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

1 . McGill University reserves the right to mak

Publication Information

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1 About the Faculty of Science

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

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

Moreover, the Faculty is transforming the way science is taught, with an increased emphasis on student/professor interaction and outreach. This approach emphasizes hands-on research at the undergraduate level and a more personal, one-on-one style between professors and students that traditionally did not begin until the graduate level.

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

2 Programs and Teaching in Science

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

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

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

There are also two Diploma programs offered in Science. The Diploma in Environment, in *Bieler School of Environment > Undergraduate > Browse Academic Programs > : Diploma (Dip.) Environment (30 credits)*, is a 30-credit program available to holders of a B.Sc. or B.A. or equivalent. The Diploma in Meteorology is a one-year program available to holders of a degree in Mathematics, Engineering, Physics, and other appropriate disciplines who wish to qualify for a professional career in Meteorology; see *section 12.3: Atmospheric and Oceanic Sciences (ATOC) > section 12.3.8: Diploma (Dip.) Meteorology (30 credits)*. All credits for these diplomas must be completed at McGill.

Finally, the Faculties of Arts and Science jointly offer the Bachelor of Arts and Science (B.A. & Sc.) degree, which is described in the *Bachelor of Arts & Science* section of the eCalendar.

3 About the Faculty of Science (Undergraduate)

3.1 Location

Dawson Hall
853 Sherbrooke Street West
Montreal QC H3A 0G5
Canada
Telephone: 514-398-5442
Faculty website: *mcgill.ca/science*
Instagram: @mcgillscience
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. & Sc. degrees.

3.2 McGill's Faculty of Science

- **McGill's second-largest faculty**: consisting of 15 schools and departments focused on teaching, research, and outreach— including the Redpath Museum, one of Canada's oldest museums—and more than a dozen research centres and institutes.
- **Students**: nearly 5,000 undergraduate and over 1,000 graduate students.
- **Over 270 faculty members**, including tenured and tenure-track professors.
- Has ties with **ten Nobel laureates**: seven were Faculty of Science graduates, while three winners were either Science faculty members or staff.
- **Canadian leader** in astrophysics and cosmology, climate change and extreme weather, green chemistry, life sciences (developmental biology), earth systems science, biodiversity and conservation, nanoscience, social neuroscience, sustainability science, and artificial intelligence.
- Offers students a variety of **Field Study** opportunities, which take students out of the traditional classroom environment and into a world of strong interdisciplinary, international, and research-based education. Students have opportunities to work with local and Indigenous communities, governmental agencies, and NGOs in a wide range of places, including East Africa, Barbados, and Panama.
- Offers the **Fessenden Professorships and Prizes in Science Innovation**, the first such endowed program in Canada, to encourage and support the commercialization of research in science conducted by world-class scholars.
- **McGill's most multidisciplinary faculty**, which conducts teaching and research in collaboration with many of the University's other faculties, including Medicine, Engineering, Music, Arts, Education, and Management.
- State-of-the-art facilities including the **$120 million McGill Life Sciences Research Complex**, consisting of the **Francesco Bellini Building** and **Cancer Research Building**, which are physically linked to the McIntyre Medical and Stewart Biology Buildings.
- Established Canada's first comprehensive **Earth System Science Program**, to study and research new forms of energy and gain a better understanding of climate change and natural hazards.
- The **Tomlinson Project in University-Level Science Education (T-PULSE)** conducts groundbreaking university-level science education research, and develops innovative and effective 1 81.693dF9fthod0 0 9.1 Tf1 0 0 1 207.591 iF1 1ringf1 0 0 1 67.52 639.217 Tm(•)Tj442.519 Tw/F1 8.1 Tf21 0 0 1 81.693 51

While departmental and faculty advisors and staff are always available to give advice and guidance, the ultimate responsibility for completeness and correctness of course selection and registration; for compliance with, and completion of, program and de

5.3 Time and Credit Limit for the Completion of the Degree

Students who need 96 or fewer credits to complete their degree requirements are expected to complete their degree in no more than eight terms after their initial registration for the degree.

Students in the Freshman/Foundation Year Program become subject to these regulations one year after their initial registration. Students who wish to exceed this time limit must submit their request in writing (by email) to their Faculty advisor, to be approved by the Associate Dean, Student Affairs, of the Faculty of Science.

Students registered in the B.Sc. are expected to complete the requirements of their program and degree within 120 credits. Students will receive credit for all courses (subject to degree regulations) taken up to and including the semester in which they obtain 120 credits. Students who want to remain at McGill beyond that semester must submit their request in writing (by email) to their Faculty advisor, to be approved by the Associate Dean, Student Affairs, Faculty of Science. Permission for exceeding the time and/or credit limits will normally be granted only for valid academic reasons, such as a change of program (subject to departmental approval) and part-time status. If permission is granted, students will receive credit only for required and complementary courses necessary to complete their program requirements.

Students who have been granted Advanced Standing for the International Baccalaureate, Advanced Placement examinations, GCE A-Levels, French Baccalaureate, and other qualifications may complete 120 credits following admission, as per the University regulations described in *University Regulations and Resources* > *Student Records* > *: Advanced Standing Transfer Credits*.

5.4 Program Requirements

The Faculty of Science offers a vast array of study and research opportunities at the undergraduate level, and it is very important that students familiarize themselves with all the alternatives available before deciding on a program of study. For an overvie

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

For a list of minor programs, see *section 9.2: Minor Programs*; for minor concentrations that are approved for Science students, see *section 9.5: Arts Major and Minor Concentrations Open to Science Students*.

5.4.3 Other Second Programs

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

5.4.4 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.

5.4.4.1 B.Sc. Global Designation

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

5.4.4.2 Internship Program Designation

All B.Sc. programs can include an internship component. For more details, students should refer to *section 11: Science Internships and Field Studies* and *mcgill.ca/science/undergraduate/internships-field/internships*.

5.4.5 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* .

courses offered by faculties other than Science requires the permission of the Associate Dean (Student Affairs) Science, and will be granted only under exceptional circumstances.

Credit for statistics courses for **Arts, Science, and Bachelor of Arts and Science students** will be given with the following stipulations:

- Credit will be given for only **one** of the following introductory statistics courses: AEMA 310, BIOL 373, ECON 227D1/D2, ECON 257D1/D2, EDPE 375, GEOG 202, MATH 203, MGCR 271, MGCR 273, POTH 204, SOCI 350.
- Students who have already received credit for PSYC 204 will **not** receive credit for any of the following: AEMA 310, BIOL 373, ECON 227D1/D2, ECON 257D1/D2, EDPE 375, GEOG 202, MATH 203, MGCR 271, MGCR 273, POTH 204, SOCI 350.
- Credit will be given for only **one** of the following intermediate statistics courses: AEMA 411, ECON 227D1/D2, ECON 257D1/D2, GEOG 351, MATH 204, PSYC 305, SOCI 461, with the exception that you may receive credit for both PSYC 305 and ECON 227D1/D2 or ECON 257D1/D2.
- Students who have already received credit for MATH 324 or MATH 357 will **not** receive credit for any of the following: AEMA 310, AEMA 411, BIOL 373, ECON 227D1/D2, ECON 257D1/D2, GEOG 202, GEOG 351, MATH 203, MATH 204, MGCR 271, MGCR 273, PSYC 204, PSYC 305, SOCI 350.
- For 500-level statistics courses not listed above, students must consult a program/department advisor 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.

5.5.2 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 courses outside the Faculty of Science)*. Students may take courses on the approved list and may not, under any circumstances, take courses on the restricted list for credit. Requests for permission to take courses that are not on either list should be submitted in writing (by email) to the Faculty advisor (SOUSA), to be approved by the Associate Dean (Student Affairs), Science.

The regulations are as follows:

- Students may take only 6 credits per year, up to 18 credits in all, of courses outside the Faculties of Arts and of Science.
- Courses offered in the Faculty of Science or in the Faculty of Arts are found in the eCalendar's *All Courses* search, when filtered by “Faculty of Science” or by “Faculty of Arts”.
- Courses in other faculties that are considered as taught by Science (e.g., BIOT, EXMD, and PHAR) are so designated as offered by the Faculty of Science in the eCalendar's *All Courses* search.
- Courses in Music are considered as outside the Faculties of Arts and of Science, except MUAR courses, which are considered Arts courses.
- All courses listed in the Religious Studies (RELG) section are considered courses in Arts and Science except for courses restricted to B.Th. or S.T.M. students and courses that require permission from the Chair of the B.Th. Committee.
- Students should consult the list of restricted courses outside of the Faculties of Arts and of Science in the *Science Undergraduate Handbook (Section 3.2.2 List of approved and restricted courses outside the F*

- The combined total of regular course credits and distance education course credits do not exceed the permitted maximum number of credits per term according to Faculty regulations.
- Courses taught through distance education may not be used to complete program requirements, except on an individual basis when serious, documented circumstances warrant it.

5.5.4 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*.

5.5.5 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	
EPSC 199	FYS: Earth & Planetary Exploration
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*.

5.5.6 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.

6 Advising

Students who need 96 or fewer credits to complete their degree requirements must consult an academic advisor 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/Foundation year courses. **Regardless of how many advanced standing credits received, students are responsible for ensuring their Freshman/Foundation Year science program requirements are met.** To facilitate program planning, students must contact their Faculty (SOUSA) advisor 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 re

Science students, refer to the Accepted Student website *B.Sc. Freshman/Foundation Year course selection* section on FIGs; Bachelor or Arts & Science students, refer to the Accepted Student website *B.A. & Sc. Freshman/Foundation Year course selection* section on FIGs.

8 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.

9 Overview of Programs Offered

Programs Offered

section 9.1: 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 9.2: Minor Programs

section 9.3: Bachelor of Arts and Science

section 9.4: Internships, Field Studies, and Global Designation

section 9.5: Arts Major and Minor Concentrations Open to Science Students

9.1 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 5.4.1: Liberal, Major, and Honours Programs*.

The groups within the B.Sc. are:

- *section 9.1.1: Biological, Biomedical & Life Sciences Group*
- *section 9.1.2: Bio-Physical-Computational Sciences Group*
- *section 9.1.3: Neuroscience Group*
- *section 9.1.4: 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. For additional information on the degree transfer process, please refer to this link: *mcgill.ca/science/undergraduate/academic-advising/inter-faculty-and-intra-faculty-transfers*.

9.1.1 Biological, Biomedical & Life Sciences Group

9.1.1.1 Liberal Program – Core Science Components

- Anatomy and Cell Biology: *section 12.2.3: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Anatomy and Cell Biology (48 credits)*
- Biochemistry: *section 12.4.3: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biochemistry (47 credits)*
- Biology: *section 12.5.6: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Biology (47 credits)*
- Microbiology and Immunology: *section 12.23.3: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (50 credits)*
- Physiology: *section 12.31.3: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physiology (50 credits)*
- Psychology: *section 12.33.6: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Psychology (45 credits)*

9.1.1.2 Major Programs

- Anatomy and Cell Biology: *section 12.2.4: Bachelor of Science (B.Sc.) - Major Anatomy and Cell Biology (67 credits)*
- Biochemistry: *section 12.4.4: Bachelor of Science (B.Sc.) - Major Biochemistry (64 credits)*
- Biology: *section 12.5.7: Bachelor of Science (B.Sc.) - Major Biology (59 credits)*
- Biology – Quantitative Biology: *section 12.5.8: Bachelor of Science (B.Sc.) - Major Biology - Quantitative Biology (73 credits)*
- Microbiology and Immunology: *section 12.23.4: Bachelor of Science (B.Sc.) - Major Microbiology and Immunology (66 credits)*
- Pharmacology: *section 12.29.4: Bachelor of Science (B.Sc.) - Major Pharmacology (67 credits)*
- Physiology: *section 12.31.4: Bachelor of Science (B.Sc.) - Major Physiology (66 credits)*
- Psychology: *section 12.33.7: Bachelor of Science (B.Sc.) - Major Psychology (54 credits)*

9.1.1.3 Honours Programs

- Anatomy and Cell Biology: *section 12.2.5: Bachelor of Science (B.Sc.) - Honours Anatomy and Cell Biology (73 credits)*
- Biochemistry: *section 12.4.5: Bachelor of Science (B.Sc.) - Honours Biochemistry (73 credits)*
- Biology: *section 12.5.10: Bachelor of Science (B.Sc.) - Honours Biology (72 credits)*
- Biology – Quantitative Biology: *section 12.5.11: Bachelor of Science (B.Sc.) - Honours Biology - Quantitative Biology (79 credits)*
- Immunology (Interdepartmental): *section 12.18.3: Bachelor of Science (B.Sc.) - Honours Immunology (Interdepartmental) (75 credits)*
- Microbiology and Immunology: *section 12.23.5: Bachelor of Science (B.Sc.) - Honours Microbiology and Immunology (72 credits)*
- Pharmacology – application required, see departmental section for information: *section 12.29.5: Bachelor of Science (B.Sc.) - Honours Pharmacology (76 credits)*
- Physiology: *section 12.31.7: Bachelor of Science (B.Sc.) - Honours Physiology (75 credits)*
- Psychology: *section 12.33.8: Bachelor of Science (B.Sc.) - Honours Psychology (60 credits)*

9.1.2 Bio-Physical-Computational Sciences Group

9.1.2.1 Major Programs

- Biology and Mathematics: *section 12.5.9: Bachelor of Science (B.Sc.) - Major Biology and Mathematics (76 credits)*
- Computer Science and Biology: *section 12.9.11: Bachelor of Science (B.Sc.) - Major Computer Science and Biology (74 credits)*
- Physiology and Mathematics: *section 12.31.5: Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (79 credits)*
- Physiology and Physics: *section 12.31.6: Bachelor of Science (B.Sc.) - Major Physiology and Physics (82 credits)*

9.1.2.2 Honours Program

- Computer Science and Biology: *section 12.9.15: Bachelor of Science (B.Sc.) - Honours Computer Science and Biology (77 credits)*

