Access, a project that gives Science students universal access to email, the Internet, and the latest in science software through computer 'infopoints' located in areas of the campus frequented by Science students.

The Faculty of Science offers programs leading to the degree of Bachelor of Science (B.Sc.). Admission is selective; fulfilment of the minimum requirements does not guarantee acceptance. Admission criteria are described under "Admission Requirements" beginning on page 13.

There are also two Diploma programs offered in Science. The Diploma in Environment, a 30-credit program available to holders of a B.Sc. or B.A. or equivalent, is described in the section on the McGill School of Environment, page 471. The Diploma in Meteorology is a one-year program available to holders of a degree in Mathematics, Engineering, Physics and other appropriate disciplines who wish to qualify for a professional career in Meteorology. For more information, see Atmospheric and Oceanic Sciences, page 362. All credits for these diplomas must be completed at McGill.

The concurrent B.Sc./B.Ed. program is designed to provide students with the opportunity to obtain both a B.Sc. and a B.Ed. after a minimum of 135 credits of study. For more information see section 11.28 and the Faculty of Education section 5.1.3.

A Bachelor of Software Engineering program (subject to Ministry of Education Approval) will be offered jointly with the Faculty of Engineering; see Faculty of Engineering section, page 252.

1.4 Student Affairs Office

The Student Affairs Office, located in Dawson Hall, provides assistance in interpreting records as well as general academic information and advice on the following: prerequisites and programs, degree requirements, registration, course change, procedures for withdrawal, deferred exams, supplemental exams, rereads, academic standing, inter-faculty transfer, year or term away, transfer credits, second programs, second degrees, and graduation.

Special requests can be made, in writing, to the Associate Dean (Academic and Student Affairs).

The Committee on Student Standing (CSS) will consider appeals of the Associate Dean's decisions. For information about CSS, see the Associate Dean's secretary.

2 Faculty Degree Requirements

Each student in the Faculty of Science must be aware of the Faculty Regulations as stated in this Calendar. While departmental and faculty advisers and staff are always available to give advice and guidance, the ultimate responsibility for completeness and correctness of course selection and registration, for compliance with, and completion of, program and degree requirements, and for the observance of regulations and deadlines *rests with the student*. It is the student's responsibility to seek guidance from the Student Affairs Office if in any doubt; misunderstanding or misapprehension will not be accepted as cause for dispensation from any regulation, deadline, program or degree requirement.

To be eligible for a B.Sc. degree, students must fulfil all Faculty and program requirements as indicated below:

Minimum Credit Requirement (section 2.1)
Residency (section 2.2)
CGPA (section 2.3)
Time Limit for the Completion of the Degree (section 2.4)
Program Requirements (section 2.5)
Course Requirements (section 2.6)

2.1 Minimum Credit Requirement

Each student's minimum credit requirement for the degree is determined at the time of acceptance and is specified in the letter of admission.

Normally, Quebec students who have completed the Diplôme

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For a more detailed description of the Science Freshman Program, students should consult the Arts and Science Freshman Student information available on the Internet, http://www.mcgill.ca/artscisao.

2.5.2 Faculty, Major, and Honours Programs

Science students who need 96 or fewer credits to complete their degree requirements are required to have an approved degree program and to select their courses in each term with a view to timely completion of their degree and program requirements. Students must register in one of the following types of departmental programs leading to the degree of Bachelor of Science:

A Faculty program is an approved coherent selection of courses giving students a useful concentration in a recognized area. Students in a Faculty program may choose a pattern of study that can range from one yielding a broad education to one specializing in particular areas.

Major programs are more specialized than Faculty programs and are usually centred on a specific discipline or department. For prospective teachers, the Faculty also offers Major programs in two subjects that can constitute the Science component of the Concurrent B.Sc./B.Ed. Program. For more information about this joint degree, please consult section 2.5.5.

Honours programs typically involve an even higher degree of specialization, often include supervised research, and require students to maintain a high academic standard. Although Honours

Credit for statistics courses will be given with the following stipulations:

1. Credit will be given for ONLY ONE of the following introductory statistics courses: 154-227D, 154-257D, 166-350A, 177-373A, 186-215B, 189-203A/B/C/L, 204-204A/B, 280-271A/B, 360-310A.

2. Credit will be given for ONLY ONE of the following intermediate statistics courses: 154-227D, 154-257D, 166-461B, 177-483B, 183-351B, 189-204B, 204-305A/B, 280-272B, 360-411B.

3. Students in Mathematics or Computer Science programs, and students who have already received credit for 189-324B, will NOT receive credit for any of the following: 154-227D, 154-257D, 166-350A, 177-373A, 186-215B, 189-203A/B/C/L, 189-204B, 204-204A/B, 204-305A/B, 280-271A/B, 280-272B, 360-310A, 360-411B.

4. For 500-level statistics courses not listed above, students must consult a program advisor to ensure that no significant overlap exists. Where such overlap exists with a course for which the student has already received credit, credit for the 500 level course will not be allowed.

5. Credit for statistics courses offered by faculties other than Arts and Science requires the permission of the Associate Dean of Science (Academic and Student Affairs), except for students in the B.Sc. Major in Environment, who may take required statistics courses in the Faculty of Agricultural and Environmental Sciences necessary to satisfy their program requirements.

2.6.2 Project Courses

Students may normally receive no more than 12 credits for individual project or independent study courses toward a B.Sc. degree.

2.6.3 Courses Outside the Faculties of Arts and Science

Students in the Faculty of Science should consult the statement of regulations for taking courses outside the Faculties of Arts and of Science. The regulations are posted in the Student Affairs Office, Dawson Hall, and on the Internet, http://www.mcgill.ca/artscisao. A list of approved/not approved courses in other faculties is posted with the regulations; students may take courses on the approved list and may not, under any circumstances, take courses on the not-approved list. Request for permission to take courses that are not on either list should be addressed to the Associate Dean.

