Faculty of Science, including School of Computer Science

Programs, Courses and University Regulations

2018-2019

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

1 . McGill University reserves the right to mak

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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 opened its Office for Undergraduate Research in Science enables students to participate in research projects from the start of their degree, exposing them to the process and products of scholarship.

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.

In addition to the Major program in Software Engineering offered in the Faculty of Science, there is also a Bachelor of Software Engineering program offered jointly with the Faculty of Engineering (refer to *Faculty of Engineering* > *Undergraduate* > *Browse Academic Units & Programs* > *: Electrical and Computer Engineering*).

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

4 About the Faculty of Science (Undergraduate)

4.1 Location

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Faculty and program requirements

section 6.4: Program Requirements

section 6.5: Course Requirements

6.1 Minimum Credit Requirement

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

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

6.1.1 Advanced Standing

Advanced Standing of up to 30 credits may be granted to students who obtain satisfactory results in International Baccalaureate, French Baccalaureate, Advanced Levels, Advanced Placement tests, or the Diploma of Collegial Studies (DCS). Quebec students with a DCS in Science are granted 30 credits Advanced Standing and will have normally completed the equivalent of, and are therefore exempt from, the basic science courses in biology, chemistry

that semester, you must also seek permission of the Director of Advising Services, Faculty of Science. Permission for exceeding the time and/or credit limits will normally be granted only for valid academic reasons, such as a change of program (subject to departmental approval) and part-time status. If permission is granted, you will receive credit only for required and complementary courses necessary to complete your program requirements.

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*.

6.4 Program Requirements

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

6.4.1 Liberal, Major, and Honours Programs

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

6.4.1.1 Liberal Programs

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

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

- Minor Program (18–24 credits) – one of the programs listed in *section 10.2: Minor Programs*.
- Arts Minor or Major Concentration (18 or 36 credits) – one of the programs listed in *section 10.5: Arts Major and Minor Concentrations Open to Science Students*.
- A Core Science Component in a second area (45–50 credits) – at least 24 credits must be distinct from the courses used to satisfy the primary Core Science Component. Note that a second Core Science Component can be selected from any of the Science groups.

6.4.1.2 Major Programs

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

6.4.1.3 Honours Programs

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

6.4.2 Minor and Minor Concentration Programs

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

Science minors consist of up to 24 credits.

Arts minor concentrations consist of 18 credits.

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

For a list of "Minor Programs," see *section 10.2: Minor Programs*; for minor concentrations that are approved for Science students, see *section 10.5: Arts Major and Minor Concentrations Open to Science Students*.

6.4.3 Other Second Programs

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

6.4.4 Special Designations

vxperenceyThe Faculty of Science recognizes Bachelor of Science (B.Sc.) students who have gone be

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

6.5.4 Courses in English as a Second Language (ESL)

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

6.5.5 First-Year Seminars: Registration

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

You may take only one First-Year Seminar. If you register for more than one, you will be obliged to withdraw from all b

9 Examinations

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

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

Students are warned not to make travel arrangements j1 0 hej1 0 0 1 18326357940.315 Tm(v)Tj1 0 0 1 187.076 600.315 Tm(v)TcGihs reExaprioo

- Chemistry – Biological option: *section 13.7.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - Biological (47 credits)*
- Chemistry – General option: *section 13.7.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - General (49 credits)*
- Computer Science: *section 13.9.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Computer Science (45 credits)*
- Earth and Planetary Sciences: *section 13.10.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Earth and Planetary Sciences (45 credits)*
- Geography: *section 13.17.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Geography (49 credits)*
- Mathematics: *section 13.22.9: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Mathematics (45 credits)*
- Physics: *section 13.30.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physics (48 credits)*
- Software Engineering: *section 13.9.9: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Software Engineering (49 credits)*
- Statistics: *section 13.22.10: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Statistics (48 credits)*

10.1.4.2 Major Programs

- Atmospheric Science: *section 13.3.6: Bachelor of Science (B.Sc.) - Major Atmospheric Science (62 0 g/F0 8 Tf1 . Major*

- Mathematics and Computer Science – see Mathematics and Statistics: *section 13.22.12: Bachelor of Science (B.Sc.) - Major Mathematics and Computer Science (72 credits)*
- Physics and Computer Science – see Physics: *section 13.30.12: Bachelor of Science (B.Sc.) - Major Physics and Computer Science (66 credits)*
- Physics and Geophysics: *section 13.30.11: Bachelor of Science (B.Sc.) - Major Physics and Geophysics (69 credits)*
- Statistics and Computer Science: *section 13.22.13: Bachelor of Science (B.Sc.) - Major Statistics and Computer Science (72 credits)*

10.1.4.4 Honours Programs

- Applied Mathematics: *section 13.22.14: Bachelor of Science (B.Sc.) - Honours Applied Mathematics (60 credits)*
- Atmospheric Science: *section 13.3.8: Bachelor of Science (B.Sc.) - Honours Atmospheric Science (74 credits)*
- Chemistry: *section 13.7.15: Bachelor of Science (B.Sc.) - Honours Chemistry (71 credits)*
- Chemistry – Bio-organic option: *section 13.7.17: Bachelor of Science (B.Sc.) - Honours Chemistry - Bio-organic (75 credits)*
- Chemistry – Atmosphere and Environment option: *section 13.7.16: Bachelor of Science (B.Sc.) - Honours Chemistry - Atmosphere and Environment (75 credits)*
- Chemistry – Materials: *section 13.7.19: Bachelor of Science (B.Sc.) - Honours Chemistry - Materials (74 credits)*
- Chemistry – Measurement: *section 13.7.20: Bachelor of Science (B.Sc.) - Honours Chemistry - Measurement (74 credits)*
- Computer Science: *section 13.9.14: Bachelor of Science (B.Sc.) - Honours Computer Science (75 credits)*
- Earth System Science: *section 13.11.5: Bachelor of Science (B.Sc.) - Honours Earth System Science (66 credits)*
- Environment: *: Bachelor of Science (B.Sc.) - Honours Environment (72 credits)*
- Geography: *section 13.17.9: Bachelor of Science (B.Sc.) - Honours Geography (66 credits)*
- Geology: *section 13.10.9: Bachelor of Science (B.Sc.) - Honours Geology (75 credits)*
- Mathematics: *section 13.22.15: Bachelor of Science (B.Sc.) - Honours Mathematics (60 credits)*
- Physics: *section 13.30.13: Bachelor of Science (B.Sc.) - Honours Physics (78 credits)*
- Planetary Sciences: *section 13.10.10: Bachelor of Science (B.Sc.) - Honours Planetary Sciences (78 credits)*
- Probability and Statistics: *section 13.22.16: Bachelor of Science (B.Sc.) - Honours Probability and Statistics (65 credits)*
- Software Engineering: *section 13.9.16: Bachelor of Science (B.Sc.) - Honours Software Engineering (75 credits)*

10.1.4.5 Joint Honours Programs

- Mathematics and Computer Science: *section 13.22.18: Bachelor of Science (B.Sc.) - Honours Mathematics and Computer Science (75 credits)*
- Mathematics and Physics: *section 13.30.15: Bachelor of Science (B.Sc.) - Honours Mathematics and Physics (81 credits)*
- Physics and Chemistry: *section 13.30.16: Bachelor of Science (B.Sc.) - Honours Physics and Chemistry (80 credits)*
- Statistics and Computer Science: *section 13.22.17: Bachelor of Science (B.Sc.) - Honours Statistics and Computer Science (79 credits)*

10.2 Minor Programs

Minor Programs

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

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

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

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

Chemistry, *section 13.7.5: Bachelor of Science (B.Sc.) - Minor Chemistry (18 credits)*

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

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

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

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

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

Entrepreneurship for Science Students, *section 13.12.2: Bachelor of Science (B.Sc.) - Minor Entrepreneurship for Science Students (18 credits)*

Minor Programs

Environment, *: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Minor Environment (18 credits)*

Field Study, *section 13.15.1: Field Studies - Minor Field Studies (18 credits)*

Finance for Non-Management Students, *section 13.21.1: Bachelor of Commerce (B.Com.) - Minor Finance (For Non-Management Students) (18 credits)*

General Science, *section 13.16.3: Bachelor of Science (B.Sc.) - Minor General Science (18 credits)*

Geochemistry, *section 13.10.6: Bachelor of Science (B.Sc.) - Minor Geochemistry (18 credits)*

Geography, *section 13.17.5: Bachelor of Science (B.Sc.) - Minor Geography (18 credits)*

Geographic Information Systems and Remote Sensing, *section 13.17.6: Bachelor of Science (B.Sc.) - Minor Geographic Information Systems and Remote Sensing (18 credits)*

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

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

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

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

Management for Non-Management Students, *section 13.21.2: Bachelor of Commerce (B.Com.) - Minor Management (For Non-Management Students) (18 credits)*

Marketing for Non-Management Students, *section 13.21.3: Bachelor of Commerce (B.Com.) - Minor Marketing (For Non-Management Students) (18 credits)*

Mathematics, *section 13.22.7: 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*

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Minor Concentrations

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

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

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

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

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

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

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

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

Minor Concentrations

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

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

11.2.1 NSERC Undergraduate Student Research Awards

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

To apply, you must be a Canadian citizen or permanent resident of Canada. Apply through the university where you wish to hold the award. See *www.mcgill.ca/science/research/ours/nserc* for more information.

11.2.2 NSERC Experience Awards

NSERC's Experience Awards (pre

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: *www.mcgill.ca/science/programs/internships*

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

The Internship Program is open to all Science under

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

What about Interdisciplinary Programs?

There are many ways to create interdisciplinary programs in the Faculty of Science. You can add a minor to a major or honours program, you can take a liberal program that contains both a core science component and a breadth component, or you can select an explicit interdisciplinary major. The Faculty of Science offers three such interdisciplinary programs: Earth System Science, Environment, and Neuroscience.

13.1 B.Sc. Freshman Program

If you need 97–120 credits (four years) to complete your degree requirements, you must register in the Science Freshman program, which is designed to provide the basic science foundation for your subsequent three-year Liberal, Major, or Honours program. For a detailed description of the Science Freshman program, you should consult *section 13.1.1: Bachelor of Science (B.Sc.) - Freshman Program (30 credits)* and the Science Freshman Student information available on the SOUSA website, *www.mcgill.ca/science/student/newstudents/u0*.

If you have completed the Diploma of Collegial Studies, Advanced Placement exams, Advanced Levels, the International Baccalaureate, the French Baccalaureate, or McGill placement examinations, you may receive exemption and/or credit for all or part of the basic science courses in biology1 67.52 679.961 Tma

CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
GEOG 205	(3)	Global Change: Past, Present and Future
MATH 133**	(3)	Linear Algebra and Geometry
MATH 134***	(3)	Enriched Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

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

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

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

First calculus course, one of:

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

Second calculus course, one of:

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

First physics course, one of:

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

Second physics course, one of:

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

Electives

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

13.2 Anatomy and Cell Biology (ANAT)

13.2.1 Location

Strathcona Anatomy and Dentistry Building, Room M-28
3640 University Street
Montreal, Quebec H3A 0C7

Telephone: 514-398-6350
Website: *www.mcgill.ca/anatomy*

13.2.2 About Anatomy and Cell Biology

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

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

The **Honours** program is designed as the first phase in the training of career cell and molecular biologists. The **Major** and **Liberal** programs offer decreasing levels of specialization in Anatomy and Cell Biology but with a broader base in other biological sciences. These programs also form a sound background for graduate studies in Anatomy and Cell Biology, or for further professional training. Students should choose their major based on their interest and also consider the **Interdisciplinary Minor** in Life Sciences. A B.Sc. in Anatomy and Cell Biology provides an excellent preparation for technical and administrative positions in laboratories of universities, research institutions, hospitals, pharmaceutical, and biotechnological industries.

The Department is equipped to perform protein purification; recombinant DNA technology; micro-injection of molecules into single cells; cytochemical; immunocytochemical and fluorescent analysis and electron microscopy; proteomics; and genomics. The Department has a well-equipped centre for electron microscopy as well as a centre for confocal and immunofluorescence. The new cryo-electron microscope facility in the Department is unique and represents a cutting edge technology to apply fundamental discoveries to therapeutic applications.

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

13.2.3 Anatomy and Cell Biology (ANAT) Faculty

Chair

Craig Mandato

Emeritus Professors

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

John J.M. Bergeron; B.Sc.(McG.), Ph.D.(Oxf.)

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

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

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

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

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

Professors

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

Susanne Bechstedt; B.Sc.(Flor. St.), M.Sc.(Friedrich Schiller Univ.), Ph.D.(Max Planck)

Khanh Huy Bui; B.Sc.(Wales), M.Sc.(Chalmers), Ph.D.(Zürich)

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

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

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

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

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

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

Joaquin Ortega; B.Sc.(Zaragoza), Ph.D.(Autonoma, Madrid)

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

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

Professors

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

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

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

Hojatollah Vali; B.Sc., M.Sc., Ph.D.(Munich)

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

Associate Members

Jason Tanny (*Pharmacology & Therapeutics*)

Adjunct Professors

Gregor Andelfinger; M.D.(Ulm)

Christopher Brett; Ph.D.(Johns Hop.)

Philippe Campeau; M.D.(Lav

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

Complementary Courses (16 credits)

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

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 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 314	(3)	Molecular Biology of Oncogenes
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

Revision, May 2018. End of revision.

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

Required Courses (43 credits)

Note: ANAT 261 must be taken in U1.

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

ANAT 212	(3)	Molecular Mechanisms of Cell Function
		Systemic Human

ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Immunochemistry
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
BIOL 514	(3)	Neurobiology Learning and Memory
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 532	(3)	Developmental Neurobiology Seminar
	r	Genetic Basis of Life Span

NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 451	(3)	Advanced Neurophysiology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Cellular Immunology
PHGY 515	(3)	Physiology of Blood 1
PHGY 516	(3)	Physiology of Blood 2
PHGY 517	(3)	Artificial Internal Organs
PHGY 518	(3)	Artificial Cells
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

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

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

Required Courses (52 credits)

Note: ANAT 261 must be taken in U1.

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

ANAT 212	(3)	Molecular Mechanisms of Cell Function
ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 432	(9)	Honours Research Project
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 212*	(4)	Introductory Organic Chemistry 1

CHEM 222*	(4)	Introductory Organic Chemistry 2
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

One of the following statistics courses:

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

Complementary Courses (21 credits)

Revision, May 2018. Start of revision.

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

Revision, May 2018. End of revision.

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

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

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

BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Immunochemistry
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
		Neural Basis of Behaviour

PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHGY 311	(3)	Channels, Synapses and Hormones
		Respiratory

- **Minor**
- **Joint Major**

Adjunct Professors

L. Fillion; Ph.D.(McG.)

P. Kollias; Ph.D.(Miami)

H. Lin; Ph.D.(McG.)

L.-P. Nadeau; Ph.D.(McG.)

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

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

Required Courses (3 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere

Complementary Courses (15 credits)

3-6 credits selected from:

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

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

Complementary Course

9-12 credits selected from:

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

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

45-48 credits

Required Courses (21 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection

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

CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
MATH 203*	(3)	Principles of Statistics 1
MATH 317	(3)	Numer70.52e6S
MATH 319	(3)	Introduction to Parti.52Diferenti.52Equations
MATH 32uEs	(3)	Probability

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

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

Climate Science Stream (15 credits)

6 credits from:

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

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

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

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 542	(3)	Chemical Oceanography
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
		Probability

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 542	(3)	Chemical Oceanography
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids

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

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

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

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

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

Required Courses (57 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves

PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
	ssical Mechanics	Topics in Classical Mechanics

COMP 208	(3)	Computers in Engineering
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (47 credits)

45-47 credits

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

Core (24 credits)

3-6 credits selected from:

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

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

3 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

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

6-9 credits selected from:

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

MATH 323	(3)	Probability
MATH 324	(3)	Statistics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340**	(3)	Majors Electricity and Magnetism

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

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

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

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

ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 542	(3)	Chemical Oceanography
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
MATH 423	(3)	Regression and Analysis of Variance
MATH 555++	(4)	Fluid Dynamics
PHYS 432++	(3)	Physics of Fluids

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

Atmospheric Chemistry and Physics Stream (21 credits)

15 credits from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
		Introductory Physical Chemistry 2: Kinej1 ry Ph

CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 542	(3)	Chemical Oceanography
MATH 423	(3)	Regression and Analysis of Variance

13.4 Biochemistry (BIOC)

13.4.1 Location

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 take higher degrees in research and attain academic positions in universities and colleges.

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

13.4.3 Biochemistry Faculty

Chair

Albert Berghuis

Emeritus Professors

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

Philip E. Branton; B.Sc., M.Sc., Ph.D.(Tor.), F

Associate Professors

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

Jason C. Young; B.Sc.(Tor.), Ph.D.(McM.)

Assistant Professors

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

Maxime Denis; B.Sc., Ph.D.(Montr.)

Sidong Huang; B.A.(Boston), Ph.D.(Calif.) (*Canada Research Chair in Functional Genomics*)

Lawrence Kazak; Ph.D.(Camb.)

William Pastor; Ph.D.(Harv.)

