



Josie D'Amico

**Assistant to the Dean**

science requirements defined below. At least two-thirds of all departmental program requirements (Honours, Major, Faculty Program, or Minor) must



exceed the 18-credit limit for courses outside the Faculties of Arts and of Science, provided that all such courses are necessary to complete their program of study.

- Students in the Major in Software Engineering may take as many courses outside the Faculties of Arts and of Science as are necessary to complete their program of study. They may also take up to 18 credits of approved courses outside the Faculties of Arts and Science beyond the requirements of their major.
- Students taking the Minor in Management may take 21 credits of courses outside the Faculties of Arts and of Science.
- The 18-credit limit applies to students taking the Minor in Nutrition; equivalent courses in Science should be taken instead of courses in the Faculty of Agricultural and Environmental Sciences.

#### 12.3.6.4 Correspondence, Distance Education or Web-based Courses

Science students may obtain transfer credit for correspondence, distance education or Web-based courses if they receive prior approval from the appropriate McGill department for the course content **and** prior approval from the Associate Dean of Science (Student Affairs) for the method of delivery and evaluation.

#### 12.3.6.5 Courses taken under the Satisfactory/Unsatisfactory Option

Students may take one elective course per term that is to be graded under the Satisfactory/Unsatisfactory Option, to a maximum of 10% of credits taken at McGill to fulfill their degree requirements. The decision to have an elective course graded as Satisfactory/Unsatisfactory must be made by students before the end of the Drop/Add period. This option is not available to Special, Visiting, Exchange or IUT students. For more information, students should consult "[Courses Taken under the Satisfactory/Unsatisfactory \(S/U\) Option](#)", in [section 4.3.5](#).

#### 12.3.6.6 Courses in English as a Second Language (ESL)

ESL courses are open to Science students under the regulations specified by the English and French Language Centre.

#### 12.3.6.7 Auditing of Courses

No auditing of courses is permitted at McGill.

#### 12.3.6.8 Course Credit Weight

The credit assigned to a particular course should reflect the amount of effort it demands of the student. 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.

advising and registration procedures, students should refer to *Welcome to McGill*, which they receive upon acceptance from the Admissions, Recruitment and Registrar's Office, as well as to the information posted on the Student Affairs Website, [www.mcgill.ca/artscisao](http://www.mcgill.ca/artscisao).

Students who need 97-120 credits to complete their degree requirements will normally be registered in a Freshman Program until they complete their first year. They must consult an adviser in the Student Affairs Office to obtain advice and approval of their course selection. For a detailed description of advising and registration procedures, Freshman students should refer to *Welcome to McGill*, which they receive upon acceptance from the Admissions, Recruitment and Registrar's Office, as well as the information on the Student Affairs Website, [www.mcgill.ca/artscisao](http://www.mcgill.ca/artscisao).

Advising for all returning students takes place in March for the upcoming academic year. For more information, students should refer to the information on the Student Affairs Website, [www.mcgill.ca/artscisao](http://www.mcgill.ca/artscisao).

Academic advising is also available by e-mail. The address is [adviser.artsci@mcgill.ca](mailto:adviser.artsci@mcgill.ca).

## 12.5 Registration

All students register by Minerva, McGill's Web-based registration system.

New students register in August prior to the first day of classes. For detailed information about registration, students should refer to "[Registration](#)", in [section 4.3](#), *Welcome to McGill*, the Student Affairs Website, [www.mcgill.ca/artscisao](http://www.mcgill.ca/artscisao), and the Minerva Website, [www.mcgill.ca/minerva](http://www.mcgill.ca/minerva).

Returning students register at the end of March, April and May for the coming academic year. For detailed information about registration, students should refer to "[Registration](#)", in [section 4.3](#), the Student Affairs Website, [www.mcgill.ca/artscisao](http://www.mcgill.ca/artscisao), and the Minerva Website, [www.mcgill.ca/minerva](http://www.mcgill.ca/minerva).

Students who fall into unsatisfactory standing at the end of the academic year will have their registration cancelled. They may not re-register in the Faculty. However, students who can provide proof of exceptional extenuating circumstances that affected their academic performance may appeal to the Associate Dean of Science (Student Affairs) for readmission. For more information, students should consult the Student Affairs Office, or read the information on the Student Affairs Website, [www.mcgill.ca/artscisao](http://www.mcgill.ca/artscisao).

Students who have an outstanding fee balance from a previous term or outstanding fines will not be permitted to register. In addition, students who have registered for the upcoming academic

## 12.4 Advising

Fall-term academic advising for newly admitted students takes place during the week prior to the beginning of classes. Students who are newly admitted to the Winter term should consult the Calendar of Dates for exact advising dates.

Students who need 96 or fewer credits to complete their degree requirements must consult an academic adviser in their proposed department of study to obtain advice and approval of their course selection. Quebec students with a Diploma of Collegial Studies in Science have normally taken the equivalent of, and are therefore exempt from, the 100-level basic science courses in Biology, Chemistry, Mathematics and Statistics, and Physics. Such students may also be exempt from some 200-level courses. Students with satisfactory results in International Baccalaureate, French Baccalaureate, Advanced Levels, and Advanced Placement tests may also be exempt from some or all of the basic sciences courses. To facilitate program planning, they must present their transcripts and letters of admission. For a detailed description of

## 12.5.2 Course Registration

### All courses have limited enrolment.

Subject to the course restrictions listed in this section and unless otherwise indicated, students in the Faculty of Science may register for and take for credit any course in the sections of the Calendar applicable to the Faculties of Arts and of Science.

Since the registration system is unable to verify whether or not Faculty regulations are respected, it is technically possible to register for courses that are closed to Science students. When students' records are manually verified, however, any "closed" courses will be flagged after the end of course change period as "not for credit towards the B.Sc." As a result, the students' expected date of graduation may be delayed.

Some courses may require special permission. Students should consult this Calendar and/or the Class Schedule to determine if permission is required of the instructor, the department, or the Faculty for any course they wish to take.

Students who believe they have valid reasons to take a course that is normally closed to Science students must obtain permission from the Associate Dean of Science (Student Affairs) before registering for the course. Only the Associate Dean or, on appeal, the Committee on Student Standing, can make exceptions to the Faculty rules.

### 12.5.2.1 Registration for First-Year Seminars

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 even fewer than that.

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

CHEM199 FYS: Why Chemistry?

GEOG199 FYS: Geo-Environments

PHGY199 FYS: History of Genetic Engineering

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 Arts "[First-Year Seminars](#)", in [section 5.12.1](#).

### 12.5.2.2 Registration in Multi-Term Courses

Students who select a multi-term course are making a commitment to that course for its entirety. Student MUST register in the same section in all terms of a multi-term course. Credit will be jeopardized if students deliberately register in different sections of a multi-term course. In exceptional cases, when circumstances are beyond the student's control, the Student Affairs Office may grant permission to change sections mid-way through a multi-term course. Students must make their request in writing to the Associate Dean (Student Affairs) citing their reason for the request. The request must also have the written support of the instructors of the sections involved and of the coordinator of the course (if applicable).

## 12.5.3 Registration for Graduation

Students in their final year must indicate their expected date of graduation on Minerva and must verify this date on unofficial transcripts. When final-year students change their expected date of graduation, they must notify the Student Affairs Office immediately. Failure to do so may postpone graduation.

Students who complete their degree requirements at any time after their last registered term at McGill must apply to the Associate Dean (Student Affairs) to graduate. Application to graduate

must be made sufficiently in advance of the expected graduation date to allow the Faculty to verify the student's record. For further information, students should contact the Student Affairs Office.

## 12.6 Grading and Credit

Before the end of the course change (drop/add) period, each instructor will inform students of the following:

- whether there will be a final examination in the course;
- how term work will affect the final mark in the course;
- how term work will be distributed through the term;
- whether there will be a supplemental examination in the course, and if so, whether term work will be included in the supplemental grade (courses normally have supplemental examinations, and courses with formal final examinations *must* have supplementals);
- whether students with marks of D, F, J or U will have the option of submitting additional work, and, if so, how the supplemental mark will be calculated with the extra work.

### 12.6.1 Incomplete Grades

An instructor who believes that there is justification for a student to delay submitting term work may extend the deadline until after the end of the course. In this case, the instructor will submit a grade of K (incomplete), indicating the date by which the work is to be completed. The maximum extensions for the submission of grades to the Student Affairs Office are as follows:

- students graduating in June:
 

Fall, Winter and spanned courses	April 30
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- non-graduating students:
 

Fall	April 30
Winter and spanned courses	July 30

Students' deadlines for submitting their work must be sufficiently in advance of these dates to ensure that the work can be graded and the mark submitted on time. It is important to note that instructors may impose earlier deadlines than those listed above.

If marks to clear Ks have not been submitted to the Student Affairs Office by April 30 for Fall courses, or July 30 for Winter/Winter courses and courses spanning Fall/Winter, the K is automatically changed to a KF and counts as an F in the GPA.

Students with a grade of K who have serious extenuating circumstances may request an extension of the K deadline (KE) from the Associate Dean (Student Affairs). Please refer to "[Grading and Grade Point Averages \(GPA\)](#)", in [section 4.6.3](#) for more information about grading and credit.

## 12.7 Examinations

Students should refer to "[Examinations](#)", in [section 4.7](#), for information about final examinations and deferred examinations. Note that for the Faculty of Science, "[University Regulations Concerning Final Examinations](#)", in [section 4.7.2.1](#) applies to courses up to and including the 500 level.

The exam schedules are posted on the McGill Website, [www.mcgill.ca](http://www.mcgill.ca) and in the Student Affairs Office, Dawson Hall, Room 110, normally one month after the start of classes for the Tentative Exam Schedule, and two months after the start of classes for the Final Examination Schedule. Students should also refer to the Student Affairs Website for more information: [www.mcgill.ca/artscisao](http://www.mcgill.ca/artscisao).

## 12.8 Supplemental Assessments

### 12.8.1 Supplemental Examinations

Students who wish to write supplemental examinations for certain courses must apply to the Student Affairs Office for permission. The following conditions apply:

- students must be in satisfactory or probationary standing;
- students must have received a final grade of D, F, J or U in the course;
- students must avail themselves of this privilege at the time of the next supplemental examination period;
- special permission is required if a student wishes to write supplementals totalling more than 8 credits;
- only one supplemental examination is allowed in a course;
- the supplemental result may or may not include the same proportion of class work as did the original grade; the instructor will announce the arrangements to be used for the course by the end of the course change period;
- the format of the supplemental examination (e.g., multiple-choice or essay questions) will not necessarily be the same as the format for the final examination, so students should consult the instructor about the format of the supplemental;
- the supplemental result will not erase the grade originally obtained, which is used in calculating the GPA; both the original mark and the supplemental result will be calculated in the CGPA;
- in courses in which both a supplemental examination and additional work are available, the student may choose the additional work or the examination or both; where both are written, only one supplemental mark will be submitted, reflecting marks for both the supplemental examination and the additional work;
- additional credit will not be given for a supplemental exam where the original grade for the course was a D and the student already received credit for the course;
- supplemental examinations in courses outside the Faculties of Arts or of Science are subject to the deadlines, rules and regulations of the relevant faculty;
- no supplemental examinations are available for students who fail to achieve satisfactory grades in a course with a deferred examination.

For courses in the Faculties of Arts and of Science, the supplemental examination period for Fall courses is during the months of April and May; for Wintriod for Frse;e56 Tw (laticc -0.1056 Tw -9.75 TD Tw nt ) Tj T\*s0r 25 TD 0.375 Tc 0 Tw (•) Tj 9.75 0 TD 0u-work;work;fail t su





## 12.10 Awards and Honorary Designations

### 12.10.1 Honours and First-Class Honours

Departments may recommend to the Faculty that graduating students registered in an Honours program be awarded *Honours* or *First-Class Honours* under the following conditions:

- students must complete all requirements imposed by the department;
- for *Honours*, the CGPA at graduation must be at least 3.00;
- for *First-Class Honours*, the CGPA at graduation must be at least 3.50;
- some departments may impose additional requirements, which must be met before students are recommended for *Honours* or *First-Class Honours*. These will be found in the departmental descriptions of Honours programs.

Students in an Honours program whose CGPA is below 3.00 or who did not satisfy certain program ns:



### 12.11.10 Faculty of Arts Major and Minor Concentration Programs Available to Science Students

For more information, please see the relevant departmental entries in the Faculty of Arts section.

#### Major Concentrations

African Studies  
 Anthropology  
 Art History  
 Canadian Studies  
 Classics  
 East Asian Studies  
 Economics  
 English – Cultural Studies  
 English – Drama and Theatre  
 English – Literature  
 Geography (Urban Systems)  
 German Language and Literature  
 German Literature and Culture  
 German Studies, Contemporary  
 Hispanic Languages  
 Hispanic Literature and Culture  
 History  
 Humanistic Studies  
 International Development Studies  
 Italian Civilization  
 Italian Language and Literature  
 Jewish Studies  
 Langue et littérature françaises – Létres  
 Langue et littérature françaises – Létres et traduction  
 Langue et littérature françaises – Linguistique du français  
 Latin-American Studies  
 Linguistics  
 Middle East Studies  
 Music  
 North American Studies  
 Philosophy  
 Philosophy and Western Religions  
 Political Science  
 Québec Studies  
 Russian  
 Scriptures and Interpretation – see Religious Studies  
 Sociology  
 Women's Studies  
 World Religions – see Religious Studies

#### Minor Concentrations

African Studies  
 Anthropology  
 Art History  
 Canada/Québec - see Political Science  
 Canadian Ethnic Studies  
 Canadian Studies  
 Catholic Studies  
 Classics  
 Comparative Politics – see Political Science  
 East Asian Language and Literature  
 East Asian Cultural Studies  
 East Asian Studies, Advanced  
 Economics  
 English – Cultural Studies  
 English – Literature  
 English – Drama and Theatre  
 Geographical Information Systems – see Geography  
 Geography  
 German Language  
 German Literature  
 German Literature and Culture in Translation  
 Hispanic Languages

Hispanic Literature and Culture  
 History  
 History and Philosophy of Science  
 Humanistic Studies  
 International Development Studies  
 International Relations – see Political Science  
 Italian Language and Literature  
 Italian Civilization  
 Jewish Law  
 Jewish Studies  
 Langue et littérature françaises – Létres  
 Langue et littérature françaises – Létres et traduction  
 Langue et littérature françaises – Langue et traduction  
 Langue et littérature françaises – Langue française  
 Langue et littérature françaises – Théorie et critique littéraires  
 Linguistics  
 Middle East Studies  
 Middle East Languages  
 Music  
 North American Studies  
 Philosophy  
 Philosophy and Western Religions  
 Political Science  
 Political Economy – see Political Science  
 Politics, Law and Society – see Political Science  
 Québec Studies  
 Russian – see Russian and Slavic Studies  
 Russian Civilization – see Russian and Slavic Studies  
 Scriptural Languages - see Religious Studies  
 Social Studies of Medicine  
 Sociology  
 South Asia – see Political Science  
 World Religions – see Religious Studies  
 Women's Studies

## 12.12 Academic Programs

### 12.12.1 Anatomy and Cell Biology (ANAT)

Strathcona Anatomy and Dentistry Building  
 3640 University Street, Room 1/48  
 Montreal, QC H3A 2B2

Telephone: (514) 398-6335  
 Website: [www.medicine.mcgill.ca/anatomy](http://www.medicine.mcgill.ca/anatomy)

*Chair* — John J.M. Bergeron

#### *Emeritus Professors*

Yves Clermont; B.Sc.(Montr.), Ph.D.(McG.), F.R.C.S.  
 Dennis G. Osmond; B.Sc., M.B., Ch.B., D.Sc.(Brit.), M.R.C.S.,  
 L.R.C.P., F.R.S.C.  
 H. Warshawsky; B.Sc.(Sir G.Wms), M.Sc., Ph.D.(McG.)

