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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 F aculty of Science

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

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

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

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

2 Histor y of the F aculty of Science

The study of science at McGill goes back almost two centuries, when the lower campus was a rough and muddy cow pasture and the University struggled to establish itself. In 1855, the job of principal was given to a Nova Scotia–born geologist, John William Dawson. When he arrived at McGill, Dawson laid out plans for walks and roads, and at his own expense arranged the planting of trees on the entrance avenue. More importantly, Dawson worked diligently to transform McGill from a poor976pense Sh8(a Scotia–bo.ed anv506 624.615 Tm22k)Tduasform McGilv 1 25.1col37 571.155 Tm263.4ransform McGilgf bol f0 0 1 2

The Concurrent B.Sc. and B.Ed. program is designed to provide you with the opportunity to obtain both a B.Sc. and a B.Ed. after a minimum of 135 credits of study. For more information, see *section 13.35: Science or Mathematics for Teachers* and *Faculty of Education* .

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

4.3   Administrative Officer s

Dean

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

Associate Dean (Academic)

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

Director of Advising Services

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

Chief Academic Adviser

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

Associate Dean (Graduate Education)

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

Associate Dean (Research)

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

Assistants to the Dean

Josie D'Amico

Angela Mansi

4.4   Science Office f or Under graduate Student Ad vising (SOUSA)

The Science Office for Undergraduate Student Advising (SOUSA) provides ongoing advice and guidance on academic issues related to programs, degree requirements, registration, course change, withdrawal, deferred exams, supplemental exams, academic standing, inter- and intra-faculty transfer, year or term away, transfer credits, second programs, second degrees, and graduation.

Every student in the B.Sc. degree is assigned an adviser in SOUSA. The adviser's name appears near the top of your Advising Transcript on Minerva. You can contact your adviser directly, or if you do not yet have a SOUSA adviser, at *adviser.science@mcgill.ca*.

SOUSA advisers provide assistance with degree planning and are a valuable referral source. They are a good place to start if you are not sure where to address your question. They also offer help managing academic situations during periods of personal, financial, or medical problems, by working with you to identify various possibilities and strategies for making informed decisions.

Special requests can be made, in writing, to the Director of Advising Services.casu tr name leriod, to the Director of

6.3   Time and Credit Limit f   or the Completion of the Degree

For a list of "Minor Programs," see *section 10.2: Minor Programs*; for minor concentrations that are approved for Science students, see *section 10.6: Faculty of Arts Major and Minor Concentration Programs Available to Science Students*.

6.4.3   Other Second Pr ograms

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   Concurrent B.Sc. and B.Ed. Program

The Concurrent B.Sc. and B.Ed. program described in *section 13.35: Science or Mathematics for Teachers* is designed to provide you with the opportunity to obtain both a B.Sc. and a B.Ed. after a minimum of 135 credits of study.

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

For more information, see the *B.Sc. and B.Ed. website* or contact Pete Barry, *pete.barry@mcgill.ca*.

6.4.5   Special Designations

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

6.5.3 Correspondence, Distance Education, or Web-based Courses

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

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

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 but one of them. Please consult the departmental listings for course descriptions and availability.

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

The First-Y

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

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8 Freshman Interest Gr oups

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

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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 to leave Montreal prior to the scheduled end of any examination period.

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10 Over view of Pr ograms Off ered

Programs Offered

section 10.1: Bachelor of Science Program Groups, which may include Liberal Program – Core Science Components, Major Programs, Joint Major Programs, Honours Programs, and Joint Honours Programs

section 10.2: Minor Programs

section 6.4.4: Concurrent B.Sc. and B.Ed. Program (Note: The Concurrent B.Sc. and B.Ed. program is no longer accepting new students as of Fall 2011.)

section 10.4: Bachelor of Arts and Science

section 10.5: Internships, Field Studies, and Global Designation

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

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10.1 Bachelor of Science Pr ogram Gr oups

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

The groups within the B.Sc. are:

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

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

- *section 10.1.1: Biological, Biomedical & Life Sciences Group*
- *section 10.1.2: Neuroscience Group*
- *section 10.1.3:e7seip022 T.12o48.4hxaminations:*

- *section 10.3: Concurrent B.Sc. and B.Ed. Program (Science or Mathematics for Teachers)* (Note that as of September 2011, no new students are being admitted to this group.)

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

- Environment – Renewable Resource Management domain: *: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major Environment - Renewable Resource Management (63 credits)*
- Environment – Water Environments and Ecosystems domain – Biological: *: Bachelor of Science (Agricultural and Environmental Sciences) (B.Sc.(Ag.Env.Sc.)) or Bachelor of Science (B.Sc.) - Major En*

10.2   Minor Pr ograms

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*

Minor Programs

Statistics, *section 13.22.8: Bachelor of Science (B.Sc.) - Minor Statistics (24 credits)*

Notes:

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

Major Concentrations

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

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

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

Classics, *: Bachelor of Arts (B.A.) - Major Concentr*

- *section 11.2.1: NSERC Undergraduate Student Research Awards*
- *section 11.2.2: NSERC Industrial Undergraduate Student Research Awards*
- *section 11.2.3: SURA: Science Undergraduate Research Awards*

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

11.2.1   NSERC Undergraduate Student Resear ch 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. o apply

12 Science Internships and Field Studies

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

Dawson Hall, Room 408
853 Sherbrooke Street West
Montreal QC H3A 0G5
Telephone: 514-398-1063
Email: *internshipsfieldstudies.science@mcgill.ca*
Website: *www.mcgill.ca/science/programs/internships*

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

What is a B.Sc. Liberal Program?

This is a flexible and modular program. You combine a core science component (CSC) in a Science discipline with a breadth component, which may be a minor from a wide variety of areas, a major concentration from the Faculty of Arts, or a second CSC from any group in Science. Consider the Liberal program if you do not want to overly specialize—plus, you will still have room left over for elective courses.

What about Joint Programs?

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

What about Interdisciplinary Programs?

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

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 biology, chemistry, mathematics, and physics. Similarly, if you have completed courses at other universities or colleges, you may receive exemptions and/or credits. You should consult *www.mcgill.ca/students/transfercredit* for more information.

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

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

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

General Math and Science Breadth

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

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

or

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

Science Complementary

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

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.

2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.

3. Students entering the Freshman Program should be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/student/newstudents/u0/bscfreshman/specific.

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

5. Some medical and dental schools have specific freshman course requirements. Check the admission requirements of the school(s) to which you intend to apply.

List of approved Freshman Science Courses

Select the approved courses according to the instructions above.

ATOC 100	(3)	Extreme-Weather and Climate-Change Physics
BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
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 115 is not open to students who are taking or have taken CHEM 110 or CHEM 120.

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

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

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

First calculus course, one of:

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

Second calculus course, one of:

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

First physics course, one of:

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

Second physics course, one of:

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

Electives

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

13.2 Anatom y and Cell Biology (ANA T)

13.2.1 Location

Strathcona Anatomy and Dentistry Building, Room M-28
3640 University Street

Professors

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 U37.52 735.bdOcs Moraleroaquin U37.52 6.02bdOcs Moralear McPhersZaragoz Tm(gentinaAutonoma(eadridPh.D.(McG.))Tj1 0 46.98.921 Barry I. Posner;

Associate Members

Christian Rocheleau (*Endocrinology and Metabolism*)

Edward S. Ruthazer (*Neurology & Neurosurgery*)

Peter Siegel (*Medicine & Biochemistry*)

Charles E. Smith; D.D.S., Ph.D.(McG.)

Thomas Stroh (*Neurology & Neurosurgery*)

Jason Tanny (*Pharmacology & Therapeutics*)

One of the following statistics courses:

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

Complementar

ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

One of the following statistics courses:

BIOL 373	(3)	Biometry
MA	(3)	Principles of Statistics 1

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

PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 451	(3)	Advanced Neurophysiology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Cellular Immunology
PHGY 515	(3)	Physiology of Blood 1
PHGY 516	(3)	Physiology of Blood 2
PHGY 517	(3)	Artificial Internal Organs
PHGY 518	(3)	Artificial Cells
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.2.6   Bachelor of Science (B.Sc.) - Honour s Anatom y 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 Cour ses (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 |

Complementar y Cour ses (21 credits)

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

18 credits selected from:

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

ANAT 321*	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 323*	(3)	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 315	(3)	Anatomy/Limbs and Back
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
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
BIOL 514	(3)	Neurobiology Learning and Memory
BIOL 518	(3)	Advanced Topics in Cell Biology

BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 544	(3)	Genetic Basis of Life Span
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 575	(3)	Human Biochemical Genetics
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BIOT 505	(3)	Selected Topics in Biotechnology
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes
	(3)	Cellular Neurobiology

PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.3   Atmospheric and Oceanic Sciences (A   TOC)

13.3.1   Location

Burnside Hall, Room 945
805 Sherbrooke Street West
Montreal QC H3A 0B9
Telephone: 514-398-3764
Fax: 514-398-6115
Email: *info.aos@mcgill.ca*
Website: *www.mcgill.ca/meteo*

13.3.2   About Atmospheric and Oceanic Sciences

The Department of Atmospheric and Oceanic Sciences offers, at the undergraduate level, a broad range of courses and degree programs in atmospheric science (meteorology).

Complementar y Cour

ATOC 219	(3)	Introduction to Atmospheric Chemistry	

3 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

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

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

ATOC 309	(3)	Weather Radars and Satellites
ATOC 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
		Ci Tmbd

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

Complementar y Cour ses (38 credits)

36-38 credits

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

Core (21 credits)

3-6 credits selected from:

| ATOC 215 | (3) | Oceans, Weather and Climate |

PHYS 340**	(3)	Majors Electricity and Magnetism
PHYS 342***	(3)	Majors Electromagnetic Waves
PHYS 350**	(3)	Honours Electricity and Magnetism
PHYS 352***	(3)	Honours Electromagnetic Waves

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

** Students cannot receive credit for both PHYS 340 and PHYS 350.

*** Students cannot receive credit for both PHYS 342 and PHYS 352.

Weather Anal ysis and Forecasting Stream (17 credits)

(16-17 credits)

13 credits from:

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

3-4 credits selected from:

ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 525	(3)	Atmospheric Radiation
ATOC 530	(3)	Paleoclimate Dynamics
ATOC 531	(3)	Dynamics of Current Climates
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids

+ 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
MATH 323	(3)	Probability

Atmospheric Chemistry and Physics Stream (15 credits)

15 credits from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 404+	(3)	Climate Physics
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
PHYS 404+	(3)	Climate Physics

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

General Stream (17 credits)

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

ATOC 309	(3)	Weather Radars and Satellites
ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 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 Ph ysics (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 Cour ses (57 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere
ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves

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:

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

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

** Students cannot receive credit for both PHYS 340 and PHYS 350.

*** Students cannot receive credit for both PHYS 342 and PHYS 352.

Weather Anal ysis and Forecasting Stream (23 credits)

(22-23 credits)

16 credits from:

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

6-7 credits selected from:

ATOC 404+	(3)	Climate Physics
ATOC 513	(3)	Waves and Stability
		Turbulence in

+ 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
		Chemical Oceanograph

EPSC 542	(3)	Chemical Oceanography
MATH 423	(3)	Regression and Analysis of Variance
PHYS 404+	(3)	Climate Physics

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

General Stream (22 credits)

21-22 credits (at least 15 of which must be ATOC) selected from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 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
MATH 423	(3)	Regression and Analysis of Variance
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids

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

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

13.3.9   Diploma (Dip.) Meteor ology (30 credits)

The Department offers an intensive, one-year program in theoretical and applied meteorology to B.Sc. or B.Eng. graduates of suitable standing in physics, applied mathematics or other appropriate disciplines, leading to a Diploma in Meteorology. The program is designed for students with little or no previous background in meteorology who wish to direct their experience to atmospheric or environmental applications, or who need to fulfil academic prerequisites in meteorology to qualify for employment. For further information, consult the Administrative Officer, Burnside Hall, Room 946.

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

Required Cour ses (15 credits)

ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 521	(3)	Cloud Physics

13.4 Bioc hemistr y (BIOC)

13.4.1 Location

McIntyre Medical Building
3655 Promenade Sir-William-Osler

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 (BIOC) Faculty

Chair

Albert M. Berghuis

Emeritus Professors

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

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

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

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

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

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

Joseph Shuster; B.Sc.(McG.), Ph.D.(Calif.), M.D.(Alta.) (*joint appt. with Medicine*)

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

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

Professors

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

Albert M. Berghuis; B.Sc., M.Sc.(Rijks Univ. Groningen), Ph.D.(Br. Col.) (*Canada Research Chair in Structural Biology*) (*joint appt. with Microbiology and Immunology*)

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

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

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

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

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

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

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

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

Arnim Pause; B.Sc., M.Sc.(Konstanz), Ph.D.(McG.)

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

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

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

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

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

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

Associate Professors

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

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

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

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

U1 Complementary Courses** (6 credits)

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

6 credits selected from:

BIOL 205	(3)	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)

U1 Required Cour ses (23 credits)

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

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

U1 Complementar y Cour ses (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 Cour ses (20 credits)

ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 320	(3)	Laboratory Methods in Biochemistry and Molecular Biology 2
CHEM 214	(3)	Physical Chemistry/Biological Sciences 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 362	(2)	Advanced Organic Chemistry Laboratory

U2 Complementar y Cour ses (3 credits)

3 credits selected from:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
CHEM 267	(3)	Introductory Chemical Analysis
COMP 202	(3)	Foundations of Programming
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
PSYC 204	(3)	Introduction to Psychological Statistics

U3 Required Cour ses (6 credits)

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

U3 Complementar y Cour ses (6 credits)

3-6 credits selected from:

BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 470	(3)	Lipids and Lipoproteins in Disease
BIOC 491	(6)	Independent Research
BIOC 503	(3)	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
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses & Hormones

13.4.6 Bachelor of Science (B.Sc.) - Honour s Bioc hemistr y (73 credits)

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

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

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

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

U1 Required Cour ses (23 credits)

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

BIOC 212	(3)	Molecular Mechanisms of Cell Function
BIOC 220	(3)	Laboratory Methods in Biochemistry and Molecular Biology 1
BIOL 200	(3)	Molecular Biology

BIOL 202	(3)	Basic Genetics
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

BIOC 470	(3)	Lipids and Lipoproteins in Disease
BIOC 491	(6)	Independent Research
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

Channels, Tmdamental (3)PHAR 300(3/F0 Tm6(Lipids and 81 007 3ino2949 5206 cAR 300)Tj1 98.957 3ino2949 525.

