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

1 . McGill University reserves the right to mak

Publication Information

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Not all courses are offered every year and changes can be made after publication. Always check the Minerva Class Schedule link at https://horizon.mcgill.ca/pban1/bwckschd.p_disp_dyn_sched for the most up-to-date information on whether a course is offered.

13.9.6 Computer Science Faculty, page 97

13.9.7

1 About the Faculty of Science

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

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

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

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

2 History of the Faculty of Science

The study of science at McGill goes back almost two centuries, when the lower campus was a rough and muddy cow pasture and the University struggled to establish itself. In 1855, the job of principal was given to a Nova Scotia–born geologist, John19opb1 0 0 1 281.2 4W.855 Tm(e)Tj6 0 1 0 1 281.2 4t them Da(er the n

About the F

Associate Dean (Student Affairs)

Anthony Mittermaier

Chief Academic Adviser

Pete Barry

Associate Dean (Graduate Education)

Laura Nilson

Associate Dean (Research)

John Stix

4.4 Science Office for Undergraduate Student Advising (SOUSA)

The Science Office for Undergraduate Student Advising (SOUSA) provides ongoing advice and guidance on academic issues related to programs, degree requirements, registration, course change, withdrawal, deferred exams, supplemental e

Faculty and program requirements

section 6.5: Course Requirements

6.1 Minimum Credit Requirement

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

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

6.1.1 Advanced Standing

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

limits will normally be granted only for valid academic reasons, such as a change of program (subject to departmental approv

6.4.4 Special Designations

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

6.4.4.1 B.Sc. Global Designation

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

6.4.4.2 Internship Program Designation

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

6.4.5 Bieler School of Environment

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

6.5 Course Requirements

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

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

Full details of the course requirements for all programs offered are given in each unit’s section together with the locations of departmental advisory offices,(ut)Tj0 Tw1 0

- Credit will be given for **only one** of the following intermediate statistics courses: AEMA 411, ECON 227D1/D2, ECON 257D1/D2, GEOG 351, MATH 204, PSYC 305, SOCI 461, with the exception that you may receive credit for both PSYC 305 and ECON 227D1/D2 or ECON 257D1/D2.
- Students who have already received credit for MATH 324 or MATH 357 will **not** receive credit for any of the following: AEMA 310, AEMA 411, BIOL 373, ECON 227D1/D2, ECON 257D1/D2, GEOG 202, GEOG 351, MATH 203, MATH 204, MGCR 271, MGCR 273, PSYC 204, PSYC 305, SOCI 350.
- For 500-level statistics courses not listed above, students must consult a program/department adviser to ensure that no significant overlap exists. Where such overlap exists with a course for which the student has already received credit, credit for the 500-level course will not be allowed.
- PSYC 204 may not be taken if a grade of 75% was received in an equivalent course completed at CEGEP.

6.5.2 Courses Outside the Faculties of Arts and Science

As a student in the Faculty of Science, you should consult the statement of regulations for taking courses outside the Faculties of Arts and of Science (see below). A list of approved/not-approved courses in other faculties is posted on the SOUSA website (*mcgill.ca/science/undergraduate/handbook*). You may take courses on the approved list and may not, under any circumstances, take courses on the not-approved list for credit. Requests for permission to take courses that are not on either list should be addressed to the Associate Dean, Student Affairs for Science.

The regulations are as follows:

- You may take only 6 credits per year, up to 18 credits in all, of courses outside the Faculties of Arts and of Science.
- Courses offered “in the Faculty of Science” or “in the Faculty of Arts” are found in the eCalendar *All Courses* search, when filtered by “Faculty of Science” or by “Faculty of Arts.”
- Courses in other faculties that are considered as taught by Science (e.g., BIOT, EXMD, and PHAR) are so designated as offered by the “Faculty of Science” in the eCalendar *All Courses* search.
- Courses in Music are considered as outside the Faculties of Arts and of Science, except MUAR courses, which are considered Arts courses.
- All courses listed in the Religious Studies (RELG) section are considered courses in Arts and Science except for courses restricted to B.Th. or S.T.M. students and courses that require permission from the Chair of the B.Th. Committee.
- Students should consult the list of restricted courses outside of the Faculties of Arts and of Science on the SOUSA website (*mcgill.ca/science/undergraduate/handbook*).
- You must have the necessary prerequisites and permission of the instructor for such courses.
- Credit for computer and statistics courses offered by faculties other than Arts and Science require the permission of the Associate Dean, Student Affairs for Science and will be granted only under exceptional circumstances.
- If you use Minerva to register for a course, and it exceeds the specified limitations or it is not approv

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 in the Handbook under Course Restrictions *mcgill.ca/science/undergraduate/handbook/*.

6.5.5 First-Year Seminars: Registration

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

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

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

The First-Year Seminars offered by the Faculty of Arts are also open to Science students. For a complete listing, please consult *Faculty of Arts* > *Undergraduate* > *Browse Aca demic Units & Programs* > *: First-Year Seminars*.

6.5.6 Course Credit Weight

The credit assigned to a particular course should reflect the amount of effort it demands of you. Normally, one credit will represent three hours total work per week for one term—including a combination of lecture hours, other contact hours, such as laboratory periods, tutorials, and problem periods, as well as personal study time.

7 Advising

If you need 96 or fewer credits to complete your degree requirements, you must consult an academic adviser in your proposed department of study to obtain advice and approval of your course selection. Quebec students with a Diploma of Collegial Studies in Science have normally taken the equivalent of, and are therefore exempt from, the 100-level basic science courses in Biology, Chemistry, Mathematics, and Physics. Such students may also be exempt from some 200-level courses. If you are a student with satisfactory results in International Baccalaureate, French Baccalaureate, Advanced Levels, and Advanced Placement tests, you may also be exempt from some or all of the Science Freshman courses. Regardless of how many advanced standing credits you have received, you are responsible for ensuring that your freshman science program requirements are met. To facilitate program planning, you must contact your Science SOUSA advisor for course approval before registering for your first year courses. For a detailed description of advising and registration procedures, you should refer to *University Regulations & Resources* > *Undergraduate* > *: Undergraduate Advising* and *: Registration*; the *website for newly admitted undergraduate students*; the SOUSA website at *mcgill.ca/science/undergraduate/handbook#first-year*; and your department's website.

If you need 97–120 credits to complete your degree requirements, you will normally be registered in a Freshman program until you complete your first year. You must consult a SOUSA adviser in the Science Office for Undergraduate Student v

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*

- Chemistry – General option: *section 13.7.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Chemistry - General (49 credits)*
- Computer Science: *section 13.9.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Computer Science (45 credits)*
- Earth and Planetary Sciences: *section 13.10.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Earth and Planetary Sciences (45 credits)*
- Geography: *section 13.21.7: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Geography (49 credits)*
- Mathematics: *section 13.22.9: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Mathematics (45 credits)*
- Physics: *section 13.30.8: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Physics (45 credits)*
- Software Engineering: *section 13.9.9: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Software Engineering (49 credits)*
- Statistics: *section 13.22.10: Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Statistics (48 credits)*

10.1.4.2 Major Programs

- Atmospheric Science: *section 13.3.6: Bachelor of Science (B.Sc.) - Major Atmospheric Science (62 credits)*
- Chemistry: *section 13.7.8: Bachelor of Science (B.Sc.) - Major Chemistry (59 credits)*
- Chemistry – Bio-organic option: *section 13.7.9: Bachelor of Science (B.Sc.) - Major Chemistry - Bio-organic (63 credits)*
- Chemistry – Biophysical option: *section 13.7.10: Bachelor of Science (B.Sc.) - Major Chemistry: Biophysical Chemistry (66 credits)*
- Computer Science: *section 13.9.10: Bachelor of Science (B.Sc.) - Major Computer Science (63 credits)*
- Computer Science – Computer Games option: *section 13.9.12: Bachelor of Science (B.Sc.) - Major Computer Science - Computer Games (65 credits)*
- Earth System Science: *section 13.11.4: Bachelor of Science (B.Sc.) - Major Earth System Science (57 cr*

Minor Programs

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

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

Human Nutrition – see *Faculty of Agricultural & Environmental Sciences* > *Undergraduate*

10.5.1 Major Concentrations

Major Concentrations

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Music (available to students in B.Sc. Liberal only), *: Bachelor of Arts (B.A.) - Major Concentration Music (36 credits)*

Minor Concentrations

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

East Asian Language and Literature, *: Bachelor of Arts (B.A.) - Minor Concentration East Asian Language and Literature (18 credits)*

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

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

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

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

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

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

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

Geography, *: Bachelor of Arts (B.A.) - Minor Concentration Geography (18 cr***18 c.52 605.8 Tm0 0 548.92 6uTm(Urbata5n on6udies (18 c.–548.92 6uT.8 Tm0 0**

Minor Concentrations

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

11 Undergraduate Research Opportunities

McGill is a research-intensive university and research is therefore a cornerstone of undergraduate science education at McGill. Most Science B.Sc. students take part in research during their undergraduate studies, and there are many undergraduate research opportunities at McGill, in affiliated hospitals, at other universities, and in the field. Many of these are organized through formal courses or programs organized by the Faculty of Science or its departments. For more information, see the following:

- *section 11.1: Research Project Courses*
- *section 11.1.1: "396" Undergraduate Research Project Courses*
- *section 11.2: Undergraduate Student Research Awards* – such as NSERC USRA and SURA
- *section 11.3: Undergraduate Poster Showcase*
- *section 11.4: Getting involved in research as an undergraduate*
- Dean's Multidisciplinary Undergraduate Research List – see description in *University Regulations and Resources* > *Undergraduate* > *Graduation* > *Graduation Honours* > *: Faculty of Science Dean's Multidisciplinary Undergraduate Research List*

Because internships and field study programs *may* include a research component, please also see: *section 12: Science Internships and Field Studies*

11.1 Research Project Courses

Departments offer a variety of research-based courses that allow you to perform research under the supervision of a McGill researcher for academic credit. Depending on the unit, courses featuring undergraduate research may bear names such as: majors project, honours project, advanced lab, independent research, technical project, independent study, or research project and seminar. For more information, refer to the research course list at *mcgill.ca/science/research/undergraduate-research/researchcourses* or browse the course listings at *mcgill.ca/study/courses/search*. Research courses can also help you qualify for the *Dean's Multidisciplinary Undergraduate Research List* or the *B.Sc. Global Designation*.

11.1.1 "396" Undergraduate Research Project Courses

"396" undergraduate research project courses are offered by all undergraduate science departments and schools—ANAT 396, AT

USRA; three differences are that *international students may apply*, not only Canadians; SURAs can support projects in social science or medical science, not only natural science or engineering; and SURAs are only for B.Sc. and B.A. & Sc. students (B.A. students may wish to look into programs offered by the Faculty of Arts).

Please refer to *mcgill.ca/science/research/undergraduate-research/sura* for more information.

11.3 Undergraduate Poster Showcase

Each year, the Faculty of Science holds an undergraduate poster showcase to celebrate the work of our undergraduate students. This event, sponsored by the Office of Science Education, is an opportunity for students to present research, projects and assignments completed inside or outside class.

Everyone is welcome to attend.

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

11.4 Getting involved in research as an undergraduate

Opportunities at McGill

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

Some are formal programs that you can find more information about elsewhere in the eCalendar:

- *section 11.1: Research Project Courses*
- *section 11.1.1: "396" Undergraduate Research Project Courses*
- *section 11.2: Undergraduate Student Research Awards*

Others come about through informal discussions between students and professors.

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

Internships and field studies

Some science internships and field study programs include a research component. Refer to *section 12: Science Internships and Field Studies* for more information.

Beyond McGill

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

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 information on internship opportunities to students who are in Science programs at McGill. Whether you decide to participate in a field study semester or apply classroom theory to practice, the *Science Internships & Field Studies Office* will offer you assistance in your decision.

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

Internship Program: Industrial Practicum (IP) and Internship

chance to add a practical element to your studies, to solidify your career goals, to gain some valuable experience, and to earn money. Internships may have a basis in research.

To be eligible to apply:

- You must be registered as a full time student before and after the IP or the IYS is completed.
- You must have completed at least 27 credits and have at least 12 credits remaining in your degree program.
- Your CGPA must be 2.7 or higher.
- International McGill students are eligible to apply to summer IP and IYS positions (unless otherwise indicated on the job posting). Restrictions apply; interested students should visit the Internships & Field Studies Office for details.

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

Internship Program Designation

The Internship Program will also give you the opportunity to enhance your degree: if you are a student in the Faculty of Science and you complete two *Industrial Practica* (IP) or participate in an *Internship Year in Science*

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, *mcgill.ca/science/undergraduate/handbook*.

If you have completed the Diploma of Collegial Studies, Advanced Placement exams, Advanced Lev

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

The **Honours** program is designed as the first phase in the training of career cell and molecular biologists. The **Major** and **Liberal** programs offer decreasing le

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

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

One of the following statistics courses:

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

Complementary Courses (16 credits)

Students complete a minimum of 15 or a maximum of 16 complementary course credits selected as follows:4)(3Mus24 oskw

9 credits of advanced anatomy courses1 Th.APSYC 204

ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 514	(3)	Advanced Human Anatomy Laboratory
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 565	(3)	Diseases-Membrane Trafficking
NEUR 310	(3)	Cellular Neurobiology

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

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 503	(3)	Biochemistry of Immune Diseases
BIOL 300	(3)	Molecular Biology of the Gene

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EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes
NEUR 310	(3)	Cellular Neurobiology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 451	(3)	Advanced Neurophysiology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Translational Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

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

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

Required Courses (52 credits)

Note: ANAT 261 must be taken in U1.

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

ANAT 212	(3)	Molecular Mechanisms of Cell Function
ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 432	(9)	Honours Research Project
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

One of the following statistics courses:

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

Complementary Courses (21 credits)

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

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

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

ANAT 314	(3)	Human Musculoskeletal Anatomy
ANAT 321**	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 323**	(3)	Clinical Neuroanatomy
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458	(3)	Membranes and Cellular Signaling
ANAT 514	(3)	Advanced Human Anatomy Laboratory
		Cell and Molecular Biology of

ANAT 321 (3) Circuitry of the Human Brain

MIMM 387	(3)	The Business of Science
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 509	(3)	Inflammatory Processes
NEUR 310	(3)	Cellular Neurobiology
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 451	(3)	Advanced Neurophysiology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Translational Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.3 Atmospheric and Oceanic Sciences (ATOC)

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: *mcgill.ca/meteo*

13.3.2 About Atmospheric and Oceanic Sciences

The Department of Atmospheric and Oceanic Sciences offers, at the undergraduate level, a broad range of courses in atmospheric chemistry, atmospheric physics, meteorology, ocean and atmosphere dynamics, and climate. The study of atmospheric and oceanic sciences is based largely on physics and applied

mathematics. All required courses except those at the introductory level generally have prerequisites or corequisites in physics, mathematics, and atmospheric science.

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

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

The Department of Atmospheric and Oceanic Sciences offers six programs:

- *section 13.3.4:* ***Minor*** *in Atmospheric Science*
- *section 13.3.5:* ***Liberal Program*** *- Core Science Component Atmospheric and Oceanic Sciences*
- *section 13.3.6:* ***Major*** *in Atmospheric Sciences*
- *section 13.3.7:* ***Major*** *in Atmospheric Science and Physics*
- *section 13.3.8:* ***Honours*** *in Atmospheric Science*
- *section 13.3.9:* ***Diploma*** *in Meteorology*

The **Honours** program is meant for students with high standing. It is based on courses similar to those in the Major program, but provides opportunities to perform research and to take advanced courses. The **Major** program, although somewhat less intensive, satisfies the requirements for a professional career as a meteorologist, and like the Honours program equips the student to undertake postgraduate study in atmospheric and oceanic sciences at any of the leading universities. The Department also offers a special one-year **Diploma** program to B.Sc. or B.Eng. graduates.

An undergraduate degree in Atmospheric Science is an excellent background for professional careers in government service or private industry and/or graduate study in the physical sciences. Our students have been traditionally employed by Environment and Climate Change Canada (and the Meteorological Service of Canada in particular), but are also highly sought after by provincial governments, private forecasting companies, environmental consulting and engineering firms, and insurance companies. Academic positions in teaching and research are available to M.Sc. and Ph.D. graduates.

Students interested in any of the undergraduate programs should contact:

Carolina Dufour, Undergraduate Program Adviser
Email: *carolina.dufour@mcgill.ca*

13.3.3 Atmospheric and Oceanic Sciences Faculty

Chair

D. Kirshbaum

Emeritus Professors

P. Bartello (*joint appt. with Mathematics and Statistics*); J.F. Derome;H.G. Leighton; L.A. Mysak; M.K. Yau; I. Zawadzki.

Professors

P. Ariya (*joint appt. with Chemistry*); J.R. Gyakum; B. Tremblay.

Associate Professors

F. Fabry (*joint appt. with Bieler School of Environment*); Y. Huang; D. Kirshbaum; T. Preston (*joint appt. with Chemistry*); D. Straub; A. Zuend.