The regulations are as follows:

- except for Music performance courses, courses taught in other faculties *and* specifically listed in the Arts or Science section are considered as courses taught in Arts or Science;

- restrictions apply to Music courses, even those listed in the Arts or Science section, unless the courses are part of a Minor in Music;

- courses in other faculties can be taken as elective courses or as part of a program as specified in the Calendar;

- students may take only 6 credits per year, up to 18 credits in all, of courses outside the Faculties of Arts and of Science;

- students must have the necessary prerequisites and permission of the instructor for such courses;

-

4   Registration

All students register by MARS, McGill's automated registration system.

New students register in August prior to the first day of classes.

5.1 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: A, B, D courses: April 30
- non-graduating students: A courses: April 30
  B, D 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. Please consult the General University Information section 4.7 for more information about grading and credit.

6 Examinations

Students should refer to the General University Information section 5 for information about final examinations and deferred examinations.

7 Supplemental Assessments

7.1 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 change of course 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.

For courses in the Faculties of Arts and of Science, the supplemental examination period for A courses is during the months of April and May, and for B and D courses during the last week of

August. Supplemental applications are available at the Student Affairs Office. The deadline for submission of applications is March 1 for A courses and July 15 for B and D courses. A non-refundable fee for each supplemental paper is payable at the time of application. Students who register for a supplemental examination and subsequently find themselves unprepared for it should not write it; except for the loss of the registration fee, there is no penalty for not writing a supplemental examination. Students should consult the Student Affairs Office for further information.

7.2 Additional Work

Instructors of courses that include graded written term work may choose to provide the option of additional work to eligible students. The following conditions apply:

- if there is an option for additional work, it must be announced in the course outline at the beginning of the course;
- additional work involves revising one or more previously submitted papers or submitting new written work to replace the original work;
- students must be in satisfactory or probationary standing;
- students must have received a final grade of D, J, F, or U in the course;
- the weight of the additional work will be equal to the weight given the work revised or replaced when the original mark was submitted;
- the mark resulting from the revised or additional work will be recorded as a supplemental mark;
- the supplemental result will not erase the grade originally obtained, which is used in calculating the GPA; both the original mark and the supplemental mark will count in calculating 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 work in courses outside the Faculties of Arts and of Science is subject to the deadlines, rules, and regulations of the relevant faculty.

Additional work applications are available in the Student Affairs Office. The deadline for submission of applications is Marc h1 for A courses and July 15 for B and D courses. A non-refundable fee is payable for each course at the time of application. Students should consult the Student Affairs Office for further information.

7.3 Reassessments and Rereads

In accordance with the Charter of Student Rights, and subject to the conditions stated therein, students have the right to consult any written submission for which they have received a mark as well as the right to discuss this submission with the examiner.

If, after discussion with the instructor, students request a formal final examination re-read, they must apply in writing to the Student Affairs Office. The following conditions apply:

- requests for rereads in more than one course per term will not be permitted;
- grades may be either raised or lowered as the result of a reread;
- rereads in courses outside the Faculty of Science are subject to the deadlines, rules and regulations of the relevant faculty.

Application for rereads must be made by March 31 for fall-term courses and by September 30 for winter-term and summer-term courses. Students are assessed a fee for formal rereads. Any request to have term work re-evaluated must be made directly to the instructor concerned. Students should consult the Student Affairs Office for further information.

8 Academic Standing

Academic standing is based on students' grade point average

- for *Great Distinction*, the CGPA at graduation must be 3.50 or greater;
- these designations may be withdrawn, in the case of transfer

10.5 Joint Honours Programs

Mathematics and Computer Science – see Mathematics and
  Statistics, also check with the School of Computer Science,
  since that unit may limit enrolment.
Mathematics and Physics – see Physics

10.6 Minor Programs

Atmospheric Science
Biology
Biotechnology
Chemical Engineering – see Chemistry
Chemistry
Cognitive Science
Computer Science
Earth and Planetary Sciences
Education for Science Students – see Science for Teachers
Electrical Engineering – see Physics
Environment
Geochemistry – see Earth and Planetary Sciences
Geography
Geographical Information Systems – see Geography
Human Nutrition – see Faculty of Agricultural and Environmental
  Sciences entry for School of Dietetics and Human Nutrition
Management* – see Faculty of Science entry for Management
Mathematics
Music – see Faculty of Science entry for Music
Music Technology – application required, see Faculty of Science
  entry for Music
Neuroscience
Pharmacology
Physics
Psychology
Statistics – see Mathematics and Statistics
Technological Entrepreneurship for Science Students* – see
  Faculty of Science entry (awaiting Final approval)

* Application procedures will be announced in September. Please
  consult the Student Affairs Office Website.

Notes:
1. The Minor in Computer Science is not available to students in
    the following programs: Honours in Computer Science;
    Honours in Mathematics and Computer Science; Faculty
    Program in Mathematics and Computer Science.

2. The Minor in Chemical Engineering is only available to stu-
    dents in Chemistry.

3. The Minor in Electrical Engineering is only available to students
    in the Major Program in Physics.

10.7 Internship Programs – Internship Year For Engineering And Science (IYES)

The following programs are also available with an Internship com-
ponent. For more information, please see section 2.8 in the Faculty
of Engineering section.