13.5 Biology (BIOL)

13.5.1 Location

Stewart Biology Building, Room TBA
1205 avenue Docteur Penfield
Montreal QC H3A 1B1
T

13.5.4.2 Biological Diver sity and Systematics

The study of biological diversity deals with the maintenance, emergence, and history of the inexhaustible variety of different kinds of organisms. It is deeply concerned with the particular characteristics of different organisms and therefore emphasizes the detailed study of particular groups and forms the basis of comparative biology. Our knowledge of diversity is organized through the study of systematics, which seeks to understand the history of life and the phylogenetic and genetic relationships of li

For students intending to proceed to graduate work, one independent studies course (BIOL 466, BIOL 467, BIOL 468D1/BIOL 468D2, or BIOL 469D1/BIOL 469D2) is recommended. Because of the importance of numerical analyses in all fields of ecology, courses in Biometry (*e.g.*, BIOL 373) and Computer Science (COMP 202 or COMP 273) are recommended.

13.5.4.5 Evolutionar y Biology Concentration

Evolutionary biology is the study of processes that change organisms and their characteristics through time. Evolutionary biologists are concerned with adaptations of organisms and the process of natural selection.

Key courses: BIOL 304, BIOL 305, BIOL 307, BIOL 320, BIOL 324, BIOL 331, BIOL 352, BIOL 373, BIOL 377, BIOL 463, BIOL 466 or BIOL 467, BIOL 468D1/BIOL 468D2, BIOL 469D1/BIOL 469D2, 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 434, 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/BIOL 468D2, BIOL 469D1/BIOL 469D2, CHEM 203 or both CHEM 204 and CHEM 214, CHEM 222, HGEN 400, MIMM 314.

13.5.4.7 Molecular Genetics and De velopment Concentration

The discoveries that have fuelled the ongoing biomedical and biotechnology revolution have been deriv

Emeritus Professors

Ronald Chase; A.B.(Stan.), Ph.D.(MIT)

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

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

Martin J. Lechowicz; B.A.(Mich. St.), M.S., Ph.D.(Wisc.) (*Liber Ero Chair in Conservation Biology*)

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

Barid B. Mukherjee; B.Sc., M.Sc.(Calc.), M.Sc.(BYU), Ph.D.(Utah)

Laura Nilson; B.A.(Colgate), Ph.D.(Yale) (*Associate Dean [Graduate Education], Faculty of Science*)

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

Ronald Poole; B.Sc., Ph.D.(Birm.)

Derek Roff; B.Sc.(Syd.), Ph.D.(Br. Col.)

Professors

Ehab Abouheif; M.Sc.(C'dia), Ph.D.(Duke) (*on sabbatical*)

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

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

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

Gregor Fussmann; Dipl.(Free Univ., Berlin), Ph.D.(Max Planck & Kiel)

Andrew Gonzalez; B.Sc.(Nott.), Ph.D.(Imperial Coll., Lond.) (*Canada Research Chair in Biodiversity Science*) (*Ero Chair in Conservation Biology*) (*on academic leave*)

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

Siegfried Hekimi; M.Sc., Ph.D.(Geneva), F.R.S.C. (*Robert Archibald & Catherine Louise Campbell Chair in Developmental Biology*) (*on leave Fall 2017*)

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

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

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

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

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

Associate Professors

Jacalyn Vogel; B.Sc., M.Sc.(E. Ill.), Ph.D.(Kansas) (*Associate Member, School of Computer Science and Goodman Cancer Research Centre*)

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

Tamara Western; B.Sc.(Dal.), Ph.D.(Br. Col.) (*Associate Dean [Academic], Faculty of Science*)

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

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

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

Assistant Professors

Anna Hargreaves; M.Sc.(Calg.), Ph.D.(Qu.)

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

Tomoko Oyama; M.Sc.(Keio), Ph.D.(Baylor Coll.)

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

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

Associate Members

Anatomy and Cell Biology: Craig Mandato

Anthropology: Colin Chapman

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

MUHC: Hugh J. Clarke, Daniel Dufort, Rima Rozen, David Rosenblatt, Teruko Taketo

MNI: Kenneth Hastings

Physics: Paul Francois

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

Adjunct Professors

BELLUS Health Inc.: Francesco Bellini

Centre National de la Recherche Scientifique (CNRS): Fran

Complementar y Cour ses (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 Pr   ogram - 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 Cour ses (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

Complementar y Cour ses (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 cour   ses

9 credits of which, in cl.281 Tmulta51 165. credigy

| 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 Complementar y Cour ses (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 Complementar y Cour ses (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 ph

| 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 598.

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

Stream 2: Physical Biology (21 credits)

| BIOL 319 | (3) | Introduction to Biophysics |
| PHYS 329 | (3) | Statistical Physics with Biophysical Applications |

PHYS 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 521.949 670.26 Tm(Mo)ge21.949 67.64Tjdn0 0.dt360,765126.259pment4Tj1 n Cell Biar Biology of the 0 1 165.864 536.36 T67.64Tj1 j1 0 0 1 70.52 536.36 T67.

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 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
PHYS 329	(3)	Statistical Physics with Biophysical Applications

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

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

Advising notes for U0 students:

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

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

Required Cour ses (37 credits)

Bio-Ph ysical Sciences Core

28 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 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

Complementar y Cour ses (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 Resear ch Courh Cour

Molecular Ev olution 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

Neur osciences 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 Behaviour
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.) - Honour s 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

Interdisciplinary research that draws from the natural and physical sciences is an important aspect of modern biology. The Quantitative Biology (QB) Honours 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 through both coursework and a research project. The QB B.Sc. Honours option has two streams: a theoretical ecology and evolutionary biology stream and a physical biology stream. Both streams provide a balance of theory and experimental components that along with a research component will provide outstanding preparation for graduate training. Students must attain a 3.50 CGPA to enter and to complete the Honours program. First Class Honours will be awarded to students in the QB Honours option graduating with a CGPA of 3.75 or greater.

Students may complete this program with a minimum of 74 credits or a maximum of 79 credits depending on whether MATH 222 and CHEM 212 are completed.

Advising notes f or U0 students

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

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

Required Cour ses (49 credits)

Bio-Ph ysical 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 247**	(3)	Honours Applied Linear Algebra
MATH 315+	(3)	Ordinary Differential Equations
MATH 323++	(3)	Probability
MATH 324+++	(3)	Statistics
		Honours Ordinary Dif 315+

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 f or Quantitative Biology Streams

21 credits from one of the following two streams:

Stream 1: Theoretical Ecology and Ev olutionar y 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

Complementar y Cour ses (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)	Topics in Geometry

| MATH 437 | (3) | Mathematical Methods in Biology |
| MATH 447 | (3) | Introduction to Stochastic Processes |

* Students may take COMP 350 OR MATH 317.

** 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
	4o36 Tm((3))9hhD)iscrete Structures 2

13.5.13.4 Africa Field Stud y Semester

The Department of Geography, Faculty of Science, coordinates the 15-credit interdisciplinary Africa Field Study Semester; see *Study Abroad & Field Studies > Undergraduate > Field Study Semesters and Off-Campus Courses > Field Study Minor > : Africa Field Study Semester*. You can also visit the following website for details:

13.6.5 Bachelor of Science (B.Sc.) - Minor Biotechnology (f or 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 Cour ses (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

Complementar y Cour ses (9 credits)

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

Biomedicine

ANAT 541	(3)	Cell and Molecular Biology of Aging
EXMD 504	(3)	Biology of Cancer

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

Micr obiology

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 (Bioc hemistr y)

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
PHGY 518	(3)	Artificial Cells

Pollution

CHEE 593	(3)	Industrial Water Pollution Control

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

13.6.6   Biotec hnology (BIO T) Related Pr ograms

13.6.6.1 Program f or Students in the F aculty of Engineering

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

13.7   Chemistr y (CHEM)

13.7.1   Location

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

Student Advisory Office: Pulp & Paper Building, Room 108
Website: *www.mcgill.ca/chemistry/current-undergraduate-students/advising*

13.7.2   Office f or Science and Society

The Office for Science and Society is dedicated to the promotion of critical thinking and the presentation of practical scientific information to the public, educators, and students in an accurate and responsible fashion. The Office answers queries from the public as well as from the media, with a view toward establishing scientific accuracy. The Office also offers a v

4. physical chemistry, which treats the physical laws, kinetics, and energetics governing chemical reactions, behaviour of materials, and molecular structure.

Naturally, there is a great deal of overlap between these different areas, and the boundaries are becoming increasingly blurred. After a general course at the introductory level, courses in organic, inorganic, analytical, and physical chemistry are offered throughout the university years. Since chemistry is an experimental science, laboratory classes accompany most under

Associate Professors

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

At least one of:

CHEE 220	(3)	Chemical Engineering Thermodynamics
CHEE 314	(3)	Fluid Mechanics

with the remainder chosen from the following:

* Students select either CHEE 494 or CHEE 495

CHEE 230	(3)	Environmental Aspects of Technology
CHEE 315	(3)	Heat and Mass Transfer
CHEE 351	(3)	Separation Processes
CHEE 370	(3)	Elements of Biotechnology
CHEE 380	(3)	Materials Science
CHEE 438	(3)	Engineering Principles in Pulp and Paper Processes
CHEE 452	(3)	Particulate Systems
CHEE 494*	(3)	Research Project and Seminar 1
CHEE 495*	(4)	Research Project and Seminar 2
CHEE 587	(3)	Chemical Processing: Electronics Industry
CHEE 592	(3)	Industrial Air Pollution Control
CHEE 593	(3)	Industrial Water Pollution Control
MATH 314	(3)	Advanced Calculus

13.7.7   Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - Biological (47 credits)

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Basic Core Courses (26 credits)

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

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

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

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

* Denotes courses with CEGEP equivalents.

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory

CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 381	(3)	Inorganic Chemistry 2
MATH 222**	(3)	Calculus 3

Biological Option Cour ses (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 Pr ogram - Core Science Component Chemistr y - 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 Cour ses (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 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 263	(1)	Introductory Physical Chemistry 2 Laboratory
CHEM 267	(3)	Introductory Chemical Analysis
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
PHYS 242	(2)	Electricity and Magnetism

Complementary Course (6 credits)

6 credits from:

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

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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 higher.

13.7.10 Bachelor of Science (B.Sc.) - Major Chemistry - Atmosphere and Environment (63 credits)

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

Students entering from the Freshman program must have included CHEM 110 and CHEM 120 or CHEM 115, BIOL 111 or BIOL 112, MATH 133, MATH 140/MATH 141 or MATH 150/MATH 151, PHYS 131/PHYS 142, or their equivalents in their Freshman year. Quebec students must have completed the

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

Complementar6 credits)

Introduction: Physics of the

CHEM 267	(3)	Introductory Chemical Analysis
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 283	(2)	Physical Chemistry Laboratory
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

Complementar y Cour se (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 Chemistr y: Bioph ysical Chemistr y (66 credits)

NEW PROGRAM

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 Cour ses (59 credits)

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

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

* Denotes courses with CEGEP equivalents.

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

Bio-Physical Sciences Core

BIOL 219	(4)	Introduction to Physical 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
		Ordinary Dif

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

CHEM 534	(3)	Nanoscience and Nanotechnology
CHEM 571	(3)	Polymer Synthesis
CHEM 585	(3)	Colloid Chemistry
MATH 315	(3)	Ordinary Differential Equations

13.7.14 Bachelor of Science (B.Sc.) - Major Chemistr y - Measurement (62 credits)

** NEW PROGRAM **

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

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 Cour ses (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. Students completing this program will not be eligible for admission to the Ordre des chimistes du Québec without additional chemistry electives. This program is not currently accredited by the Canadian Society for Chemistry. See http://www.chemistry.mcgill.ca/advising/inside/advisors.php.

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

* Denotes courses with CEGEP equivalents.

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 283	(2)	Physical Chemistry Laboratory
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 493	(2)	Advanced Physical Chemistry Laboratory
CHEM 575	(3)	Chemical Kinetics
COMP 208	(3)	Computers in Engineering
MATH 222**	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 242	(2)	Electricity and Magnetism

Complementar

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

12 credits of additional Chemistry courses as follows:

6 credits of Chemistry courses at the 300 level or higher, or MATH 315 plus 3 credits of Chemistry courses at the 300 level or higher, and

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

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

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Courses (63 credits)

The required courses in this program consist of 63 credits in chemistry and mathematics, listed below. The courses marked with an asterisk (*) are omitted

CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 283	(2)	Physical Chemistry 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 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

Complementar y Cour ses (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:

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

3 credits, one of:

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

13.7.17   Bachelor of Science (B.Sc.) - Honour s Chemistr y - Bio-or ganic (75 credits)

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Cour ses (57 credits)

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

BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 365	(2)	Statistical Thermodynamics
CHEM 502	(3)	Advanced Bio-Organic Chemistry
MATH 315	(3)	Ordinary Differential Equations
MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

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

Bachelor of Science (B.Sc.) - Honours Chemistry: Biophysical Chemistr

CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 283	(2)	Physical Chemistry Laboratory
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 470	(6)	Research Project 1
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
PHYS 242	(2)	Electricity and Magnetism

Complementar y Cour ses

(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

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.) - Honour s Chemistr y - Measurement (74 credits)

** NEW PROGRAM **

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

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 Cour ses (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. Students completing this program will not be eligible for admission to the Ordre des chimistes du Québec without additional chemistry electives. This program is not currently accredited by the Canadian Society for Chemistry. See http://www.mcgill.ca/chemistry/current-undergraduate-students/advising/.

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

* Denotes courses with CEGEP equivalents.

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

CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 223	(2)	Introductory Physical Chemistry 1
CHEM 243	(2)	Introductory Physical Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 283	(2)	Physical Chemistry Laboratory
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 365	(2)	Statistical Thermodynamics
		Instrumental

6 credits from:

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

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   Chemistr y (CHEM) Related Pr ograms

13.7.21.1 Joint Honour s in Ph ysics and Chemistr y

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

13.8   Cognitive Science

13.8.1   About Cognitive Science

Cognitive Science is the multidisciplinary study of cognition in humans and machines. The goal is to understand the principles of intelligence and thought with the hope that this will lead to a better understanding of the mind and of learning, and to the development of intelligent dev7lead to a be.eyTm(79S0 0 1 391.837 3 0

Required Cour se (3 credits)

PSYC 433	(3)	Cognitive Science

Complementar y Cour ses (21 credits)

Note:

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

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

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

Computer Science and Mathematics

COMP 206	(3)	Introduction to Software Systems
COMP 230	(3)	Logic and Computability
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theory of Computation
COMP 417	(3)	Introduction Robotics and Intelligent Systems
COMP 424	(3)	Artificial Intelligence
COMP 527	(3)	Logic and Computation
COMP 531	(3)	Advanced Theory of Computation
MATH 318	(3)	Mathematical Logic

Linguistics

LING 201	(3)	Introduction to Linguistics
LING 330	(3)	Phonetics
LING 331	(3)	Phonology 1
LING 355	(3)	Language Acquisition 1
LING 371	(3)	Syntax 1
LING 419	(3)	Linguistic Theory and its Foundations
LING 440	(3)	Morphology
LING 455	(3)	Second Language Syntax
LING 571	(3)	Syntax 2
LING 590	(3)	Language Acquisition and Breakdown

Philosoph y

PHIL 210	(3)	Introduction to Deductive Logic 1
PHIL 304	(3)	Chomsky
PHIL 306	(3)	Philosophy of Mind
PHIL 310	(3)	Intermediate Logic
PHIL 415	(3)	Philosophy of Language
PHIL 474	(3)	Phenomenology

Psychology

(3)   Cognition

- Robotics (algorithms that control robots)

- Computational biology (algorithms and methods that address problems inspired by biology)

Computer science also plays an important role in many other fields, including Biology, Physics, Engineering, Business, Music, and Neuroscience, where it is necessary to process and reason large amounts of data. Computer Science is strongly related to mathematics, linguistics, and engineering.