#### *Professors*

Alain Beaudet; M.Sc., Ph.D., M.D.(Montr.) (*joint appoint. with  
 Neurology & Neurosurgery*)  
 Gary C. Bennett; B.A., B.Sc.(Sir G.Wms.), M.Sc., Ph.D.(McG.)  
 John J.M. Bergeron; B.Sc.(McG.), Ph.D., D.Phil.(Oxon.)  
 James R. Braver; B.S.(Tufts), Ph.D.(Harv.)  
 Miguel Burnier; M.D., M.Sc., Ph.D.(Brazil) (*joint appoint. with  
 Ophthalmology*)  
 Louis Hermo; B.A.(Loyola), M.Sc., Ph.D.(McG.)  
 Charles P. Leblond; M.D.(Paris), Ph.D.(Montr.), D.Sc.(Acad.),  
 F.R.S., F.R.S.C.  
 Sandra C. Miller; B.Sc.(Sir G.Wm.), M.Sc., Ph.D.(McG.)  
 Carlos R. Morales; DVM.(U.N., Argentina), Ph.D.(McG.)  
 Barry I. Posner; M.D.(Man.), F.R.C.P.(C) (*joint appoint. with  
 Medicine*)  
 Alfredo Ribeiro-da-Silva; M.D., Ph.D.(Oporto) (*joint appoint. with  
 Pharmacology and Therapeutics*)

#### *Associate Professors*

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



PATH300.  
PHAR300, PHAR301, PHAR303, PHAR562, PHAR563.  
PHGY311, PHGY312, PHGY313, PHGY314, PHGY451,  
PHGY502, PHGY508, PHGY513, PHGY515, PHGY516,  
PHGY517, PHGY518, PHGY552, PHGY556.  
PSYT500.

#### MAJOR IN ANATOMY AND CELL BIOLOGY

(67 credits)

##### Required Courses (46 credits)

all Faculty Program required courses, plus:

BIOL301 (4) Cell and Molecular Laboratory  
MIMM314 (3) Immunology

##### Complementary Courses (21 credits)

9 credits selected from:

ANAT322 (3) Neuroendocrinology  
ANAT365 (3) Cell Biology: Secretory Process  
ANAT381 (3) Basis of Embryology  
ANAT458 (3) Membranes and Cellular Signaling  
ANAT541 (3) Cell and Molecular Biology of Aging  
NEUR310 (3) Cellular Neurobiology

12 credits of biologically oriented courses (BOC), as defined in the Faculty Program.

#### HONOURS IN 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 3.00 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 (55 credits)

all Major Program required courses, plus:

ANAT432 (9) Research Project: Anatomical Science

##### Complementary Courses (18 credits)

15 credits from:

ANAT322 (3) Neuroendocrinology  
ANAT365 (3) Cell Biology: Secretory Process  
ANAT381 (3) Basis of Embryology  
ANAT458 (3) Membranes and Cellular Signaling  
ANAT541 (3) Cell and Molecular Biology of Aging  
NEUR310 (3) Cellular Neurobiology

3 credits of biologically oriented courses (BOC), as defined in the Faculty Program.

### 12.12.2 Atmospheric and Oceanic Sciences (ATOC)

Burnside Hall, Room 945  
805 Sherbrooke Street West  
Montreal, QC H3A2K6

Telephone: (514) 398-3764

Fax: (514) 398-6115

E-mail: [undergraduateinfo.aos@mcgill.ca](mailto:undergraduateinfo.aos@mcgill.ca)

Website: [www.mcgill.ca/meteo](http://www.mcgill.ca/meteo)

*Chair* — John R. Gyakum

##### *Emeritus Professors*

Roddy R. Rogers; B.S.(Texas), S.M.(M.I.T.), Ph.D.(N.Y.U.)  
Edward J. Stansbury; M.A., Ph.D.(Tor.)

##### *Professors*

Jacques F. Derome; M.Sc.(McG.), Ph.D.(Mich.)  
Henry G. Leighton; M.Sc.(McG.), Ph.D.(Alta.)  
Charles A. Lin; B.Sc.(U.B.C.), Ph.D.(M.I.T.)

Lawrence A. Mysak; B.Sc.(Alta.), M.Sc.(Adel.), A.M.,  
Ph.D.(Harv.), F.R.S.C. (*Canada Steamship Lines Professor of  
Meteorology*)

Ronald E. Stewart; B.Sc.(Man.), M.Sc., Ph.D.(Tor.)  
Man Kong (Peter) Yau; S.B., S.M., Sc.D.(M.I.T.)  
Isztar I. Zawadzki; B.Sc.(Buenos Aires), M.Sc., Ph.D.(McG.)

##### *Associate Professors*

Peter Bartello; M.Sc., Ph.D.(McG.) (*joint appoint. with  
Mathematics and Statistics*)

John R. Gyakum; B.Sc.(Penn.), M.Sc., Ph.D.(M.I.T.)  
David Straub; B.S., M.S.(SW Louisiana), Ph.D.(Wash)

##### *Assistant Professors*

Parisa Ariya; B.Sc., Ph.D.(York) (*William Dawson Scholar*) (*joint  
appoint. with Chemistry*)

Frédéric Fabry; B.Sc., M.Sc., Ph.D.(McG.) (*joint appoint. with  
McGill School of Environment*)

Michel Bourqui; B.Sc., M.Sc.(EPFL, Switzerland), Ph.D.(ETHZ,  
Switzerland) (*joint appoint. with Chemistry*)

##### *Adjunct Professors*

Gilbert Brunet, PierreGauthier, StéphaneLaroche,  
RichardMénard, FrançoisSaucier, AyrtonZadra

The Department of Atmospheric and Oceanic Sciences offers, at the undergraduate level, a broad range of courses and degree programs in atmospheric science. At the postgraduate level, programs of study are offered in physical oceanography, air-sea interaction, and climate research as well as in different branches of atmospheric science. The study of atmospheric science 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, but atmospheric science is more than weather forecasting.

Another important area of study focuses on the possible changes in global climate caused by the changing chemical composition of the atmosphere. The approach is always quantitative. Like other parts of physics, atmospheric science attempts to create theoretical models of its complex processes, as a means of analyzing the motion and composition of the air, its thermodynamic behaviour, and its interaction with radiation and with the solid or liquid surface beneath it.

From one viewpoint, the atmosphere may be studied as a large volume of gas by the methods of fluid mechanics: winds, circulation patterns, turbulence, and energy and momentum exchanges are the ideas employed in this approach. Alternatively, the atmosphere may be studied from the point of view of its detailed physics: how water condenses in the air, how cloud droplets make rain, how sunlight warms the ground and the ground warms the air above it by radiation and convection, 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 four main programs in Atmospheric Science: Honours, Major, Minor, and a Joint Major in Atmospheric Science and Physics. The Honours program is meant for students with high standing. It is based on courses similar to those in the Major program, but provides the opportunity to take advanced optional 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 meteorology, atmospheric science, and related sciences (physical oceanography) at any of the leading universities. The Department also offers a special one-year Diploma program to B.Sc. or B.Eng. graduates.

A degree in Atmospheric Science can lead to a professional career in government service or private industry. The Meteorological Service of Canada has traditionally been the main employer of graduating students, but certain provincial governments and environmental consulting and engineering firms also employ graduates trained in atmospheric science. Positions in teaching and

research are available to graduates with M.Sc. and Ph.D. degrees. Students interested in any of the undergraduate programs should consult the Undergraduate Adviser, Room 946, Burnside Hall.

**Internship Year for Engineering and Science (IYES)**

IYES is a pre-graduate work experience program available to eligible students and normally taken between their U2 and U3 years. For more information, see "[IYES: Internship Year for Engineering](#)"

MATH315	(3)	Ordinary Differential Equations
MATH319	(3)	Partial Differential Equations
PHYS230	(3)	Dynamics of Simple Systems
PHYS232	(3)	Heat and Waves
PHYS257	(3)	Experimental Methods 1

**Complementary Courses** (18 credits)**Complementary Courses** (12 credits)**EARTH SYSTEM SCIENCE INTERDEPARTMENTAL MAJOR**

This program is offered by the Departments of Atmospheric & Oceanic Sciences, Earth & Planetary Sciences and Geography.

Students in the Department of Atmospheric & Oceanic Sciences interested in this program should contact Professor Peter Yau (peter.yau@mcgill.ca). For more information, [see section 12.12.10 "Earth System Science Interdepartmental Major \(ESYS\)"](#).

**12.12.3 Biochemistry (BIOC)**

McIntyre Medical Sciences Building, Room 802  
3655 Promenade Sir William Osler  
Montreal, QC H3G 1Y6

Telephone: (514) 398-1898

Fax: (514) 398-7384

E-mail: rachel.leger@mcgill.ca

Website: [www.mcgill.ca/biochemistry/](http://www.mcgill.ca/biochemistry/)

*Chair* — David Y. Thomas

*Emeritus Professors*

Angus F. Graham; M.Sc.(Tor.), Ph.D., D.Sc.(Edin.), F.R.S.C.

Rose M. Johnstone; B.Sc., Ph.D.(McG.), F.R.S.C.

Samuel Solomon; M.Sc., Ph.D.(McG.), F.R.S.C.

Theodore L. Sourkes; M.Sc.(McG.), Ph.D.(Corn.), F.R.S.C.

*Professors*

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

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

Philip E. Branton; B.Sc., M.Sc., Ph.D.(Tor.) (*Gilman Cheney Professor of Biochemistry*)

Peter E. Braun; B.Sc., M.Sc.(U.B.C.), Ph.D.(Berk.)

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

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

Annette A. Herscovics; B.Sc., Ph.D.(McG.), F.R.S.C. (*joint appoint. with Oncology*)

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

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

William Muller; B.Sc., Ph.D.(McG.)

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

Morag Park; B.Sc., Ph.D.(Glasgow) (*William Dawson Scholar*) (*joint appoint. with Oncology*)

Jerry Pelletier; B.Sc., Ph.D.(McG.)

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

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

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

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

Clifford P. Stanners; B.Sc.(McM.), M.A., Ph.D.(Tor.) (*joint appoint. with Oncology*)

**DIPLOMA IN 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, consult the Administrative Officer, Burnside Hall, Room 946.

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

**Required Courses** (18 credits)

David Y. Thomas; B.Sc.(Bristol), M.Sc.,Ph.D.(Univ. College, Lond.), F.R.S.C.

Michel L. Tremblay; B.Sc., M.Sc.(Sher.), Ph.D.(McM.)

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

*Associate Professors*

Albert Berghuis; B.Sc., M.Sc.(Rijks Univ.Groningen, the Netherlands), Ph.D.(U.B.C.)

Kalle Gehring; M.Sc.(Mich.), Ph.D.(Berk.)

Alain Nepveu; B.Sc., M.Sc.(Montr.), Ph.D.(Sher.) (*joint appoint. with Oncology*)

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

*Assistant Professors*

Maxime Bouchard; B.Sc, Ph.D.(Laval)

Imed Gallouzi; Maitrise, DEA, Ph.D.(Montpellier,France)

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

*Associate Members*

Karine Auclair (*Chemistry*); John J. Bergeron (*Anatomy & Cell Biology*); Katherine Cianflone (*Exp. Medicine, RVH*); Mark S. Featherstone (*Oncology*); William C. Galley (*Chemistry*); Michael Hallett (*Computer Science*); Martin Latterich (*Anatomy & Cell Biology*); Peter J. Roughley (*Shriners Hospital*); Erwin Schurr (*Exp. Medicine, RVH*); Charles S. Sriver (*Pediatrics, MCH*); Peter Siegel (*Medicine*); Bernard Turcotte (*Exp. Medicine, RVH*); Simon Wing (*Medicine*); Xiang-Jiao Yang (*Molecular Oncology, RVH*)

*Adjunct Professors*

Prabhat Arya (*NRC, Ottawa*); Michael Cordingley (*Boehringer-Ingelheim*); Mirek Cygler (*B.R.I.*); Jacques Drouin (*Clin. Res. Inst.*); Karen Meerovitch (*Phytobiotech*); Donald Nicholson (*Merck Frosst*); Maureen D. O'Connor-McCourt (*B.R.I.*); Enrico Purisima (*B.R.I.*); Martine Raymond (*Clin. Res. Inst.*); Sophie Roy (*Merck Frosst*); Marc Therrien (*Clin. Res. Inst.*)

Biochemistry is the application of chemical, genetic, and biophysical approaches to the study of biological processes at the cellular and molecular level. Biochemists are interested in the dynamic events that occur in cells, for example, in mechanisms of brain function; cellular differentiation; energy utilization by animals and microorganisms and in the molecular basis of inheritance and disease. The biochemist seeks to determine how specific molecules such as proteins, nucleic acids, lipids, vitamins and hormones function in various cellular processes. Biochemists place particular emphasis on the regulation of reactions in living cells. The knowledge and methods developed by biochemists are applied in all fields of medicine, in agriculture and in many chemical and health-related industries. Biochemistry is unique in providing basic theoretical training as well as basic practical laboratory training and research in both enzymology and genetic engineering, the two basic components in the rapidly expanding field of Biotechnology.