Assistant Professors

C. Dufour; D. Romanic; I. Tan.

Adjunct Professors

L. Barrie; M. Buehner; P. Kollias; H. Lin; L.-P. Nadeau.

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

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

Required Courses (3 credits)

ATOC 214	(3)	Introduction: Physics of the Atmosphere

Complementary Courses (15 credits)

3-6 credits selected from:

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

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

Complementary Course

9-12 credits selected from:

ATOC 309	(3)	Weather Radars and Satellites
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
ATOC 357	(3)	Atmospheric and Oceanic Science Laboratory
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 548	(3)	Mesoscale Meteorology
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics

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

45-48 credits

Required Courses (21 credits)

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

Complementary Courses (24-27 credits)

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

3-6 credits selected from:

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

3 credits selected from:

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

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

12-15 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 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
ATOC 548	(3)	Mesoscale Meteorology
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
COMP 208	(3)	Computer Programming for Physical Sciences and Engineering
MATH 203	(3)	Principles of Statistics 1
MATH 319	(3)	Partial Differential Equations
PHYS 333	(3)	Thermal and Statistical Physics

PHYS 340	(3)	Majors Electricity and Magnetism

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

Required Courses (24 credits)

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

Complementary Courses (36-38 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
ATOC 219*	(3)	Introduction to Atmospheric Chemistry
CHEM 219*	(3)	Introduction to Atmospheric Chemistry

* Students may take ATOC 219 or CHEM 219.

3 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

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

6-9 credits selected from:

CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics

MATH 203*	(3)	Principles of Statistics 1
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 323	(3)	Probability
MATH 324*	(3)	Statistics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340**	(3)	Majors Electricity and Magnetism
PHYS 342***	(3)	Majors Electromagnetic Waves
PHYS 350**	(3)	Honours Electricity and Magnetism
PHYS 352***	(3)	Honours Electromagnetic Waves

* Students may take either MATH 203 or MATH 324.

** Students may take either PHYS 340 or PHYS 350.

*** Students may take either PHYS 342 and PHYS 352.

15-17 credits from one of the following streams:

Weather Analysis and Forecasting Stream (16-17 credits)

13 credits from:

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

3-4 credits selected from:

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

+ Students may take either ATOC 404 or PHYS 404.

++ Students may take either PHYS 432 or MATH 555.

Climate Science Stream (15 credits)

6 credits from:

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

+ Students may take either ATOC 404 or PHYS 404.

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

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

Atmospheric Chemistry and Physics Stream (15 credits)

ATOC 309	(3)	Weather Radars and Satellites
ATOC 404+	(3)	Climate Physics

ATOC 513	(3)	Waves and Stability
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
ATOC 548	(3)	Mesoscale Meteorology
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
GEOG 322	(3)	Environmental Hydrology
GEOG 372	(3)	Running Water Environments
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
PHYS 432++	(3)	Physics of Fluids
PHYS 512	(3)	Computational Physics with Applications

+ Students may take either ATOC 404 or PHYS 404.

++ Students may take either PHYS 432 or MATH 555.

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

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

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

Required Courses (57 credits)

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

15 credits from:

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

+ Students may take either ATOC 404 or PHYS 404.

Students may take either MATH 203 or MATH 324.

6-7 credits (3 credits must be an ATOC course) selected from:

ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 540	(3)	Synoptic Meteorology 1
		Research Methods: Synoptic Met .941 Tmsl40 1 165.8oF 0 1 e 0 1 e 1 aTmsl40 1 169.221 Tm((3))Tj1 Tmsl40 1 16 449

ATOC 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 525	(3)	Atmospheric Radiation
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
MATH 423	(3)	Applied Regression
PHYS 404+	(3)	Climate Physics
PHYS 512	(3)	Computational Physics with Applications

+ Students may take either ATOC 404 or PHYS 404.

General Stream (21-22 credits)

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

ATOC 309	(3)	Weather Radars and Satellites
ATOC 404+	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
ATOC 531	(3)	Dynamics of Current Climates
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
ATOC 548	(3)	Mesoscale Meteorology
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
ATOC 558	(3)	Numerical Methods and Laboratory
ATOC 568	(3)	Ocean Physics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 575	(3)	Chemical Kinetics
EPSC 513	(3)	Climate and the Carbon Cycle
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
MATH 423	(3)	Applied Regression
MATH 555++	(4)	Fluid Dynamics
PHYS 404+	(3)	Climate Physics
	(3)	Physics of Fluids

+ Students may take either ATOC 404 or PHYS 404.

++ Students may take either PHYS 432 or MATH 555.

13.3.9 Diploma (Dip.) Meteorology (30 credits)

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

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

Required Courses (15 credits)

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

Complementary Courses (15 credits)

6 credits selected from the courses below.

* Students may take either ATOC 519 or CHEM 519.

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

9 credits ordinarily selected from:

* Students take either PHYS 432 or MATH 555.

ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 517	(3)	Boundary Layer Meteorology
ATOC 525	(3)	Atmospheric Radiation
ATOC 548	(3)	Mesoscale Meteorology
ATOC 557	(3)	Research Methods: Atmospheric and Oceanic Science
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 555*	(4)	Fluid Dynamics
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 432*	(3)	Physics of Fluids

13.3.10 Atmospheric and Oceanic Sciences (ATOC) Related Programs

13.3.10.1 Internship Year in Science (IYS)

IYS is a pregraduate work experience program available to eligible students and normally taken between their U2 and U3 years. For more information, see *section 12: Science Internships and Field Studies*.

The following programs are also available with an internship component:

- Major in Atmospheric Science
- Honours in Atmospheric Science

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

13.4 Biochemistry (BIOC)

13.4.1 Location

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

13.4.2 About Biochemistry

What is Biochemistry?

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

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

- **Honours**

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

Our Major and Honours programs provide a sound background for students aiming for a professional career in biochemistry. The less specialized Liberal program allows students to select courses in other fields of interest. The Liberal program provides students with the opportunity to study the core of one science discipline along with a breadth component from another area of science or from many other disciplines; for more information, see *Faculty of Science > Undergraduate > Faculty Degree Requirements > Program Requirements > section 6.4.1: Liberal, Major, and Honours Programs*.

During the first year, each program provides introductory lecture and laboratory courses in biochemistry, as well as basic courses in cell and molecular biology and organic and physical chemistry. In the second and third years, the programs offer an expanded focus in biochemistry through lecture courses, a second laboratory course in biochemistry, and opportunities to carry out research projects in f

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 Required Courses (23 credits)

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

BIOC 212	(3)	Molecular Mechanisms of Cell Function
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)

6 credits selected from:

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

U2 Required Courses (20 credits)

ANAT 262	(3)	Introductory Molecular and Cell Biology
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 320	(3)	Laboratory Methods in Biochemistry and Molecular Biology 2
CHEM 214	(3)	Physical Chemistry/Biological Sciences 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 362	(2) U3)	Advanced Organic Chemistry Laboratory

U2 Complementary Courses (3 credits)

3 credits selected from:

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)

6 credits selected from:

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

U2 Required Courses (20 credits)

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

U2 Complementary Courses (3 credits)

3 credits selected from:

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

U3 Required Courses (15 credits)

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

U3 Complementary Courses (6 credits)

3-6 credits selected from:

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

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

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 482	(3)	Organic Chemistry: Natural Products
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 532	(3)	Structural Organic Chemistry
CHEM 552	(3)	Physical Organic Chemistry
CHEM 572	(3)	Synthetic Organic Chemistry
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHGY 311	(3)	Channels, Synapses and Hormones

13.4.7 Biochemistry (BIOC) Related Programs

13.4.7.1 Interdepartmental Honours in Immunology

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

Students interested in the program should contact:

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

OR

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

13.5 Biology (BIOL)

13.5.1 Location

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

13.5.2 About Biology

Biology is the study of living things at the molecular, cellular, organismal, and ecosystem levels. It deals with fundamental questions such as:

- the origin and ev

Undergraduate students are represented by the MBSU (McGill Biology Students Union) in the Departmental Assembly and in Standing Committees.

Inquiries about undergraduate programs should be directed to:

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

Note to those interested in the B.A. & Sc. program: Both a major and a minor concentration in Biology are available to students pursuing the B.A. & Sc. degree. These concentrations are described in *Bachelor of Arts and Science* > *Undergraduate* > *Browse Academic Units & Programs* > *: Biology (BIOL)*.

13.5.3 Preprogram Requirements

Requirements for the Major and Honours programs in Biology are:

- two courses in elementary Biology;
- two courses in general Chemistry;
- two courses in Mathematics (as per the Freshman requirements);
- one or two courses in Physics (mechanics and electromagnetism), depending on your choice of upper year courses.

Students entering the B.A. & Sc., the Liberal program, and the Biology Science Minor have the same biology, chemistry, and mathematics requirements. The physics requirements will vary according to their future direction. Note that satisfying the minimum Freshman science requirements does not necessarily qualify students for medical or dental school admissions requirements.

Students planning to take one of the joint majors or the Quantitative Biology Major or Honours options should consult:

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

to ensure they are taking the appropriate prerequisites.

13.5.4 Biology Concentrations

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

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

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

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

13.5.4.1 CEEB: Conservation, Ecology, Evolution and Behaviour

BIOL 304, BIOL 305, BIOL 308, BIOL 309, BIOL 310, BIOL 311, BIOL 320, BIOL 324, BIOL 331, BIOL 334D1,D2, BIOL 335, BIOL 352, BIOL 363, BIOL 377, BIOL 396, BIOL 413, BIOL 418, BIOL 427, BIOL 428, BIOL429, BIOL 432, BIOL 436, BIOL 441, BIOL 451, BIOL 465, BIOL 466, BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, BIOL 507, BIOL 510, BIOL 515, BIOL 517, BIOL 540, BIOL 553, BIOL 569, BIOL 573, BIOL 592, BIOL 594, GEOG 302, GEOG 305, GEOG 308, GEOG 322, GEOG 470, REDM 400; MAC CAMPUS: PARA 424, PLNT 358, PLNT 460, WILD 307, WILD 350, WILD 415, WILD 420, WILD 421

13.5.4.1.1 MCDB: Molecular, Cellular and Developmental Biology

BIOL 300, BIOL 301, BIOL 302, BIOL 303, BIOL 306, BIOL 309, BIOL 313, BIOL 314, BIOL 316, BIOL 324, BIOL 370, BIOL 377, BIOL 396, BIOL 413, BIOL 416, BIOL 466, BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, BIOL 518, BIOL 520, BIOL 524, BIOL 544, BIOL 546, BIOL 551, BIOL 565, BIOL 568, BIOL 569, BIOL 575, BIOL 588, BIOL 592, BIOC 311, HGEN 400, MIMM 314

13.5.4.1.1.1 NBB: Neurobiology and behaviour

BIOL 300, BIOL 303, BIOL 304, BIOL 305, BIOL 306, BIOL 307, BIOL 309, BIOL 320, BIOL 377, BIOL 389, BIOL 413, BIOL 414, BIOL 466, BIOL 467, BIOL 468D1/D2, BIOL 469D1/D2, BIOL 506, BIOL 507, BIOL 517, BIOL 530, BIOL 532, BIOL 580, BIOL 588, BIOL 592, ANAT 321, ANAT 322, NEUR 310, PHAR 562, PHGY 311, PHGY 314, PHGY 425, PHGY 451, PHGY 556, PSYC 311, PSYC 318, PSYC 342, PSYC 410, PSYC 470, PSYC 455, PSYT 500

13.5.5 Biology Faculty

Chair

Gregor Fussmann

Graduate Program Director

Frédéric Guichard

Tamara Western: *Acting GPD*

Fiona Soper: *Acting Vice-GPD*

Emeritus Professors

Gregory G. Brown; A. Howard Bussey; Robert L. Carroll, *in memoriam*; Ronald Chase; Rajinder S. Dhindsa; Jacob Kalff; Donald L. Kramer; Martin J. Lechowicz; Louis Lefebvre; Barid B. Mukherjee; Gerald S. Pollack; Ronald Poole; Derek Roff; Rolf Sattler.

Professors

Ehab Abouheif; Graham A.C. Bell; Lauren Chapman; Melania Cristescu; Gregor Fussmann; Andrew Gonzalez; Irene Gregory-Eaves; Frédéric Guichard; Sie

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

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

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

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

Required Courses (15 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 205	(3)	Functional Biology of Plants and Animals
BIOL 215	(3)	Introduction to Ecology and Evolution

Complementary Courses (10 credits)

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

To include:

CHEM 212*	(4)	Introductory Organic Chemistry 1

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

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

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

The Liberal Program - Core Science Component Biology is a flexible program focusing on the fundamentals of biology. Topics include a range of biological concepts spanning molecules and cells to organisms and ecosystems, including development, behaviour and evolution. This program is well suited to students with varied interests who do not want to focus solely on biology in their studies.

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

Required Courses (24 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 205	(3)	Functional Biology of Plants and Animals
BIOL 206	(3)	Methods in Biology
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 216	(3)	Biology of Behaviour
BIOL 302	(3)	Fundamentals of Genetics and Genomics
COMP 204	(3)	Computer Programming for Life Sciences

Complementary Courses (21-23 credits)

Core (6-8 credits)

3 or 4 credits selected from:

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

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

3 or 4 credits selected from:

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

Other (15 credits)

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

Bac

BIOL 303	(3)	Developmental Biology
BIOL 313	(3)	Eukaryotic Cell Biology

Block C-Neuro/Behaviour:

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

Other (15 credits)

15 credits other Biology courses at the 300-500 lev

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 Ev

BIOL 306	(3)	Neural Basis of Behaviour
BIOL 309	(3)	Mathematical Models in Biology
BIOL 313	(3)	Eukaryotic Cell Biology

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

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

Complementary Courses

Quantitative Biology - Theoretical Ecology and Evolutionary Biology

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 Mathematics
MATH 423	(3)	Applied Regression
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
PHYS 329	(3)	Statistical Physics with Biophysical Applications

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 Courses (37 credits)

Bio-Physical Sciences Core

28 credits

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 395	(1)	Quantitative Biology Seminar
CHEM 212*	(4)	Introductory Organic Chemistry 1
COMP 202**	(3)	Foundations of Programming
MATH 222*	(3)	Calculus 3
MATH 223***	(3)	Linear Algebra
MATH 247***	(3)	Honours Applied Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability

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

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

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

Biology and Mathematics Core

9 credits

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

Complementary Courses (39 credits)

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

Math or Biology Research Course

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

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

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

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

Math Courses

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

Stream 1: Theory

12 credits from the following courses:

* Students may take either MATH 317 or MATH 327.

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

Stream 2: Statistics

9 credits from the following:

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

Remaining Math Courses

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

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

BIOL, NEUR, PHGY, PHYS, PSYC Courses

BIOL 202	(3)	Basic Genetics

At least 12 credits selected from the following list:

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

Neurosciences Stream

At least 15 credits selected as follows:

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour

At least 12 credits selected from:

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

Remaining BIOL, NEUR, PHGY, PSYC

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

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

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

Acceptance into the Honours program at the end of U2 requires a CGPA of 3.50 and approval of a 9- or 12-credit Independent Studies proposal (see listing of BIOL 479D1/BIOL 479D2, BIOL 480D1/BIOL 480D2 for details). For an Honours degree, a minimum CGPA of 3.50 at Graduation and adherence to the program as outline rt93 100 y

Required Courses (35 credits)

BIOL 200	(3)	Molecular Biology
BIOL 201	(3)	Cell Biology and Metabolism
BIOL 205	(3)	Functional Biology of Plants and Animals
BIOL 206	(3)	Methods in Biology
BIOL 215	(3)	Introduction to Ecology and Evolution
BIOL 216	(3)	Biology of Behaviour
BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 302	(3)	Fundamentals of Genetics and Genomics
BIOL 311	(3)	Advanced Methods in Organismal Biology
BIOL 499D1	(2)	Honours Seminar in Biology
BIOL 499D2	(2)	Honours Seminar in Biology
COMP 204	(3)	Computer Programming for Life Sciences

Complementary Courses (36-37 credits)

Core 12-13 credits:

3 or 4 credits selected from CHEM block:

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

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

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

Block A- Ecology and Evolution:

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

Block B- Molecular and Cellular:

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

Block C-Neuro/Behaviour:

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

Honours Block (9-12 credits)

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

++ Students take MATH 323 or MATH 356.

+++ Students take MATH 324 or MATH 357.

Note: 6 credits of either MATH or PHYS courses to be taken at the honours level. Honours equivalents of core Math and Physics courses are listed. All 500-level Math courses are considered as honours courses and can be applied to the 6 credit requirement.

Biology (6 credits)

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

Research Component (6 credits)

BIOL 468	(6)	Independent Research Project 3

Physics (6 credits)

6 credits from:

PHYS 230*	(3)	Dynamics of Simple Systems
PHYS 232**	(3)	Heat and Waves
PHYS 251*	(3)	Honours Classical Mechanics 1
PHYS 253**	(3)	Thermal Physics

* Students take PHYS 230 or PHYS 251.

** Students take PHYS 232 or PHYS 253.

Course Requirements for Quantitative Biology Streams

21 credits from one of the following two streams:

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

Biology

12 credits from the following:

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

Field Courses

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

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

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

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

BIOL 432	(3)	Limnology
BIOL 434	(3)	Theoretical Ecology
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 346	(3)	Majors Quantum Physics

* Students choose either BIOL 319 or PHYS 319

300-level complementary courses

6 credits from the following:

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

500-level complementary courses

6 credits from the following:

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

Complementary Courses (9 credits)

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

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

COMP 350*	(3)	Numerical Computing
COMP 364	(3)	Computer Tools for Life Sciences
MATH 235**	(3)	Algebra 1
MATH 240**	(3)	Discrete Structures
MATH 314	(3)	Advanced Calculus
MATH 317*	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 348	(3)	Euclidean Geometry
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes

* Students may take COMP 350 OR MATH 317.