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

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

- Major, Honours, Liberal, and Minor programs in **Computer Science**;

- Major and Liberal programs in **Software Engineering**;

- Major in **Computer Science: Computer Games Option**;

- Joint Major and Joint Honours in **Mathematics and Computer Science** (see *section 13.22: Mathematics and Statistics (MATH)*);

- Joint Major and Joint Honours in **Statistics and Computer Science** (see *section 13.22: Mathematics and Statistics (MATH)*);

- Joint Major in **Physics and Computer Science** (see *section 13.30: Physics (PHYS)*);

- Joint Major and Joint Honours in **Computer Science and Biology** (see *section 13.5: Biology (BIOL)*).

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

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

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

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

13.9.3   Internship Oppor tunities

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

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

For more information on these opportunities, consult *section 12: Science Internships and Field Studies* or *www.mcgill.ca/science/student/internships-field*.

13.9.4   Research Oppor tunities

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

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

13.9.5   Admissions

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

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

13.9.6 Computer Science (COMP) F aculty

Director

Bettina Kemme

Emeritus Professors

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

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

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

Monroe Ne

Assistant Professors

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

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

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

Faculty Lecturer

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

Associate Members

Daniel J. Levitin (*Psychology*)

Dirk Schlimm (*Philosophy*)

Raja Sengupta (*Geography*)

F. Bruce Shepherd (*Mathematics*)

Thomas Richard Shultz (*Psychology*)

Adjunct Professors

André Barreto; B.Sc., M.Sc., D.Sc.(Federal Rio de Janeiro)

Pieter Mosterman; B.Sc., M.Sc.(Twente), D.Phil.(Vanderbilt)

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

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

Ger Otto Sabidussi; Ph.D.(Vienna)

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

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

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

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

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

Required Cour ses (9 credits)

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

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

Complementar y Cour ses (15 credits)

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

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

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

MATH 240	(3)	Discrete Structures 1

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

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

Required Cour ses (21 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
MATH 222	(3)	Calculus 3
MATH 240	(3)	Discrete Structures 1

Complementar y Cour ses (24 credits)

3-6 credits from:

MA	(3)	Linear Algebra

Required Cour ses (36 credits)

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

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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

Complementar y Cour ses (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.

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, 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.

Required Cour ses (46 credits)

36-46 credits:

Bio-Ph ysical 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 251	(3)	Algorithms and Data Structures
MATH 240	(3)	Discrete Structures 1

Biology

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

Required Joint Cour ses

COMP 401	(3)	Project in Biology and Computer Science

* Students with CEGEP-level credit for the equivalents of MATH 222 and/or CHEM 212 (see http://www

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 360	(3)	Algorithm Design
COMP 361D1*	(3)	Software Engineering Project
COMP 361D2*	(3)	Software Engineering Project
MATH 240	(3)	Discrete Structures 1

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

Biology Bloc k

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
		Biodiversity and Ecosof

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

13.9.12   Bachelor of Science (B.Sc.) - Major Computer Science - Computer Games (67 credits)

This program is a specialization within Computer Science. It fulfils all the basic requirements of the Major Computer Science. Complementary courses focus on topics that are important to understanding the technology behind computer games and to gaining experience in software development and design needed for computer game development.

Students may complete this program with a minimum of 62 credits or a maximum of 67 credits depending if they are exempt from taking COMP 202 and their choice of complementary courses.

Required Cour ses (50 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 308	(1)	Computer Systems Lab
COMP 310	(3)	Operating Systems
COMP 322	(1)	Introduction to C++
COMP 330	(3)	Theory of Computation
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
COMP 557	(3)	Fundamentals of Computer Graphics
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1
MATH 323	(3)	Probability

Complementar y Cour ses (17 credits)

Students complete a minimum of 15 or a maximum of 17 complementary credits selected as follows:

3 credits selected from:

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

6-8 credits selected from:

COMP 424	(3)	Artificial Intelligence
COMP 521	(4)	Modern Computer Games
COMP 522	(4)	Modelling and Simulation
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
COMP 551	(4)	Applied Machine Learning
COMP 559	(4)	Fundamentals of Computer Animation

6 credits selected from:

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

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

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

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

Required Cour ses (39 credits)

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

** Students may select either COMP 310 or ECSE 427, but not both.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310**	(3)	Operating Systems
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
ECSE 427**	(3)	Operating Systems
ECSE 429	(3)	Software Validation
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1

Complementar y Cour ses (24 credits)

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

Group A:

MATH 222	(3)	Calculus 3

Group B:

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

At least 15 credits selected from the following, with at least 6 credits selected from Software Engineering Specializations, and at least 6 credits selected from Applications Specialties.

Software Engineering Specializations

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

COMP 409*	(3)	Concurrent Programming
COMP 523	(3)	Language-based Security
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
ECSE 420*	(3)	Parallel Computing
ECSE 539	(3)	Advanced Software Language Engineering

Application Specialties

* Students may select either COMP 557 or ECSE 532, but not both.

COMP 350	(3)	Numerical Computing
COMP 417	(3)	Introduction Robotics and Intelligent Systems
COMP 421	(3)	Database Systems
COMP 424	(3)	Artificial Intelligence
COMP 512	(4)	Distributed Systems
COMP 520	(4)	Compiler Design
COMP 521	(4)	Modern Computer Games
COMP 522	(4)	Modelling and Simulation
COMP 535	(3)	Computer Networks 1
COMP 551	(4)	Applied Machine Learning
COMP 557*	(3)	Fundamentals of Computer Graphics
COMP 558	(3)	Fundamentals of Computer Vision
ECSE 424	(3)	Human-Computer Interaction
ECSE 532*	(3)	Computer Graphics

13.9.14   Bachelor of Science (B.Sc.) - Honour s Computer Science (75 credits)

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

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

Required Cour ses (48 credits)

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

** Students take either MATH 340 or MATH 350.

COMP 202COMP 202.	(3)	Foundations of Programming

COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 350	(3)	Numerical Computing
COMP 362	(3)	Honours Algorithm Design
COMP 400	(3)	Project in Computer Science
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures 1
MATH 340**	(3)	Discrete Structures 2
MATH 350**	(3)	Graph Theory and Combinatorics

Complementar y Cour ses (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.) - Honour s 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 Cour ses
39-49 credits:

Bio-Ph ysical 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 Cour ses

| 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.

Complementar y Cour ses

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 Bloce:05 dits to be ch at least ts from the 0 le

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 Bloc k

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

COMP 409*	(3)	Concurrent Programming
COMP 523	(3)	Language-based Security
COMP 525	(3)	Formal Verification
COMP 529	(4)	Software Architecture
COMP 533	(3)	Model-Driven Software Development
ECSE 420*	(3)	Parallel Computing
ECSE 539	(3)	Advanced Software Language Engineering

Application Specialties

COMP 350	(3)	Numerical Computing
COMP 417	(3)	Introduction Robotics and Intelligent Systems
COMP 421	(3)	Database Systems
COMP 424	(3)	Artificial Intelligence
COMP 512	(4)	Distributed Systems
COMP 520	(4)	Compiler Design
COMP 521	(4)	Modern Computer Games
COMP 522	(4)	Modelling and Simulation
COMP 535	(3)	Computer Networks 1
COMP 551	(4)	Applied Machine Learning
COMP 557	(3)	Fundamentals of Computer Graphics
COMP 558	(3)	Fundamentals of Computer Vision
ECSE 424	(3)	Human-Computer Interaction

At least 6 credits selected from any COMP courses at the 500 level or above. These may include courses on the Software Engineering Specializations and Application Specialties lists.

13.9.17   Computer Science (COMP) Related Pr ograms

13.9.17.1 Joint Major in Mathematics and Computer Science

For more information, see *section 13.22: Mathematics and Statistics (MATH)*.

13.9.17.2 Joint Honour s in Mathematics and Computer Science

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

13.9.17.3 Joint Major in Statistics and Computer Science

For more information, see *section 13.22: Mathematics and Statistics (MATH)*.

13.9.17.4 Joint Honour s in Statistics and Computer Science

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

13.9.17.5 Joint Major in Ph ysics and Computer Science

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

13.9.17.6 Minor in Cognitive Science

Students following Major or Honours programs in Computer Science may want to consider the Minor in 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: *mariel.edwards-carreau@mcgill.ca* or *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 to understand how planets like the Earth changed over time and continue to evolve.

Career opportunities are many and diverse in the Earth and Planetary Sciences. Graduates of the Major and Honours in Geology are often recruited by resource (fossil fuel and mineral) exploration companies, as well as the mining and environmental sectors. Industry or government agencies may hire undergraduate students during the summer months, providing them with both financial benefits and first-hand geoscientific experience. Career opportunities in planetary science can also be found in universities and research organizations.

The Department has a full-time staff of 16 professors and one faculty lecturer. There are approximately 50 graduate and 50 undergraduate students registered in the various programs offered. Classes are therefore small at all levels, resulting in an informal and friendly atmosphere throughout the Department in which most of the faculty and students interact on a first-name basis. Emphasis is placed equally on quality teaching and research, providing undergraduate students with a rich and exciting environment in which to explore and learn.

13.10.3   Undergraduate Studies

The undergraduate curriculum is designed to provide both a strong foundation in the physical sciences and the flexibility to create an individualized program in preparation for careers in industry, teaching, or research. In addition to the **Major** and **Honours** undergraduate programs, the Department is one of the three departments that actively contribute to the Earth System Science Interdepartmental program, and also offers a **Joint Major in Physics and Geophysics**, which combines a rigorous mathematics and physics curriculum with exposure to the geosciences.

The **Minor in Geology** offers students from other departments the opportunity to discover the earth sciences in the classroom and in the field, while the **Minor in Geochemistry** is designed for Chemistry Major students who want to apply chemical principles to the study of planetary processes.

Students interested in any of the programs should inquire at:

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

or should consult the Undergraduate Director:

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

13.10.4   Earth and Planetary Sciences (EPSC) Faculty

Chair
Jeffrey McKenzie

Emeritus Professors
Don M. Francis; B.Sc.(McG.), M.Sc.(Br. Col.), Ph.D.(MIT)
Jafar Arkani-Hamed; B.Sc.(MIT)

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

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

Required Courses (9 credits)

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

Complementary Courses (9 credits)

9 credits selected from:

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

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

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

Required Courses (21 credits)

EPSC 203	(3)	Structural Geology
EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
EPSC 231	(3)	Field School 1
EPSC 233	(3)	Earth and Life History

EPSC 320	(3)	Elementary Earth Physics

Complementar y Cour ses (24 credits)

3 credits, one of:

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

plus 21 credits chosen from the following:

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

EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 334	(3)	Invertebrate Paleontology
EPSC 340	(3)	Earth and Planetary Inference
EPSC 350	(3)	Tectonics
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology

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

Required Cour ses (30 credits)

EPSC 203	(3)	Structural Geology
EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
		Field School 1

EPSC 470D2	(3)	Undergraduate Thesis Research
EPSC 482	(3)	Research in Earth and Planetary Sciences
EPSC 501	(3)	Crystal Chemistry
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 530	(3)	Volcanology
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

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

13.10.9 Bachelor of Science (B.Sc.) - Honour s Geology (75 credits)

** NEW PROGRAM **

The program curriculum is designed to provide a rigorous foundation in the fundamental earth science disciplines and in the advanced subjects relevant to fundamental and applied research in exploration for energy resources or industrial and ore minerals, and in environmental geosciences. The program meets the academic requirements shared by the professional orders for geologists and environmental geoscientists in most Canadian provinces. It is intended to provide an excellent preparation for graduate work in the earth sciences but offers enough flexibility to prepare for a wide range of careers in industry and teaching.

Required Cour ses (42 credits)

EPSC 203	(3)	Structural Geology
EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology
EPSC 220	(3)	Principles of Geochemistry
EPSC 231	(3)	Field School 1
EPSC 233	(3)	Earth and Life History
EPSC 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
MA	(3)	Ordinary Differential Equations

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

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

EPSC 350	(3)	Tectonics
EPSC 435	(3)	Applied Geophysics
EPSC 501	(3)	Crystal Chemistry
EPSC 510	(3)	Geodynamics and Geomagnetism
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 530	(3)	Volcanology
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.) - Honour s Planetar y Sciences (78 credits)

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

Note: Honours students must maintain a CGPA equal to or greater than 3.20.

Required Cour ses (66 credits)

EPSC 203	(3)	Structural Geology
EPSC 210	(3)	Introductory Mineralogy
EPSC 212	(3)	Introductory Petrology

EPSC 220	(3)	Principles of Geochemistry
EPSC 231	(3)	Field School 1
EPSC 233	(3)	Earth and Life History
EPSC 320	(3)	Elementary Earth Physics
EPSC 330	(3)	Earthquakes and Earth Structure
EPSC 340	(3)	Earth and Planetary Inference
EPSC 350	(3)	Tectonics
EPSC 423	(3)	Igneous Petrology
EPSC 480D1	(3)	Honours Research Thesis
EPSC 480D2	(3)	Honours Research Thesis
EPSC 510	(3)	Geodynamics and Geomagnetism
EPSC 570	(3)	Cosmochemistry
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
PHYS 340	(3)	Majors Electricity and Magnetism

Complementar y Cour ses (12 credits)

3 credits from:

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

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

Note: Courses at the 300 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

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

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

Atmospheric and Oceanic Sciences (ATOC)

Earth and Planetary Sciences (EPSC)

Geography (GEOG)

Required Courses (12 credits)

ESYS 200	(3)	Earth System Processes
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
ESYS 500	(3)	Earth System Applications

Complementary Courses (6 credits)

Two courses from 2 of 3 ESYS Departments (EPSC, ATOC, or GEOG), 300 level or higher

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 499	(3)	Subarctic Field Studies
GEOG 501	(3)	Modelling Environmental Systems
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
MATH 314	(3)	Advanced Calculus
MATH 315*	(3)	Ordinary Differential Equations
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 323	(3)	Probability
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 423	(3)	Regression and Analysis of Variance
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes
MATH 525	(4)	Sampling Theory and Applications
NRSC 540	(3)	Socio-Cultural Issues in Water
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432	(3)	Physics of Fluids

* MATH 315 is a required course for the B.Sc. Honours Earth System Science.