Three programs are offered by the Department of Biochemistry. The Honours and Major programs provide a sound background for students who wish to have a professional career in biochemistry and can lead to postgraduate studies and research careers in hospital, university or industrial laboratories. The Faculty program is less specialized, offering students opportunities to select courses in other fields of interest.

During the first year, each program provides basic training in organic, physical and analytical chemistry as well as in biology and physiology. The Honours and Major programs become more specialized in biochemistry during the following two years with additional work in chemistry and biology.

Students interested in pursuing an *ad hoc* Joint Major or Joint Honours degree between Biochemistry and a second discipline may consult with our Chief Adviser.

The increasing involvement of complex technology in modern society requires personnel trained in both chemistry and biology. With the advent of biotechnology, the combination of chemistry, molecular biology, enzymology and genetic engineering found in the biochemistry program provides the essential background and training in this area as well. The biochemist is in an advantageous position to combine the study of chemistry and biology. The combination of chemistry, molecular biology, enzymology and genetic engineering found in the biochemistry program provides the essential background and training in this area as well. The biochemist is in an advantageous



BIOL303	(3)	Developmental Biology
BIOL304	(3)	Evolution
BIOL314	(3)	Molecular Biology of Oncogenes
CHEM214	(3)	Physical Chemistry/Biological Sciences 2
CHEM257D1	(2)	Introductory Analytical Chemistry
CHEM257D2	(2)	Introductory Analytical Chemistry
CHEM352	(3)	Structural Organic Chemistry
CHEM362	(2)	Advanced Organic Chemistry Laboratory
CHEM382	(3)	Organic Chemistry: Natural Products
CHEM402	(3)	Advanced Bio-organic Chemistry
CHEM572	(3)	Synthetic Organic Chemistry
MIMM211	(3)	Introductory Microbiology
MIMM314	(3)	Immunology
PHAR300	(3)	Drug Action
PHAR301	(3)	Drugs and Disease
PHGY209	(3)	Mammalian Physiology 1
PHGY210	(3)	Mammalian Physiology 2

**MAJOR IN BIOCHEMISTRY (67 or 70 credits)**

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

**U1 Required Courses (20 credits)**

BIOC212	(3)	Molecular Mechanisms of Cell Function
BIOL200	(3)	Molecular Biology
BIOL202	(3)	Basic Genetics
CHEM204	(3)	Physical Chemistry/Biological Sciences 1
CHEM222	(4)	Introductory Organic Chemistry 2
CHEM257D1	(2)	Introductory Analytical Chemistry
CHEM257D2	(2)	Introductory Analytical Chemistry

**U1 Complementary Courses (9 credits)**

6 credits, selected from:

BIOL205	(3)	Biology of Organisms
MIMM211	(3)	Introductory Microbiology
PHGY209	(3)	Mammalian Physiology 1
PHGY210	(3)	Mammalian Physiology 2

3 credits selected from:

BIOL309	(3)	Mathematical Models in Biology
BIOL373	(3)	Biometry
COMP202	(3)	Introduction to Computing 1
MATH203	(3)	Principles of Statistics 1
MATH222	(3)	Calculus 3
PSYC204	(3)	Introduction to Psychological Statistics

**U2 Required Courses (23 credits)**

(3)	CHEM222	(3)	Physical Chemistry/Biological Sciences 1
	CHEM222		

**U2 Complementary Courses (3 credits)****U3 Required Courses (6 credits)****U3 Complementary Courses (6 or 9\* credits)****HONOURS IN BIOCHEMISTRY (76 credits)**

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

Students seeking admission to the Honours program must obtain permission from the Student Affairs Officer during the Add/Drop period in September of their second year.

Promotion to U3 year is based on satisfactory completion of U2 courses with a GPA of at least 3.20 and a B in every required course. In borderline cases, the marks received in BIOC311 and BIOC312 will be of particular importance for continuation in the U3 Honours year.

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

**U1 Required Courses (20 credits)****U1 Complementary Courses (9 credits)****U2 Required Courses (23 credits)****U2 Complementary Courses (3 credits)****U3 Required Courses (15 credits)****U3 Complementary Courses (6 credits)**



studies and research careers in universities, research institutes, hospitals, and industrial or governmental laboratories.

The Department of Biology has well-equipped teaching and

systematics, which seeks to understand the history of life and the phylogenetic and genetic relationships of living things. Appreciation and knowledge of diversity and systematics are essential in

Advisers: Drs. M. Mackey and L. Glass (Department of Physiology)

**MAJOR IN BIOLOGY** (55 credits)

The Major requires 55 credits comprising 34 as specified below and 21 additional credits which are to be chosen by students in consultation with their adviser.

**U1 Required Courses** (18 credits)

**U2 or U3 Required Courses** (4 credits)

**U2 or U3 Complementary Courses** (12 credits)

**Other Complementary Courses** (21 credits)

To be selected in consultation with the student's adviser. All courses must be at the 300 level or higher; they are to include any seven Biology courses of which at most three may be substituted, given the adviser's consent, with science courses offered by other departments. Unless required by the Major Program, prerequisites for these courses must be taken as electives.

**BIOLOGY CONCENTRATIONS**

The concentrations set out below are only guidelines for specialized training. They do not constitute sets of requirements. Students interested in advanced studies in any biological discipline are strongly advised to develop their skills in computing as appropriate. As an aid to students wishing to specialize, the concentrations list key and other suggested courses by discipline.

**Animal Behaviour Concentration**

Understanding the diverse ways in which animals feed, mate, care for their offspring, avoid predators, select their habitats, communicate, and process information constitute the subject matter of behaviour. Several approaches are used to study these questions. Some focus on ecological consequences and determinants, some on physiological, genetic and developmental mechanisms, others on evolutionary origins.

Key courses:

BIOL304, BIOL305, BIOL306, BIOL307, BIOL331 or BIOL334 or another field course with a significant behavioural component, BIOL373.

Other suggested courses:

BIOL377, BIOL471D1/BIOL471D2, BIOL477, BIOL478

Since animal behaviour builds upon the fields of behaviour, ecology, and evolutionary biology, most courses from these fields will be relevant. Some courses that focus on a particular taxonomic group such as birds (Natural Resource Sciences WILD420), amphibians and reptiles (BIOL327) and marine mammals (BIOL335) include a significant amount of behaviour.

**Biological Diversity and Systematics**

The study of biological diversity deals with the maintenance, emergence, and history of the inexhaustible variety of different kinds of organisms. It is deeply concerned with the particular characteristics of different organisms and therefore emphasizes the detailed study of particular groups and forms the basis of comparative biology. Our knowledge of diversity is organized through the study of

has been conducted upon model eukaryotic organisms, such as yeast, nematode, the fruit fly, and the mustard weed, *Arabidopsis*. In the molecular genetics and development concentration students will obtain a comprehensive understanding of how the “model eukaryotes” have advanced our knowledge of the mechanisms responsible for cellular function and organismal development. Graduates from this concentration will be well prepared to pursue higher degrees in the fields of basic biology, biotechnology, and biomedicine or to assume a wide variety of positions in government, universities, and medical and industrial institutions.

**Key courses:**

BIOL300, BIOL301, BIOL303, BIOL373, BIOL551, BIOL569; CHEM203 or CHEM204, CHEM214

**Other suggested courses:**

BIOL313, BIOL314, BIOL471D1/BIOL471D2, BIOL477, BIOL478, BIOL516, BIOL518, BIOL520, BIOL524, BIOL544

**Neurobiology Concentration**

Nervous systems are perhaps the most complex entities in the natural world, being composed of up to trillions of interconnected cells that must operate in a coordinated manner to produce behaviour which can range from the mundane (e.g., regulation of heart rate) to the magnificent (e.g., musical composition). The neurobiology discipline is one of the fastest growing areas of modern biology, seeks to understand the evolution, development, and operation of nervous systems. The neurobiology concentration addresses these issues by examination of neural structure, function and development at levels of organization that range from the molecular to the organismal. As a result of exposure to a wide range of experimental and intellectual approaches, students receive a sound, broadly based education in biology.

**Key courses:**

BIOL306, BIOL373, BIOL389, BIOL530, BIOL531, BIOL532, BIOL588

**Other suggested courses:**

ANAT321, ANAT322; BIOC455; BIOL300, BIOL303, BIOL471D1/BIOL471D2, BIOL477, BIOL478; NEUR310; PHAR562; PHGY451, PHGY520, PHGY556; PSYC311, PSYC318, PSYC342, PSYC410, PSYC470, PSYC522; PSYT500

**CONCENTRATIONS AVAILABLE WITHIN THE AREA OF ECOLOGY**

Ecology is the study of the interactions between organisms and environment that affect distribution, abundance, and other characteristics of the organisms. A strong analytical and quantitative orientation is common to all areas of ecology, and thus students wishing to specialize in these areas are strongly encouraged to develop their background in statistical analysis, computing, and mathematical modelling. Many of the ecology courses feature a strong analytical component, and students will find that background preparation in this area is very useful, if not essential. Ecology depends heavily on field research, and thus BIOL331 and/or other field courses should be considered as vital to all concentrations in this area.

**Aquatic Ecology Concentration**

This concentration is designed to introduce the principles of ecology as they pertain to aquatic ecosystems and aquatic biota. Since it is essential to know how knowledge is obtained, as well as what has been learned, three of the courses (limnology, fish ecology, and aquatic invertebrate ecology) involve field components that stress the techniques used to study aquatic ecology. In addition, the concentration includes a field course in ecology. There is also a variety of courses in aquatic disciplines offered in other departments that complement the aquatic ecology courses offered in Biology.

**Key courses:**

BIOL305, BIOL308, BIOL331 or another field course, BIOL373, BIOL432, BIOL441, BIOL442, BIOL465; COMP202 or COMP273

**Other suggested courses:**

BIOL307, BIOL329, BIOL534; GEOG305, GEOG306, GEOG308, GEOG322

**Macdonald Campus:**

ZOOL315

**General and Applied Ecology Concentration**

The concentration in general and applied ecology is designed to introduce the breadth of contemporary ecology, at the levels of the ecosystem, communities and populations, and at the level of the individual organism, with an accent on the application of this science to practical problems in environmental management, and the management of resources and pests. In addition to general courses dealing with general principles, there is a selection of courses dealing with particular groups of organisms. Since it is essential to know how knowledge is obtained, the concentration includes a field course in ecology.

**Key courses:**

BIOL305, BIOL308, BIOL331 or BIOL334, BIOL350, BIOL373; COMP202 or COMP273

**Other suggested courses:**

BIOL307, BIOL324, BIOL327, BIOL328, BIOL329, BIOL432, BIOL441, BIOL442, BIOL465, BIOL534, BIOL540, BIOL571, BIOL594; GEOG302

Macdonald Campus: PLNT451, PLNT460

**Marine Biology Concentration**

This concentration is designed to offer students a broad introduction to marine biology and marine ecology, which will form the basis for graduate studies in the fields, or to employment in aquatic biology and oceanography.

**Key courses:**

BIOL305, BIOL308, BIOL335, BIOL373, BIOL441, BIOL442

**Other suggested courses:**

ATOC220, ATOC512, ATOC550, ATOC551, ATOC561; BIOL329, BIOL331, BIOL334, BIOL432, BIOL465, BIOL534; EPSC542

For students intending to proceed to graduate work, one independent studies course (BIOL471D1/BIOL471D2, BIOL477 or BIOL478) is recommended. Because of the importance of numerical analyses in all fields of ecology, courses in Biometry (e.g. BIOL373) and Computer Science (COMP202 or COMP273) are recommended.

**HONOURS IN BIOLOGY (68 or 71 credits)**

The Honours Program in Biology is designed expressly as a preparation for graduate studies and research, and provides students with an enriched training in biology and some research experience in a chosen area. Acceptance into the Honours Program at the end of U2 requires a CGPA of 3.50 and approval of a 9- or 12-credit Independent Studies proposal (see listing of BIOL479 and BIOL480 for details). For an Honours degree, a minimum CGPA of 3.50 in the U3 year and adherence to the program as outlined below are the additional requirements. The new 3.50 requirement applies only beginning with students entering McGill in the Fall of 2005.

**U1 Required Courses (18 credits)**

as for the Major program

**U2 and U3 Required Courses (7 credits)**

BIOL301	(4)	Cell and Molecular Laboratory
BIOL373	(3)	Biometry

**U2 and U3 Complementary Courses (30 credits)**

12 credits selected from:

BIOL300	(3)	Molecular Biology of the Gene
BIOL303	(3)	Developmental Biology
BIOL304	(3)	Evolution
BIOL306	(3)	Neurobiology and Behaviour
BIOL308	(3)	Ecological Dynamics

18 credits in Biology at the 300 level or higher

**U3 Required Courses** (4 credits)

**U3 Complementary Courses** (9 or 12 credits)

**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 [see section 15.1.3 "Panama Field Study Semester"](#) . You can also visit the following Website for details:

[www.mcgill.ca/mse/field\\_study/panama](http://www.mcgill.ca/mse/field_study/panama)

**AFRICAN FIELD STUDY SEMESTER** The Department of Geography, Faculty of Science, coordinates the 15-credit interdisciplinary African Field Study Semester, [see section 15.1.1 "African Field Study Semester"](#) .

## 12.12.6 Chemistry (CHEM)

Otto Maass Chemistry Building  
801 Sherbrooke Street West  
Montreal, QC H3A 2K6

Website: [www.mcgill.ca/chemistry](http://www.mcgill.ca/chemistry)

Departmental Office: Room 322. Telephone: (514) 398-6999  
Student Advisory Office: Room 304. Telephone: (514) 398-3653  
Website: [www.mcgill.ca/chemistry/advising](http://www.mcgill.ca/chemistry/advising)

*Chair* — R. Bruce Lennox

### *Emeritus Professors*

Byung Chan Eu; B.Sc.(Seoul), Ph.D.(Brown)  
Tak-Hang Chan; B.Sc.(Tor.), M.A., Ph.D.(Prin.), F.C.I.C., F.R.S.C.  
(*Tomlinson Professor of Chemistry*)  
John F. Harrod; B.Sc., Ph.D.(Birm.)  
(*Tomlinson Emeritus Professor of Chemistry*)  
Alan S. Hay; B.Sc., M.Sc.(Alta.), Ph.D.(Ill.), D.Sc.(Alta.), F.R.S.,  
F.N.Y., Acad.Sci. (*Tomlinson Emeritus Professor of Chemistry*)  
Robert H. Marchessault; B.Sc.(Loyola), Ph.D.(McG.), D.Sc.  
(C'dia), F.R.S.C. (*E.B. Eddy Professor of Industrial Chemistry*)  
Mario Onyszchuk; B.Sc.(McG.), M.Sc.(W.Ont.), Ph.D.(McG.),  
Ph.D.(Cantab.)  
Donald Patterson; M.Sc.(McG.), Doc.(St-Etienne) (*Otto Maass  
Emeritus Professor of Chemistry*)  
Arthur S. Perlin; M.Sc., Ph.D.(McG.), F.R.S.C.  
(*E.B. Eddy Emeritus Professor of Industrial Chemistry*)  
William C. Purdy; B.A.(Amherst), Ph.D.(M.I.T.), F.C.I.C.  
(*William C. Macdonald Emeritus Professor of Chemistry*)  
Leon E. St-Pierre; B.Sc.(Alta.), Ph.D.(Notre Dame, Ind.), F.C.I.C.  
Michael A. Whitehead; B.Sc., Ph.D., D.Sc.(Lond.), F.C.I.C.

