL 506	(3)	Neurobiology of Learning
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BMDE 519	(3)	Biomedical Signals and Systems
COMP 546	(4)	Computational Perception
MATH 437	(3)	Mathematical Methods in Biology
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
NEUR 503	(3)	Computational Neuroscience
NEUR 507	(3)	Topics in Radionuclide Imaging
NEUR 550	(3)	Free Radical Biomedicine
PHAR 562	(3)	Neuropharmacology
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 513	(3)	Translational Immunology

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PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 443	(3)	Affective Neuroscience
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 502	(3)	Psychoneuroendocrinology
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 529	(3)	Music Cognition
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.27   Nutrition (NUTR)

13.27.1 Location

School of Human Nutrition
Macdonald-Stewart Building, Room MS2-045
21,111 Lakeshore Road
Sainte-Anne-de-Bellevue QC H9X 3V9
Website: *mcgill.ca/nutrition*

13.27.2 About Nutrition

The School of Human Nutrition offers a **Minor in Human Nutrition** which can be taken by Science students; see *Faculty of Agricultural and Environmental Sciences > Undergraduate > Overview of Programs Offered > : Bachelor of Science in Nutritional Sciences – B.Sc.(Nutr.Sc.) (Overview)*.

NUTR 307 is considered as a course taught by the Faculty of Science.

13.28   Pathology (PATH)

13.28.1 Location

Department of Pathology
Duff Medical Building, B wing
3775 University Street
Montreal QC H3A 2B4
Telephone: 514-398-3045
Website: *mcgill.ca/pathology*

13.28.2   About Pathology

projects in pharmacology is also available to provide students with the opportunity to get first-hand experience in a pharmacology research laboratory. These courses provide students with knowledge concerning the actions of drugs on living systems and insight into approaches to basic pharmacological research.

13.29.3 Pharmacology and Therapeutics (PHAR) Faculty

Chair

Koren K. Mann

Emeritus Professors

Radan Capek; Hans H. Zingg; Dusica Maysinger

Professors

Daniel Bernard; Derek Bowie; Paul B.S. Clarke; A. Claudio Cuello; Barbara Hales; Terence Hébert; Anne McKinney; Gerhard Multhaup; Alfredo Ribeiro-da-Silva; Bernard Robaire; H. Uri Saragovi; Moshe Szyf; Jacquetta Trasler; Koren K. Mann

Associate Professors

Jason Chaim Tanny; Lisa Maria Munter; Bastien Castagner; Jean-François Trempe

Assistant Professors

Maureen McKeague; Ajitha Thanabalasuriar

Associate Members

Carolyn Baglole; Nathan Luedtke; Stephane Laporte; Stanley Nattel; Cristian O'Flaherty; Simon Rousseau; Edith A. Zorychta; Mark Basik; Michael Pollak; Sarah Kimmins

Adjunct Professors

Bruce Allen; Sylvain Chemtob; Yves De Koninck; Greg FitzHarris; Jean-Sebastien Joyal; Thomas Sanderson; Fabrice Le Boeuf; Laura Stone

Affiliate Members

Mathieu Boucher; Lionel Breton; Lorella Garofalo; John Gillard; Joseph Mancini; Karen Meerovitch; Christopher Wright; Taylor Cohen

13.29.4 Bachelor of Science (B.Sc.) - Minor Pharmacology (24 credits)

The Minor Pharmacology i0 0 noru66227.iy f(Tw2ret.m(13.29.4)T.m(13.29e1 Tm(e; Stepharuao)TjTjdrmacolcomplem(1ary Mino 0 0gram who o)T227.ireTjTdrmaco

3 credits selected from the following:

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

12 credits selected from the following:

PHAR 303	(3)	Principles of Toxicology
PHAR 503*	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 505*	(3)	Structural Pharmacology
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 510	(3)	New Advances in Antimicrobial
PHAR 540	(3)	Advances in Industrial Biotechnology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets
PHAR 599D1**	(3)	Pharmacology Research Project
PHAR 599D2**	(3)	Pharmacology Research Project

* Students may take either PHAR 503 or PHAR 505.

** PHAR 599D1 and PHAR 599D2 are taken together.

13.29.5   Bachelor of Science (B.Sc.) - Major Pharmacology (67 credits)

This program incorporates extensive studies in Pharmacology with a strong component of related biomedical sciences, providing a solid preparation for employment opportunities or for entry into graduate or professional training programs. Students must consult the Student Affairs Coordinator upon entering the program and every year thereafter to verify courses and progress.

Required Courses (40 credits)

U1

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
PHAR 200	(1)	Introduction to Pharmacology 1
PHAR 201	(1)	Introduction to Pharmacology 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

* Students who have taken the equivalent of CHEM 212, CHEM 222,and/or MATH 203 in CEGEP (as defined at: http://www.mcgill.ca/students/transfercredit/prospective/cegep) are exempt and may not take these courses at McGill. Students must replace these credits with appropriate complementary course credits to satisfy the total credit requirements for their degree.

U2

BIOC 311	(3)	Metabolic Biochemistry

BIOL 301	(4)	Cell and Molecular Laboratory
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology

Complementary Courses (27 credits)

3 credits, one of (recommended to be taken in Year 1):

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

3 credits, one of (usually in Year 2):

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

3 credits, one of (usually in Year 2):

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

9 credits selected from the following Pharmacology courses:

PHAR 503**	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 505**	(3)	Structural Pharmacology
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 510	(3)	New Advances in Antimicrobial
PHAR 540	(3)	Advances in Industrial Biotechnology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets

9 credits selected from the following courses:

Committee approval is required to substitute a science course not in the list below.

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381+	(3)	Experimental Embryology
ANAT 458*	(3)	Membranes and Cellular Signaling
BIEN 510	(3)	Engineered Nanomaterials for Biomedical Applications
BIOC 312	(3)	Biochemistry of Macromolecules

BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOC 470***	(3)	Lipids and Lipoproteins in Disease
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 370	(3)	Human Genetics Applied
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 462	(3)	Green Chemistry
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery
CHEM 522	(3)	Stereochemistry
		Ph

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 425+	(3)	Analyzing Physiological Systems
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PPHS 501	(3)	Population Health and Epidemiology
PSYC 302	(3)	The Psychology of Pain
PSYC 305***	(3)	Statistics for Experimental Design
PSYC 311	(3)	Human Cognition and the Brain
PSYC 317***	(3)	Genes and Behaviour
PSYC 318***	(3)	Behavioural Neuroscience 2
PSYT 301	(3)	Issues in Drug Dependence
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
REDM 410	(3)	Writing Research Articles

Note:

* Students may take either ANAT 458 or BIOC 458.