13.11.5 Bachelor of Science (B.Sc.) - Honour s Ear th Science (66 credits)

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

Atmospheric and Oceanic Sciences (ATOC)

Earth and Planetary Sciences (EPSC)

Geography (GEOG)

A rigorous foundation in earth system science and the flexibility to create an individualized program in preparation for careers in industry, teaching, and research. It is also intended to provide an excellent preparation for graduate work in earth system science. A CGPA of 3.20 or higher is required for registration in and graduation from this program.

"First Class Honours" is awarded to students who obtain a minimum cumulative grade point average of 3.70, a minimum program GPA of 3.20, and a minimum grade of B+ in ESYS 300, ESYS 301, and ESYS 500.

Required Cour ses (33 credits)

COMP 202	(3)	Foundations of Programming
ENVR 201	(3)	Society, Environment and Sustainability
ESYS 200	(3)	Earth System Processes

ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
ESYS 480D1	(3)	Honours Research Project
ESYS 480D2	(3)	Honours Research Project
ESYS 500	(3)	Earth System Applications
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations

Complementar y Cour ses (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

PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432	(3)	Physics of Fluids

* MATH 315 is a required course for the B.Sc. Honours Earth System Science.

13.12   Entrepreneur ship f or Science Students

13.12.1   About Entrepreneur ship f or Science Students

This Minor is geared toward Science students with an interest in entrepreneurship and key business topics. The set of six courses will introduce them to concepts and skills needed to effectively complement the technical expertise obtained. These concepts and skills form the basis of successful companies in the high technology sector, be they start-ups, small-, or medium-sized.

13.12.2   Bachelor of Science (B.Sc.) - Minor Entrepreneur   ship f or Science Students (18 credits)

This Minor is a collaboration of the Faculty of Science and Desautels Faculty of Management and is designed to provide Science (B.Sc.) students with an understanding of how to conceptualize, develop, and manage successful new ventures - including for-profit private companies, social enterprises, and cooperatives as well as intrapreneurship initiatives. The program covers the essentials of management and is interdisciplinary and integrative. Many courses in the Minor will address a mix of students from across multiple McGill faculties.

Students in this Minor are not permitted to take the Desautels Minors in Management, Marketing, Finance or Operations Management (for Non-Management students).

To obtain the Minor, all courses must be completed with a grade of C or better.

Advising note: Desautels Faculty of Management courses in this Minor have limited enrolment and include INTG 201, INTG 202, MGPO 362, MGPO 364, MGPO 438, and BUSA 465. For advising regarding Management courses, students should contact the Desautels Faculty of Management, B.Com. Office (see coordinates in the calendar notes). For advising regarding MIMM 387, see your adviser in the Science Office for Undergraduate Student Advising (SOUSA) in Dawson Hall.

Required Cour ses (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

Complementar y Cour ses (6 credits)

13.14   Experimental Medicine (EXMD)

13.14.1   Location

Lady Meredith House, Room 101
1110 Pine Avenue West
Montreal QC H3A 1A3
Telephone: 514-398-3466
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		
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 01
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
EXMD 509	(3)	Gastrointestinal Physiology and Pathology
EXMD 510	(3)	Bioanalytical Separation Methods
EXMD 511	(3)	Joint Venturing with Industry

13.15   Field Stud y

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 Stud y 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.

CIVE 452	(3)	Water Resources in Barbados
CIVE 519	(6)	Sustainable Development Plans
URBP 519	(6)	Sustainable Development Plans

Barbados Inter disciplinar y Tropical Studies Field Semester (15 credits)

The Barbados Interdisciplinary Tropical Studies (BITS) Field Semester is an activity-filled, hands-on experience for students with an interest in international studies with a Caribbean flavour. The focus is on sustainable agri-food, nutrition, and energy production on a tropical island with a tourist-based economy. It is offered annually (in the Summer). It consists of two 2-hour orientation sessions conducted on the Macdonald campus and at the Bellairs Research Institute in Barbados, followed by three 3-credit and one 6-credit project courses at Bellairs Research Institute. This program integrates intensive course work with group project work and contributes to the formation of professionals with planning, managing, decision-making, and communication skills. The program addresses a global need for experienced professionals capable of interacting with various levels of gov

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 Cour se

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

13.16.2 About the General Science Minor

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

13.17   Geograph y (GEOG)

13.17.1   Location

Burnside Hall, Room 705
805 Sherbrooke Street West
Montreal QC H3A 0B9
Telephone: 514-398-4951 or 514-398-4111
Fax: 514-398-7437
Website: *www.mcgill.ca/geography*

13.17.2   About Geograph y

The Department of Geography offers programs in both Arts and Science. All Bachelor of Arts (B.A.) programs in Geography (including Urban Systems) can be found in *Faculty of Arts* > *Undergraduate* > *Browse Academic Units & Programs* > *: Geography (GEOG).*

Geography is a broad, holistic discipline; both a natural and a social science because it examines people and their environment and serves as a bridge between physical and cultural processes.

Human Geography (B.A. programs) is concerned especially with the political, economic, social, and cultural processes and resource practices that create spatial patterns and define particular places.

Physical Geography (B.Sc. programs) integrates disciplines such as climatology, geomorphology, geology, biology, hydrology, ecology, soil science, and

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:

MATH 203	(3)	Principles of Statistics 1
PSYC 204	(3)	Introduction to Psychological Statistics
SOCI 350	(3)	Statistics in Social Research

One course (3 credits) from the following GIS/Remote Sensing courses:

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

Four courses (12 credits) from the following:

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

One course (3 credits) from the following field courses:

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

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

Two additional courses (6 credits) from the list of approved Geography courses below, including at least one at the 400 level or above.

GEOG 404	(3)	Environmental Management 2
GEOG 501	(3)	Modelling Environmental Systems
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration

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

The BSc Major in Geography provides students with strong training in the theory and tools of physical geography. Students will explore the science of how physical, chemical, and biological processes interact at various spatial and temporal scales to produce distinct environments over the planet, and study different suites of ecosystem services while investigating sustainability challenges for human communities that depend on them. The program includes core training in systematic areas of physical geography (geomorphology, hydrology, soil biogeochemistry, biogeography and climatology), field courses providing hands on exposure to environmental data collection, and courses in quantitative techniques and in GIS and Remote Sensing..

Required Cour ses (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

Complementar y Cour ses (45 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

3 credits of field courses:

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

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

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

6 or 9 credits of 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, including any geography courses from the above complementary lists.

Admission to 500-level courses in Geography requires the instructor's.4a)where in the F

GEOG 302	(3)	Environmental Management 1
GEOG 351	(3)	Quantitative Methods
GEOG 381	(3)	Geographic Thought and Practice
GEOG 491D1	(3)	Honours Research
GEOG 491D2	(3)	Honours Research

Complementar y Cour ses (42 credits)

6 credits of introductory courses, two of:

GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World

3 credits of statistics*, one of:

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

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

3 credits of GIS techniques:

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

12 credits of systematic physical geography:

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

3 credits of field courses:

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

15 credits from approved courses in Geography, or elsewhere in the Faculty of Science or the Faculty of Engineering; at least 9 credits of which are to be taken outside Geography. Students may also include any courses that are not already counted towards the GIS techniques or the systematic physical geography requirements. Admission to 500-level courses in Geography requires the instructor's permission. It is not advisable to tak3111 1 T399.98e1 0talso include a65.0811 1 T3

Advising Note: See the Geography website for the list of approved courses in the Faculty of Science. Some courses require the permission of the Department and from the Associate Dean of Science, Student Affairs.

GEOG 404	(3)	Environmental Management 2
GEOG 501	(3)	Modelling Environmental Systems
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
GEOG 555	(3)	Ecological Restoration
URBP 556	(3)	Urban Economy: A Spatial Perspective

13.17.10 Geography (GEOG) Related Programs and Study Semesters

13.17.10.1 African Field Study Semester

The Faculty of Science coordinates the 15-credit interdisciplinary African Field Study Semester, also known as Canadian Field Studies in Africa. For more information, see *www.mcgill.ca/africa*.

13.17.10.2 Panama Field Study Semester

The program is a joint venture between McGill University and the Smithsonian Tropical Research Institute (STRI) in Panama. For more information, see *www.mcgill.ca/pfss*.

13.17.10.3 Earth System Science Interdepartmental Major

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

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

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

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

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

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

Adviser: Brian Robinson, Dr.
Telephone: 514-398-3453
Email: *brian.e.robinson@mcgill.ca*

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

13.18 Immunology

13.18.1 Location

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

or

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

13.18.2   About Imm unology

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

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

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

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

Apply to:

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

or

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

13.18.3   Bachelor of Science (B.Sc.) - Honour s Imm unology (Inter depar tmental) (75 credits)

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

For graduation in the Honours program, the student must complete a minimum of 90 credits, and achieve a CGPA of not less than 3.30. The immunology courses (BIOC 503, MIMM 214, MIMM 314, MIMM 414, MIMM 509, PHGY 419D1/D2, PHGY 513, PHGY 531) must all be passed with a grade not less than B.

Required Cour ses (48 credits)

U1 Required Cour ses

20 credits selected as follows:

* Students select either BIOC 212 or BIOL 201.

** Students select either PHGY 209 or MIMM 211.

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

PHGY 209*	(3)	Mammalian Physiology 1

U2 Required Cour ses

13 credits from the following:

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

U3 Required Cour ses

15 credits from the following:

MIMM 414	(3)	Advanced Immunology

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U2 Complementary Courses

12 credits chosen as follows:

6 credits selected from:

Students may take

* BIOC 220 and BIOC 320 or

** PHGY 212 and PHGY 213 and BIOL 301

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

plus 6 credits, selected from:

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

ANAT 365	(3)	Cellular Trafficking
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309*	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
CHEM 302	(3)	Introductory Organic Chemistry 3
MATH 222	(3)	Calculus 3
MATH 315*	(3)	Ordinary Differential Equations
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

U3 Complementary Courses

9 credits of U3 complementary courses chosen in the following manner:

3 credits selected from:

BIOC 503	(3)	Immunochemistry
MIMM 509	(3)	Inflammatory Processes
PHGY 531	(3)	Topics in Applied Immunology

Depth requirement:

at least 6 credits must be at the 300 level or above.

Breadth requirement:

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

at least 3 credits from the Health Social Sciences List,

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

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

Basic Lif e 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(v)b 5sTjmunit0 (3) 70.52 115.iscd	(3)	Introductory Immunology: Elements of Immunity
	(3)	Intermediate Immunology

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)	(3)(3)	Metabolism and Human Nutrition

(3)

(3)

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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
		Computer Tools for Life ScienceaseRo61 662 0 1 1645pfor L0 0 1 221.4(Hj1 0 0 1 70 0 1 (acience.631694d.181 Tm(T)

Website: *www.mcgill.ca/edu-kpe*

Program Adviser: Yasmine Zein; *kpe-advising.education@mcgill.ca*

13.20.2   About Kinesiology f   or 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 Cour ses (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

Complementar y Cour ses (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 f or 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 available to Science students is the Minor in Entrepreneurship for Science students; see *section 13.12: Entrepreneurship for Science Students*. Students in this Minor are not permitted to take the Desautels Minors in Finance, Management, Marketing, or Operations Management (for Non-Management students).

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 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 448	(3)	Financial Derivatives
FINE 449	(3)	Market Risk Models
FINE 451	(3)	Fixed Income Analysis
FINE 480	(3)	Global Investments
FINE 482	(3)	International Finance 1
FINE 492	(3)	International Corporate Finance
FINE 541N1	(1.5)	Applied Investments
FINE 541N2	(1.5)	Applied Investments
FINE 547	(3)	Advanced Finance Seminar

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

* Prerequisite: MGCR 271, Business Statistics, or another equivalent Statistics course approv

MGCR 341*	(3)	Introduction to Finance

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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

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6 credits selected from:

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

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

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

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

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

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

13.21.3 Bachelor of Commer ce (B.Com.) - Minor Marketing (For Non-Mana gement Students) (18 credits)

The Minor Marketing consists of 18 credits of Management courses and is currently offered to non-Management students in the Faculties of Arts, Engineering, Science, and the Schulich School of Music.

This Minor is designed to provide students with an understanding of the fundamental concepts in marketing and a framework for applying marketing in a decision-making context. Students will be introduced to the basic concepts in marketing. The use of marketing theory and concepts for decision making will be covered. Marketing research methods for marketing decisions is introduced. Subsequently, students will be able to specialize by choosing from the list of complementary courses.

Required Cour ses (9 credits)

MGCR 352	(3)	Principles of Marketing
MRKT 354	(3)	Marketing Strategy
MRKT 451	(3)	Marketing Research

Complementar y Cour ses (9 credits)

3 credits:

MGCR 271*	(3)	Business Statistics

6 credits selected from:

MRKT 357	(3)	Marketing Planning 1
MRKT 365	(3)	New Products
MRKT 438	(3)	Brand Management
MRKT 452	(3)	Consumer Behaviour

13.22   Mathematics and Statistics (MA   TH)

13.22.1   Location

Burnside Hall, Room 1005
805 Sherbrooke Street West
Montreal QC H3A 0B9
Telephone: 514-398-3800
Fax: 514-398-3899
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   Under graduate Pr ogram 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 very demanding. 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   Resear ch Oppor tunities

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 Oppor   tunities

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

rams:

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.iMatsathem(t has MAtyram, b:

Professors

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

John A. Toth; B.Sc., M.Sc.(McM.), Ph.D.(MIT)

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

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

Associate Professors

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

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

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

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

Johanna Neslehova; Vor.Dip.(Prague), Dip.(Hamburg), Ph.D.(Oldenburg)

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

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

Mikael Pichot; B.Sc.(Lyon), M.S., Ph.D.(École Normale-Lyon)

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

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

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

Assistant Professors

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

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

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

Maksym Radziwill; B.Sc.(McG.), Ph.D.(Stan.)

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

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*)

P.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 (*Pediatrics*)

James O. Ramsay (*Psychology*)

Christina Wolfson (*Epidemiology and Biostatistics*)

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 taken outside the Department of Mathematics and Statistics.

Further credits (if needed) may be freely chosen from the required and complementary courses for majors and honours students in Mathematics, with the obvious exception of courses that involve duplication of material.

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

Program Prerequisites

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

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

Guidelines for Selection of Courses

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

Students interested in computer science are advised to choose courses from the following: MATH 317, MATH 318, MATH 327, MATH 328, MATH 335, MATH 340, MATH 407, MATH 417 and to complete the Computer Science Minorose courses from thhi 0 1 165.864 216.064 .t5.082 Tm5

MATH 317, MATH 319, MATH 327, MATH 329, MATH 407, MATH 417, MATH 423, MATH 430, MATH 447, MATH 523, MATH 525.