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

Recommendations for Physical Biology stream

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

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

Recommendations for Theoretical Ecology and Evolutionary Biology stream

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

13.5.13 Biology (BIOL) Related Programs and Study Semesters

13.5.13.1 Joint Major in Computer Science and Biology

For more information, see *section 13.9.11: Bachelor of Science (B.Sc.) - Major Computer Science and Biology (74 credits)*.

13.5.13.2 Joint Honours in Computer Science and Biology

For more information, see *section 13.9.15: Bachelor of Science (B.Sc.) - Honours Computer Science and Biology (77 credits)*.

13.5.13.3 Panama Field Study Semester

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

13.5.13.4 Africa Field Study Semester

Program Supervisor

Telephone: 514-398-4654
Email: *audrey.moores@mcgill.ca*

Program Adviser

Chantal Grignon

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

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

To obtain the Minor Biotechnology, Science students must:

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

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

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

Required Courses (15 credits)

* Students may take either BIOL 201 or BIOC 212.

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

Complementary Courses (9 credits)

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

Biomedicine

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

Chemical Engineering

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

Chemistry

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

General

FACC 300	(3)	Engineering Economy

Immunology

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

Management

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

Microbiology

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

Molecular Biology (Biology)

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

Molecular Biology (Biochemistry)

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

Physiology

EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 1

EXMD 503	(3)	Advanced Endocrinology 02
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHGY 518	(3)	Artificial Cells

Pollution

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

13.6.6 Biotechnology (BIOT) Related Programs

13.6.6.1 Program for Students in the Faculty of Engineering

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

13.7 Chemistry (CHEM)

13.7.1 Location

Otto Maass Chemistry Building
801 Sherbrooke Street West
Montreal QC H3A 0B8
Departmental Gr342 Tm1 0 “(y 705 505. 1 81.693 368.823 Tm5art705c05 00 1 2. 1pe693 39 391Mnl G514-398-6999 0 “(y 705 505. 1 81 0 38391.263 Tm(W)Tj1

and testing laboratories. Such positions are expected to increase with the currently growing concern for the environment and for consumer protection. A background in chemistry is also useful as a basis for advanced study in other related fields, such as medicine and the biological sciences. For a business career, a B.Sc. in Chemistry can profitably be combined with a master's degree in Business Administration, or a study of law for work as a patent lawyer or forensic scientist.

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

* Denotes courses with CEGEP equivalents.

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

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

General Option Courses (17 credits)

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

Complementary Course (6 credits)

6 credits from:

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

Chemistry courses at the 300+ level.

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

Program Prerequisites

PRE-PROGRAM REQUIREMENTS:

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

Required Courses (53 credits)

The required courses in this program consist of 53 credits in chemistry, physics and mathematics, listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level but the Chemistry courses must be replaced by courses in that discipline if students wish to be eligible for admission to the Ordre des chimistes du Québec. Students from outside Quebec or transfer students should consult the Academic Adviser.

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

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

* Denotes courses with CEGEP equivalents.

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

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

CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
	(3)	Introductory Physical Chemistry 2: Kinetics and Methods

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

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

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

13.7.12 Bachelor of Science (B.Sc.) - Honours Chemistry - Bio-organic (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 (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 (j/F0 8.3 Tf1 0 01.5

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Chemistry

CHEM 213	(3)	Introductory Physical Chemistry 1: Thermodynamics
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 267	(3)	Introductory Chemical Analysis
CHEM 273	(3)	Introductory Physical Chemistry 2: Kinetics and Methods
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 345	(3)	Introduction to Quantum Chemistry
CHEM 355	(3)	Applications of Quantum Chemistry
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 470	(6)	Research Project 1
CHEM 493	(2)	Advanced Physical Chemistry Laboratory
PHYS 242	(2)	Electricity and Magnetism

Complementary Courses

(9-10 credits)

3 credits of:

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

6-7 credits of:

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

13.7.14 Chemistry (CHEM) Related Programs

13.7.14.1 Joint Honours in Physics and Chemistry

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

13.8 Cognitive Science

13.8.1 About Cognitive Science

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PHIL 310	(3)	Intermediate Logic
PHIL 311	(3)	Philosophy of Mathematics
PHIL 341	(3)	Philosophy of Science 1
PHIL 411	(3)	Topics in Philosophy of Logic and Mathematics
PHIL 415	(3)	Philosophy of Language
PHIL 441	(3)	Philosophy of Science 2
PHIL 474	(3)	Phenomenology

Psychology

PSYC 213	(3)	Cognition
PSYC 301	(3)	Animal Learning and Theory
PSYC 304	(3)	Child Development
PSYC 310	(3)	Intelligence
PSYC 311	(3)	Human Cognition and the Brain
PSYC 315	(3)	Computational Psychology
PSYC 340	(3)	Psychology of Language
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 413	(3)	Cognitive Development

13.9 Computer Science (COMP)

13.9.1 Location

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

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

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

13.9.2 About Computer Science

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

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

- The study of algorithms and data structures
- Programming languages and methodology

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

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

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

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

- Major, Honours, Liberal, and Minor programs in Computer Science;
- Major, Honours, and Liberal programs in Software Engineering;
- Major in Computer Science: Computer Games Option;
- Major and Honours in Mathematics and Computer Science (see *section 13.22: Mathematics and Statistics (MATH)*);
- Major and Honours in Statistics and Computer Science (see *section 13.22: Mathematics and Statistics (MATH)*);
- Major and Honours in Physics and Computer Science (see *section 13.30: Physics (PHYS)*);
- Major and 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 *cs.mcgill.ca/academic/undergrad/advising*).

13.9.3 Internship Opportunities

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

- The **Internship Year in Science** (IYS) is offered for a duration of 8, 12, or 16 months. It will be reflected on the student's transcript and is included in the program name won tfore gr.266 336.34 TY

13.9.5 Admissions

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

Complementary Courses (15 credits)

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

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

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

This program provides an introduction to the principles of computer science and offers opportunity to get insight into some of its sub-areas. Haw and computer scienc1ic

Group D

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

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

The remaining complementary credits must be selected from any COMP courses at the 300 level or above except COMP 364 and COMP 396e9e9e9e9e9e9e9e9e9t CO

ECSE 437	(3)	Software Delivery
ECSE 539	(4)	Advanced Software Language Engineering

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

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

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

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

Required Courses (33 credits)

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

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

Complementary Courses (30 credits)

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

At least 6 credits selected from:

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

3-9 credits selected from:

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

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

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

The remaining credits selected from computer science courses at the 300 level or above (except COMP courses at the 3P 2733)

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

3-6 from the following:

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

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

Computer Science Block

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

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

COMP 273	(3)	Introduction to Computer Systems
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

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

Biology Block

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

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 308	(3)	Ecological Dynamics
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 316	(3)	Biomembranes and Organelles
BIOL 319	(3)	Introduction to Biophysics
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 395	(1)	Quantitative Biology Seminar

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

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

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

Students may complete this program with a minimum of 62 credits or a maximum of 65 credits depending on whether they are exempt from taking COMP 202.

Required Courses

(46-49 credits)

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

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

MATH 323	(3)	Probability

Complementary Courses (16 credits)

3 credits selected from:

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

At least 7 credits selected from:

COMP 308	(1)	Computer Systems Lab
COMP 424	(3)	Artificial Intelligence
	)pmq0c.merical Computing (3)	Modern Computer Games

Complementary Courses (24 credits)

9 credits selected from Groups

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

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

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

Required Courses (48 credits)

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

** Students take either MATH 340 or MATH 350.

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
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
MATH 340**	(3)	Discrete Mathematics
MATH 350**	(3)	Honours Discrete Mathematics

Complementary Courses (27 credits)

6 credits selected from:

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

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

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

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

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

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

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

Required Courses

43-53 credits:

Bio-Physical Sciences Core

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

Computer Science and Mathematics

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

Biology

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

Joint Courses

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

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

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

Complementary Courses (24 credits)

3-6 credits from the following:

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

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

Computer Science Block

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

COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 307	(2)	Principles of Web Development
COMP 310	(3)	Operating Systems
COMP 322	(1)	Introduction to C++
COMP 330	(3)	Theory of Computation
COMP 350	(3)	Numerical Computing

BIOL 551	(3)	Principles of Cellular Control
BIOL 568	(3)	Topics on the Human Genome
BIOL 569	(3)	Developmental Evolution
BIOL 575	(3)	Human Biochemical Genetics
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 310	(3)	Cellular Neurobiology

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

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

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

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

Required Courses

39-42 credits

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
COMP 361D1	(3)	Software Engineering Project
COMP 361D2	(3)	Software Engineering Project
COMP 400	(4)	Project in Computer Science
ECSE 429	(3)	Software Validation
MATH 223	(3)	Linear Algebra
MATH 240	(3)	Discrete Structures

Complementary Courses (33 credits)

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

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

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

Group A:

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

Group B:

COMP 330	(3)	Theory of Computation

COMP 360	(3)	Algorithm Design

Group C: Software Engineering Specialization

13.10 Earth and Planetary Sciences (EPSC)

13.10.1 Location

Frank Dawson Adams Building, Room 238
3450 University Street
Montreal QC H3A 0E8
Telephone: 514-398-6767
Fax: 514-398-4680
Email: *kristy.thornton@mcgill.ca*
Website: *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 hired by resource exploration and extraction companies (industrial minerals, fossil and nuclear fuels, geothermal energy, ore deposits of base, precious and critical metals). Knowledge of geochemistry and hydrogeology is also valued in the environmental consulting sector. Industry or government agencies may hire undergraduate students during the summer months, providing them with both financial benefits and first-hand geoscientific experience. Career opportunities in planetary science can also be found in universities and research organizations.

The Department has a full-time staff of 17 professors and one faculty lecturer. There are approximately 75 graduate and 20-30 undergraduate students registered in the various programs offered. Classes are therefore small at all levels, resulting in an informal and friendly atmosphere throughout the Department, in which most of the faculty and students interact on a first-name basis. Emphasis is placed equally on quality teaching and research, providing undergraduate students with a rich and exciting environment in which to explore and learn.

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 in a B.A. program may choose Earth and Planetary Sciences as their area of specialization for the **Minor Concentration for Arts Students**.

Students interested in any of the programs should inquire at:

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

or should consult the Undergraduate Director:

Professor Jeanne Paquette
Frank Dawson Adams Building, Room 214
Telephone: 514-398-4402
Email: *jeanne.paquette@mcgill.ca*.**paquette21.207 1 0 64lG0 Under**

Complementary Courses (9 credits)

9 credits selected from:

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

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

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

Required Courses (21 credits)

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

Complementary Courses (24 credits)

3 credits, one of:

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

plus 21 credits chosen from the fo1 0 0 1 80.407 s 21 cre 4n from the fo1 0 0 1 80.4 0 12T2h1 credits chosen from tls c55l 3T2h1 cNote:.01 T1 Tfatcre 43006.90higj1 le

EPSC 530	(3)	Volcanology
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Igneous Petrogenetic Mechanisms
EPSC 549	(3)	Hydrogeology
EPSC 550	(3)	Selected Topics 1
EPSC 551	(3)	Selected Topics 2
EPSC 552	(3)	Selected Topics 3

3 credits of field school

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

3 credits of environmental and ore-forming processes

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

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

EPSC 350	(3)	Tectonics
EPSC 435	(3)	Applied Geophysics
EPSC 470D1	(3)	Undergraduate Thesis Research
EPSC 470D2	(3)	Undergraduate Thesis Research
EPSC 482	(3)	Research in Earth and Planetary Sciences
EPSC 501	(3)	Crystal Chemistry
EPSC 503	(3)	Advanced Structural Geology
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 525	(3)	Microbiology of the Earth System
EPSC 530	(3)	Volcanology
EPSC 540	()	Crustal Rheology
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Igneous Petrogenetic Mechanisms
EPSC 550	(3)	Selected Topics 1
EPSC 551	(3)	Selected Topics 2
EPSC 552	(3)	Selected Topics 3
EPSC 567	(3)	Advanced Volcanology

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

Bachelor of Science (B.Sc.) - Honour

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

Complementary Courses (33 credits)

15 credits of advanced earth science

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

3 credits of field school

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

3 credits of environmental and ore-forming processes

Climate and d Plbming7Tj1 0 0 1w5.4M1

EPSC 547	(3)	Modelling Geochemical Processes
	(3)	Igneous Petrogenetic Mechanisms

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 445	(3)	Metamorphic Petrology
EPSC 501	(3)	Crystal Chemistry
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 520	(3)	Earthquake Physics and Geology
EPSC 530	(3)	Volcanology
EPSC 540	()	Crustal Rheology
EPSC 547	(3)	Modelling Geochemical Processes
EPSC 548	(3)	Igneous Petrogenetic Mechanisms
EPSC 549	(3)	Hydrogeology
EPSC 550	(3)	Selected Topics 1
EPSC 551	(3)	Selected Topics 2
EPSC 552	(3)	Selected Topics 3
EPSC 561	(3)	Ore-forming Processes
EPSC 567	(3)	Advanced Volcanology
EPSC 590	(3)	Applied Geochemistry Seminar

13.10.11 Earth and Planetary Sciences (EPSC) Related Programs

13.10.11.1 Joint Major in Physics and Geophysics

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

13.10.11.2 Earth System Science Interdepartmental Major

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

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

13.10.11.3 Earth System Science Interdepartmental Honours

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

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

13.11 Earth System Science (ESYS)

13.11.1 Location

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

13.11.2 About Earth System Science

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

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

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

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

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

The ESS programs are offered jointly by the Department of *section 13.3: Atmospheric and Oceanic Sciences (ATOC)*, the Department of *section 13.10: Earth and Planetary Sciences (EPSC)*, and the Department of *section 13.17: Geography (GEOG)*.

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

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

ENVR 201	(3)	Society, Environment and Sustainability
ESYS 200	(3)	Earth System Processes
ESYS 300	(3)	Investigating the Earth System
ESYS 301	(3)	Earth System Modelling
ESYS 500	(3)	Earth System Applications
MATH 222	(3)	Calculus 3

Complementary Courses (39 credits)

3 credits from the following:

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

3 credits from the following:

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

3 credits from the following:

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

3 credits from the following:

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

3 credits from the following:

GEOG 308	(3)	Remote Sensing for Earth Observation
GEOG 314	(3)	Geospatial Analysis

3 credits from the following:

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

3 credits from the following:

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

3 credits from the following:

ANTH 339	(3)	Ecological Anthropology

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

EPSC 334	(3)	Invertebrate Paleontology
EPSC 340	(3)	Earth and Planetary Inference
EPSC 341	(3)	Field School 3
EPSC 350	(3)	Tectonics
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits
EPSC 519	(3)	Isotopes in Earth and Environmental Science
EPSC 525	(3)	Microbiology of the Earth System
EPSC 530	(3)	Volcanology
EPSC 549	(3)	Hydrogeology
EPSC 561	(3)	Ore-forming Processes
EPSC 567	(3)	Advanced Volcanology
EPSC 590	(3)	Applied Geochemistry Seminar
GEOG 272	(3)	Earth's Changing Surface
GEOG 305	(3)	Soils and Environment
GEOG 321	(3)	Climatic Environments
GEOG 322	(3)	Environmental Hydrology
GEOG 351	(3)	Quantitative Methods
		Running Water En(3)

MATH 447	(3)	Introduction to Stochastic Processes
MATH 525	(4)	Sampling Theory and Applications
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 404	(3)	Climate Physics
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.) - Honours Earth System 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)

3 credits from the following:

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

3 credits from the following:

GEOG 308	(3)	Remote Sensing for Earth Observation
GEOG 314	(3)	Geospatial Analysis

3 credits from the following:

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

3 credits from the following:

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

3 credits from the following:

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

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

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

ATOC 215	(3)	Oceans, Weather and Climate
ATOC 309	(3)	Weather Radars and Satellites
ATOC 312	(3)	Rotating Fluid Dynamics
ATOC 315	(3)	Thermodynamics and Convection
ATOC 404	(3)	Climate Physics
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 515	(3)	Turbulence in Atmosphere and Oceans
ATOC 519	(3)	Advances in Chemistry of Atmosphere
ATOC 521	(3)	Cloud Physics
ATOC 525	(3)	Atmospheric Radiation
AT	(3)	Dynamics of Current Climates
AT1of 40	(3)	Synoptic Meteorology 1

ATOC 541	(3)	Synoptic Meteorology 2
BIOL 308	(3)	Ecological Dynamics
BIOL 309	(3)	Mathematical Models in Biology
BIOL 310	(3)	Biodiversity and Ecosystems
BIOL 432	(3)	Limnology
BIOL 434	(3)	Theoretical Ecology
BIOL 441	(3)	Biological Oceanography
BIOL 465	(3)	Conservation Biology
BIOL 540	(3)	Ecology of Species Invasions
BIOL 573	(3)	Vertebrate Palaeontology Field Course
BREE 217	(3)	Hydrology and Water Resources
BREE 319	(3)	Engineering Mathematics
BREE 509	(3)	Hydrologic Systems and Modelling.
BREE 510	(3)	Watershed Systems Management
BREE 515	(3)	Soil Hydrologic Modelling
BREE 533	(3)	Water Quality Management
ECON 347	(3)	Economics of Climate Change
ECON 405	(3)	Natural Resource Economics
EPSC 212	(3)	Introductory Petrology
EPSC 320	(3)	Elementary Earth Physics
EPSC 331	(3)	Field School 2
EPSC 334	(3)	Invertebrate Paleontology
EPSC 340	(3)	Earth and Planetary Inference
EPSC 341	(3)	Field School 3
EPSC 350	(3)	Tectonics
EPSC 355	(3)	Sedimentary Geology
EPSC 423	(3)	Igneous Petrology
EPSC 425	(3)	Sediments to Sequences
EPSC 445	(3)	Metamorphic Petrology
EPSC 452	(3)	Mineral Deposits