9.1.3 Neuroscience Group

9.1.3.1 Major Program

- Neuroscience – application required, see *section 12.26: Neuroscience* for information, and *section 12.26.4: Bachelor of Science (B.Sc.) - Major Neuroscience (65 credits)*

9.1.3.2 Honours Program

- Neuroscience – application required, see *section 12.26: Neuroscience* for information, and *section 12.26.5: Bachelor of Science (B.Sc.) - Honours Neuroscience (74 credits)*

9.1.4 Physical, Earth, Math & Computer Science Group

9.1.4.1 Liberal Program – Core Science Components

- Atmospheric Science: *section 12.3.4: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Atmospheric and Oceanic Sciences (48 credits)*

- Chemistry – General option: *section 12.7.6: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - General (49 credits)*
- Computer Science: *section 12.9.7: Bachelor of Science (B.Sc.) - Liberal Pro*

9.1.4.4 Honours Programs

- Applied Mathematics: *section 12.22.14: Bachelor of Science (B.Sc.) - Honours Applied Mathematics (63 credits)*
- Atmospheric Science: *section 12.3.7: Bachelor of Science (B.Sc.) - Honours Atmospheric Science (75 credits)*
- Chemistry: *section 12.7.10: Bachelor of Science (B.Sc.) - Honours Chemistry (71 credits)*
- Chemistry - Bio-organic option: *section 12.7.11: Bachelor of Science (B.Sc.) - Honours Chemistry - Bio-organic (75 credits)*
- Computer Science: *section 12.9.14: Bachelor of Science (B.Sc.) - Honours Computer Science (75 credits)*
- Earth System Science: *section 12.11.5: Bachelor of Science (B.Sc.) - Honours Earth System Science (66 credits)*
- Environment: *: Bachelor of Science (B.Sc.) - Honours Environment (72 credits)*
- Geography: *section 12.17.8: Bachelor of Science (B.Sc.) - Honours Geography (66 credits)*
- Geology: *section 12.10.8: Bachelor of Science (B.Sc.) - Honours Geology (75 credits)*
- Mathematics: *section 12.22.15: Bachelor of Science (B.Sc.) - Honours Mathematics (63 credits)*
- Physics: *section 12.30.12: Bachelor of Science (B.Sc.) - Honours Physics (81 credits)*
- Planetary Sciences: *section 12.10.9: Bachelor of Science (B.Sc.) - Honours Planetary Sciences (78 credits)*
- Software Engineering: *section 12.9.16: Bachelor of Science (B.Sc.) - Honours Software Engineering (75 credits)*
- Statistics: *section 12.30.13: Bachelor of Science (B.Sc.) - Honours Statistics (63 credits)*

9.1.4.5 Joint Honours Programs

- Mathematics and Computer Science: *section 12.22.18: Bachelor of Science (B.Sc.) - Honours Mathematics and Computer Science (78 credits)*
- Mathematics and Physics: *section 12.30.14: Bachelor of Science (B.Sc.) - Honours Mathematics and Physics (81 credits)*
- Physics and Chemistry: *section 12.30.15: Bac 1 361.243 605.46 Tm(edits))Tj0 G0 g/F1 1 0 03lanetary Sci2f12 Tf(1 361.243 605.46 Tm(edits))Tj0 G0 g/063.36 Tm*

Minor Programs

Geology: *section 12.10.4: 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 12.19.3: Bachelor of Science (B.Sc.) - Minor Interdisciplinary Life Sciences (24 credits)*

Kinesiology: *section 12.20.3: Bachelor of Science (B.Sc.) - Minor Kinesiology (24 credits)*

Management for Non-Management Students: *section 12.21.1: Bachelor of Commerce (B.Com.) - Minor Management (For Non-Management Students) (18 credits)*

Mathematics: *section 12.22.6: Bachelor of Science (B.Sc.) - Minor Mathematics (24 credits)*

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)*

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)*

Natural History: *section 12.34.3: Bachelor of Science (B.Sc.) - Minor Natural History (24 credits)*

Neuroscience: *section 12.26.3: Bachelor of Science (B.Sc.) - Minor Neuroscience (25 credits)*

Pharmacology: *section 12.29.3: Bachelor of Science (B.Sc.) - Minor Pharmacology (24 credits)*

Physics: *section 12.30.5: Bachelor of Science (B.Sc.) - Minor Physics (18 credits)*

Psychology: *section 12.33.5: Bachelor of Science (B.Sc.) - Minor Psychology (24 credits)*

Statistics: *section 12.22.7: Bachelor of Science (B.Sc.) - Minor Statistics (27 credits)*

Notes:

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

9.3 Bachelor of Arts and Science

Please see *Bachelor of Arts and Science* for details.

9.4 Internships, Field Studies, and Global Designation

For opportunities to enhance your de

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)*

Minor Concentrations

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

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

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

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

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

German Language: *: Bachelor of Arts (B.A.) - Minor Concentration German Language (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)*

Langue et littérature françaises – Études et pratiques littéraires: *: Baccalauréat ès Arts (B.A.) - Concentration mineure Langue et littérature françaises - Études et pratiques littéraires (18 crédits)*

Langue et littérature françaises – Langue française: *: Baccalauréat ès Arts (B.A.) - Concentration mineure Langue & littérature françaises - Langue française (18 crédits)*

Langue et littérature françaises – Traduction: *: Baccalauréat ès Arts (B.A.) - Concentration mineure Langue et litt. françaises - Traduction (18 crédits)*

Latin American & Caribbean Studies: *: Bachelor of Arts (B.A.) - Minor Concentration Latin American & Caribbean Studies (18 credits)*

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

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

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

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

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

Québec Studies: *: Bachelor of Arts (B.A.) - Minor Concentration Quebec Studies & Community-Engaged Learning/ La concentration Mineure en Études sur le Québec et apprentissage par engagement communautaire (18 credits)*

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

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

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

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

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

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

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

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

World Islamic & Middle East Studies: *: Bachelor of Arts (B.A.) - Minor Concentration World Islamic & Middle East Studies (18 credits)*

10 Undergraduate Research Opportunities

McGill is a research-intensive university and research is therefore a cornerstone of undergraduate science education. Most Bachelor of Science students take part in research during their undergraduate studies, and there are many undergraduate research opportunities at McGill, in affiliated hospitals, at other

universities, and in the field. Many of these are organized through formal courses or programs organized by the Faculty of Science or its departments. For more information, see the following:

- *section 10.1: Research Project Courses*
- *section 10.1.1: "396" Undergraduate Research Project Courses*
- *section 10.2: Undergraduate Student Research Awards* – such as the Tri-Agency USRA and SURA programs
- *section 10.3: Undergraduate Poster Showcase*
- *section 10.4: Getting Involved in Research as an Undergraduate*
- Dean's Multidisciplinary Undergraduate Research List – see description in *University Regulations and Resources* > *Undergraduate* > *Graduation* > *Graduation Honours* > *: Faculty of Science Dean's Multidisciplinary Undergraduate Research List*.

Because internships and field study programs may include a research component, please also refer to: *section 11: Science Internships and Field Studies*.

10.1 Research Project Courses

Departments offer a variety of research-based courses that allow you to perform research under the supervision of a McGill researcher for academic credit. Depending on the unit, courses featuring undergraduate research may bear names such as: majors project, honours project, advanced lab, independent research, technical project, independent study, or research project and seminar. For more information, refer to the research course list at *mcgill.ca/science/research/undergraduate-research/resear*

10.3 Undergraduate Poster Showcase

Each year, the Faculty of Science hosts the Undergraduate Poster Showcase to celebrate the work of undergraduate students. This initiative, sponsored by the Office of Science Education, is an opportunity for students to develop academic skills and present research, projects, and assignments completed inside or outside of class.

All McGill community members, and friends and family are welcome to attend.

For more details, please refer to *mcgill.ca/ose/undergraduate-poster-showcase*.

10.4 Getting Involved in Research as an Undergraduate

Opportunities at McGill

Departments and individual researchers at McGill offer various opportunities for undergraduate students to get involved in research. These arrangements may be voluntary or remunerated by academic credit or income.

Some are formal programs that you can find more information about in the *e*Calendar at *Faculty of Science* > *Undergraduate* > *Undergraduate Research Opportunities*:

- *section 10.1: Research Project Courses*
- *section 10.1.1: "396" Undergraduate Research Project Courses*
- *section 10.2: Undergraduate Student Research Awards*

Others come about through informal discussions between students and professors.

For more information on finding research opportunities at McGill, including tips for contacting researchers, visit *mcgill.ca/science/research/undergraduate-research/finding-opportunities*.

Internships and Field Studies

Some science internships and field study programs include a research component. Refer to *section 11: Science Internships and Field Studies* for more information.

Beyond McGill

You may also want to look for opportunities funded or offered by external foundations or institutions, research agencies, other academic institutions, or scholarly societies. Examples include: a provincial cancer research society, the science funding agency of another country which you wish to visit or where you hold citizenship, research hospitals or universities in another city, or an international psychological association.

11 Science Internships and Field Studies

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

Burnside Hall, Room 720
805 Sherbrooke Street West
Montreal QC H3A 0B9
Telephone: 514-398-1063; 514-398-8365
Email: *ifso.science@mcgill.ca*
Website:*mcgill.ca/science/undergraduate*

11.1 Internship Program: Industrial Practicum (IP) and Internship Year in Science (IYS)

The Internship Program is open to all Science undergraduate students, as well as qualified students in undergraduate Arts or Arts & Science programs majoring in Environment, Computer Science, Software Engineering, Geography, Mathematics, and Psychology. Participating in an internship offers you the chance to add a practical element to your studies, solidify your career goals, gain some valuable experience, and earn money. Internships may have a basis in research.

To be eligible to apply:

- You must be registered as a full time student before and after the IP or the IYS is completed.
- 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.
-

Students who have completed the Diploma of Colle

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

Second calculus course, one of:

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

First physics course, one of:

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

Second physics course, one of:

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

Electives

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

12.2 Anatomy and Cell Biology (ANAT)

12.2.1 Location

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

12.2.2 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 DNA technology; micro-injection of molecules into single cells; cytochemical, immunocytochemical, and fluorescent analysis and electron microscopy; proteomics; and genomics. The department has a well-equipped centre for electron

microscopy as well as a centre for confocal and immunofluorescence. The department's cryo-electron microscope facility is unique and provides cutting edge technology with which to apply fundamental discoveries to therapeutic applications. Human anatomy classes are taught in the fully-equipped cadaver lab and students have access to 3D printers and other learning tools.

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

The B.Sc.; Liberal Program – Core Science Component in Anatomy and Cell Biology is a flexible program that focuses on the fundamentals of cell and molecular biology and human anatomy. The program includes a range of biomedical science disciplines such as biology, experimental medicine, pharmacology and neurobiology. Students may complete this program with a minimum of 47 credits or a maximum of 48 credits depending on their choice of complementary courses.

Required Courses (32 credits)

* Students who have taken the equivalent of CHEM 212 and/or MATH 203 in CEGEP and receive a course exemption upon admission are exempt from the program requirement(s) and must replace these credits with elective course credits to satisfy the total credit requirement for their degree.

ANAT 212	(3)	Molecular Mechanisms of Cell Function
ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

3 credits from the following statistics courses:

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

Complementary Courses (15-16 credits)

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

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

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 514	(3)	Advanced Human Anatomy Laboratory
ANAT 565	(3)	Diseases-Membrane Trafficking
NEUR 310	(3)	Cellular Neurobiology

6-7 credits of biologically oriented courses (BOC) selected from:

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking

ANAT 381	(3)	Experimental Embryology
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 320	(3)	Evolution of Brain and Behaviour
COMP 204	(3)	Computer Programming for Life Sciences
EXMD 504	(3)	Biology of Cancer
NEUR 310	(3)	Cellular Neurobiology
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease

(43 creempt from full Degree: 214

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

The B.Sc.; Major in Anatomy and Cell Biology focuses on the fundamentals of biomedical science, with a strong foundation in cell and molecular biology, as well as the essential concepts of human anatomy. The program includes a wide range of biomedical science disciplines such as experimental medicine, microbiology and immunology, pharmacology and physiology.

Required Courses (43 credits)

* Students who have taken the equivalent of CHEM 212, CHEM 222, and/or MATH 203 in CEGEP and receive a course exemption upon admission are exempt from the program requirement(s) and must replace these credits with elective course credits to satisfy the total credit requirement for their degree.

ANAT 212	**(3)**	Molecular Mechanisms of Cell Function
ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANA	(3)	Introductory Molecular and Cell Biology

(3)

Complementary Courses (24 credits)

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

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

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

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

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	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

PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

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

Students should register at the Major level in U1 and, if accepted, may enter the Honours program at the be

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
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
NEUR 310	(3)	Cellular Neurobiology
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, 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

12.3 Atmospheric and Oceanic Sciences (ATOC)

12.3.1 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*

12.3.2 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 o1 0 0 1tsiences ois based la

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

3-6 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

PHYS 230	(3)	Dynamics of Simple Systems

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

(60-63 credits)

The B.Sc.; Major in Atmospheric Science provides the fundamentals of atmospheric physics and dynamics along with applications to weather and climate problems. The program includes the choice of a wide selection of topics spanning from atmospheric chemistry, to weather forecasting and climate dynamics. The program may be completed in 60-63 credits.

Required Courses (24 credits)

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

Complementary Courses (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:

A: StNculus 3	(3)	Oceans, Weather and Climate

CHEM 367	(3)	Instrumental Analysis 1
	(3)CHEM 367	Chemical Kinetics

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)	Earth Data Analysis
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 323	(3)	Probability
PHYS 512	(3)	Computational Physics with Applications

Atmospheric Chemistry and Physics Stream (15 credits)

ATOC 309	(3)	Weather Radars and Satellites
ATOC 404+	(3)	Climate Physics
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
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 (15-17 credits)

15-17 credits (at least 12 credits must be ATOC courses) selected from:

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 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

Complementary Courses (12-13 credits)

3 credits selected from:

ATOC 357	(3)	Atmospheric and Oceanic Science Laboratory
PHYS 258	(3)	Experimental Methods 2

9-10 credits selected from:

ATOC 357	(3)	Atmospheric and Oceanic Science Laboratory
ATOC 404*	(3)	Climate Physics
ATOC 480	(3)	Honours Research Project
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
	(3)(3)	Mesoscale Meteorology

* Students cannot take both ATOC 404 and PHYS 404.