Required Cour ses (27 credits)

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

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

MATH 222**	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 236	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 249*	(3)	Honours Complex Variables
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 316*	(3)	Complex Variables
MATH 323	(3)	Probability

Complementar y Cour ses (18 credits)

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

MATH 317	(3)	Numerical Analysis
MATH 324	(3)	Statistics
MATH 335	(3)	Computational Algebra
MATH 340	(3)	Discrete Structures 2

the remainder of the 18 credits to be selected from:

MATH 204	(3)	Principles of Statistics 2
MATH 318	(3)	Mathematical Logic
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 320	(3)	Differential Geometry
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 346	(3)	Number Theory
		T46

MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis

13.22.10 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Statistics (45 credits)

Program Prerequisites

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

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

Required Courses (27 credits)

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

MATH 222*	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 236	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 314	(3)	Advanced Calculus
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MATH 423	(3)	Regression and Analysis of Variance

Complementary Courses (18 credits)

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

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

MATH 249*	(3)	Honours Complex Variables
MATH 315	(3)	Ordinary Differential Equations
MATH 316*	(3)	Complex Variables
MATH 317	(3)	Numerical Analysis
MATH 335	(3)	Computational Algebra
MATH 340	(3)	Discrete Structures 2

at least 7 credits selected from:

| MAtherC30e..67 121.184221.949 239.36 i0 2 | | Introduction to Stochastic Processes |

the remainder of the 18 credits to be selected from:

MATH 204	(3)	Principles of Statistics 2
MATH 318	(3)	Mathematical Logic
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 320	(3)	Differential Geometry
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 346	(3)	Number Theory
MATH 348	(3)	Topics in Geometry
MATH 352	(1)	Problem Seminar
MATH 407	(3)	Dynamic Programming
MATH 410	(3)	Majors Project
MATH 417	(3)	Mathematical Programming
MATH 427	(3)	Statistical Quality Control
MATH 430	(3)	Mathematical Finance

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

Program Prerequisites

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

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

Guidelines f or Selection of Cour ses in the Major Pr ogram

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

Complementar y Cour ses (27 credits)

27 credits selected as follows:

6-12 credits selected from the following:

MATH 317	(3)	Numerical Analysis
MATH 324	(3)	Statistics
MATH 335	(3)	Computational Algebra
MATH 340	(3)	Discrete Structures 2

15-21 credits selected from the following: at least 6 credits must be at the 400 or 500 level.

MATH 204	(3)	Principles of Statistics 2
MATH 318	(3)	Mathematical Logic
		Introduction to P

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

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

Program Prerequisites

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

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

Required Cour ses (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.

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| MATH 140 | (3) | Calculus 1 |
| MATH 141 | (4) | Calculus 2 |

Required Cour ses (51 credits)

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

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

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

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

Complementar y Cour ses (21 credits)

12 credits in Mathematics selected from:

* Students take either MATH 340 or MATH 350, but not both.

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

MATH 327	(3)	Matrix Numerical Analysis
MATH 340*	(3)	Discrete Structures 2
MATH 350*	(3)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar
MATH 410	(3)	Majors Project
MATH 427	(3)	Statistical Quality Control

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MATH 545	(4)	Introduction to Time Series Analysis
MATH 578**	(4)	Numerical Analysis 1

9 credits in Computer Science selected as follows:

At least 6 credits selected from:

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

The remaining Computer Science credits are selected from COMP courses at the 300 level or above (except COMP 396 and COMP 431) and ECSE 508.

Bachelor of Science (B.Sc.) - Honour

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 487, MATH 550, MATH 552, MATH 560.

3 credits selected from:

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

at least 3 credits selected from:

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

and the remainder of credits selected from:

COMP 362	(3)	Honours Algorithm Design
MATH 352	(1)	Problem Seminar
MATH 377	(3)	Honours Number Theory
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 480	(3)	Honours Independent Study
MATH 487	(3)	Honours Mathematical Programming
MATH 488	(3)	Honours Set Theory
MATH 490	(3)	Honours Mathematics of Finance

* 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 348	(3)	Topics in Geometry
MATH 407	(3)	Dynamic Programming

Other courses with the permission of the Department.

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

Program Prerequisites

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

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

To remain in an Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GPA in the required and complementary Mathematics courses of the program, as well as an overall CGPA of 3.00.

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

Required Cour ses (45 credits)

* MATH 314 may be substituted for MATH 248 if MATH 222 had to be taken in the Fall.

** 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 380.

+ 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 375.

MATH 235	(3)	Algebra 1
MATH 248*	(3)	Honours Advanced Calculus
MATH 251	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 325	(3)	Honours Ordinary Differential Equations
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 366	(3)	Honours Complex 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
MATH 458^	(3)	Honours Differential Geometry
MATH 470	(3)	Honours Research Project
MATH 475+++	(3)	Honours Partial Differential Equations

Complementar y Cour ses (15 credits)

3 credits selected from;

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

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

12 credits selected from:

MATH 350	(3)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 377	(3)	Honours Number Theory
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis
MATH 480	(3)	Honours Independent Study
MATH 487	(3)	Honours Mathematical Programming
MATH 488	(3)	Honours Set Theory

all MATH 500-level courses.

Honours-level courses from related disciplines:
* COMP 250 may be preceded by COMP 202.

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

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

MATH 204	(3)	Principles of Statistics 2
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 348	(3)	Topics in Geometry
MATH 407	(3)	Dynamic Programming

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

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

Required Cour ses (47 credits)

* COMP 250 may be preceded by COMP 202.
** Students select either MATH 251 or MATH 247, but not both.

COMP 250*	(3)	Introduction to Computer Science
MATH 235	(3)	Algebra 1
MATH 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 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

Complementar y Cour ses (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

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

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13.22.17 Bachelor of Science (B.Sc.) - Honour s 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 Cour ses (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

Complementar y Cour ses (33 credits)

18 credits in Mathematics selected as follows:

3 credits selected from:

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

* It is strongly recommended that students take MATH 254.

3 credits selected from:

MATH 387	(3)	Honours Numerical Analysis

MATH 397   (3)   Honours Matrix Numerical Analysis

At least 8 credits selected from:

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

The remaining Mathematics credits selected from:

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

MATH 350	(3)	Graph Theory and Combinatorics
MATH 352	(1)	Problem Seminar
MATH 454	(3)	Honours Analysis 3
MATH 545	(4)	Introduction to Time Series Analysis
MATH 578**	(4)	Numerical Analysis 1

MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2

Required Cour ses (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

Complementar y Cour ses (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 abo

13.22.19 Mathematics and Statistics (MATH) Related Programs

13.22.19.1 Joint 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 Joint 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 Joint 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

13.23.3 Microbiology and Immunology (MIMM) Faculty

Chair

Benoit Cousineau (*Interim*)

Emeritus Professors

Nicholas H. Acheson; A.B.(Harv.), Ph.D.(Rockefeller)

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

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

James W. Coulton; B.Sc.(Tor.), M.Sc.(Calg.), Ph.D.(W. Ont.)

Professors

Albert Berghuis; M.Sc.(Rijks Univ. Groningen), Ph.D.(Br. Col.)

Greg Matlashewski; B.Sc.(C'dia), Ph.D.(Ott.)

Robert A. Murgita; B.Sc.(Maine), M.S.(Vermont), Ph.D.(McG.)

Martin Olivier; B.Sc.(Montr.), Ph.D.(McG.)

Ciriaco Piccirillo; B.Sc., Ph.D.(McG.)

Donald Sheppard; M.D.(Tor.)

Mary Stevenson; M.Sc., Ph.D.(Catholic Univ. of Amer.)

Mark A. Wainberg; B.Sc.(McG.), M.Sc., Ph.D.(Col.)

Associate Professors

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

Dalius J. Briedis; B.A., M.D.(Johns Hop.)

Benoit Cousineau; B.Sc., M.Sc., Ph.D.(Montr.)

Sylvie Fournier; Ph.D.(Montr.)

Jörg Fritz; Ph.D.(Vienna)

Samantha Gruenheid; B.Sc.(Br. Col.), Ph.D.(McG.)

Hervé Le Moual; Ph.D.(Montr.)

Gregory T. Marczynski; B.Sc., Ph.D.(Ill.)

Assistant Professors

Irah King; B.Sc.(Ohio St.), M.Sc.(Pitt. St.), Ph.D.(Roch.)

Connie Krawczyk; B.Sc.(Guelph), Ph.D.(Tor.)

Corinne Maurice; M.Sc., Ph.D.(Montpellier II)

Martin J. Richer; B.Sc.(McG.), M.Sc.(Montr.), Ph.D.(Br. Col.)

Selena Sagan; B.Sc.(McG.), Ph.D.(Ott.)

Associate Members

Epidemiology and Infectious Diseases: Marcel Behr, Andre Dascal, Vivian Loo

Immunology, Autoimmunity, Host Defense: Jack Antel, Amit Bar-Or, Miguel Burnier, Ines Colmegna, Philippe Gros, Arnold Kristof, Judith Mandl, Alexandre Orthwein, Joyce Rauch, Maya Saleh, Christos Tsoukas, Silvia Vidal

Immunology and Parasitology: Petra Rohrbach, Brian Ward, Momar Ndao, Ji Zhang

Microbiology: Maziar Divangahi, Chen Liang, Dao Nguyen, Michael Reed, Donald Cuong Vinh

Molecular Biology: Nicolas Cermakian, Sabah Hussain, Armando Jardim, Andrew Mouland, Kostas Pantopoulos, Michel Tremblay, Bernard Turcotte, Jianguo (Jeff) Xia

Virology: Anne Gatignol, Antonis Koromilas, Rongtuan Lin, Jose Teodoro

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

Javier Marcelo Di Noia; Ph.D.(Buenos Aires)

Andres Finzi; B.Sc., M.Sc., Ph.D.(Montr.)

Matthias Götte; Ph.D.(Max Planck)

Nathalie Grandvaux; Ph.D.(Grenoble)

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

Peter Lau; Ph.D.(Ott.)

Sylvie Lesage; B.Sc., Ph.D.(McG.)

Shan-Lu Liu; Ph.D.(Wash.)

Catherine Paradis-Bleau; B.Sc.(Sher.), M.Sc., Ph.D.(Laval)

Ancuta Petronela; M.Sc., Ph.D.(Paris XI)

Kelly Pike; B.Sc.(McG.), Ph.D.(Tor.)

Woong-Kyung Suh; B.Sc., M.Sc.(Seoul Nat.), Ph.D.(Tor.)

13.23.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (49 credits)

U1 Required Courses (18 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

U1 Complementary Course (3 credits)

3 credits, select one from:

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

U1, U2, or U3 Required Course (3 credits)

3 credits, select one from:

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

U2 Required Courses (15 credits)

MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory

MIMM 385	(3)	Laboratory in Immunology

U3 Complementar y Cour ses (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 Complementar y Cour ses (3 credits)

3 credits selected from:

* Students who have taken CHEM 212 or CHEM 222 in CEGEP must replace it with another complementary course.

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458	(3)	Membranes and Cellular Signaling
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
COMP 364	(3)	Computer Tools for Life Sciences
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHGY 209	(3)	Mammalian Physiology 1

PHGY 210	(3)	Mammalian Physiology 2

13.23.5 Bachelor of Science (B.Sc.) - Major Micr obiology and Imm unology (68 credits)

The Major program is designed for students who want to acquire a substantial background in microbiology and immunology and related disciplines (chemistry, biology, biochemistry) which will prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes.

U1 Required Cour ses (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 Cour se (3 credits)
One of:

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

U2 Required Cour ses (21 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Cour ses (9 credits)

MIMM 413	(3)	Parasitology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Complementar y Cour ses (9 credits)

9 credits selected from:

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

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458*	(3)	Membranes and Cellular Signaling
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 302	(3)	Introductory Organic Chemistry 3
COMP 364	(3)	Computer Tools for Life Sciences
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

13.23.6   Bachelor of Science (B.Sc.) - Honour s Micr obiology and Imm unology (74 credits)

The Honours program is designed to offer, in addition to the substantial background given by the Major program, a significant research experience in a laboratory within the Department during the U3 year. Students are prepared for this independent research project by following an advanced laboratory course in U2. This program is intended to prepare students for graduate study in microbiology and immunology or related fields, but could also be chosen by students intending to enter medical research after medical school, or intending to enter the job market in a laboratory research environment.

Students intending to apply to Honours must follow the Major program in U1 and U2 and must obtain a CGPA of at least 3.50 at the end of their U2 year. For graduation in Honours, students must pass all required courses with a C or better, and achieve a sessional GPA of at least 3.30 in the U3 year.

U1 Required Cour ses (25 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and must replace these credits with an elective course(s).

** Students who have taken CHEM 222 in CEGEP are exempt and must replace these credits with an elective course(s).

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222**	(4)	Introductory Organic Chemistry 2
MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

One of:

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

U1, U2, or U3 Required Cour se (3 credits)
One of:

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

U2 Required Cour ses (21 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Cour ses (21 credits)

MIMM 413	(3)	Parasitology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 501D1*	(6)	Honours Research Project in Immunology
MIMM 501D2*	(6)	Honours Research Project in Immunology
MIMM 502D1*	(6)	Honours Research Project in Microbiology
MIMM 502D2*	(6)	Honours Research Project in Microbiology

* Students take either MIMM 501D1 and MIMM 501D2 OR MIMM 502D1 and MIMM 502D2.

Complementar y Cour se (3 credits)
3 credits selected from:

ANAT 458	(3)	Membranes and Cellular Signaling
BIOC 404	(3)	Biophysical Methods in Biochemistry
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 520	(3)	Gene Activity in Development
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
COMP 364	(3)	Computer Tools for Life Sciences

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, sciene in

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
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 433	(3)	Cognitive Science
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 501	(3)	Auditory Perception
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 514***	(3)	Neurobiology of Learning and Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
PSYT 505	(3)	Neurobiology of Schizophrenia

13.26.4 Bachelor of Science (B.Sc.) - Major Neur oscience (65 credits)

The Neuroscience Major is a focused program for students interested in how the nervous system functions. It is highly interdisciplinary and borrows principles and methodologies from a number of fields including: biology, biochemistry, physiology, psychology, mathematics, physics, computer science, and immunology. T

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
MA	(4)	Calculus 1 with Precalculus

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.

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
		Introduction to Computer Science

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 & 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 507	(3)	Topics in Radionuclide Imaging
NEUR 550	(3)	Free Radical Biomedicine
PHAR 562	(3)	Neuropharmacology
		Analyzing Physiological Systems

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 Behaviour
PSYC 433	(3)	Cognitive Science
PSYC 470	(3)	Memory and Brain
PSYC 502	(3)	Psychoneuroendocrinology
		Cognitive Neuroscience of

Complementar y Cour ses (30 credits)

3 credits from:

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

3 credits from:

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

3 credits from:

Note: Students who have successfully completed an equivalent to MATH 222 at CEGEP or elsewhere, must replace these credits with a 3-credit elective course to satisfy the total credit requirement for the Honours Neuroscience.