Atmospheric and Oceanic Sciences
Major in Atmospheric Science
Honours in Atmospheric Science

Computer Science
Major in Computer Science
Honours in Computer Science

Mathematics and Statistics
Major in Mathematics
Honours in Mathematics
Honours in Applied Mathematics
Honours in Probability & Statistics
Joint Majors in Mathematics & Computer Science
Joint Honours in Mathematics & Computer Science

Physics
Faculty Program in Physics
Major in Physics
Honours in Physics
Joint Honours Program in Physics & Mathematics
Joint Faculty Program in Mathematics, Chemistry & Physics
Joint Major Program in Atmospheric Science & Physics
Joint Major Program in Physics & Geophysics

10.8 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 – Literature
English – Drama and Theatre
English – Cultural Studies
Langue et littérature françaises – Léttres
Langue et littérature françaises – Léttres et traduction
Langue et littérature françaises – Linguistique du français
Geography (Urban Systems)
German Language and Literature – see German Studies
German Literature and Culture – see German Studies
Contemporary German Studies – see German Studies
Hispanic Literature and Culture – see Hispanic Studies
Hispanic Languages – see Hispanic Studies
History
Humanistic Studies
International Development Studies
Italian Studies
Italian Studies (Medieval and Renaissance)
Jewish Studies
Latin-American Studies
Linguistics
Middle East Studies
Music
North American Studies
Philosophy
Political Science
Québec Studies
Religious Studies – Scriptures and Interpretation
Religious Studies – World Religions
Russian
Sociology
Women's Studies

Minor Concentrations
African Studies
Anthropological Archaeology – see Anthropology
Anthropology, Socio-Cultural
Art History
Canadian Ethnic Studies
Canadian Studies
Catholic Studies
Classics
East Asian Language and Literature
East Asian Cultural Studies
East Asian Studies, Advanced
Economics
English – Literature
English – Drama and Theatre
English – Cultural Studies
Langue et littérature françaises – Léttres
Langue et littérature françaises – Léttres et traduction
Langue et littérature françaises – Langue et traduction

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 (for example 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.

An industrial internship year is available to students enrolled in Atmospheric Science programs. IYES, the internship year program in Engineering and Science, is a pre-graduate work experience program available to eligible students and normally taken between their U2 and U3 years. See Faculty of Engineering section 2.8 for further information on IYES.

MINOR PROGRAM IN ATMOSPHERIC SCIENCE (18 credits)
[MARS Program Code 6-662000]

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

Required Courses (15 credits)
195-214A	(3)	Intro. to the Physics of the Atmosphere
195-215B	(3)	Weather Systems and Climate
195-219B	(3)	Intro to Atmosp. Chemistry
or 180-219B		
195-308A	(3)	Principles of Remote Sensing
or 183-308A		
195-315A	(3)	Water in the Atmosphere

Complementary Course (3 credits)
195-402A	(3)	Atmosphere-Ocean Transports
or 195-540A	(3)	Synoptic Meteorology I

MAJOR PROGRAM IN ATMOSPHERIC SCIENCE (61 credits)
[MARS Program Code 1-662000]

Required Courses (49 credits)
195-214A	(3)	Intro. to the Physics of the Atmosphere
195-215B	(3)	Weather Systems and Climate
195-308A	(3)	Principles of Remote Sensing
or 183-308A		
195-315A	(3)	Water in the Atmosphere
195-512A	(3)	Atmospheric and Oceanic Dynamics
195-513B	(3)	Waves and Stability
195-540A	(3)	Synoptic Meteorology I
195-541B	(3)	Synoptic Meteorology II
195-546B	(1)	Current Weather Discussion
189-222A,B	(3)	Calculus III
189-223A,B	(3)	Linear Algebra
189-314A,B	(3)	Advanced Calculus
189-315A,B	(3)	Ordinary Differential Equations
198-230A	(3)	Dynamics of Simple Systems
198-232B	(3)	Heat and Waves
198-257A	(3)	Experimental Methods I
308-208A,B	(3)	Computers in Engineering

Complementary Courses (12 credits)
3 - 6 credits to satisfy a statistics requirement, usually:
189-203A,B	(3)	Principles of Statistics I
or 189-323A,B	(3)	Probability Theory
and 189-324A,B	(3)	Statistics

3 credits selected from:
198-333B	(3)	Thermal & Statistical Physics
198-340A	(3)	Electricity and Magnetism

3 - 6 credits ordinarily selected from:
183-522A	(3)	Advanced Environmental Hydrology
189-317A	(3)	Numerical Analysis
189-319B	(3)	Partial Differential Equations
195-414B	(3)	Applications of Remote Sensing
195-419B	(3)	Adv. In Chem. of Atmosphere
or 180-419B		
195-515B	(3)	Turbulence
198-241B	(3)	Signal Processing
198-248A	(3)	Physics of Energy
198-331B	(3)	Mechanics
198-340A	(3)	Electricity and Magnetism
198-342B	(3)	Electromagnetic Waves
198-332B	(3)	Physics of Fluids
or 305-331A,B	(3)	Fluid Mechanics I

JOINT MAJOR PROGRAM IN ATMOSPHERIC SCIENCE AND PHYSICS (70 credits) [MARS Program Code 1-662200]

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

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

Required Courses (67 credits)
195-214A	(3)	Intro. to the Physics of the Atmosphere
195-215B	(3)	Weather Systems and Climate
195-308A	(3)	Principles of Remote Sensing
or 183-308A		
195-315A	(3)	Water in the Atmosphere
195-512A	(3)	Atmospheric and Oceanic Dynamics
195-513B	(3)	Waves and Stability
195-540A	(3)	Synoptic Meteorology I
195-541B	(3)	Synoptic Meteorology II
195-546B	(1)	Current Weather Discussion
198-230A	(3)	Dynamics of Simple Systems
198-232B	(3)	Heat and Waves
198-257A	(3)	Experimental Methods I
198-258B	(3)	Experimental Methods II
198-331B	(3)	Mechanics
198-333B	(3)	Thermal and Statistical Physics
198-339B	(3)	Measurements Laboratory
198-340A	(3)	Electricity and Magnetism
198-342B	(3)	Electromagnetic Waves
198-446A	(3)	Quantum Physics
189-222A,B	(3)	Calculus III
189-223A,B	(3)	Linear Algebra
189-314A,B	(3)	Advanced Calculus
189-315A,B	(3)	Ordinary Differential Equations