** Students may take either PHAR 503 or PHAR 505.

*** Access to these courses is not guaranteed.

+ Open to students who have the prerequisites.

++ Access to these courses is not guaranteed. Open to students who have the prerequisites.

^ If chosen, PHAR 522D1 and PHAR 522D2 are taken together.

^^ If chosen, PHAR 599D1 and PHAR 599D2 are taken together.

13.29.6   Bachelor of Science (B.Sc.) - Honours Pharmacology (76 credits)

The Honours program is designed as a preparation for graduate studies and research. In addition to the strong training provided by the Major program, it requires students to have direct research experience in a chosen area during their final year of study. Acceptance into the Honours program takes place in the Winter term of U2 and requires a CGPA of 3.50. Students who wish to enter the Honours program should follow the Major program; those who satisfactorily complete the first three terms with a CGPA of at least 3.50 and a mark of B+ or higher in core Pharmacology courses (PHAR 300, PHAR 301, and PHAR 303) are eligible for admission. Applications can be obtained from the office of the Department of Pharmacology in the McIntyre Medical Building or on the Departmental website.

Required Courses (46 credits)

U1

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
PHAR 200	(1)	Introduction to Pharmacology 1
PHAR 201	(1)	Introduction to Pharmacology 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1

PHAR 565   (3)   Epigenetic Drugs and Targets

9 credits selected for the following science courses:

Committee approval is required to substitute a science course not in the list belo

PHAR 504	(3)	Drug Discovery and Development 2
PHAR 505**	(3)	Structural Pharmacology
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 510	(3)	New Advances in Antimicrobial

Email: *chairsec.physics@mcgill.ca*
Website: *physics.mcgill.ca*

13.30.2   About Physics

Physics is in many ways the parent of the other natural sciences and its discoveries and laws continually affect their development. Its range and scope extend in space and time from subnuclear particles to the universe itself. The subfields of physics—such as mechanics, thermodynamics, electricity, atomic physics, and quantum mechanics, to mention but a few—permeate all other scientific disciplines. People trained in physics are employed in industry, government, and educational systems where they find many challenges as teachers, researchers, administrators, and in the rapidly developing area of scientific business.

The two main undergraduate programs in physics at McGill are the Honours and the Major. The **Honours** program is highly specialized and the courses are very demanding. This program is appropriate for students who wish to make an in-depth study of the subject in preparation for graduate work and an academic or professional career in physics. The three multidisciplinary honours programs—in Mathematics and Physics, in Physics and Chemistry, and in Physics and Computer Science—are even more specialized and demanding. They are intended for students who wish to develop a strong basis in both physics and the other discipline and are intended as preparation for graduate work and a professional or academic career. Although these programs have a bias for theoretical work, they are broad enough and strong enough to prepare students for further study in either experimental physics or respectively mathematics, chemistry, or computer science.

The **Major** program, on the other hand, offers a broad training in classical and modern physics and yet leaves room for the student to take a meaningful sequence of courses in other areas. It is intended primarily for students who wish to pursue careers in fields for which physics provides a basis. However, this program also provides a preparation for graduate studies.

It is possible for students to transfer from the Major program to the Honours program after the first year of studies; see *section 13.30.9: Bachelor of Science (B.Sc.) - Major Physics (63 credits)*

13.30.4 Science Freshman Program

Students entering McGill with a Quebec CEGEP profile in Science will normally begin their programs in Physics with courses at the 200 level.

Students without this profile should normally take courses PHYS 131 and PHYS 142 if they have previously taken physics at the high school level and should be taking differential calculus concurrently with PHYS 131 and integral calculus concurrently with PHYS 142. Those students who have not previously taken physics at the high school level and who intend to do programs in the Biological Sciences may instead take courses PHYS 101 and PHYS 102. All students are expected to have reasonable fluency in algebra, geometry, and trigonometry at the high school level. If this is not the case, then MATH 112 should be taken concurrently with PHYS 101. Those for whom this is not necessary are advised to take MATH 139 concurrently with PHYS 101.

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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 Cour

ECSE 210	(3)	Electric Circuits 2
ECSE 303	(3)	Signals and Systems 1
ECSE 330	(3)	Introduction to Electronics

Complementary Courses (12 credits)

3 credits from the following and 9 credits of ECSE courses at the 200, 300, or 400 level subject to approval by the Department of Electrical and Computer Engineering.

| ECSE 305 | (3) | Probability and Random Signals 1 |
| ECSE 334 | (3) | Introduction to Microelectronics |

13.30.8   Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physics (45 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 (36 credits)

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 333	(3)	Thermal and Statistical Physics

| PHYS 340 | (3) | Majors Electricity and Magnetism |
| PHYS 346 | (3) | Majors Quantum Physics |

Complementary Courses (9 credits)

9 credits selected from:

PHYS 328	(3)	Electronics
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 434	(3)	Optics
PHYS 447	(3)	Applications of Quantum Mechanics

13.30.9   Bachelor of Science (B.Sc.) - Major Physics (63 credits)

The B.Sc.; Major in Physics program covers a range of fundamental physical concepts from classical physics to modern topics relevant to contemporary research. The program may be completed in 60-63 credits.

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
MATH 133	(3)	Linear Algebra and Geometry
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

7-8 credits from:

MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

Note: Either MATH 140 and MATH 141 or MATH 150 and MATH 151.

Required Courses (45 credits)

* Students coming into the program with sufficient knowledge of computer programming may replace COMP 208 with PHYS 512 or another 3-credit COMP course at the 200 level or above after consulting with an adviser.

COMP 208*	(3)	Computer Programming for Physical Sciences and Engineering
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1

PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 346	(3)	Majors Quantum Physics
PHYS 447	(3)	Applications of Quantum Mechanics

Complementary Courses

(15-18 credits)

0-3 credits from:

MATH 222*	(3)	Calculus 3

* Students who did complete an equivalent to MATH 222 on entering the program must take this course.