BIOL 309	(3)	Mathematical Models in Biology
MATH 222	(3)	Calculus 3

The remaining 21 credits should be taken from the following lists. At least 15 of the 21 credits must be taken at the 400- or 500-level.

200- and 300-level courses:

*Students may take either COMP 206 or COMP 250, but not both.

BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 389	(3)	Laboratory in Neurobiology
CHEM 222	(4)	Introductory Organic Chemistry 2
COMP 206*	(3)	Introduction to Software Systems
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 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.

- 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 vie

Associate Members

Luda Diatchenko; M.D., Ph.D.(RNRMU)

Serge Gauthier; M.D.(Montr.)

Timothy Geary; Ph.D.(Mich.)

Complementar y Cour ses (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 Cour ses (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 selected from (usually in Year 1):

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

3 credits selected from (usually in Year 2):

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

3 credits selected from (usually in Year 2):

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

3 credits selected from (usually in Year 3):

| PHAR 503 | (3) | Drug Discovery and Development 1 |
| PHAR 505 | (3) | Structural Pharmacology |

3 credits selected from (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.

* Note: Students may take either ANAT 458 or BIOC 458.

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 458*	(3)	Membranes and Cellular Signaling
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 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 511	(3)	Joint Venturing with Industry
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets
PHAR 599D1	(3)	Pharmacology Research Project
PHAR 599D2	(3)	Pharmacology Research Project
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 520	(3)	Ion Channels

PPHS 501	(3)	Population Health and Epidemiology	
PSYC 302	(3)	The Psychology of Pain	
PSYC 311	(3)	Human Cognition and the Brain	
PSYT 301	(3)	Issues in Drug Dependence	
PSYT 455	(3)	Neurochemistry	
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders	
REDM 410	(3)	Writing Research Articles	

13.29.6 Bachelor of Science (B.Sc.) - Honour s Pharmacology (76 credits)

The Honours program is designed as a preparation for graduate studies and research. In addition to the strong training provided by the Major program, it requires students to have direct research experience in a chosen area during their final year of study. Acceptance into the Honours program takes place in the Winter term of U2 and requires a CGPA of 3.50. Students who wish to enter the Honours program should follow the Major program; those who satisfactorily complete the first three terms with a CGPA of at least 3.50 and a mark of B+ or higher in core Pharmacology courses (PHAR 300, PHAR 301, and PHAR 303) are eligible for admission. Applications can be obtained from the office of the Department of Pharmacology in the McIntyre Medical Building or on the Departmental website.

U1 Required Cour ses (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 Cour ses (16 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOL 301	(4)	Cell and Molecular Laboratory
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology

U3 Required Cour ses (6 credits)

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

Complementar y Cour ses (30 credits)

15 credits selected as follows:

3 credits selected from (usually in Year 1):

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

3 credits selected from (usually in Year 2):

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

3 credits selected from (usually in Year 2):

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

3 credits selected from (usually in Year 3):

PHAR 503	(3)	Drug Discovery and Development 1
PHAR 505	(3)	Structural Pharmacology

3 credits selected from (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.

* Note: Students may take either ANAT 458 or BIOC 458.

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 458*	(3)	Membranes and Cellular Signaling
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3

Associate Professors

Keshav Dasgupta; B.Sc., M.Sc.(IIT), Ph.D.(Tata)

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

Paul Francois; B.Sc.(École Poly., France), M.Sc., Ph.D.(ENS Paris)

Michael Hilke; B.Sc., M.Sc., Ph.D.(Geneva)

Alex Maloney; B.Sc., M.Sc.(Stan.), Ph.D.(Harv.) (*William Dawson Scholar*)

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

Steve Robertson; B.Sc.(Calg.), M.Sc., Ph.D.(Vic., BC)

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

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

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

Andreas Warburton; B.Sc.(Vic., BC), M.Sc., Ph.D.(Tor.)

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

Assistant Professors

Thomas Brunner; Ph.D.(Munich)

Simon Caron-Huot; B.Sc.(Laval), M.Sc., Ph.D.(McG.)

Lilian Childress; B.A., Ph.D.(Harv.)

David Cooke; B.Sc.(St. FX), Ph.D.(Alta.)

Nicolas Cowan; B.Sc.(McG.), Ph.D.(Wash.)

Daryl Haggard; B.A.(St. John's Coll.), M.Sc.(San Francisco St.), Ph.D.(Wash.)

Sabrina Leslie; B.Sc.(Br. Col.), Ph.D.(Calif., Berk.)

Tamar Pereg-Barnea; B.Sc.(Hebrew), M.Sc., Ph.D.(Br. Col.)

Jack Sankey; B.Sc.(Minn.), M.Sc., Ph.D.(Cornell)

Associate Members

M. Chacron (*Physiology*)

K. Gehring (*Biochemistry*)

P. Kambhampati (*Chemistry*)

M. Mackey (*Physiology*)

J. Nadeau (*Biomedical Engineering*)

G.B. Pike (*MNI and Biomedical Engineering*)

E. Podgorsak (*Radiation Oncology*)

D. Rassier (*Kinesiology and Physical Education*)

D. Ronis (*Chemistry*)

J. Seuntjens (*Medical Physics*)

T. Szkopek (*Electrical and Computer Engineering*)

Curator (Rutherford Museum and McPherson Collection)

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

13.30.6   Bachelor of Science (B.Sc.) - Minor Ph   ysics (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

ECSE 303	(3)	Signals and Systems 1
ECSE 330	(3)	Introduction to Electronics

Complementar y Cour ses (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 Pr ogram - Core Science Component Ph ysics (48 credits)

Program Prerequisites

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

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

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

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

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

Required Cour ses (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 |

Complementar y Cour ses (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 Ph   ysics (60 credits)

Program Prerequisites

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

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

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

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

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

U1 Required Cour ses (21 credits)

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2

U2 Required Cour ses (24 credits)

MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 328	(3)	Electronics
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics

BIOL 202   (3)   Basic Genetics

anced Calculus   Advanced Calculus

BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology

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

U2 Required Cour ses (24 credits)

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

U3 Required Cour ses (21 credits)

COMP 360	(3)	Algorithm Design
MATH 323	(3)	Probability
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 446	(3)	Majors Quantum Physics
PHYS 489	(3)	Special Project

13.30.13 Bachelor of Science (B.Sc.) - Honour s Physics (78 credits)

Students entering this program for the first time should have high standing in mathematics and physics. In addition, a student who has not completed the equivalent of MATH 222 must take it in the first term without receiving credit toward the 78 credits required in the Honours program.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (unless it is improved to a C or higher in a supplementary examination or by retaking the course), may not register in the Honours program the following year, or graduate with the Honours degree, except with the permission of the Department.

Program Prerequisites

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

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

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

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

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

U1 Required Courses (27 credits)

MATH 247	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced Calculus
MATH 249	(3)	Honours Complex Variables
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 260	(3)	Modern Physics and Relativity

U2 Required Courses (24 credits)

MATH 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

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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
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics
PHYS 557	(3)	Nuclear Physics
PHYS 558	(3)	Solid State Physics
PHYS 559	(3)	Advanced Statistical Mechanics
PHYS 562	(3)	Electromagnetic Theory
PHYS 567	(3)	Particle Physics

13.30.14 Bachelor of Science (B.Sc.) - Honour s Physics: Biological Ph ysics (82 credits)

NEW PROGRAM

The B.Sc. Honours Physics: Biological Physics program keeps a strong core of foundational physics and specializes through courses in biology, mathematics, physiology, computer science, and chemistry. The Honours program offers a more rigorous preparation, with additional research experience, for students with a strong interest in biophysics. In the final year, students will have an opportunity to carry out a research project within a biophysics lab in the department. This program provides a very strong foundation for students wishing to pursue graduate studies in bioph

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

Complementar y Cour ses

(18-19 credits)

3 credits selected from:

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

3 credits selected from:

PHYS 328	(3)	Electronics
PHYS 351	(3)	Honours Classical Mechanics 2

3 credits selected from:

PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 359	(3)	Honours Laboratory in Modern Physics 1

3 credits selected from:

CHEM 514	(3)	Biophysical Chemistry
MATH 437	(3)	Mathematical Methods in Biology
PHGY 425	(3)	Analyzing Physiological Systems
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 447	(3)	Applications of Quantum Mechanics

6 to 7 credits selected from:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 316	(3)	Biomembranes and Organelles
BIOL 551	(3)	Principles of Cellular Control

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 Cour ses (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

Complementar y Cour ses (18 credits)

U1 Complementar y Cour se (3 credits)

MATH 247	(3)	Honours Applied Linear Algebra
MATH 251	(3)	Honours Algebra 2

U2 Complementar y Cour ses (3 credits)

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

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

U3 Complementar y Cour ses (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.) - Honour s Physics and Chemistr y (80 credits)

This is a specialized and demanding program intended primarily, although not exclusively, for students with a theoretical bias who are interested in working in fields of study at the crossroads of physical chemistry and physics. The program will prepare students for either theoretical or experimental graduate work in departments where there is an emphasis on such cross-disciplinary areas as condensed matter physics, chemical physics, or material science.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (unless the student improves the grade to a C or above by taking a supplemental exam or retaking the course), may not register in this Honours program the following year, or graduate with the Honours degree, except with permission of both departments.

The student will have two advisers, one from Chemistry and the other from Physics.

Program Prerequisites

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

CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
PHYS 131	(4)	Mechanics and Waves
PHYS 142	(4)	Electromagnetism and Optics

One of:

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

MATH 133 and 949 391 0 0 1 76.119 552.T15 or 8302 Tm(TH 133 an40/1(yo0 1 76.119 552.T21 Tm3302 Tm(TH 133 an50/1511 0 0 1 221.949 511.033355(BIOL Lir

Course	Credits	Title
MATH 247	(3)	Honours Applied Linear Algebra
MATH 248	(3)	Honours Advanced Calculus
PHYS 251	(3)	Honours Classical Mechanics 2
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 457	(3)	Honours Quantum Physics 2
PHYS 558	(3)	Solid State Physics

Complementar4.1credits(3))TT /F1 8.1 Tf 1 0 0 1 67.5489.38192 Tm (with at least 31credits in Chemistrity an31credits in e Ph)Tj 1 0 0 145.4455489.

PHYS7249	(3)	

13.31.3 Physiology (PHGY) Faculty

Chair

John Orlowski

Emeritus Professors

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

Kresmir Krnjevic; O.C., B.Sc., Ph.D., M.B., Ch.B.(Edin.), F.R.S.C

Wayne Lapp; M.S.A.(Tor.), Ph.D.(McG.)

Mortimer Levy; B.Sc., M.D.,C.M.(McG.), F.R.C.P.(C) (*joint appt. with Medicine*)

Michael Mackey; B.A., Ph.D.(Wash.) (*Joseph Morley Drake Professor of Physiology*)

George Mandl; B.Sc.(C'dia), Ph.D.(McG.)

Geoffrey Melvill Jones; B.A., M.A., M.B., B.Ch., M.D.(Cant.)

Joseph Milic-Emili; M.D.(Milan)

Canio Polosa; M.D., Ph.D.(McG.)

Douglas G.D. Watt; M.D., Ph.D.(McG.)

Professors

Monroe W. Cohen; B.Sc., Ph.D.(McG.)

Ellis J. Cooper; B.Eng.(Sir G. Wms.), M.Sc.(Sur.), Ph.D.(McM.)

Kathleen Cullen; B.Sc.(Brown), Ph.D.(Chic.)

Leon Glass; B.S.(Brooklyn), Ph.D.(Chic.) (*Isadore Rosenfeld Professor of Cardiology*)

Phil Gold; C.C., B.Sc., M.Sc., Ph.D., M.D.,C.M.(McG.), F.R.C.P.(C.), F.R.S.C. (*Douglas G. Cameron Professor of Medicine*) (*joint appt. with Medicine*)

David Goltzman; B.Sc., M.D.,C.M.(McG.) (*Antoine G. Massabki Professor of Medicine*) (*joint appt. with Medicine*)

John Hanrahan; Ph.D.(Br. Col.)

Gergely Lukacs; M.D., Ph.D.(Budapest)

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)

Alvin Shrier; B.Sc.(C'dia), Ph.D.(Dal.) (*Hosmer Professor of Applied Physiology*)

John White; B.Sc., M.Sc.(Car.), Ph.D.(Harv.)

Associate Professors

Maurice Chacron; Ph.D.(Ott.)

Erik Cook; Ph.D.(Baylor College, Houston)

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

Michael Guevara; B.Sc., M.Eng., Ph.D.(McG.)

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.)

Assistant Professors

PHGY 213	(1)	Introductory Physiology Laboratory 2
PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

Complementar y Cour ses (12 credits)

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
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)	Human Visceral Anatomy

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 fr om the Upper -Level Science (ULS)

Note: For Chemistry, Neurology, and Neurosurgery: select from all courses 300 level and above and the ULS courses listed below.

For Biochemistry, Computer Science, Microbiology and Immunology, Mathematics, Physics, and Pathology: select from all courses 300 level and above.

For Anatomy, Biology, Experimental Medicine, Pharmacology, and Psychology: select from the ULS courses listed below:

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458*	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 542	(3)	Transmission Electron Microscopy
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 309	(3)	Mathematical Models in Biology
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 324	(3)	Ecological Genetics
BIOL 370	(3)	Human Genetics Applied
BIOL 373	(3)	Biometry
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 416	(3)	Genetics of Mammalian Development
BIOL 468	(6)	Independent Research Project 3
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 532	(3)	Developmental Neurobiology Seminar

Bio-Ph ysical 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 323	(3)	Probability
MATH 325**	(3)	Honours Ordinary Differential Equations

* Students may take either MATH 223 or MATH 247.

** Students may take either MATH 315 or MATH 325.

Physiology and Mathematics Core

BIOL 309	(3)	Mathematical Models in Biology
BMDE 519	(3)	Biomedical Signals and Systems
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 248***	(3)	Honours Advanced Calculus
MATH 314***	(3)	Advanced Calculus
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Introduction to Partial Differential Equations

MATH 3270.*su5n3aD 386.8(2) TmtonlCT0 1 Statisti94s 386.822 Tmunced CalculuN1amTf1 1 1Chao 386.822 Tm((3))Tj1 1 1Chao 36322 Tm(Statistics)Tj1 0 0 1 165.