12.3.7 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
		Computer Programming for Ph

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 MA

ATOC 568	(3)	Ocean Physics
ESYS 300	(3)	Earth Data Analysis
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 ATOC course) selected from:

ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
EPSC 513	(3)	Climate and the Carbon Cycle
ESYS 300	(3)	Earth Data Analysis
ESYS 301	(3)	Earth System Modelling
MATH 423	(3)	Applied Regression
MATH 555++	(4)	Fluid Dynamics
PHYS 432++	(3)	Physics of Fluids
PHYS 512	(3)	Computational Physics with Applications

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

Atmospheric Chemistry and Physics Stream (21 credits)

15 credits from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 519	(3)	Advances in Chemistry of Atmosphere

ATOC 521	(3)	Cloud Physics
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods

6 credits selected from:

ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 525	(3)	Atmospheric Radiation
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
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
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
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics

EPSC 513	(3)	Climate and the Carbon Cycle
ESYS 300	(3)	Earth Data Analysis
ESYS 301	(3)	Earth System Modelling
MATH 423	(3)	Applied Regression
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.

12.3.8 Diploma (Dip.) Meteorology (30 credits)

The Department offers an intensive, one-year program in theoretical and applied meteorology to B.Sc. or B.Eng. graduates of suitable standing in physics, applied mathematics or other appropriate disciplines, leading to a Diploma in Meteorology. The program is designed for students with little or no previous background in meteorology who wish to direct their experience to atmospheric or environmental applications, or who need to fulfill academic prerequisites in meteorology to qualify for employment. For further information, contact the Undergraduate Program Director (https://www.mcgill.ca/meteo/facultystaff/staff

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

Required Courses (15 credits)

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

Complementary Courses (15 credits)

6 credits selected from the courses below.

* Students may take either ATOC 519 or CHEM 519.

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

9 credits ordinarily selected from:

* Students take either PHYS 432 or MATH 555.

ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 525	(3)	Atmospheric Radiation
ATOC 548	(3)	Mesoscale Meteorology
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
MATH 317	(3)	Numerical Analysis

MATH 319	(3)	Partial Differential Equations
MATH 555*	(4)	Fluid Dynamics
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432*	(3)	Physics of Fluids

12.3.9 Atmospheric and Oceanic Sciences (ATOC) Related Programs

12.3.9.1 Internship Year in Science (IYS)

IYS is a pregraduate work experience program available to eligible students and normally taken between their U2 and U3 years. For more information, see *section 11: Science Internships and Field Studies* and visit *mcgill.ca/science/undergraduate/internships-field/internships*.

The following programs are also available with an internship component:

- Major in Atmospheric Science
- Honours in Atmospheric Science

Earth System Science Inter

- *A varied science*: As the broadest of the basic sciences, biochemistry includes many subspecialties such as neurochemistry, bioorganic chemistry, clinical biochemistry, physical biochemistry, molecular genetics, biochemical pharmacology, and immunochemistry. Recent advances in these areas have created links among technology, chemical engineering, and biochemistry.

The Department of Biochemistry offers three undergraduate programs:

- **Liberal Program**

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

- **Major**

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

- **Honours**

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

Our Major and Honours programs provide a sound background for students aiming for a professional career in biochemistry. The less specialized Liberal program allows students to select courses in other fields of interest. The Liberal program provides students with the opportunity to study the core of one science discipline along with a breadth component from another area of science or from many other disciplines; for more information, see *Faculty of Science > Undergraduate > Faculty Degree Requirements > Program Requirements > section 5.4.1: Liberal, Major, and Honours Programs*.

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

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

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

12.4.3 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 214	(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

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

Students may tra50 1549 443.842

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
	(3)	Mammalian Physiology 1

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
		Foundations of Programming26.332 452.422 Tm(ourM4ions of Prograology)Tj1 0 0 1 165.864 499.582 Tmlogy

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

12.4.6 Biochemistry (BIOC) Related Programs

12.4.6.1 Interdepartmental Honours in Immunology

For more information, see *section 12.18: 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
T

- mechanisms of embryonic development;
- structure and function of the living cell and individual molecules within it;
- molecular basis of inheritance;
- biochemical and genetic basis of human diseases; and
- how the brain and the nervous system control behaviour.

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

The Department of Biology offers:

- Liberal program;
- Major program;
- Joint Majors with Computer Science and with Mathematics;
- Honours program;
- Joint Honours with Computer Science;
- **Minor** program;
- **Minor concentration** in Science for Arts students;
- Biology **Major** and **Honours option** in Quantitative Biology; as well as
- **Major** and **Minor concentrations** in the B.A. & Sc.

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

The Department of Biology's well-equipped research laboratories are located in the Stewart Biology Building, 1205 Docteur Penfield Avenue and in the adjacent Bellini Life Sciences Building. Due to massive renovations that began in the Fall of 2017, only the North Wing of the Ste

Undergraduate Advisor
Stewart Biology Building, Room N7/9B
Telephone: 514-398-4109
Email: *nancy.nelson@mcgill.ca*
Website: *mcgill.ca/biology/undergraduate-studies/advising-planning/biology-advising*

to ensure they are taking the appropriate prerequisites.

12.5.4 Biology Concentrations

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

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

Note: Please see guidelines and policies for taking courses outside Arts and Science at *mcgill.ca/science/undergraduate/handbook#bsc-outside-course-restrictions*.

If you are interested in advanced studies in any biological discipline, you are strongly advised to develop your skills in computing as appropriate. As an aid to students wishing to specialize, key and suggested courses are listed by discipline.

CEEB: Conservation, Ecology, Evolution, and Behaviour

To include:

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.

12.5.6 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. This program is well suited to students with varied interests who do not want to focus solely on biology in their studies.

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

Required Courses (24 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
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 302	(3)	Fundamentals of Genetics and Genomics
COMP 204	(3)	Computer Programming for Life Sciences

Complementary Courses (21-23 credits)

Core (6-8 credits)

3 or 4 credits selected from:

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.

3 or 4 credits selected from:

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 311	(3)	Advanced Methods in Organismal Biology

Other (15 credits)

15 credits of Biology complementary courses at the 300-500 levels, including at least 3 credits at the 400-500 levels. Up to 6 credits may be from non-BIOL science courses, with Adviser permission. Up to 6 credits of independent research may be included.

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

The Biology Major covers a range of fundamental biological concepts spanning molecules and cells to organisms and ecosystems, including development, behaviour and evolution. The areas of focus include: (1) molecular, cellular and developmental biology, (2) conservation, ecology and evolution, and (3) neurobiology and behaviour.

Required Courses (31 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
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.

12.5.8 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

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

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 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
PHYS 329	(3)	Statistical Physics with Biophysical Applications

Bac

15-21 credits selected as follows:

3 credits from:

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

3 credits from:

BIOL 202	(3)	Basic Genetics
BIOL 302	(3)	Fundamentals of Genetics and Genomics

6-12 credits from:

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

15-21 credits selected as follows:

3 credits from:

BIOL 202	(3)	Basic Genetics

3 credits

BIOL 202	(3)	Basic Genetics
BIOL 302	(3)	Fundamentals of Genetics and Genomics

9-15 credits selected from:

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

15-21 credits selected as follows:

6 credits from:

BIOL 216	(3)	Biology of Behaviour
BIOL 306	(3)	Neural Basis of Behaviour

9-15 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.

12.5.10 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
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
BIOL 499D1	(2)	Honours Seminar in Biology
BIOL 499D2	(2)	Honours Seminar in Biology
COMP 204	(3)	Computer Programming for Life Sciences

Complementary Courses (36-37 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, 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.

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

79 credits

Interdisciplinary research that draws from the natural and ph

BIOL 215	(3)	Introduction to Ecology and Evolution

Research Component (6 credits)

BIOL 468	(6)	Independent Research Project 3

Physics (6 credits)

6 credits from:

PHYS 230*	(3)	Dynamics of Simple Systems
PHYS 232**	(3)	Heat and Waves
PHYS 251*	(3)	Honours Classical Mechanics 1
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 596*	(1)	Advanced Experimental Design
BIOL 597*	(2)	Advanced Biostatistics
BIOL 598*	(3)	Advanced Design and Statistics

Stream 2: Physical Biology

21 credits

9 credits from:

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

* Students choose either BIOL 319 or PHYS 319

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 (9 credits)

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

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 350*	(3)	Numerical Computing
COMP 364	(3)	Computer Tools for Life Sciences
MATH 235**	(3)	Algebra 1
MATH 240**	(3)	Discrete Structures
MATH 314	(3)	Advanced Calculus
MATH 317*	(3)	Numerical Analysis

MATH 319	(3)	Partial Differential Equations
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 348	(3)	Euclidean Geometry
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes

* Students may take COMP 350 OR MATH 317.

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

Recommendations for Physical Biology stream

BIEN 310	(3)	Introduction to Biomolecular Engineering
BIEN 320	(3)	Molecular, Cellular and Tissue Biomechanics
BIEN 340	(3)	Transport Phenomena in Biological Systems 2
BIEN 510	(3)	Engineered Nanomaterials for Biomedical Applications
BIEN 530	(3)	Imaging and Bioanalytical Instrumentation
CHEM 222	(4)	Introductory Organic Chemistry 2
PHYS 242*	(2)	Electricity and Magnetism
PHYS 257	(3)	Experimental Methods 1
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 413	(3)	Physical Basis of Physiology
PHYS 434	(3)	Optics
PHYS 519	(3)	Advanced Biophysics
PHYS 534	(3)	Nanoscience and Nanotechnology

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

Recommendations for Theoretical Ecology and Evolutionary Biology stream

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

12.5.12 Biology (BIOL) Related Programs and Study Semesters

12.5.12.1 Joint Major in Computer Science and Biology

For more information, see *section 12.9.11: Bachelor of Science (B.Sc.) - Major Computer Science and Biology (74 credits)*.

12.5.12.2 Joint Honours in Computer Science and Biology

For more information, see *section 12.9.15: Bachelor of Science (B.Sc.) - Honours Computer Science and Biology (77 credits)*.

12.5.12.3 Panama Field Study Semester

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

12.5.12.4 Africa Field Study Semester

The Department of Geography

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

* Approved substitutions must be made for an

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
		PMIMM 324

12.6.6 Biotechnology (BIOT) Related Programs

12.6.6.1 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.

12.7 Chemistry (CHEM)

12.7.1 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*.

12.7.2 Office for Science and Society

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

Director

Joseph A. Schwarcz

Members

Ariel Fenster; David N. Harpp

12.7.3 About Chemistry

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

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

Chemistry courses at the university level are traditionally divided into four areas of specialization:

1. organic chemistry, dealing with the compounds of carbon;
2. inorganic chemistry, concerned with the chemistry and compounds of elements other than carbon;
3. analytical chemistry, which deals with the identification of substances and the quantitative measurement of their compositions; and
4. physical chemistry, which treats the physical laws, kinetics, and energetics governing chemical reactions, behaviour of materials, and molecular structure.

Naturally, there is a great deal of overlap between these different areas, and the boundaries are becoming increasingly blurred. After a general course at the introductory level, courses in organic, inorganic, analytical, and physical chemistry are offered throughout the university years. Since chemistry is an experimental science, laboratory classes accompany most undergraduate courses. In addition, courses are offered in polymer, theoretical, green, nano, and biological chemistry to upper-year undergraduates.

There are two main programs in the Department of Chemistry: Honours and Major. 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*.

12.7.4 Bachelor of Science (B.Sc.) - Minor Chemistry (20 credits)

The goal of this minor program is to provide interested B.Sc. students with a good grounding in chemistry through an introduction to one of the traditional sub-disciplines in chemistry (analytical, inorganic, organic, and physical).

Required Courses (13 credits)

* Denotes courses with CEGEP equivalents.

If any of the required courses are part of your primary program or were taken at CEGEP, then they must be substituted by courses from the minor options list that are not part of your primary program. The total number of credits exclusive to the minor is at least 19.

CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 281	(3)	Inorganic Chemistry 1

Complementary Courses

6-7 credits **

CHEM 214	(3)	Physical Chemistry/Biological Sciences 2
CHEM 219	(3)	Introduction to Atmospheric Chemistry
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 319	(3)	Chemistry of Energy, Storage and Utilization
CHEM 334	(3)	Advanced Materials
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.

12.7.5 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 an

12.7.6 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, BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 101/PHYS 102 or 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 (43 credits)

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.

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

Students entering from the Freshman program must have included CHEM 110 and CHEM 120, BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 101/PHYS 102 or 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 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.

* I1 do not h445.999 613.21 Tm79* I1 do not hir Fre67.52 588.961 Tm(* 74.38 not ha*1 Tm(e no.m(* 74.521 0u02fmin65ples strongly recommended during U1 for st

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 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 242*	(4)	Organic Chemistry 1 for Chemistry and Biochemistry
CHEM 252	(4)	Organic Chemistry 2 for Chemistry and Biochemistry
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

12.7.9 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. The program may be completed in 65 or 66 credits.

Program Prerequisites

Pre-Program Requirements: Students entering from the Freshman program must have included CHEM 110 and CHEM 120, BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 101/PHYS 102, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the DEC with appropriate science and mathematics courses. Note that students who have successfully completed MATH 150 and MATH 151 do not have to take MATH 222.

Required Courses (59 credits)

The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level. Students completing the program will not be eligible for admission to the Ordre des chimistes du Québec without additional chemistry electives. This program is not currently accredited by the Canadian Society for Chemistry.

Completion of Mathematics MATH 222 and MATH 315 during U1 is strongly recommended.