3 credits from:

PHYS 329	(3)	Statistical Physics with Biophysical Applications
PHYS 333	(3)	Thermal and Statistical Physics

12 credits from:

PHYS 319	(3)	Introduction to Biophysics
PHYS 320	(3)	Introductory Astrophysics
	(3)	Data Science and Observational Astrophysics

13.30.10 Bachelor of Science (B.Sc.) - Major Physics: Biological Physics (82 credits)

The B.Sc. Major Physics: Biological Physics program keeps a strong core of foundational physics and specializes through courses in biology, mathematics, physiology, computer science, and chemistry. Complementary courses provide background in molecular and cell biology, computer science, and organic chemistry, whereas introductory and advanced biophysics courses offered by the Physics Department as integrative courses. This program provides students with the skills necessary to continue on to graduate studies in biophysics/biological physics, or for research careers in hospital, industrial, or university settings.

Required Courses (63 credits)

Bio-Physical Science Core (27 credits)

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

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

Biology and Mathematics (6 credits)

BIOL 202	(3)	Basic Genetics
MATH 314	(3)	Advanced Calculus

Physics (30 credits)

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 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 346	(3)	Majors Quantum Physics
PHYS 449	(3)	Majors Research Project
PHYS 519	(3)	Advanced Biophysics

Complementary Courses

(18-19 credits)

3 credits selected from:

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

3 credits selected from:

| PHYS 328 | (3) | Electronics |
| PHYS 331 | (3) | Topics in Classical Mechanics |

3 credits selected from:

| PHYS 339 | (3) | Measurements Laboratory in General Physics |
| PHYS 439 | (3) | Majors Laboratory in Modern Physics |

3 credits selected from:

CHEM 514	(3)	Biophysical Chemistry
MATH 437	(3)	Mathematical Methods in Biology
PHGY 425	(3)	Analyzing Physiological Systems
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 447	(3)	Applications of Quantum Mechanics

6 to 7 credits selected from:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 316	(3)	Biomembranes and Organelles
BIOL 551	(3)	Principles of Cellular Control

Bac

MATH 133 and either MATH 140/141 or MATH 150/151.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

Required Courses (57 credits)

EPSC 231	(3)	Field School 1
EPSC 240	(3)	Geology in the Field
EPSC 303	(3)	Structural Geology
EPSC 320	(3)	Elementary Earth Physics
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 346	(3)	Majors Quantum Physics
PHYS 432	(3)	Physics of Fluids

Complementary Courses (12 credits)

EPSC 350	(3)	Tectonics
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 482	(3)	Research in Earth and Planetary Sciences
EPSC 510	(3)	Geodynamics
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 549	(3)	Hydrogeology
MATH 319	(3)	Partial Differential Equations
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 404	(3)	Climate Physics
PHYS 449	(3)	Majors Research Project

13.30.12 Bachelor of Science (B.Sc.) - Major Physics and Computer Science (66 credits)

The Major Physics and Computer Science is designed to give motivated students the opportunity to combine the two fields in a way that will distinguish them from the graduates of either field by itself. The two disciplines complement each other, with physics providing an analytic problem-solving outlook and basic understanding of nature, while computer science enhances the ability to make practical and marketable applications, in addition to having its own theoretical interest. Graduates of this program may be able to present themselves as being more immediately useful than a pure physics major, but with more breadth than just a programmer. They will be able to demonstrate their combined expertise in the Special Project course which is the centrepiece of the final year of the program.

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology

MATH 133 and either MATH 140/141 or MATH 150/151.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
		Calculus B 0 1 82.67 363.162 r9e of:

| PHYS 232 | (3) | Heat and Waves |
| PHYS 241 | (3) | Signal Processing |

U3 Required Courses (21 credits)

COMP 360	(3)	Algorithm Design
MATH 323	(3)	Probability
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 346	(3)	Majors Quantum Physics
PHYS 489	(3)	Special Project

13.30.13 Bachelor of Science (B.Sc.) - Honours Physics (78 credits)

Students entering this program for the first time should have high standing in mathematics and physics.

To graduate with an Honours degree, a student must have, at time of graduation, a CGPA of at least 3.0 in the required and complementary courses of the program, as well as an overall CGPA of at least 3.0.

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/MATH141 or MATH 150/MATH 151 or MATH 222.

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
MATH 222	(3)	Calculus 3

Required Courses (27 credits)

U1

MATH 247	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Vector Calculus
MATH 249	(3)	Honours Complex Variables

MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 260	(3)	Modern Physics and Relativity

U2

MATH 475	(3)	Honours Partial Differential Equations
PHYS 253	(3)	Thermal Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 359	(3)	Advanced Physics Laboratory 1
PHYS 362	(3)	Statistical Mechanics
PHYS 457	(3)	Honours Quantum Physics 2

U3

PHYS 352	(3)	Honours Electromagnetic Waves

Complementary Courses (24 credits)

U3

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)	Advanced Physics Laboratory 2
PHYS 479	(3)	Physics Research Project

18 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 404	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 479	(3)	Physics Research Project
PHYS 512	(3)	Computational Physics with Applications
PHYS 514	(3)	General Relativity
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics
PHYS 534	(3)	Nanoscience and Nanotechnology
PHYS 551	(3)	Quantum Theory

PHYS 557	(3)	Nuclear Physics
PHYS 558	(3)	Solid State Physics
PHYS 559	(3)	Advanced Statistical Mechanics
PHYS 562	(3)	Electromagnetic Theory
PHYS 567	(3)	Particle Physics

13.30.14 Bachelor of Science (B.Sc.) - Honours Physics: Biological Physics (82 credits)

The B.Sc. Honours Physics: Biological Physics program keeps a strong core of foundational physics and specializes through courses in biology, mathematics, physiology, computer science, and chemistry. The Honours program offers a more rigorous preparation, with additional research experience, for students with a strong interest in biophysics. In the final year, students will have an opportunity to carry out a research project within a biophysics lab in the department. This program provides a very strong foundation for students wishing to pursue graduate studies in biophysics, as well as for research careers in industrial, hospital, or academic laboratory settings.