3 credits, one of:

PHYS 413	(3)	Physical Basis of Physiology
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
MATH 248***	(3)	Honours Advanced Calculus
MATH 314***	(3)	Advanced Calculus
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 437	(3)	Mathematical Methods in Biology
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2
PHGY 312	(3)	Respiratory, Renal, & Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, & Immune Systems Physiology
PHGY 461D1	(4.5)	Experimental Physiology
PHGY 461D2	(4.5)	Experimental Physiology
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 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism

PHYS 446	(3)	Majors Quantum Physics

*** Students may take either MATH 248 or MATH 314.

Complementary Courses (6 credits)

3 credits, one of:

PHGY 311	(3)	Channels, Synapses & Hormones
PHGY 314	(3)	Integrative Neuroscience

3 credits, one of:

PHYS 413	(3)	Physical Basis of Physiology
PHYS 519	(3)	Advanced Biophysics

13.31.8 Bachelor of Science (B.Sc.) - Honours Physiology (75 credits)

All admissions to the Honours program will be in U2, and the student must have a U1 GPA of 3.30, with no less than a B in PHGY 209 and PHGY 210. Admission to U3 requires a U2 CGPA of 3.20 with no less than a B in U2 Physiology courses. Decisions for admission to U3 will be heavily influenced by student standing in U2 courses.

The Department reserves the right to restrict the number of entering students in the Honours program. Students who do not maintain Honours standing may transfer their registration to the Major program in Physiology.

The deadline to apply to the Honours program is August 15, 2018. Application forms are av

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

13.31.9 Physiology (PHGY) Related Programs

13.31.9.1 Interdepartmental Honours in Immunology

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

Students interested in the program should contact:

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

OR

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

13.32   Psychiatry (PSYT)

13.32.1 Location

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

13.32.2 About Psychiatry

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

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

Courses

Issues in Forensic Mental Health

and, in some cases, that research experience has been obtained. During the U2 year, undergraduate students are strongly advised to verify the admission requirements of various graduate programs. This is to ensure that sufficient time is available for students to complete all necessary requirements for admission to their preferred graduate programs.

Emeritus Professors

Peter M. Milner; B.Sc.(Leeds), M.Sc., Ph.D.(McG.)

Debbie S. Moskowitz; B.S.(Kirkland Coll.), M.A., Ph.D.(Conn.)

Robert O. Pihl; B.A.(Lawrence), Ph.D.(Ariz.)

James O. Ramsay; B.Ed.(Alta.), Ph.D.(Princ.)

Barbara B. Sherwin; B.A., M.A., Ph.D.(C'dia)

Yoshio Takane; B.L., M.A.(Tokyo), Ph.D.(N. Carolina)

Yuriko Oshima-Takane; B.A.(Tokyo Women's Christian Univ.), M.A.(Tokyo), Ph.D.(McG.)

Donald M. Taylor; B.A., M.A., Ph.D.(W. Ont.)

Norman M. White; B.A.(McG.), M.S., Ph.D.(Pitt.)

Retired

Andrew G. Baker; B.A.(Br. Col.), M.A., Ph.D.(Dal.)

Professors

MrBrkBakhrorkBakhro6h1 0 0 1 70 0 tteOe7khrorkBakhro6h

Lecturer

Paola Carvajal; B.Sc.(C'dia), M.A.(McG.)

Professionals

Rhonda Amsel; B.Sc., M.Sc.(McG.) (*Associate*)

Ian F. Bradley; B.Sc., M.Sc.(Tor.), Ph.D.(Wat.) (*Assistant*)

Elizabeth Foley; B.Sc., Ph.D.(McG.) (*Assistant*)

Judith LeGallais; B.A., M.A., Ph.D.(McG.) (*Faculty Lecturer*)

Jennifer Russell; B.A., Ph.D.(McG.) (*Assistant*)

Marco Sinai; B.Sc., M.A., Ph.D.(C'dia) (*Assistant*)

Stephen Stotland; B.A., M.A., Ph.D.(McG.) (*Assistant*)

Associate Members

Clinical Research Institute of Montreal: Terence J. Coderre

Douglas Hospital: Jorge Armony, Suzanne King, Martin Lepage, Jens Pruessner, Maria Natasha Rajah, Howard Steiger

Neurology and Neurosurgery: L. Koski

Institute of Health and Social Policy, McGill: Frank Elgar

Jewish General Hospital: David Dunkley, Brett Thombs, Phyllis Zelkowitz

Montreal Neurological Institute: Alain Dagher, Lesley Fellows, Daniel Guitton, Marilyn Jones-Gotman, Brenda Milner, Edward Ruthazer, Wayne Sossin, Viviane Sziklas, Robert Zatorre

Psychiatry: Marco Leyton, Amir Raz

Schulich School of Music: Stephen McAdams

Vision Research Unit (Ophthalmology): Curtis Baker, Robert Hess, Frederick A.A. Kingdom, Kathleen Mullen

Adjunct Professors

M. Bruck; B.A.(Wheaton), M.A., Ph.D.(McG.)

P. Delise; B.Sc., M.Ps., Ph.D.(Montr.)

S. Harnard; B.A.(McG.), M.A.(McG.), M.A., Ph.D.(Princ.)

Z. Pleszewski; M.A., Ph.D.(Poznan)

P. Zelazo; B.A.(Amer

18-21 credits selected from Psychology courses at the 300 level or above.

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

This Core Science Component Psychology requires the completion of 45 credits in Psychology, all of which need to be passed with a minimum grade of C. A prerequisite to the program is PSYC 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 & Theory
PSYC 302	(3)	The Psychology of Pain
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 329	(3)	Introduction to Auditory Cognition
PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour
PSYC 352	(3)	Cognitive Psychology Laboratory
PSYC 403	(3)	Modern Psychology in Historical Perspective
PSYC 406	(3)	Psychological Tests
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 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 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 Psyc   hology (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 Bac kgr ound

It is expected that most students who enter the Major program in Psychology will have taken introductory psychology, biology, and statistics at the collegial level. Recommended CEGEP courses include Psychology 350-101 or 350-102 or equivalent; Biology CEGEP objective 00UK, 00XU or equivalent; and Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-level statistics course. In the first year those students who have not taken the recommended collegial-level statistics course, or those who have obtained a grade below 75%, must take Psychology PSYC 204. Those who have not taken the recommended collegial-level biology must take BIOL 111 or BIOL 112, and those who have not taken Introductory Psychology in college must take PSYC 100.

U1 Required Cour ses (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 Cour se (3 credits)

PSYC 305	(3)	Statistics for Experimental Design

Complementar y Cour ses (39 credits)

List A

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

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning & Theory
PSYC 302	(3)	The Psychology of Pain
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 329	(3)	Introduction to Auditory Cognition

PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour
PSYC 352	(3)	Cognitive Psychology Laboratory
PSYC 403	(3)	Modern Psychology in Historical Perspective
PSYC 406	(3)	Psychological Tests
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 427	(3)	Sensorimotor Behaviour
PSYC 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 & 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
		Inter-O1ist B e

PSYC 414	(3)	Social Development
PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations
PSYC 512	(3)	Advanced Personality Seminar
PSYC 528	(3)	Vulnerability to Depression 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 follo

PSYC 212	(3)	Perception
PSYC 213	(3)	Cognition
PSYC 215	(3)	Social Psychology

U1 or U2 Required Cour

PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development
PSYC 427	(3)	Sensorimotor Behaviour
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 & 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
Montreal QC H3A 0C4
Telephone: 514-398-4086 ext. 3188
Fax: 514-398-3185
Email: *redpath.museum@mcgill.ca*
Website: *www.mcgill.ca/redpath*

13.34.2 About the Redpath Museum

The Redpath Museum fosters the study of the history and diversity of the natural world. Its mandate includes biological, geological, and cultural diversity, and science education. It conducts academic teaching and research activities and also provides academic services to other units. The Redpath Museum offers a B.Sc. **Minor** program in Natural History. REDM courses listed below are considered as ones taught by the Faculty of Science.

Redpath Museum Courses	
REDM 396	Undergraduate Research Project
REDM 400	Science and Museums
REDM 405	Natural History of East Africa
REDM 511	Advanced Museum-Based Science

13.34.3 Redpath Museum (REDM) F aculty

Director
Hans C.E. Larsson

Emeritus Professor
Robert L. Carroll; B.Sc.(Mich.), Ph.D.(Harv.), F.R.S.C., F.L.S.

Professors
David M. Green; B.Sc.(Br. Col.), M.Sc.7, F

Professors

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

Associate Professors

Hans C.E. Larsson; B.Sc.(McG.), Ph.D.(Chic.)

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

Anthony Ricciardi; B.Sc.(Agr.), M.Sc., Ph.D.(McG.) (*joint appt. with McGill School of Environment*)

Assistant Professor

Rowan D.H. Barrett; B.Sc.(Guelph), M.Sc.(McG.), Ph.D.(Br. Col.) (*CRC Tier 2 Chair in Biodiversity Science*)

Associate Members

Biology: Graham A.C. Bell, Lauren J. Chapman

BIOL 331	(3)	Ecology/Behaviour Field Course	
BIOL 334	(3)	Applied Tropical Ecology	
BIOL 335	(3)	Marine Mammals	
BIOL 573	(3)	Vertebrate Palaeontology Field Course	
ENTO 340	(3)	Field Entomology	
EPSC 231	(3)	Field School 1	
NRSC 405*	(3)	Natural History of East Africa	
REDM 405*	(3)	Natural History of East Africa	
WILD 475	(3)	Desert Ecology	

13.35 Science or Mathematics f or 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 f or Teachers

Note: New students are no longer being admitted to the Concurrent B.Sc. and B.Ed.

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 several programs for students who wish to combine Science or Mathematics with Education at McGill. These include the **Minor** in Education for Science Students, and the **Concurrent B.Sc. and B.Ed.** (no longer accepting new students). The traditional **Bachelor of Education**, Secondary Program, Science and Technology, or Secondary Program, Mathematics is also available within the Faculty of Education; see *Faculty of Education > 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*).

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 hav

- *section 13.35.6: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Chemistry for Teachers (135 credits)*
- *section 13.35.7: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Physics for Teachers (135 credits)*
- *section 13.35.8: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Physics for Teachers (135 credits)*
- *section 13.35.9: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Biology for Teachers (135 credits)*
- *section 13.35.10: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Physics for Teachers (135 credits)*
- *section 13.35.13: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Mathematics for Teachers (135 credits)*
- *section 13.35.11: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Biology for Teachers (135 credits)*
- *section 13.35.12: Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Physics with Minor Chemistry for Teachers (135 credits)*

13.35.3 Science or Mathematics f or 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 f or Science Students (18 credits)

This Minor allows Science students to develop or explore an interest in Education without committing themselves to completing a B.Ed. degree. Science students who have taken this Minor in Education will have completed some of the credits for the B.Ed. degree should they wish to enrol in that program. Students graduating with a B.Sc. should also consider the Master of Arts in Teaching and Learning (http://www.mcgill.ca/dise/grad/) if they are interested in obtaining a teaching license.

This minor program requires an application due to limited enrolment space. Please see http://www.mcgill.ca/isa/faculty-advising/minor-programs for procedures and deadlines.

For more information please contact:

Vanessa Smith

Internships & Student Affairs Office, Faculty of Education

General Information: 514-398-7042

Website: http://www.mcgill.ca/isa

Required Cour se (3 credits)

EDPE 300	(3)	Educational Psychology

Complementar y Cour ses (15 credits)

9 credits selected from:

One of:

EDEC 233	(3)	Indigenous Education

| EDEC 248 | (3) | Equity and Education |
| EDEC 249 | (3) | Global Education and Social Justice |

One of:

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

One of:

| EDEC 247 | (3) | Policy Issues in Quebec Education |
| EDEM 220 | (3) | Contemporary Issues in Education |

6 credits from the list belo

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available

First physics course, one of:

Introductory Ph

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	Indigenous Education
EDEC 248*	(3)	Equity and Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

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

Major Concentration Biology - Cell/Molecular (36 credits)

The Major Concentration Biology - Cell/Molecular is a planned sequence of courses designed to permit a degree of specialization in cell/molecular biology.

Advising Note: Freshman students should be aware that PHYS 101 and/or PHYS 102 are required for some of the courses in the major and minor concentrations in Biology.

Required Courses

25 credits selected as follows:

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology

Complementary Courses

At least 11 credits selected from:

BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 370	(3)	Human Genetics Applied
BIOL 373	(3)	Biometry
BIOL 413	(1)	Directed Reading
BIOL 568	(3)	Topics on the Human Genome
BIOL 575	(3)	Human Biochemical Genetics

or other appropriate course at the 300 level or higher with the permission of an adviser.

Minor Chemistr y (18 credits)

Required Cour ses

18 credits selected as follows:

* Note: denotes courses with CEGEP equivalents.

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

CHEM 203	(3)	Survey of Physical Chemistry
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 253	(1)	Introductory Physical Chemistry 1 Laboratory
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 281	(3)	Inorganic Chemistry 1

Additional Science Cour ses

15 credits selected as follows:

12 credits:

BIOL 210	(3)	Perspectives of Science
CHEM 381	(3)	Inorganic Chemistry 2
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3

plus 3 credits, one of:

CHEM 180	(3)	World of Chemistry: Environment
CHEM 181	(3)	World of Chemistry: Food
CHEM 182	(3)	World of Chemistry: Technology
CHEM 183	(3)	World of Chemistry: Drugs

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

13.35.6 Concurrent Bac helor of Science (B.Sc.) and Bac helor of Education (B.Ed.) - Major Concentration Biology - Or ganismal with Minor Chemistr y for Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Organismal with Minor Chemistry for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs." and "Quebec Teacher Certification".

The Major Concentration Biology - Organismal with Minor Chemistry is one of the nine variations of the program and allows students to focus their Science degree in Organismal Biology with a subspecialization in Chemistry.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of Major Concentration Biology - Organismal

- 18 credits of Minor Chemistry

- 15 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website http://www.mcgill.ca/scienceforteachers/.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at http://www.mcgill.ca/science/sousa. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

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

General Math and Science Breadth

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

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

or

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

Science Complementary

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

Notes:

1. Students who have not studied all of Biology, Chemistry and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.

2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.

3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/student/newstudents/u0/bscfreshman/.

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

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

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

MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

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

Second calculus course, one of:

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

First physics course, one of:

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

Second physics course, one of:

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

Electives

Students wishing to take elective courses may choose them from introductory courses offered by departments in the Faculties of Science or of Arts. A list of recommended courses is found at http://www.mcgill.ca/science/sousa/new_students/u0/bsc_freshman/approved/. Certain courses offered by other faculties may also be taken, but some restrictions apply.

Consult the SOUSA website at http://www.mcgill.ca/science/sousa/continuing_students/bsc/outside/ for more information about taking courses from other faculties.