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

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

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120, BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 101/PHYS 102 or 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 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 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 242*	(4)	Organic Chemistry 1 for Chemistry and Biochemistry
CHEM 252	(4)	Organic Chemistry 2 for Chemistry and Biochemistry
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 (18 credits)

6 credits of research*:

* Students may take up to 12 Research Project credits b

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

Complementary Courses (18 credits)

6 credits of research*:

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

CHEM 470	(6)	Research Project 1
CHEM 480	(3)	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.

12.7.12 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 integrative, interdisciplinary courses in bio-physical sciences. This program may be completed in 74 or 75 credits.

Program Prerequisites

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

Pre-Program Requirements: Students entering from the Freshman program must have included CHEM 110 and CHEM 120, BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 101/PHYS 102, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the DEC with appropriate science and mathematics courses. Note that students who have successfully completed MATH 150 and MATH 151 do not have to take MATH 222.

Required Courses (65 credits)

The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level. Students completing the program will not be eligible for admission to the Ordre des chimistes du Québec without additional chemistry electives. This program is not currently accredited by the Canadian Society for Chemistry.

Completion of Mathematics MATH 222 and MATH 315 during U1 is strongly recommended.

* Denotes courses with CEGEP equivalents.

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

Bio-Physical Sciences Core

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 319	(3)	Introduction to Biophysics
BIOL 395	(1)	Quantitative Biology Seminar

CHEM 242*	(4)	Organic Chemistry 1 for Chemistry and Biochemistry
MATH 222**	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
PHYS 329	(3)	Statistical Physics with Biophysical Applications

Chemistry

CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 252	(4)	Organic Chemistry 2 for Chemistry and Biochemistry
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
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 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
	(3)	Chemical Kinetics

12.7.13 Chemistry (CHEM) Related Programs

12.7.13.1 Joint Honours in Physics and Chemistry

For more information, see *section 12.30: Physics (PHYS)*.

12.8 Cognitive Science

12.8.1 About Cognitive Science

Cognitive Science is the interdisciplinary study of intelligent behaviour in humans, animals, and machines. It encompasses the traditional disciplines of Computer Science, Linguistics, Neuroscience, Philosophy and Psychology. By taking a computational view of the mind, Cognitive Science seeks to establish a mechanistic understanding of the mental processes underpinning intelligent behaviour, inform our understanding of our mind, and guide the design and development of intelligent systems.

Students wishing to complete the **Minor in Cognitive Science** should contact the *Cognitive Science Program Advisor* if there are any questions about the requirements. Please refer to *mcgill.ca/cogsci* for advising information.

12.8.2 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
		Algorithms and Dat91 0 0,tre reas.ot tak

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
PSYC 319	(3)	Computational Models - Cognition
PSYC 340	(3)	Psychology of Language
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 538	(3)	Categorization, Communication and Consciousness

12.9 Computer Science (COMP)

12.9.1 Location

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

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

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

Website: *cs.mcgill.ca*

12.9.2 About Computer Science

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

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

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

Computer science also plays an important role in many other fields, including biology, physics, engineering, business, music, and neuroscience, where it is necessary to process and reason about large amounts of data. Computer science is strongly related to mathematics, linguistics, and engineering.

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

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

- Major, Honours, Liberal, and Minor programs in Computer Science;
- Major in Computer Science: Artificial Intelligence Concentration;
- Major, Honours, and Liberal programs in Software Engineering;
- Major in Computer Science: Computer Games Option;
- Major and Honours in Mathematics and Computer Science (see *section 12.22: Mathematics and Statistics (MATH)*);
- Major and Honours in Statistics and Computer Science (see *section 12.22: Mathematics and Statistics (MATH)*);
- Major and Honours in Physics and Computer Science (see *section 12.30: Physics (PHYS)*);
- Major and Honours in Computer Science and Biology (see *section 12.5: Biology (BIOL)*).

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

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

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

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

12.9.3 Internship Opportunities

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

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

For more information on these opportunities, consult *section 11: Science Internships and Field Studies* or *mcgill.ca/science/undergraduate/internships-field/internships*.

12.9.4 Research Opportunities

Computer science undergraduates have excellent opportunities to participate in research. Each summer, several awards are available, such as the NSERC Undergraduate Student Research Awards; these offer financial support for a research experience in an academic setting. Other research assistantship and volunteering opportunities in research labs are also available.

Students may also take undergraduate research project courses such as COMP 396 *Undergraduate Research Project*, COMP 400 *Project in Computer Science*, and COMP 401 *Project in Biology and Computer Science*. Students who have participated in substantial and broad undergraduate research may qualify for the Dean's Multidisciplinary Undergraduate Research List at graduation time. For more information, consult *University Regulations & Resources > Undergraduate > Graduation > Graduation Honours > : Faculty of Science Dean's Multidisciplinary Undergraduate Research List*.

12.9.5 Admissions

Students intending to pursue a program in Computer Science or Software Engineering should have a reasonable mathematical background and should have completed MATH 140 (or MATH 150), MATH 141 (or MATH 151), and MATH 133, or their CEGEP equivalents. These three mathematics courses should have been completed with at least an average of B-. A background in computer science is not necessary as students may start their studies with the introductory course COMP 202 or COMP 204 or COMP 208. For example, taking COMP 202 in the Freshman year, or completing an equivalent course in CEGEP, would be an asset that would allow students to take more advanced courses earlier in their program.

More information about the admission process and programs is available on the School of Computer Science website at *cs.mcgill.ca*.

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

Students must obtain approval from their main program adviser, and are also strongly encouraged to speak with a School of Computer Science adviser before choosing complementary courses. A particular course selection must be approved before the student registers for their final term of studies.

Students should note that COMP 251 is a prerequisite for many upper level COMP courses. Upper level COMP courses may have prerequisites that are not part of the Minor such as MATH 222, MATH 223, or MATH 323. Students will not get credit for these courses toward the Minor.

Students may receive up to 6 credits toward the Minor by taking certain approved courses outside the School of Computer Science. These courses must have a high computer science content and must be approved by the School of Computer Science in advance. If a student's Major program requires Computer Science courses, up to 6 credits of Computer Science courses may be used to fulfill both Major and Minor requirements.

Required Courses (9 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science

Complementary Courses (15 credits)

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

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

12.9.7 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 Cour

COMP 250 (3) Introduction to Computer Science

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)

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 371	(3)	Introduction to Data Science

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).

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

This program will focus on the fundamentals of biology and the computational and mathematical skills needed to manage, analyze, and model large biological datasets.

Students may complete this program with a minimum of 63 credits and maximum of 74.

Program prerequisites: U0 (freshman) students should take: BIOL 111, BIOL 112, CHEM 110, CHEM 120, MATH 133, MATH 140, MATH 141 or MATH 150, MATH 151, PHYS 101, PHYS 102 or PHYS 131, PHYS 142. Note that MATH 150, MATH 151 provide 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

(36-46 credits)

Bio-Physical Sciences Core

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

Computer Science and Mathematics

COMP 202**	(3)	Foundations of Programming
COMP 204**	(3)	Computer Programming for Life Sciences
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
MATH 240	(3)	Discrete Structures

Biology

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

Required Joint Courses

COMP 401	(3)	Project in Biology and Computer Science

* Students with CEGEP-level credit for the equivalents of MATH 222 and/or CHEM 212 do not have to take these courses. Students should speak with an advisor if uncertain if they are exempted.

** Students may take either COMP 202 or COMP 204, but not both. Students who have taken the equivalent of COMP 202/COMP 204 prior to their McGill studies are exempt from COMP 202/COMP 204.

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:

COMP 273	(3)	Introduction to Computer Systems

and any other COMP courses at the 300 level or above, except COMP 400, COMP 401, COMP 402, COMP 462, and COMP 561. At least 3 of these 9-12 credits must be at the 400 level or above.

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

Adv

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

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

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

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

Required Courses

36-39 credits

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

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

Complementary Courses (24 credits)

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

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

Group A:

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

MATH 324	(3)	Statistics

Group B:

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

Group C: Software Engineering Specialization

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

COMP 409*	(3)	Concurrent Programming
COMP 523	(3)	Language-based Security
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
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

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

This program provides a more advanced version of the Major Computer Science program. It focuses on more advanced and theory-based algorithms and computer science content, and it includes a required project.

Students may complete this program with a minimum of 72 or a maximum of 75 credits.

Honours students must have a CGPA of at least 3.00 at graduation.

Required Courses (46-49 credits)

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

** Students take either MATH 340 or MATH 350.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
		Softw

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
MATH 223	(3)	Linear Algebra
MATH 323	(3)	Probability

Computer Science and Mathematics

COMP 202**	(3)	Foundations of Programming
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 equivalents of MATH 222 and/or CHEM 212 do not have to take these courses. Students should speak with an adviser if uncertain if they are exempted.

** Students may take either COMP 202 or COMP 204, but not both. Students who have taken the equivalent of COMP 202/COMP 204 prior to their McGill studies are exempt from COMP 202/COMP204.

*** Students with credit for COMP 251 instead of COMP 252 must include in their Complementary courses at 6 COMP credits at the 400 level or above, including at least 3 credits at the 500 level or above.

Complementary Courses (24 credits)

3-6 credits from the following:

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

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

Computer Science Block

9-12 credits from :

COMP 273	(3)	Introduction to Computer Systems

and any other COMP courses at the 300 level or above - except COMP 400, COMP 401, COMP 402, COMP 462, and COMP 561. At least 3 of theses 9-12 credits must be at the 400 level or above.

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

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

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

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

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

Required Courses

39-42 credits

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science

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

Complementary Courses (33 credits)

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

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

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

Group A:

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

Group B:

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

Group C: Software Engineering Specialization

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

COMP 409*	(3)	Concurrent Programming
COMP 523	(3)	Language-based Security
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
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

12.9.17 Computer Science (COMP) Related Programs

12.9.17.1 Major and Honours in Mathematics and Computer Science

For more information, see *section 12.22: Mathematics and Statistics (MATH)*. Honours students must consult an Honours advisor in both departments.

12.9.17.2 Major and Honours in Statistics and Computer Science

For more information, see *section 12.22: Mathematics and Statistics (MATH)*. Honours students must consult an Honours advisor in both departments.

12.9.17.3 Major and Honours in Physics and Computer Science

For more information, see *section 12.30: Physics (PHYS)*. Honours students must consult an Honours advisor in both departments.

12.9.17.4 Minor in Cognitive Science

Students following Major or Honours programs in Computer Science may want to consider the Minor in Cognitive Science. For more information, see *section 12.8: Cognitive Science*.

12.10 Earth and Planetary Sciences (EPSC)

12.10.1 Location

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

12.10.2 About Earth and Planetary Sciences

Earth and Planetary Sciences is a multidisciplinary field that includes the solid Earth and its hydrosphere and extends to the neighbouring terrestrial planets. Principles of chemistry, physics, and mathematics are applied to elucidate the complex and diverse planetary processes at play as we seek to understand how planets like the Earth changed over time and continue to evolve.

Career opportunities are many and diverse in the Earth and Planetary Sciences. Graduates of the major and honours in geology are often hired by resource exploration and extraction companies (industrial minerals; fossil and nuclear fuels; geothermal energy; ore deposits of base, precious, and critical metals). Knowledge of geochemistry and hydrogeology is also valued in the environmental consulting sector. Industry or government agencies may hire undergraduate students during the summer months, providing them with both financial benefits and first-hand geoscientific experience. Career opportunities in planetary science can also be found in universities and research organizations.

The Department has a full-time staff of 18 professors and one faculty lecturer. There are approximately 70 graduate and 20-30 undergraduate students registered in the various programs offered. Classes are therefore small at all levels, resulting in an informal and friendly atmosphere throughout the department,

in which most of the faculty and students interact on a first-name basis. Emphasis is placed equally on quality teaching and research, providing undergraduate students with a rich and exciting environment in which to explore and learn.

12.10.3 Undergraduate Studies

The undergraduate curriculum is designed to provide both a strong foundation in the physical sciences and the flexibility to create an individualized program in preparation for careers in industry, teaching, or research. In addition to the **major** and **honours** undergraduate programs, the department is one of the three departments that actively contribute to the Earth System Science Interdepartmental program, and also offers a **Joint Major in Physics and Geophysics**, which comT9Major in Ph

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

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

The B.Sc. (Liberal) program in Earth and Planetary Sciences provides the graduate with a solid core of kno

EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences

EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits

3 credits of field school

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

3 credits of environmental and ore-forming processes

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

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

EPSC 350	(3)	Tectonics
EPSC 435	(3)	Applied Geophysics
EPSC 470D1	(3)	Undergraduate Thesis Research
EPSC 470D2	(3)	Undergraduate Thesis Research
EPSC 482	(3)	Research in Earth and Planetary Sciences
EPSC 501	(3)	Crystal Chemistry
EPSC 503	(3)	Advanced Structural Geology
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 525	(3)	Microbiology of the Earth System
EPSC 530	(3)	Volcanology
EPSC 540	()	Crustal Rheology
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

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

Bachelor of Science (B.Sc46 1lcpC 520

Required Courses (42 credits)

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

Complementary Courses (33 credits)

15 credits of earth science topics among

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
GEOG 272	(3)	Earth's Changing Surface

3 credits of field school

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

3 credits of en

EPSC 482	(3)	Research in Earth and Planetary Sciences
EPSC 501	(3)	Crystal Chemistry
EPSC 503	(3)	Advanced Structural Geology
EPSC 510	(3)	Geodynamics
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 522	(3)	Advanced Environmental Hydrology
EPSC 525	(3)	Microbiology of the Earth System
EPSC 530	(3)	Volcanology
EPSC 540	(3)	Crustal Rheology
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Igneous Petrogenetic Mechanisms
EPSC 567	(3)	Advanced Volcanology
GEOG 322	(3)	Environmental Hydrology

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.