Required Courses (63 credits)

Bio-Physical Sciences Core (24 credits)

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 395	(1)	Quantitative Biology Seminar
CHEM 212*	(4)	Introductory Organic Chemistry 1
MATH 247	(3)	Honours Applied Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
PHYS 319	(3)	Introduction to Biophysics
PHYS 329	(3)	Statistical Physics with Biophysical Applications

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

Biology and Mathematics (6 credits)

BIOL 202	(3)	Basic Genetics
MATH 248	(3)	Honours Vector Calculus

Physics (33 credits)

PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 253	(3)	Thermal Physics
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 346	(3)	Majors Quantum Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 459D1	(3)	Honours Research Thesis
PHYS 459D2	(3)	Honours Research Thesis
PHYS 519	(3)	Advanced Biophysics

Complementary Courses

(18-19 credits)

3 credits selected from:

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

3 credits selected from:

| PHYS 328 | (3) | Electronics |
| PHYS 351 | (3) | Honours Classical Mechanics 2 |

3 credits selected from:

| PHYS 339 | (3) | Measurements Laboratory in General Physics |
| PHYS 359 | (3) | Advanced Physics Laboratory 1 |

3 credits selected from:

CHEM 514	(3)	Biophysical Chemistry
MATH 437	(3)	Mathematical Methods in Biology
PHGY 425	(3)	Analyzing Physiological Systems
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 447	(3)	Applications of Quantum Mechanics

6 to 7 credits selected from:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 316	(3)	Biomembranes and Organelles
BIOL 551	(3)	Principles of Cellular Control

13.30.15 Bachelor of Science (B.Sc.) - Honours Mathematics and Physics (81 credits)

This is a specialized and demanding program intended for students who wish to develop a strong basis in both Mathematics and Physics in preparation for graduate work and a professional or academic career. Although the program is optimized for theoretical physics, it is broad enough and strong enough to prepare students for further study in either experimental physics or mathematics.

The minimum requirement for entry into the program is completion with high standing of the usual CEGEP courses in physics and in mathematics, or the Physics Program Prerequisites as explained below. In addition, a student who has not completed the equivalent of MATH 222 must take it in the first term without receiving credit toward the 81 credits required in the Honours program.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (unless the student improves the grade to a C or higher through a supplemental exam or by retaking the course), may not register in the Honours program the following year, or graduate with the Honours degree, except with the permission of both departments. The student will have two advisers, one from Mathematics and the other from Physics.

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
	(4)	Mechanics and Waves

MATH 458	(3)	Honours Differential Geometry
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 359	(3)	Advanced Physics Laboratory 1

Complementary Courses (18 credits)

U1 Complementary Course (3 credits)

MATH 247	(3)	Honours Applied Linear Algebra
MATH 251	(3)	Honours Algebra 2

U2 Complementary Courses (3 credits)

MATH 242	(3)	Analysis 1
MATH 254**	(3)	Honours Analysis 1

** It is strongly recommended that students take MATH 254.

U3 Complementary Courses (12 credits)

12 credits are selected as follows:

3 credits from:

MATH 455	(3)	Honours Analysis 4
MATH 456	(3)	Honours Algebra 3

6 credits selected from:

PHYS 404	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids
PHYS 459D1*	(3)	Honours Research Thesis
PHYS 459D2*	(3)	Honours Research Thesis
PHYS 479	(3)	Physics Research Project
PHYS 512	(3)	Computational Physics with Applications
PHYS 514	(3)	General Relativity
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics
PHYS 551	(3)	Quantum Theory
PHYS 557	(3)	Nuclear Physics
PHYS 558	(3)	Solid State Physics
PHYS 559	(3)	Advanced Statistical Mechanics
PHYS 562	(3)	Electromagnetic Theory
PHYS 567	(3)	Particle Physics

* Note: PHYS 459D1 and PHYS 459D2 are taken together.

3 credits in Honours Mathematics.

PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 457	(3)	Honours Quantum Physics 2
PHYS 558	(3)	Solid State Physics

Complementary Courses (12 credits)

(with at least 3 credits in Chemistry and 3 credits in Physics)

3 credits selected from:

| CHEM 593 | (3) | Statistical Mechanics |
| PHYS 559 | (3) | Advanced Statistical Mechanics |

9 credits selected from the list below:

Note: PHYS 459D164 64

Required Courses (63 credits)

*Note: The student must then take MATH 314 in their second semester instead of MATH 248, if scheduling requires it.

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 350	(3)	Numerical Computing
MATH 240	(3)	Discrete Structures
MATH 247	(3)	Honours Applied Linear Algebra
MATH 248*	(3)	Honours Vector Calculus
MATH 249	(3)	Honours Complex Variables
MATH 314*	(3)	Advanced Calculus
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 253	(3)	Thermal Physics
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 362	(3)	Statistical Mechanics
		Honours Quantum Ph

Any COMP course at the 400- or 500-level (excluding COMP 400) (3 or 4 credits)

3-4 credits from:

MATH 323	(3)	Probability
MATH 340	(3)	Discrete Mathematics
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 359	(3)	Advanced Physics Laboratory 1
PHYS 404	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 469	(3)	Advanced Physics Laboratory 2

Any number of PHYS courses at the 500 level (3 credits each)

Any number of COMP courses at the 400 or 500-level (excluding COMP 400) (3 or 4 credits each)

13.30.18 Physics (PHYS) Related Programs

13.30.18.1 Major in Atmospheric Science and Physics

See *section 13.3: Atmospheric and Oceanic Sciences (ATOC)*. This program provides a firm basis for graduate work in atmospheric science and related fields as well as a sound preparation for those who wish to embark on a career directly after the B.Sc. Students should consult undergraduate advisers in both departments.

13.30.18.2 Major in Physiology and Physics

See *section 13.31: Physiology (PHGY)*. This program provides a firm basis for graduate work in bio-physics and other interdisciplinary fields involving the physical and biological sciences.

13.31   Physiology (PHGY)

13.31.1   Location

McIntyre Medical Sciences Building, Room 1021
3655 Promenade Sir-William-Osler
Montreal QC H3G 1Y6
Telephone: 514-398-4316
Website: *mcgill.ca/physiology*

13.31.2   About Physiology

Physiology has its roots in many of the basic sciences including biology, chemistry, mathematics, and physics; and it overlaps with other biomedical sciences such as anatomy, biochemistry, pathology, pharmacology, psychology, and biomedical engineering. Physiology is one of the prime contributors of basic scientific knowledge to the clinical medical sciences.