Ian Watson; B.Sc., Ph.D.(Tor.) (*Canada Research Chair in Functional Genomics of Melanoma*)

Associate Members

BIOL 202	(3)	Basic Genetics
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2

U1 Complementary Courses** (6 credits)

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

6 credits selected from:

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

U2 Required Courses (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
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
PSYC 204	(3)	Introduction to Psychological Statistics

U3 Complementary Courses (3 credits)

3 credits selected from:

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

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

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

U1 Required Courses (23 credits)

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2

U1 Complementary Courses (6 credits)

6 credits selected from:

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

U2 Required Courses (20 credits)

ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOC 311	(3)	Metabolic Biochemistry
BIOC 3142 Tm(AN)Tj1 0 0 1 3 es	(3)	Biochemistry of Macromolecules

BIOC 503	(3)	Immunochemistry
PSYT 455	(3)	Neurochemistry

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

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
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 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses and Hormones

13.4.7 Biochemistry (BIOC) Related Programs

Interdepartmental Honour

Telephone: 514-398-4109
Fax: 514-398-5069
Website: *biology.mcgill.ca*

13.5.2 About Biology

Biology is the study of living things at the molecular, cellular, org

Stewart Biology Building, Room N7/9B
Telephone: 514-398-4109
Email: *nancy.nelson@mcgill.ca*
Website: *biology.mcgill.ca/undergrad/bscprog.html*

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

Preprogram Requirements

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

Other suggested courses in Organismal Biology: BIOL 335, BIOL 350, BIOL 427, BIOL 428, BIOL 463.

Macdonald campus: PLNT 358, WILD 420.

Genetics and Development: BIOL 300, BIOL 303.

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

13.5.4.6 Human Genetics Concentration

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

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

Other suggested courses: BIOC 311, BIOL 314, BIOL 377, BIOL 466, BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, CHEM 203 or both CHEM 204 and CHEM 214, CHEM 222, HGEN 396, MIMM 314.

13.5.4.7 Molecular Genetics and Development Concentration

The discoveries that have fuelled the ongoing biomedical and biotechnology revolution have been derived from the fusion of a number of fields of biological investigation, including molecular biology; genetics; cellular and developmental biology; and biochemistry. A substantial amount of this research has been conducted upon model eukaryotic organisms, such as yeast, the fruit fly (*Drosophila*), the nematode (*C. elegans*), and the mustard weed (*Arabidopsis*). In the molecular genetics and development concentration, students will obtain a comprehensive understanding of how these “model eukaryotes” have advanced our knowledge of the mechanisms responsible for cellular function and organismal development. Graduates from this concentration will be well prepared to pursue higher de

Associate Professors

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

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

Assistant Professors

Mélanie Guigueno; M.Sc.(Manit.), Ph.D.(Western) (*beginning Jan. 2019*)

Anna Hargreaves; B.Sc.(Trent), MSc.(Calg.), Ph.D.(Qu.)

Arnold Hayer; M.Sc.(ESBS, France), Ph.D.(ETH Zurich)

Michael Hendricks; B.A.(Bowdoin), Ph.D.(Sing.)

Tomoko Ohyama; B.Sc., M.Sc.(Keio), Ph.D.(Baylor)

Rodrigo Reyes Lamothe; Lic.(UNAM), M.Sc.(C'dia), D.Phil.(Oxf.)

Jennifer Sunday; B.Sc.(Br. Col.), Ph.D.(Simon Fraser)

Stephanie C. Weber; B.Sc.(Duke), Ph.D.(Stan.)

Associate Members

Biochemistry: Maxime Bouchard

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

Environment: Colin Chapman

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

MCH: Rima Rozen

Medical Genetics, Chair: David Rosenblatt

MNI: Kenneth Hastings

Physics: Paul Francois

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

Adjunct Professors

BELLUS Health Inc.: Francesco Bellini

Humboldt Univ., Berlin: Rudiger Krahe

IRCM: Frédéric Charron, David Hipfner

NRC Lab: Malcolm S. Whiteway

STRI: Andrew Altieri, Hector Guzman, William Owen McMillan, Mark Torchin

Univ. of British Columbia: Jonathan Davies

Univ. of the West Indies: Henri Valles

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

The Minor Biology may be taken in conjunction with any primary program in the Faculty of Science (other than programs offered by the Department of Biology). Students are advised to consult the undergraduate adviser in Biology as early as possible (preferably during their first year), in order to plan their course selection.

See Nancy Nelson, Stewart Biology Building, 514-398-4109, email: nancy.nelson@mcgill.ca.

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

Required Courses (15 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics

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BIOL 205	(3)	Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution

Complementary Courses (10 credits)

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

To include:

CHEM 212*	(4)	Introductory Organic Chemistry 1

Plus an additional two courses from the Biology department's course offerings, at the 300 level or above.

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

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

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

Required Courses (19 credits)

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

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

Complementary Courses (28 credits)

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

3 or 4 credits selected from:

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

24 credits of Biology courses

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

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

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

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

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

Required Courses

25-26 credits:

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics

BIOL 205	(3)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 301	(4)	Cell and Molecular Laboratory
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 a 3- or 4-credit complementary course to be approved by the Biology Adviser.

Core Complementary Courses (12 credits)

12 credits selected from:

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

Other Complementary Courses (21 credits)

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

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

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

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

Advising notes for U0 students

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

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

Required Courses (43 credits)

Bio-Physical Sciences Core (31 credits)

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

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

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

Biology (6 credits)

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

Physics (6 credits)

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

Course Requirements for Quantitative Biology Streams (21 credits)

21 credits from one of the following two streams:

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

Biology

BIOL 205	(3)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
BIOL 304	(3)	Evolution
BIOL 308	(3)	Ecological Dynamics

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

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

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

* Students choose either both BIOL 596 and BIOL 597, or BIOL 597 0 1Nc6

Stream 2: Physical Biology (21 credits)

BIOL 319	(3)	Introduction to Biophysics
PHYS 329	(3)	Statistical Physics with Biophysical Applications
PHYS 446	(3)	Majors Quantum Physics

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

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

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

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

Complementary Courses

**MA

COMP 202**	(3)	Foundations of Programming
MATH 222*	(3)	Calculus 3
MATH 223***	(3)	Linear Algebra
MATH 247***	(3)	Honours Applied Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability

* If a student has already taken CHEM 212 or its equivalent, or MATH 222 or its equivalent, the credits can be made up with a complementary course in consultation with the Program Adviser.

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

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

Biology and Mathematics Core

9 credits

BIOL 215	(3)	Introduction to Ecology and Evolution
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2

Complementary Courses (39 credits)

For the 39 credits, students complete 21 credits of BIOL, NEUR, PHGY, PSYC courses including one of three streams (Ecology and Evolutionary Ecology, Molecular Evolution, Neurosciences) and 18 credits of MATH courses.

Math or Biology Research Course

Note: Students selecting a BIOL course count this toward their 21 credits of BIOL, NEUR, PHGY, PSYC courses while students selecting a MATH course count this toward their 18 credits of MATH courses.

3-6 credits from the following Math or Biology research courses:

BIOL 466	(3)	Independent Research Project 1
BIOL 467	(3)	Independent Research Project 2
BIOL 468	(6)	Independent Research Project 3
MATH 410	(3)	Majors Project

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

Math Courses

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

Stream 1: Theory

12 credits from the following courses:

* Students may take either MATH 317 or MATH 327.

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

Stream 2: Statistics

9 credits from the following:

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

Remaining Math Courses

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

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

BIOL, NEUR, PHGY, PHYS, PSYC Courses

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

Note: Some courses in the streams may have prerequisites.

Ecology and Evolutionar

BIOL 434	(3)	Theoretical Ecology
BIOL 509	(3)	Methods in Molecular Ecology
BIOL 569	(3)	Developmental Evolution
BIOL 594	(3)	Advanced Evolutionary Ecology

Molecular Evolution Stream

At least 15 credits selected as follows:

3 credits

BIOL 202	(3)	Basic Genetics

At least 12 credits selected from the following list:

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

Neurosciences Stream

At least 15 credits selected as follows:

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour

At least 12 credits selected from:

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

Remaining BIOL, NEUR, PHGY, PSYC

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

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

Students may complete this program with a minimum of 71 credits or a maximum of 72 credits depending on their choice of complementary courses.

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

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

U1 Required Courses (33 credits)

32-33 credits:

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 373*	(3)	Biometry
BIOL 499D1	(2)	Honours Seminar in Biology
BIOL 499D2	(2)	Honours Seminar in Biology
CHEM 212**	(4)	Introductory Organic Chemistry 1

* If a student has already taken an equivalent statistics course, the credits can be made up with a 3-credit Biology complementary course.

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

Complementary Courses (39 credits)

Honours (9-12 courses)

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

OR

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

Core

12 credits selected from:

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

Other (15-18 credits)

18 credits of Biology courses at the 300+ level if taking BIOL 479, and 15 credits if taking BIOL 480. With permission of the Biology

BIOL 202	(3)	Basic Genetics
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)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
BIOL 304	(3)	Evolution
BIOL 308	(3)	Ecological Dynamics

Field Courses

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

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

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

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

BIOL 432	(3)	Limnology
BIOL 434	(3)	Theoretical Ecology
BIOL 435	(3)	Natural Selection
BIOL 465	(3)	Conservation Biology
BIOL 509	(3)	Methods in Molecular Ecology
BIOL 510	(3)	Advances in Community Ecology
BIOL 515	(3)	Advances in Aquatic Ecology

BIOL 540	(3)	Ecology of Species Invasions
BIOL 594	(3)	Advanced Evolutionary Ecology
BIOL 596*	(1)	Advanced Experimental Design
BIOL 597*	(2)	Advanced Biostatistics
BIOL 598*	(3)	Advanced Design and Statistics

Stream 2: Physical Biology

21 credits

9 credits from:

BIOL 319*	(3)	Introduction to Biophysics
PHYS 319*	(3)	Introduction to Biophysics
PHYS 329	(3)	Statistical Physics with Biophysical Applications
PHYS 446	(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 1

MATH 314	(3)	Advanced Calculus
MATH 317*	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 348	(3)	Euclidean Geometry
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes

* Students may take COMP 350 OR MATH 317.

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

Recommendations for Physical Biology stream

BIEN 310	(3)	Introduction to Biomolecular Engineering
BIEN 320	(3)	Molecular, Cellular and Tissue Biomechanics
BIEN 340	(3)	Transport Processes in Biological Systems
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 Structures 2
MATH 423	(3)	Regression and Analysis of Variance
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications

13.5.13.2 Joint Honours in Computer Science and Biology

For more information, see

Program Adviser

Nancy Nelson

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

To obtain the Minor Biotechnology, Science students must:

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

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

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

Required Courses (15 credits)

* Students may take either BIOL 201 or BIOC 212.

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

Complementary Courses (9 credits)

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

Immunology

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

Management

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

Microbiology

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

Molecular Biology (Biology)

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

Molecular Biology (Biochemistry)

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

Physiology

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

PHGY 517	(3)	Artificial Internal Organs Artificial Cells

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 la

Professors

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

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

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

* Denotes courses with CEGEP equivalents.

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 381	(3)	Inorganic Chemistry 2
MATH 222**	(3)	Calculus 3

Biological Option Courses (21 credits)

18 credits:

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory
CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry

3 credits from any CHEM course at the 300 or higher level.

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Basic Core Courses (26 credits)

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

See http://www.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.

* Denotes courses with CEGEP equivalents.

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics

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

General Option Courses (17 credits)

CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 392	(3)	Integrated Inorganic/Organic Laboratory

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

Complementary Courses (6 credits)

6 credits of Chemistry (CHEM) courses at the 400 level or higher, or MATH 315 plus 3 credits of Chemistry courses at the 400 level or higherTH 315 plu4e 400 le

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

Complementary Courses (6 credits)

3 credits, one of:

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

3 credits, one of:

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

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

Complementary Course (6 credits)

6 credits from:

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

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

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

Program Prerequisites

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

Required Courses (57th appropri(e MA 1 474.04 Tm((2)) 0 1 67.52 174.423 Tm(and MY 0 0 1 93.39eE0G8t8150/M nd MY 0 0 1 93H 1nP 174.42

Bio-Physical Sciences Core

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

Chemistry

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

COMP 208	(3)	Computers in Engineering

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Courses (59 credits)

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

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

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

* Denotes courses with CEGEP equivalents.

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

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

Complementary Course (3 credits)

3 credits from the following:

CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 534	(3)	Nanoscience and Nanotechnology

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

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

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Courses (53 credits)

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

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

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

* Denotes courses with CEGEP equivalents.

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 332	(3)	Biological Chemistry
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
CHEM 367	(3)	Instrumental Analysis 1

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

Complementary Courses (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

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

Complementary Courses (12 credits)

6 credits of research*:

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

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

3 credits, one of:

AT	(3)	Introduction: Physics of the Atmosphere

The required courses in this program consist of 57 credits in chemistry, biology and mathematics, listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level but the Chemistry courses must be replaced by courses in

MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

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

13.7.18 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.

Program Prerequisites

Note: Attainment of the Honours de

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)	NMR Spectroscopy
CHEM 575	(3)	Chemical Kinetics
COMP 208	(3)	Computers in Engineering

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

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120 or CHEM 115, BIOL 111 or BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 131/PHYS 142, or their equi

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

Complementary Courses (9 credits)

9 credits from the following:

* Students take either ANAT 542 or MIME 542.

ANAT 542*	(3)	Transmission Electron Microscopy
CHEM 462	(3)	Green Chemistry
CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 533	(3)	Small Molecule Crystallography
CHEM 534	(3)	Nanoscience and Nanotechnology
CHEM 571	(3)	Polymer Synthesis
CHEM 582	(3)	Supramolecular Chemistry
CHEM 585	(3)	Colloid Chemistry
MATH 315	(3)	Ordinary Differential Equations
MIME 260	(3)	Materials Science and Engineering
MIME 542*	(3)	Transmission Electron Microscopy

13.7.20 Bachelor of Science (B.Sc.) - Honours Chemistry - Measurement (74 credits)

The B.Sc. Honours in Chemistry; Measurement provides an emphasis on additional background and advanced courses of interest to physical and analytical chemists.

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

Program Prerequisites

CHEM 585	(3)	Colloid Chemistry
CHEM 593	(3)	Statistical Mechanics
CHEM 597	(3)	Analytical Spectroscopy

6 credits of research*:

* Students may take up to 9 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

Or other research-related courses at the 400 or 500 level.

3 additional credits at the 400 or 500 level.

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

13.7.21 Chemistry (CHEM) Related Programs

13.7.21.1 Joint Honours in Physics and Chemistry

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

13.8 Cognitive Science

13.8.1 About Cognitive Science

Cognitiv

PSYC 413 (3) Cognitive Development

- Major and Liberal programs in **Software Engineering**;
- Major in **Computer Science: Computer Games Option**;
- Major and Honours in **Mathematics and Computer Science** (see

Emeritus Professors

G.F.G. Ratzer; B.Sc.(Glas.), M.Sc.(McG.)

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

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

Post-Retirement

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

Professors

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

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

L. Hendren; B.Sc., M.Sc.(Qu.), Ph.D.(Cornell), F.R.S.C. (*Canada Research Chair*)

X. Liu; B.Sc., M.Sc.(Tsinghua), Ph.D.(Ill.) (*William Dawson Scholar*)

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

B. Reed; B.Sc., Ph.D.(McG.) (*Canada Research Chair*)

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

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

Associate Professors

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

X.W. Chang; B.Sc., M.Sc.(Nanjing), Ph.D.(McG.)

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

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

H. Hatami; B.Sc.(Sharif), M.Sc., Ph.D.(Tor.)

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

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

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

M. Langer; B.Sc.(McG.), M.Sc.(Tor.), Ph.D.(McG.)

M. Maheswaran; B.Sc.(U. Peradeniya), M.Sc., Ph.D.(Purdue)

B. Pientka; B.Sc., M.Sc.(Tech. U. of Darmstadt, Germany), Ph.D.(Carn. Mell)

J. Pineau; B.Sc.(Wat.), M.Sc., Ph.D.(Carn. Mell) (*William Dawson Scholar*)

D. Precup; B.Sc.(Tech. U. of Cluj-Napoca), M.Sc., Ph.D.(Mass.)

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

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

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

J. Waldispuhl; B.Sc.(Nice Sophia Antipolis), M.Sc.(Paris VII), Ph.D.(École Poly., France)

Assistant Professors

Y. Cai; B.S.(Peking), M.S., Ph.D.(MIT) (*William Dawson Scholar*)

J. Cheung; B.Sc.(Br. Col.), M.Sc., Ph.D.(Tor.)

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

Faculty Lecturer

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

Associate Members

D. Schlimm (*Philosophy*)

Associate Members

T.R. Shultz (*Psychology*)

Adjunct Professounct Pr

Complementary Courses (13 credits)

3 credits selected from:

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

10 credits from:

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

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

Revision, April 2018. End of revision.

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

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

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

Required Courses (33 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1

Complementary Courses (30 credits)

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

At least 6 credits selected from:

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

3-9 credits selected from:

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

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

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

	(3)	Algoritsce anD date Structurgn

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

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

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

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

Students may complete this program with a maximum of 74 credits or a minimum of 63 credits. This depends upon the student's choice of required courses and whether or not the student is exempt from taking COMP 202.