GEOG 401	(3)	Socio-Environmental Systems: Theory and Simulation
GEOG 414	(3)	Advanced Geospatial Analysis
GEOG 470	(3)	Wetlands
GEOG 495	(3)	Field Studies - Physical Geography
GEOG 499	(3)	Subarctic Field Studies
GEOG 505	(3)	Global Biogeochemistry
GEOG 506	(3)	Advanced Geographic Information Science
GEOG 523	(3)	Global Ecosystems and Climate
GEOG 530	(3)	Global Land and Water Resources
GEOG 535	(3)	Remote Sensing and Interpretation
GEOG 536	(3)	Geocryology
GEOG 537	(3)	Advanced Fluvial Geomorphology
GEOG 550	(3)	Historical Ecology Techniques
MATH 314	(3)	Advanced Calculus
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 323	(3)	Probability
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 423	(3)	Applied Regression
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Introduction to Stochastic Processes
MATH 525	(4)	Sampling Theory and Applications
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 404	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids

13.12 Entrepreneurship for Science Students

13.12.1 About Entrepreneurship for Science Students

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

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 Courses (12 credits)

INTG 201	(3)	Integrated Management Essentials 1
INTG 202	(3)	Integrated Management Essentials 2

Experimental Medicine Courses		
EXMD 505	(3)	Directed Readings in Regenerative Medicine
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
EXMD 509	(3)	Gastrointestinal Physiology and Pathology
EXMD 510	(3)	Bioanalytical Separation Methods
EXMD 511	(3)	Joint Venturing with Industry

13.15 Field Study

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

13.15.1 Field Studies - Minor Field Studies (18 credits)

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

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

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

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

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

Africa Field Study Semester (15 credits)

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

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

Africa Field Study Semester - Required Courses

6 credits

Students select one course titled "Research in Society and Dev

GEOG 404*	(3)	Environmental Management 2
GEOG 408	(3)	Geography of Development
GEOG 423	(3)	Dilemmas of Development
HIST 498	(3)	Independent Research
NRSC 405	(3)	Natural History of East Africa
NUTR 404	(3)	Nutrition Field Studies in East Africa
REDM 405	(3)	Natural History of East Africa
WILD 420*	(3)	Ornithology

Barbados Field Study Semester (15 credits)

The Barbados Field Study Semester (BFSS) provides one term of integrated field study for students with an interest in global issues related to natural resource use as affected by socio-economic, management, urban, and physical constraints. Offered at the Bellairs Research Institute in Barbados, this program challenges students to be more effective environmental decision makers, policy makers, and managers. There is a growing need for professionals with such skills at all levels of government, within NGOs, and in the private sector. The overall goal of the BFSS is to equip future leaders to address the complexity of issues associated with the formulation and implementation of organizational strategies compatible with the societal goal of sustainable use and development of our natural resources.

The BFSS is intended for senior undergraduate students from across the University. Students must apply to participate in the program. Selection will be based on the student's Academic Standing and demonstrated interests and involvement in international issues related to natural resource use.

Barbados Field Study Semester - Required Courses

6 credits

URBP 507	(3)	Planning and Infrastructure
URBP 520	(3)	Globalization: Planning and Change

Barbados Field Study Semester - Complementary Courses

9 credits

Students select one 3-credit course titled "Water Resources in Barbados" and one 6-credit course titled "Sustainable Development Plans" from the list below.

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

Barbados Interdisciplinary Tropical Studies Field Semester (15 credits)

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

Barbados Interdisciplinary Tropical Studies Field Semester - Required Courses

15 credits

AEBI 421	(3)	Tropical Horticultural Ecology
AEBI 423	(3)	Sustainable Land Use
AEBI 425	(3)	Tropical Energy and Food

AEBI 427	(6)	Barbados Interdisciplinary Project

Panama Field Study Semester (15 credits)

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

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

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

Panama Field Study Semester - Required Courses

9 credits

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

Panama Field Study Semester - Complementary Courses

6 credits

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

First Winter semester complementary courses:

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

Second Winter semester complementary courses:

GEOG 404	(3)	Environmental Management 2
HIST 510	(3)	Environmental History of Latin America (Field)

McGill Arctic Field Study Semester

Required Courses (15 credits)

9 credits

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

and 6 credits from

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

Minor Field Studies - Complementary Course

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

13.16 General Science

13.16.1 Location

Interdisciplinary Programs Adviser
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 credits)* for more information.

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

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

Complementary Courses (18 credits)

Courses are to be chosen according to the following guidelines:

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

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

Two options:

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

or

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

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

13.17 Geography (GEOG)

13.17.1 Location

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

13.17.2 About Geography

The Department of Geography offers programs in both Arts and Science.

Refer to Faculty of Arts > *Undergraduate* > *Browse Academic Units & Programs* > *: Geography (GEOG)*for B.A. programs in Geography, including Urban Studies.

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

Geography also administers the B. A. & Sc. interfaculty programs in Sustainability, Science and Society in partnership with the Bieler School of En

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

13.17.3 Prerequisites

There are no departmental prerequisites for entrance to the B.Sc. Geography programs. Students who have completed college or pre-university geography courses fully equivalent to those in the first year of university may, with the adviser's approval, substitute other courses as part of their program.

13.17.4 Geography Faculty

Chair

N.T. Roulet

Graduate Program Director

TBA

Emeritus Professors

T.R. Moore; S. Olson; W.H. Pollard; G.W. Wenzel.

Professors

P.G. Brown, *cross appt. with Bieler School of Environment*; G.L. Chmura; O.T. Coomes; N.T. Roulet; S. Turner; J. Unruh.

Associate Professors

S. Breau; B. Forest; M. Kalacska; B. Lehner; G. MacDonald; K. Manaugh; T.C. Meredith; S. Moser; B. Robinson; R. Sengupta; R. Sieber.

Assistant Professors

M. Bendixen; G. McKenzie; M. Riva; C. von Sperber.

Adjunct Professors

G. Leblanc; N.A. Ross, *cross appt. with Natural Resource Sciences*.

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

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

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

This Minor permits no overlap with any other programs.

Required Courses (6 credits)

GEOG 203	(3)	Environmental Systems
GEOG 272	(3)	Earth's Changing Surface

Complementary Courses (12 credits)

3 credits of Geography courses at the 200 level below.

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

3 credits of statistics*

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

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

9 credits of systematic physical geography

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

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

6 or 9 credits of environmental analysis/techniques

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

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

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

9 credits on human-environment linkages

GEOG 210	(3)	Global Places and Peoples
GEOG 216	(3)	Geography of the World Economy
GEOG 217	(3)	Cities in the Modern World
GEOG 221	(3)	Environment and Health
GEOG 303	(3)	Health Geography

GEOG 310	(3)	Development and Livelihoods
GEOG 311	(3)	Economic Geography
GEOG 315	(3)	Urban Transportation Geography

3 credits of field courses:

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

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

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 environmental analysis/techniques

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

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-en

GEOG 303	(3)	Health Geography
GEOG 310	(3)	Development and Livelihoods
GEOG 311	(3)	Economic Geography
GEOG 315	(3)	Urban Transportation Geography

3 credits of statistics*, one of:

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

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

9 credits of systematic physical geography:

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

3 credits of field courses:

949 362.4AysEn		Field Studies - Physical Geography

GEOG 360	(3)	Analyzing Sustainability
GEOG 460	(3)	Research in Sustainability

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

Geography Approved Course List - Major, Honours and Liberal Programs

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

13.17.10 Geography (GEOG) Related Programs and Study Semesters

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

13.17.10.1 Africa Field Study Semester

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

13.17.10.2 Panama Field Study Semester

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

13.17.10.3 Arctic Field Study Semester

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

13.17.10.4 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)*.

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

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

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

Michelle Maillet

Email: *advisor.g*

U1 Required Courses

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 Courses

13 credits from the following:

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

U3 Required Courses

15 credits from the following:

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

Complementary Courses (27 credits)

U1 Complementary Courses

6 credits chosen in the following manner.

3 credits selected from:

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

plus 3 credits selected from the following:

* Students take either PHGY 209 or MIMM 211.

** Students take either CHEM 203 or CHEM 204.

	(3)	Systemic Human Anatomy

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

U2 Complementary Courses

12 credits chosen as follows:

6 credits selected from:

Students may take

* BIOC 220 and BIOC 320, or

** MIMM 384 and MIMM 385, or

*** PHGY 212 and PHGY 213 and BIOL 301

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

plus 6 credits, selected from:

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

ANAT 365	(3)	Cellular Trafficking
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309*	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Cancer
CHEM 302	(3)	Introductory Organic Chemistry 3
MATH 222	(3)	Calculus 3
MATH 315*	(3)	Ordinary Differential Equations
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

U3 Complementary Courses

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

3 credits selected from:

BIOC 503	(3)	Biochemistry of Immune Diseases
MIMM 509	(3)	Inflammatory Processes
PHGY 531	(3)	Topics in Applied Immunology

plus 6 credits selected from:

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

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

13.19 Interdisciplinary Life Sciences

13.19.1 Location

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

13.19.2 About the Interdisciplinary Life Sciences Minor

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

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

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

The Interdisciplinary Life Sciences Minor will allow students from the earth, physical, math, and computational science areas to broaden their studies with some basic life sciences, health social science, and empirical technological science. The Minor is 24 credits and allows students flexibility in their course selections. Students must take 9 credits from an extensive list of basic life science courses, 3 credits from an extensive list of health and social science courses, and 3 credits from an empirical and technological science list. The remaining 9 credits may be taken from courses listed in any of the three categories.

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

BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 370	(3)	Human Genetics Applied
CHEM 212	(4)	Introductory Organic Chemistry 1
CHEM 222	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
MIMM 211	(3)	Introductory Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 387	(3)	The Business of Science
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
NSCI 201	(3)	Introduction to Neuroscience 2
NUTR 307	(3)	Metabolism and Human Nutrition
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHAR 303	(3)	Principles of Toxicology
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PSYC 211	(3)	Introductory Behavioural Neuroscience
PSYC 311	(3)	Human Cognition and the Brain
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2

(3)viour(3)vioealth Sciences and Behaviour

ANTH 314	(3)	Psychological Anthropology 01
ECON 440	(3)	Health Economics
GEOG 221	(3)	Environment and Health
GEOG 303	(3)	Health Geography
HIST 249	(3)	Health and the Healer in Western History
HIST 335	(3)	Science and Medicine in Canada
HIST 350	(3)	Science and the Enlightenment
HIST 381	(3)	Colonial Africa
HIST 424	(3)	Gender, Sexuality and Medicine
HSEL 308	(3)	Issues in Women's Health
	(3)	Women's Reproductive Health

MATH 323	(3)	Probability
MATH 324*	(3)	Statistics
PSYC 204	(3)	Introduction to Psychological Statistics
PSYC 305	(3)	Statistics for Experimental Design

13.20 Kinesiology for Science Students

13.20.1 Location

EDKP 445	(3)	Exercise Metabolism
EDKP 446	(3)	Physical Activity and Ageing
EDKP 447	(3)	Motor Control
EDKP 448	(3)	Exercise and Health Psychology
EDKP 449	(3)	Neuromuscular and Inflammatory Pathophysiology
EDKP 485	(3)	Cardiopulmonary Exercise Pathophysiology
EDKP 495	(3)	Scientific Principles of Training
EDKP 498	(3)	Sport Psychology
EDKP 542	(3)	Environmental Exercise Physiology
EDKP 566	(3)	Advanced Biomechanics Theory

13.21 Management for Science Students

The Desautels Faculty of Management offers 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

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

Complementary Courses (9 credits)

9 credits selected from anUnderad Tm(Fics coTm(.)Tj/F0 8.6 Tf1 0 0 1 80.2 1 0338.61 Tm(Bac)Tj1 0 0 1 96.2 1 0338.61 Tm(helor of Commer)Tj1 0 0 1 1642 1 0338.6

9 credits selected from:

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

Category C

6 credits selected from:

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

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

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

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

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

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

13.21.3 Bachelor of Commerce (B.Com.) - Minor Marketing (For Non-Management 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 Courses (9 credits)

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

Complementary Courses (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
MRKT 453	(3)	Advertising and Media
MRKT 455	(3)	Sales Management
MRKT 459	(3)	Retail Management

MRKT 483 (3) International Marketing Management

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

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

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

Bachelor of Commerce (B.Com.) - Minor Operations Manag

Telephone: 514-398-3800
Website: *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, machine learning, graph theory, mathematical physics, numerical analysis, optimization, and probability.

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

13.22.3 Undergraduate Program Options

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

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

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

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

13.22.4 Research Opportunities

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

- Funded summer research projects allowing students to engage in state-of-the art research with faculty members
- Opportunities for hands-on experience with data analysis oft87u9l682 Tme1g6uOs for handseToen3 4a52 TpTze vto the profes1 T. v68281.693 256.743 Tme1 0 0

13.22.6 Mathematics and Statistics Faculty

Chair

Jacques C. Hurtubise

Graduate Program Director

Jérôme Vétois

Undergraduate Program Director

Johanna Neslehova

Emeritus Professors

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

Professors

Louigi Addario-Berry; Masoud Asgharian; Peter Bartello; Rustum Choksi; Henri Darmon; Christian Genest; Eyal Z. Goren; Pengfei Guan; Jacques C. Hurtubise; Dmitry Jakobson; Vojkan Jaksic; Niky Kamran; Johanna Neslehova; Adam Oberman; Charles Roth; David A. Stephens; Valentino Tosatti; John A. Toth; Adrian Vetta; Daniel T. Wise.

Associate Professors

Linan Chen; Tim Hoheisel; Antonecton

* MATH 223 may be replaced by MATH 235 and MA

PHYS 559	(3)	Advanced Statistical Mechanics
SOCI 504	(3)	Quantitative Methods 1

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

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

Program Prerequisites

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

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

Guidelines for Selection of Courses

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

Students interested in computer science are advised to choose courses from the following: MATH 317,9 580Ae such substitutisti9

MATH 340	(3)	Discrete Mathematics

the remainder of the 18 credits to be selected from:

MATH 204	(3)	Principles of Statistics 2
MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 318	(3)	Mathematical Logic
MATH 319	(3)	Partial Differential Equations
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 338	(3)	History and Philosophy of Mathematics
MATH 346	(3)	Number Theory
MATH 348	(3)	Euclidean Geometry
MATH 352	(1)	Problem Seminar
MATH 378	(3)	Nonlinear Optimization
MATH 410	(3)	Majors Project
MATH 417	(3)	Linear Optimization
MATH 423	(3)	Applied Regression
MATH 430	(3)	Mathematical Finance
MATH 447	(3)	Introduction to Stochastic Processes
MATH 463	()	
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis

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

(45 or 48 credits)

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

Students may complete this program with a minimum of 45 credits or a maximum of 48 credits depending on whether or not they are required to take MATH 203.

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

In addition, a student who has not completed the equivalent of MATH 203 on entering the program must consult an academic adviser and take MATH 203 in the first semester, increasing the total number of program credits from 45 to 48.

Required Courses (27 credits)

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

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

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

+ Students have to take MATH 204 prior to MATH 324.

COMP 202**	(3)	Foundations of Programming
MATH 204+	(3)	Principles of Statistics 2
MATH 222*	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 236***	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 323	(3)	Probability
MATH 324+	(3)	Statistics
MATH 423	(3)	Applied Regression

Complementary Courses

18 or 21 credits

0-3 credits from:

MATH 203	(3)	Principles of Statistics 1

At least 6 credits selected from:

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

COMP 250	(3)	Introduction to Computer Science
COMP 350*	(3)	Numerical Computing
MATH 243	(3)	Analysis 2
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
MATH 316	(3)	Complex Variables
MATH 317*	(3)	Numerical Analysis
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 327	(3)	Matrix Numerical Analysis
MATH 329	(3)	Theory of Interest
MATH 340	(3)	Discrete Mathematics
MATH 350	(3)	Honours Discrete Mathematics
MATH 378	(3)	Nonlinear Optimization
MATH 417	(3)	Linear Optimization
MATH 430	(3)	Mathematical Finance
MATH 463	()	

At least 9 credits selected from:

*Students can take either MATH 410 or MATH 420, but not both.

COMP 551	(4)	Applied Machine Learning

MATH 208	(3)	Introduction to Statistical Computing
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 410*	(3)	Majors Project
MATH 420*	(3)	Independent Study
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 540	(4)	Life Actuarial Mathematics
MATH 541	(4)	Nonlife Actuarial Models
MATH 545	(4)	Introduction to Time Series Analysis
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 558	(4)	Design of Experiments
MATH 598	(4)	Topics in Probability and Statistics
WCOM 314	(3)	Communicating Science

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

Program Prerequisites

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

MATH 133	(3)	Linear Algebrau*e 3Geometry
MATH 140	(3)	Calculus 1
MATH 141	(4)	Calculus 2

Guidelines for Selection of Courses in the Major Program

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

Students interested in comput 0uscience are advised to choose courses from the following: MATH 317, MATH 318, MATH 327, MATH 335, MATH 340, MATH 417u*e 3to complete the Comput 0uScience Minor

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

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

Students considering a care 0uin secondaryuschool teaching are advised to take MATH 318, MATH 338, MATH 346, MATH 348.