### *Professors*

D. Scott Bohle; B.A.(Reed College), M.Phil., Ph.D.(Auck.),  
(*CRC Tier I Chair*)  
Ian S. Butler; B.Sc., Ph.D.(Brist.), F.C.I.C., C.Chem.,  
F.R.S.C.(U.K.)  
Masad J. Damha; B.Sc., Ph.D.(McG.) (*James McGill Professor*)  
Adi Eisenberg; B.S.(Worcester Polytech.), M.A., Ph.D.(Prin.),  
F.C.I.C. (*Otto Maass Professor of Chemistry*)

Derek G. Gray; B.Sc. (Belf.), M.Sc., Ph.D.(Man.), F.C.I.C.  
(*NSERC Paprican Chair*)  
David N. Harpp; A.B.(Middlebury), M.A.(Wesleyan),  
Ph.D.(N.Carolina), F.C.I.C. (*William C. Macdonald Professor of  
Chemistry*)  
George Just; Ing.Chem.(E.T.H. Zürich), Ph.D.(W.Ont.), F.C.I.C.  
(*William C. Macdonald Professor of Chemistry*)  
R. Bruce Lennox; B.Sc., M.Sc., Ph.D.(Tor.)  
C.J. Li; B.Sc.(Zhengzhou), M.Sc.(C.A.S.), Ph.D.(McG.),  
(*CRC Tier I Chair*)  
David Ronis; B.Sc.(McG.), Ph.D.(M.I.T.)  
Eric D. Salin; B.Sc.(Calif.), Ph.D.(Oreg.St.)  
Bryan C. Sanctuary; B.Sc., Ph.D.(U.B.C.)  
Alan G. Shaver; B.Sc.(Car.), Ph.D.(M.I.T.)  
Theo G.M. van de Ven; Kand. Doc.(Utrecht), Ph.D.(McG.),  
(*NSERC Paprican Chair*)

### *Associate Professors*

Mark P. Andrews; B.Sc., M.Sc., Ph.D.(Tor.)  
Bruce Arndtsen; B.A.(Car. College), Ph.D.(Stan.)  
David H. Burns; B.Sc.(Puget Sound), Ph.D.(Wash)  
William C. Galley; B.Sc.(McG.), Ph.D.(Calif.)  
James Gleason; B.Sc.(McG.), Ph.D.(Virginia)  
Ashok K. Kakkar; B.Sc.(Punjab), M.Sc.(H.P.U.), Ph.D.(Wat.)  
Joan F. Power; B.Sc., Ph.D.(C'dia)  
Linda Reven; B.A.(Car. College), Ph.D.(Ill.)

### *Assistant Professors*

Parisa Ariya; B.Sc., Ph.D.(York) (*William Dawson Scholar*) (*joint  
appoint. with Atmospheric & Oceanic Sciences*)  
Karine Auclair; B.Sc.(U.Q.A.C.), Ph.D.(Alta.)  
Christopher J. Barrett; B.Sc., M.Sc., Ph.D.(Queen's)  
Patanjali Kambhampati; B.A.(Car. College), Ph.D.(Texas)  
Nicolas Moitessier; Ph.D.(Nancy)  
Hanadi Sleiman; B.Sc.(A.U.B.), Ph.D.(Stan.) (*William Dawson  
Scholar*)  
Paul Wiseman; B.Sc.(St.F.X.), Ph.D.(W.Ont.) (*joint appoint. with  
Physics*)

### *Faculty Lecturers*

John Finkenbine; B.S.(Capital), Ph.D.(McG.)  
Grazyna Wilczek; M.Sc., Doctorate Chem. Sci.(Warsaw)

### *Associate Members*

James A. Finch (*Mining & Metallurgical Engineering*)  
K. Gehring (*Biochemistry*)  
P. Grütter (*Physics*)  
Orval A. Mamer (*University Clinic*)  
Barry I. Posner (*Medicine*)

### *Adjunct Professors*

Yvan Guindon; B.Sc., Ph.D.(Montr.), F.C.I.C., F.R.S.C.  
Romas Kazlauskas; B.Sc.(Clev.St.), Ph.D.(M.I.T.)  
R. St. John Manley; B.Sc., Ph.D.(McG.), D.Sc.(Uppsala)  
Christian Reber; B.Sc., Ph.D.(Berne)  
Youla Tsantrizos; B.Sc., Ph.D.(McG.)  
Ivor Wharf; B.Sc., Ph.D.(Lond.), A.R.C.S., D.I.C.  
C.T. Yim; B.Sc.(Fu-Dan), Ph.D.(McG.)  
Robert Zamboni; B.Sc., Ph.D.(McG.)

### **Office for Science and Society**

The Office for Science and Society is dedicated to the promotion  
McG.), 2T. Yim; B.Sc4AM5j T\* 0.271sOD1n of n cvsenT1AeYork) McG0.1and0  
Stan.)

David N. Harpp; A.B.(Middlebury), M.A.(Wesleyan),  
Ph.D.(N.Carolina), F.C.I.C. (*William C. Macdonald Professor of  
Chemistry*)



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

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

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

#### **HONOURS IN CHEMISTRY: ENVIRONMENTAL CHEMISTRY OPTION (77credits)**

##### **Required Courses (62 credits)**

56 credits, all courses specified above for Honours Chemistry, plus the following 6 credits

CHEM219 (3) Introduction to Atmospheric Chemistry  
CHEM307 (3) Analytical Chemistry of Pollutants

##### **Complementary Courses (15 credits)**

6 credits of research\*:

CHEM470 (6) Research Project  
or CHEM480 (3) Research Project  
and CHEM490 (3) Research Project

3 credits, one of:

CHEM419 (3) Advances in Chemistry of Atmosphere  
CHEM462 (3) Green Chemistry  
CHEM567 (3) Chemometrics: Data Analysis  
CHEM575 (3) Chemical Kinetics

6 credits, two of

ATOC220 (3) Introduction to Oceanic Sciences  
CHEM352 (3) Structural Organic Chemistry  
CHEM597 (3) Analytical Spectroscopy  
EPSC542 (3) Chemical Oceanography

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

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

#### **HONOURS WITH MATERIALS OPTION (77credits)**

##### **Required Courses (62 credits)**

56 credits, all courses specified above for Honours Chemistry plus the following 6 credits:

CHEM344 (3) Advanced Materials  
CHEM455 (3) Introductory Polymer Chemistry

##### **Complementary Courses (15 credits)**

6 credits of research\*:

CHEM470 (6) Research Project  
or CHEM480 (3) Research Project  
and CHEM490 (3) Research Project

6 credits, two of:

CHEM531 (3) Chemistry of Inorganic Materials  
CHEM534 (3) Nanoscience and Nanotechnology  
CHEM543 (3) Chemistry of Pulp and Paper  
CHEM571 (3) Polymer Synthesis  
CHEM585 (3) Colloid Chemistry

3 credits, one of:

CHEE481 (3) Polymer Engineering  
MIME260 (3) Materials Science and Engineering  
MRKT360 (3) Marketing of Technology

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

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

**JOINT HONOURS IN PHYSICS AND CHEMISTRY, see "Physics (PHYS)", section 12.12.25.**

#### **MAJOR IN CHEMISTRY (62 credits)**

##### **Required Courses (56 credits)**

56 credits as listed above

##### **Complementary Courses (6 credits)**

6 credits of additional Chemistry courses at the 300 level or higher.

Attainment of the Major degree requires a CGPA of 2.00.

#### **MAJOR WITH BIO-ORGANIC OPTION (66 credits)**

##### **Required Courses (63 credits)**

54 credits, all courses specified above for the Chemistry Major, except PHYS242

plus the following 9 credits:

BIOL200 (3) Molecular Biology  
BIOL201 (3) Cell Biology and Metabolism  
CHEM502 (3) Advanced Bio-Organic Chemistry

##### **Complementary Course (3 credits)**

one of:

BIOL202 (3) Basic Genetics  
BIOL301 (3) Cell and Molecular Laboratory  
MIMM211 (3) Introductory Microbiology  
PHGY201 (3) Human Physiology: Control Systems  
PHGY202 (3) Human Physiology: Body Functions  
PHGY209 (3) Mammalian Physiology 1  
PHGY210 (3) Mammalian Physiology 2

Attainment of the Major degree requires a CGPA of 2.00.

#### **MAJOR IN CHEMISTRY: ENVIRONMENTAL CHEMISTRY OPTION (65 credits)**

##### **Required Courses (62 credits)**

56 credits, all courses specified above for the Chemistry Major, plus the following 6 credits:

CHEM219 (3) Introduction to Atmospheric Chemistry  
CHEM307 (3) Analytical Chemistry of Pollutants

##### **Complementary Course (3 credits)**

one of:

CHEM419 (3) Advances in Chemistry of Atmosphere  
CHEM462 (3) Green Chemistry  
CHEM567 (3) Chemometrics: Data Analysis  
CHEM575 (3) Chemical Kinetics

Attainment of the Major degree requires a CGPA of 2.00.

#### **MAJOR WITH MATERIALS OPTION (65 credits)**

##### **Required Courses (62 credits)**

56 credits, all courses specified above for the Chemistry Major, plus the following 6 credits:

CHEM344 (3) Advanced Materials  
CHEM455 (3) Introductory Polymer Chemistry

##### **Complementary Course (3 credits)**

one of:

CHEM531 (3) Chemistry of Inorganic Materials  
CHEM534 (3) Nanoscience and Nanotechnology  
CHEM543 (3) Chemistry of Pulp and Paper  
CHEM571 (3) Polymer Synthesis  
CHEM585 (3) Colloid Chemistry

Attainment of the Major degree requires a CGPA of 2.00.

#### **FACULTY PROGRAMS IN CHEMISTRY**

Faculty programs in Chemistry are constructed from the U1 courses and the general courses of U2 and U3 intended for these students. Consult the Department of Chemistry Student Advisory Office for an adviser. A computer science course, either COMP102 or COMP202, will be required during U1 for students who have no previous introduction to computer programming.

#### **FACULTY PROGRAM IN CHEMISTRY (52 credits)**

##### **Required Courses (31 credits)**

CHEM212\* (4) Introductory Organic Chemistry 1  
CHEM222\* (4) Introductory Organic Chemistry 2

CHEM277D1	(1.5)	Analytical Chemistry
CHEM277D2	(1.5)	Analytical Chemistry
CHEM302	(3)	Introductory Organic Chemistry 3
CHEM345	(3)	Molecular Properties and Structure 1
CHEM367	(3)	Instrumental Analysis 1
CHEM377	(3)	Instrumental Analysis 2
MATH222*	(3)	Calculus 3
MATH315	(3)	Ordinary Differential Equations
PHYS242	(2)	Electricity and Magnetism

\* asterisks denote courses with CEGEP equivalents

**Complementary Courses** (21 credits)

6 credits, one of the following course sets:

CHEM204	(3)	Physical Chemistry/Biological Sciences 1 and CHEM214 (3) Physical Chemistry/Biological Sciences 2 or CHEM213 (3) Introductory Physical Chemistry and CHEM355 (3) Molecular Properties and Structure 2
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6 credits, two of the following courses:

CHEM201	(3)	Modern Inorganic Chemistry 1 or CHEM281 (3) Inorganic Chemistry 1
CHEM301	(3)	Modern Inorganic Chemistry 2 or CHEM381 (3) Inorganic Chemistry 2

9 credits from:

CHEM352	(3)	Structural Organic Chemistry
CHEM355	(3)	Molecular Properties and Structure 2
CHEM363	(2)	Physical Chemistry Laboratory 1
CHEM382	(3)	Organic Chemistry: Natural Products
CHEM392	(3)	Integrated Inorganic/Organic Laboratory
CHEM393	(2)	Physical Chemistry Laboratory 2

or any 400-level courses in Chemistry for which the prerequisites are satisfied.

**FACULTY PROGRAM IN CHEMISTRY AND BIOLOGICAL SCIENCES** (55 credits)

**Required Courses** (49 credits)

BIOL200	(3)	Molecular Biology
BIOL201	(3)	Cell Biology and Metabolism
BIOL205	(3)	Biology of Organisms
BIOL301	(4)	Cell and Molecular Laboratory
BIOL304	(3)	Evolution
CHEM204	(3)	Physical Chemistry/Biological Sciences 1
CHEM214	(3)	Physical Chemistry/Biological Sciences 2
CHEM222*	(4)	Introductory Organic Chemistry 2
CHEM257D1	(2)	Introductory Analytical Chemistry
CHEM257D2	(2)	Introductory Analytical Chemistry
CHEM302	(3)	Introductory Organic Chemistry 3
CHEM352	(3)	Structural Organic Chemistry
CHEM362	(2)	Advanced Organic Chemistry Laboratory
CHEM382	(3)	Organic Chemistry: Natural Products
PHGY209	(3)	Mammalian Physiology 1
PHGY210	(3)	Mammalian Physiology 2
PHYS242	(2)	Electricity and Magnetism

\* asterisks denote courses with CEGEP equivalents

**Complementary Courses** (6 credits)

6 credits approved by the adviser.