Program prerequisites: To ensure they meet the core requirements of the program it is highly recommended that the following courses be selected by U0 (Freshman) students: BIOL 111-112, CHEM 110-120, MATH 133, MATH 140-141 or MATH 150-151, PHR 0 1 186.283 91nn 343.101 Tm(9TH e3SLntroductorT.s: 3t 1

MATH 3s.Mathemats)	(3)	Probability

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 De

Required Courses (50 credits)

* Students who have sufficient kno

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

Revision, April 2018. Start of revision.

ECSE 420*	(3)	Parallel Computing
	(3)	Human-Computer Interaction

MATH 350**	(3)	Graph Theory and Combinatorics

Complementary Courses (27 credits)

6 credits selected from:

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

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

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

This honours program will train students in the fundamentals of biology - with a focus on molecular biology - and will give them computational and mathematical skills needed to manage, analyze, and model large biological datasets. Integrative features of the program include interdisciplinary introductory and seminar courses in bio-physical sciences, and a joint independent studies project. Compared to its non-Honours counterpart, the Honours program requires additional research credits and a larger number of advanced courses. Students must have and maintain a minimum CPGA of 3.5. Students may complete this program with a maximum of 77 credits or a minimum of 66 credits. This depends upon the student's choice of required courses and whether or not the student is exempt from taking COMP 202.

Program prerequisites: To ensure they meet the core requirements of the program it is highly recommended that the following courses be selected by U0 (Freshman) students: BIOL 111-112, CHEM 110-120, MATH 133, MATH 140-141 or MATH 150-151, PHYS 101-102 or PHYS 131-142. Note that MATH 150-151 provides equivalence for required course MATH 222, it is also advisable to take COMP 202 during U0 if possible. It is highly recommended that Freshman BIOL, CHEM, MATH and PHYS courses be selected with an adviser to ensure they meet the core requirements of the COMP-BIO program.

Required Courses

39-49 credits:

Bio-Physical Sciences Core

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

Computer Science and Mathematics

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
MATH 240	(3)	Discrete Structures 1

Biology

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

Joint Courses

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

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

** Students who have sufficient knowledge in a programming language are not required to take COMP 202. *** Students take either COMP 462 or COMP 561.

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

COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 307	(2)	Principles of Web Development
COMP 310	(3)	Operating Systems
COMP 322	(1)	Introduction to C++
COMP 330	(3)	Theory of Computation
COMP 350	(3)	Numerical Computing
COMP 361D1***	(3)	Software Engineering Project
COMP 361D2***	(3)	Software Engineering Project
COMP 362	(3)	Honours Algorithm Design

*** Students must take both COMP 361D1 and COMP 361D2.

Biology Block

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

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

BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
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 1
BIOL 416	(3)	Genetics of Mammalian Development
BIOL 434	(3)	Theoretical Ecology
BIOL 435	(3)	Natural Selection
BIOL 495	(1)	Quantitative Biology Seminar 2
BIOL 509	(3)	Methods in Molecular Ecology
BIOL 514	(3)	Neurobiology Learning and Memory
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 568	(3)	Topics on the Human Genome
BIOL 569	(3)	Developmental Evolution
BIOL 575	(3)	Human Biochemical Genetics
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 310	(3)	Cellular Neurobiology

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

Revision, April 2018. Start of revision.

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 1

Complementary Courses (33 credits)

COMP 512	(4)	Distributed Systems
COMP 520	(4)	Compiler Design
COMP 521	(4)	Modern Computer Games
COMP 522	(4)	Modelling and Simulation
COMP 535	(4)	Computer Networks 1
COMP 551	(4)	Applied Machine Learning
COMP 557	(4)	Fundamentals of Computer Graphics
COMP 558	(3)	Fundamentals of Computer Vision

Revision, April 2018. End of revision.

13.9.17 Computer Science (COMP) Related Programs

13.9.17.1 Major and Honours in Mathematics and Computer Science

For more information, see *section 13.22: Mathematics and Statistics (MATH)*. Honours students must consult an Honours adviser in both departments.

13.9.17.2 Major and Honours in Statistics and Computer Science

For more information, see *section 13.22: Mathematics and Statistics (MATH)*. Honours students must consult an Honours adviser in both departments.

13.9.17.3 Major and Honours in Physics and Computer Science

For more information, see *section 13.30: Physics (PHYS)*. Honours students must consult an Honours adviser in both departments.

13.9.17.4 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 13.8: Cognitive Science*.

13.10 Earth and Planetary Sciences (EPSC)

13.10.1 Location

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

13.10.2 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.831lanrocesses at p st 0 1h120.7

Assistant Professors

James Kirkpatrick; B.Sc., M.Sc.(Leeds), Ph.D.(Glas.)

Nagissa Mahmoudi; B.Sc.(Tor.), Ph.D.(McM.)

Vincent van Hinsberg; Propadeuse, Doctorandus(Utrecht), Ph.D.(Brist.) (*Osisko Faculty Scholar*)

Faculty Lecturer

W. Minarik; B.A.(St. Olaf), M.Sc.(Wash.), Ph.D.(Rensselaer Poly.)

Adjunct Professors

R. Léveillé, B. Sundby

Retired Professor

R. Hesse

13.10.5 Bachelor of Science (B.Sc.) - Minor Geology (18 credits)

The Minor Geology offers students from other departments the opportunity to obtain exposure to the Earth Sciences.

Required Courses (6 credits)

EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology

Complementary Courses (12 credits)

3 credits, one of:

EPSC 201	(3)	Understanding Planet Earth
EPSC 233	(3)	Earth and Life History

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

EPSC 203	(3)	Structural Geology
EPSC 231	(3)	Field School 1
EPSC 334	(3)	Invertebrate Paleontology
EPSC 350	(3)	Tectonics
EPSC 452	(3)	Mineral Deposits
		Chemical Oceanograph

EPSC 220	(3)	Principles of Geochemistry
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotope Geology
EPSC 542	(3)	Chemical Oceanography
EPSC 561	(3)	Ore-forming Processes
EPSC 570	(3)	Cosmochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Ear

EPSC 542	(3)	Chemical Oceanography
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Processes of Igneous Petrology
EPSC 549	(3)	Hydrogeology
EPSC 550	(3)	Selected Topics 1
EPSC 551	(3)	Selected Topics 2
EPSC 552	(3)	Selected Topics 3
EPSC 561	(3)	Ore-forming Processes
EPSC 567	(3)	Advanced Volcanology
EPSC 570	(3)	Cosmochemistry
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
ESYS 500	(3)	Earth System Applications

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

The program curriculum provides a rigorous foundation in the fundamental earth science subjects and in the advanced subjects relevant to exploration for energy resources, industrial and ore minerals, and to environmental geosciences. The program meets the academic requirements shared by the professional orders for geologists and environmental geoscientists in most Canadian pro

3 credits of field school

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

3 credits of en

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 320	(3)	Elementary Earth Physics
EPSC 340	(3)	Earth and Planetary Inference
EPSC 480D1	(3)	Honours Research Thesis
EPSC 480D2	(3)	Honours Research Thesis
MATH 222	(3)	Calculus 3
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (33 credits)

15 credits of advanced earth science

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

3 credits of field school

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

3 credits of environmental and ore-forming processes

EPSC 513	(3)	Climate and the Carbon Cycle
EPSC 519	(3)	Isotope Geology
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

EPSC 452

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

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

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

The program curriculum is designed to provide a rigorous foundation in physical sciences and the flexibility to create an individualized program in preparation for careers in industry, teaching, and research. It is intended to provide an excellent preparation for graduate work in the earth and planetary sciences.

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

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

EPSC 334	(3)	Invertebrate Paleontology
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotope Geology
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 530	(3)	Volcanology
EPSC 542	(3)	Chemical Oceanography
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Processes of Igneous Petrology
EPSC 549	(3)	Hydrogeology
EPSC 550	(3)	Selected Topics 1
EPSC 551	(3)	Selected Topics 2
EPSC 552	(3)	Selected Topics 3
EPSC 561	(3)	Ore-forming Processes
EPSC 567	(3)	Advanced Volcanology
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar

13.10.11 Earth and Planetary Sciences (EPSC) Related Programs

13.10.11.1 Joint Major in Physics and Geophysics

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

13.10.11.2 Earth System Science Interdepartmental Major

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

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

13.10.11.3 Earth System Science Interdepartmental Honours

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

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

13.11 Earth System Science (ESYS)

13.11.1 Location

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

Website: *www.ess.mcgill.ca*

13.11.2 About Earth System Science

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

Required Courses (24 credits)

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

Complementary Courses (33 credits)

One of the following two courses:

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

One of the following two courses:

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

One of the following two courses:

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

One of the following two courses:

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

One of the following two courses:

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

One of the following courses:

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

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

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

ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 315	(3)	Thermodynamics and Convection
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
BIOL 308	(3)	Ecological Dynamics
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 432	(3)	Limnology
BIOL 434	(3)	Theoretical Ecology
BIOL 441	(3)	Biological Oceanography
BIOL 465	(3)	Conservation Biology
BIOL 540	(3)	Ecology of Species Invasions
BIOL 573	(3)	Vertebrate Palaeontology Field Course
BREE 217	(3)	Hydrology and Water Resources
BREE 319	(3)	Engineering Mathematics
BREE 509	(3)	Hydrologic Systems and Modelling
BREE 510	(3)	Watershed Systems Management
BREE 515	(3)	Soil Hydrologic Modelling
BREE 533	(3)	Water Quality Management
ECON 347	(3)	Economics of Climate Change
ECON 405	(3)	Natural Resource Economics
EPSC 212	(3)	Introductory Petrology
EPSC 320	(3)	Elementary Earth Physics
EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 331	(3)	Field School 2
EPSC 334	(3)	Invertebrate Paleontology
EPSC 340	(3)	Earth and Planetary Inference
EPSC 341	(3)	Field School 3
EPSC 350	(3)	Tectonics
EPSC 355	(3)	Sedimentary Geology

EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits
EPSC 519	(3)	Isotope Geology
EPSC 530	(3)	Volcanology
EPSC 542	(3)	Chemical Oceanography
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes
EPSC 567	(3)	Advanced Volcanology
EPSC 580	(3)	Aqueous Geochemistry
EPSC 590	(3)	Applied Geochemistry Seminar
GEOG 272	(3)	Earth's Changing Surface
GEOG 305	(3)	Soils and Environment
GEOG 307	(3)	Socioeconomic Applications of GIS
GEOG 321	(3)	Climatic Environments
GEOG 322	(3)	Environmental Hydrology
GEOG 350	(3)	Ecological Biogeography
GEOG 351	(3)	Quantitative Methods
GEOG 372	(3)	Running Water Environments
GEOG 470	(3)	Wetlands
GEOG 495	(3)	Field Studies - Physical Geography
GEOG 491 165.864 379.72 Tm(gOG 491 165.8640)Tj	(3)	Subarctic Field Studies

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

* MA

One of the following two courses:

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

One of the following two courses:

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

One of the following courses:

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

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

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

ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 315	(3)	Thermodynamics and Convection
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
BIOL 308	(3)	Ecological Dynamics
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 432	(3)	Limnology
BIOL 434	(3)	Theoretical Ecology
BIOL 441	(3)	Biological Oceanography
BIOL 465	(3)	Conservation Biology

BIOL 540	(3)	Ecology of Species Invasions
BIOL 573	(3)	Vertebrate Palaeontology Field Course
BREE 217	(3)	Hydrology and Water Resources
BREE 319	(3)	Engineering Mathematics
BREE 509	(3)	Hydrologic Systems and Modelling
BREE 510	(3)	Watershed Systems Management
BREE 515	(3)	Soil Hydrologic Modelling
BREE 533	(3)	Water Quality Management
ECON 347	(3)	Economics of Climate Change
ECON 405	(3)	Natural Resource Economics
EPSC 212	(3)	Introductory Petrology
		Elementary Earth Physics

Required Courses (12 credits)

INTG 201	(3)	Integrated Management Essentials 1
INTG 202	(3)	Integrated Management Essentials 2
MGPO 362	(3)	Fundamentals of Entrepreneurship
MGPO 364	(3)	Entrepreneurship in Practice

Complementary Courses (6 credits)

Choose 6 credits from the following:

BUSA 465	(3)	Technological Entrepreneurship
MGPO 438	(3)	Social Entrepreneurship and Innovation
MIMM 387	(3)	The Business of Science

13.13 Environment

Science students who are interested in studying the environment should refer to *McGill School of Environment* > *Undergraduate*.

- Minor: *: Minor in Environment*
- Major: *: Major in Environment – B.Sc.(Ag.Env.Sc.) and B.Sc.* or *: Major in Environment – B.Sc.*
- Honours: *: Honours Program in Environment*
- Diploma: *: Diploma in Environment*

13.14 Experimental Medicine (EXMD)

13.14.1 Location

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

13.14.2 About Experimental Medicine

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

Experimental Medicine Courses

Ph

Experimental Medicine Courses		
EXMD 509	(3)	Gastrointestinal Physiology and Pathology
EXMD 510	(3)	Bioanalytical Separation Methods
EXMD 511	(3)	Joint Venturing with Industry

13.15 Field Study

For details about the available Field Study Semesters, see *Study Abroad & Field Studies* .

13.15.1 Field Studies - Minor Field Studies (18 credits)

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

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

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

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

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

Africa Field Study Semester (15 credits)

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

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

Africa Field Study Semester - Required Courses

6 credits

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

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

Africa Field Study Semester - Complementary Courses

9 credits from:

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

ANTH 411	(3)	Primate Studies & Conservation
ANTH 416	(3)	Environment/Development: Africa
BIOL 428	(3)	Biological Diversity in Africa
BIOL 429	(3)	East African Ecology
GEOG 404*	(3)	Environmental Management 2
GEOG 408	(3)	Geography of Development
GEOG 423	(3)	Dilemmas of Development
HIST 413	(3)	Independent Research

NRSC 405	(3)	Natural History of East Africa
NUTR 404	(3)	Nutrition Field Studies in East Africa
REDM 405	(3)	Natural History of East Africa
WILD 420*	(3)	Ornithology

Barbados Field Study Semester (15 credits)

The Barbados Field Study Semester (BFSS) provides one term of integrated field study for students with an interest in global issues related to natural resource use as affected by socio-economic, management, urban, and physical constraints. Offered at the Bellairs Research Institute in Barbados, this program challenges students to be more effectiv

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
HIST 510	(3)	Environmental History of Latin America (Field)

McGill Arctic Field Study Semester

Required Courses (15 credits)

9 credits

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

and 6 credits from

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

Minor Field Studies - Complementary Course

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

13.16 General Science

13.16.1 Location

Interdisciplinary Programs Adviser

A Science Major Concentration in Geography – Physical Geography option is available to students pursuing the B.A. & Sc. degree. This Major concentration is described in *Bachelor of Arts & Science* > *Undergraduate* > *Browse Academic Units & Programs* > *: Geography (GEOG)*.

13.17.4 Geography Faculty

13.17.5 Bachelor of Science (B.Sc.) - Minor Geography (18 credits)

The Minor Geography is expandable into the B.Sc. Major Geography.

The Minor Geography is designed to provide students in the Faculty of Science with an overview of basic elements of geography at the introductory and advanced level.

This Minor permits no overlap with any other programs.

Required Courses (6 credits)

GEOG 203	(3)	Environmental Systems
GEOG 216	(3)	Geography of the World Economy

Complementary Courses (12 credits)

3 credits of Geography courses at the 200 level below.

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 205	(3)	Global Change: Past, Present and Future
GEOG 210	(3)	Global Places and Peoples
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health
GEOG 272	(3)	Earth's Changing Surface

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

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

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

Required Courses (6 credits)

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

Complementary Courses (12 credits)

3 credits selected from:

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

6 credits selected from:

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

3 credits selected from:

ANTH 511	(3)	Computational Approaches to Prehistory
ATOC 309	(3)	Weather Radars and Satellites

COMP 208	(3)	Computers in Engineering
COMP 250	(3)	Introduction to Computer Science
ESYS 300	(3)	Investigating the Earth System
GEOG 306*	(3)	Raster Geo-Information Science
GEOG 307*	(3)	Socioeconomic Applications of GIS
GEOG 308*	(3)	Principles of Remote Sensing
GEOG 384*	(3)	Principles of Geospatial Web
GEOG 506*	(3)	Advanced Geographic Information Science
GEOG 535*	(3)	Remote Sensing and Interpretation

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

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

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

Required Courses (13 credits)

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

Complementary Courses (36 credits)

3 credits of statistics*

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

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

9 credits of systematic physical geography

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

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

3 to 6 credits of 300 level environmental analysis/techniques

GEOG 306	(3)	Raster Geo-Information Science
GEOG 307	(3)	Socioeconomic Applications of GIS
GEOG 308	(3)	Principles of Remote Sensing
GEOG 384	(3)	Principles of Geospatial Web

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

The Global Environmentl En

GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration

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

The BScu C"c.