Students interested in care 0s in business, industry or government are advised to select courses from the following list:

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

Required Courses (27 credits)

Note: Students who have done well in MATH 235 and MATH 242 should consider entering the Honours stream by registering in MATH 251 and MATH 255 instead of MATH 236 and MATH 243.

* 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 bett 0umay omit MATH 222, but must replace it with 3 credits of complementary courses.

MATH 222**	(3)	Calculus 3
MATH 235	(3)	Algebrau1

MATH 236	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 243	(3)	Analysis 2
MATH 249*	(3)	Honours Complex Variables
	(3)	Advanced Calculus

Part I: 6 credits selected from:

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

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

Part II: 14 credits selected from:

* Students take either MATH 410 or MATH 420, but not both.

+ Students can take either COMP 451 or COMP 551, but not both.

COMP 451+	(3)	Fundamentals of Machine Learning
COMP 551+	(4)	Applied Machine Learning
MATH 308	(3)	Fundamentals of Statistical Learning
MATH 410*	(3)	Majors Project
MATH 420*	(3)	Independent Study
MATH 427	(3)	Statistical Quality Control
MATH 447	(3)	Introduction to Stochastic Processes
MATH 463	()	
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications
MATH 540	(4)	Life Actuarial Mathematics
MATH 541	(4)	Nonlife Actuarial Models
MATH 545	(4)	Introduction to Time Series Analysis
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 558	(4)	Design of Experiments
MATH 598	(4)	Topics in Probability and Statistics
WCOM 314	(3)	Communicating Science

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

Program Prerequisites

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

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

Required Courses (54 credits)

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 360	(3)	Algorithm Design
MATH 222	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 236	(3)	Algebra 2
MATH 242	(3)	Analysis 1
MATH 315	(3)	Ordinary Differential Equations
MATH 317	(3)	Numerical Analysis
MATH 318	(3)	Mathematical Logic
MATH 323	(3)	Probability
MATH 340	(3)	Discrete Mathematics

Complementary Courses (18 credits)

9 credits from the set of courses recommended for a major https://www.mcgill.ca/study/faculties/science/undergraduate/programs/bachelor-science-bsc-major-mathematics or honours https://www.mcgill.ca/study/faculties/science/undergraduate/programs/bachelor-science-bsc-honours-mathematics program in Mathematics.

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

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

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

Required Courses (51 credits)

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

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

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

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

COMP 202*	(3)	Foundations of Programming
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 251	(3)	Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 330	(3)	Theory of Computation
COMP 350**	(3)	Numerical Computing
COMP 360	(3)	Algorithm Design
MA	(3)	Calculus 3

MATH 447	(3)	Introduction to Stochastic Processes
MATH 523	(4)	Generalized Linear Models
MATH 524	(4)	Nonparametric Statistics

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

Required Courses

(39-42 credits)

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

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

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

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

Complementary Courses (21 credits)

3 credits selected from:

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

+ It is strongly recommended that students take MATH 254.

Advising Notes:

Students interested in continuous applied mathematics are urged to choose these as part of their Complementary Courses: MATH 454, MATH 455 and MATH 478, and are advised to choose additional courses from MATH 387, MATH 397, MATH 555, MATH 574, MATH 578, MATH 579, MATH 580, MATH 581.

Students interested in discrete applied mathematics are advised to choose from these as part of their Complementary Courses: COMP 362, COMP 490, MATH 456, MATH 457, MATH 517, MATH 547, MATH 550, MATH 552.

3 credits selected from:

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

at least 3 credits selected from:

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

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

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

and the remainder of credits selected from:

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

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

All MATH 500-level courses.

Other courses with the permission of the Department.

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

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

Program Prerequisites

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

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

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

Students who have not completed an equivalent of MATH 222 on entering the program must consult an academic adviser and take MATH 222 as a required course in the first semester, increasing the total number of program credits from 60 to 63. Students who have successfully completed MATH 150/1151 are not required to take MATH 222.

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

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

45-48 credits

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

* Not open to students who have taken MATH 354.

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

Complementary Courses (15 credits)

3 credits selected from:

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

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

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

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

6-12 credits selected from:

COMP 250++	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
MATH 350	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 376	(3)	Honours Nonlinear Dynamics

MATH 377	(3)	Honours Number Theory
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis
MATH 398	(3)	Honours Euclidean Geometry
MATH 462	(3)	Honours Mathematics for Machine Learning
MATH 480	(3)	Honours Independent Study
MATH 488	(3)	Honours Set Theory

all MATH 500-level courses.

++ Students with limited programming experience should take COMP 202 or COMP 204 or COMP 208 or equivalent before COMP 250.T326Tm53.03 250pobability a

MATH 247**	(3)	Honours Applied Linear Algebra
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 470	(3)	Honours Research Project
MATH 533	(4)	Regression and Analysis of Variance

Complementary Courses (32 credits)

Advising notes:

- Students wishing to pursue probability or mathematical statistics in graduate school are strongly advised to take MATH 587 and recommended to take honours mathematics courses as complementary courses in Part 11, in particular MATH 358, MATH 454 and MATH 455.

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

- Students with interest in actuarial science are advised to choose from the following as part of their Complementary Courses: MATH 329, MATH 430, MATH 524, MATH 540, MATH 541, MATH 545, MATH 547.

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

Part 1: 3 credits selected from:

* It is strongly recommended that students take MATH 254.

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

Part II: at least 6 credits in mathematics and computer science selected from:

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

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

COMP 206	(3)	Introduction to Software Systems
COMP 252	(3)	Honours Algorithms and Data Structures
MATH 248+	(3)	Honours Vector Calculus
MATH 325	(3)	Honours Ordinary Differential Equations
MATH 350	(3)	Honours Discrete Mathematics
MATH 352	(1)	Problem Seminar
MATH 358+	(3)	Honours Advanced Calculus
MATH 376	(3)	Honours Nonlinear Dynamics
MATH 387	(3)	Honours Numerical Analysis
MATH 397	(3)	Honours Matrix Numerical Analysis
MATH 398	(3)	Honours Euclidean Geometry
MATH 454	(3)	Honours Analysis 3
MATH 455++	(3)	Honours Analysis 4
MATH 458	(3)	Honours Differential Geometry
MATH 466	(3)	Honours Complex Analysis
MATH 475	(3)	Honours Partial Differential Equations
MATH 478	(3)	Computational Methods in Applied Mathematics

MATH 480	(3)	Honours Independent Study

and any 500-level course offered by the Department of Mathematics and Statistics not listed in Part III below.

Part III: at least 18 credits in probability and statistics selected as follows:

At least 8 credits selected from:

MATH 308	(3)	Fundamentals of Statistical Learning
MATH 524	(4)	Nonparametric Statistics
MATH 547	(4)	Stochastic Processes
MATH 556	(4)	Mathematical Statistics 1
MATH 557	(4)	Mathematical Statistics 2
MATH 587	(4)	Advanced Probability Theory 1
MATH 589	(4)	Advanced Probability Theory 2

At least 7 credits selected from:

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

MATH 204+++	(3)	Principles of Statistics 2
MATH 523	(4)	Generalized Linear Models
MATH 525	(4)	Sampling Theory and Applications
MATH 545	(4)	Introduction to Time Series Analysis
MATH 558	(4)	Design of Experiments

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

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

The remaining credits selected from:

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

COMP 424	(3)	Artificial Intelligence
COMP 451	(3)	Fundamentals of Machine Learning
COMP 551	(4)	Applied Machine Learning
MATH 430	(3)	Mathematical Finance
MATH 462	(3)	Honours Mathematics for Machine Learning
MATH 540	(4)	Life Actuarial Mathematics
MATH 541	(4)	Nonlife Actuarial Models
MATH 594+++	(4)	Topics in Mathematics and Statistics
MATH 598+++	(4)	Topics in Probability and Statistics

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

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

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

Program Prerequisites

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

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

Required Courses (46 credits)

* 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 Vector Calculus
MATH 251**	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 356	(3)	Honours Probability
MATH 357	(3)	Honours Statistics
MATH 533	(4)	Regression and Analysis of Variance

Complementary Courses (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

Sampling Theory and Applications

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

Required Courses

(36-39 credits)

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

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
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 222*	(3)	Calculus 3
MATH 235	(3)	Algebra 1
MATH 251	(3)	Honours Algebra 2
MATH 255	(3)	Honours Analysis 2
MATH 350	(3)	Honours Discrete Mathematics

Complementary Courses

36-39 credits

0-3 credits selected from:

COMP 202**	(3)	Foundations of Programming
COMP 204**	(3)	Computer Programming for Life Sciences
COMP 208**	(3)	Computer Programming for Physical Sciences and Engineering

** Students who have sufficient knowledge of computer programming are not required to take COMP 202/COMP 204/COMP 208.

3 credits selected from:

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

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

3 credits selected from:

MATH 248	(3)	Honours Vector Calculus
MATH 358	(3)	Honours Advanced Calculus

18 credits in Mathematics, at least 9 credits selected from:

+ Not open to students who have taken MATH 354.

Honours ProbaSu6e0nN8y1 0 0 1 165.864 171.002 Tm(Hon))Tj1 0 0 1 70.52 171.002 Tm(HonTj1 0 0 1 82.67 171.002

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 and 500-level courses given by the Department of Mathematics and Statistics.

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

13.22.20 Mathematics and Statistics (MATH) Related Programs

13.22.20.1 Major in Biology and Mathematics

For more information, see *section 13.5: Biology (BIOL)* > *section 13.5.10: Bachelor of Science (B.Sc.) - Major Biology and Mathematics (76 credits)*.

13.22.20.2 Major in Physiology and Mathematics

For more information, see *section 13.31: Physiology (PHGY)* > *section 13.31.6: Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (79 credits)*.

13.22.20.3 Honours Program in Mathematics and Physics

For more information, see *section 13.30: Physics (PHYS)* > *section 13.30.15*

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

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

An online undergraduate handbook, containing course and program information and information on careers in microbiology and immunology is available on our *website*.

All new students should attend a departmental **orientation/advising session** in August. Please check *mcgill.ca/microimm/undergraduate-programs/advising* for dates.

13.23.3 Microbiology and Immunology Faculty

Chair

Samantha Gruenheid (*Interim*)

Emeritus Professors

N. Acheson, M. Baines, J.W. Coulton

Professors

J. Archambault, A. Berghuis, S. Gruenheid, G.J. Matlashewski, M. Olivier, C. Piccirillo, D. Sheppard, M. Stevenson

Associate Professors

D.J. Briedis, B. Cousineau, S. Fournier, J. Fritz, G.T. Marczynski, S. Sagan, A. Shapiro

Assistant Professors

J Chahal, .I. King, C. Maurice

Associate Members

Epidemiology and Infectious Diseases: M. Behr, A. Dascal

Genetics: K. Dewar, E. Schurr

Immunology, Autoimmunity, Host Defense: J. Antel, M. Burnier, I. Colmegna, P. Gros, A. Kristof, J. Mandl, A. Orthwein, J. Rauch, J. Spicer, C. Tsoukas, S. Vidal

Immunology and Parasitology: B. Brenner, C.T. Costiniuk, M. Ndao, P. Rohrbach, B. Ward, J. Zhang

Microbiology: D. Cuong Vinh, M. Divangahi, C. Liang, D. Nguyen, M. Reed

Molecular Biology: N. Cermakian, A. Jardim, D. Langlais, A. Mouland, K. Pantopoulos, M. Tremblay, B. Turcotte, J. Xia

Virology: A. Gatignol, A.E. Koromilas, R. Lin, J.Teodoro

Adjunct Professors

E. Cohen, A. Descoteaux, J.M. Di Noia, A. Finzi, C. Krawczyk, G. Kukolj, P. Lau, S. Lesage, A. Petronela, K. Pike, W-K. Suh

Adjunct Member

F. Veyrier

13.23.4 Bachelor of Science (B.Sc.) - Liberal Program - Core Science Component Microbiology and Immunology (50 credits)

U1 Required Courses (19 credits)

* Students who have taken CHEM 212 in CEGEP are ,

(3)U1,U1,

MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

U1 Complementary Course (3 credits)

3 credits, select one from:

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

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

3 credits, select one from:

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

U2 Required Courses (16 credits)

MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology

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(3)

(3)B.52 212

(3)U1,U1,

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BIOC 458	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
CHEM 302	(3)	Introductory Organic Chemistry 3
COMP 204	(3)	Computer Programming for Life Sciences
COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
EXMD 504	(3)	Biology of Cancer
MIMM 387	(3)	The Business of Science
MIMM 390	(3)	SEA-PHAGES: Phage Discovery
MIMM 391	(3)	SEA-PHAGES: Genome Annotation
MIMM 413	(3)	Parasitology
MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis
MIMM 496D1	(3)	Microbiology Advanced Research Project
MIMM 496D2	(3)	Microbiology Advanced Research Project
MIMM 497D1	(3)	Immunology Advanced Research Project
MIMM 497D2	(3)	Immunology Advanced Research Project
MIMM 509	(3)	Inflammatory Processes
PATH 300	(3)	Human Disease
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2

13.23.5 Bachelor of Science (B.Sc.) - Major Microbiology and Immunology (66 credits)

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

U1 Required Courses (26 credits)

* Students who have taken CHEM 212 in CEGEP are exempt and /F1 8 orarcplacm forseits)

MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

One of:

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

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

One of:

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

U2 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Course (3 credits)

MIMM 413	(3)	Parasitology

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Complementary Courses (9 credits)

9 credits selected from:

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

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology
ANAT 365	(3)	Cellular Trafficking
ANAT 458*	(3)	Membranes and Cellular Signaling
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids

BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 309	(3)	Mathematical Models in Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

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MIMM 211	(3)	Introductory Microbiology
MIMM 212	(3)	Laboratory in Microbiology
MIMM 214	(3)	Introductory Immunology: Elements of Immunity

One of:

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

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

One of:

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

U2 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
MIMM 301	(1)	Scientific Writing Skills in MIMM
MIMM 314	(3)	Intermediate Immunology
MIMM 323	(3)	Microbial Physiology
MIMM 324	(3)	Fundamental Virology
MIMM 384	(3)	Molecular Microbiology Laboratory
MIMM 385	(3)	Laboratory in Immunology

U3 Required Courses (15 credits)

MIMM 413	(3)	Parasitology
MIMM 501D1*	(6)	Honours Research Project in Immunology
MIMM 501D2*	(6)	Honours Research Project in Immunology
MIMM 502D1*	(6)	Honours Research Project in Microbiology
MIMM 502D2*	(6)	Honours Research Project in Microbiology

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

U3 Complementary Courses (6 credits)

6 credits selected from:

MIMM 414	(3)	Advanced Immunology
MIMM 465	(3)	Bacterial Pathogenesis
MIMM 466	(3)	Viral Pathogenesis

Complementary Courses (3 credits)

3 credits selected from:

ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 262	(3)	Introductory Molecular and Cell Biology

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Department of Physiology
McIntyre Medical Sciences Building, Room 1136
Telephone: 514-398-4342
Email: *monroe.cohen@mcgill.ca*

OR

Dr. Ciro Piccirillo
Department of Microbiology and Immunology
McGill University Health Centre, Glen Site
1001 Decarie Boulevard, Bloc E, Office EM23248
Telephone: 514-934-1934, ext. 76143
Email: *ciro.piccirillo@mcgill.ca*

13.24 Music for Science Students

13.24.1 Location

Strathcona Music Building
555 Sherbrooke Street West
Montreal QC H3A 1E3
Telephone: 514-398-4535
Fax: 514-398-1540
Website: *mcgill.ca/music*

13.24.2 About Music

The Schulich School of Music offers some programs that are open to students in the Faculty of Science. For more information, see *Schulich School of Music > Undergraduate > : Browse Academic Units & Programs*.

13.24.3 Music Faculty

Department of Music Research Chair

Gary Scavone

Department of Performance Chair

TBC

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

Adelina Lameiras
Telephone: 514-398-4541
Email: *adelina.lameiras@mcgill.ca*

Diana (Dino) Dutz; B.Mus.(UWO), Grad.Dip.(C'dia)
Telephone: 514-398-6337
Email: *dino.dutz@mcgill.ca*

13.24.4 Music Related Programs

13.24.4.1 Minor in Musical Applications of Technology and Minor in Musical Science and Technology

- **Minor in Musical Science and Technology** – see *Schulich School of Music > Undergraduate > Browse Academic Units & Programs > Department of Music Research: Composition; Music Education; Music History; Theory; Faculty Program > : Bachelor of Music (B.Mus.) - Minor Musical Science and Technology (18 credits)*

Enrolment in Music Technology programs is highly restricted. Interested applicants must submit an *online application* via the Schulich School of Music

This Minor is intended to provide students with a basic understanding of how the nervous system functions.

BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
NEUR 502	(3)	Basic and Clinical Aspects of Neuroimmunology
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 556	(3)	Topics in Systems Neuroscience
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 415	(3)	Electroencephalography (EEG) Laboratory in Psychology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 514	(3)	Neurobiology of Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
PSYT 505	(3)	Neurobiology of Schizophrenia

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

The Neuroscience Major is a focused program for students interested in how the nervous system functions. It is highly interdisciplinary and borrows principles and methodologies from a number of fields including: biology, biochemistry, physiology, psychology, mathematics, physics, computer science, and immunology. To ensure that they have the appropriate foundation, students are required to take 29 credits in lower-level courses from physiology, biology, mathematics, computer science, psychology, and ethics. The program offers students a concentrated selection of 15 credits to be taken from one of three areas of current scientific activities in the neurosciences: Cell/Molecular, Neurophysiology/Computation, or Cognition/Behaviour. In addition, students select 21 credits from a wide array of complementary courses to obtain more specialized training in areas of neuroscience that best suit their interests.