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

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

PHYS 340	(3)	Majors Electricity and Magnetism

Complementary Courses (12 credits)

3 credits from:

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

plus 9 credits (three courses) chosen from the following:

Note: Courses at the 300 lev

12.11 Earth System Science (ESYS)

12.11.1 Location

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

12.11.2 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 government. They are:

- Global biogeochemical cycles;
- Climate variability and change;
- Land use and land cover change;
- Energy and resources;
- Earth hazards: volcanoes, earthquakes, and hurricanes; and
- Earth-atmosphere observation, analysis, and prediction.

Many of our graduates go on to M.Sc. or Ph.D. programs in a variety of scientific fields that address these grand challenges, including those arising from the interaction of human activities and natural systems.

Career opportunities after a B.Sc. are diverse and increasing. Our graduates work for environmental consulting firms (assessing suitable sites for new industrial facilities and predicting their environmental impact, and cleaning contaminated sites), research groups in re-insurance firms (evaluating risks of natural disasters), in product life cycle management (studying energy and resources use, and the effect of recycling or waste disposal), and software companies that develop algorithms to assist farmers on choices of crops and soil management practices, and business owners with inventory management.

The **Honours** program in Earth System Science (ESYS) prepares students for graduate studies in a wide range of transdisciplinary programs that address these challenges.

The ESS programs are offered jointly by the Department of *section 12.3: Atmospheric and Oceanic Sciences (ATOC)*, the Department of *section 12.10: Earth and Planetary Sciences (EPSC)*, and the Department of *section 12.17: Geography (GEOG)*.

The individual departments, their disciplines, and specific courses offered by them are described in their respective entries in this publication.

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

The Minor in Earth System Science combines interdisciplinary knowledge with quantitative tools to explore global connections between the atmosphere, oceans, solid Earth, and the dynamic ecological and human processes at the Earth surface. The program aims to provide fundamental understanding relevant to navigating the challenges of sustainability and climate change, and addresses timescales ranging from the vastness of Earth history to the fast-moving events of the

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

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

Atmospheric and Oceanic Sciences (ATOC)

Earth and Planetary Sciences (EPSC)

Geography (GEOG)

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

Required Courses (18 credits)

ENVR 201	(3)	Society, Environment and Sustainability
ESYS 200	(3)	Earth-System Interactions
ESYS 300	(3)	Earth Data Analysis
ESYS 301	(3)	Earth System Modelling
ESYS 500	(3)	Earth System Applications
MATH 222	(3)	Calculus 3

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	(3)	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
		Cities in the Modern

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
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

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	(3)	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.

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
	(3)	Thermodynamics and Convection

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

12.12 Entrepreneurship for Science Students

12.12.1 About Entrepreneurship for Science Students

This Minor is geared toward Science students with an interest in entrepreneurship and key business topics. The set of six courses will introduce them to concepts and skills needed to effectively complement the technical expertise obtained.

12.14 Experimental Medicine (EXMD)

12.14.1 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*

12.14.2 About Experimental Medicine

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

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

Africa Field Study Semester - Required Courses

6 credits

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

Research in Society and Development in Africa

work with group project work and contributes to the formation of professionals with planning, managing, decision-making, and communication skills. The program addresses a global need for experienced professionals capable of interacting with various levels of government, non-governmental organizations, and the private sector. BITS welcomes applications from senior undergraduate students from across the University.

Barbados Interdisciplinary Tropical Studies Field Semester - Required Courses

15 credits

AEBI 421	(3)	Tropical Horticultural Ecology
AEBI 423	(3)	Sustainable Land Use
AEBI 425	(3)	Tropical Energy and Food
AEBI 427	(6)	Barbados Interdisciplinary Project

Panama Field Study Semester (15 credits)

This program is offered in Panama with the support of the Smithsonian Tropical Research Institute (STRI).

Hands-on experience is gained through research projects organized around multidisciplinary environmental issues. The nature of these projects will centre on practical environmental problems/questions important for Panama. Students will form teams that will work with Panamanian institutions (NGO, governmental, or research).

There is a one- or two-day period of transition and 13 weeks of course attendance in Panama. Field trips will be integrated into each of the courses offered.

Panama Field Study Semester - Required Courses

9 credits

BIOL 553	(3)	Neotropical Environments
ENVR 451	(6)	Research in Panama

Panama Field Study Semester - Complementary Courses

6 credits

Complementary courses change from year to year. Students will register for the 6 credits offered the Winter of their participation in the field study semester.

First Winter semester complementary courses:

AGRI 550	(3)	Sustained Tropical Agriculture
GEOG 498	(3)	Humans in Tropical Environments

Second Winter semester complementary courses:

GEOG 404	(3)	Environmental Management 2

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.

12.16 General Science

12.16.1 Location

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

12.16.2 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 Advisor for this program. See the program description in *section 12.16.3: Bachelor of Science (B.Sc.) - Minor General Science (18 credits)* for more information.

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

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

Complementary Courses (18 credits)

Courses are to be chosen according to the following guidelines:

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

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

Two options:

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

or

12 credits at the 300 level or above and at least 6 credits outside the student's core science component subject.

* Note: All Undergraduate research project courses with the 396 or 397 course number cannot be used toward the Minor General Science.

12.17 Geography (GEOG)

12.17.1 Location

Burnside Hall, Room 305
805 Sherbrooke Street West
Montreal QC H3A 0B9
Telephone: 514-398-4951
Email:*undergrad.geog@mcgill.ca*
Website:*mcgill.ca/geography*

Refer to *Bachelor of Arts & Science* > *Undergraduate* > *Browse Academic Units & Programs* > *: Geography(GEOG)* for B.A. & Sc. programs in Geography.

The Department of Geography offers 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.

Physical geography integrates disciplines such as climatology, geomorphology, geology, biology, hydrology, ecology, soil science, and even marine science.

Whether considering greenhouse gas emissions, the spread of disease, or threats to biodiversity, geographers are interested in where things happen, why, and with what consequences. Our graduates go on to careers in environmental consulting, social agencies, or non-governmental organizations. Skills in Geographic Information Science (GIS) are very marketable. Students are well prepared for graduate work in social sciences, urban planning, and environmental studies at leading schools.

12.17.3 Prerequisites and Student Advising

There are no prerequisites for entrance to the B.Sc. Geography programs. Students who are interested in these programs should contact the Geography undergraduate advisor at *advisor.geog@mcgill.ca*.

Bac

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

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 Interactions
ESYS 300	(3)	Earth Data Analysis
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

GEOG 499

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
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration

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

The BSc Major in Geography provides students with strong training in the theory and tools of physical geography. Students will explore the science of how physical, chemical, and biological processes interact at various spatial and temporal scales to produce distinct environments over the planet, and study different suites of ecosystem services while investigating sustainability challenges for human communities that depend on them. The program includes core

GEOG 372	(3)	Running Water Environments
GEOG 373	(3)	Arctic Geomorphology
GEOG 470	(3)	Wetlands

3 credits of field courses:

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

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

Students must take a total of 15 credits from the next 2 blocks; they will choose 9 credits from one block and 6 credits from the other block, 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	(3)	Earth System Geographic Information Science

6 or 9 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 Interactions
ESYS 300	(3)	Earth Data Analysis
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

12.17.8 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
GEOG 351	(3)	Quantitative Methods
GEOG 381	(3)	Geographic Thought and Practice
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	(3)	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 Interactions
ESYS 300	(3)	Earth Data Analysis
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

BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOL 200	(3)	Molecular Biology
BIOL 201*	(3)	Cell Biology and Metabolism
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
MIMM 211**	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHGY 209**	(3)	Mammalian Physiology 1

U2 Required Courses

13 credits from the following:

ANAT 261	(4)	Introduction to Dynamic Histology
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
MIMM 314	(3)	Intermediate Immunology

U3 Required Courses

15 credits from the following:

MIMM 414	(3)	Advanced Immunology
PHGY 419D1	(4.5)	Immunology Research Project
PHGY 419D2	(4.5)	Immunology Research Project
PHGY 513	(3)	Translational Immunology

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 220 and BIOC 320, or

** MIMM 384 and MIMM 385, or

*** PHGY 212 and PHGY 213 and BIOL 301

BIOC 220*	(3)	Laboratory Methods in Biochemistry and Molecular Biology 1
BIOC 320*	(3)	Laboratory Methods in Biochemistry and Molecular Biology 2
BIOL 301***	(4)	Cell and Molecular Laboratory
MIMM 384**	(3)	Molecular Microbiology Laboratory
MIMM 385**	(3)	Laboratory in Immunology
PHGY 212***	(1)	Introductory Physiology Laboratory 1
PHGY 213***	(1)	Introductory Physiology Laboratory 2

plus 6 credits, selected from:

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

ANAT 365	(3)	Cellular Trafficking
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309*	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of 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 531	(3)	Topics in Applied Immunology

plus 6 credits selected from:

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

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

12.19 Interdisciplinary Life Sciences

12.19.1 Location

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

12.19.2 About the Interdisciplinary Life Sciences Minor

The Interdisciplinary Life Sciences Minor allows students to obtain exposure to Life Sciences and life science related areas. Students must consult with the advisor to review course selection.

Please note: Students studying in Anatomy and Cell Biology; Biochemistry; Honours Immunology; Microbiology and Immunology; Neuroscience; Pharmacology; and Physiology are not permitted to complete this Minor.

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
	(3)	Metabolism and Human Nutrition

HIST 335	(3)	Science and Medicine in Canada
HIST 350	(3)	Science and the Enlightenment
HIST 381	(3)	Colonial Africa
HIST 424	(3)	Gender, Sexuality and Medicine
		Issues in W

12.20 Kinesiology for Science Students

12.20.1 Location

Department of Kinesiology and Physical Education
Currie Gymnasium
475 Pine Avenue West, 2nd Floor
Montreal QC H2W 1S4
Telephone: 514-398-2357
Fax: 514-398-4186
Email: *studentaffairs.kpe@mcgill.ca*
Website: *mcgill.ca/edu-kpe/programs/ug/bsckinminor*

Program Advisor: Nada Abu-Merhy; *studentaffairs.kpe@mcgill.ca*

12.20.2 About Kinesiology for Science Students

Students planning a career in the health sciences, whether as a health professional or a biomedical researcher, will find courses in Kinesiology to be of interest from both theoretical and applied perspectives. There is a focus on the benefits of physical activity for health and well-being, as well as appropriate prescription of exercise in the treatment of various diseases, injuries, and disabilities. Courses deal with both prevention and rehabilitation.

Students are not permitted to enrol in more than the 18 credits of EDKP courses required for the Minor in Kinesiology for Science Students.

12.20.3 Bachelor of Science (B.Sc.) - Minor Kinesiology (24 credits)

The Minor Kinesiology is designed to provide students in B.Sc. programs with basic but comprehensive knowledge of scientific bases of human physical activity and its relationship with health and well-being.

Students registered in the Minor Kinesiology may not take additional courses outside the Faculties of Arts and of Science.

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.

Required Courses (15 credits)

EDKP 206	(3)	Biomechanics of Human Movement
EDKP 261	(3)	Motor Development
EDKP 395	(3)	Exercise Physiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

Complementary Courses (9 credits)

9 credits, three of the following courses:

EDKP 330	(3)	Physical Activity and 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

12.21 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 Offered by the Desautels Faculty of Management* > *: Minor for Non-Management Students* for detailed information about program requirements and applying.

Also available to Science students is the Minor in Entrepreneurship for Science students; see *section 12.12: Entrepreneurship for Science Students*. Students in this Minor are not permitted to take the Desautels Minors in Finance, Management, Marketing, or Operations Management (for Non-Management students).

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

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

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

Complementary Courses (18 credits)

9 credits selected from:

MGCR 211	(3)	Introduction to Financial Accounting
MGCR 222	(3)	Introduction to Organizational Behaviour
MGCR 271**	(3)	Business Statistics
MGCR 293***	(3)	Managerial Economics
MGCR 331	(3)	Information Technology Management
MGCR 341*	(3)	Introduction to Finance
MGCR 352	(3)	Principles of Marketing
MGCR 372*	(3)	Operations Management.
MGCR 382	(3)	International Business

9 credits selected from any Management courses not already chosen from the first list or any 300- or 400-level Management courses for which prerequisites have been met.

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

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

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

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

12.22 Mathematics and Statistics (MATH)

12.22.1 Location

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

12.22.2 About Mathematics and Statistics

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

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

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

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

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

12.22.3 Undergraduate Program Options

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

There are two popular undergraduate streams. The **Honours** programs in Mathematics, Applied Mathematics, Statistics (including **Joint Honours** with Physics or Computer Science) are at an advanced level for students who wish to specialize their studies in the mathematical sciences. The Honours stream is well suited for students who intend to move on to graduate school and essential for those who are envisaging research careers in the mathematical sciences. The **Major** programs in Mathematics and Statistics are less intense and more flexible, leaving room for a **Minor** or a second Major Concentration in another discipline. The Major stream is particularly suited for students whose future creative activity will involve Mathematics, Statistics, or Data Science and its applications in another area. With satisfactory performance in an appropriate selection of courses, the **Major Statistics** program can lead to the professional

- 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*.

12.22.6 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)

MATH 209	(3)	Fundamentals of Statistical Modeling and Inference
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.

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

The B.Sc.; Liberal Program – Core Science Component in Mathematics provides a general overview of Mathematics, including a rigorous foundation and exploration of the different branches of Mathematics,

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 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

Algebra 1

MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis

12.22.9 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
MA	(4)	Calculus 2

MATH 243	(3)	Analysis 2
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 316	(3)	Complex Variables
MATH 317*	(3)	Numerical Analysis
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 340	(3)	Discrete Mathematics
MATH 350	(3)	Honours Discrete Mathematics
MATH 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 462	(3)	Machine Learning
MATH 510	(4)	Quantitative Risk Management
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

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

The B.Sc.; Major in Mathematics provides a general overview of Mathematics including a rigorous foundation and the exploration of the different branches of Mathematics.