Complementary Course (3 credits)
198-434A	(3)	Optics
or 198-439A	(3)	Laboratory in Modern Physics

HONOURS PROGRAM IN ATMOSPHERIC SCIENCE
(70 credits) [MARS Program Code 2-662000]

Students can be admitted to the Honours program after completion of the U1 year of the Major in Atmospheric Science program with a minimum GPA of 3.30. Students having completed a U1 year in a different program with high standing may be admitted to the Honours program on the recommendation of the Department.

A minimum GPA of 3.30 in the Honours Program courses (taken as a whole) is required to remain in the program. A CGPA of 3.30 on the total program is also required to graduate with honours.

Required Courses (58 credits)

195-214A	(3)	Intro. to the Physics of the Atmosphere
195-215B	(3)	Weather Systems and Climate
195-308A	(3)	Principles of Remote Sensing
or 183-308A		
195-315A	(3)	Water in the Atmosphere
195-480A,B	(3)	Honours Research Project
195-512A	(3)	Atmospheric and Oceanic Dynamics
195-513B	(3)	Waves and Stability
195-530A	(3)	Climate Dynamics I
195-540A	(3)	Synoptic Meteorology I
195-541B	(3)	Synoptic Meteorology II
195-546B	(1)	Current Weather Discussion
189-222A,B	(3)	Calculus III
189-223A,B	(3)	Linear Algebra
189-314A,B	(3)	Advanced Calculus
189-315A,B	(3)	Ordinary Differential Equations
189-319B	(3)	Partial Differential Equations
198-230A	(3)	Dynamics of Simple Systems
198-232B	(3)	Heat and Waves
198-257A	(3)	Experimental Methods I
308-208A,B	(3)	Computers in Engineering

Complementary Courses (12 credits)

3-6 credits to satisfy a statistics requirement, usually:

189-203A,B	(3)	Principles of Statistics I
or 189-323A,B	(3)	Probability Theory
and 189-324A,B	(3)	Statistics

3 credits selected from:

198-333B	(3)	Thermal and Statistical Physics
198-340A	(3)	Electricity and Magnetism

3-6 credits ordinarily selected from:

183-522A	(3)	Advanced Env. Hydrology
189-317A	(3)	Numerical Analysis
195-414B	(3)	Applications of Remote Sensing
195-419B	(3)	Adv. in Chem. of Atmosphere
or 180-419B		
195-515B	(3)	Turbulence
198-241B	(3)	Signal Processing
198-248B	(3)	Physics of Energy
198-331B	(3)	Mechanics
198-340B	(3)	Electricity and Magnetism
198-342B	(3)	Electromagnetic Waves
198-332B	(3)	Physics of Fluids
or 305-331A,B	(3)	Fluid Mechanics I

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, Engineering, Science, or other appropriate disciplines, leading to a Diploma in Meteorology. The program is designed for students with little or no previous background in meteorology who wish to direct their experience to atmospheric or environmental applications, or who need to fulfil academic prerequisites in meteorology to qualify for employment. For further information, consult the Graduate Coordinator, Burnside Hall, Room 945.

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)

195-512A	(3)	Atmospheric & Oceanic Dynamics
195-513B	(3)	Waves and Stability
195-530A	(3)	Climate Dynamics I
195-531B	(3)	Climate Dynamics II
195-540A	(3)	Synoptic Meteorology I
195-541B	(3)	Synoptic Meteorology II

Complementary Courses (12 credits)

6 credits selected from:

195-308A	(3)	Principles of Remote Sensing
or 183-308A		
195-315A	(3)	Water in the Atmosphere
195-414B	(3)	Applications of Remote Sensing
195-419B	(3)	Adv. in Chem. of Atmosphere
or 180-419B		

6 credits ordinarily selected from:

183-522A	(3)	Advanced Env. Hydrology
189-317A	(3)	Numerical Analysis
189-319B	(3)	Partial Differential Equations
195-515B	(3)	Turbulence
198-331B	(3)	Mechanics
198-340A	(3)	Electricity and Magnetism
198-342B	(3)	Electromagnetic Waves
198-332 B	(3)	Physics of Fluids
or 305-331A,B	(3)	Fluid Mechanics I

INTERNSHIP PROGRAMS – INTERNSHIP YEAR FOR ENGINEERING AND SCIENCE (IYES)

The following programs are also available with an Internship component. For more information, please see section 2.8 in the Faculty of Engineering section.

> Major in Atmospheric Science
> Honours in Atmospheric Science

COURSE DESCRIPTIONS

All courses have limited enrolment.

The names of course instructors are listed on the Course Timetable available on *info*McGill via the Web http://www.mcgill.ca/students/courses/.

The course credit weight is given in parentheses after the title.

● Denotes courses not offered in 2001-02.

★ Denotes courses taught only in alternate years.

195-199B FYS: WEATHER, CLIMATE, HISTORY. (3) (2 hours lectures; 1 hour seminar) (FYS - for first year students only, maximum 25) A seminar course on how weather and climate have influenced human history. The impact of weather and climate on agriculture, disease, demography, economic cycles and history. The Little Ice Age in Eurpose will be used as an example for study. Methods to establish linkage between weather, climate and history.