Enrolment in the Neuroscience Major is limited to a total of 50 students per year. U0 students seeking admission to this program should consult the neuroscience website for admissions requirements and should have completed the courses listed below or their equivalents.

Program Prerequisites

Students may complete this program with a minimum of 65 or a maximum of 67 credits.

Notes on admission to the Neuroscience Major program: Enrolment in the Neuroscience Major is limited to a total of 50 students per year. U0 students seeking admission to this program should consult the neuroscience website for admissions requirements and should have completed the courses listed below or equivalent.

* Students complete one of MATH 139, MA

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

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

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

BIOL 112	(3)	Cell and Molecular Biology
CHEM 110	(4)	General Chemistry 1
CHEM 120	(4)	General Chemistry 2
MATH 139*	(4)	Calculus 1 with Precalculus
MATH 140*	(3)	Calculus 1
MATH 141**	(4)	Calculus 2

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3 credits from:

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

3 credits from:

MIMM 214	(3)	Introductory Immunology: Elements of Immunity
PHAR 300	(3)	Drug Action

B. Neurophysiology/Neural Computation Stream

3 credits as follows:

PHGY 311	(3)	Channels, Synapses and Hormones

3 credits as follows:

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

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

6 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.

ANAT 321	(3)	Circuitry of the Human Brain
BIOL 309	(3)	Mathematical Models in Biology
COMP 206**	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra

C. Cognitive/Behavioural Stream

6 credits as follows:

PSYC 213	(3)	Cognition
PSYC 318	(3)	Behavioural Neuroscience 2

3 credits from:

BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

6 credits from:

ANAT 321	(3)	Circuitry of the Human Brain
PSYC 302	(3)	The Psychology of Pain
PSYC 317	(3)	Genes and Behaviour
PSYC 342	(3)	Hormones and Behaviour

Other Complementary Courses

21-23 credits chosen as follows:

3-16 credits from:

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 389	(3)	Laboratory in Neurobiology
NSCI 410D1	(3)	Independent Research 1
NSCI 410D2	(3)	Independent Research 1
NSCI 420D1	(4.5)	Independent Research 2
NSCI 420D2	(4.5)	Independent Research 2

5-20 of the credits should be taken from the following lists. At least 15 of the 21-23 credits must be at the 400- or 500-level, which could include the above NSCI 410D1/NSCID2 or NSCI 420D1/NSCI 420D2 research courses:

200- and 300-level courses:

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

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

ANAT 321	(3)	Circuitry of the Human Brain
BIOC 212*	(3)	Molecular Mechanisms of Cell Function
BIOC 311	(3)	Metabolic Biochemistry
BIOL 201*	(3)	Cell Biology and Metabolism
BIOL 202	(3)	Basic Genetics
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 307	(3)	Behavioural Ecology
BIOL 320	(3)	Evolution of Brain and Behaviour
CHEM 222	(4)	Introductory Organic Chemistry 2
COMP 206**	(3)	Introduction to Software Systems
COMP 250**	(3)	Introduction to Computer Science
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
		Probabilit3)BIOL 201*

3 credits from:

BIOL 373	(3)	Biometry
MATH 324	(3)	Statistics
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 Honours Neuroscience.

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

3 credits from:

ANAT 321	(3)	Circuitry of the Human Brain
BIOL 306	(3)	Neural Basis of Behaviour
PHGY 314	(3)	Integrative Neuroscience

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 307	(3)	Behavioural Ecology
BIOL 320	(3)	Evolution of Brain and Behaviour
BIOL 389	(3)	Laboratory in Neurobiology
CHEM 222	(4)	Introductory Organic Chemistry 2
COMP 206*	(3)	Introduction to Software Systems
COMP 250*	(3)	Introduction to Computer Science
MATH 223	(3)	Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
MATH 324	(3)	Statistics
MIMM 214	(3)	Introductory Immunology: Elements of Immunity
MIMM 314	(3)	Intermediate Immunology
NEUR 310	(3)	Cellular Neurobiology
PHAR 300	(3)	Drug Action

PSYC 302	(3)	The Psychology of Pain
PSYC 315	(3)	Computational Psychology
PSYC 317	(3)	Genes and Behaviour
PSYC 319	(3)	Computational Models - Cognition
PSYC 342	(3)	Hormones and Behaviour

400- and 500-level courses:

BIOL 414	(3)	Invertebrate Brain Circuits and Behaviours
BIOL 506	(3)	Neurobiology of Learning
BIOL 530	(3)	Advances in Neuroethology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 580	(3)	Genetic Approaches to Neural Systems
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
BMDE 519	(3)	Biomedical Signals and Systems
COMP 54PSYC 315764PSYC431B03TH 43 0 0 1 221.949 678.4 4 529d	(4)	Computational Perception level couion

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

13.27 Nutrition (NUTR)

13.27.1 Location

School of Human Nutrition
Macdonald-Stewart Building, Room MS2-045
21,111 Lakeshore Road
Sainte-Anne-de-Bellevue QC H9X 3V9
Website: *mcgill.ca/nutrition*

13.27.2 About Nutrition

The School of Human Nutrition offers a **Minor in Human Nutrition** which can be taken by Science students; see *Faculty of Agricultural and Environmental Sciences > Undergraduate > Overview of Programs Offered > : Bachelor of Science in Nutritional Sciences – B.Sc.(Nutr.Sc.) (Overview)*.

NUTR 307 is considered as a course taught by the Faculty of Science.

13.28 Pathology (PATH)

13.28.1 Location

Department of Pathology
Duff Medical Building, B wing
3775 University Street
Montreal QC H3A 2B4
Telephone: 514-398-3045
Website: *mcgill.ca/pathology*

13.28.2 About Pathology

Pathology is a branch of medical science that involves the study and diagnosis of disease through the examination of surgically removed organs, tissues (biopsy samples), bodily fluids, and in some cases the whole body (autopsy). Aspects of a bodily specimen that may be considered include its gross anatomical make up, appearance of the cells using immunological markers, and chemical signatures in the cells. Pathology also includes the related scientific study of disease processes whereby the causes, mechanisms, and extent of disease are examined. Areas of study include cellular adaptation to injury, necrosis (death of living cells or tissues), inflammation, wound healing, and neoplasia (abnormal new growth of cells). Pathologists specialize in a wide range of diseases including cancer and the vast majority of cancer diagnoses are made by pathologists. The cellular pattern of tissue samples are observed under a microscope to help determine if a sample is cancerous or non-cancerous (benign). Pathologists also employ genetic studies and gene markers in the assessment of various diseases. Investigators in a pathology department may be utilizing information and experimental techniques originally developed in almost any area of modern biology and, in return, may contribute new knowledge of benefit to many other disciplines. Research on disease may target any of the organ systems, in normal and abnormal conditions, and studies may be conducted from a structural, biochemical or functional perspective at any level, from the intact organism down to specific components of the individual cell. There are no B.Sc. programs in Pathology, students who are interest96 TwTechanism 0 0 1 402.256 198.8r

Telephone: 514-398-3623
Website: *mcgill.ca/pharma*

13.29.2 About Pharmacology and Therapeutics

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

Pharmacology is a multidisciplinary science. It has developed its own set of principles and methods to study the mode of the action of drugs, but it has also utilized many techniques and approaches from various disciplines including biochemistry, physiology, anatomy, and molecular biology, as well as others. Pharmacology encompasses a number of different areas such as:

- pharmacogenomics;
- molecular biology;
- bioinformatics;
- neuropharmacology;
- reproductive pharmacology;
- endocrine pharmacology;
- receptor pharmacology;
- cardiovascular pharmacology;
- toxicology;
- developmental pharmacology;
- autonomic pharmacology;
- biochemical pharmacology;
- therapeutics.

Training in pharmacology is conducted at both the undergraduate and graduate levels. Because of its breadth, students may be attracted to the subject from a variety of viewpoints; this includes those completing a bachelor's degree in any number of basic science disciplines, such as biology, zoology, chemistry, physics, biochemistry, microbiology, anatomy, and physiology. At the undergraduate level, seven lecture courses are offered. A course involving research projects in pharmacology is also available to provide students with the opportunity to get first-hand experience in a pharmacology research laboratory. These courses provide students with knowledge concerning the actions of drugs on living systems and insight into approaches to basic pharmacological research.

13.29.3 Pharmacology and Therapeutics (PHAR) Faculty

Chair

Koren K. Mann

Emeritus Professors

Radan Capek; Hans H. Zingg.

Professors

Daniel Bernard; Derek Bowie; Paul B.S. Clarke; A. Claudio Cuello; Barbara Hales; Terence Hébert; Dusica Maysinger; Anne McKinney; Gerhard Multhaup; Alfredo Ribeiro-da-Silva; Bernard Robaire; H. Uri Saragovi; Moshe Szyf; Jacquetta Trasler; Koren K. Mann.

Associate Professors

Jason Chaim Tanny; Lisa Maria Munter; Bastien Castagner; Jean-François Trempe.

Assistant Professors

Maureen McKeague; Ajitha Thanabalasuriar

Associate Members

Carolyn Baglole; Nathan Luedtke; Stephane Laporte; Stanley Nattel; Cristian O’Flaherty; Simon Rousseau; Edith A. Zorychta; Mark Basik; Michael Pollak.

Adjunct Professors

Bruce Allen; Sylvain Chemtob; Yves De Koninck; Greg FitzHarris; Jean-Sebastien Joyal; Thomas Sanderson; Fabrice Le Boeuf; Laura Stone.

Affiliate Members

Mathieu Boucher; Lionel Breton; Lorella Garofalo; John Gillard; Joseph Mancini; Karen Meerovitch; Christopher Wright.

13.29.4 Bachelor of Science (B.Sc.) - Minor Pharmacology (24 credits)

The Minor Pharmacology is intended for students registered in a complementary B.Sc. program who are interested in a focused introduction to specialized topics in pharmacology to prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes.

Students should declare their intent to enter the Minor in Pharmacology at the beginning of their U2 year. They must consult with, and obtain the approval of, the Coordinator for the Minor Program in the Department of Pharmacology and Therapeutics. Please contact the Student Affairs Coordinator: Chantal Grignon (undergradstudies.pharmacology@mcgill.ca; 514-398-3622).

All courses in the Minor program must be passed with a minimum grade C or better. Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program.

Required Courses (6 credits)

PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease

Complementary Courses (18 credits)

3 credits selected from the following:

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

3 credits selected from the following:

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

12 credits selected from the following:

PHAR 303	(3)	Principles of Toxicology
PHAR 503*	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 505*	(3)	Structural Pharmacology
PHAR 508	(3)	Drug Discovery and Development 3
		Ne

13.29.5 Bachelor of Science (B.Sc.) - Major Pharmacology (67 credits)

This program incorporates extensive studies in Pharmacology with a strong component of related biomedical sciences, providing a solid preparation for employment opportunities or for entry into graduate or professional training programs. Students must consult the Student Affairs Coordinator upon entering the program and every year thereafter to verify courses and progress.

Required Courses (40 credits)

U1

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 212*	(4)	Introductory Organic Chemistry 1
CHEM 222*	(4)	Introductory Organic Chemistry 2
PHAR 200	(1)	Introduction to Pharmacology 1
PHAR 201	(1)	Introduction to Pharmacology 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

* Students who have taken the equivalent of CHEM 212, CHEM 222,and/or MATH 203 in CEGEP (as defined at: http://www.mcgill.ca/students/transfercredit/prospective/cegep) are exempt and may not take these courses at McGill. Students must replace these credits with appropriate complementary course credits to satisfy the total credit re(v)Tjurse se credits

9 credits selected from the following Pharmacology courses:

PHAR 503**	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 505**	(3)	Structural Pharmacology
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 510	(3)	New Advances in Antimicrobial
PHAR 540	(3)	Advances in Industrial Biotechnology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets

9 credits selected from the following courses:

Committee approval is required to substitute a science course not in the list below.

PHAR 599D1 and PHAR 599D2 are taken together.

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EXMD 504	(3)	Biology of Cancer
EXMD 509***	(3)	Gastrointestinal Physiology and Pathology
EXMD 511	(3)	Joint Venturing with Industry
HGEN 400***	(3)	Genetics in Medicine
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 466++	(3)	Viral Pathogenesis
NEUR 310	(3)	Cellular Neurobiology
PARA 410	(3)	Environment and Infection
PATH 300	(3)	Human Disease
PHAR 503**	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 505**	(3)	Structural Pharmacology
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 510	(3)	New Advances in Antimicrobial
PHAR 540	(3)	Advances in Industrial Biotechnology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets
PHAR 599D1	(3)	Pharmacology Research Project
PHAR 599D2	(3)	Pharmacology Research Project
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 425+	(3)	Analyzing Physiological Systems
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PPHS 501	(3)	Population Health and Epidemiology
PSYC 302	(3)	The Psychology of Pain
PSYC 305***	(3)	Statistics for Experimental Design
PSYC 311	(3)	Human Cognition and the Brain
PSYC 317***	(3)	Genes and Behaviour
PSYC 318***	(3)	Behavioural Neuroscience 2
PSYT 301	(3)	Issues in Drug Dependence
PSYT 455	(3)	Neurochemistry
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders
REDM 410	(3)	Writing Research Articles

Note:

* Students may take either ANAT 458 or BIOC 458.

** Students may take either PHAR 503 or PHAR 505.

*** Access to these courses is not guaranteed.

+ Open to students who have the prerequisites.

++ Access to these courses is not guaranteed. Open to students who have the prerequisites.

Bac

CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

3 credits selected from the following (usually in Year 2):

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

12 credits selected from the following Pharmacology courses:

PHAR 390	(3)	Laboratory in Pharmacology
PHAR 503**	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 505**	(3)	Structural Pharmacology
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 510	(3)	New Advances in Antimicrobial
PHAR 540	(3)	Advances in Industrial Biotechnology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets

9 credits selected for the following science courses:

Committee approval is required to substitute a science course not in the list below.

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381+	(3)	Experimental Embryology
ANAT 458*	(3)	Membranes and Cellular Signaling
BIEN 510	(3)	Engineered Nanomaterials for Biomedical Applications
BIOC 312	(3)	Biochemistry of Macromolecules
BIOC 450	(3)	Protein Structure and Function
BIOC 454	(3)	Nucleic Acids
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOC 470***	(3)	Lipids and Lipoproteins in Disease
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 306	(3)	Neural Basis of Behaviour
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 370	(3)	Human Genetics Applied
BIOT 505	(3)	Selected Topics in Biotechnology
CHEM 302	(3)	Introductory Organic Chemistry 3
CHEM 334	(3)	Advanced Materials
CHEM 462+	(3)	Green Chemistry

CHEM 502	(3)	Advanced Bio-Organic Chemistry
CHEM 503	(3)	Drug Discovery
CHEM 522	(3)	Stereochemistry
CHEM 552	(3)	Physical Organic Chemistry
COMP 204	(3)	Computer Programming for Life Sciences
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 504	(3)	Biology of Cancer
EXMD 509***	(3)	Gastrointestinal Physiology and Pathology
EXMD 511	(3)	Joint Venturing with Industry
HGEN 400***	(3)	Genetics in Medicine
MIMM 387	(3)	The Business of Science
MIMM 414	(3)	Advanced Immunology
MIMM 466++	(3)	Viral Pathogenesis
NEUR 310	(3)	Cellular Neurobiology
PARA 410	(3)	Environment and Infection
PATH 300	(3)	Human Disease
PHAR 390	(3)	Laboratory in Pharmacology
PHAR 503**	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 505**	(3)	Structural Pharmacology
PHAR 508	(3)	Drug Discovery and Development 3
PHAR 510	(3)	New Advances in Antimicrobial
PHAR 540	(3)	Advances in Industrial Biotechnology
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PHAR 565	(3)	Epigenetic Drugs and Targets
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
		Aj1(3)

Note:

* Students may take either ANAT 458 or BIOC 458.

**Students may take either PHAR 503 or PHAR 505.

*** Access to these courses is not guaranteed

+ Open to students who have the prerequisites

++ Access to these courses is not guaranteed. Open to students who have the prerequisites.

13.30 Physics (PHYS)

13.30.1 Location

Rutherford Physics Building, Room 108
3600 University Street
Montreal QC H3A 2T8
Telephone: 514-398-6477
Email: *chairsec.physics@mcgill.ca*
Website: *physics.mcgill.ca*

13.30.2 About Physics

Physics is in many ways the parent of the other natural sciences and its discoveries and laws continually affect their development. Its range and scope extend in space and time from subnuclear particles to the universe itself. The subfields of physics such as mechanics, thermodynamics, electricity, atomic physics, and quantum mechanics, to mention but a few, permeate all other scientific disciplines. People trained in physics are employed in industry, government, and educational systems where they find many challenges as teachers, researchers, administrators, and in the rapidly developing area of scientific business.