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 300 level environmental analysis/techniques

GEOG 306	(3)	Raster Geo-Information Science
GEOG 307	(3)	Socioeconomic Applications of GIS
GEOG 308	(3)	Principles of Remote Sensing
GEOG 384	(3)	Principles of Geospatial Web

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

9 credits on human-environment linkages

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

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

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

Geography Approved Course List - Major, Honours and Liberal Programs

GEOG 404	(3)	Environmental Management 2
GEOG 501	(3)	Modelling Environmental Systems
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources

GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration

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

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

Required Courses (21 credits)

GEOG 201	(3)	Introductory Geo-Information Science
GEOG 203	(3)	Environmental Systems
GEOG 272	(3)	Earth's Changing Surface
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 300 level environmental analysis/techniques

GEOG 306	(3)	Raster Geo-Information Science
		Socine

13.17.10 Geography (GEOG) Related Programs and Study Semesters

The following programs, as well as several other opportunities for field study, are offered by the Faculty of Science. For further information, refer to the *Study Abroad & Field Studies* Undergraduate section or the *Science Internship & Field Studies Office website*.

13.17.10.1 Africa Field Study Semester

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

13.17.10.2 Panama Field Study Semester

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

13.17.10.3 Arctic Field Study Semester

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

Earth System Science Interdepar

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

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

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

Apply to:

*** 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 Oncogenes
CHEM 302	(3)	Introductory Organic Chemistry 3
MATH 222	(3)	Calculus 3
MATH 315*	(3)	Ordinary Differential Equations
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

U3 Complementary Courses

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

Revision, April 2018. End of revision.

13.19 Interdisciplinary Life Sciences

13.19.1 Location

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

13.19.2 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 Adviser 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.

Breadth requirement:

at least 9 credits must be taken from the Basic Life Sciences List,

at least 3 credits from the Health Social Sciences List,

at least 3 credits from the Empirical Science and Technology List.

The remaining 9 credits may be selected from any of the lists.

Basic Life Sciences

At least 9 credits from:

* Students take either ANAT 212 or BIOC 212, but not both.

ANAT 212*	(3)	Molecular Mechanisms of Cell Function
ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 321	(3)	Circuitry of the Human Brain
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 311	(3)	Metabolic Biochemistry
BIOC 450	(3)	Protein Structure and Function
BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery
CHEM 504	(3)	Drug Design
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	The Business of Science
MIMM 465	(3)	Bacterial Pathogenesis

MIMM 466	(3)	Viral Pathogenesis
NSCI 201	(3)	Introduction to Neuroscience 2
NUTR 307	(3)	Metabolism and Human Nutrition
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PSYC 211	(3)	Introductory Behavioural Neuroscience
PSYC 311	(3)	Human Cognition and the Brain
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour

Health Social Science

At least 3 credits from:

ANTH 204	(3)	Anthropology of Meaning
ANTH 227	(3)	Medical Anthropology
ANTH 302	(3)	New Horizons in Medical Anthropology
ANTH 314	(3)	Psychological Anthropology 01
ECON 440	(3)	Health Economics
GEOG 221	(3)	Environment and Health
GEOG 303	(3)	Health Geography
HIST 249	(3)	Health and the Healer in Western History
HIST 335	(3)	Science and Medicine in Canada
HIST 350	(3)	Science and the Enlightenment
HIST 381	(3)	Colonial Africa
HIST 424	(3)	Gender, Sexuality & Medicine
HSEL 308	(3)	Issues in Women's Health
HSEL 309	(3)	Women's Reproductive Health
PHIL 237	(3)	Contemporary Moral Issues
PHIL 343	(3)	Biomedical Ethics
POLI 417	(3)	Health Care in Canada
PSYC 215	(3)	Social Psychology
PSYC 304	(3)	Child Development
PSYC 333	(3)	Personality and Social Psychology

PSYC 412	(3)	Developmental Psychopathology
PSYC 413	(3)	Cognitive Development
PSYC 414	(3)	Social Development
SOCI 225	(3)	Medicine and Health in Modern Society
SOCI 309	(3)	Health and Illness
SOCI 310	(3)	Sociology of Mental Disorder
SOCI 338	(3)	Introduction to Biomedical Knowledge
SOCI 365	(3)	Health and Development
SOCI 390	(3)	Gender and Health
SOCI 515	(3)	Medicine and Society
SOCI 525	(3)	Health Care Systems in Comparative Perspective
SOCI 538	(3)	Selected Topics in Sociology of Biomedical Knowledge

Empirical Science and Technology

At least 3 credits from:

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

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

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 202	(3)	Foundations of Programming
COMP 364	(3)	Computer Tools for Life Sciences
COMP 462	(3)	Computational Biology Methods
GEOG 202	(3)	Statistics and Spatial Analysis
MATH 203	(3)	Principles of Statistics 1
MATH 204	(3)	Principles of Statistics 2
MATH 323	(3)	Probability
MATH 324*	(3)	Statistics
PSYC 204	(3)	Introduction to Psychological Statistics
PSYC 305	(3)	Statistics for Experimental Design

13.20 Kinesiology for Science Students

13.20.1 Location

Department of Kinesiology and Physical Education
Currie Gymnasium
475 Pine Avenue West, 2nd Floor
Montreal QC H2W 1S4
Telephone: 514-398-4184, ext. 09689
Fax: 514-398-4186
Email: *ugrad.kpe@mcgill.ca*
Website: *www.mcgill.ca/edu-kpe*

Program Adviser: Nada Abu-Merhy; *ugrad.kpe@mcgill.ca*

13.20.2 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.

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

13.21 Management for Science Students

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

Also av

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

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

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

Required Courses (9 credits)

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

Complementary Courses (9 credits)

9 credits selected from:

FINE 434	(3)	Topics in Finance 1
FINE 435	(3)	Advanced Topics in Finance
FINE 442	(3)	Capital Markets and Institutions
FINE 443	(3)	Applied Corporate Finance
FINE 444	(3)	Principles and Strategies of Securities Trading
FINE 445	(3)	Real Estate Finance
FINE 446	(3)	Behavioural Finance
FINE 447	(3)	Venture Capital and Entrepreneurial Finance
FINE 448	(3)	Financial Derivatives
FINE 449	(3)	Market Risk Models
FINE 451	(3)	Fixed Income Analysis
FINE 452	(3)	Applied Quantitative Finance
	A25.6	Global Investments

Category B

9 credits selected from:

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

Category C

6 credits selected from:

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

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

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

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

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

Note: Students should select their Statistics course only after consulting the "Course Overlap" section in the Faculty of Arts, the "Course Overlap" section in the Faculty of Science, and the "Course Ov

MRKT 455	(3)	Sales Management
MRKT 459	(3)	Retail Management
MRKT 483	(3)	International Marketing Management

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

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

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

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

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

It provides non-Management students with the opportunity to pursue a career that involves decision making at the operational level. Graduates will be able to find employment in consulting, manufacturing, supply chain, distribution, retail operations, healthcare management and environmental management for profit and non-profit corporations. This Minor has been designed to provide students with an understanding of the key concepts in operations management theory and practice.

Required Courses (6 credits)

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

Complementary Courses (12 credits)

3 credits

MGCR 271*	(3)	Business Statistics

9 credits selected from:

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

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

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

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

13.22 Mathematics and Statistics (MATH)

13.22.1 Location

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

13.22.2 About Mathematics and Statistics

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

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

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

Applied mathematics develops and utilizes advanced mathematical methods to solve problems in a broad range of applications in science, technology, engineering, computer science, and business. Core areas of expertise in applied mathematics include discrete mathematics, game theory, graph theory, mathematical 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, high-dimensional data modeling, multivariate analysis, and survival analysis.

13.22.3 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 and probability/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** versions are less intense and leave 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 or statistics and its applications in another area. Several **Joint Major** programs and a **Liberal** program are also available.

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

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

13.22.4 Research Opportunities

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

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

13.22.5 Internship Opportunities

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

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

For more information on these opportunities, consult *section 12: Science Internships and Field Studies*.

Note: Students entering a program listed below that has MATH 222 (Calculus 3) as a required course and who have successfully completed a course equivalent to MATH 222 with a grade of C or better may omit MATH 222 (Calculus 3) from the program, but must replace it with 3 credits of mathematics complementary courses chosen after consultation with a Mathematics adviser.

13.22.6 Mathematics and Statistics Faculty

Chair

David A. Stephens

Graduate Program Director

Dmitry Jakobson

Emeritus Professors

William J. Anderson; B.Eng., Ph.D.(McG.)

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

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

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

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

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

Paul Koosis; B.A., Ph.D.(Calif., Berk.)

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

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

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

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

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

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

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

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

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

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

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

Professors

Masoud Asgharian; B.Sc.(Shahid Beheshti), M.Sc., Ph.D.(McG.)

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

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

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

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

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

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

Pengfei Guan; B.Sc.(Zhejiang), M.Sc., Ph.D.(Princ.) (*Canada Research Chair*)

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

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

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

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

Professors

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

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

David A. Stephens; B.Sc., Ph.D.(Nott.) (*James McGill Professor*)

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

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

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

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

Associate Professors

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

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

Abbas Khalili; B.S., M.S.(Isfahan Univ. of Tech), Ph.D.(Wat.)

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

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

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

Sergey Norin; M.S.(Saint Petersburg St.), Ph.D.(Georgia Tech.)

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

Russell Steele; B.S., M.S.(Carn. Mell), Ph.D.(Wash.)

Gantumur Tsogtgerel; B.Sc.(Nat. Univ. Mongolia), M.Sc., Ph.D.(Utrecht)

Assistant Professors

Linan Chen; B.S.(Tsinghua), Ph.D.(MIT)

Sarah Harrison; B.Sc.(MIT), Ph.D.(Stan.)

Tim Hoheisel; Dipl., Ph.D.(Wurzburg)

Jessica Lin; B.A.(NYU), Ph.D.(Chic.)

Piotr Przytycki; M.Sc., Ph.D.(Warsaw)

Maksym Radziwill; B.Sc.(McG.), Ph.D.(Stan.) (*Canada Research Chair*)

Marcin Sabok; M.Sc., Ph.D.(Warsaw)

Jérôme Vétois; Ph.D.(Cergy-Pontoise)

Yi Yang; B.S.(Sichuan), M.S., Ph.D.(Minn.)

Associate Members

Xiao-Wen Chang (*Computer Science*)

Luc P. Devroye (*Computer Science*)

Pierre R.L. Dutilleul (*Plant Science*)

Leon Glass (*Physiology*)

James A. Hanley (*Epidemiology and Biostatistics*)

Hamed Hatami (*Computer Science*)

Lawrence Joseph (*Epidemiology and Biostatistics*)

Anmar Khadra (*Physiology*)

Michael Mackey (*Physiology*)

Erica E.M. Moodie (*Epidemiology and Biostatistics*)

Prakash Panangaden (*Computer Science*)

Robert W. Platt (*Epidemiology and Biostatistics*)

Associate Members

James O. Ramsay (*Psychology*)

Alexandra Schmidt (*Epidemiology and Biostatistics*)

Kaleem Siddiqi (*Computer Science*)

Christina Wolfson (*Epidemiology and Biostatistics*)

Adjunct Professors

Renato C. Calleja; B.S.(Tec. Autonomo de Mexico), Ph.D.(Texas-Austin)

Vasek Chvatal; Ph.D.(Wat.)

Eliot Freid; B.S.(Calif. Poly. St.), M.S., Ph.D.(Calif. Tech.)

Andrew Granville; B.A., CASM(Camb.), Ph.D.(Qu.)

Adrian Iovita; B.S.(Bucharest), Ph.D.(Boston)

Payman L. Kassaei; B.Sc.(Sharif Tech.), Ph.D.(MIT)

Dimitris Koukoulopoulos; M.Sc., Ph.D.(Ill.-Chic.)

Etienne Marceau; B.Sc., M.Sc.(Laval); Ph.D.(Louvain)

Ming Mei; B.Sc., M.Sc.(Jiangxi Normal Uni.), Ph.D.(Kanazawa)

Claude-Alain Pillet; M.Sc., Ph.D.(ETH Zurich)

Iosif Polterovich; M.Sc.(Moscow St.), Ph.D.(Weizmann Inst.)

M. Ram Murty; B.Sc.(Car.), Ph.D.(MIT), F.R.S.C.

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

F. Bruce Shepherd; B.Sc.(Vic., Tor.), M.Sc., Ph.D.(Wat.)

Armen Shirikyan; M.Sc., Ph.D.(Moscow St.); Habilitation(Paris-Sud XI)

Johannes Walcher; Dip., Ph.D.(ETH Zurich) (*joint appt. with Physics*)

Senior Faculty Lecturer

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

Faculty Lecturers

José A. Correa; M.Sc.(Wat.), Ph.D.(Car.)

Armel Djivede Kelome; M.Sc.(Benin), M.Sc.(McG.), Ph.D.(Georgia Tech.)

Sidney Trudeau; Ph.D.(McG.)

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

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

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

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

Required Courses (9 credits)

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

MATH 222	(3)	Calculus 3
MATH 223*	(3)	Linear Algebra

MATH 315	(3)	Ordinary Differential Equations

Complementary Courses (15 credits)

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

13.22.8 Bachelor of Science (B.Sc.) - Minor Statistics (24 credits)

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

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

Required Courses (15 credits)

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

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

Complementary Courses (9 credits)

9 credits selected from:

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

No more than 6 credits may be tak

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 407, MATH 417 and to complete the Computer Science Minor

MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 346	(3)	Number Theory
MATH 348	(3)	Euclidean Geometry
MATH 352	(1)	Problem Seminar
MATH 407	(3)	Dynamic Programming
MATH 410	(3)	Majors Project
MATH 417	(3)	Linear Optimization
MATH 423	(3)	Regression and Analysis of Variance
MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MA	(4)	Introduction to Time Series Analysis

MATH 236***	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 323	(3)	Probability
MATH 324+	(3)	Statistics
MATH 423	(3)	Regression and Analysis of Variance

Complementary Courses

18 or 21 credits

0-3 credits from:

MATH 203	(3)	Principles of Statistics 1

At least 6 credits selected from:

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

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MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 598	(4)	Topics in Probability and Statistics

Revision, April 2018. End of revision.

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

Revision, May 2018. Start of revision.

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.

Linear

6-12 credits selected from the following:

Required Courses (54 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 360	(3)	Algorithm Design
MATH 222	(3)	Calculus 3

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
H 324	(3)	Regression and Analysis of Variance

COMP 462	(3)	Computational Biology Methods
COMP 526	(3)	Probabilistic Reasoning and AI
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.

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

Revision, April 2018. Start of revision.

Applied Mathematics is a very broad field and students are encouraged to choose a coherent program of complementary courses. Most students specialize in "continuous" or "discrete" applied mathematics, but there are many sensible combinations of courses, and the following informal guidelines should be discussed with the student's adviser. Also, aside from seeking to develop a sound basis in Applied Mathematics, one of the objectives of the program is to kindle the students' interest in possible areas of application. To develop an appreciation of the diversity of Applied Mathematics, students are advised to develop some depth (e.g., by completing a minor) in a field related to Applied Mathematics such as Atmospheric and Oceanic Sciences, Biology, Biochemistry, Chemistry, Computer Science, Earth and Planetary Sciences, Economics, Engineering, Management, Physics, Physiology, and Psychology.

Required Courses (39 credits)

* COMP 250 may be preceded by COMP 202.

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

COMP 250*	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
MATH 235	(3)	Algebra 1
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced Calculus
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 325	(3)	Honours Ordinary Differential Equations
MATH 350	(3)	Graph Theory and Combinatorics
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 470	(3)	Honours Research Project
MATH 475	(3)	Honours Partial Differential Equations

Complementary Courses (21 credits)

3 credits selected from:

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

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

Advising Notes:

Students interested in continuous applied mathematics are urged to choose these as part of their Complementary Courses: MATH 454 and MATH 455, and are advised to choose additional courses from MATH 387, MATH 397, MATH 555, MATH 560, MATH 574, MATH 578, MATH 579, MATH 580, MATH 581.

Students interested in discrete applied mathematics are advised to choose from these as part of their Complementary Courses: COMP 362, COMP 490, MATH 456, MATH 457, MATH 407, MATH 547, MATH 550, MATH 552, MATH 560.

3 credits selected from:

MATH 249	(3)	Honours Complex Variables
MATH 366	(3)	Honours Complex Analysis

at least 3 credits selected from:

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

and the remainder of credits selected from:

COMP 362	(3)	Honours Algorithm Design
MATH 352	(1)	Problem Seminar
MATH 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 478	(3)	Computational Methods in Applied Mathematics
MATH 480	(3)	Honours Independent Study
MATH 488	(3)	Honours Set Theory
MATH 490	(3)	Honours Mathematics of Finance
MATH 517	(4)	Honours Linear Optimization

* Not open to students who have taken MATH 354.

** Not open to students who have taken MATH 355.

*** Not open to students who have taken MATH 370.

+ Not open to students who have taken MATH 371.

++ Not open to students who have taken MATH 380.

All MATH 500-level courses.

No more than 6 credits from the following courses for which no Honours equivalent exists:

MATH 204	(3)	Principles of Statistics 2
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 407	(3)	Dynamic Programming

Other courses with the permission of the Department.