Members of the Department of Physiology at McGill are engaged in studies dealing with molecules, single cells, or entire systems in a variety of vertebrates, including humans. A wide range of interest and expertise is represented, including:

- cardiovascular;
- respiratory;
- g

- biophysics; and
- biomathematics.

Some faculty members have formal or informal links with the departments of mathematics, physics, electrical enginee   linical departments (medicine, surgery, pediatrics, neurology, obstetrics, psychiatry, anesthesia), reflecting and reinforcing th   y and other disciplines.

Graduates at the B.Sc. level have found rewarding careers in secondary school and CEGEP teaching, government service,   stance such as in pharmaceutical houses, hospitals, and institutions of higher learning. Moreover, physiology provides an excell   ., dentistry or other postgraduate work, in such fields as physiology, experimental medicine, pharmacology, biochemistry, o

The programs offered in Physiology differ in their orientation but they all have a common core of material covering:

- cardiovascular;
- respiratory;
- gastrointestinal and renal physiology;
- neurophysiology;
- endocrinology; and
- immunology.

The specified U1 courses are identical for all programs except the Joint Major programs in Physiology and Physics, Physiology ar   the Joint Honours program in Immunology, and thus, afford students maximum flexibility before deciding on a particular program to f

All new students to the Department, Freshman and CEGEP, must contact the Student Affairs Officer at 514-398-3689 for advising;   is available on the *Physiology website*.

Returning students are encouraged to consult with the Student Affairs Officer regularly throughout the year, in particular at the begi   l year, to ensure they have met all departmental requirements.

Please note: Complementary courses are not electives.

The difference between complementary courses and required courses is that complementary courses are defined as offering an element of   er small that choice may be. Students may choose from the two (or more) courses specified within complementary course segments of a prog   on, but ONLY from those. For further information, refer to *University Regulations & Resources > Undergraduate > Registration > : Course I   d Regulations*.

13.31.3 Physiology Faculty

Chair
John White

Graduate Program Director
Alvin Shrier

Emeritus Professors
Thomas M.S. Chang, Leon Glass, Kresimir Krnjevic, Wayne S. Lapp, Mortimer Levy, Michael Mackey, George Mandl, Geoffrey Melvill Jones, Jose Milic-Emili, Canio Polosa, Douglas G.D. Watt

Associate Professor (Post-Retirement)
Ann Wechsler

Professors
Maurice Chacron, Monroe W. Cohen, Ellis J. Cooper, Phil Gold, John Hanrahan, David Goltzman, Steve Lomber, Gergely Lukacs, Sheldon Magder, John Orlowski,

Assistant Professors

Pouya Bashivan, Arjun Krishnaswamy, Judith Mandl, Anastasia Nijnik, Masha Prager-Khoutorsky, Daniela Quail, Melissa Vollrath

Associate Members

Anaesthesia: Steven Backman

Biomedical Engineering: Satya Prakash

Mathematics: Anthony Humphries

Medicine: Volker Blank, Mark Blostein, Andrey Cybulsky, Anne-Marie Lauzon, James Martin, Shafaat Rabbani, Simon Rousseau, Benjamin M. Smith, Mary Stevenson, Tomoko Takano, Elena Torban, Simon Wing

Microbiology and Immunology: Jör

3 credits, one of:

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience

3 credits selected from:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science
PSYC 305	(3)	Statistics for Experimental Design

Upper-Level Physiology (ULP) Courses

6 credits selected from the Upper-Level Physiology (ULP) course list as follows:

* 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 532	(3)	Developmental Neurobiology Seminar
BMDE 505	(3)	Cell and Tissue Engineering
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
PHGY 425	(3)	Analyzing Physiological Systems
	(3)	Advanced Neurophysiology

PHGY 531	(3)	Topics in Applied Immunology
PHGY 550	(3)	Molecular Physiology of Bone
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.31.5 Bachelor of Science (B.Sc.) - Major Physiology (65 credits)

The Major program includes, in addition to some intensive studies in Physiology, a strong core content of related biomedical sciences. Admission to the Major program will be in U2, upon completion of the U1 required courses, and in consultation with the student's adviser.

If not previously taken, CHEM 212 "Introductory Organic Chemistry 1" must be completed in addition to the 64-65 program credits.

Students may complete this program with a minimum of 64 credits or a maximum of 65 credits depending on their choice of complementary courses.

U1 Required Courses (18 credits)

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 222	(4)	Introductory Organic Chemistry 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

U2 and U3 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOL 301	(4)	Cell and Molecular Laboratory
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

Complementary Courses (28 credits)

12-13 credits selected as follows:

3 credits, one of:

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

3 credits, one of:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science

PSYC 305	(3)	Statistics for Experimental Design

3 credits, one of:

BIOC 312	(3)	Biochemistry of Macromolecules
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

3-4 credits, one of:

ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 316	(3)	Clinical Human Visceral Anatomy

9 credits selected from the Upper-Level Physiology (ULP) course list as follows:

BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 505	(3)	Cell and Tissue Engineering
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 1
		Advanced Endocrinology 02

PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

* the 6-credit course equals 3 credits of ULP and 6 credits of electives.

** the 9-credit course equals 3 credits of ULP and 6 credits of electives.

6 credits selected from the Upper-Level Science (ULS)

Note: For Chemistry, Neurology, and Neurosurgery: select from all courses 300 level and above and the ULS courses listed below.

For Biochemistry, Computer Science, Microbiology and Immunology, Mathematics, Physics, and Pathology: select from all courses 300 level and above.

For Anatomy, Biology, Experimental Medicine, Pharmacology, and Psychology: select from the ULS courses listed below:

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458*	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 542	(3)	Transmission Electron Microscopy of Biological Samples
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 309	(3)	Mathematical Models in Biology
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 324	(3)	Ecological Genetics
BIOL 370	(3)	Human Genetics Applied
BIOL 373	(3)	Biometry
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 416	(3)	Genetics of Mammalian Development
BIOL 468	(6)	Independent Research Project 3
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 544	(3)	Genetic Basis of Life Span
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 575	(3)	Human Biochemical Genetics
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
CHEM 214	(3)	Physical Chemistry/Biological Sciences 2

EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
		Advanced T

13.31.7 Bachelor of Science (B.Sc.) - Major Physiology and Physics (82 credits)

This program provides a firm foundation in physics, mathematics, and physiology. It is appropriate for students interested in applying methods of the physical sciences to problems in physiology and allied biological sciences.