**FACULTY PROGRAM IN CHEMISTRY AND MATHEMATICS** (51 or 52credits)

**Required Courses** (46 credits)

CHEM212*	(4)	Introductory Organic Chemistry 1
CHEM222*	(4)	Introductory Organic Chemistry 2
CHEM277D1	(1.5)	Analytical Chemistry
CHEM277D2	(1.5)	Analytical Chemistry
CHEM281	(3)	Inorganic Chemistry 1
CHEM345	(3)	Molecular Properties and Structure 1
CHEM355	(3)	Molecular Properties and Structure 2
MATH222*	(3)	Calculus 3
MATH223	(3)	Linear Algebra
MATH314	(3)	Advanced Calculus

MATH315	(3)	Ordinary Differential Equations
MATH317	(3)	Numerical Analysis
MATH319	(3)	Partial Differential Equations
MATH323	(3)	Probability
MATH324	(3)	Statistics
PHYS242	(2)	Electricity and Magnetism

\* asterisks denote courses with CEGEP equivalents

**Complementary Courses** (5 or 6 credits)

5 or 6 credits, one of the following course sets:

CHEM204	(3)	Physical Chemistry/Biological Sciences 1 and CHEM214 (3) Physical Chemistry/Biological Sciences 2 or CHEM213 (3) Introductory Physical Chemistry and CHEM365 (2) Statistical Thermodynamics
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**FACULTY PROGRAM IN MATHEMATICS, CHEMISTRY AND PHYSICS**, see "Mathematics and Statistics (MATH)", in section 12.12.17.

The Major Concentration in Chemistry (part of B.A. & Sc. degree), the Faculty Programs in Chemistry, and Minor in Chemistry are not accredited by l'Ordre des chimistes du Québec or the Chemical Institute of Canada.

**MINOR IN CHEMISTRY** (18 credits)

**Required Courses** (18 credits)

CHEM203	(3)	Survey of Physical Chemistry
CHEM212	(4)	Introductory Organic Chemistry 1
CHEM222*	(4)	Introductory Organic Chemistry 2
CHEM257D1	(2)	Introductory Analytical Chemistry
CHEM257D2	(2)	Introductory Analytical Chemistry
CHEM281	(3)	Inorganic Chemistry 1

\* asterisks denote courses with CEGEP equivalents

Substitutions for these by more advanced courses may be made at the discretion of the adviser.

**MINOR IN CHEMICAL ENGINEERING** (24 credits)

A Chemical Engineering Minor will be of interest to Chemistry students who wish to study the problems of process engineering and its related subjects. A student completing this Minor will be able to make the important link between molecular sciences and industrial processing. This Minor will not provide Professional Engineering accreditation.

**Required Courses** (7 credits)

CHEE200	(4)	Introduction to Chemical Engineering
CHEE204	(3)	Chemical Manufacturing Processes

**Complementary Courses** (17 credits)

at least one of:

CHEE220	(3)	Chemical Engineering Thermodynamics
CHEE314	(4)	Fluid Mechanics

with the remainder chosen from the following:

CHEE230	(3)	Environmental Aspects of Technology
CHEE315	(4)	Heat and Mass Transfer
CHEE351	(3)	Separation Processes
CHEE370	(3)	Elements of Biotechnology
CHEE380	(3)	Materials Science
CHEE392	(4)	Project Laboratory 1
and CHEE393	(5)	Project Laboratory 2
CHEE438	(3)	Engineering Principles in Pulp and Paper Processes
CHEE452	(3)	Particulate Systems
CHEE471	(3)	Industrial Water Pollution Control
CHEE472	(3)	Industrial Air Pollution Control
CHEE481	(3)	Polymer Engineering
CHEE487	(3)	Chemical Processing: Electronics Industry
CHEE494	(3)	Research Project and Seminar
or CHEE495	(4)	Research Project and Seminar
MATH314	(3)	Advanced Calculus





COMP523	(3)	Language-based Security	COMP310	(3)	Computer Systems and Organization
COMP524	(3)	Theoretical Foundations of Programming Languages	COMP330	(3)	Theoretical Aspects: Computer Science
COMP526	(3)	Probabilistic Reasoning and AI	COMP350	(3)	Numerical Computing
COMP533	(3)	Object-Oriented Software Development	COMP360	(3)	Algorithm Design Techniques
COMP534	(3)	Team Software Engineering	MATH222	(3)	Calculus 3
COMP535	(3)	Computer Networks 1	MATH223	(3)	Linear Algebra
COMP537	(3)	Internet Programming	MATH240	(3)	Discrete Structures 1
COMP538	(3)	Person-Machine Communication	MATH323	(3)	Probability
COMP540	(3)	Matrix Computations			
COMP557	(3)	Fundamentals of Computer Graphics			
COMP558	(3)	Fundamentals of Computer Vision			
COMP560	(3)	Graph Algorithms and Applications			
COMP563	(3)	Molecular Evolution Theory			
COMP564	(3)	Computational Gene Regulation			
COMP566	(3)	Discrete Optimization 1			
COMP567	(3)	Discrete Optimization 2			
COMP573	(3)	Microcomputers			
COMP575	(3)	Fundamentals of Distributed Algorithms			
COMP577	(3)	Distributed Database Systems			
MATH240	(3)	Discrete Structures 1			

or from courses outside the School approved by the adviser, to a maximum of 6 credits.

\* Note: COMP 251 is a prerequisite for many of the other complementary courses, and MATH240 is a prerequisite for COMP251.

#### MINOR IN COMPUTATIONAL MOLECULAR BIOLOGY

(24credits)

Computational molecular biology is the sub-discipline of bioinformatics that is located at the intersection of computer science and molecular biology. The focus of this area is on techniques for managing and analyzing molecular sequence data. This program will provide undergraduate students in the biological sciences with the skills from computer science to solve computational problems arising in molecular biology and genomics and will provide students with the necessary skills to build software tools from these algorithms.

**The Minor in Computational Molecular Biology is not open to students in Computer Science or Joint Computer Science programs.**

#### Required Courses (24 credits)

COMP202	(3)	Introduction to Computing 1
COMP203	(3)	Introduction to Computing 2
COMP251	(3)	Data Structures and Algorithms
COMP360	(3)	Algorithm Design Techniques
COMP462	(3)	Computational Biology Methods
COMP563	(3)	Molecular Evolution Theory
COMP564	(3)	Computational Gene Regulation
MATH240	(3)	Discrete Structures 1

**FACULTY PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE** under "Mathematics and Statistics (MATH)", in section 12.12.17.

**FACULTY PROGRAM IN MATHEMATICS, STATISTICS AND COMPUTER SCIENCE** under "Mathematics and Statistics (MATH)", in section 12.12.17.

#### MAJOR IN COMPUTER SCIENCE (60 credits)

Freshman Program students interested in Computer Science should try to take COMP202 if possible, but it is not required for entry to the Major. A student entering the Major with insufficient programming background may take COMP202, which will not count for credit toward the Major but will count for elective credit.

#### Required Courses (42 credits)

COMP250	(3)	Introduction to Computer Science
COMP251	(3)	Data Structures and Algorithms
COMP206	(3)	Introduction to Software Systems
COMP273	(3)	Introduction to Computer Systems
COMP302	(3)	Programming Languages and Paradigms



**Mathematics Group:**

Honours in Mathematics  
 Honours in Applied Mathematics  
 Honours in Probability and Statistics

**12.12.9 Earth and Planetary Sciences (EPSC)**

Frank Dawson Adams Building, Room 238  
 3450 University Street  
 Montreal, QC H3A2A7

Telephone: (514) 398-6767  
 Fax: (514) 398-4680  
 E-mail: carol.matthews@mcgill.ca  
 Website: [www.eps.mcgill.ca](http://www.eps.mcgill.ca)

*Chair* — Alfonso Mucci

*Emeritus Professors*

Wallace H. MacLean; B.Geol.Eng.(Colorado Sch. of Mines),  
 M.Sc.(Appl.), Ph.D.(McG.)  
 Eric W. Mountjoy; B.A.Sc.(U.B.C.), Ph.D.(Tor.) (*William E. Logan  
 Emeritus Professor of Geology*)  
 Colin W. Stearn; B.Sc.(McM.), M.S., Ph.D.(Yale), F.R.S.C.

*Professors*

Jafar Arkani-Hamed; B.Eng.(Tehran), Ph.D.(M.I.T.)  
 Don M. Francis; B.Sc.(McG.), M.Sc.(U.B.C.), Ph.D.(M.I.T.)  
 (*Dawson Professor of Geology*)  
 Andrew J. Hynes; B.Sc.(Tor.), Ph.D.(Cantab.) (*William E. Logan  
 Professor of Geology*)  
 Olivia G. Jensen; B.Sc., M.Sc., Ph.D.(U.B.C.)  
 Robert F. Martin; B.Sc.(Ott.), M.S.(Penn. State), Ph.D.(Stan.)  
 Alfonso Mucci; B.Sc., M.Sc.(Montr.), Ph.D.(Miami)  
 A.E. (Willy) Williams-Jones; B.Sc., M.Sc.(Natal), Ph.D.(Queen's)

*Associate Professors*

Don Baker; B.A.(Chic.), Ph.D.(Penn.)  
 Bruce Hart; B.A.(McM.), M.Sc.(U.Q. à Rimouski), Ph.D.(W.Ont.)  
 Jeanne Paquette; B.Sc., M.Sc.(McG.), Ph.D.(Stonybrook)  
 John Stix; AB (Dart.), M.Sc., Ph.D.(Tor.)  
 Hojatollah Vali; B.Sc., M.Sc., Ph.D.(Munich) (*Director, Electron  
 Microscopy Centre*)

*Assistant Professor*

Mairi Best; B.Sc.(Laurentian), Ph.D.(Chic.)

The domain of Earth and Planetary Sciences includes the solid Earth and its hydrosphere and extends to the neighbouring terrestrial planets. It is a multidisciplinary field in which the principles of chemistry, physics, and mathematics are applied to the rich problems of the real world in order to understand how planets like the Earth work; in the past, the present, and the future.

Career opportunities are many and varied for graduates in the Earth and Planetary Sciences. There is presently a demand for graduates with expertise in many disciplines of the Earth Sciences. Our students are recruited for employment in the petroleum and mining industries, and in the environmental sector. During the Summer months undergraduate students are generally able to obtain employment from industry or government agencies, providing them with both financial benefits and first-hand geoscientific experience. Career opportunities in planetary science are presently limited to universities and research organizations.

The Department has a full-time staff of 13 professors and one faculty lecturer. There are approximately 50 graduate and 60 undergraduate students. 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.

The undergraduate curriculum is designed to provide both a rigorous 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 also offers a Joint Major in Physics and Geophysics which provides a rigorous math-

ematics and physics preparation and a geological background in the geosciences.

The Minor in Earth and Planetary Sciences offers Science students from other departments the opportunity to obtain exposure to the Earth Sciences, while the Minor in Geochemistry is oriented towards Chemistry Major students who want to see the application of chemistry to problems in the Earth and Planetary Sciences.

Students interested in any of the programs should inquire at Room 238, Frank Dawson Adams Building, (514) 398-6767, or should consult the Undergraduate Director, Don Baker, Room 310, Frank Dawson Adams Building, (514) 398-7485, if they do not have an adviser.

A Science Major Concentration in Earth, Atmosphere and Ocean Sciences is available to students pursuing the B.A. & Sc. degree. This Major Concentration is described in the Bachelor of Arts and Science section of the Calendar; see "[Earth, Atmosphere and Ocean Sciences](#)", in [section 6.12.7](#) for details.

**MINOR IN EARTH AND PLANETARY SCIENCES (18 credits)****Required Courses (7 credits)**

EPSC210 (3) Introductory Mineralogy  
 EPSC212 (4) Introductory Petrology

**Complementary Courses (11 credits)**

EPSC201 (3) Understanding Planet Earth  
 or EPSC233 (3) Earth and Life History

8 credits selected from:

EPSC203 (3) Structural Geology 1  
 EPSC231 (2) Field School 1  
 EPSC243 (3) Environmental Geology  
 EPSC334 (3) Invertebrate Paleontology  
 EPSC350 (3) Tectonics  
 EPSC451 (3) Hydrothermal Mineral Deposits  
 EPSC452 (3) Mineral Deposits 2  
 EPSC542 (3) Chemical Oceanography  
 EPSC561 (3) Ore-forming Processes 1  
 EPSC562 (3) Ore-forming Processes 2  
 BIOL352 (3) Vertebrate Evolution  
 Other Earth and Planetary Sciences courses may be substituted with permission.

**MINOR IN GEOCHEMISTRY (25 credits)****Required Courses (10 credits)**

EPSC201 (3) Understanding Planet Earth  
 EPSC210 (3) Introductory Mineralogy  
 EPSC212 (4) Introductory Petrology

**Complementary Courses (15 credits)**

15 credits selected from:  
 EPSC220 (3) Principles of Geochemistry  
 EPSC243 (3) Environmental Geology  
 EPSC501 (3) Crystal Chemistry  
 EPSC519 (3) Isotope Geology  
 EPSC542 (3) Chemical Oceanography  
 EPSC545 (3) Low-Temperature Geochemistry  
 EPSC561 (3) Ore-forming Processes 1  
 EPSC562 (3) Ore-forming Processes 2

**MAJOR IN EARTH AND PLANETARY SCIENCES (66 credits)**

Undergraduate Director: Don Baker, FD Adams, Room 310, (514) 398-7485

**U1 Required Courses (27 credits)**

EPSC203 (3) Structural Geology 1  
 EPSC210 (3) Introductory Mineralogy  
 EPSC212 (4) Introductory Petrology  
 EPSC220 (3) Principles of Geochemistry  
 EPSC231 (2) Field School 1  
 EPSC233 (3) Earth and Life History  
 EPSC312 (3) Spectroscopy of Minerals

MATH222 (3) Calculus 3  
approved (3) statistics course

**Note:** Students who have not had the following course or its equivalent in CEGEP or the Freshman Program may be required to take MATH133 Vectors, Matrices and Geometry.

**U2 and/or U3 Required Courses** (24 credits)

**HONOURS IN PLANETARY SCIENCES** (81 credits)

CGPA  $\geq$  3.20

**U1 Required Courses** (27 credits)

**HONOURS IN EARTH SCIENCES** (75 credits)

(CGPA  $\geq$  3.20)

**U1 Required Courses** (27 credits)

**Note:** Students who have not had the following course or its equivalent in CEGEP or the Freshman Program may be required to take MATH133 Vectors, Matrices and Geometry.

**U2 and/or U3 Required Courses** (42 credits)

**Note:** Students who have not had the following course or its equivalent in CEGEP or the Freshman Program may be required to take MATH133 Vectors, Matrices and Geometry.