195-210A,B INTRODUCTION TO ATMOSPHERIC SCIENCE. (3) (3 hours lectures) (Open to all students except those who have taken 195-214A.) A survey of the Earth's atmosphere, weather and climate system. Topics include the fundamental processes that determine interactions between the atmosphere, ocean and biosphere; anthropogenic effects such as global warming, the ozone hole and acid rain; a perspective on future climate change.

195-214A INTRO. TO THE PHYSICS OF THE ATMOSPHERE. (3) (3 hours lectures) (Prerequisite: CEGEP Physics.) An introduction to physical meteorology designed for students in the physical sciences. Topics include: composition of the atmosphere; heat transfer; the upper atmosphere; atmospheric optics; formation of clouds and precipitation; instability; adiabatic charts.

195-215B WEATHER SYSTEMS AND CLIMATE. (3) (3 hours lectures) (Prerequisite: CEGEP Physics or permission of the instructor.) Laws of motion, geostrophic wind, gradient wind. Surface and upper-level charts. Local wind systems, global wind systems. Air masses, fronts and middle latitude cyclones. Thunderstorms, tornadoes and hurricanes. Global climate, climate change. Weather on the "web".

★195-219B INTRODUCTION TO ATMOSPHERIC CHEMISTRY. (3) (3 hours lectures) (Prerequisite: CEGEP DEC in Science or permission of instructor.) (Not open to students who have taken 180-219, 180-419 or 195-419.) (Offered in odd years. Students should register in 180-219 in even years.) An introduction to the basic topics in atmospheric chemistry. The fundamentals of the chemical

composition of the atmosphere and its chemical reactions. Selected topics such as smog chamber, acid rain, and ozone hole will be examined.

195-220A,B INTRODUCTION TO OCEANIC SCIENCES. (3) (3hours lectures) (Not open to students who have taken 186-360A or 186-560A.) Air-sea interaction; oceanic properties; global climate change, carbon cycle; polar oceans, sea ice, polynyas; El Niño; remote sensing of oceans; physical control of biological processes in the sea.

● **195-230B CLIMATE AND CLIMATE CHANGE.** (3) (3 hours lectures) (Prerequisite: CEGEP Physics or 183-203.)

195-250A NATURAL DISASTERS. (3) (3 hours lectures) (Not open to students who have taken or are taking 186-250.)This course examines the science behind different types of disasters and our ability or inability to control and predict such events. From this course the student will gain an appreciation of natural disasters beyond the newspaper headlines, and will better understand how the effects of disasters can be reduced.

195-308A PRINCIPLES OF REMOTE SENSING. (3) (3 hours lectures) (Not open to students who have taken or are taking 183-308.) A conceptual view of remote sensing and the underlying physical principles are presented. Ground-based and satellite systems and various components of the acoustic and electromagnetic spectrum – from visible to microwave – are discussed. Substantial emphasis is devoted to the application of remote sensed data in geography and atmospheric sciences.

● **195-310B PHYSICAL OCEANOGRAPHY.** (3) (3 hours lectures) (Prerequisite: 195-220, 189-141 or equivalent. Not open to students who have taken 186-360A.)

195-315A WATER IN THE ATMOSPHERE. (3) (3 hours lectures) (Prerequisite: 195-214.) Global distribution of water in the atmosphere. Moist processes. Global and mesoscale precipitation systems.Quantitative forecasting of precipitation. Extreme precipitation events. Large-scale influences. Precipitation modification.

● **195-330A PHYSICAL METEOROLOGY.** (3) (3 hours lectures) (Prerequisite: 195-214A OR permission of instructor. Not open to students who have taken 195-320A and -321B.)

195-400D INDEPENDENT STUDY

11.3 Biochemistry (507)

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

Telephone: (514) 398-7266
Fax: (514) 398-7384
Email: Caron@med.mcgill.ca
Website: http://www.biochem.mcgill.ca

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.
Leonhard S. Wolfe; M.Sc.(N.Z.), Ph.D.(Cantab.), F.R.S.C.

Professors
Rhoda Blostein; B.Sc., M.Sc., Ph.D.(McG.)
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 appt. with Oncology)*
Philippe Gros; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)
Annette A. Herscovics; B.Sc., Ph.D.(McG.) *(joint appt. 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.)
Walter E. Mushynski; 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.)
John R. Silvius; B.Sc., Ph.D.(Alta.)
Nahum Sonenberg; M.Sc., Ph.D.(Weizmann Inst.), F.R.S.C.
Clifford P. Stanners; B.Sc.(McM.), M.A., Ph.D.(Tor.) *(joint appt. with Oncology)*
David Y. Thomas; B.Sc.(Bristol), M.Sc., Ph.D.(Lond.), F.R.S.C.
Maria Zannis-Hadjopoulos; B.Sc., M.Sc., Ph.D.(McG.) *(joint appt. with Oncology)*

Associate Professors
Nicole Beauchemin; B.Sc., M.Sc., Ph.D.(Montr.) *(joint appt. with Oncology)*
Alain Nepveu; B.Sc., M.Sc.(Montr.), Ph.D.(Sher.) *(joint appt. with Oncology)*
Morag Park; B.Sc., Ph.D.(Glasgow) *(William Dawson Scholar) (joint appt. with Oncology)*
Jerry Pelletier; B.Sc., Ph.D.(McG.)
Michel L. Tremblay; B.Sc., M.Sc.(Sher.), Ph.D.(McM.)

Assistant Professors
Kalle Gehring; M.Sc.(Mich.), Ph.D.(Berk.)
Alice Vrielink; B.Sc, M.Sc.(Cal.), Ph.D.(Lond.)