Revision, April 2018. End of revision.

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

Revision, April 2018. Start of revision.

Program Prerequisites

The minimum requirement for entry into the Honours program is that the student has completed with high standing the following courses below or their equivalents. In addition, a student who has not completed the equivalent of MATH 222 must take it in the first term without receiving credits toward the credits required in the Honours program.

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

To remain in an Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GP

MATH 254**	(3)	Honours Analysis 1

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

12 credits selected from:

MATH 350	(3)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 377	(3)	Honours Number Theory
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours M04Aix NumericaAnalysis
MATH 398	(3)	Honours Euclidean Geometry
MATH 480	(3)	Honours Independent Study
MATH 488	(3)	Honours Set Theory
MATH 517	(4)	Honours Linear Optimization

all MATH 500-level courses.

Honours-level courses from related disciplines:

* COMP 250 may be preceded by COMP 202.

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

no more than 6 credits from the following courses for which no Honours equivalent exists:

MATH 204	(3)	Principles of Statistics 2
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of M04hematics
MATH 407	(3)	Dynamic Programming

Students may select o4her courses with the permission of the Department.

Revision, April 2018. End of revision.

13.22.16 Bachelor of Science (B.Sc.) - Honours Probability and Statistics (65 credits)

Required Courses (47 credits)

MATH 454	(3)	Honours Analysis 3
MATH 470	(3)	Honours Research Project
MATH 523	(4)	Generalized Linear Models
MATH 533	(4)	Honours Regression and Analysis of Variance
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 587	(4)	Advanced Probability Theory 1

Complementary Courses (18 credits)

3 credits selected from:

* It is strongly recommended that students take MATH 254.

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

Revision, April 2018. Start of revision.

12-15 credits selected from:

* MATH 455 cannot be taken as a substitute for MATH 587. Students may obtain credit for both MATH 587 and MATH 455.

MATH 325	(3)	Honours Ordinary Differential Equations
MATH 350	(3)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar
MATH 366	(3)	Honours Complex Analysis
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis
MATH 455*	(3)	Honours Analysis 4
MATH 458	(3)	Honours Differential Geometry
MATH 475	(3)	Honours Partial Differential Equations
MATH 480	(3)	Honours Independent Study
MATH 490	(3)	Honours Mathematics of Finance
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis
MATH 547	(4)	Stochastic Processes
MATH 550	(4)	Combinatorics
MATH 589	(4)	Advanced Probability Theory 2
MATH 594	(4)	Topics in Mathematics and Statistics
MATH 598	(4)	Topics in Probability and Statistics

Revision, April 2018. End of revision.

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

MATH 204	(3)	Principles of Statistics 2
MATH 407	(3)	Dynamic Programming
		Statistical Quality ControlHonours10 from the fo114.999rs .52 117.7 of - of9, F0.374 0 1 165.8 678.s .52 117.7acul1 01

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

This is a challenging program providing students with a solid training in both computer science and statistics suitable for entry into graduate school in either discipline.

Students may complete this program with a minimum of 76 credits or a maximum of 79 credits depending on whether or not they are exempt from taking COMP 202.

Program Prerequisites

Students entering the Joint Honours in Statistics and Computer Science are normally expected to have completed the courses below or their equivalents. Otherwise, they will be required to make up any deficiencies in these courses over and above the 76-79 credits of courses in the program.

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

Required Courses (46 credits)

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

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theory of Computation
COMP 362	(3)	Honours Algorithm Design
MATH 235	(3)	Algebra 1
MATH 247**	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced Calculus
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 533	(4)	Honours Regression and Analysis of Variance

Complementary Courses (33 credits)

18 credits in Mathematics selected as follows:

3 credits selected from:

	673p5H 247**	Analysis 1

MATH 397	(3)	Honours Matrix Numerical Analysis

At least 8 credits selected from:

MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2

The remaining Mathematics credits selected from:

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

MATH 350	(3)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar
MATH 454	(3)	Honours Analysis 3
MATH 545	(4)	Introduction to Time Series Analysis
MATH 578**	(4)	Numerical Analysis 1
MATH 587	(4)	Advanced Probability Theory 1
MATH 594	()	Topics in Mathematics and Statistics

15 credits in Computer Science selected as follows:

At least 6 credits selected from:

COMP 424	(3)	Artificial Intelligence
COMP 462	(3)	Computational Biology Methods
COMP 526	(3)	Probabilistic Reasoning and AI
COMP 540**	(3)	Matrix Computations
COMP 547	(4)	Cryptography and Data Security
COMP 551	(4)	Applied Machine Learning
COMP 552	(4)	Combinatorial Optimization
COMP 564	(3)	Advanced Computational Biology Methods and Research
COMP 566	(3)	Discrete Optimization 1
COMP 567	(3)	Discrete Optimization 2

The remaining Computer Science credits are selected from COMP courses at the 300 level or above excluding COMP 396.

13.22.18 Bachelor of Science (B.Sc.) - Honours Mathematics and Computer Science (75 credits)

Students may complete this program with a minimum of 72 credits or a maximum of 75 credits depending on whether or not they are exempt from taking COMP 202.

Program Prerequisites

Students must consult an Honours adviser in both departments. Students entering the Joint Honours in Mathematics and Computer Science are normally expected to have completed the courses below or their equivalents. Otherwise, they will be required to make up any deficiencies in these courses over and above the 72E2uAv

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

Required Courses (42 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 362	(3)	Honours Algorithm Design
MATH 235	(3)	Algebra 1
MATH 248	(3)	Honours Advanced Calculus
MATH 251	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 350	(3)	Graph Theory and Combinatorics

Complementary Courses (33 credits)

3 credits selected from:

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

* It is strongly recommended that students take MATH 254.

18 credits in Mathematics, at least 12 credits selected from:

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

*** Not open to students who have taken MATH 355.

+ Not open to students who have taken MATH 370.

++ Not open to students who have taken MATH 371.

MATH 356*	(3)	Honours Probability
MATH 387	(3)	Honours Numerical Analysis
MATH 454**	(3)	Honours Analysis 3
MATH 455***	(3)	Honours Analysis 4
MATH 456+	(3)	Honours Algebra 3
MATH 457++	(3)	Honours Algebra 4

The remaining credits should be selected from honours courses given by the Department of Mathematics and Statistics.

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

13.22.19 Mathematics and Statistics (MATH) Related Programs

13.22.19.1 Major in Biology and Mathematics

For more information, see *section 13.5: Biology (BIOL)* > *section 13.5.10: Bachelor of Science (B.Sc.) - Major Biology and Mathematics (76 credits)*.

13.22.19.2 Major in Physiology and Mathematics

For more information, see *section 13.31: Physiology (PHGY)* > *section 13.31.6: Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (79 credits)*.

13.22.19.3 Honours Program in Mathematics and Physics

For more information, see *section 13.30: Physics (PHYS)* > *section 13.30.15: Bachelor of Science (B.Sc.) - Honours Mathematics and Physics (81 credits)*.

13.23 Microbiology and Immunology (MIMM)

13.23.1 Location

Lyman Duff Medical Sciences Building, Room 511
3775 University Street
Montreal QC H3A 2B4
Telephone: 514-398-3915
Fax: 514-398-7052
Email: *undergrad.microimm@mcgill.ca*
Website: *www.mcgill.ca/microimm*

13.23.2 About Microbiology and Immunology

Microbiology is the study of microorganisms such as bacteria, viruses, unicellular eukaryotes, and parasites. Microorganisms play an important role in human and animal disease; food production (bread, cheese, wine); decay and spoilage; and contamination and purification of water and soil. Microbiologists study these tiny, self-replicating machines to understand the basic principles of life: growth, metabolism, cell division, control of gene expression, response to environmental stimuli. Microbiologists are also concerned with controlling or harnessing microorganisms for the benefit of people, by isolating antibiotics or producing vaccines to protect against disease, and by developing and perfecting microorganisms for industrial uses.

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

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

- microbial physiology and genetics;
- microbial pathogenesis;
- molecular virology;
- cellular and molecular immunology;
- 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, the veterinary sciences, research, and education.

An online undergraduate handbook, containing course and program information and information on careers in microbiology and immunology is available on our *website*.

All new students should attend a departmental **orientation/advising session** in August. Please check *www.mcgill.ca/microimm/student-affairs/advising* for dates.

13.23.3 Microbiology and Immunology Faculty

Interim Chair

G. Matlashewski

Emeritus Professors

N. Acheson, M. Baines, J.W. Coulton

Professors

J. Archambault; Ph.D.(Tor.)

A. Berghuis; M.Sc.(Rijks Univ. Groningen), Ph.D.(Br. Col.)

G.J. Matlashewski; B.Sc.(C'dia), Ph.D.(Ohio)

R.A. Murgita; B.Sc.(Maine), M.S.(Vermont), Ph.D.(McG.)

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

C. Piccirillo; B.Sc., Ph.D.(McG.)

D. Sheppard; M.D.(Tor.)

M. Stevenson; M.Sc., Ph.D.(Catholic Univ. of Amer.)

Associate Professors

D.J. Briedis; B.A., M.D.(Johns Hop.)

B. Cousineau; B.Sc., M.Sc., Ph.D.(Montr.)

S. Fournier; Ph.D.(Montr.)

J. Fritz; Ph.D.(Vienna)

S. Gruenheid; B.Sc.(Br. Col.), Ph.D.(McG.)

G. T. Marczynski; B.Sc., Ph.D.(Ill.)

Assistant Professors

Adjunct Professors

E. Emani

A. Finzi

N. Grandvaux

G. Kukolj

P. Lau

S. Lesage

S.L. Liu

J. Madrenas

R. Moutih

C. Paradis-Bleau

A. Petronela

K. Pike

W-K. Suh

S. Tran

13.23.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (50 credits)

U1 Required Courses (19 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

U1 Complementary Course (3 credits)

3 credits, select one from:

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

U1,Tm(BIOL 201S 67.52 221.2942 Tm((4))Tje0 8.3m(BIOL 201S 67.52 2212)Tj1 0 0 v)Tj1 0 0 1 18(4Tj1 0 0 v

MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes

U1, U2 or U3 Complementary Courses (3 credits)

3 credits selected from:

* Students who have taken CHEM 212 or CHEM 222 in CEGEP must replace it with another complementary course.

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458	(3)	Membranes and Cellular Signaling
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3

MIMM 496D1	(3)	Microbiology Advanced Research Project
MIMM 496D2	(3)	Microbiology Advanced Research Project
MIMM 497D1	(3)	Immunology Advanced Research Project
MIMM 497D2	(3)	Immunology Advanced Research Project
MIMM 509	(3)	Inflammatory Processes
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

13.23.5 Bachelor of Science (B.Sc.) - Major Microbiology and Immunology (66 credits)

Revision, April 2018. Start of revision.

The Major program is designed for students who want to acquire a substantial background in microbiology and immunology and related disciplines (chemistry, biology, biochemistry) which will prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes.

U1 Required Courses (26 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

** Students who have taken CHEM 222 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222**	(4)	Introductory Organic Chemistry 2
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

One of:

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

U1, U2, or U3 Required Course (3 credits)

One of:

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

U2 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology

MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Course (3 credits)

MIMM 413	(3)	Parasitology

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Complementary Courses (9 credits)

9 credits selected from:

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

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
	(3)	Membranes and Cellular Signaling

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

Revision, April 2018. End of revision.

13.23.6 Bachelor of Science (B.Sc.) - Honours Microbiology and Immunology (72 credits)

Revision, April 2018. Start of revision.

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 497D2	(3)	Immunology Advanced Research Project
MIMM 509	(3)	Inflammatory Processes
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PSYT 455	(3)	Neurochemistry

Revision, April 2018. End of revision.

Microbiology and Imm

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

Adelina Lameiras
Telephone: 514-398-4541
Email: *adelina.lameiras@mcgill.ca*

Diana Toni Dutz; B.Mus.(W. Ont.), Grad.Dip.(C'dia)
Telephone: 514-398-6337
Email: *dino.dutz@mcgill.ca*

13.24.4 Music Related Programs

13.24.4.1 Minor in Musical Applications of Technology and Minor in Musical Science and Technology

Science students may apply for admission to:

- **Minor in Musical Applications of Technology** – see *Schulich School of Music > Undergraduate > Browse Academic Units & Programs > Department of Music Research: Composition; Music Education; Music History; Theory; Faculty Program > : Bachelor of Music (B.Mus.) - Minor Musical Applications of Technology (18 credits)*
- **Minor in Musical Science and Technology** – see *Schulich School of Music > Undergraduate > Browse Academic Units & Programs > Department of Music Research: Composition; Music Education; Music History; Theory; Faculty Program > : Bachelor of Music (B.Mus.) - Minor Musical Science and Technology (18 credits)*

Enrolment in Music Technology programs is highly restricted. Interested applicants must submit an *online application* via the Schulich School of Music website by May 15 of each academic year. Late applications will not be accepted and no students will be admitted in January. Successful applicants will be notified by email before the end of June. Registration will be limited to available lab space.

13.25 Neurology and Neurosurgery (NEUR)

13.25.1 Location

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

13.25.2 About Neurology and Neurosurgery

There are no B.Sc. programs in Neurology and Neurosurgery, but the course NEUR 310 *Cellular Neurobiology*, which is part of the Minor in Neuroscience, is taught by the Faculty of Science.

13.26 Neuroscience

13.26.1 Location

Director of Neuroscience
Dr. Monroe Cohen
Department of Physiology
McIntyre Medical Sciences Building, Room 1150
3655 Promenade Sir-William-Osler
Montreal QC H3G 1Y6
Website: *www.mcgill.ca/neuroscience*

Interdisciplinary Programs Adviser
Ryan Bouma
Email: *ryan.bouma@mcgill.ca*

Telephone: 514-398-7330

13.26.2 About Neuroscience

Neuroscience is a multidisciplinary science devoted to the understanding of the nervous system. The brain is one of the most complex systems in the universe, and understanding how it functions is among the most challenging questions in science. Scientists are investigating the brain at many levels, from the molecules at synapses to complex forms of behaviour, and use methods of inquiry that are drawn from a number of disciplines, including molecular and cellular biology, physiology, behavioural sciences and cognitive psychology, computer science, and artificial intelligence. In addition, scientists are investigating the nervous system of many different animals, from simple invertebrates to humans. These wide-ranging investigations are providing a clearer understanding of how neurons work; how they communicate with one another; how they are organized into local or distributed networks; how the connections between neurons are established and change with experience; and how neuronal function is influenced by pharmacological agents and during disease states. As a result, we are gaining deeper insights into the neural basis of mental activity, as well as developing new therapeutic approaches to alleviate neurological and psychological diseases.

Please note: New students are required to attend an information session held at the end of August. Please consult the *Neuroscience website* in early August for the date and location.

13.26.3 Bachelor of Science (B.Sc.) - Minor Neuroscience (25 credits)

This Minor is intended to provide students with a basic understanding of how the nervous system functions. The Minor is composed of 24-25 credits: 9 required and 15-16 complementary. For the 15-16 complementary credits, at least 12-13 must be from outside the student's home department and at least 6 of the 12-13 must be at the 400 or 500 level.

All course selections for the Minor must be approved by the program's adviser, Ryan Bouma(Email: ryan.bouma@mcgill.ca; Office: Dawson Hall, Rm 405). Note 1: A maximum of 6-7 credits can be counted for both the student's primary program and for the Minor in Neuroscience.

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
LING 390	(3)	Neuroscience of Language
NEUR 310	(3)	Cellular Neurobiology

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314**	(3)	Integrative Neuroscience
PSYC 302	(3)	The Psychology of Pain
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour

6-15 credits from the following list of 400- and 500-level courses:

*** Students may select either BIOL 514 or PSYC 514.

BIOL 514***	(3)	Neurobiology Learning and Memory
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology

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

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
PHYS 131***	(4)	Mechanics and Waves
PHYS 142+++	(4)	Electromagnetism and Optics

Core Required Courses (20 credits)

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

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

Complementary Courses (45 credits)

9 core credits selected as follows:

3 credits from:

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

3 credits from:

COMP 202	(3)	Foundations of Programming
COMP 204	(3)	Computer Programming for Life Sciences

3 credits from:

Note: Students who have successfully completed an equivalent to MATH 222 at CEGEP or elsewhere, must replace these credits with a 3-credit elective course to satisfy the total credit requirement for the Neuroscience Major.