**U2 and/or U3 Required Courses** (33 credits)



**JOINT MAJOR IN PHYSICS AND GEOPHYSICS** under "Physics (PHYS)", in section 12.12.25.

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### **12.12.10 Earth System Science Interdepartmental Major (ESYS)**

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

The ESS Major is offered jointly by the following departments:

- Atmospheric and Oceanic Sciences (ATOC)
- Earth and Planetary Sciences (EPSC)
- Geography (GEOG)

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

Program Advisers:

Department of Atmospheric and Oceanic Sciences:

- Professor Peter Yau
- Burnside Hall, Room 818
- E-mail: peter.yau@mcgill.ca
- Telephone: (514) 398-3719

Department of Earth and Planetary Sciences:

- Professor Don Baker
- Frank Dawson Ad9 3459 TTIel(10.081 9.75 -9 TD 0.3u nts, Planetary Sciences (EPSC)) Tj T\* 0.393 Tc T\* 0.393 ops.lephone: (514) 398-3719

E-mail: 0 Sciences (E2SC)

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T.R. Moore; B.Sc.(Swansea), Ph.D.(Aberd.) (*on leave 2006*)  
 N.T. Roulet; B.Sc., M.Sc.(Trent), Ph.D.(McM.) (*on leave 2005*)  
 (*James McGill Professor*)

G.W. Wenzel; M.A.(Manit.), Ph.D.(McG.)

#### Associate Professors

G.L. Chmura; B.Sc.(Mass.), M.Sc.(R.I.), Ph.D.(L.S.U.)

O.T. Coomes; B.Sc.(U.Vic.), M.A.(Tor.), Ph.D.(Wsc.)

G.O. Ewing; M.A.(Glas.), M.A., Ph.D.(McM.)

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

T.C. Meredith; B.E.S.(Wat.), M.Sc., Dip.Cons.(Lond.),  
 Ph.D.(Camb.)

L. Müller-Wille; Dr.phil.(Münster) (*on leave Sept. 2005 -  
 August 2006*)

W.H. Pollard; B.A., M.Sc.(Guelph), Ph.D.(Ott.)

J. Unruh; B.A.(Kansas), M.S.(Wisc.), Ph.D.(Ariz.)

#### Assistant Professors

K.D. Mok; B.E.S., B. Math.(Wat.), M. Pl.(Queen's), Ph.D.(Tor.)

G. Peterson; B.A.Sc., M.Sc.(Wat.), Ph.D.(Florida)

N.A. Ross; B.A., M.A.(Queen's), Ph.D.(McM.)

J.W. Seaquist; B.Sc.(Tor.), Ph.D.(Lund)

R. Sengupta; B.Sc.(Bombay), M.Sc.(Indian IT Mumbai), M.S.,  
 Ph.D.(S.Illinois-Carbondale) (*joint appoint. with McGill School  
 of Environment*)

R.E. Sieber; B.Sc.(Mich. St.), M.P.A.(W. Mich.), Ph.D.(Rutgers)  
 (*joint appoint. with McGill School of Environment*)

I.B. Strachan; B.Sc.(Tor.), M.Sc., Ph.D.(Queen's) (*cross appoint.  
 with Natural Resource Sciences*)

S. Turner; B.Soc.Sci., M.Soc.Sc.(Waikata), Ph.D.(Hull)

J. Wiles; B.A., M.A.(Otago), Ph.D.(Queen's)

**The Department of Geography offers programs in both Arts and Science. All B.A. programs in Geography (including Urban Systems) can be found in the Faculty of Arts entry Geography (GEOG), in section 5.12.23.**

Geography is the study of physical environments and human habitats. It deals with people and places. It covers issues such as global warming and climate change, regional economic disparities, urban transportation, native land claims and permafrost problems. Both a physical and a social science, it provides a unique opportunity

### 12.12.11 Environment

All courses given by the McGill School of Environment (Subject Code ENVR) are considered as courses taught by the Faculty of Science.

Science students who are interested in studying the environment should refer to the "**McGill School of Environment**", in **section 14**, where they will find information concerning the Minor Program in Environment and the B.Sc. Major Program in Environment.

### 12.12.12 Experimental Medicine (EXMD)

Lady Meredith House, Room 101

E-mail: [experimental.medicine@mcgill.ca](mailto:experimental.medicine@mcgill.ca)

Website: [www.medicine.mcgill.ca/EXPMED/expmed1.html](http://www.medicine.mcgill.ca/EXPMED/expmed1.html)

Experimental Medicine is a division of the Department of Medicine. There are no B.Sc. programs in Experimental Medicine, but the EXMD courses listed in the Courses section of this Calendar are considered as courses taught by the Faculty of Science.

### 12.12.13 Geography (GEOG)

Burnside Hall, Room 705  
 805 Sherbrooke Street West  
 Montreal, QC H3A2K6

Telephone: (514) 398-4951 or 398-4111

Fax: (514) 398-7437

Website: [www.geog.mcgill.ca](http://www.geog.mcgill.ca)

*Chair* — G.O. Ewing

*Emeritus Professor*

B.J. Garnier; M.A.(Cantab.)

*Professors*

P.G. Brown; B.A.(Haverford), M.A., Ph.D.(Col.) (*joint appoint. with  
 McGill School of Environment and Natural Resource Sciences*)

A Science Major Concentration in Geography - Physical Option is available to students pursuing the B.A. & Sc. degree. This Major Concentration is described in the Bachelor of Arts and Science section of the Calendar; see "[Geography \(GEOG\)](#)", [section 5.12.23](#) for details.

**MINOR IN GEOGRAPHY** (expandable into the B.Sc. Major in Geography) (18 credits)

The Minor in 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** (12 credits)

- GEOG203 (3) Environmental Systems
- GEOG216 (3) Geography of the World Economy
- GEOG217 (3) The Canadian City
- GEOG302 (3) Environmental Management 1

**Complementary Courses** (6 credits)

6 credits of Geography courses at the 300 and 400 level.

**B.Sc. MINOR IN GEOGRAPHICAL INFORMATION SYSTEMS** (18 credits)

The Minor in GIS is designed to provide students in the Faculty of Science who have an interest in GIS with a basic, but comprehensive, knowledge of concepts and methods relating to the analysis of geospatial data.

**Required Courses** (15 credits)

- GEOG201 (3) Introductory Geo-Information Science
- GEOG306 (3) Raster Geo-Information Science
- GEOG307 (3) Socioeconomic Applications of GIS
- GEOG308 (3) Principles of Remote Sensing
- GEOG506 (3) Perspectives on Geographic Information Analysis

**Complementary Course** (3 credits)

one course to be chosen from:

- ATOC414 (3) Applications of Remote Sensing
- COMP420 (3) Files and Databases
- COMP557\* (3) Fundamentals of Computer Graphics
- GEOG535 (3) Remote Sensing and Interpretation
- GEOG551 (3) Environmental Decisions
- URBP505 (3) Geographic Information Systems

\*Note prerequisites

**B.Sc. MAJOR IN GEOGRAPHY** (58 credits)

The Major is designed to provide a coverage of the main elements of physical geography.

**Required Courses** (22 credits)

- GEOG201 (3) Introductory Geo-Information Science
- GEOG203 (3) Environmental Systems
- GEOG216 (3) Geography of the World Economy
- GEOG217 (3) The Canadian City
- GEOG272 (3) Earth's Changing Surface
- GEOG302 (3) Environmental Management 1
- GEOG351 (3) Quantitative Methods
- GEOG290 (1) Local Geographical Excursion  
(In 2005 reserve Sept. 23-25)

**Complementary Courses** (36 credits)

3 credits of statistics\*

- BIOL373 (3) Biometry
- GEOG202 (3) Statistics and Spatial Analysis
- MATH203 (3) Principles of Statistics 1
- PSYC204 (3) Introduction to Psychological Statistics
- SOCI350 (3) Statistics in Social Research

\* Credit given for statistics courses is subject to certain restrictions, see Faculty Degree Requirements, [section 12.3.6.1 "Course Overlap"](#)

3 credits of GIS techniques:

- GEOG306 (3) Raster Geo-Information Science

- GEOG308 (3) Principles of Remote Sensing

12 credits of systematic physical geography:

- GEOG305 (3) Soils and Environment
- GEOG321 (3) Climatic Environments
- GEOG322 (3) Environmental Hydrology
- GEOG350 (3) Ecological Biogeography
- GEOG372 (3) Running Water Environments

3 credits of field courses:

- GEOG495 (3) Field Studies - Physical Geography
- GEOG496 (3) Geographical Excursion
- GEOG497 (3) Ecology of Coastal Waters
- GEOG499 (3) Subarctic Field Studies

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

15 credits from **approved** courses in Geography, or elsewhere in the Faculty of Science, or in the Faculty of Engineering; at least 9 credits of which are to be taken outside Geography. Students may also include any courses that are not already counted towards the GIS techniques or the systematic physical geography requirements. Admission to 500-level courses in Geography requires the instructor's permission. It is not advisable to take more than one 500-level course in a term.

**Geography Approved Course List – Majors and Honours**

- GEOG404 (3) Environmental Management 2
- GEOG501 (3) Modelling Environmental Systems
- GEOG505 (3) Global Biogeochemistry
- GEOG506 (3) Perspectives on Geographic Information Analysis
- GEOG522 (3) Advanced Environmental Hydrology
- GEOG523 (3) Advanced Climatology
- GEOG535 (3) Remote Sensing and Interpretation
- GEOG536 (3) Geocryology
- GEOG537 (3) Advanced Fluvial Geomorphology
- GEOG550 (3) Quaternary Paleocology

**B.Sc. HONOURS IN GEOGRAPHY** (66 credits)

The Honours program is designed to provide specialized systematic training in physical geography. Honours students are required to achieve better than a B- in all courses counted towards their program. In addition, Honours students must complete a 6-credit research paper. Honours students are encouraged to participate in 500-level seminars with graduate students, but it is not advisable to take more than one in a term.

In addition to the Faculty requirement that Honours students maintain a minimum CGPA and program GPA of at least 3.20, students who enter a Geography Honours Program on or after September 2004 must achieve at least a B in all required program courses.

**Required Courses** (24 credits)

- GEOG201 (3) Introductory Geo-Information Science
- GEOG203 (3) Environmental Systems
- GEOG272 (3) Earth's Changing Surface
- GEOG302 (3) Environmental Management 1
- GEOG351 (3) Quantitative Methods
- GEOG381 (3) Geographic Thought and Practice
- GEOG491D1 (3) Honours Research
- GEOG491D2 (3) Honours Research

**Complementary Courses** (42 credits)

6 credits of introductory courses, two of:

- GEOG210 (3) Global Places and Peoples
- GEOG216 (3) Geography of the World Economy
- GEOG217 (3) The Canadian City

3 credits of statistics\*, one of:

- BIOL373 (3) Biometry
- GEOG202 (3) Statistics and Spatial Analysis
- MATH203 (3) Principles of Statistics 1
- PSYC204 (3) Introduction to Psychological Statistics
- SOCI350 (3) Statistics in Social Research

\* Credit given for statistics courses is subject to certain restrictions, see Faculty Degree Requirements, [section 12.3.6.1 "Course Overlap"](#)

3 credits of GIS techniques:

GEOG306 (3) Raster Geo-Information Science  
GEOG308 (3) Principles of Remote Sensing

12 credits of systematic physical geography:

GEOG305 (3) Soils and Environment  
GEOG321 (3) Climatic Environments  
GEOG322 (3) Environmental Hydrology  
GEOG350 (3) Ecological Biogeography  
GEOG372 (3) Running Water Environments

3 credits of field courses:

GEOG495 (3) Field Studies - Physical Geography  
GEOG496 (3) Geographical Excursion  
GEOG497 (3) Ecology of Coastal Waters  
GEOG499 (3) Subarctic Field Studies

15 credits from **approved** courses - in Geography, or elsewhere in the Faculty of Science or the Faculty of Engineering; at least 9 credits of which are to be taken outside Geography. Students may also include any courses that are not already counted towards the GIS techniques or the systematic physical geography requirements. Admission to 500-level courses in Geography requires the instructor's permission. It is not advisable to take more than one in a term.

#### AFRICAN FIELD STUDY SEMESTER

The Department of Geography, Faculty of Science, coordinates the 15-credit interdisciplinary African Field Study Semester, [see section 15.1.1 "African Field Study Semester"](#). **Note: The AFSS will only be offered in 2005-06 pending approval by the Dean of Science.**

#### 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 [see section 15.1.3 "Panama Field Study Semester"](#).

#### GEOGRAPHY COURSES OF MOST INTEREST TO SCIENCE STUDENTS:

GEOG199 FYS: Geo-Environments  
GEOG201 Introductory Geo-Information Science  
GEOG203 Environmental Systems  
GEOG205 Global Change: Past, Present and Future  
GEOG272 Earth's Changing Surface  
GEOG290 Local Geographical Excursion  
GEOG302 Environmental Management 1  
GEOG305 Soils and Environment  
GEOG306 Raster Geo-Information Science  
GEOG308 Principles of Remote Sensing  
GEOG321 Climatic Environments  
GEOG322 Environmental Hydrology  
GEOG350 Ecological Biogeography  
GEOG351 Quantitative Methods  
GEOG370 Protected Areas  
GEOG372 Running Water Environments  
GEOG404 Environmental Management 2  
GEOG490 Geography: Independent Studies  
GEOG495 Field Studies - Physical Geography  
GEOG496 Geographical Excursion  
GEOG497 Ecology of Coastal Waters  
GEOG499 Subarctic Field Studies  
GEOG501 Modelling Environmental Systems  
GEOG505 Global Biogeochemistry  
GEOG506 Perspectives on Geographic Information Analysis  
GEOG522 Advanced Environmental Hydrology  
GEOG523 Advanced Climatology  
GEOG535 Remote Sensing and Interpretation  
GEOG536 Geocryology  
GEOG537 Advanced Fluvial Geomorphology  
GEOG550 Quaternary Paleocology

#### EARTH SYSTEM SCIENCE INTERDEPARTMENTAL MAJOR, [see section 12.12.10 "Earth System Science Interdepartmental Major \(ESYS\)"](#).

This program is offered by the Departments of Atmospheric & Oceanic Sciences, Earth & Planetary Sciences and Geography.

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

- Professor Timothy Moore, until December 2005 (tim.moore@mcgill.ca)
- Professor Raja Sengupta, from January 2006 (sengupta@geog.mcgill.ca)

#### 12.12.14 Immunology Interdepartmental Honours

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

For graduation in the Honours program, the student must complete a minimum of 90 credits, and achieve a CGPA of not less than 3.30. The five immunology courses (MIMM314, BIOC503, MIMM414, PHGY419D1/D2, PHGY513) must all be passed with a grade not less than B.

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

Apply to Dr. M. G. Baines, Microbiology and Immunology, malcolm.baines@mcgill.ca, (514) 398-4443 or (514) 398-3928 or Dr. Julie Desbarats, Physiology, julie.desbarats@mcgill.ca, (514) 398-4327 or (514) 398-5126.