Associate Members
John J. Bergeron *(Anatomy & Cell Biology)*; Katherine Cianflone *(Exp. Medicine, RVH)*; L. Fernando Congote *(Exp. Medicine, RVH)*; Robert Dunn *(Exp. Medicine, MGH)*; Mark S. Featherstone *(Oncology)*; William C. Galley *(Chemistry)*; Michael A. Parniak *(JGH, Lady Davis Inst.)*; Peter J. Roughley *(Shriners Hospital)*; Erwin Schurr *(Exp. Medicine, RVH)*; Charles Scriver *(Pediatrics, MCH)*; Bernard Turcotte *(Exp. Medicine, RVH)*; Simon Wing *(Medicine)*; Xiang-Jiao Yang *(Molecular Oncology, RVH)*

Adjunct Professors
Michael Cordingley; B.A.(Cantab.), Ph.D.(Glasgow) *(Boehringer-Ingelheim)*
Mirek Cygler; M.Sc., Ph.D.(Poland)*(B.R.I.)*
Jacques Drouin; B.Sc., Ph.D.(Laval) *(Clin. Res. Inst.)*
Feng Ni; B.A.(Lanzhou), M.Sc., Ph.D.(C'nell) *(B.R.I.)*
Donald Nicholson; B.Sc., Ph.D.(W.Ont.) *(Merck Frosst)*
Maureen D. O'Connor-McCourt; B.Sc.(Guelph), Ph.D.(Alta.) *(B.R.I.)*
Sophie Roy; B.Sc., M.Sc., Ph.D.(McG.) *(Merck Frosst)*
Andrew C. Storer; B.Sc., Ph.D.(Birm.) *(B.R.I.)*
Marc Therrien; B.Sc., Ph.D.(Montr.) *(Clin. Res. Inst.)*

Andre Veillette; B.Sc., M.D.(Laval *(Clin. Res. Inst.)*
Lee A. Wall; B.Sc., Ph.D.(McG.) *(U. de Montr., CHUM, L'Inst. du cancer)*

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 post graduate 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. The rigorous training in chemistry, which distinguishes the Biochemistry program from Biological Sciences, can lead to admission to the Professional Order of Chemists – a requirement needed to function as a recognized chemist in the Province of Québec.

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 fulfil this role and assume a wide variety of positions in industry and the health field. These range from research and development in the chemical and pharmaceutical industries to testing as well as research in government and hospital laboratories to management. Many graduates take higher degrees in research and attain academic positions in universities and colleges.

PRE-PROGRAM REQUIREMENTS
Entrance requirements for the Faculty, Major and Honours programs are: 6 credits in elementary biology, 6 credits in general chemistry, 3 credits in organic chemistry, 6 credits in calculus, 8-9 credits in physics.

FACULTY PROGRAM IN BIOCHEMISTRY (55 credits)
[MARS Program Code 4-142000]

U1 Required Courses (16 credits)

507-212B	(3)	Molecular Mechanisms of Cell Function
177-200A	(3)	Molecular Biology
177-202B	(3)	Basic Genetics
180-204A,B	(3)	Physical Chem./Biol. Sci. I
180-222A,B	(4)	Organic Chemistry II

U1 Complementary Courses (9 credits)
6 credits selected from:

552-209A	(3)	Mammalian Physiology I
552-210B	(3)	Mammalian Physiology II
528-211A	(3)	Biology of Microorganisms
177-205B	(3)	Biology of Organisms

U2 Required Courses (23 credits)

U2 Required Courses (15 credits)

U2 Complementary Courses (3 credits)

U2 Complementary Courses (3 credits)

U3 Required Courses (6 credits)

U3 Complementary Courses (6 or 9* credits)

U3 Complementary Courses (12 credits)

MAJOR PROGRAM IN BIOCHEMISTRY (67 or 70 credits)
[MARS Program Code 1-142000]

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

U1 Required Courses (20 credits)

U1 Complementary Courses (9 credits)

HONOURS PROGRAM IN BIOCHEMISTRY (76 credits)
[MARS Program Code 2-142000]

Admission to the Honours program will not be granted until U2.

MINOR PROGRAM IN BIOLOGY (24 credits)
[MARS Program Code 6-144500]

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

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

Required Courses (18 credits)

177-200A	(3)	Molecular Biology
177-201B	(3)	Cell Biology and Metabolism
177-202B	(3)	Basic Genetics
177-205B	(3)	Biology of Organisms
177-208A	(3)	Ecology
177-304A	(3)	Evolution

Complementary Courses (6 credits)
6 credits to be chosen from the Biology Department's course offerings, at the 300 level or above.

FACULTY PROGRAMS

In view of the constantly changing job market for B.Sc. graduates in biology, the Department has designed Faculty Programs to allow students to prepare for a wide range of employment opportunities. The programs offer students an opportunity to specialize in more than one area of biology, to broaden the scope of their scientific background. The programs can be tailored to provide a relatively broad spectrum of biology courses, or provide a degree of specialization in biology which approaches that of a Major Program (total 36 to 54 biology credits). The flexibility and scope of these programs will not only enhance the graduate's prospects for employment, but also entrance into graduate studies.

FACULTY PROGRAM IN BIOLOGY (54 credits)
[MARS Program Code 4-144500]

Required Courses (18 credits)

177-200A	(3)	Molecular Biology
177-201B	(3)	Cell Biology and Metabolism
177-202B	(3)	Basic Genetics
177-205B	(3)	Biology of Organisms
177-208A	(3)	Introduction to Ecology
177-304A	(3)	Evolution

Complementary Courses (36 credits)
18 credits of Biology courses, including 3 credits selected from:

	177-206A	(3)	Methods in Biology of Organisms
or	177-301A,B	(3)	Cell and Molecular Laboratory

18 credits of Science courses including, at most, 3 credits of general interest Science courses (not listed in Science Major Programs).