BIOL 309	(3)	Mathematical Models in Biology
MATH 222	(3)	Calculus 3

Streams

15 credits selected from one of the following streams:

A. Cell and Molecular Stream

15 credits selected as follows:

9 credits as follows:

BIOC 311	(3)	Metabolic Biochemistry
BIOL 202	(3)	Basic Genetics
PHGY 311	(3)	Channels, Synapses and Hormones

3 credits from:

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

3 credits from:

MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHAR 300	(3)	Drug Action

B. Neurophysiology/Neural Computation Stream

15 credits selected as follows:

6 credits as follows:

ANAT 321	(3)	Circuitry of the Human Brain
PHGY 311	(3)	Channels, Synapses and Hormones

3 credits from:

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

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour

PHGY 314	(3)	Integrative Neuroscience

3 credits from:

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
COMP 206**	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
MATH 222	(3)	Calculus 3

C. Cognitive/Behavioural Stream

15 credits selected as follows:

9 credits as follows:

ANAT 321	(3)	Circuitry of the Human Brain
PSYC 213	(3)	Cognition
PSYC 318	(3)	Behavioural Neuroscience 2

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

3 credits from:

PSYC 302	(3)	The Psychology of Pain
PSYC 317	(3)	Genes and Behaviour
PSYC 342	(3)	Hormones and Behaviour

Other Complementary Courses

(21-23 credits)

3-16 credits from:

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 389	(3)	Laboratory in Neurobiology
NSCI 410	(6)	Independent Research 1
NSCI 420D1	(4.5)	Independent Research 2
NSCI 420D2	(4.5)	Independent Research 2

The remainder of the credits should be taken from the following lists. At least 15 of the 21-23 credits must be at the 400- or 500-level, which could include the above NSCI 410 or NSCI 420D1/NSCI 420D2 research courses:

200- and 300-level courses:

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

** Students take either COMP 206 or COMP 250, but not both.

ANAT 321	(3)	Circuitry of the Human Brain
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 311	(3)	Metabolic Biochemistry
BIOL 201*	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 320	(3)	Evolution of Brain and Behaviour
CHEM 222	(4)	Introductory Organic Chemistry 2
COMP 206**	(3)	Introduction to Software Systems
COMP 250**	(3)	Introduction to Computer Science
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
NEUR 310	(3)	Cellular Neurobiology
PHAR 300	(3)	Drug Action
PHGY 210	(3)	Mammalian Physiology 2
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience
PSYC 213	(3)	Cognition
PSYC 302	(3)	The Psychology of Pain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour

400- and 500-level courses:

***Students may take either BIOL 514 or PSYC 514, but not both.

BIOL 514***	(3)	Neurobiology Learning and Memory
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BMDE 519	(3)	Biomedical Signals and Systems
COMP 546	(4)	Computational Perception
MATH 437	(3)	Mathematical Methods in Biology
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology

(3) Topics in Radionuclide Imaging

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 (33 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
PSYC 305	(3)	Statistics for Experimental Design

3 credits from:

Note: Students who hav

MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
NEUR 310	(3)	Cellular Neurobiology
PHAR 300	(3)	Drug Action
PHGY 210	(3)	Mammalian Physiology 2
PHGY 314	(3)	Integrative Neuroscience
PSYC 213	(3)	Cognition
PSYC 302	(3)	The Psychology of Pain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 342	(3)	Hormones and Behaviour

400- and 500-level courses:

** Students may take either BIOL 514 OR PSYC 514, but not both.

BIOL 514**	(3)	Neurobiology Learning and Memory
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BMDE 519	(3)	Biomedical Signals and Systems
COMP 546	(4)	Computational Perception
MATH 437	(3)	Mathematical Methods in Biology
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
NEUR 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)	Cellular 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 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 Learning and 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

Revision, April 2018. End of revision.

13.27 Nutrition (NUTR)

13.27.1 Location

School of Human Nutrition
Macdonald-Stewart Building, Room MS2-045
21,111 Lakeshore Road
Sainte-Anne-de-Bellevue QC H9X 3V9
Website: *www.mcgill.ca/nutrition*

13.27.2 About Nutrition

The School of Human Nutrition offers a **Minor in Human Nutrition** which can be taken by Science students; see *Faculty of Agricultural and Environmental Sciences* > *Undergraduate* > *Overview of Programs Offer*

Telephone: 514-398-3623
Website: *www.mcgill.ca/pharma*

13.29.2 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, it is evident that pharmacology is a very extensive subject.

Pharmacology is a multidisciplinary science. It has developed its own set of principles and methods to study the mode of the action of drugs, but it has also utilized many techniques and approaches from various disciplines including biochemistry, physiology, anatomy, and molecular biology, as well as others. Pharmacology encompasses a number of different areas such as:

- pharmacogenomics;
- molecular biology;
- bioinformatics;
- neuropharmacology;
- reproductive pharmacology;
- endocrine pharmacology;
- receptor pharmacology;
- cardiovascular pharmacology;
- toxicology;
- developmental pharmacology;
- autonomic pharmacology;
- biochemical pharmacology;
- therapeutics.

Training in pharmacology is conducted at both the undergraduate and graduate levels. Because of its breadth, students may be attracted to the subject from a variety of viewpoints; this includes those completing a bachelor's degree in any number of basic science disciplines, such as biology, zoology, chemistry, physics, biochemistry, microbiology, anatomy, and physiology. At the undergraduate level, seven lecture courses are offered. A course involving research projects in pharmacology is also available to provide the student with the opportunity to get first-hand experience in a pharmacology research laboratory. These courses provide students with knowledge concerning the actions of drugs on living systems and insight into approaches to basic pharmacological research.

13.29.3 Pharmacology and Therapeutics (PHAR) Faculty

Chair

Gerhard Multhaup

Emeritus Professors

Radan Capek; M.D., Ph.D.(Prague)

Hans H. Zingg; M.D., Ph.D.(McG.)

Professors

Daniel Bernard; Ph.D.(Johns Hop.)

Derek Bowie; B.Sc., Ph.D.(Lond.)

Paul B.S. Clarke; M.A.(Cant.), Ph.D.(Lond.)

A. Claudio Cuello; M.D.(Buenos Aires), M.A., D.Sc.(Oxf.), F.R.S.C.

Barbara Hales; M.Sc.(Phil. Coll. of Pharm. and Science), Ph.D.(McG.)

Terence Hébert; M.Sc.(Windsor), Ph.D.(Tor.)

Dusica Maysinger; Ph.D.(USC)

Anne McKinney; Ph.D.(Ulster)

Gerhard Multhaup; Ph.D.(Cologne)

Alfredo Ribeiro-da-Silva; M.D., Ph.D.(Oporto)

Professors

Bernard Robaire; B.A.(Calif.), Ph.D.(McG.)

H. Uri Saragovi; Ph.D.(Miami)

Moshe Szyf; M.Sc., Ph.D.(Hebrew)

Jacquetta Trasler; M.D.,C.M., Ph.D.(McG.)

Associate Professors

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

Assistant Professors

Bastien Castagner; Ph.D.(Col.)

Maureen McKeague; Ph.D.(Carleton)

Lisa-Marie Munter; Ph.D.(Berlin)

Jean-François Trempe; D.Phil.(Oxf.)

Associate Members

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

Carolyn Baglole; M.Sc.(PEI), Ph.D.(Calg.)

Luda Diatchenko; M.D., Ph.D.(RNRMU)

Serge Gauthier; M.D.(Montr.)

Timothy Geary; Ph.D.(Mich.)

Bertrand Jean-Claude; M.Sc.(Moncton), Ph.D.(McG.)

Brigitte Keiffer; Ph.D.(Louis Pasteur)

Sarah Kimmins; Ph.D.(Dal.)

Stephane Laporte; Ph.D.(Sher.)

Stanley Nattel; B.Sc., M.D., C.M.(McG.)

Cristian O'Flaherty; Ph.D.(McG.)

Pedro Rosa-Neto; M.D.(Lisbon), Ph.D.(Aarhus)

Simon Rousseau; Ph.D.(Laval)

Laura Stone; Ph.D.(Minn.)

Marc Ware; M.D.(Univ. West Indies, Kingston)

Edith A. Zorychta; B.Sc.(St. FX), M.Sc., Ph.D.(McG.)

Adjunct Professors

Bruce Allen; Ph.D.(Br. Col.)

Sylvain Chemtob; M.D.(Montr.), Ph.D.(McG.)

Yves De Koninck; Ph.D.(McG.)

Jean-Sebastien Joyal; M.D., Ph.D.(McG.)

Thomas Sanderson; Ph.D.(Br. Col.)

Affiliate Members

Mathieu Boucher; Ph.D.(Montr.)

Lionel Breton; Ph.D.(Paris V)

Lorella Garofalo; Ph.D.(McG.)

John Gillard; Ph.D.(Tasmania)

Joseph Mancini; M.Sc., Ph.D.(McG.)

Affiliate Members

Karen Meerovitch; Ph.D.(McG.)

13.29.4 Bachelor of Science (B.Sc.) - Minor Pharmacology (24 credits)

The Minor Pharmacology is intended for students registered in a complementary B.Sc. program who are interested in a focused introduction to specialized topics in pharmacology to prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes.

Students should declare their intent to enter the Minor in Pharmacology at the beginning of their U2 year. They must consult with, and obtain the approval of, the Coordinator for the Minor Program in the Department of Pharmacology and Therapeutics. Please contact the Student Affairs Coordinator: Chantal Grignon (undergradstudies.pharmacology@mcgill.ca; 514-398-3622).

All courses in the Minor program must be passed with a minimum grade C or better. Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program.

Required Courses (6 credits)

PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease

Complementary Courses (18 credits)

18 credits selected as follows:

3 credits from:

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

3 credits from:

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

3 credits from:

PHAR 503	(3)	Drug Discovery and Development 1
PHAR 505	(3)	Structural Pharmacology

3 credits from:

PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology

6 credits from:

PHAR 303	(3)	Principles of Toxicology
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology

PHAR 565	(3)	Epigenetic Drugs and Targets
PHAR 599	(6)	Pharmacology Research Project

13.29.5 Bachelor of Science (B.Sc.) - Major Pharmacology (67 credits)

This program incorporates extensive studies in Pharmacology with a strong component of related biomedical sciences, providing a solid preparation for employment opportunities or for entry into graduate or professional training programs. Students must consult the Student Affairs Coordinator upon entering the program and every year thereafter to verify courses and progress.

U1 Required Courses (24 credits)

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
PHAR 200	(1)	Introduction to Pharmacology 1
PHAR 201	(1)	Introduction to Pharmacology 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

* Students who have taken the equivalent of CHEM 212, CHEM 222,and/or MATH 203 in CEGEP (as defined at: http://www.mcgill.ca/students/transfercredit/prospective/cegep) are exempt and may not take these courses at McGill. Students must replace these credits with appropriate complementary course credits to satisfy the total credit requirements for their degree.

U2 Required Courses (16 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOL 301	(4)	Cell and Molecular Laboratory
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology

Complementary Courses (27 credits)

15 credits selected as follows:

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

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

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

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

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

BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
MATH 203*	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

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

PHAR 503	(3)	Drug Discovery and Development 1
PHAR 505	(3)	Structural Pharmacology

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

PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology

12 credits selected from the following upper-level science courses:

Committee approval is required to substitute an upper-level science course not in the list below.

PHAR 599D1 and PHAR 599D2 are taken together.

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 Oncogenes
BIOL 370	(3)	Human Genetics Applied
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 462***	(3)	Green Chemistry
CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery
CHEM 504	(3)	Drug Design
CHEM 5t2Pcts	(3)	Stereochemistry

CHEM 552	(3)	Physical Organic Chemistry
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 504	(3)	Biology of Cancer
EXMD 509**	(3)	Gastrointestinal Physiology and Pathology
EXMD 511	(3)	Joint Venturing with Industry
HGEN 400**	(3)	Genetics in Medicine
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 466+	(3)	Viral Pathogenesis
NEUR 310	(3)	Cellular Neurobiology
PARA 410	(3)	Environment and Infection

CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

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

BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
MATH 203*	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics

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

PHAR 503	(3)	Drug Discovery and Development 1
PHAR 505	(3)	Structural Pharmacology

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

PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology

15 credits selected from the following upper-level science courses:

Committee approval is required to substitute an upper-level science course not in the list below.

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381***	(3)	Experimental Embryology
ANAT 458*	(3)	Membranes and Cellular Signaling
BIEN 510	(3)	Engineered Nanomaterials for Biomedical Applications
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOC 470**	(3)	Lipids and Lipoproteins in Disease
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 370	(3)	Human Genetics Applied
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 462***	(3)	Green Chemistry
CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery

CHEM 504	(3)	Drug Design
CHEM 522	(3)	Stereochemistry
CHEM 552	(3)	Physical Organic Chemistry
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 504	(3)	Biology of Cancer
EXMD 509**	(3)	Gastrointestinal Physiology and Pathology
EXMD 511	(3)	Joint Venturing with Industry
HGEN 400**	(3)	Genetics in Medicine
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 466+	(3)	Viral Pathogenesis
NEUR 310	(3)	Cellular Neurobiology
PARA 410	(3)	Environment and Infection
PATH 300	(3)	Human Disease
PHAR 390	(3)	Laboratory in Pharmacology
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 425***	(3)	Analyzing Physiological Systems
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PPHS 501	(3)	Population Health and Epidemiology
PSYC 302	(3)	The Psychology of Pain
PSYC 305**	(3)	Statistics for Experimental Design
PSYC 311	(3)	Human Cognition and the Brain
PSYC 317**	(3)	Genes and Behaviour
PSYC 318**	(3)	Behavioural Neuroscience 2
PSYT 301	(3)	Issues in Drug Dependence
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
REDM 410	(3)	Writing Research Articles

Note: * Students may take either ANAT 458 or BIOC 458

** Access to these courses is not guaranteed

*** Open to students who have the Pre-requisites

+ Access to these courses is not guaranteed. Open to students who have the Pre-requisites

13.30 Physics (PHYS)

13.30.1 Location

Rutherford Physics Building, Room 108
3600 University Street
Montreal QC H3A 2T8
Telephone: 514-398-6477
Fax: 514-398-8434
Email: *chairsec.physics@mcgill.ca*
Website: *www.physics.mcgill.ca*

13.30.2 About Physics

Physics is in many ways the parent of the other natural sciences and its discoveries and laws continually affect their development. Its range and scope extend in space and time from subnuclear particles to the universe itself. The subfields of physics such as mechanics, thermodynamics, electricity, atomic physics, and quantum mechanics, to mention but a few, permeate all other scientific disciplines. People trained in physics are employed in industry, government, and educational systems where they find many challenges as teachers, researchers, administrators, and in the rapidly developing area of scientific business.

The two main undergraduate programs in physics at McGill are the Honours and the Major. The **Honours** program is highly specialized and the courses are very demanding. This program is appropriate for students who wish to make an in-depth study of the subject in preparation for graduate work and an academic

- Major in Physics
- Major Program in Atmospheric Science and Physics
- Major Program in Physics and Computer Science
- Major Program in Physics and Geophysics
- Honours in Physics
- Honours Program in Physics and Chemistry
- Honours Program in Physics and Computer Science
- Honours Program in Physics and Mathematics

13.30.4 Science Freshman Program

Students entering McGill with a Quebec CEGEP profile in Science will normally begin their programs in Physics with courses at the 200 level.

Students without this profile should normally take courses PHYS 131 and PHYS 142 if they have previously taken physics at the high school level and should be taking differential calculus concurrently with PHYS 131 and integral calculus concurrently with PHYS 142. Those students who have not previously taken physics at the high school level and who intend to do programs in the Biological Sciences may instead take courses PHYS 101 and PHYS 102. All students are expected to have reasonable fluency in algebra, geometry, and trigonometry at the high school level. If this is not the case, then MATH 112 should be taken concurrently with PHYS 101. Those for whom this is not necessary are advised to take MATH 139 concurrently with PHYS 101.

13.30.5 Physics Faculty

Chair

P. Grutter

Director of Graduate Studies

T. Webb

Emeritus Professors

J. Barrette; M.Sc., Ph.D.(Montr.)

J.E. Crawford; B.A., M.A.(Tor.), Ph.D.(McG.)

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

N.B. de Takacsy; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)

R. Harris; B.A.(Oxf.), Ph.D.(Sus.)

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

D.G. Stairs; B.Sc., M.Sc.(Qu.), Ph.D.(Harv.) (*Macdonald Emeritus Professor of Physics*)

J.O. Strom-Olsen; B.A., M.S., Ph.D.(Camb.)

M.J. Zuckermann; M.A., D.Phil.(Oxf.), F.R.S.C.

Post-Retirement Professors

Z. Altounian; Ph.D.(McM.)

F. Buchinger; Ph.D.(Johannes Gutenberg)

Professors

Professors

H. Guo; B.Sc.(Sichuan), M.Sc., Ph.D.(Pitt.), F.R.S.C. (*James McGill Professor*)

D. Hanna; B.Sc.(McG.), A.M., Ph.D.(Harv.) (*Macdonald Professor of Physics*)

S. Jeon; B.Sc.(Seoul National), M.Sc., Ph.D.(Wash.)

V. Kaspi; B.Sc.(McG.), M.A., Ph.D.(Princ.), F.R.S.C. (*Canada Research Chair*) (*Lorne Trottier Chair in Astrophysics and Cosmology*)

S. Lovejoy; B.Sc.(Camb.), Ph.D.(McG.)

N. Provatas; Ph.D.(McG.) (*Canada Research Chair*)

K. Ragan; B.Sc.(Alta.), Ph.D.(Geneva) (*Macdonald Professor of Physics*)

D.H. Ryan; B.A., Ph.D.(Dub.)