Required Courses (76 credits)

Bio-Physical Sciences Core

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 395	(1)	Quantitative Biology Seminar
MATH 222	(3)	Calculus 3
MATH 223*	(3)	Linear Algebra
MATH 247*	(3)	Honours Applied Linear Algebra
MATH 315**	(3)	Ordinary Differential Equations
MATH 325**	(3)	Honours Ordinary Differential Equations
		Statistical Ph

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience

3 credits, one of:

PHYS 413	(3)	Physical Basis of Physiology
PHYS 519	(3)	Advanced Biophysics

13.31.8 Bachelor of Science (B.Sc.) - Honours Physiology (75 credits)

All admissions to the Honours program will be in U2, and the student must have a U1 GPA of 3.30, with no less than a B in PHGY 209 and PHGY 210. Admission to U3 requires a U2 CGPA of 3.20 with no less than a B in U2 Physiology courses. Decisions for admission to U3 will be heavily influenced by student standing in U2 courses.

The Department reserves the right to restrict the number of entering students in the Honours program. Students who do not maintain Honours standing may transfer their registration to the Major program in Physiology.

The deadline to apply to the Honours program is August 23, 2019. Application forms are available online at physiology.med@mcgill.ca or a hard copy can be picked up at McIntyre 1021. Please contact Sonia Viselli, Student Affairs Officer (sonia.viselli@mcgill.ca; 514-398-3689) for more information. An email will be sent to acknowledge receipt of your application.

Graduation: To graduate from the Honours Physiology program, the student will have a CGPA of 3.20 with a mark no less than a B in all Physiology courses.

If not previously taken, CHEM 212 Introductory Organic Chemistry 1 must be completed in addition to the 75 program credits.

Required Courses (60 credits)

ANAT 261	(4)	Introduction to Dynamic Histology
BIOC 311	(3)	Metabolic Biochemistry
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
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 and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and 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
COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science
PSYC 305	(3)	Statistics for Experimental Design

3 credits, one of:

BIOC 312	(3)	Biochemistry of Macromolecules
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

6 credits selected from the Upper-Level Physiology (ULP) course list as follows:

BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 488	(3)	Stem Cell Biology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Translational Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 525	(3)	Cortical Plasticity
PHGY 531	(3)	Topics in Applied Immunology

13.33   Psychology (PSYC)

13.33.1   Location

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Montreal QC H3A 1G1
Telephone: 514-398-6100
Fax: 514-398-4896
Email: *undergrad.psych@mcgill.ca*
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13.33.2   About Psychology

The Department of Psychology offers programs in both Arts and Science. All B.A. programs in Psychology can be found in *Faculty of Arts* **>** *Undergraduate > Browse Academic Units & Programs > : Psychology*.

Psychology is the scientific study of mind and behaviour. It is both a **social** and a **biological** science.

- As a **social science**, psychology examines the social nature of human beings and the influence that culture, group membership, and relationships have on individual personality, thought, and behaviour.
- As a **biological science**, psychology seeks to identify the neural basis of human behaviour, both directly, through the study of humans, and indirectly, through the study of other species.

The data of psychology is collected within the psychological laboratory by the use of experimental methods in the study of behaviour, and outside the laboratory by systematic observation of the behaviour of humans and animals. The aim is to formulate general principles of perception, learning, motivation, cognition, and social psychology that are relevant to different aspects of human life. Experimentation, laboratory techniques, observational procedures, measurement, and statistical methods are important tools of the psychologist.

Psychology has many interdisciplinary aspects. The study of psychological problems often involves knowledge drawn from other disciplines such as biology, physiology, linguistics, sociology, philosophy, and mathematics. For this reason, a student with varied interests can frequently find a place for these in psychology.

Psychology is a young science, so explanations of the processes underlying observed phenomena are often theoretical and speculative. The major objectives of psychological study are to reduce the discrepancy between theory and fact and to provide better answers about why humans think and behave as they do.

Undergraduate Studies

Although a number of undergraduate courses in psychology have applied implications, applied training is not the purpose of the undergraduate curriculum. Its purpose is to introduce the student to an understanding of the basic core of psychological knowledge, theory, and method, regardless of questions of practical application.

The B.Sc. or B.A. with a **Major** or **Honours** degree in psychology is not a professional qualification; it does not qualify the individual to carry on professional work in psychology. In the province of Quebec, the minimum requirement for membership in the Order of Psychologists, the professional association governing the work of psychologists in the province, is a doctoral degree. However, the Order also has a number of undergraduate course requirements that you should consult in planning your degree if you ultimately hope to apply for membership in the Order of Psychologists of Quebec. All students planning to practise in the province of Quebec will also be examined on their proficiency in French before being admitted to the professional association. Undergraduate courses in psychology may prove to be of considerable value to students planning careers in professional fields other than psychology. These include, but are not restricted to, medicine, education, social work, human communication sciences, and business and industry.

What distinguishes the Honours program from the Major program is the Honours program's emphasis on research methodology and practice, and its requirement that students maintain a high academic standard. Honours students also have an opportunity to work closely with faculty members in small groups.

Graduate Studies

Students who are interested in psychology as a career must pursue graduate studies. Persons who hold graduate degrees in Psychology, usually the Ph.D., may find employment in universities, research institutes, hospitals, community agencies, government departments, large corporations, or may act as self-employed consultants. At the graduate level, psychology has many specialized branches including social psychology, physiological psychology, experimental psychology, clinical psychology, child psychology, industrial psychology, community psychology, educational psychology, and others.

Requirements for admission to graduate studies in psychology vary from one university to another and from one country to another. Nonetheless, both the Honours and Major degrees in Psychology may qualify the student for admission to many graduate schools, provided that sufficiently high grades are obtained and, in some cases, that research experience has been obtained. During the U2 year, undergraduate students are strongly advised to verify the admission requirements of various graduate programs. This is to ensure that sufficient time is available for students to complete all necessary requirements for admission to their preferred graduate programs.