Of the Complementary courses at least 6 of the 15 remaining Biology credits and 6 of the 18 Science credits must be above the 200-level, none may be at the 100-level; all are to be approved by the adviser.

FACULTY PROGRAM IN BIOLOGY AND MATHEMATICS
(57 credits) [MARS Program Code 4-144700]

Required Courses (21 credits)

189-133A,B,C,L,T*	(3)	Vectors, Matrices and Geometry
189-222A,B*	(3)	Calculus III
189-223A,B*	(3)	Linear Algebra
189-315A,B	(3)	Ordinary Differential Equations
189-323A,B	(3)	Probability Theory
189-324A,B	(3)	Statistics
308-202A,B	(3)	Introduction to Computing 1

* students with CEGEP equivalents of these courses must substitute other mathematics courses in consultation with the adviser

Complementary Courses (36 credits)
21 credits in Biology including
  12 credits selected from:

177-200A	(3)	Molecular Biology
177-201B	(3)	Cell Biology and Metabolism
177-202B	(3)	Basic Genetics
177-205B	(3)	Biology of Organisms
177-206A	(3)	Methods in Biology of Organisms
177-304A	(3)	Evolution
552-209A	(3)	Mammalian Physiology I
552-210B	(3)	Mammalian Physiology II

  and 9 credits selected from:

177-208A	(3)	Introduction to Ecology
or 177-307A	(3)	Behavioural Ecology/Sociobiology
177-303B	(3)	Developmental Biology
177-306A	(3)	Neurobiology and Behaviour
177-324A	(3)	Ecological Genetics
177-370B	(3)	Human Genetics Applied
177-470B	(3)	Lake Management
177-473A	(3)	Ecology of Aquatic Invertebrates
177-520B	(3)	Gene Activity in Development
177-530B	(3)	Neural Basis of Behaviour
177-531A	(3)	Neurobiology Learning Memory

6 credits of any other Biological Sciences courses
9 credits of Mathematics
  including at least 3 credits selected from:

177-309A	(3)	Mathematical Models in Biology
198-413A	(3)	The Physical Basis of Physiology

  and at least 3 credits selected from:

189-314A,B	(3)	Advanced Calculus
189-317A,B	(3)	Numerical Analysis
189-319B	(3)	Partial Differential Equations
189-327B	(3)	Matrix Numerical Analysis
189-407B	(3)	Dynamic Programming
189-423A	(3)	Regression and Analysis of Variance
189-447B	(3)	Stochastic Processes
189-525A	(3)	Sampling Theory and Applications

  or other suitable mathematics courses chosen in consultation with the adviser.

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

MAJOR PROGRAM IN BIOLOGY (54 credits)
[MARS Program Code 1-144500]

The Major requires 54 credits comprising 33 as specified below and 21 additional credits which are to be chosen by students in consultation with their adviser.

U1 Required Courses (18 credits)

177-200A	(3)	Molecular Biology
177-201B	(3)	Cell Biology and Metabolism
177-202B	(3)	Basic Genetics
177-205B	(3)	Biology of Organisms
177-206A	(3)	Methods in Biology of Organisms
177-208A	(3)	Introduction to Ecology

U2 or U3 Required Courses (6 credits)

177-301A,B	(3)	Cell and Molecular Laboratory
177-304A	(3)	Evolution

U2 or U3 Complementary Courses (9 credits)
9 credits selected from:

177-300A	(3)	Molecular Biology of the Gene
177-303B	(3)	Developmental Biology
177-305B	(3)	Diversity of Life
177-306A	(3)	Neurobiology and Behaviour

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.

MOLECULAR GENETICS AND DEVELOPMENT CONCENTRATION

The discoveries that have fuelled the ongoing biomedical and biotechnological revolution have arisen at the intersection of a number of fields of biological investigation, including molecular biology, genetics, cellular and developmental biology and biochemistry. A substantial and significant quantity of this research 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:

a   n   i   j   j   8   h   s

the lecture component but not the laboratory of 177-111A and only with permission of the Associate Dean (Academic and Student Affairs) of Science.

177-102B CELL AND MOLECULAR BIOLOGY METHODS. (1) (3.5 hours laboratory) (Exclusion: 177-112B) The laboratory component of 177-112B. May be taken only by transfer students who have completed elsewhere the lecture component but not the laboratory of 177-112B and only with permission of the Associate Dean (Academic and Student Affairs) of Science.

177-111A PRINCIPLES OF ORGANISMAL BIOLOGY. (3) (2 lectures and 3 hours laboratory) (Prerequisite: none. Exclusions: CEGEP objective 00UK or equivalent; 177-115B) An introduction to the structure, function and adaptation of plants and animals in the biosphere. Open to all students wishing introductory biology. Attendance at first lab is mandatory to confirm registration in the course.

177-112B,L CELL AND MOLECULAR BIOLOGY.

present in normal cells. The origins of these oncogenes, their genetic structure, regulation, and the biochemical properties of the oncogene-encoded proteins will be analyzed in an attempt to understand the origins of human and animal cancers.

● ★**177-324A ECOLOGICAL GENETICS.** (3) (2 hours lecture, 1 seminar) (Prerequisite: 177-202B)

177-327A HERPETOLOGY. (3) (2 hours lecture; 3 hours laboratory) (Prerequisite: 177-205B) Principles of biology as exemplifiH/gulaxc68YIMD2RGYF)H/iH/guld;HvaWgY8Y)j6UHjWgY8qIMencod 177-205h7Av

munities and species. Guest Lecturers: Staff from Smithsonian Tropical Research Institute and Panamanian Universities.