Program Prerequisites

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

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

Guidelines for Selection of Courses in the Major Program

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

Students interested in computer science are advised to choose courses from the following: MATH 317, MATH 318, MATH 327, MATH 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, MAe 4.1r13Aalent

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 427	(3)	Statistical Quality Control
MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 451	(3)	Introduction to General Topology
MATH 462	(3)	Machine Learning
MATH 463	(3)	Convex Optimization

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 MA

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 take either COMP 451 or COMP 551, but not both.

COMP 451+	(3)	Fundamentals of Machine Learning
COMP 551+	(4)	Applied Machine Learning
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 462	(3)	Machine Learning
MATH 510	(4)	Quantitative Risk Management
MATH 524	(4)	Nonparametric Statistics
		Sampling

COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 360	(3)	Algorithm Design
MATH 222	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 236	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 315	(3)	Ordinary Differential Equations
MATH 317**	(3)	Numerical Analysis
MATH 318	(3)	Mathematical Logic
MATH 323	(3)	Probability
MATH 340	(3)	Discrete Mathematics

Complementary Courses (18 credits)

9 credits from the following.

Other MATH courses, at the undergraduate level, not included in this list may be chosen in consultation with an adviser.

MATH 204	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 319	(3)	Partial Differential Equations
MATH 324	(3)	Statistics
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 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 463	(3)	Convex Optimization
MATH 478	(3)	Computational Methods in Applied Mathematics

9 credits selected from Computer Science courses at the 300 level or above (except COMP 364 and COMP 396) and ECSE 508.

12.22.13 Bachelor of Science (B.Sc.) - Major Statistics and Computer Science (72 credits)

This program provides students with a solid training in both computer science and statistics together with the necessary mathematical background. As statistical endeavours involve ever increasing amounts of data, some students may want training in both disciplines.

Program Prerequisites

Students entering the Joint Major in Statistics and Computer Science are normally expected to have completed the courses below or their equivalents. Otherwise they will be required to make up any deficiencies in these courses over and above the 72 credits of required courses.

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

Required Courses (51 credits)

* Students who have sufficient knowledge in a programming language do not need to take COMP 202 but can replace it with an additional Computer Science complementary course.

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

*** Students take either MATH 223 or MATH 236, but not both.

Both courses are equivalent as prerequisites for required and complementary Computer Science courses listed below.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theory of Computation
COMP 350**	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design
MATH 222	(3)	Calculus 3
MATH 223***	(3)	Linear Algebra
MATH 235	(3)	Algebra 1
MATH 236***	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 314	(3)	Advanced Calculus
MATH 317**	(3)	Numerical Analysis
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MATH 423	(3)	Applied Regression

Complementary Courses (21 credits)

12 credits in Mathematics selected from:

* If chosen, students take either MATH 340 or MATH 350, but not both.

** MATH 578 and COMP 540 cannot both be taken for program credit.

+ In order to receive credit for MATH 204, students must take it before MATH 324.

++ If chosen, students can take one of MATH 410, and MATH 527D1/D2, but not both.

MATH 204+	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 327	(3)	Matrix Numerical Analysis
MATH 340*	(3)	Discrete Mathematics
MATH 350*	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 410++	(3)	Majors Project
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 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 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 566	(3)	Discrete Optimization 1
COMP 567	(3)	Discrete Optimization 2

The remaining Computer Science credits are selected from COMP courses at the 300 level or above (except COMP 396) and ECSE 508.

12.22.14 Bachelor of Science (B.Sc.) - Honours Applied Mathematics (63 credits)

The B.Sc.; Honours in Applied Mathematics provides an in-depth training, at the honours level, in “discrete” or “continuous” applied mathematics. It gives the foundations and necessary tools to explore some areas such as numerical analysis, continuous and discrete optimization, graph theory, discrete probability. The program also provides the background required to pursue interdisciplinary research at the interface between mathematics and other fields such as biology, physiology, and the biomedical sciences. This program may be completed with a minimum of 60 credits or a maximum of 63 credits.

Students may complete this program with a minimum of 60 credits or a maximum of 63 credits depending if they are exempt from MATH 222.

Program Prerequisites

The minimum requirement for entry into the Honours program is that the student has Tm(ph)Tj1 0 1d(elke se02.959 136.321r9from MA)Tj1 0 0 1 504.291-7 requirem

MATH 133	(3)	Linear Algebra and Geometry
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

In particular, MATH 150/MATH 151 and MATH 140/MATH 222 are considered equivalent.

Students who have not completed an equivalent of MATH 222 on entering the program must consult an academic adviser and take MATH 222 as a required course in the first semester, increasing the total number of program credits from 60 to 63. Students who have successfully completed MATH 150/MATH 151 are not required to take MATH 222.

Note: COMP 202—or an equivalent introduction to computer programming course—is a program prerequisite. U0 students may take COMP 202 as a Freshman Science course; new U1 students should take it as an elective in their first semester.

Students who transfer to Honours in Applied Mathematics from other programs will have credits for previous courses assigned, as appropriate, by the Department.

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

Required Courses

(36-39 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/MATH 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 247**	(3)	Honours Applied Linear Algebra
		Honours

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

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	(3)	Introduction to General Topology
MATH 462	(3)	Machine Learning
MATH 478	(3)	Computational Methods in Applied Mathematics

0-12 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)	Machine Learning
MATH 480	(3)	Honours Independent Study
MATH 488	(3)	Honours Set Theory

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

All MATH 500-level courses.

Other courses with the permission of the Department.

12.22.15 Bachelor of Science (B.Sc.) - Honours Mathematics (63 credits)

The B.Sc.; Honours in Mathematics provides an in-depth training, at the honours level, in mathematics. It gives the foundations and tools needed to explore diverse areas of mathematics such as analysis, number theory, geometry, geometric group theory, and probability. This program may be completed with a minimum of 60 credits or a maximum of 63 credits.

Program Prerequisites

The minimum requirement for entry into the Honours program is that the student has completed with high standing the following courses below or their equivalents.

MATH 133	(3)	Linear Algebra and Geometry
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

In particular, MATH 150/MATH 151 and MATH 140/MATH 141/MATH 222 are considered equivalent.

Students who hav

3 credits selected from:

MATH 235	(3)	Algebra 1
MATH 245**	(3)	Honours Algebra 1

** It is strongly recommended that students take both MATH 245 and 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 462	(3)	Machine Learning
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
MATH 377	(3)	Honours Number Theory
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis
MATH 398	(3)	Honours Euclidean Geometry
MATH 462	(3)	Machine Learning
MATH 480	(3)	Honours Independent Study
MATH 488	(3)	Honours Set Theory

all MATH 500-level courses.

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

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

12.22.16 Bachelor of Science (B.Sc.) - Honours Statistics (63 credits)

The B.Sc.: Honours in Statistics provides training, at the honours level, in statistics, with a solid mathematical core, and basic training in computing. With a suitable selection of complementary courses, the program can focus on probability, mathematical statistics, applied statistics, actuarial science and finance, or data science. 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.

Program Requirements (63 credits)

Students may complete this program with a minimum of 60 credits or a maximum of 63 credits depending on whether or not they are required to take.102 242.54 Tmsl0m

Program Prerequisites

The minimum requirement for entry into the Honours program is that the student has completed with high standing the following courses or their equivalents:

MATH 133	(3)	Linear Algebra and Geometry
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

In particular, MA

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 Part III below.

Part III: 18-23 credits in probability and statistics selected as follows:

15-23 credits selected from:

+++ Students must take MATH 204 before taking MATH 357 or MATH 533. Moreover, it is strongly advised to take MATH 203 before taking MATH 204.

MATH 204+++	(3)	Principles of Statistics 2
MATH 308	(3)	Fundamentals of Statistical Learning
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 547	(4)	Stochastic Processes
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 587	(4)	Advanced Probability Theory 1
MATH 589	(4)	Advanced Probability Theory 2

0-3 credits from the following courses for which no Honours equivalent exists:

MATH 329	(3)	Theory of Interest
MATH 378	(3)	Nonlinear Optimization
MATH 427	(3)	Statistical Quality Control

0-8 credits selected from:

+++ Students may select either MATH 594 or MATH 598 but not both.

COMP 370	(3)	Introduction to Data Science
COMP 424	(3)	Artificial Intelligence
COMP 451	(3)	Fundamentals of Machine Learning
COMP 551	(4)	Applied Machine Learning
COMP 579	(4)	Reinforcement Learning
COMP 588	(4)	Probabilistic Graphical Models
MATH 430	(3)	Mathematical Finance
MATH 462	(3)	Machine Learning
MATH 562	(4)	Theory of Machine Learning
MATH 594+++	(4)	Topics in Mathematics and Statistics
MATH 598+++	(4)	Topics in Probability and Statistics

12.22.17 Bachelor of Science (B.Sc.) - Honours Statistics and Computer Science (79 credits)

The program provides a rigorous training in the area of Computer Science and Statistics at the honours level. Exploration of the interactions between the two fields.

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 (43 credits)

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

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

COMP 202*	(3)	Foundations of Programming

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theory of Computation
COMP 362	(3)	Honours Algorithm Design
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Vector Calculus
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 533	(4)	Regression and Analysis of Variance

Complementary Courses (36 credits)

3 credits selected from:

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

3 credits selected from:

MATH 235	(3)	Algebra 1
MATH 245*	(3)	Honours Algebra 1

* It is strongly recommended that students take both MATH 245 and MATH 254.

3 credits selected from:

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

8-12 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

0-4 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)	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

6-15 credits selected from:

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

0-9 credits selected from Computer Science courses selected from COMP courses at the 300 level or above excluding COMP 396.

12.22.18 Bachelor of Science (B.Sc.) - Honours Mathematics and Computer Science (78 credits)

The B.Sc.; Honours in Mathematics and Computer Science provides a rigorous training, at the honours level, in mathematics and computer science, while exploring the interaction between the two fields. This program may be completed with a minimum of 72 credits or a maximum of 78 credits.

Program Prerequisites

Students must consult an Honours adviser in both departments to ensure that they have sufficient background to enter the program. The minimum requirements are the following courses or their equivalencies:

MATH 133	(3)	Linear Algebra and Geometry
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

In particular, MATH 150/MATH151 and MATH 140/MATH 141/MATH 222 are considered equivalent.

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

Required Courses

(33-36 credits)

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

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science

MATH 454+	(3)	Honours Analysis 3
MATH 455	(3)	Honours Analysis 4
MATH 456	(3)	Honours Algebra 3
MATH 457	(3)	Honours Algebra 4

0-9 credits should be selected from honours courses and 500-level courses given by the Department of Mathematics and Statistics.

12 credits in Computer Science, selected from Computer Science courses at the 300 level or above excluding COMP 364 and COMP 396. ECSE 508 may also be taken.

12.22.19 Mathematics and Statistics (MATH) Related Programs

12.22.19.1 Major in Biology and Mathematics

For more information, see *section 12.5: Biology (BIOL)* > *section 12.5.9: Bachelor of Science (B.Sc.) - Major Biology and Mathematics (76 credits)*.

12.22.19.2 Major in Physiology and Mathematics

For more information, see *section 12.31: Physiology (PHGY)* > *section 12.31.5: Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (79 credits)*.

12.22.19.3 Honours Program in Mathematics and Physics

For more information, see *section 12.30: Physics (PHYS)* > *section 12.30.14: Bachelor of Science (B.Sc.) - Honours Mathematics and Physics (81 credits)*.

12.23 Microbiology and Immunology (MIMM)

12.23.1 Location

Duff Medical Building, Room 511
3775 University Street
Montreal QC H3A 2B4
Telephone: 514-398-3915
Email: *undergrad.microimm@mcgill.ca*
Website: *mcgill.ca/microimm*

12.23.2 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 with controlling or harnessing microorganisms for the benefit of people, by isolating antibiotics or producing vaccines to protect against disease, and by developing and perfecting microorganisms for industrial uses.

Immunology is the study of the molecular and cellular basis of host resistance and immunity to external agents such as pathogenic microorganisms. Immunologists study the mechanisms by which the body recognizes foreign antigens, generates appropriate antibodies to an enormously diverse spectrum of antigens, and sequesters and kills invading microorganisms. Their discoveries lead to vaccination against disease; transfusions and organ transplants; and treatments for allergies; cancer; autoimmune diseases; and immune-deficiency diseases such as AIDS. Antibodies may soon be used in conjunction with antibiotics or chemical agents as specific “magic bullets” to diagnose disease and attack microbes and cancers.

The disciplines of microbiology and immunology are natural partners in research, and both fields use the modern methods of cell biology, molecular biology, and genetics to study basic life processes. The members of the **Department of Microbiology and Immunology** conduct research in:

- microbial physiology and genetics;
- microbial pathogenesis;
- molecular virology;
- cellular and molecular immunology;
- parasitology.

Students registered in the Department are therefore exposed to these related areas and receive an excellent background in basic biology and chemistry, as well as in the more applied areas of biotechnology and medicine.

Many opportunities exist for careers in basic or applied microbiology and immunology, medical microbiology, environmental microbiology, and biotechnology. They include positions in industry (pharmaceutical and biotechnology), hospitals, universities, and government (environment, public health, and energy). A degree in microbiology also provides an excellent basis for entering professional and postgraduate programs in medicine, dentistry, veterinary sciences,

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

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

12.23.5 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

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.

12.25 Neurology and Neurosurgery (NEUR)

12.25.1 Location

Montreal Neurological Institute and Hospital
3801 University Street, Room 140
Montreal QC H3A 2B4
Website: *mcgill.ca/neuro*

12.25.2 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' *Neurology and Neurosurgery page*.

12.26 Neuroscience

12.26.1 Location

Department of Physiology
Dawson Hall, 4th floor
853 Sherbrooke Street West
Montreal QC H4A 0G5
Email: *prospective.neuroscience@mcgill.ca*
Website: *mcgill.ca/neuroscience*

Neuroscience Program Advisor
Curtis Sharman
Email: *curtis.sharman@mcgill.ca*
Website: *mcgill.ca/neuroscience*

12.26.2 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 ho

Required Courses (9 credits)

BIOL 200	(3)	Molecular Biology
NSCI 200	(3)	Introduction to Neuroscience 1
NSCI 201	(3)	Introduction to Neuroscience 2

Complementary Courses (16 credits)

15-16 credits selected as follows:

- At least 12-13 credits must be from outside the student's home department.