13.33.3 Information Meetings for New Students

All new students entering the Psychology undergraduate program should attend an information meeting prior to registration. Newly admitted students from CEGEPs should attend the information session in June. There will be an identical information session in August for all other students and for any CEGEP students who could not attend the earlier meeting. Please check the *Psychology Department website* for the specific dates. Students accepted into a Bachelor of Arts program must attend a different information meeting from the one offered to students in the Faculty of Science. (For details, see *Faculty of Arts > Undergraduate >*

13.33.6   Bachelor of Science (B.Sc.) - Minor Psychology (24 credits)

A minor program in Psychology is available to students registered in any B.Sc. program other than Psychology. This program is intended to complement a student's primary field of study by providing a focused introduction to specialized topics in psychology.

A separate minor concentration exists for students registered in a program in the Faculty of Arts.

The Minor program for Science students requires the completion of 24 credits in Psychology, of which no more than 6 may overlap with the primary program. All courses in the Minor program must be passed with a minimum grade of C. A prerequisite to the program is PSYC 204 or equivalent.

Program Prerequisite (0-3)

Students planning to enter the Minor Psychology program are required to complete PSYC 204 Introduction to Psychological Statistics (3 credits) * or equivalent.

*Note: CEGEP students may not take PSYC 204 if they have completed Probability & Statistics or Statistics with a minimum grade of 75%.

Complementary Courses (24 credits)

3 or 6 credits selected from the following:

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

18 or 21 credits selected from Psychology courses at the 300 level or above.

13.33.7   Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Psychology (45 credits)

This Core Science Component Psychology requires the completion of 45 credits in Psychology, all of which need to be passed with a minimum grade of C. A prerequisite to the program is PSYC 11 pass co231.780 0 1 67.52 1vtute Resear

Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-level statistics course to be exempt from PSYC 204. In the first year, those students who have not taken the recommended collegial-level statistics course, or those who have obtained a grade below 75%, must take Psychology PSYC 204. Those who have not taken Introductory Psychology in CEGEP must take PSYC 100.

Required Course (3 credits)

PSYC 204	(3)	Introduction to Psychological Statistics

Complementary Courses (42 credits)

9 credits from:

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

List A

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

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	The Psychology of Pain
PSYC 306	(3)	Research Methods in Psychology
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 319	(3)	Computational Models - Cognition
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)	Research Methods and Laboratory in Cognitive Psychology
PSYC 353	(3)	Research Methods and 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 415	(3)	Electroencephalography (EEG) Laboratory in Psychology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 443	(3)	Affective Neuroscience
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 502	(3)	Psychoneuroendocrinology

PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of 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 537	(3)	Advanced Seminar in Psychology of Language
		Cate(3)PSYC8537

Social, Health,iry aDCate   (3)

PSY45531   (3)

(3)

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15 credits in Psychology at the 300 level or above.

6 credits in Psychology at the 400 or 500 level.

13.33.8   Bachelor of Science (B.Sc.) - Major Psychology (54 credits)

The B.Sc.; Major in Psychology focuses on the in-depth overview of the core areas of psychological science as well as specialized content areas.

Program Requirements

Students majoring in Psychology must obtain a minimum grade of C in all 54 credits of the program.

Program Prerequisites (0-9)

Students planning to enter the Major Psychology program should have completed an introductory course in general psychology, biology and statistics at the collegial level. Otherwise, they can complete them in their first year of study at McGill University (see below).

Introduction to Psychology or General Psychology in CEGEP is equivalent to PSYC 100 at McGill. Students who have not completed either of those courses are advised to take PSYC 100 in their first year.

Students who have completed General Biology 1 or 2 in CEGEP would have the recommended biology background. Students who have not completed one of those courses are advised to complete BIOL 111 or BIOL 112 during their first year.

CEGEP students may not take PSYC 204 if they have completed Probability & Statistics or Statistics with a minimum grade of 75%.

McGill Freshman students are recommended to complete the following courses in their U0 year:

One of:

BIOL 111 Principles: Organismal Biology (3 credits) or BIOL 112 Cell and Molecular Biology (3 credits)

PSYC 100 Introduction to Psychology (3 credits)

PSYC 204 Intro to Psychological Stats (3 credits) can be completed in U1 concurrently with the required psychology courses.

Required Courses (15 credits)

U1

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

U1 or U2

PSYC 305*	(3)	Statistics for Experimental Design

*Note: Students who wish to apply to the Honours program in Psychology must complete the required courses above, including PSYC 305 in their U1 year to be eligible for admission. Also, all students must complete a minimum of 27 graded credits in the academic year prior to applying (fall and winter terms only). For additional information about applying to Honours, please refer to the Honours program description.

Complementary Courses (39 credits)

List A - (Behavioural Neuroscience, Cognition and Quantitative Methods)

6 credits in Psychology from List A:

PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	The Psychology of Pain
PSYC 306	(3)	Research Methods in Psychology
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology

PSYC 317   (3)   Genes and Behaviour

Beha

PSYC 351	(3)	Research Methods and Laboratory in Social Psychology
PSYC 408	(3)	Principles and Applications of Psychotherapy
PSYC 409	(3)	Positive Psychology
PSYC 411	(3)	Discrimination & Wellbeing in Marginalized Communities
PSYC 412	(3)	Child Development: Psychopathology
PSYC 414	(3)	Social Development
		Human Se

Recommended Background

It is expected that most students who enter the Honours program in Psychology will have taken introductory psychology, biology, and statistics at the collegial level. Recommended CEGEP courses include Psychology 350-101 or 350-102 or equivalent; Biology CEGEP objective 00UK, 00XU or equivalent; and Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-level statistics course. In the first year, those students who have not taken the recommended collegial-level statistics course, or those who have obtained a grade below 75%, must take Psychology PSYC 204. Those who have not taken the recommended collegial-level biology must take BIOL 111 or BIOL 112, and those who have not taken Introductory Psychology in CEGEP must take PSYC 100.

The application is available on the Psychology Dept website at:
http://www.mcgill.ca/psychology/undergraduate/current-students/research-opportunities/research-courses. The deadline is specified on the application form. Candidates will be informed of the Department's decision via email before classes begin in September.

Program Prerequisites

Admission to Honours is selective. Students with a cumulative grade point average (CGPA) of 3.00 or better are eligible to apply; however, since enrolment is limited, the usual CGPA for admission to this program is 3.50. Students must complete 27 graded credits in their U1 academic year to be eligible to apply to the Honours program.