The two main undergraduate programs in physics at McGill are the Honours and the Major. The **Honours** program is highly specialized and the courses are very demanding. This program is appropriate for students who wish to make an in-depth study of the subject in preparation for graduate work and an academic or professional career in physics. The three multidisciplinary honours programs—in Mathematics and Physics, in Physics and Chemistry, and in Physics and Computer Science—are even more specialized and demanding. They are intended for students who wish to develop a strong basis in both physics and the other discipline and are intended as preparation for graduate work and a professional or academic career. Although these programs have a bias for theoretical work, they are broad enough and strong enough to prepare students for further study in either experimental physics or respectively mathematics, chemistry, or computer science.

The **Major** program, on the other hand, ofdo42.t68 38

A Science **Major Concentration** in physics is available to students pursuing the B.A. & Sc. degree. This Major Concentration is described in *Bachelor of Arts & Science > Undergraduate > Browse Academic Units & Programs > : Physics (PHYS)*.

Internship

Associate Members

Kinesiology - D. Rassier.

Medical Physics - J. Kildea; J. Seuntjens.

Oncology - S. Devic; S. Enger.

Physiology - G. Bub; M. Chacron; A. Khadra.

Adjunct Professors

O. Hernandez, B. Palmieri, M. Pearson, W. Witczak-Krempa

Curator (Rutherford Museum and McPherson Collection)

J. Barrette

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

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

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

Required Course (3 credits)

PHYS 257	(3)	Experimental Methods 1

Complementary Courses (15 credits)

15 credits to be selected as follows:

One of:

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

One of:

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

One of:

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

One of:

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

One of:

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

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

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

[Program registration done by Student Affairs Office]

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

Required Courses (12 credits)

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

Complementary Courses (12 credits)

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

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

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

Program Prerequisites

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

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

One of:

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

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

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

MATH 151	(4)	Calculus B

Required Courses (36 credits)

MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2

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

Required Courses

(48-51 credits)

* Students who have successfully completed MATH 150/151 or an equivalent of MATH 222 on entering the program are not required to take MATH 222, reducing the total number of program credits from 63 to 60.

** Students coming into the program with sufficient knowledge of computer programming may replace COMP 208 with PHYS 512 or another 3-credit COMP course at the 200 level or above after consulting with an adviser.

COMP 208**	(3)	Computer Programming for Physical Sciences and Engineering
MATH 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 339	(3)	Measurements Laboratory in General Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 346	(3)	Majors Quantum Physics
PHYS 447	(3)	Applications of Quantum Mechanics
PHYS 449	(3)	Majors Research Project

Complementary Courses (12 credits)

3 credits from:

PHYS 329	(3)	Statistical Physics with Biophysical Applications
PHYS 333	(3)	Thermal and Statistical Physics

9 credits from:

PHYS 319	(3)	Introduction to Biophysics
PHYS 320	(3)	Introductory Astrophysics
PHYS 321	(3)	Data Science and Observational Astrophysics
PHYS 328	(3)	Electronics
PHYS 404	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics

PHYS 439	(3)	Majors Laboratory in Modern Physics
PHYS 479	(3)	Physics Research Project
PHYS 512	(3)	Computational Physics with Applications
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics

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

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

The B.Sc. Major Physics: Biological Physics program keeps a strong core of foundational physics and specializes through courses in biology, mathematics, physiology, computer science, and chemistry. Complementary courses provide background in molecular and cell biology, computer science, and organic chemistry, whereas introductory and advanced biophysics courses offered by the Physics Department as integrative courses. This program provides students with the skills necessary to continue on to graduate studies in biophysics/biological physics, or for research careers in hospital, industrial, or university settings.

Required Courses (63 credits)

Bio-Physical Science Core (27 credits)

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

* Students who have taken the equivalent of CHEM 212 or MATH 222 can make up the credits with complementary 3 or 4 credits courses in consultation wit the program adviser.

Biology and Mathematics (6 credits)

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Complementary Courses

(18-19 credits)

3 credits selected from:

PHYS 142	(4)	Electromagnetism and Optics

One of:

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

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

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

Required Courses (57 credits)

EPSC 231	(3)	Field School 1
EPSC 240	(3)	Geology in the Field
EPSC 303	(3)	Structural Geology
EPSC 320	(3)	Elementary Earth Physics
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 241	(3)	Signal Processing
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Topics in Classical Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 340	(3)	Majors Electricity and Magnetism
PHYS 342	(3)	Majors Electromagnetic Waves
PHYS 346	(3)	Majors Quantum Physics
PHYS 432	(3)	Physics of Fluids

Complementary Courses (12 credits)

EPSC 350	(3)	Tectonics
EPSC 425	(3)	Sediments to Sequences
EPSC 435	(3)	Applied Geophysics
EPSC 482	(3)	Research in Earth and Planetary Sciences
EPSC 510	(3)	Geodynamics
EPSC 520	(3)	Earthquake Physics and Geology

EPSC 549	(3)	Hydrogeology
MATH 319	(3)	Partial Differential Equations
PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 404	(3)	Climate Physics
PHYS 449	(3)	Majors Research Project
PHYS 512	(3)	Computational Physics with Applications

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

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

Program Prerequisites

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

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

One of:

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

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

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

U1 Required Courses (21 credits)

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

U2 Required Courses (24 credits)

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

U3 Required Courses (21 credits)

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

Required Courses (27 credits)

U1

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

U2

MATH 475	(3)	Honours Partial Differential Equations
PHYS 253	(3)	Thermal Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 351	(3)	Honours Classical Mechanics 2
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 359	(3)	Honours Laboratory in Modern Physics 1
PHYS 362	(3)	Statistical Mechanics
PHYS 457	(3)	Honours Quantum Physics 2

U3

PHYS 352	(3)	Honours Electromagnetic Waves

Complementary Courses (24 credits)

U3

6 credits selected from:

Note: PHYS 459D1 and PHYS 459D2 are taken together.

PHYS 459D1	(3)	Honours Research Thesis
PHYS 459D2	(3)	Honours Research Thesis
PHYS 469	(3)	Honours Laboratory in Modern Physics 2
PHYS 479	(3)	Physics Research Project

18 credits selected from the list below (students may substitute one or more courses with any 3-credit course approved by the Department of Physics):

PHYS 404	(3)	Climate Physics
PHYS 432	(3)	Physics of Fluids
PHYS 434	(3)	Optics
PHYS 479	(3)	Physics Research Project
PHYS 512	(3)	Computational Physics with Applications

PHYS 514	(3)	General Relativity
PHYS 519	(3)	Advanced Biophysics
PHYS 521	(3)	Astrophysics
PHYS 534	(3)	Nanoscience and Nanotechnology
PHYS 551	(3)	Quantum Theory
PHYS 557	(3)	Nuclear Physics
PHYS 558	(3)	Solid State Physics
PHYS 559	(3)	Advanced Statistical Mechanics
PHYS 562	(3)	Electromagnetic Theory
PHYS 567	(3)	Particle Physics

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

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

Required Courses (63 credits)

Bio-Physical Sciences Core (24 credits)

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 395	(1)	Quantitative Biology Seminar
CHEM 212*	(4)	Introductory Organic Chemistry 1
MATH 247	(3)	Honours Applied Linear Algebra
MATH 315	(3)	Ordinary Differential Equations
MATH 323	(3)	Probability
PHYS 319	(3)	Introduction to Biophysics
PHYS 329	(3)	Statistical Physics with Biophysical Applications

* Students who have taken the equivalent of CHEM 212 can make up the credits with complementary 3 or 4 credit courses in consultation with the program adviser.

Biology and Mathematics (6 credits)

BIOL 202	(3)	Basic Genetics
MATH 248	(3)	Honours Vector Calculus

Physics (33 credits)

PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 253	(3)	Thermal Physics
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 346	(3)	Majors Quantum Physics
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves

PHYS 459D1	(3)	Honours Research Thesis
PHYS 459D2	(3)	Honours Research Thesis
PHYS 519	(3)	Advanced Biophysics

Complementary Courses

(18-19 credits)

3 credits selected from:

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

3 credits selected from:

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

3 credits selected from:

PHYS 339	(3)	Measurements Laboratory in General Physics
PHYS 359	(3)	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
		Applications of Quantum1 165.864 .

PHYS 457	(3)	Honours Quantum Physics 2

U3 Required Courses (12 credits)

MATH 454	(3)	Honours Analysis 3
MATH 458	(3)	Honours Differential Geometry
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 359	(3)	Honours Laboratory in Modern Physics 1

Complementary Courses (18 credits)

U1 Complementary Course (3 credits)

es	(3)	Honours Applied Linear Algebra

3 credits in Honours Mathematics.

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

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

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

The student will have tw

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
	(3)	Experimental Methods 2

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

Required Courses (63 credits)

*Note: A student who has not taken MATH 222 (or equivalent) prior to entering the program must take it in their first semester, increasing the program credits from 78 to 81. The student must then take MATH 314 in their second semester instead of MATH 248, if scheduling requires it.

COMP 206	(3)	Introduction to Software Systems
COMP 250	(3)	Introduction to Computer Science
COMP 252	(3)	Honours Algorithms and Data Structures
COMP 273	(3)	Introduction to Computer Systems
COMP 302	(3)	Programming Languages and Paradigms
COMP 350	(3)	Numerical Computing
MATH 240	(3)	Discrete Structures
MATH 247	(3)	Honours Applied Linear Algebra
MATH 248*	(3)	Honours Vector Calculus
MATH 249	(3)	Honours Complex Variables
MATH 314*	(3)	Advanced Calculus
MATH 325	(3)	Honours Ordinary Differential Equations
PHYS 241	(3)	Signal Processing
PHYS 251	(3)	Honours Classical Mechanics 1
PHYS 253	(3)	Thermal Physics
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 350	(3)	Honours Electricity and Magnetism
PHYS 352	(3)	Honours Electromagnetic Waves
PHYS 357	(3)	Honours Quantum Physics 1
PHYS 362	(3)	Statistical Mechanics
PHYS 457	(3)	Honours Quantum Physics 2

Complementary Courses (15 credits)

At least 6 of the 15 complementary credits must come from a course at the 400- or 500-level (excluding COMP 400 and PHYS 479), and of these at least 3 must be from a COMP course.

3 or 4 credits selected from:

COMP 400	(4)	Project in Computer Science
PHYS 479	(3)	Physics Research Project

6 or 7 credits selected from:

COMP 303	(3)	Software Design
COMP 310	(3)	Operating Systems
COMP 330	(3)	Theory of Computation
COMP 362	(3)	Honours Algorithm Design

Any COMP course at the 400- or 500-level (excluding COMP 400) (3 or 4 credits)

At least 4 credits selected from:

MATH 323	(3)	Probability

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

Graduates at the B.Sc. level have found rewarding **careers**

vwJonericJosshepdtg(Gradu m(w)Tj1 0 017 6921.6751 8.4 Tork,seconuch fields asss, ph)Tj1 0 0250.977.6751 8.4 Tm(ysiol ph)Tj1 0 02782396.6751 8.4 T, d remedicinphanfocysic

Associate Members

Anaesthesia: Steven Backman

Biomedical Engineering: Satya Prakash

Mathematics: Anthony Humphries

Medicine: Volker Blank, Mark Blostein, Andrey Cybulsky, Anne-Marie Lauzon, James Martin, Shafaat Rabbani, Simon Rousseau, Benjamin M. Smith, Mary Stevenson, Tomoko Takano, Elena Torban, Simon Wing

Microbiology and Immunology: Jörg Fritz

Neurology and Neurosurgery: Jack Antel, Daniel Guitton, Christopher Pack, Ed Ruthazer, Amir Shmuel, Jesper Sjöström, Jo Anne Stratton

Ophthalmology: Curtis Baker

Pharmacology and Therapeutics: Daniel Bernard, Derek Bowie, Terence Hebert

Psychiatry: Nicolas Cermakian

Research in Neuroscience: Charles Bourque

Adjunct Professors

M. Craig, K. Cullen, P. Haghighi, J. Martinez-Trujillo

Faculty Lecturer

Céline Aguer

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

Required Courses (32 credits)

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

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

Complementary Courses (15 credits)

15 credits selected as follows:

3 credits selected from:

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

3 credits, one of:

PHGY 311	(3)	Channels, Synapses and Hormones

PHGY 314	(3)	Integrative Neuroscience

3 credits selected from:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science
PSYC 305	(3)	Statistics for Experimental Design

Upper-Level Physiology (ULP) Courses

6 credits selected from the Upper-Level Physiology (ULP) course list as follows:

* The 6-credit course PHGY 459D1/D2 equals 3 credits of ULP and 3 credits of electives.

** The 9-credit course PHGY 461D1/D2 equals 3 credits of ULP and 6 credits of electives.

BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 505	(3)	Cell and Tissue Engineering
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 459D1*	(3)	Physiology Seminar
PHGY 459D2*	(3)	Physiology Seminar
PHGY 461D1**	(4.5)	Experimental Physiology
PHGY 461D2**	(4.5)	Experimental Physiology
PHGY 488	(3)	Stem Cell Biology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Translational Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 525	(3)	Cortical Plasticity
PHGY 531	(3)	Topics in Applied Immunology
PHGY 550	(3)	Molecular Physiology of Bone
PHGY 552	(3)	Cellular and Molecular Physiology

PHGY 556	(3)	Topics in Systems Neuroscience
PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

13.31.5 Bachelor of Science (B.Sc.) - Major Physiology (65 credits)

The Major program includes, in addition to some intensive studies in Physiology, a strong core content of related biomedical sciences. Admission to the Major program will be in U2, upon completion of the U1 required courses, and in consultation with the student's adviser.

If not previously taken, CHEM 212 "Introductory Organic Chemistry 1" must be completed in addition to the 64-65 program credits.

Students may complete this program with a minimum of 64 credits or a maximum of 65 credits depending on their choice of complementary courses.

U1 Required Courses (18 credits)

BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
CHEM 222	(4)	Introductory Organic Chemistry 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2

U2 and U3 Required Courses (19 credits)

BIOC 311	(3)	Metabolic Biochemistry
BIOL 301	(4)	Cell and Molecular Laboratory
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience

Complementary Courses (28 credits)

12-13 credits selected as follows:

3 credits, one of:

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

3 credits, one of:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science
PSYC 305	(3)	Statistics for Experimental Design

3 credits, one of:

BIOC 312	(3)	Biochemistry of Macromolecules
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

3-4 credits, one of:

ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology
ANAT 316	(3)	Clinical Human Visceral Anatomy

9 credits selected from the Upper-Level Physiology (ULP) course list as follows:

BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 505	(3)	Cell and Tissue Engineering
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
MIMM 414	(3)	Advanced Immunology
MIMM 509	(3)	Inflammatory Processes
PHGY 425	(3)	Analyzing Physiological Systems
PHGY 451	(3)	Advanced Neurophysiology
PHGY 459D1*	(3)	Physiology Seminar
PHGY 459D2*	(3)	Physiology Seminar
PHGY 461D1**	(4.5)	Experimental Physiology
PHGY 461D2**	(4.5)	Experimental Physiology
PHGY 488	(3)	Stem Cell Biology
PHGY 502	(3)	Exercise Physiology
PHGY 508	(3)	Advanced Renal Physiology
PHGY 513	(3)	Translational Immunology
PHGY 515	(3)	Blood-Brain Barrier in Health and Disease
PHGY 516	(3)	Physiology of Blood
PHGY 518	(3)	Artificial Cells
PHGY 520	(3)	Ion Channels
PHGY 524	(3)	Chronobiology
PHGY 525	(3)	Cortical Plasticity
PHGY 531	(3)	Topics in Applied Immunology
PHGY 550	(3)	Molecular Physiology of Bone
PHGY 552	(3)	Cellular and Molecular Physiology
PHGY 556	(3)	Topics in Systems Neuroscience

PHGY 560	(3)	Light Microscopy-Life Science
PSYC 470	(3)	Memory and Brain
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

* the 6-credit course equals 3 credits of ULP and 6 credits of electives.

** the 9-credit course equals 3 credits of ULP and 6 credits of electives.

6 credits selected from the Upper-Level Science (ULS)

Note: For Chemistry, Neurology, and Neurosurgery: select from all courses 300 level and above and the ULS courses listed below.

For Biochemistry, Computer Science, Microbiology and Immunology, Mathematics, Physics, and Pathology: select from all courses 300 level and above.