M. Sutton; B.Sc., M.Sc., Ph.D.(Tor.) (*James McGill Professor*) (*Rutherford Professor*)

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

Associate Professors

B. Coish; Ph.D.(Basel)

A. Cumming; B.A.(Camb.), Ph.D.(Calif., Berk.)

K. Dasgupta; M.Sc., Ph.D.(TIFR)

M. Dobbs; B.Sc.(McG.), Ph.D.(Vic., BC) ( )

P. Francois; Ph.D.(Paris

M. Hilke; B.Sc., M.Sc., Ph.D.(Geneva)

A. Maloney; B.S., M.S.(Stan.), Ph.D.(Harv.) (*William Dawson STf1 t 568.36 82.595 437.6 Tm(holar)Tj/F1 8.1 Tf1 0 0 1 300.148 437.6 Tm())Tj1 0 0 1 70.52 421.88 Tm*

Associate Members

A. Khadra (*Physiology*)

J. Kildea (*Medical Physics*)

I. Levesque (*Medical Physics*)

M. Mackey (*Physiology*)

J. Nadeau (*Biomedical Engineering*)

G.B. Pike (*MNI and Biomedical Engineering*)

E. Podgorsak (*Radiation Oncology*)

D. Rassier (*Kinesiology*)

D. Ronis (*Chemistry*)

J. Seuntjens (*Medical Physics*)

T. Szkopek (*Electrical and Computer Engineering*)

Adjunct Professors

F. Drolet, M. Dubé, O. Hernandez, G. Holder, B. Palmieri, G.B. Pike, V. Tabard Cossa

Curator (Rutherford Museum and McPherson Collection)

J. Barrette

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

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

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

Required Course (3 credits)

PHYS 257	(3)	Experimental Methods 1

Complementary Courses (15 credits)

15 credits to be selected as follows:

One of:

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

One of:

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

One of:

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

One of:

PHYS 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 228	(3)	Energy and the Environment
PHYS 260	(3)	Modern Physics and Relativity
PHYS 446	(3)	Majors Quantum Physics

One of:

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

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

[Program registration done by Student Affairs Office]

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

13.30.8 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physics (48 credits)

Program Prerequisites

Students entering Physics programs from the Freshman program must have successfully completed the courses below or their 212. 0 1 R212.045 Tm(v)Tj1 0 0 im.43.52

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

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

Required Courses (39 credits)

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 446	(3)	Majors Quantum Physics
PHYS 447	(3)	Applications of Quantum Mechanics

Complementary Courses (9 credits)

9 credits selected from:

PHYS 328	(3)	Electronics
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 434	(3)	Optics
PHYS 439	(3)	Majors Laboratory in Modern Physics

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

Program Prerequisites

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

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

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

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

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

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

The B.Sc. Major Physics: Biological Physics program keeps a strong core of foundational physics and specializes through courses in biology, mathematics, physiology, computer science, and chemistry. Complementary courses provide background in molecular and cell biology, computer science, and organic chemistry, whereas introductory and advanced biophysics courses offered by the Physics Department as integrative courses. This program provides students with the skills necessary to continue on to graduate studies in biophysics/biological physics, or for research careers in hospital, industrial, or university settings.

Required Courses (63 credits)

Bio-Physic83 75.54290.962 Tm(Bio-Ph)Tj1 .2 (27Ph

3 credits selected from:

PHYS 328	(3)	Electronics
PHYS 331	(3)	Topics in Classical Mechanics

3 credits selected from:

PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 439	(3)	Majors Laboratory in Modern Physics

3 credits selected from:

CHEM 514	(3)	Biophysical Chemistry
MATH 437	(3)	Mathematical Methods in Biology
PHGY 425	(3)	Analyzing Physiological Systems
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 447	(3)	Applications of Quantum Mechanics

6 to 7 credits selected from:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 316	(3)	Biomembranes and Organelles
BIOL 551	(3)	Principles of Cellular Control

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

This joint program in Physics and Geophysics provides a firm basis for graduate work in geophysics and related fields as well as a sound preparation for those who wish to embark on a career directly after the B.Sc.

Program Prerequisites

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

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

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

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

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

Required Courses (60 credits)

EPSC 203	(3)	Structural Geology
EPSC 210	(3)	Introductory Mineralogy
EPSC 231	(3)	Field School 1
EPSC 320	(3)	Elementary Earth Physics
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 319	(3)	Introduction to Partial Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432	(3)	Physics of Fluids
PHYS 446	(3)	Majors Quantum Physics

Complementary Courses (9 credits)

EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 350	(3)	Tectonics
EPSC 435	(3)	Applied Geophysics
EPSC 510	(3)	Geodynamics
EPSC 520	(3)	Earthquake Physics and Geology

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

The Major Physics and Computer Science is designed to give motivated students the opportunity to combine the two fields in a w

PHYS 331 (3) Topics in Classical Mechanics

U2 Required Courses (24 credits)

MATH 475	(3)	Honours Partial Differential Equations
PHYS 253	(3)	Thermal Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 359	(3)	Honours Laboratory in Modern Physics 1
PHYS 362	(3)	Statistical Mechanics
PHYS 457	(3)	Honours Quantum Physics 2

U3 Required Courses (6 credits)

PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 551	(3)	Quantum Theory

U3 Complementary Courses (21 credits)

6 credits selected from:

Note: PHYS 459D1 and PHYS 459D2 are taken together.

PHYS 459D1	(3)	Honours Research Thesis
PHYS 459D2	(3)	Honours Research Thesis
PHYS 469	(3)	Honours Laboratory in Modern Physics 2
PHYS 479	(3)	Honours Research Project

15 credits selected from the list below (students may substitute one or more courses with any 3-credit course approved by the Department of Physics):

PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 479	(3)	Honours Research Project
PHYS 514	(3)	General Relativity
oHYS 514	(3)	Advanced Biophysics

Required Courses (63 credits)

Bio-Physical Sciences Core (24 credits)

BIOL 219	(4)	Introduction to Physical Biology of the Cell
BIOL 395	(1)	Quantitative Biology Seminar 1
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 Advanced 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 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 446	(3)	Majors Quantum Physics
PHYS 459D1	(3)	Honours Research Thesis
PHYS 459D2	(3)	Honours Research Thesis
PHYS 519	(3)	Advanced Biophysics

Complementary Courses

(18-19 credits)

3 credits selected from:

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

3 credits selected from:

PHYS 328	(3)	Electronics
PHYS 351	(3)	Honours Classical Mechanics 2

3 credits selected from:

Measurements Laboratory in General Physics

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

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

U1 Required Courses (27 credits)

MATH 235	(3)	Algebra 1
MATH 248	(3)	Honours Advanced Calculus
MATH 249	(3)	Honours Complex Variables
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 260	(3)	Modern Physics and Relativity

U2 Required Courses (24 credits)

MATH 255	(3)	Honours Analysis 2
MATH 475	(3)	Honours Partial Differential Equations
PHYS 253	(3)	Thermal Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 362	(3)	Statistical Mechanics
PHYS 457	(3)	Honours Quantum Physics 2

U3 Required Courses (12 credits)

MATH 454	(3)	Honours Analysis 3
MATH 458	(3)	Honours Differential Geometry
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 359	(3)	Honours Laboratory in Modern Physics 1

Complementary Courses (18 credits)

U1 Complementary Course (3 credits)

MATH 247	(3)	Honours Applied Linear Algebra
MATH 251	(3)	Honours Algebra 2

U2 Complementary Courses (3 credits)

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

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

U3 Complementary Courses (12 credits)

12 credits are selected as follows:

3 credits from:

MATH 455	(3)	Honours Analysis 4
MATH 456	(3)	Honours Algebra 3

6 credits selected from:

PHYS 432	(3)	Physics of Fluids
PHYS 479	(3)	Honours Research Project
PHYS 514	(3)	General Relativity
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics
PHYS 551	(3)	Quantum Theory
PHYS 557	(3)	Nuclear Physics
PHYS 558	(3)	Solid State Physics
PHYS 559	(3)	Advanced Statistical Mechanics
PHYS 562	(3)	Electromagnetic Theory
PHYS 567	(3)	Particle Physics

3 credits in Honours Mathematics.

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

This is a specialized and demanding program intended primarily, although not exclusively, for students with a theoretical bias who are interested in working in fields of study at the crossroads of physical chemistry and physics. The program will prepare students for either theoretical or experimental graduate work in departments where there is an emphasis on such cross-disciplinary areas as condensed matter physics, chemical physics, or material science.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (unless the student improves the grade to a C or above by taking a supplemental exam or retaking the course), may not register in this Honours program the following year, or graduate with the Honours degree, except with permission of both departments.

The student will have two advisers, one from Chemistry and the other from Physics.

Program Prerequisites

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

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
		Mechanics and Wa

BIOL 112	(3)	Cell and Molecular Biology

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

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

Required Courses (68 credits)

CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
CHEM 556	(3)	Advanced Quantum Mechanics
CHEM 574	(3)	Introductory Polymer Chemistry
COMP 208	(3)	Computers in Engineering
MATH 247	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced Calculus
MATH 249	(3)	Honours Complex Variables
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 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

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CHEM 480D1	(1.5)	Undergraduate Research Project 2
CHEM 480D2	(1.5)	Undergraduate Research Project 2
CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 575	(3)	Chemical Kinetics
CHEM 585	(3)	Colloid Chemistry
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 434	(3)	Optics
PHYS 469	(3)	Honours Laboratory in Modern Physics 2
PHYS 479	(3)	Honours Research Project
PHYS 562	(3)	Electromagnetic Theory

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

** NEW PROGRAM **

This program provides essential background in physics and computer science at a level sufficient to pursue courses at the 400- and 500-level in either discipline. The program is intended to be flexible to allow students to take either more physics or more computer science courses at the advanced level.

Students entering this Joint Honours program should have high standing in mathematics, physics, and computer science. To continue in this Joint Honours program, an average GPA of 3.00 in required and complementary courses is required. For Honours standing, the CGPA at graduation must be at least 3.00; for First-Class Honours, the CGPA must be above 3.50.

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.

Required Courses (63 credits)

*Note: A student who has not taken MATH 222 (or equivalent) prior to entering the program must take it in their first semester, increasing the program credits from 78 to 81. The student must then take MATH 314 in their second semester instead of MATH 248, if scheduling requires it.

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 350	(3)	Numerical Computing
MATH 240	(3)	Discrete Structures 1
MATH 247	(3)	Honours Applied Linear Algebra
MATH 248*	(3)	Honours Advanced Calculus
MATH 249	(3)	Honours Complex Variables
MATH 314*	(3)	Advanced Calculus
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 253	(3)	Thermal Physics
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 357	(3)	Honours Quantum Physics 1

PHYS 362	(3)	Statistical Mechanics
PHYS 457	(3)	Honours Quantum Physics 2

Complementary Courses (15 credits)

At least 6 of the 15 complementary credits must come from a course at the 400- or 500-level (excluding COMP 400 and PHYS 479), and of these at least 3 must be from a COMP course.

3 or 4 credits selected from:

COMP 400	(4)	Project in Computer Science
PHYS 479	(3)	Honours Research Project

6 or 7 credits selected from:

COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 362	(3)	Honours Algorithm Design

Any COMP course at the 400- or 500-level (excluding COMP 400) (3 or 4 credits)

At least 4 credits selected from:

MATH 323	(3)	Probability
MATH 340	(3)	Discrete Structures 2
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 359	(3)	Honours Laboratory in Modern Physics 1
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics

Any number of PHYS courses at the 500 level (3 credits each)

Any number of COMP courses at the 400 or 500-level (excluding COMP 400) (3 or 4 credits each)

13.30.18 Physics (PHYS) Related Programs

13.30.18.1 Major in Atmospheric Science and Physics

See *section 13.3: Atmospheric and Oceanic Sciences (ATOC)*. This program provides a firm basis for graduate work in atmospheric science and related fields as well as a sound preparation for those who wish to embark on a career directly after the B.Sc. Students should consult undergraduate advisers in both departments.

13.30.18.2 Major in Physiology and Physics

See *section 13.31: Physiology (PHGY)*. This program provides a firm basis for graduate work in bio-physics and other interdisciplinary fields involving the physical and biological sciences.

13.31 Physiology (PHGY)

13.31.1 Location

McIntyre Medical Sciences Building, Room 1021
3655 Promenade Sir-William-Osler
Montreal QC H3G 1Y6

Telephone: 514-398-4316
Website: *www.mcgill.ca/physiology*

13.31.2 About Physiology

Physiology has its roots in many of the basic sciences including biology, chman

Emeritus Professors

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

Kresimir Krnjevic; O.C., B.Sc., Ph.D., M.B., Ch.B.(Edin.), F.R.S.C.

Wayne S. Lapp; M.S.A.(Tor.), Ph.D.(McG.)

Mortimer Levy; B.Sc., M.D.,C.M.(McG.), F.R.C.P.(C) (*joint appt with Medicine*)

George Mandl; B.Sc.(C'dia); Ph.D.(McG.)

Michael Mackey; B.A., Ph.D.(Wash.) (*Joseph Morley Professor of Physiology*)

Geoffrey Melvill Jones; B.A., M.A., M.B., B.Ch., M.D.(Cant.)

Joseph Milic-Emili; M.D.(Milan) (*joint appt with Medicine*)

Canio Polosa; M.D., Ph.D.(McG.)

Douglas G.D. Watt; M.D., Ph.D.(McG.)

Professors

Maurice Chacron; Ph.D.(Ott.)

Monroe W. Cohen; B.Sc., Ph.D.(McG.)

Ellis J. Cooper; B.Eng.(Sir G. Wms.), M.Sc.(Surr.), Ph.D.(McM.)

Leon Glass; B.S.(Brooklyn), Ph.D.(Chic.) (*Rosenfeld Professor of Medicine*) (*joint appt. with Medicine*)

Phil Gold; C.C., B.Sc., M.Sc., Ph.D., M.D.,C.M.(McG.), F.R.C.P.(C), F.R.S.C. (*Douglas G. Cameron Professor of Medicine*) (*joint appt. with Medicine*)

John Hanrahan; Ph.D.(Br. Col.)

David Goltzman; B.Sc., M.D.,C.M.(McG.) (*Antoine G. Massabki Professor of Medicine*) (*joint appt. with Medicine*)

Gergely Lukacs; M.D., Ph.D.(Budapest)

Sheldon Magder; M.D.(Tor.) (*joint appt. with Medicine*)

Jacopo P. Mortola; M.D.(Milan)

John Orlowski; B.Sc.(McG.), M.Sc., Ph.D.(Qu.) (*James McGill Professor*)

Premsyl Ponka; M.D., Ph.D.(Prague) (*joint appt. with Medicine*)

Alvin Shrier; B.Sc.(C'dia), Ph.D.(Dal.) (*Hosmer Professor of Physiology*)

John White; B.Sc., M.Sc.(Car.), Ph.D.(Harv.) (*joint appt. with Medicine*)

Associate Professors

Erik Cook; Ph.D.(Baylor Coll., Tx)

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

Michael Guevara; Ph.D.(McG.)

Russell Jones; Ph.D.(Tor.)

Ursula Stochaj; Ph.D.(Cologne)

Associate Professor (Part-time)

Nicole Bernard; B.Sc.(McG.), Ph.D.(Duke)

Assistant Professors

Claire Brown; B.Sc.(St. Mary's), Ph.D.(W. Ont.)

Gil Bub; B.Sc., Ph.D(McG.)

Anmar Khadra; B.Sc.(C'dia), M.Sc., Ph.D.(Wat.)

Connie Krawczyk; B.Sc.(Guelph), Ph.D.(Tor.) (*joint appt. with Microbiology & Immunology*)

Arjun Krishnaswamy; B.Sc. Ph.D.(McG.)

Judith Natalia Mandl; B.Sc.(Warw.), Ph.D.(Emory)

Assistant Professors

Anastasia Nijnik; M.Biochem., Ph.D.(Oxf.)

Masha Prager-Khoutorsky; B.Sc., Ph.D.(Hebrew)

Daniela Quail; B.Sc., Ph.D.(W.Ont.)

Reza Sharif-Naeini; B.Sc.(Montr.), M.Sc., Ph.D.(McG.)

Melissa Vollrath; B.Sc.(Wisc.), Ph.D. (Baylor Coll., Houston)

Associate Members

Anaesthesia: Steven Backman

Biomedical Engineering: Robert Kearney, Satya Prakash

Biomedical Ethics: Jennifer Fishman

Kinesiology and Physical Education: Dilson Rassier

Mathematics: Anthony Humphries

Medicine: Nicole Bernard, Volker Blank, Mark Blostein, Andrey Cybulsky, Geoffrey Hendy, Louise Larose, Anne-Marie Lauzon, Serge Lemay, James Martin, Barry Posner, Shafaat Rabbani, Simon Rousseau, Mary Stevenson, Tomoko Takano, Elena Torban, Simon Wing

Microbiology and Immunology: Jörg Fritz

Neurology and Neurosurgery: Jack Antel, Massimo Avoli, Daniel Guitton, Christopher Pack, David Ragsdale, Ed Ruthazer, Amir Shmuel, Jesper Sjöström

Ophthamology: Curtis Baker

Otolaryngology: Bernard Segal

Pediatrics: Charles Rohlicek

Pharmacology and Therapeutics: Daniel Bernard, Terence Hebert

Psychiatry: Nicolas Cermakian

Research in Neuroscience: Charles Bourque, Sal. T. Carbonetto

Adjunct Professors

K. Cullen, P. Haghighi, J. Martinez-Trujillo

Associate Professor Post-Retirement

Ann Wechsler; B.A.(Tor.), M.Sc., Ph.D.(McG.)