Students must complete the following courses in their U1 year to be eligible to apply to the Honours program: PSYC 204, PSYC 211, PSYC 212, PSYC 213, and PSYC 215. Students are advised to complete PSYC 305 in their U1 year. Once in the Honours program, the student must obtain a GPA of 3.00 in the U2 year in order to continue in the program for U3. Honours students are encouraged to take at least 27 graded credits per academic year. This is also usually the minimum number of credits required to be eligible for fellowships and awards.

U1 Required Courses (12 credits)

Note: PSYC 100 may be taken as a corequisite with these b creo463 482ber of credits required h these w61th these b 1 0quiredts required o0 1 67.52 539.84m.40 0ettp:/

List A

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

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	The Psychology of Pain
PSYC 306	(3)	Research Methods in Psychology
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 319	(3)	Computational Models - Cognition
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)	Research Methods and Laboratory in Cognitive Psychology
PSYC 353	(3)	Research Methods and 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 415	(3)	Electroencephalography (EEG) Laboratory in Psychology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 443	(3)	Affective Neuroscience
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 502	(3)	Psychoneuroendocrinology
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of 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 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication and Consciousness
PSYC 541	(3)	Multilevel Modelling
PSYC 545	(3)	Topics in Language Acquisition
PSYC 560*	(3)	Machine Learning Tools in Psychology
PSYC 562	(3)	Measurement of Psychological Processes

* 1. Students who have taken COMP 202 or COMP 204 and who have taken freshman linear algebra and calculus might instead consider taking COMP 551.

2. Students in both psychology and computer science are strongly encouraged to take COMP 551 over PSYC 560.

List B

6 credits in Psychology from List B (Social, Health, and Developmental Psychology)

PSYC 304	(3)	Child Development
PSYC 328	(3)	Health Psychology
PSYC 331	(3)	Inter-Group Relations
PSYC 332	(3)	Introduction to Personality
PSYC 333	(3)	Personality and Social Psychology
PSYC 337	(3)	Introduction to Psychopathology
PSYC 351	(3)	Research Methods and Laboratory in Social Psychology
PSYC 408	(3)	Principles and Applications of Psychotherapy
PSYC 409	(3)	Positive Psychology
PSYC 411	(3)	Discrimination & Wellbeing in Marginalized Communities
PSYC 412	(3)	Child Development: Psychopathology
PSYC 414	(3)	Social Development
PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 475	(3)	Neuroscience of Social Psychology
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations
PSYC 512	(3)	Advanced Personality Seminar
PSYC 528	(3)	Vulnerability to Depression and Anxiety
PSYC 530	(3)	Applied Topics in Deafness
PSYC 535	(3)	Advanced Topics in Social Psychology
PSYC 539	(3)	Advanced Topics in Social Psychology 2

9 credits at the 300 level or above selected from:

Anatomy and Cell Biology (ANAT), Biochemistry (BIOC), Biology (BIOL), Chemistry (CHEM), Computer Science (COMP), Mathematics (MATH), Physiology (PHGY), Psychiatry (PYST), Psychology (PSYC).

13.34   Redpath Museum (REDM)

13.34.1 Location

Redpath Museum
859 Sherbrooke Street W

Complementary Courses (21 credits)

Students select 21 credits from among four course lists (A (Zoology), B (Botany), C (Earth and Environmental Sciences), and D (Field Courses)) with the following specifications.

- At least 3 credits and no more than 9 credits from each of Lists A, B, and C.

- At least 3 credits from List D.

- No more than 3 credits from any one list may be at the 200 level.

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

List A: Zoology

* Note: BIOL 205 and BIOL 215 may be applied to either List A or List B.

** Note: Students may take either ENTO 330 or one of the cross-listed courses BIOL 350 and ENTO 350 as these courses have similar content.

AEBI 211	(3)	Organisms 2
ANTH 312	(3)	Zooarchaeology
BIOL 205*	(3)	Functional Biology of Plants and Animals
BIOL 215*	(3)	Introduction to Ecology and Evolution
BIOL 305	(3)	Animal Diversity
BIOL 350**	(3)	Insect Biology and Control
BIOL 352	(3)	Dinosaur Biology
BIOL 363	(3)	Mammalian Evolution
BIOL 418	(3)	Freshwater Invertebrate Ecology
BIOL 427	(3)	Herpetology
ENTO 330**	(3)	Insect Biology
ENTO 350**	(3)	Insect Biology and Control
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)	Functional Biology of Plants and Animals
BIOL 215*	(3)	Introduction to Ecology and Evolution
BIOL 240	(3)	Monteregian Flora
BIOL 355	(3)	Trees: Ecology and 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.

	(3)	Ecology/Behaviour Field Course

13.35.3   Science or Mathematics for Teachers Faculty

Minor in Education for Science Students

Program Adviser: Jenna Prigioniero
Faculty of Education
Telephone: 514-398-7042
Website: *mcgill.ca/isa*

13.35.4   Bachelor of Science (B.Sc.) - Minor Education for Science Students (18 credits)

This Minor allows Science students to develop or explore an interest in Education without committing themselves to completing a B.Ed. degree. Science students who have taken this Minor in Education will have completed some of the credits for the B.Ed. degree should they wish to enrol in that program. Students graduating with a B.Sc. should also consider the Master of Arts in Teaching and Learning (http://www.mcgill.ca/dise/grad/) if they are interested in obtaining a teaching license.

This minor program requires an application due to limited enrolment space. Please see http://www.mcgill.ca/isa/faculty-advising/minor-programs for procedures and deadlines.

For more information please contact:

Internships & Student Affairs Office, Faculty of Education

General Information: 514-398-7042

Website: http://www.mcgill.ca/isa

Required Courses (6 credits)

EDEC 260	(3)	Philosophical Foundations
EDPE 300	(3)	Educational Psychology

Complementary Courses (12 credits)

3 credits from:

EDEC 233	(3)	Indigenous Education
EDEC 248	(3)	Equity and Education
EDEC 249	(3)	Global Education and Social Justice

3 credits from:

EDEC 247	(3)	Policy Issues in Quebec and Indigenous Education
EDEM 220	(3)	Contemporary Issues in Education

6 credits from:

* Note: Students select either EDES 335 or EDES 353.

EDEC 262	(3)	Media, Technology and Education
EDES 335*	(3)	Teaching Secondary Science 1
EDES 353*	(3)	Teaching Secondary Mathematics 1
EDPE 304	(3)	Measurement and Evaluation
EDPI 341	(3)	Instruction in Inclusive Schools