For Anatomy, Biology, Experimental Medicine, Pharmacology, and Psychology: select from the ULS courses listed below:

ANAT 321	(3)	Circuitry of the Human Brain
ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cellular Trafficking
ANAT 381	(3)	Experimental Embryology
ANAT 416	(3)	Development, Disease and Regeneration
ANAT 458*	(3)	Membranes and Cellular Signaling
ANAT 541	(3)	Cell and Molecular Biology of Aging
ANAT 542	(3)	Transmission Electron Microscopy of Biological Samples
ANAT 565	(3)	Diseases-Membrane Trafficking
BIOC 458*	(3)	Membranes and Cellular Signaling
BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 309	(3)	Mathematical Models in Biology
BIOL 313	(3)	Eukaryotic Cell Biology
BIOL 314	(3)	Molecular Biology of Cancer
BIOL 324	(3)	Ecological Genetics
BIOL 370	(3)	Human Genetics Applied
BIOL 373	(3)	Biometry
BIOL 389	(3)	Laboratory in Neurobiology
BIOL 416	(3)	Genetics of Mammalian Development
BIOL 468	(6)	Independent Research Project 3
BIOL 518	(3)	Advanced Topics in Cell Biology
BIOL 520	(3)	Gene Activity in Development
BIOL 524	(3)	Topics in Molecular Biology
BIOL 532	(3)	Developmental Neurobiology Seminar
BIOL 544	(3)	Genetic Basis of Life Span
BIOL 546	(3)	Genetics of Model Systems
BIOL 551	(3)	Principles of Cellular Control
BIOL 575	(3)	Human Biochemical Genetics
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology
CHEM 214	(3)	Physical Chemistry/Biological Sciences 2
EXMD 401	(3)	Physiology and Biochemistry Endocrine Systems
EXMD 502	(3)	Advanced Endocrinology 1

EXMD 503	(3)	Advanced Endocrinology 02
EXMD 504	(3)	Biology of Cancer
EXMD 506	(3)	Advanced Applied Cardiovascular Physiology
EXMD 507	(3)	Advanced Applied Respiratory Physiology
EXMD 508	(3)	Advanced Topics in Respiration
EXMD 510	(3)	Bioanalytical Separation Methods
NEUR 310	(3)	Cellular Neurobiology
PHAR 503	(3)	Drug Discovery and Development 1
PHAR 504	(3)	Drug Discovery and Development 2
PHAR 562	(3)	Neuropharmacology
PHAR 563	(3)	Endocrine Pharmacology
PPHS 501	(3)	Population Health and Epidemiology
PSYC 302	(3)	The Psychology of Pain
PSYC 311	(3)	Human Cognition and the Brain
PSYC 317	(3)	Genes and Behaviour
PSYC 318	(3)	Behavioural Neuroscience 2
PSYC 342	(3)	Hormones and Behaviour
PSYC 410	(3)	Special Topics in Neuropsychology
PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 470	(3)	Memory and Brain
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYT 500	(3)	Advances: Neurobiology of Mental Disorders

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

Note: Students may opt to replace 3 credits of the 6 credits of Upper Level Science with 3 credits selected from the following list:

COMP 364	(3)	Computer Tools for Life Sciences
PHIL 341	(3)	Philosophy of Science 1
PHIL 343	(3)	Biomedical Ethics
REDM 410	(3)	Writing Research Articles

13.31.6 Bachelor of Science (B.Sc.) - Major Physiology and Mathematics (79 credits)

Required Courses (70 credits)

Bio-Physical Sciences Core

BIOL 219	(4)	Introduction to Physical Molecular and Cell Biology
BIOL 395	(1)	Quantitative Biology Seminar
MATH 222	(3)	Calculus 3
MATH 223*	(3)	Linear Algebra
MATH 247*	(3)	Honours Applied Linear Algebra
MATH 315**	(3)	Ordinary Differential Equations
MATH 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 Vector Calculus
MATH 314***	(3)	Advanced Calculus
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
MATH 324	(3)	Statistics
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, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 461D1	(4.5)	Experimental Physiology
PHGY 461D2	(4.5)	Experimental Physiology

*** Students may take either MATH 248 or MATH 314.

Complementary Courses (9 credits)

3 credits, one of:

COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science

3 credits, one of:

PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 314	(3)	Integrative Neuroscience

3 credits, one of:

PHYS 413	(3)	Physical Basis of Physiology
PHYS 519	(3)	Advanced Biophysics

13.31.7 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.

3 credits, one of:

PHYS 413	(3)	Physical Basis of Physiology
PHYS 519	(3)	Advanced Biophysics

13.31.8 Bachelor of Science (B.Sc.) - Honours Physiology (75 credits)

All admissions to the Honours program will be in U2, and the student must have a U1 GPA of 3.30, with no less than a B in PHGY 209 and PHGY 210. Admission to U3 requires a U2 CGPA of 3.20 with no less than a B in U2 Physiology courses. Decisions for admission to U3 will be heavily influenced by student standing in U2 courses.

The Department reserves the right to restrict the number of entering students in the Honours program. Students who do not maintain Honours standing may transfer their registration to the Major program in Physiology.

The deadline to apply to the Honours program is August 23, 2019. Application forms are available online at physiology.med@mcgill.ca or a hard copy can be picked up at McIntyre 1021. Please contact Sonia Viselli, Student Affairs Officer (sonia.viselli@mcgill.ca; 514-398-3689) for more information. An email will be sent to acknowledge receipt of your application.

Graduation: To graduate from the Honours Physiology program, the student will have a CGPA of 3.20 with a mark no less than a B in all Physiology courses.

If not previously taken, CHEM 212 Introductory Organic Chemistry 1 must be completed in addition to the 75 program credits.

Required Courses (60 credits)

ANAT 261	(4)	Introduction to Dynamic Histology
BIOC 311	(3)	Metabolic Biochemistry
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	Basic Genetics
BIOL 301	(4)	Cell and Molecular Laboratory
CHEM 222	(4)	Introductory Organic Chemistry 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
PHGY 212	(1)	Introductory Physiology Laboratory 1
PHGY 213	(1)	Introductory Physiology Laboratory 2
PHGY 311	(3)	Channels, Synapses and Hormones
PHGY 312	(3)	Respiratory, Renal, and Cardiovascular Physiology
PHGY 313	(3)	Blood, Gastrointestinal, and Immune Systems Physiology
PHGY 314	(3)	Integrative Neuroscience
PHGY 351	(3)	Research Techniques: Physiology
PHGY 359D1	(.5)	Tutorial in Physiology
PHGY 359D2	(.5)	Tutorial in Physiology
PHGY 459D1	(3)	Physiology Seminar
PHGY 459D2	(3)	Physiology Seminar
PHGY 461D1	(4.5)	Experimental Physiology
PHGY 461D2	(4.5)	Experimental Physiology

Complementary Courses (15 credits)

9 credits selected as follows:

3 credits, one of:

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

3 credits, one of:

BIOL 309	(3)	Mathematical Models in Biology
BIOL 373	(3)	Biometry
COMP 204	(3)	Computer Programming for Life Sciences
COMP 250	(3)	Introduction to Computer Science
PSYC 305	(3)	Statistics for Experimental Design

3 credits, one of:

BIOC 312	(3)	Biochemistry of Macromolecules
CHEM 203	(3)	Survey of Physical Chemistry
CHEM 204	(3)	Physical Chemistry/Biological Sciences 1

6 credits selected from the Upper-Level Physiology (ULP) course list as follows:

BIOL 532	(3)	Developmental Neurobiology Seminar
BMDE 519	(3)	Biomedical Signals and Systems
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 02
EXMD 50BIOL 309	(3)	Advanced Applied Cardiovascular Physiology

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: *mcgill.ca/psychiatry/education/graduate-program*

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
	Issues in Drug Dependence

CSYT 500

Is(A)Tb1 381.08 284.703 Tm7b0 1ependence

13.33 Psychology (PSYC)

13.33.1 Location

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

13.33.2 About Psychology

The Department of Psychology offers programs in both Arts and Science. All B.A. programs in Psychology can be found in *Faculty of Arts* > *Undergraduate* > *Browse Academic Units & Programs* > *: Psychology (PSYC)*.

Psychology is the scientific study of mind and behaviour. It is both a **social** and a **biological** science.

- As a **social science**, psychology examines the social nature of human beings and the influence that culture, group membership, and relationships have on individual personality, thought, and behaviour.
- As a **biological science**, psychology seeks to identify the neural basis of human behaviour, both directly, through the study of humans, and indirectly, through the study of other species.

The data of psychology is collected within the psychological laboratory by the use of experimental methods in the study of behaviour, and outside the laboratory by systematic observation of the behaviour of humans and animals. The aim is to formulate general principles of perception, learning, motivation, cognition, and social psychology that are relevant to different aspects of human life. Experimentation, laboratory techniques, observational procedures, measurement, and statistical methods are important tools of the psychologist.

Psychology has many interdisciplinary aspects. The study of psychological problems often involves knowledge drawn from other disciplines such as biology, physiology, linguistics, sociology, philosophy, and mathematics. For this reason, a student with varied interests can frequently find a place for these in psychology.

Psychology is a young science, so explanations of the processes underlying observed phenomena are often theoretical and speculative. The major objectives of psychological study are to reduce the discrepancy between theory and fact and to provide better answers about why humans think and behave as they do.

Undergraduate Studies

Although a number of undergraduate courses in psychology have applied implications, applied training is not the purpose of the undergraduate curriculum. Its purpose is to introduce the student to an understanding of the basic core of psychological knowledge, theory, and method, regardless of questions of practical application.

The B.Sc. or B.A. with a **Major** or **Honours** degree in psychology is not a professional qualification; it does not qualify the individual to carry on professional work in psychology. In the province of Quebec, the minimum requirement for membership in the Order of Psychologists, the professional association governing the work of psychologists in the province, is a doctoral degree. However, the Order also has a number of undergraduate course requirements that you should consult in planning your degree if you ultimately hope to apply for membership in the Order of Psychologists of Quebec. All students planning to practise in the province of Quebec will also be examined on their proficiency in French before being admitted to the professional association. Under

13.33.3 Information Meetings for New Students

All new students entering the Psychology undergraduate program should attend an information meeting prior to registration. Newly admitted students from CEGEPs should attend the information session in June. There will be an identical information session in August for all other students and for any CEGEP students who could not attend the earlier meeting. Please check the *Psychology Department website* for the specific dates. Students accepted into a Bachelor of Arts program must attend a different information meeting from the one offered to students in the Faculty of Science. (For details, see *Faculty of Arts* > *Undergraduate* > *Browse Academic Units & Pr*

Lecturers

P. Carvajal; J. Kreitewolf.

Professionals

Ian F. Bradley; Judith LeGallais; James MacDougall; Jennifer Russell.

Associate Members

Anesthesia: T. Coderre

Douglas Mental Health University Institute Research Centre: S. King, N. Rajah, H. Steiger, M. Lepage

Educational Counselling Psychology: V Talwar

Jewish General Hospital: B Thombs

McGill Vision Research Centre: R. Hess, F.A.A. Kingdom, K. Mullen

Montreal Neurological Institute and Hospital: J. Armony, L.K. Fellows, D. Guitton, E. Ruthazer, W. Sossin, R. N. Spreng, V. Sziklas, R. Zatorre

Schulich School of Music: S. MacAdams

Psychiatry: D. Dunkley, F

PSYC 204	(3)	Introduction to Psychological Statistics

Complementary Courses (42 credits)

9 credits from:

PSYC 211	(3)	Introductory Behavioural Neuroscience
PSYC 212.o.i31 0 0 1 70.52 68	(3)	2.487 Tgnierception

Perception

PSYC 529	(3)	Music Cognition
PSYC 531	(3)	Structural Equation Models
PSYC 536	(3)	Correlational Techniques
		Advanced Seminar in Psychology of Fs7es

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

Students majoring in Psychology must obtain a minimum grade of C in all 54 credits of the program. A grade lower than C may be made up by taking another equivalent course (if there is one), by successfully repeating the course, or by successfully writing a supplemental examination (if there is one).

Recommended Background

It is expected that most students who enter the Major program in Psychology will have taken introductory psychology, biology, and statistics at the collegial level. Recommended CEGEP courses include Psychology 350-101 or 350-102 or equivalent; Biology CEGEP objective 00UK, 00XU or equivalent; and Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-le

PSYC 427	(3)	Sensorimotor Neuroscience
PSYC 433	(3)	Cognitive Science
PSYC 443	(3)	Affective Neuroscience
PSYC 444	(3)	Sleep Mechanisms and Behaviour
PSYC 470	(3)	Memory and Brain
PSYC 502	(3)	Psychoneuroendocrinology
PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 529	(3)	Music Cognition
PSYC 531	(3)	Structural Equation Models
PSYC 536	(3)	Correlational Techniques
PSYC 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication and Consciousness
PSYC 541	(3)	Multilevel Modelling
PSYC 545	(3)	Topics in Language Acquisition
PSYC 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 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 and Applications of Psychotherapy
PSYC 409	(3)	Positive Psychology
PSYC 412	(3)	Child Development: Psychopathology
PSYC 414	(3)	Social Development
PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations
PSYC 512	(3)	Advanced Personality Seminar

PSYC 528	(3)	Vulnerability to Depression and Anxiety
PSYC 530	(3)	Applied Topics in Deafness
PSYC 535	(3)	Advanced Topics in Social Psychology
PSYC 539	(3)	Advanced Topics in Social Psychology 2

6 credits at the 300 level or above.

9 credits in Psychology at the 400 or 500 level.

12 credits at the 300 level or above in any of the following disciplines: Psychology (PSYC), Anatomy and Cell Biology (ANAT), Biology (BIOL), Biochemistry (BIOC), Chemistry (CHEM), Computer Science (COMP), Mathematics (MATH), Physiology (PHGY), Psychiatry (PSYT).

13.33.9 Bachelor of Science (B.Sc.) - Honours Psychology (60 credits)

Honours in Psychology prepares students for graduate study, and so emphasizes practise in the research techniques which are used in graduate school and professionally later on. Students are normally accepted into Honours at the beginning of their U2 year, and the two-year sequence of Honours courses continues through U3.

Recommended Background

It is expected that most students who enter the Honours program in Psychology will have taken introductory psychology, biology, and statistics at the collegial level. Recommended CEGEP courses include Psychology 350-101 or 350-102 or equivalent; Biology CEGEP objective 00UK, 00XU or equivalent; and Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP-level statistics course. In the first year, those students who have not taken the recommended collegial-level statistics course, or those who ha

U3 Required Course (3 credits)

PSYC 482	(3)	Advanced Honours Seminar

Complementary Courses (33 credits)

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

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

List A

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

NSCI 201	(3)	Introduction to Neuroscience 2
PSYC 301	(3)	Animal Learning and Theory
PSYC 302	(3)	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 319	(3)	Computational Models - Cognition
PSYC 329	(3)	Introduction to Auditory Cognition
PSYC 340	(3)	Psychology of Language
PSYC 341	(3)	The Psychology of Bilingualism
PSYC 342	(3)	Hormones and Behaviour
		Cognitive Psychology Laboratory

PSYC 506	(3)	Cognitive Neuroscience of Attention
PSYC 513	(3)	Human Decision-Making
PSYC 514	(3)	Neurobiology of Memory
PSYC 522	(3)	Neurochemistry and Behaviour
PSYC 526	(3)	Advances in Visual Perception
PSYC 529	(3)	Music Cognition
PSYC 531	(3)	Structural Equation Models
PSYC 536	(3)	Correlational Techniques
PSYC 537	(3)	Advanced Seminar in Psychology of Language
PSYC 538	(3)	Categorization, Communication and Consciousness
PSYC 541	(3)	Multilevel Modelling
PSYC 545	(3)	Topics in Language Acquisition
PSYC 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 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 and Applications of Psychotherapy
PSYC 409	(3)	Positive Psychology
PSYC 412	(3)	Child Development: Psychopathology
PSYC 414	(3)	Social Development
PSYC 436	(3)	Human Sexuality and Its Problems
PSYC 471	(3)	Human Motivation
PSYC 473	(3)	Social Cognition and the Self
PSYC 474	(3)	Interpersonal Relationships
PSYC 475	(3)	Neuroscience of Social Psychology
PSYC 483	(3)	Seminar in Experimental Psychopathology
PSYC 491D1	(3)	Advanced Study: Behavioural Disorders
PSYC 491D2	(3)	Advanced Study: Behavioural Disorders
PSYC 507	(3)	Emotions, Stress, and Illness
PSYC 509	(3)	Diverse Clinical Populations
PSYC 512	(3)	Advanced Personality Seminar
PSYC 528	(3)	Vulnerability to Depression and Anxiety
PSYC 530	(3)	Applied Topics in Deafness
PSYC 535	(3)	Advanced Topics in Social Psychology
PSYC 539	(3)	Advanced Topics in Social Psychology 2

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: *rail:*

Adjunct Professors

Robert Holmes; Henry M. Reiswig; Michael Woloch.

13.34.4 Bachelor of Science (B.Sc.) - Minor Natural History (24 credits)

The Minor Natural History involves the exploration of the natural world via specimen-based studies, object-oriented investigations and field studies. Museum collections are used to provide hands-on experience with real objects and specimens. The required course brings students to the Redpath Museum and other McGill natural science museums and exposes them to natural history methodologies and the value of specimen-based studies. Complementary course lists are drawn from a variety of disciplines to emphasize breadth and integration with the inclusion of specimen- or object-based courses and field courses in zoology, botany, and earth and environmental sciences. To ensure breadth, students are required to choose courses from among these lists. A compulsory field course component rounds out the program.

Required Course (3 credits)

REDM 400	(3)	Science and Museums

Complementary Courses (21 credits)

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

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

- At least 3 credits from List D.

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

Note: Students may take up to a maximum of 9 credits of courses outside the Faculties of Arts and of Science.

List A: Zoology

13.35.2 About Science or Mathematics for Teachers

The training and certification of school teachers has traditionally been the responsibility of the Faculty of Education and requires the completion of a Bachelor of Education, subject to re

6 credits from:

* Note: Students select either EDES 335 or EDES 353.

EDEC 262	(3)	Media, Technology and Education
EDES 335*	(3)	Teaching Secondary Science 1
EDES 353*	(3)	Teaching Secondary Mathematics 1
EDPE 304	(3)	Measurement and Evaluation
EDPI 341	(3)	Instruction in Inclusive Schools

6 credits from the list below:

* Note: Students select either EDES 335 or EDES 353.

EDEC 262	(3)	Media, Technology and Education
EDES 335*	(3)	Teaching Secondary Science 1
EDES 353*	(3)	Teaching Secondary Mathematics 1
EDPE 304	(3)	Measurement and Evaluation
EDPI 341	(3)	Instruction in Inclusive Schools