- At least 6 of the 12-13 credits have to be at the 400 or 500 level.

0-10 credits from the following list of 200- and 300-level courses:

* Students may select ANAT 212 or BIOC 212 or BIOL 201.

** Students may select either BIOL 306 or PHGY 314.

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

ANAT 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOL 201*	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 306**	(3)	Neural Basis of Behaviour
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 389	(3)	Laboratory in Neurobiology
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)	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

12.26.4 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 MATH 150.

** Students complete one of either MATH 141 OR MATH 151.

*** Students complete one of either PHYS 101 OR PHYS 131.

+++ Students complete one of either PHYS 102 OR PHYS 142.

BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
MATH 139*	(4)	Calculus 1 with Precalculus
MATH 140*	(3)	Calculus 1
MATH 141**	(4)	Calculus 2
MATH 150*	(4)	Calculus A
MATH 151**	(4)	Calculus B
PHYS 101***	(4)	Introductory Physics - Mechanics
PHYS 102+++	(4)	Introductory Physics - Electromagnetism
		Mechanics and W

PHYS 142+++	(4)	Electromagnetism and Optics

Core Required Courses (20 credits)

Note: Students who have successfully completed an equivalent of CHEM 212 in CEGEP or elsewhere must replace these credits with a 3-credit elective course to satisfy the total credit requirement for the Neuroscience Major.

BIOL 200	(3)	Molecular Biology
CHEM 212	(4)	Introductory Organic Chemistry 1
NSCI 200	(3)	Introduction to Neuroscience 1
NSCI 201	(3)	Introduction to Neuroscience 2
NSCI 300	(3)	Neuroethics
NSCI 400D1	(.5)	Neuroscience Seminar
NSCI 400D2	(.5)	Neuroscience Seminar
PSYC 311	(3)	Human Cognition and the Brain

Complementary Courses (45-47 credits)

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BIOL 373	(3)	Biometry
MATH 324	(3)	Statistics
PSYC 305	(3)	Statistics for Experimental Design

3 credits from:

COMP 202	(3)	**F**oundations 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

3 credits from:

(3) Introductory Immunology: Elements of Immunity

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

PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 319	(3)	Computational Models - Cognition
		Hormones and Behaviour

PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

12.26.5 Bachelor of Science (B.Sc.) - Honours Neuroscience (74 credits)

The Honours program is intended for students who are interested in laboratory-based research and in acquiring a foundation in each of the 3 streams of the Neuroscience Major Program (cell and molecular; neurophysiology and computational; and cognition and behaviour). Students are admitted to the program after one year in a major.

Applicants must have taken a minimum of 27 graded credits in their U1 year, must have a CGPA of at least 3.5, and must have obtained minimum grades of B+ in both NSCI 200 and NSCI 201, as well as a minimum grade of C in BIOL 200, BIOC 212 or BIOL 201, and CHEM 212. Additional requirements for applying are provided on the Neuroscience website: (www.mcgill.ca/neuroscience). Meeting the minimum requirements does not guarantee admission to the Honours Neuroscience program.

To graduate from the program, students must have a CGPA of 3.30 and a minimum grade of B+ in NSCI 300, NSCI 400, and NSCI 430D1/D2.

"First Class Honours" is awarded to students who obtain a minimum cumulative grade point average of 3.70, a minimum program GPA of 3.30, and a minimum grade of B+ in NSCI 300, NSCI 400, and NSCI 430D1/D2.

Required Courses (38 credits)

Note: Students who have successfully completed an equivalent of CHEM 212 in CEGEP or elsewhere must replace these credits with a 3-credit elective course to satisfy the total credit requirement for Honours Neuroscience.

BIOC 311	(3)	Metabolic Biochemistry
BIOL 200	(3)	Molecular Biology
CHEM 212	(4)	Introductory Organic Chemistry 1
NSCI 200	(3)	Introduction to Neuroscience 1
NSCI 201	(3)	Introduction to Neuroscience 2
NSCI 300	(3)	Neuroethics
NSCI 400D1	(.5)	Neuroscience Seminar
NSCI 400D2	(.5)	Neuroscience Seminar
NSCI 430D1	(4.5)	Honours Research Project
NSCI 430D2	(4.5)	Honours Research Project
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

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

Neurobiology of Memory1 0 0 1 70.52(Neurobiology of Memo5opharmacology)T 0 0 1 165.8 and BehaMemors and Be

12.27 Nutrition (NUTR)

12.27.1 Location

School of Human Nutrition
Macdonald-Stewart Building, Room MS2-045
21,111 Lakeshore Road
Sainte-Anne-de-Bellevue QC H9X 3V9
Website: mcgiAboutrition

Montreal QC H3G 1Y6
Telephone: 514-398-3623
Website: *mcgill.ca/pharma*

12.29.2 About Pharmacology and Therapeutics

Pharmacology is the science that deals with all aspects of drugs and their interactions with living organisms. Thus, it involves the physical and chemical properties of drugs, their biochemical and physiological effects, mechanisms of action, pharmacokinetics, and therapeutic and other uses. Since the word “drug” encompasses all chemical substances that produce an effect on living cells, pharmacology is evidently a very extensive subject.

Pharmacology is a multidisciplinary science. It has developed its own set of principles and methods to study the mode of the action of drugs, but it has also utilized man

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.

12.29.4 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
CHEM 552	(3)	Physical Organic Chemistry
COMP 204	(3)	Computer Programming for Life Sciences
	(3)	Physiology and Biochemistry Endocrine Systems

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)	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.

12.29.5 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

PHGY 213	(1)	Introductory Physiology Laboratory 2

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

U3

PHAR 598D1	(3)	Honours Pharmacology Research Project
PHAR 598D2	(3)	Honours Pharmacology Research Project

* 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.

Complementary Courses (30 credits)

3 credits, one of (highly recommended in Year 1):

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

3 credits, one of (usually in Year 2):

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

3 credits, one of (usually in Year 2):

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

12 credits selected from the following Pharmacology courses:

PHAR 390	(3)	Laboratory in Pharmacology
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 for the following science 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
CHEM 552	(3)	Physical Organic Chemistry
COMP 204	(3)	Computer Programming for Life Sciences
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 504	(3)	Biology of Cancer
EXMD 509***	(3)	Gastrointestinal Physiology and Pathology
EXMD 511	(3)	Joint Venturing with Industry
HGEN 400***	(3)	Genetics in Medicine
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 466++	(3)	Viral Pathogenesis
NEUR 310	(3)	Cellular Neurobiology
PARA 410	(3)	Environment and Infection
		Human Disease

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 522D1^	(3)	Fundamentals of Disease Therapy
PHAR 522D2^	(3)	Fundamentals of Disease Therapy
PHAR 524	(3)	Clinical Mentorship
PHAR 540	(3)	Advances in Industrial Biotechnology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, 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)	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.

12.30 Physics (PHYS)

12.30.1 Location

Rutherford Physics Building, Room 108
3600 University Street
Montreal QC H3A 2T8
Telephone: 514-398-6477

Email: *c*

12.30.4 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.

12.30.5 Bachelor of Science (B.Sc.) - Minor Physics (18 credits)

The 18-credit Minor permits no overlap with any other programs. It contains no Mathematics courses, although many of the courses in it have Math pre- or corequisites. It will, therefore, be particularly appropriate to students in Mathematics, but it is also available to any Science student with the appropriate mathematical background.

Students in certain programs (e.g., the Major Chemistry) will find that there are courses in the Minor that are already part of their program, or that they may not take for credit because of a substantial overlap of material with a course or courses in their program. After consultation with an adviser, such students may complete the Minor by substituting any other physics course(s) from the Major or Honours Physics programs.

Required Course (3 credits)

PHYS 257	(3)	Experimental Methods 1

Complementary Courses (15 credits)

15 credits to be selected as follows:

One of:

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

One of:

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

One of:

PHYS 241	(3)	Signal Processing
PHYS 258	(3)	Experimental Methods 2

One of:

PHYS 224	(3)	Physics of Music
PHYS 228	(3)	Energy and the Environment
PHYS 260	(3)	Modern Physics and Relativity
PHYS 320	(3)	Introductory Astrophysics
PHYS 346	(3)	Majors Quantum Physics

One of:

PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 350	(3)	Honours Electricity and Magnetism

12.30.6 Bachelor of Science (B.Sc.) - Minor Electrical Engineering (24 credits)

This Minor program is currently under review. Students are encouraged to contact Department of Electrical & Computer Engineering for detailed information.

[Program registration done by Student Affairs Office]

The Minor program does not carry professional recognition. Only students who satisfy the requirements of the Major Physics are eligible for this Minor. Students registered for this option cannot count PHYS 241 toward the requirements of the Major in Physics, and should replace this course by another Physics or Mathematics course. Students who select ECSE 334 in the Minor cannot count PHYS 328 toward the requirements of the Major in Physics, and should replace this course by another Physics or Mathematics course.

Required Courses (12 credits)

ECSE 200	(3)	Electric Circuits 1
ECSE 210	(3)	Electric Circuits 2
ECSE 303	(3)	Signals and Systems 1
ECSE 330	(3)	Introduction to Electronics

Complementary Courses (12 credits)

3 credits from the following and 9 credits of ECSE courses at the 200, 300, or 400 level subject to approval by the Department of Electrical and Computer Engineering.

ECSE 305	(3)	Probability and Random Signals 1
ECSE 334	(3)	Introduction to Microelectronics

12.30.7 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physics (45 credits)

The B.Sc.; Liberal Program - Core Science Component in Physics offers an overview of key physics topics, focusing on fundamentals. Topics include dynamics, electricity and magnetism, quantum mechanics, experimental methods and more. This program allows students also pursue a minor or major concentration in another discipline.

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

12.30.8 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

PHYS 512	(3)	Computational Physics with Applications
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics

** NOTE: If chosen, PHYS 459D1 and PHYS 459D2 are taken together.

^ Note: A maximum of 6 credits of complementary courses may be from research courses PHYS 449, PHYS 479, and PHYS 459D1/459D2.

Note: It is possible for students to transfer from the Major to the Honours program after U1 year if they have passed all the 200-level required courses listed above and MATH 314 and MATH 315 with a C or better, and obtained a cumulative GPA of 3.5 or better in these courses. The written permission of an adviser is required for this change of program. The missing MATH 249 and PHYS 260 from the U1 Honours year should be taken in U2.

12.30.9 Bachelor of Science (B.Sc.) - Major Physics: Biological Physics (82 credits)

This program may be completed in 81 or 82 credits.

The B.Sc.; Major in Physics; Biological Physics program keeps a strong core of foundational physics and specializes 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

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
		Heat and W

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 359	(3)	Advanced Physics Laboratory 1
PHYS 469	(3)	Advanced Physics Laboratory 2

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

12.30.10 Bachelor of Science (B.Sc.) - Major Physics and Geophysics (69 credits)

The joint program in Physics and Geophysics focuses on geophysics and related fields.

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their equivalents. Quebec students must have completed the DEC with appropriate science and mathematics courses.

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves

PHYS 142	(4)	Electromagnetism and Optics

One of:

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology

MATH 133 and either MATH 140/141 or MATH 150/151.

MATH 133	(3)	Linear Algebra and Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2
MATH 150	(4)	Calculus A
MATH 151	(4)	Calculus B

Required Courses (57 credits)

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
	(3)	Linear Algebra

EPSC 520	(3)	Earthquake Physics and Geology
EPSC 540	(3)	Crustal Rheology
EPSC 549	(3)	Hydrogeology
MATH 319	(3)	Partial Differential Equations
PHYS 320	(3)	Introductory Astrophysics
PHYS 321	(3)	Data Science and Observational Astrophysics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 404	(3)	Climate Physics

0-6 credits from the following:

EPSC 482	(3)	Research in Earth and Planetary Sciences
PHYS 449	(3)	Majors Research Project
PHYS 459D1	(3)	Research Thesis
PHYS 459D2	(3)	Research Thesis
PHYS 512	(3)	Computational Physics with Applications
PHYS 521	(3)	Astrophysics

Note: If chosen, PHYS 459D1 and D2 must be taken together.

12.30.11 Bachelor of Science (B.Sc.) - Major Physics and Computer Science (66 credits)

The Major Physics and Computer Science is designed to give motivated students the opportunity to combine the two fields in a way that will distinguish them from the graduates of either field by itself. The two disciplines complement each other, with physics providing an analytic problem-solving outlook and basic understanding of nature, while computer science enhances the ability to make practical and marketable applications, in addition to having its own theoretical interest. Graduates of this program may be able to present themselves as being more immediately useful than a pure physics major, but with more breadth than just a programmer. They will be able to demonstrate their combined expertise in the Special Project course which is the centre,to. 0 lp7ak

U1 Required Courses (21 credits)

COMP 250	(3)	Introduction to Computer Science
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2

U2 Required Courses (24 credits)

COMP 206	(3)	Introduction to Software Systems
COMP 251	(3)	Algorithms and Data Structures
COMP 302	(3)	Programming Languages and Paradigms
COMP 350	(3)	Numerical Computing
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing

U3 Required Courses (21 credits)

COMP 360	(3)	Algorithm Design
MATH 323	(3)	Probability
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 346	(3)	Majors Quantum Physics
PHYS 489	(3)	Special Project

12.30.12 Bachelor of Science (B.Sc.) - Honours Physics (81 credits)

The B.Sc.; Honours in Physics provides a broad view of physics from classical to modern topics as well as a choice of specialized high level courses relevant for contemporary research. The students have the opportunity to participate in research.

This is a demanding program. This program may be completed in 78 or 81 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
	(4)	Calculus A

PHYS 479	(3)	Physics Research Project

Note: Students cannot take both PHYS 359 and PHYS 469 to meet this requirement as one of them was taken to meet the previous requirement above.