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

Required Courses (38 credits)

* Students who have taken CHEM 212 and/or CHEM 222 in CEGEP are exempted and must replace these credits with 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 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology

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

Complementary Courses (12 credits)

12 credits selected as follows:

3 credits selected from:

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

3 credits selected from:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 202	(3)	Foundations of Programming
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
	(3)	Advanced Endocrinology 1

Adced Immunology

PHGY 516	(3)	Physiology of Blood 2
PHGY 518	(3)	Artificial Cells
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 531	(3)	Topics in Applied Immunology
PHGY 550	(3)	Molecular Physiology of Bone
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.31.5 Bachelor of Science (B.Sc.) - Major Physiology (65 credits)

The Major program includes, in addition to some intensive studies in Physiology, a strong core content of related biomedical sciences. Admission to the Major program will be in U2, upon completion of the U1 required courses, and in consultation with the student's adviser.

If not previously taken, CHEM 212 "Introductory Organic Chemistry 1" must be completed in addition to the 64-65 program credits.

Students may complete this program with a minimum of 64 credits or a maximum of 65 credits depending on their choice of complementary courses.

U1 Required Courses (18 credits)

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 222	(4)	Introductory Organic Chemistry 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

U2 and U3 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOL 301	(4)	Cell and Molecular Laboratory
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

Complementary Courses (28 credits)

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 202	(3)	Foundations of Programming
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)	Cellular Immunology
PHGY 515	(3)	Physiology of Blood 1
PHGY 516	(3)	Physiology of Blood 2
PHGY 518	(3)	Artificial Cells
PHGY 520	(3)	Ion Channels

PHGY 524	(3)	Chronobiology
PHGY 531	(3)	Topics in Applied Immunology
PHGY 550	(3)	Molecular Physiology of Bone
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

* 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 belowF listed belo, Biology

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)	The Psychology of 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
		Neurochemistry and Beha

MATH 222	(3)	Calculus 3
MATH 223*	(3)	Linear Algebra
MATH 247*	(3)	Honours Applied Linear Algebra

PHYS 519	(3)	Advanced Biophysics

13.31.7 Bachelor of Science (B.Sc.) - Major Physiology and Physics (82 credits)

This program provides a firm foundation in physics, mathematics, and physiology. It is appropriate for students interested in applying methods of the physical sciences to problems in physiology and allied biological sciences.

Required Courses (76 credits)

Bio-Physical Sciences Core

BIOL 219	(4)	Introduction to Physical Biology of the Cell
BIOL 395	(1)	Quantitative Biology Seminar 1
MATH 222	(3)	Calculus 3
MATH 223*	(3)	Linear Algebra
MATH 247*	(3)	Honours Applied Linear Algebra
MATH 315**	(3)	Ordinary Differential Equations
MATH 325**	(3)	Honours Ordinary Differential Equations
PHYS 329	(3)	Statistical Physics with Biophysical Applications

* Students may take either MATH 223 or MATH 247.

** Students may take either MATH 315 or MATH 325.

Physiology and Physics Core

BMDE 519	(3)	Biomedical Signals and Systems
MA	(3)	Honours Advanced Calculus

Complementary Courses (6 credits)

3 credits, one of:

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience

3 credits, one of:

PHYS 413	(3)	Physical Basis of Physiology
PHYS 519	(3)	Advanced Biophysics

13.31.8 Bachelor of Science (B.Sc.) - Honours Physiology (75 credits)

All admissions to the Honours program will be in U2, and the student must have a U1 GP

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 202	(3)	Foundations of Programming
COMP 250	(3)	Introduction to Computer Science
PSYC 305	(3)	Statistics for Experimental Design

3 credits, one of:

BIOC 312	(3)	Biochemistry of Macromolecules

PHGY 550	(3)	Molecular Physiology of Bone
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.33 Psychology (PSYC)

13.33.1 Location

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

13.33.2 About Psychology

The Department of Psychology offers programs in both Arts and Science. All B.A. programs in Psychology can be found in *Faculty of Arts* > *Undergraduate* > *Browse Academic Units & Programs* > *: Psychology (PSYC)*.

Psychology is the scientific study of mind and behaviour. It is both a **social** and a **biological** science.

- As a **social science**, psychology examines the social nature of human beings and the influence that culture, group membership, and relationships have on individual personality, thought, and behaviour.
- As a **biological science**, psychology seeks to 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 are collected within the psychological laboratory by the use of experimental methods in the study of beha

13.33.3 Information Meetings for New Students

All new students entering the Psychology undergraduate program should attend an information meeting prior to registration. Newly admitted students from CEGEPs should attend the information session in June. There will be an identical information session in August for all other students and for any CEGEP students who could not attend the earlier meeting. Please check the *Psychology Department website* for the specific dates. Students accepted into a Bachelor of Arts program must attend a different information meeting from the one offered to students in the Faculty of Science. (For details, see *Faculty of Arts* > *Undergraduate* > *Browse Academic Units & Programs* > *: Psychology (PSYC)*). At this meeting, Paola Carvajal, the Academic Adviser, will explain the requirements of the Department's programs. Incoming students will hav

Emeritus Professors

R.O. Pihl; B.A.(Lawrence), Ph.D.(Ariz.)

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

This Core Science Component Psychology requires the completion of 45 credits in Psychology, all of which need to be passed with a minimum grade of C. A prerequisite to the program is PSYC 100 or equivalent. Students completing a Liberal Program with a Core Science Component Psychology must also complete at least one breadth component in a second area.

Recommended Background

It is expected that most students who enter the Liberal program in Psychology will have taken introductory psychology, biology, and statistics at the collegial level. Recommended CEGEP courses include Psychology 350-101 or 350-102 or equivalent; Biology CEGEP objective 00UK, 00XU or equivalent; and Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-level statistics course to be exempt from PSYC 204. In the first year, those students who have not taken the recommended collegial-level statistics course, or those who have obtained a grade below 75%, must take Psychology PSYC 204. Those who have not taken Introductory Psychology in CEGEP must take PSYC 100.

Required Course (3 credits)

PSYC 204	(3)	Introduction to Psychological Statistics

Complementary Courses (42 credits)

9 credits from:

PSYC 211	(3)	Introductory Behavioural Neuroscience
PSYC 212	(3)	Perception
PSYC 213	(3)	Cognition
PSYC 215	(3)	Social Psychology

List A

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

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	The Psychology of Pain
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 329	(3)	Introduction to Auditory Cognition
PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour
PSYC 352	(3)	Cognitive Psychology Laboratory
PSYC 403	(3)	Modern Psychology in Historical Perspective
PSYC 406	(3)	Psychological Tests
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 444	(3)	Sleep Mechanisms and Behaviour

PSYC 451	(3)	Human Factors Research and Techniques
PSYC 470	(3)	Memory and Brain
PSYC 501	(3)	Auditory Perception
PSYC 502	(3)	Psychoneuroendocrinology
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of Learning and Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 529	(3)	Music Cognition
PSYC 531	(3)	Structural Equation Models
PSYC 536	(3)	Correlational Techniques
PSYC 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication and Consciousness
PSYC 541	(3)	Multilevel Modelling
PSYC 545	(3)	Topics in Language Acquisition
PSYC 561	(3)	Methods: Developmental Psycholinguistics
PSYC 562	(3)	Measurement of Psychological Processes

List B

6 credits in Psychology from List B (Social, Health, and Developmental Psychology).

PSYC 304	(3)	Child Development
PSYC 316	(3)	Psychology of Deafness
PSYC 328	(3)	Health Psychology
PSYC 331	(3)	Inter-Group Relations
PSYC 332	(3)	Introduction to Personality
PSYC 333	(3)	Personality and Social Psychology
PSYC 337	(3)	Introduction to Psychopathology
PSYC 351	(3)	Research Methods in Social Psychology
PSYC 408	(3)	Principles of Cognitive Behaviour Therapy
PSYC 409	(3)	Positive Psychology
PSYC 412	(3)	Developmental Psychopathology
PSYC 414	(3)	Social Development
PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 475	(3)	Neuroscience of Social Psychology
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations

PSYC 512	(3)	Advanced Personality Seminar
PSYC 528	(3)	Vulnerability to Depression and Anxiety
PSYC 530	(3)	Applied Topics in Deafness
PSYC 533	(3)	International Health Psychology
PSYC 535	(3)	Advanced Topics in Social Psychology

15 credits in Psychology at the 300 level or above.

6 credits in Psychology at the 400 or 500 level.

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

Students majoring in Psychology must obtain a minimum grade of C in all 54 credits of the program. A grade lower than C may be made up by taking another equivalent course (if there is one), by successfully repeating the course, or by successfully writing a supplemental examination (if there is one).

Recommended Background

It is expected that most students who enter the Major program in Psychology will have taken introductory psychology, biology, and statistics at the collegial level. Recommended CEGEP courses include Psychology 350-101 or 350-102 or equivalent; Biology CEGEP objective 00UK, 00XU or equivalent; and Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-level statistics course. In the first year those students who have not taken the recommended collegial-level statistics course, or those who have obtained a grade below 75%, must take Psychology PSYC 204. Those who have not taken the recommended collegial-level biology must tak

PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations
PSYC 512	(3)	Advanced Personality Seminar
PSYC 528	(3)	Vulnerability to Depression and Anxiety
PSYC 530	(3)	Applied Topics in Deafness
PSYC 533	(3)	International Health Psychology
PSYC 535	(3)	Advanced Topics in Social Psychology

6 credits at the 300 level or above.

9 credits in Psychology at the 400 or 500 level.

12 credits at the 300 level or above in any of the following disciplines: Psychology (PSYC), Anatomy and Cell Biology (ANAT), Biology (BIOL), Biochemistry (BIOC), Chemistry (CHEM), Computer Science (COMP), Mathematics (MATH), Physiology (PHGY), Psychiatry (PSYT).

13.33.9 Bachelor of Science (B.Sc.) - Honours Psychology (60 credits)

Honours in Psychology prepares students for graduate study, and so emphasizes practise in the research techniques which are used in graduate school and professionally later on. Students are normally accepted into Honours at the beginning of their U2 year, and the two-year sequence of Honours courses continues through U3.

Recommended Background

It is expected that most students who enter the Honours program in Psychology will have taken introductory psychology, biology, and statistics at the collegial level. Recommended CEGEP courses include Psychology 350-101 or 350-102 or equivalent; Biology CEGEP objective 00UK, 00XU or equivalent; and Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-level statistics course. In the first year, those students who have not taken the recommended collegial-level statistics course, or those who have obtained a grade below 75%, must take Psychology PSYC 204. Those who have not taken the recommended collegial-level biology must take BIOL 111 or BIOL 112, and those who have not taken Introductory Psychology in CEGEP must take PSYC 100.

The application is available on the Psychology Dept website at:
http://www.mcgill.ca/psychology/undergraduate/current-students/research-opportunities/research-courses. The deadline is specified on the application form. Candidates will be informed of the Department's decision via email before classes begin in September.

Program Prerequisites

Admission to Honours is selective. Students with a cumulative grade point average (CGPA) of 3.00 or better are eligible to apply; however, since enrolment is limited, the usual CGPA for admission to this program is 3.50. Students must complete 27 graded credits in their U1 academic year to be eligible to apply to the Honours program.

Students must complete the following courses in their U1 year to be eligible to apply to the Honours program: PSYC 204, PSYC 211, PSYC 212, PSYC 213, and PSYC 215. Students are advised to complete PSYC 305 in their U1 year. Once in the Honours program, the student must obtain a GPA of 3.00 in the U2 year in order to continue in the program for U3. Honours students are encouraged to take at least 27 graded credits per academic year. This is also usually the minimum number of credits required to be eligible for fellowships and awards.

U1 Required Courses (12 credits)

Note: PSYC 100 may be taken as a corequisite with these basic courses.

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

PSYC 213	(3)	Cognition
PSYC 215	(3)	Social Psychology

U1 or U2 Required Course (3 credits)

PSYC 305	(3)	Statistics for Experimental Design

U2 Required Courses (9 credits)

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

U3 Required Course (3 credits)

PSYC 482	(3)	Advanced Honours Seminar

Complementary Courses (33 credits)

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

PSYC 403	(3)	Modern Psychology in Historical Perspecti
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)	The Psychology of Pain
PSYC 310	(3)	Intelligence
		Human Cognition and the ,e62 Tm(Honours64 249 260j1 034.378 324.965 Tm(viourao 0 1 728.67.245 Tj/Fual Non213)

PSYC 413	(3)	Cognitive Development
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 451	(3)	Human Factors Research and Techniques
PSYC 470	(3)	Memory and Brain
PSYC 501	(3)	Auditory Perception
PSYC 502	(3)	Psychoneuroendocrinology
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of Learning and Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 529	(3)	Music Cognition
PSYC 531	(3)	Structural Equation Models
PSYC 536	(3)	Correlational Techniques
PSYC 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication and Consciousness
PSYC 541	(3)	Multilevel Modelling
PSYC 545	(3)	Topics in Language Acquisition
PSYC 561	(3)	Methods: Developmental Psycholinguistics
PSYC 562	(3)	Measurement of Psychological Processes

List B

6 credits in Psychology from List B (Social, Health, and Developmental Psychology)

PSYC 304	(3)	Child Development
PSYC 316	(3)	Psychology of Deafness
PSYC 328	(3)	Health Psychology
PSYC 331	(3)	Inter-Group Relations
PSYC 332	(3)	Introduction to Personality
PSYC 333	(3)	Personality and Social Psychology
PSYC 337	(3)	Introduction to Psychopathology
PSYC 351	(3)	Research Methods in Social Psychology
PSYC 408	(3)	Principles of Cognitive Behaviour Therapy
PSYC 409	(3)	Positive Psychology
PSYC 412	(3)	Developmental Psychopathology
PSYC 414	(3)	Social Development
PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 475	(3)	Neuroscience of Social Psychology
PSYC 483	(3)	Seminar in Experimental Psychopathology

PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations
PSYC 512	(3)	Advanced Personality Seminar
PSYC 528	(3)	Vulnerability to Depression and Anxiety
PSYC 530	(3)	Applied Topics in Deafness
PSYC 533	(3)	International Health Psychology
PSYC 535	(3)	Advanced Topics in Social Psychology

9 credits at the 300 level or above selected from:

Anatomy and Cell Biology (ANAT), Biochemistry (BIOC), Biology (BIOL), Chemistry (CHEM), Computer Science (COMP), Mathematics (MATH), Physiology (PHGY), Psychiatry (PYST), Psychology (PSYC).

13.34 Redpath Museum (REDM)

13.34.1 Location

Redpath Museum
859 Sherbrooke Street West

BIOL 418	(3)	Freshwater Invertebrate Ecology
BIOL 427	(3)	Herpetology
BIOL 463	(3)	Mammalian Evolution
ENTO 330**	(3)	Insect Biology
ENTO 350**	(3)	Insect Biology and Control
ENTO 440	(3)	Insect Diversity
ENTO 535	(3)	Aquatic Entomology
EPSC 334	(3)	Invertebrate Paleontology
WILD 307	(3)	Natural History of Vertebrates
WILD 350	(3)	Mammalogy
WILD 420	(3)	Ornithology

List B: Botany

* Note: BIOL 205 and BIOL 215 may be applied to either List A or List B.

AEBI 210	(3)	Organisms 1
BIOL 205*	(3)	Biology of Organisms
BIOL 215*	(3)	Introduction to Ecology and Evolution
BIOL 240	(3)	Monteregian Flora
BIOL 355	(3)	Trees: Ecology & Evolution
PLNT 304	(3)	Biology of Fungi
	(3)	Plant Structure and Function

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

13.35 Science or Mathematics for Teachers

13.35.1 Location

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

13.35.2 About Science or Mathematics for Teachers

Note: The Concurrent B.Sc. and B.Ed. degree has been retired effective 2018.

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

The traditional **Bachelor of Education**, Secondary Program, Science and Technology, or Secondary Program, Mathematics is available within the Faculty of Education; see *Faculty of Education > Undergraduate > Browse Academic Units & Programs > Department of Integrated Studies in Education > : Overview of Programs (Integrated Studies in Education)*. Additionally, the **Master of Arts in Teaching and Learning** (MATL) is available in the Faculty of Education (see *Faculty of Education > Graduate > Browse Academic Units & Programs > : Integrated Studies in Education*).

13.35.3 Science or Mathematics for Teachers Faculty

Concurrent B.Sc. and B.Ed.

Coordinator, Pete Barry
Faculty of Science
Telephone: 514-398-3202

Minor in Education for Science Students

Program Adviser, Vanessa Smith
Faculty of Education
Telephone: 514-398-7042
Website: *www.mcgill.ca/isa*

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

This Minor allows Science students to develop or explore an interest in Education without committing themselves to completing a B.Ed. degree. Science students who have taken this Minor in Education will have completed some of the credits for the B.Ed. degree should they wish to enrol in that program.