Education Component (60 credits)

60 credits of Education Component consisting of:

54 credits of required courses

6 credits of complementary courses

Required Cour ses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)

EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementar y Cour ses

6 credits selected as follows:

* Note: The courses mark

Complementary Courses

12 credits selected from:

| BIOL 303 | (3) | Developmental Biology |
| | | Animal Diversity |

CHEM 183   (3)   World of Chemistry: Drugs

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

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

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Biology - Cell/Molecular with Minor Physics for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Biology - Cell/Molecular with Minor Physics is one of the nine variations of the program and allo

Education Component (60 credits)

60 credits of Education Component, consisting of:

Major Concentration Biology - Cell/Molecular (36 credits)

The Major Concentration Biology - Cell/Molecular is a planned sequence of courses designed to permit a degree of specialization in cell/molecular biology.

Advising Note: Freshman students should be aware that PHYS 101 and/or PHYS 102 are required for some of the courses in the major and minor concentrations in Biology.

Required Cour ses*

29 credits selected as follows:

* Students who have already taken CHEM 212 or its equivalent will choose another appropriate complementary course, to be approved by the Adviser. Regardless of the substitution, students must take at least 36 credits in this program.

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 303	(3)	Developmental Biology
CHEM 212*	(4)	Introductory Organic Chemistry 1

Complementar y Cour ses

At least 7 credits selected from:

BIOL 306	(3)	Neural Basis of Behaviour
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Oncogenes
BIOL 370	(3)	Human Genetics Applied
BIOL 373	(3)	Biometry
BIOL 413	(1)	Directed Reading
BIOL 568	(3)	Topics on the Human Genome
BIOL 575	(3)	Human Biochemical Genetics

or other appropriate course at the 300 level or higher with the permission of an adviser.

Minor Ph ysics (18 credits)

Required Cour se

3 credits

PHYS 257	(3)	Experimental Methods 1

Complementar y Cour ses

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:

Heat and Wa

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

70 credits of Science Component consisting of:

- 37 credits of Major Concentration Biology - Organismal

- 18 credits of Minor Physics

- 15 credits of Additional Science Courses

5 credits of Electives, of which at least 2 credits must be Science Electives, depending on how many credits count toward both the B.Sc. and the B.Ed. degrees.

For details on the counting of credits toward both degrees (double-counting) visit the program website http://www.mcgill.ca/scienceforteachers/.

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at http://www.mcgill.ca/science/student. Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

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

General Math and Science Breadth

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

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

or

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

Science Complementary

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

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.

2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.

3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at http://www.mcgill.ca/science/student/newstudents/u0/bscfreshman/specific.

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

List of Approved Freshman Science Courses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

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

MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

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

Second calculus course, one of:

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

First physics course, one of:

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

Second physics course, one of:

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

Electives

Students wishing to take elective courses may choose them from introductory courses offered by departments in the Faculties of Science or of Arts. A list of recommended courses is found at http://www.mcgill.ca/science/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.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Cour ses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman Year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)

EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementar y Cour ses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	Indigenous Education
EDEC 248*	(3)	Equity and Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

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

Major Concentration Biology - Or ganismal (37 credits)

The Major Concentration Biology - Organismal is a planned sequence of courses designed to permit a degree of specialization in organismal biology.

Advising Note: Freshman students should be aware that PHYS 101 and/or PHYS 102 are required for some of the courses in the major and minor concentrations in Biology.

Required Cour ses*

28 credits selected as follows:

* Students who have already taken CHEM 212 or its equivalent will choose another appropriate complementary course, to be approved by the Adviser. Regardless of the substitution, students must take at least 36 credits in this program.

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Biology of Organisms
BIOL 206	(3)	Methods in Biology of Organisms
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 304	(3)	Evolution

One of:

PHYS 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 260	(3)	Modern Physics and Relativity
PHYS 271	(3)	Introduction to Quantum Physics

One of:

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

Additional Science Courses (15 credits)

BIOL 210	(3)	Perspectives of Science
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus

Electives (5 credits)

5 credits, of which at least 2 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

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

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Biology for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Fv

B.Sc. Freshman Program

Students who enter Science in U0 will normally be registered in the Science Freshman Program until they complete their first year. They must consult an adviser in the Science Office for Undergraduate Student Advising (SOUSA) to obtain advice and approval of their course selection. Full details are available on the SOUSA website at http://www.mcgill.ca/science/student.

Academic advising is also available by email. The address is newstudentadvising.science@mcgill.ca.

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

General Math and Science Breadth

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

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

or

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

Science Complementary

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

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.

2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.

3. Students entering the Freshman Program must be aware of the department specifich3equi

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:

	(4)	Introductory Physics - Electromagnetism

| EDPI 309* | (3) | Diverse Learners |
| EDPI 341 | (3) | Instruction in Inclusive Schools |

Complementary Courses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	Indigenous Education
EDEC 248*	(3)	Equity and Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

Philosophical F

CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 571	(3)	Polymer Synthesis
CHEM 582	(3)	Supramolecular Chemistry
CHEM 591	(3)	Bioinorganic Chemistry

Minor Biology (24 credits)

Required Cour ses

15 credits

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

Complementar y Cour ses

9 credits selected from the Biology Department's course offerings, at the 300 level or above.

Additional Science Cour ses (9 credits)

BIOL 210	(3)	Perspectives of Science
MATH 203	(3)	Principles of Statistics 1
MATH 222	(3)	Calculus 3

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.

13.35.10 Concurrent Bac helor of Science (B.Sc.) and Bac helor of Education (B.Ed.) - Major Concentration Chemistr y with Minor Physics f or Teachers (135 credits)

Note: New students are no longer being admitted to this program.

The Concurrent Bachelor of Science (B.Sc.) and Bachelor of Education (B.Ed.) - Major Concentration Chemistry with Minor Physics for Teachers is jointly offered by the Faculty of Science and the Faculty of Education. Separately, the Bachelor of Science degree requires 90 credits (or 120 credits for students who have not completed the basic sciences) and the Bachelor of Education degree requires 120 credits. In the concurrent program, the requirements for the two degrees are combined in such a way that students complete 135 (or 165 credits) to fulfil all the requirements for graduation for both the B.Sc. and the B.Ed.

Graduates of the B.Ed. degree are recommended by the University to the Quebec Ministère de l'Éducation, du Loisir et du Sport (MELS) for Quebec Teacher Certification. For more information about teacher certification in Quebec, please refer to the Faculty of Education section under "Overview of Faculty Programs", "Undergraduate Education Programs", and "Quebec Teacher Certification".

The Major Concentration Chemistry with Minor Physics is one of the nine variations of the program and allows students to focus their Science degree in Chemistry with a subspecialization in Physics.

To fulfil the requirements for graduation for the Concurrent Bachelor of Science and Bachelor of Education, the 135 credits (or 165 credits for students admitted without basic sciences) include the following:

(30 credits of Science Freshman Program (for students admitted without basic sciences))

60 credits of Education Component

69 credits of Science Component consisting of:

- 36 credits of the Major Concentration Chemistry

- 18 credits of the Minor Physics

- 15 credits of Additional Science Courses

6 credits of Electives, of which at least 3 credits must be Science Electives, depending on how many credits count tow

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.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Cour ses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 335	(3)	Teaching Secondary Science 1
EDES 350	(3)	Classroom Practices
EDES 435	(3)	Teaching Secondary Science 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)

EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementar y Cour ses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	Indigenous Education
EDEC 248*	(3)	Equity and Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

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

Major Concentration Chemistr y (36 credits)

The Major Concentration Chemistry is not certified by the Ordre des Chimistes du Québec. Students interested in pursuing a career in Chemistry in Quebec are advised to take an appropriate B.Sc. program in Chemistry.

The Major concentration the tw

CHEM 381	(3)	Inorganic Chemistry 2
CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 531	(3)	Chemistry of Inorganic Materials
CHEM 571	(3)	Polymer Synthesis
CHEM 582	(3)	Supramolecular Chemistry
CHEM 591	(3)	Bioinorganic Chemistry

Minor Physics (18 credits)

Required Course

3 credits

| PHYS 257 | (3) | Experimental Methods 1 |

Complementary Courses

15 credits to be selected as follows:

One of:

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus

Electives (6 credits)

6 credits, of which at least 3 credits must be Science Electives.

The electives must be chosen in such a w

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.

2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.

3. Students entering the Freshman Program must be aww

EDEC 261*	(3)	Philosophy of Catholic Education

Major Concentration Physics (36 credits)

The Major Concentration Physics is a planned sequence of courses designed to permit a degree of specialization in this discipline.

Required Courses*

30 credits selected as follows:

* Note: Required courses taken at CEGEP or elsewhere that are not credited toward the Concurrent B.Sc. and B.Ed. must be replaced by courses from the Complementary Course List equal to or exceeding their credit value. Regardless of the substitution, students must take at least 36 credits in this program.

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 257	(3)	Experimental Methods 1
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 446	(3)	Majors Quantum Physics

Complementary Courses

6 credits selected from:

PHYS 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 241	(3)	Signal Processing
PHYS 258	(3)	Experimental Methods 2
PHYS 534	(3)	Nanoscience and Nanotechnology

or any 300- or 400-level course approved by an adviser.

Minor Biology (24 credits)

24-25 credits for the Minor Biology selected as follows:

15 credits of required courses

9-10 credits of complementary courses

Required Courses

15 credits

	(3)	Molecular Biology

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

or

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

Science Complementar y

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

Notes:

1. Students who have not studied all of Biology, Chemistry, and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their Freshman Program.

2. Many students will complete more than seven courses from the Approved Freshman Science Courses list, particularly those who wish to leave several options open for their choice of major.

3. Students entering the Freshman Program must be aware of the department specific requirements when selecting their courses. Detailed advising information is available at : http://www.mcgill.ca/science/student/newstudents/u0/bscfreshman/specific.

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

List of Appr oved Freshman Science Cour ses

Select the approved courses according to the instructions above.

Note:

* CHEM 115 (not open to students who are taking or have taken CHEM 110 or CHEM 120)

* CHEM 120 (not open to students who have taken CHEM 115)

BIOL 111	(3)	Principles: Organismal Biology
BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 115*	(4)	Accelerated General Chemistry: Giants in Science
CHEM 120*	(4)	General Chemistry 2
COMP 202	(3)	Foundations of Programming
ESYS 104	(3)	The Earth System
MATH 133	(3)	Linear Algebra and Geometry
PSYC 100	(3)	Introduction to Psychology

First calculus course, one of:

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

Second calculus course, one of:

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

First physics course, one of:

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

Second physics course, one of:

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

Electives

Students wishing to take elective courses may choose them from introductory courses offered by departments in the Faculties of Science or of Arts. A list of recommended courses is found at http://www

| EDEC 248* | (3) | Equity and Education |
| EDEC 249* | (3) | Global Education and Social Justice |

3 credits, one of the two following courses:

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

Major Concentration Physics (36 credits)

The Major Concentration Physics is a planned sequence of courses designed to permit a degree of specialization in this discipline.

Required Courses*

30 credits

* Note: Required courses taken at CEGEP or elsewhere that are not credited toward the Concurrent B.Sc. and B.Ed. must be replaced by courses from the Complementary Course List equal to or exceeding their credit value. Regardless of the substitution, students must take at least 36 credits in this program.

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 257	(3)	Experimental Methods 1
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 446	(3)	Majors Quantum Physics

Complementary Courses

6 credits selected from:

PHYS 214	(3)	Introductory Astrophysics
PHYS 224	(3)	Physics of Music
PHYS 241	(3)	Signal Processing
PHYS 258	(3)	Experimental Methods 2
PHYS 534	(3)	Nanoscience and Nanotechnology

or any 300- or 400-level course approved by an adviser.

Minor Chemistry (18 credits)

Required Courses

18 credits selected as follows:

* denotes courses with CEGEP equivalents.

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

Nan0Tm(e)Tj6 1 C1 05 xnics(3)l Chemthods lSurvey of Physical Chemistry

(1)   Introductory Physical Chemistry 1 Laboratory

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.

Education Component (60 credits)

60 credits of Education Component, consisting of:

54 credits of required courses

6 credits of complementary courses

Required Cour ses

54 credits

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

The English Language Requirement (EDEC 215) must be taken in the Fall semester following the Freshman year.

EDEC 201	(1)	First Year Professional Seminar
EDEC 215	(0)	English Exam for Teacher Certification
EDEC 247*	(3)	Policy Issues in Quebec Education
EDEC 254	(1)	Second Professional Seminar (Secondary)
EDEC 262*	(3)	Media, Technology and Education
EDEC 351	(2)	Third Professional Seminar (Secondary)
EDEC 404	(3)	Fourth Year Professional Seminar (Sec)
EDES 350	(3)	Classroom Practices
EDES 353	(3)	Teaching Secondary Mathematics 1
EDES 453	(3)	Teaching Secondary Mathematics 2
EDFE 200	(2)	First Field Experience (K/Elem & Secondary)
EDFE 254	(3)	Second Field Experience (Secondary)
EDFE 351	(8)	Third Field Experience (Secondary)
EDFE 451	(7)	Fourth Field Experience (Secondary)
EDPE 300*	(3)	Educational Psychology
EDPE 304	(3)	Measurement and Evaluation
EDPI 309*	(3)	Diverse Learners
EDPI 341	(3)	Instruction in Inclusive Schools

Complementar y Cour ses

6 credits selected as follows:

* Note: The courses marked with an asterisk are counted toward both degrees. They will count as "electives" for the B.Sc. degree, although a grade of "C" or better is required.

3 credits, one of the three following courses:

EDEC 233*	(3)	Indigenous Education
EDEC 248*	(3)	Equity and Education
EDEC 249*	(3)	Global Education and Social Justice

3 credits, one of the two following courses:

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

Major Mathematics (54 credits)

Program Prerequisites

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

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

Required Cour ses

27 credits

Where appropriate, Honours courses may be substituted for equivalent Major courses.

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

MATH 222	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 236	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 249*	(3)	Honours Complex Variables
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
		Complex

at least 3 credits from:

MATH 317	(3)	Numerical Analysis
MATH 335	(3)	Computational Algebra
MATH 340	(3)	Discrete Structures 2

12 credits from:

It is highly recommended that students include MATH 318 and MATH 346 in their complementary courses.

MATH 204	(3)	Principles of Statistics 2
MATH 318	(3)	Mathematical Logic
MATH 319	(3)	Introduction to Partial Differential Equations
MATH 320	(3)	Differential Geometry
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 346	(3)	Number Theory
MATH 352	(1)	Problem Seminar
MATH 407	(3)	Dynamic Programming
MATH 410	(3)	Majors Project
MATH 417	(3)	Mathematical Programming
MATH 423	(3)	Regression and Analysis of Variance
MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications

In consultation with an adviser, 3 of the 12 credits may be selected from other MATH courses or related disciplines.

Electives (21 credits)

21 credits of electives, of which at least 18 credits must be Science Electives chosen in consultation with the Science Adviser.

The electives must be chosen in such a way that the credit counts needed for graduation are satisfied.