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

12.30.13 Bachelor of Science (B.Sc.) - Honours Physics: Biological Physics (82 credits)

The B.Sc.; Honours in Physics; Biological Physics program contains a strong core of foundational physics and specializes in biology, mathematics, physiology, computer science, and chemistry. This Honours program offers a more rigorous preparation, with additional research experience, in biophysics. The program includes a research project within a biophysics lab in the department that is completed in the final year. This program may be completed in 81 or 82 credits

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)	Research Thesis
PHYS 459D2	(3)	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
PHYS 469	(3)	Advanced Physics Laboratory 2

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:

	(3)	Molecular Biology of the Gene

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BIOL 316	(3)	Biomembranes and Organelles
BIOL 551	(3)	Principles of Cellular Control

12.30.14 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 urs progrmit to52 1mentary courses in an

U2 Required Courses (24 credits)

MA	(3)	Honours Analysis 2

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.

12.30.15 Bachelor of Science (B.Sc.) - Honours Physics and Chemistry (80 credits)

This program provides a strong basis in both chemistry and physics. It contains a core of chemistry courses and a mix of honours-level courses in physics and mathematics.

To graduate with an Honours degree, a student must havvide4.Gs well.Gs Tm strong basis 1.2131 T03.0 512.74im 269.2249.5150.06 T03.0 512.74erall.584.G.Q5543n(

CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
CHEM 556	(3)	Advanced Quantum Mechanics
CHEM 574	(3)	Introductory Polymer Chemistry
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering
MATH 247	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Vector Calculus
MATH 249	(3)	Honours Complex Variables
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 457	(3)	Honours Quantum Physics 2
PHYS 558	(3)	Solid State Physics

Complementary Courses (12-15 credits)

(with at least 3 credits in Chemistry and 3 credits in Physics)

0-3 credits from:

MATH 222*	(3)	Calculus 3

*Note: A student who has not taken not tak

PHYS 404	(3)	Climate Physics
PHYS 434	(3)	Optics
PHYS 459D1	(3)	Research Thesis
PHYS 459D2	(3)	Research Thesis
PHYS 469	(3)	Advanced Physics Laboratory 2
PHYS 479	(3)	Physics Research Project
PHYS 512	(3)	Computational Physics with Applications
PHYS 562	(3)	Electromagnetic Theory

12.30.16 Bachelor of Science (B.Sc.) - Honours Physics and Computer Science (81 credits)

This program pro

Complementary Courses (15 credits)

At least 6 of the 15 complementary credits must come from a course at the 400- or 500-levr 500-le

12.31 Physiology (PHGY)

12.31.1 Location

McIntyre Medical Sciences Building, Room 1021
3655 Promenade Sir-William-Osler
Montreal QC H3G 1Y6
Telephone: 514-398-4316
Website: *mcgill.ca/physiology*

12.31.2 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;
- gastrointestinal and renal physiology;
- the physiology of exercise;
- neurophysiology;
- endocrinology;
- immunology;
- biophysics; and
- biomathematics.

Some faculty members have formal or informal links with the departments of mathematics, physics, electrical engineering, and chemistry, and with clinical departments (medicine, surgery, pediatrics, neurology, obstetrics, psychiatry, anesthesia), reflecting and reinforcing the close ties between physiology and other disciplines.

Graduates at the B.Sc. level have found rewarding careers in secondary school and CEGEP teaching, government service, and laboratory technical assistance such as in pharmaceutical houses, hospitals, and institutions of higher learning. Moreover, physiology provides an excellent background for medicine, dentistry or other postgraduate work, in such fields as physiology, experimental medicine, pharmacology, biochemistry, or physiological psychology.

The programs offered in Physiology differ in their orientation but they all have a common core of material covering:

- cardiovascular;
- respiratory;
- gastrointestinal and renal physiology;
- neurophysiology;
- endocrinology; and

12.31.3 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physiology (50 credits)

Required Courses (32 credits)

* Students who have taken CHEM 212 and/or CHEM 222 in CEGEP are exempted and must replace these credits with 4 or 8 credits of elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology

Complementary Courses (15 credits)

15 credits selected as follows:

3 credits selected from:

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

3 credits, 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
PHGY 451	(3)	Advanced Neurophysiology
PHGY 459D1*	(3)	Physiology Seminar
PHGY 459D2*	(3)	Physiology Seminar
PHGY 461D1**	(4.5)	Experimental Physiology
PHGY 461D2**	(4.5)	Experimental Physiology
PHGY 488	(3)	Stem Cell Biology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	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
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

12.31.4 Bachelor of Science (B.Sc.) - Major Physiology (66 credits)

(65-66 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
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 459D1*	(3)	Physiology Seminar
PHGY 459D2*	(3)	Physiology Seminar
PHGY 461D1**	(4.5)	Experimental Physiology
PHGY 461D2**	(4.5)	Experimental Physiology
PHGY 488	(3)	Stem Cell Biology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	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
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

* 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
EXMD 508	(3)	Advanced Topics in Respiration
EXMD 510	(3)	Bioanalytical Separation Methods
NEUR 310	(3)	Cellular Neurobiology
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PPHS 501	(3)	Population Health and Epidemiology
PSYC 302	(3)	Pain
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
PSYC 410	(3)	Special Topics in Neuropsychology

PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 470	(3)	Memory and Brain
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
		Adv

MATH 437	(3)	Mathematical Methods in Biology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
	(1)	Introductory Physiology Laboratory 1

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 Ph

Email: *ciro.piccirillo@mcgill.ca*

12.32 Psychiatry (PSYT)

12.32.1 Location

1033 Pine Avenue West, Room 104
Montreal QC H3A 1A1
Telephone: 514-398-4176
Website: *mcgill.ca/psychiatry/education*

12.32.2 About Psychiatry

There are no B.Sc. programs in Psychiatry, but the PSYT courses listed below are administered by the Faculty of Science and are open to Arts and Science students and to graduate students, subject to the regulations and restrictions of their home faculty.

Courses	
PSYT 199	FYS: Mental Illness and the Brain
PSYT 301	Issues in Drug Dependence
PSYT 400D1/PSYT 400D2	Research Project in Psychiatry
PSYT 455	Neurochemistry
PSYT 500	Advances: Neurobiology of Mental Disorders
PSYT 502	Brain Evolution and Psychiatry
PSYT 503	Mental Health Services and Policy
PSYT 504	Issues in Forensic Mental Health
PSYT 515	Advanced Studies in Addiction

12.33 Psychology (PSYC)

12.33.1 Location

2001 McGill College, Room 740
Montreal QC H3A 1G1
Telephone: 514-398-6100
Fax: 514-398-4896
Email: *undergrad.psych@mcgill.ca*
Website: *mcgill.ca/psychology*

12.33.2 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 pro

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.

12.33.6 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Psychology (45 credits)

Psychology is the scientific study of the mind and behavior. The B.Sc. Liberal Core Science Component in Psychology (45 credits) provides students with a broad overview of the field of psychological science. It is less specialized than the B.Sc. Major in Psychology as students choose a selection of the core courses in psychology as well as advanced courses in specialized content areas. Students may also have the option to complete a research course(s). This program provides students with the space to take the additional courses they may need for applying to graduate school in psychology and for completing the undergraduate credits in psychology as specified by the Ordre des Psychologues du Québec (which are required by some graduate psychology programs). However, students desiring a more specialized program should consider the B.Sc. Major in Psychology.

Program Requirements

The Liberal Program - 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. Students completing a Liberal Program with a Core Science Component Psychology must also complete at least one breadth component in a second area.

Program Prerequisites (0-6 credits)

Students planning to enter the Core Science Component Psychology program should have completed an introductory course in general psychology and biology in CEGEP. 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.

McGill Freshman students are recommended to complete the following courses in their U0 year:

0-3 credits from:

PSYC 100	(3)	Introduction to Psychology

0-3 credits from:

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology

Required Course (3 credits)

PSYC 204	(3)	Introduction to Psychological Statistics

*Note: CEGEP students are exempt from PSYC 204 if they have completed Probability & Statistics or Statistics with a minimum grade of 75%. If the equivalent of PSYC 204 was completed in CEGEP, then students must replace it with 3 credits in Psychology (PSYC) at the 300-level or above.

Complementary Courses (42 credits)

9 credits from:

PSYC 211	(3)	Introductory Behavioural Neuroscience
PSYC 212	(3)	Perception

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 309	(3)	Positive Psychology: Science of Well-Being
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 339	(3)	Introduction to Applied Psychology
PSYC 351	(3)	Research Methods and Laboratory in Social Psychology
PSYC 408	(3)	Principles and Applications of Psychotherapy
PSYC 409	(3)	Positive Psychology
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

15 credits in Psychology at the 300 level or above.

6 credits in Psychology at the 400 or 500 level.

Unclassified Courses

Students may also select complementary courses from the research and topics courses below:

PSYC 385	(3)	Independent Research Project 1
PSYC 450D1	(4.5)	Research Project and Seminar
PSYC 450D2	(4.5)	Research Project and Seminar
PSYC 484D1	(3)	Independent Research Project 2
PSYC 484D2	(3)	Independent Research Project 2
PSYC 485	(3)	Independent Research Project 3
PSYC 492	(3)	Special Topics Seminar 1
PSYC 493	(3)	Special Topics Seminar 2
PSYC 499	(1)	Reading Project

12.33.7 Bachelor of Science (B.Sc.) - Major Psychology (54 credits)

Psychology is the scientific study of the mind and behavior. The B.Sc. Major in Psychology (54 credits) provides students with an in-depth overview, covering the core areas of psychological science as well as more advanced courses in specialized content areas. Students also have the option to complete a research course(s) and/or gain additional training in science related disciplines (see Program Requirements for details). This program provides students with the space to take the additional courses they may need for applying to graduate school in psychology and for completing the undergraduate credits in psychology as specified by the Ordre des Psychologues du Québec (which are required by some graduate psychology programs).

Program Prerequisites (0-9 credits)

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 Unl0 0 1 83.mts)

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 the following:

PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	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 439	(3)	Correlational Techniques
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

U1 or U2 Required Course (3 credits)

PSYC 305	(3)	Statistics for Experimental Design

U2 Required Courses (9 credits)

PSYC 380D1	(4.5)	Honours Research Project Seminar
PSYC 380D2	(4.5)	Honours Research Project Seminar

U3 Required Course (3 credits)

PSYC 482	(3)	Advanced Honours Seminar

Complementary Courses (33 credits)

12 credits to be selected from the list below and any Psychology course at the 500 level.

PSYC 403	(3)	Modern Psychology in Historical Perspective
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 495	(6)	Psychology Research Project 2
PSYC 496	(6)	Senior Honours Research 1
PSYC 497	(6)	Senior Honours Research 2
PSYC 498D1	(4.5)	Senior Honours Research
PSYC 498D2	(4.5)	Senior Honours Research

List A

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

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	Pain
PSYC 306	(3)	Research Methods in Psychology
PSYC 310	(3)	Intelligence
		Human Cognition and the D0g6Tm((3))Tj1 0 0 1ne4185.8 A.d the D0g6Tm((3))Tj1 01 1((3))Tj1 01 1((3))Tj6uroscience

PSYC 413	(3)	Cognitive Development
PSYC 415	(3)	Electroencephalography (EEG) Laboratory in Psychology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 439	(3)	Correlational Techniques
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 309	(3)	Positive Psychology: Science of Well-Being
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 339	(3)	Introduction to Applied Psychology
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

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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

Required Course (3 credits)

REDM 400	(3)	Science and Museums

Complementary Courses (21 credits)

Students select 21 credits from among four course lists (A (Zoology), B (Botany), C (Earth and Environmental Sciences), and D (Field Courses)) with the following specifications.

- At least 3 credits and no more than 9 credits from each of Lists A, B, and C.

- At least 3 credits from List D.

- No more than 3 credits from any one list may be at the 200 level.

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 Interactions
ESYS 300	(3)	Earth Data Analysis
GEOG 203	(3)	Environmental Systems
GEOG 272	(3)	Earth's Changing Surface
GEOG 470	(3)	Wetlands
GEOG 550	(3)	Historical Ecology Techniques

List D: Field Studies

* Note: Students may take either of the cross-listed courses NRSC 405 and REDM 405, but not both.

Students may also take other field courses with the permission of the Program Adviser.

BIOL 331	(3)	Ecology/Behaviour Field Course
BIOL 335	(3)	Marine Mammals
BIOL 573	(3)	Vertebrate Palaeontology Field Course
ENTO 340	(3)	Field Entomology
EPSC 231	(3)	Field School 1
NRSC 405*	(3)	Natural History of East Africa
REDM 405*	(3)	Natural History of East Africa
WILD 475	(3)	Desert Ecology

12.35 Science or Mathematics for Teachers

12.35.1 Location

Dawson Hall, Room 405
853 Sherbrooke Street West
Montreal QC H3A 0G5
Email: *pete.barry@mcgill.ca*
Website: *mcgill.ca/scienceforteachers*

12.35.2 About Science or Mathematics for Teachers

The training and certification of school teachers has traditionally been the responsibility of the Faculty of Education and requires the completion of a Bachelor of Education, subject to regulations set by the Government of Quebec. The Faculties of Education and of Science offer the **Minor** in Education for Science Students for students in the B.Sc. who wish to combine Science or Mathematics with Education at McGill. The **Minor** allows Science students to develop or explore an interest in Education without committing themselves to completing a B.Ed. degree. Science students who have taken this Minor will have completed some of the necessary credits for the B.Ed. degree should they wish to enrol in that program. For details, see section 12.35.3 *Minor in Science (B.Sc.) - Minor Education for Science Students (18 credits)*.

The traditional **Bachelor of Education**, Secondary Program, Science and Technology, or Secondary Program, (in Educationeithout committing the41, (in5e04 Tm(ech

Faculty of Education
Telephone: 514-398-7042
Email: *isa.administrator@mcgill.ca*

12.35.3 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
		Teaching Secondary Science 1TT