**INTERDEPARTMENTAL HONOURS IN IMMUNOLOGY**

(77credits)

**U1 Required Courses** (20 credits)

BIOL200	(3)	Molecular Biology
BIOL201	(3)	Cell Biology and Metabolism
or BIOC212	(3)	Molecular Mechanisms of Cell Function
CHEM203	(3)	Survey of Physical Chemistry
or CHEM204	(3)	Physical Chemistry/Biological Sciences 1
CHEM212	(4)	Introductory Organic Chemistry 1
CHEM222	(4)	Introductory Organic Chemistry 2
PHGY209	(3)	Mammalian Physiology 1
or MIMM211	(3)	Introductory Microbiology

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

BIOL373	(3)	Biometry
or MATH203	(3)	Principles of Statistics 1
or PSYC204	(3)	Introduction to Psychological Statistics

**U1 Complementary Courses** (6 credits)

3 credits, one of:

ANAT261	(4)	Introduction to Dynamic Histology
MIMM211	(3)	Introductory Microbiology
PHGY210	(3)	Mammalian Physiology 2

3 credits selected from:

ANAT214	(3)	Systematic Human Anatomy
ANAT262	(3)	Introductory Molecular and Cell Biology
BIOL202	(3)	Basic Genetics
BIOL205	(3)	Biology of Organisms
BIOL304	(3)	Evolution
CHEM257D1	(2)	Introductory Analytical Chemistry
and CHEM257D2	(2)	Introductory Analytical Chemistry
COMP202	(3)	Introduction to Computing 1
COMP203	(3)	Introduction to Computing 2
MATH204	(3)	Principles of Statistics 2
MIMM212	(2)	Laboratory in Microbiology
PHGY209	(3)	Mammalian Physiology 1

**U2 Required Courses** (15 credits)

BIOC311	(3)	Metabolic Biochemistry
BIOC312	(3)	Biochemistry of Macromolecules
MIMM314	(3)	Immunology
BIOC300D1	(3)	Laboratory in Biochemistry
and BIOC300D2	(3)	Laboratory in Biochemistry
or MIMM386D1	(3)	Laboratory in Microbiology and Immunology
and MIMM386D2	(3)	Laboratory in Microbiology and Immunology

**U2 Complementary Courses** (9 credits)

one of:

ANAT261	(4)	Introduction to Dynamic Histology
MIMM211	(3)	Introductory Microbiology
PHGY210	(3)	Mammalian Physiology 2

plus two courses, 6 credits, selected from:

ANAT265	(3)	Cell Biology: Secretory Process
BIOL300	(3)	Molecular Biology of the Gene
BIOL314	(3)	Molecular Biology of Oncogenes
CHEM302	(3)	Introductory Organic Chemistry 3
MATH222	(3)	Calculus 3
MATH315	(3)	Ordinary Differential Equations
or BIOL309	(3)	Mathematical Models in Biology
MIMM323	(3)	Microbial Physiology
MIMM324	(3)	Fundamental Virology
PATH300	(3)	Human Disease
PHAR300	(3)	Drug Action
PHAR301	(3)	Drugs and Disease
PHAR303	(3)	Principles of Toxicology
PHGY311	(3)	Intermediate Physiology 1
PHGY312	(3)	Intermediate Physiology 2
PHGY313	(3)	Intermediate Physiology 3
PHGY314	(3)	Integrative Neuroscience

**U3 Required Courses** (18 credits)

BIOC503	(3)	Immunochemistry
MIMM414	(3)	Advanced Immunology
PHGY419D1	(4.5)	Project and Seminar in Immunology
PHGY419D2	(4.5)	Project and Seminar in Immunology
PHGY513	(3)	Cellular Immunology

**U3 Complementary Courses** (6 credits)

6 credits selected from:

BIOL520	(3)	Gene Activity in Development
BIOC404	(3)	Biophysical Chemistry
BIOC450	(3)	Protein Structure and Function
BIOC454	(3)	Nucleic Acids
BIOC458	(3)	Membranes and Cellular Signaling
or ANAT458	(3)	Membranes and Cellular Signaling
MIMM413	(3)	Parasitology
MIMM465	(3)	Bacterial Pathogenesis
MIMM466	(3)	Viral Pathogenesis
MIMM509	(3)	Inflammatory Processes
PHAR503	(3)	Drug Design and Development 1
PHAR504	(3)	Drug Design and Development 2
PHGY531	(3)	Topics in Applied Immunology
PHGY552	(3)	Cellular and Molecular Physiology

**12.12.15 Kinesiology for Science Students**

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

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

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

**MINOR IN KINESIOLOGY FOR SCIENCE STUDENTS**

(24 credits)

**Required Courses** (9 credits)

EDKP206	(3)	Biomechanics of Human Movement
EDKP393	(3)	Skill Learning and Expertise
EDKP395	(3)	Exercise Physiology

**Complementary Courses** (15 credits)

6 credits, two of the following courses:

PHGY201	(3)	Human Physiology: Control Systems
or PHGY209	(3)	Mammalian Physiology 1
PHGY202	(3)	Human Physiology: Body Functions
or PHGY210	(3)	Mammalian Physiology 2

9 credits, three of the following courses:

EDKP261	(3)	Motor Development
EDKP303	(3)	Advanced Biomechanics
EDKP330	(3)	Physical Activity and Health
EDKP394	(3)	Historical Perspectives
EDKP396	(3)	Adapted Physical Activity
EDKP444	(3)	Ergonomics
EDKP445	(3)	Exercise Metabolism
EDKP446	(3)	Physical Activity and Ageing
EDKP447	(3)	Motor Development 2
EDKP448	(3)	Exercise and Health Psychology
EDKP449	(3)	Exercise Pathophysiology 2
EDKP485	(3)	Exercise Pathophysiology 1
EDKP495	(3)	Scientific Principles of Training
EDKP498	(3)	Sport Psychology
EDKP505	(3)	Sport in Society
EDKP542	(3)	Environmental Exercise Physiology
EDKP550	(3)	Analyzing Instructional Behaviors
EDKP553	(3)	Physical Activity Assessments
EDKP566	(3)	Biomechanical Assessment
EDKP568	(3)	Biomechanics Instrumentation



*Adjunct Professors*

Donald A. Dawson; B.Sc., M.Sc.(McG.), Ph.D.(M.I.T.)

Martin J. Gander; M.S.(ETH), M.S., Ph.D.(Stan.)

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

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

*Faculty Lecturers*

Jose A. Correa; M.Sc.(Wat.), Ph.D.(Carleton)

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

Mathematics has evolved to a discipline which is mainly characterized by its method of proof, its concern for a progressive broadening of its concepts, and by the search for mathematical entities and operations that represent aspects of reality. It is a subject which is pursued by many for its own sake, and regarded as part of the mainstream of human culture. Mathematics pervades modern society with an impact which, already immense, is rapidly growing.

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the requirements for the Minor from the Departmental Chief Adviser (or delegate).

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

**Required Courses** (15 credits)

MATH222 (3) Calculus 4 TD 0.1507 Tw (eyE65 TD 0.195 Tc ((3)) Tj 18 0 TD 0.2583 Tn6Tf 0 0.2Tj 18 0 TD 0.2583 Tc -0.0933 Tw (Calculus 4 8Tj -3

**Complementary Courses** (6 credits)

**FACULTY PROGRAM IN MATHEMATICS, STATISTICS AND COMPUTER SCIENCE** (54 credits)

**Required Courses** (33 credits)

**Complementary Courses** (9 credits)

No more than 6 credits may be taken outside the Department of Mathematics and Statistics.

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

**FACULTY PROGRAMS**

Programs linking mathematics and other disciplines are available. With careful selection of courses in U1, it is possible to transfer to a Major program in Mathematics in U2. Except where otherwise noted these Faculty Programs lead to a B.Sc. degree. Students interested in any of these Faculty Programs should consult the Department of Mathematics and Statistics for an adviser.

**FACULTY PROGRAM IN BIOLOGY AND MATHEMATICS** under "Biology (BIOL)", in section 12.12.4.

**FACULTY PROGRAM IN CHEMISTRY AND MATHEMATICS** under "Chemistry (CHEM)", in section 12.12.6.

**FACULTY PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE** (54 credits)

**Required Courses** (48 credits)

**Complementary Courses** (21 credits)

**FACULTY PROGRAM IN MATHEMATICS, CHEMISTRY AND PHYSICS** (56 credits)

**Required Courses** (47 credits)





**Complementary Courses (15 credits)**

12 credits of extra-mural courses:  
chosen in consultation with the student's adviser from approved courses in other departments. A list of such courses is available from the Department of Mathematics and Statistics. Student initiative is encouraged in suggesting other courses that fulfill the intentions of this section as described above. Such suggestions must receive departmental approval. They must be in a field related to Applied Mathematics such as Atmospheric and Oceanic Science, Biology, Biochemistry, Chemistry, Computer Science, Earth and Planetary Science, Economics, Engineering, Management, Physics, Physiology and Psychology. At least 6 credits must be chosen from a single department other than Computer Science.

**HONOURS IN APPLIED MATHEMATICS (68 credits)**

Aside from seeking to develop a sound basis in Applied Mathematics, one of the objectives of the program is to kindle the students' interest in possible areas of application. The extra-mural courses are included to ensure that the student has some appreciation of the scope of Applied Mathematics and is familiar with at least one of the diverse areas in which applications can be found.

**Required Courses (39 credits)**

**HONOURS IN PROBABILITY AND STATISTICS (63 credits)**

**Complementary Courses (29 credits)**

**JOINT HONOURS IN MATHEMATICS AND COMPUTER SCIENCE** (72credits)

Students must consult an Honours adviser in both departments.

**Required Courses** (42 credits)

Malcolm G. Baines; B.Sc., M.Sc., Ph.D.(Queen's)  
 James W. Coulton; B.Sc.(Tor.), M.Sc.(Calg.), Ph.D.(W.Ont.)  
 John Hiscott; B.Sc., M.Sc.(W.Ont.), Ph.D.(N.Y.)  
 Greg Matlashewski; B.Sc.(C'dia), Ph.D.(Ott.)  
 Robert A. Murgita; B.Sc.(Me.), M.S.(Vt.), Ph.D.(McG.)  
 Trevor Owens; B.Sc., M.Sc.(McG.), Ph.D.(Ott.)  
 Mark A. Wainberg; B.Sc.(McG.), M.Sc., Ph.D.(Col.)

*Associate Professors*

Albert Berghuis; M.Sc.(The Netherlands), Ph.D.(Br.Col.)  
 Dalius J. Briedis; B.A., M.D.(Johns H.)

*Assistant Professors*

Benoit Cousineau; B.Sc., M.Sc., Ph.D.(Montr.)  
 Sylvie Fournier; Ph.D.(Montr.)  
 Hervé Le Moual; Ph.D.(Montr.)  
 Gregory T. Marczynski; B.Sc., Ph.D.(Illinois)  
 Martin Olivier; B.Sc.(Montr.), Ph.D.(McG.)  
 Ciriaco Piccirillo; B.Sc., Ph.D.(McG.)  
 Donald Sheppard; M.D. (Tor.)

*Associate Members*

Institute of Parasitology: Gaetan Faubert, Armando Jardim,  
 PaulaRibeiro, Terence Spithill  
 Division of Experimental Medicine: Clement Couture  
 Microbiology & Immunology: LawrenceKleiman  
 Medicine: Marcel Behr, AndreDascal, SabahHussain, Richard  
 Lalonde, VivianLoo, J.DickMaclean, JackMendelson,  
 MarkA.Miller, Jay Nadeau, MariannaNewkirk,  
 RogerG.E.Palfree, Kostas Pantopoulos, Joyce E.Rauch,  
 Mary Stevenson, McG.)  
 Montr.)

**Complementary Courses** (30 credits)

**JOINT HONOURS IN MATHEMATICS AND PHYSICS** under  
 "Physics (PHYS)", in section 12.12.25.

**12.12.18 Microbiology and Immunology (MIMM)**

Lyman Duff Medical Sciences Building, Room 511  
 3775 University Street  
 Montreal, QC H3A 2B4

Telephone: (514) 398-3915  
 Fax: (514) 398-7052  
 E-mail: office.microimm@mcgill.ca  
 Website: [www.mcgill.ca/microimm](http://www.mcgill.ca/microimm)

*Chair* — Greg J. Matlashewski

*Emeritus Professor*

Eddie C.S. Chan; M.A.(Texas), Ph.D.(Maryland)

*Professors*

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



**Complementary Courses** (9 credits)

This program is offered by the Departments of Biochemistry, Microbiology and Immunology, and Physiology.

Students interested in immunology may choose between this Honours program and the Honours program of the Department of Microbiology and Immunology.

Details of this program may also be obtained from Professor Baines in the Department of Microbiology and Immunology, Room 404, telephone (514) 398-4443 or 3928, e-mail malcolm.baines@mcgill.ca.

**12.12.19 Music**

Strathcona Music Building  
555 Sherbrooke Street West  
Montreal, QC H3A 1E3

Telephone: (514) 398-4535

Fax: (514) 398-8061

Website: [www.mcgill.ca/music](http://www.mcgill.ca/music)

*Department of Theory — TBA*

*Department of Performance — Douglas McNabney (Chair)*

*Adviser (B.A./B.Sc. Music programs) — B. Minorgan  
(514)398-4535, ext. 6333*

**SCIENCE MINOR IN MUSIC TECHNOLOGY** (24 credits)

[Program registration done by Student Affairs Office]

Enrolment in the Minor in Music Technology program is highly restricted. Application forms will be available from the Department of Theory office of the /s TD 0.ent of Py47.5 ajor of The3514) 3

**HONOURS IN MICROBIOLOGY AND IMMUNOLOGY**

(73 required credits)

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

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

**U1 Required Courses** (25 credits)**U1, U2 or U3 Required Statistics Courses** (3 credits)**U2 Required Courses** (21 credits)**U3 Required Courses** (21 credits)**Complementary Courses** (3 credits)

**INTERDEPARTMENTAL HONOURS IN IMMUNOLOGY**, under "Immunology Interdepartmental Honours", in section 12.12.14.



Alfredo Ribeiro-da-Silva; M.D., Ph.D.(Oporto)  
Bernard Robaire; B.A.(Calif.), Ph.D.(McG.) (*James McGill  
Professor*)

Moshe Szyf; M.Sc., Ph.D.(Hebrew U.)  
Jacquetta Trasler; M.D.C.M., Ph.D.(McG.)  
Daya R. Varma; M.D.(Lucknow), Ph.D.(McG.)  
Hans H. Zingg; M.D., Ph.D.(McG.)

*Associate Professors*

Barbara Esplin; M.D.(Warsaw)  
Dusica Maysinger; Ph.D.(Los Angeles)  
Anne McKinney; Ph.D.(Ulster)  
Stanley Nattel; B.Sc., M.D.,C.M.(McG.)  
Ante L. Padjen; M.D., M.Sc., D.Sc.(Zagreb)  
H. Uri Saragovi; Ph.D.(Miami)  
Betty I. Sasyniuk; B.S.P., Ph.D.(Man.)  
Edith A. Zorychta; B.Sc.(F.X.), M.Sc., Ph.D.(McG.)

*Assistant Professor*

Derek Bowie; B.Sc., Ph.D.(Lond.)

*Associate Members*





Students from outside of the Province of Quebec will ordinarily register in the Science Freshman program. Physics offers two sequences of courses for this program: they are described below.

The list of pre- and corequisites is not absolute. In many cases permission of the Department may be sought to have a specific prerequisite waived. The procedure is to ask the professor in charge of the course to review the request for such a waiver. The prerequisites of the 100-level courses are described in the following section entitled Science Freshman Program.

Students interested in any of the Physics programs should contact the Department for an Adviser.

A Science Major Concentration in Physics is available to students pursuing the B.A. & Sc. degree. This Major Concentration is described in the Bachelor of Arts and Science section of the Calendar; see "[Physics \(PHYS\)](#)", in [section 12.12.25](#) for details.

#### **Internship Year for Engineering and Science (IYES)**

IYES is a pre-graduate work experience program available to eligible students and normally taken between their U2 and U3 years. For more information, see "[IYES: Internship Year for Engineering and Science](#)", in [section 8.2.8](#), under Faculty of Engineering.

The following programs are also available with an internship component:

- Faculty Program in Physics

- Major in Physics

- Honours in Physics

- Joint Honours Program in Physics and Chemistry

- Joint Honours Program in Physics and Mathematics

- Joint Faculty Program in Mathematics, Chemistry and Physics

- Joint Major Program in Atmospheric Science and Physics

- Joint Major Program in Physics and Computer Science

- Joint Major Program in Physics and Geophysics

for program available 301 T\* 0.30966115 -9.75 TD 0.2e Tc Tc 0 -0.165 TD 0 the SciCEGEPthe ril0.25ysics andchemistry

**JOINT MAJOR IN PHYSICS AND GEOPHYSICS** (68 credits)

The Joint Major program in Physics and Geophysics provides a firm basis for graduate work in geophysics and related fields as well as a sound preparation for those who wish to embark on a career directly after the B.Sc.

**U1 Required Courses** (29 credits)

**U2 Required Courses** (18 credits)

**U2 or U3 Required Courses** (6 credits)

**U3 Required Courses** (15 credits)

**JOINT MAJOR IN ATMOSPHERIC SCIENCE AND PHYSICS**

under "Atmospheric and Oceanic Sciences (ATOC)", in section 12.12.2

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**JOINT MAJOR IN PHYSIOLOGY AND PHYSICS (80credits)**

[A minor program revision is under consideration for September 2005. Go to [www.mcgill.ca](http://www.mcgill.ca) (Course Calendars) in July for details.]

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.

**U1 Required Courses (17 credits)**

**U1 Complementary Courses (9 credits)**

**U2 Required Courses (21 credits)**

**U2 Complementary Course (6 credits)**

**U2 or U3 Required Courses (6 credits)**

**U3 Required Courses (21 credits)**

**HONOURS IN PHYSIOLOGY (75 credits)**

[A minor program revision is under consideration for September 2005. Go to [www.mcgill.ca](http://www.mcgill.ca) (Course Calendars) in July for details.]

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 PHGY209 and PHGY210. 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 June 1. Application forms are available in McIntyre 1021. Students should include in their letters telephone numbers where they can be

(514) 393-8353. August 5, 2005. 0981-1500-1213-0135 (47 credits) -9Bnts ,m(6 cre0PYTfl bYy Hicklastupetters telephont. d ) Tj Ttyre 10

Ronald Melzack; M.Sc., Ph.D.(McG.), F.R.S.C. (*E.P. Taylor Emeritus Professor of Psychology*)  
Peter M. Milner; B.Sc.(Leeds), M.Sc., Ph.D.(McG.)

#### Professors

Frances E. Aboud; B.A.(Tor.), M.A., Ph.D.(McG.)  
Irving M. Binik; B.A.(N.Y.U.), B.H.L.(Jewish Theological Seminary), M.A., Ph.D.(Penn.)  
Avi Chaudhuri; B.Sc., M.Sc.(Tor.), Ph.D.(Berk.) (*James McGill Professor*)  
Blaine Ditto; B.S.(Iowa), Ph.D.(Ind.)  
Keith B.J. Franklin; B.A., M.A.(Auck.), Ph.D.(Lond.)  
Fred H. Genesee; B.A.(W.Ont.), M.A., Ph.D.(McG.)  
Jeffrey S. Mogil; B.Sc.(Tor.), Ph.D.(UCLA) (*E.P. Taylor Professor of Psychology and Canada Research Chair in Genetics of Pain*)  
Debbie S. Moskowitz; B.S.(Kirkland), M.A., Ph.D.(Ct.)  
Yuriko Oshima-Takane; B.A., M.A.(Tokyo), Ph.D.(McG.)  
David J. Ostry; B.A.Sc., M.A.Sc., Ph.D.(Tor.)  
Caroline Palmer; B.Sc.(Univ. of Michigan, Ann Arbor), M.Sc.(Rutgers), Ph.D.(Cornell) (*Canada Research Chair in Cognitive Neuropsychology of Performance*)  
Michael Petrides; B.Sc., M.Sc.(Lond.), Ph.D.(Cantab.)  
Robert O. Pihl; B.A.(Lawrence), Ph.D.(Ariz.)  
James O. Ramsay; B.Ed.(Alta.), Ph.D.(Prin.)  
Barbara B. Sherwin; B.A., M.A., Ph.D.(C'dia) (*James McGill Professor*)  
Thomas R. Shultz; B.A.(Minn.), Ph.D.(Yale)  
Yoshio Takane; B.L., M.A.(Tokyo), Ph.D.(N.Carolina)  
Donald M. Taylor; B.A., M.A., Ph.D.(W.Ont.)  
Norman M. White; B.A.(McG.), M.S., Ph.D.(Pitt.)  
David C. Zuroff; B.A.(Harv.), M.A., Ph.D.(Conn.)

#### Associate Professors

John R.Z. Abela; B.A.(Brown), M.A., Ph.D.(Penn.)  
A.G. Baker; B.A.(U.B.C.), M.A., Ph.D.(Dal.)  
Evan S. Balaban; B.A.(Michigan State), Ph.D.(Rockefeller)  
Mark Baldwin; B.A.(Tor.), M.A., Ph.D.(Waterloo)  
Don C. Donderi; B.A., B.Sc.(Chic.), Ph.D.(C'neil)  
Richard F. Koestner; B.A., Ph.D.(Roch.)  
Daniel J. Levitin; A.B.(Stan.), M.S., Ph.D.(Oregon) (*Bell Professor of Psychology and E-Commerce*)  
John Lydon; B.A.(Notre Dame), M.A., Ph.D.(Wat.)  
James C. Macdougall; B.A.(Car.), M.A., Ph.D.(McG.) (part-time)  
Morton J. Mendelson; B.Sc.(McG.), A.M., Ph.D.(Harv.)  
Gillian A. O'Driscoll; B.A.(Wellesley), M.A., Ph.D.(Harv.) (*William Dawson Scholar*)

#### Assistant Professors

Ian F. Bradley; B.Sc., M.Sc.(Tor.), Ph.D.(Wat.) (part-time)  
Moon-Ho R. Ho; B.Sc., M.Phil.(Chinese Univ. of Hong Kong), M.S., Ph.D.(Illinois)  
Baerbel Knaeuper; Diploma, Dr. phil.(U. of Mannheim), Dr. phil. habil. (Free University of Berlin)  
Karim Nader; B.Sc., Ph.D.(Tor.)  
Kristine Onishi; B.A. (Brown), M.A., Ph.D.(Ill.)  
Zeev Rosberger; B.Sc.(McG.), M.A., Ph.D.(C'dia) (part-time)  
Debra Titone; B.A.(NY), M.A., Ph.D.(SUNY, Binghamton)  
Athena Vouloumanos; B.Sc.(McG), Ph.D.(UBC)

#### Lecturers

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

#### Associate Members

Clinical Research Institute of Montreal: Terrance J.Coderre  
Douglas Hospital: Howard Steiger  
Faculty of Management (McG.): Ulf Bockenholt  
Montreal Neurological Institute: Marilyn Jones-Gotman,  
Brenda Milner, Tomas Paus, Wayne Sossin, Viviane Sziklas,  
Robert Zatorre  
Psychiatry: Frances Abbott  
Vision Research Unit (Ophthalmology): Curtis Baker,  
Robert Hess, Frederick A.A. Kingdom, Kathleen Mullen

#### Adjunct Professors

S. Bergeron; B.Sc.(U. of Montreal), Ph.D.(McG.)  
S. Burstein; B.Sc.(McG.), M.A., Ph.D.(Wat.)

F. Cramer-Azima; B.A.(Queen's), M.A. (Cornell), Ph.D.(Mont.)  
P. Delise; B.Sc., M.Ps., Ph.D.(Montr.)  
C. Garson; B.A.,(C'dia), Ph.D.(McG.)  
P. Gregoire; B.A.(College St. Marie), B.Ph., L.Ph., Ph.D.(Montr.)  
A. Routtenberg; B.A.(McG.), M.A.(Northwestern), Ph.D.(Michigan)  
D. Sookman; B.A.(McG.), M.A.(Guelph), Ph.D.(C'dia)  
M. Spevack; B.Sc.(McG.), M.A.(Dal.), Ph.D.(McG.)  
S. Stotland; B.A.(C'dia), M.A.(Tor.), Ph.D.(McG.)  
A. Surkis; Ph.D.(Montr.)  
P. Zelazo; B.A.(Amer.Int'l. Coll.), M.S.(N. Carolina), Ph.D.(Wat.)

#### Part-time Appointments

Jorge Armony; B.Sc.(Buenos Aires), M.Sc., Ph.D.(NYU)  
Veronique Bohbot; B.A.(McG.), M.A., Ph.D.(Ariz.)  
Pasqualina Di Dio; B.A.(McG.), M.A., Ph.D.(Roch.),  
Judith LeGallais; B.A., M.A., Ph.D.(McG.)  
Martin LePage; B.A.(C'dia), Ph.D.(UQAM)  
Marco Leyton; B.Sc.(Memorial), M.A., Ph.D.(Conc.)  
Sonia Lupien; B.Sc., M.Sc., Ph.D.(Montr.)  
Zbigniew Pleszewski; M.A., Ph.D.(U. of Poznan)  
Stephen Stotland; B.A.(C'dia), M.A.(Tor), Ph.D.(McG.)

**The Department of Psychology offers programs in both Arts and Science. All B.A. programs in Psychology can be found in the Faculty of Arts entry, see section 5.12.43 "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 studies social interactions. As a biological science, it regards humans as the product of evolution and so studies them in biological perspective, comparing and contrasting human behaviour with that of other species.

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**Bachelor of Education Secondary Program (120 credits)**

The aim of this B.Ed. is to prepare teachers for the secondary school level through a program of academic studies and professional studies centred on school-based practicum components supported by courses in pedagogy, curriculum and educational foundations. In the case of the Concurrent Program, the academic component must be chosen from those listed above.

See the Faculty of Education for a full description of the **Bachelor of Education Secondary Program**, in section 7.5.1.1. In summary, it consists of the following:

**Academic components (54 credits):** in the present case these courses will be selected from the B.Sc. components of the Concurrent Program, and will count towards both degrees.

**Professional components (60 credits):** these include professional seminars, field experiences, foundation courses, pedagogy courses, and pedagogical support courses.

Pedagogy courses for the Concurrent program must include EDES370 Teaching General Science and EDEC335 Teaching Secondary Science, **or**, if Mathematics is the academic component chosen, EDES353 Secondary School Mathematics 1 and EDEC 338 Secondary School - Mathematics 2.

The following 18 credits can be included as electives in the B.Sc. component of the Concurrent program, and will count towards both degrees: EDEC247, EDEC262, EDPI309, EDPE300, either EDEC260 or EDEC261, and one of EDEC410, EDPE300, or EDPI309.

**Electives (6 credits).**

**Bachelor of Science Major or Major Concentration with a Minor for Teachers (120 credits)**

These B.Sc. programs, with the exception of the Major in Mathematics, are designed specifically as the Science component of the Concurrent B.Sc./B.Ed. Program. The general structure of these B.Sc. programs is as follows:

**Basic sciences (30 credits).** 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 statistics, and physics. Students with satisfactory results in International Baccalaureate, French Baccalaureate and Advanced Levels, and Advanced Placement tests may be exempt from some or all of the basic science courses.

**Required and complementary courses (54-70 credits).** The details of these programs are given below. Note that 54 of these credits can be counted towards the academic component of the B.Ed. program, but only for students in the Concurrent Program.

**Elective courses (20-36 credits).** These are electives from the B.Sc. perspective, but they must be suitably chosen if the stu-

**Additional Science courses** (9 credits)

**MAJOR CONCENTRATION IN PHYSICS WITH A MINOR IN CHEMISTRY FOR TEACHERS** (69 credits)

This program includes the 36 credits of the **MAJOR CONCENTRATION IN PHYSICS**, under "**Physics (PHYS)**", in **section 12.12.25**, the 18 credits of the **MINOR IN CHEMISTRY**, under "**Chemistry (CHEM)**", in **section 12.12.6** and the 15 credits of Science courses listed below.

**Additional Science courses** (15 credits)

**MAJOR IN MATHEMATICS FOR TEACHERS** (54 credits)

This program includes the 54 credits of the **MAJOR IN MATHEMATICS**, under "**Mathematics and Statistics (MATH)**", in **section 12.12.17**. Students taking the Major in Mathematics as part of the Concurrent Program are **required** to include the following courses as part of the Major.

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**12.12.30 Technological Entrepreneurship for Science Students**

Science students who wish to become entrepreneurs or to enter small to medium-sized companies in the high technology sector will find within this Minor a set of six (6) courses that cover relevant