★**177-555L FUNCTIONAL ECOLOGY OF TREES.** (3) (Lectures and laboratory taught in residence at the Gault Nature Reserve) (Prerequisites: 177-204A/304A, 177-205B, 177-357A) Functional organization in trees: physiology, architecture, and life history. Emphasis on trees in natural habitats.

177-560A AQUATIC CONSERVATION. (3) (2 lecture hours, 1 conference) (Prerequisites: 177-208A/308B and 177-365A or permission) (Not open to students who have taken 177-460A.) An advanced conservation course, focused on marine and freshwater environments. Begins with the ultimate, distal and proximate processes that explain current global calamities. Then considers management responses such as fisheries modifications, protected areas, alternative livelihoods, and habitat restoration. Conferences include group work to produce real conservation action plans.

● ★**177-562B EVOLUTION OF LIFE CYCLES.** (3) (2hours lecture, 1 hour seminar) (Prerequisites: Core Program in Biology.) (Not open to students who have taken 177-462B.)

177-570B ADVANCED SEMINAR IN EVOLUTION. (3) (3hours seminar) (Open to undergraduates by permission.) Detailed analysis of a topic in evolutionary biology, involving substantial original research.

★**177-572A MOLECULAR EVOLUTION.** (3) (4hours lecture/seminar) (Prerequisite: 177-300A) (Not open to students who have

Molecular Biology (Biology)

Molecular Biology (Biochemistry)

Physiology

Plant Biology

Pollution*

* These courses may not also be used for a Environmental Engineering Minor by Engineering students.

General:

COURSE DESCRIPTION
All courses have limited enrolment.
The names of course instructors are listed on the Course Time-table available on *info*McGill via the Web http://www.mcgill.ca/students/courses/.

The course credit weight is given in parentheses after the title.

202-505A SELECTED TOPICS IN BIOTECHNOLOGY. (3) (Restricted to U3 students) Current methods and recent advances in biological, medical, agricultural and engineering aspects of biotechnology will be described and discussed. An extensive reading list will complement the lecture material.

11.6   Chemistry (180)

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

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

Chair — David N. Harpp

Emeritus Professors
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)*
Mario Onyszchuk, B.Sc.(McG.), M.Sc.(W.Ont.), Ph.D.(McG.),
   Ph.D.(Cantab,)
Donald Patterson; M.Sc.(McG.), Doc. Hon. Causa(St-Etienne)
   (Otto Maass Emeritus Professor of Chemistry)
Arthur S. Perlin; M.Sc., Ph.D.(McG.), F.R.S.C.

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

Chemistry courses at the university level are traditionally divided into four areas of specialization: 1) organic chemistry, dealing with the compounds of carbon; 2) inorganic chemistry, concerned with the chemistry and compounds of elements other than carbon; 3) analytical chemistry, which deals with the identification of substances and the quantitative measurement of their compositions; and 4) physical chemistry, which treats the physical laws and energetics governing chemical reactions. Naturally there is a great deal of overlap between these different areas, and the boundaries are becoming increasingly blurred. After a general course at the collegial level, courses in organic, inorganic, analytical and physical chemistry are offered through the university years. Since chemistry is an experimental science, laboratory classes accompany most undergraduate courses. In addition, courses are offered in polymer, nuclear, theoretical, radio- and biological chemistry to upper year undergraduates.

There are two main programs in chemistry, Honours and Major. The Honours program is intended primarily for students wishing to pursue graduate studies in chemistry. While the Major program is somewhat less specialized, it is still recognized as sufficient training for a career in chemistry. It can also lead to graduate studies although an additional qualifying year may be necessary. There are also a number of Faculty programs available. Interested students may inquire about these at the Student Advisory Office, Room 309A, Otto Maass Chemistry Building.

PRE-PROGRAM REQUIREMENTS

Students entering from the Freshman program must have included Mathematics 189-140/141, Chemistry 180-121/111 or -120/110, Biology 177-111, Physics 198-131/142, or their equivalents in their Freshman year. Québec students must have completed the DEC with appropriate science and mathematics courses.

REQUIRED COURSES IN CHEMISTRY PROGRAMS

The required courses in Chemistry programs consist of 56 credits in chemistry, physics and mathematics, listed below. The courses marked with an asterisk (*) are omitted from the program of students who have successfully completed them at the CEGEP level but the Chemistry courses must be replaced by courses in that dis-

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180-302A,B ORGANIC CHEMISTRY III. (3) (3 lectures) (Prerequisites: 180-212 and 222.) Topics covered may include the following: aromatics and heterocyclics, carbanions, rearrangements, molecular orbital considerations, polymers and biomolecules.

● **180-307A ENVIRONMENTAL ANALYSIS.** (3) (2lectures and laboratory with field trips) (Prerequisites: One course in analytical chemistry.)

180-334A ADVANCED MATERIALS. (3) (Prerequisites: 180-110/120 or 180-111/121 and 198-101/102 or 198-131/142, or CEGEP Physics and Chemistry, or equivalent. Corequisite: one of 180-203, 180-204, 180-213, 180-214 or equivalent; or one of 198-230 and 198-232, or equivalent; or permission of instructor.) (Not open to students who have taken or are taking 198-334.) The physicochemical properties of advanced materials. Topics discussed include photonics, information storage, 'smart' materials, biomaterials, clean energy materials, porous materials, and polymers.

180-345A MOLECULAR PROPERTIES & STRUCTURE I. (3) (3 lectures) (Prerequisite: 180-213, 189-315. For Chemistry Honours and Majors only.) An introduction to quantum chemistry covering the historical development, wave theory, methods of quantum mechanics, and applications of quantum chemistry.

● **180-350A EARTH, AIR, FIRE, W**

11.7   Cognitive Science

Program Director — TBA

Website: http://www.cogsci.mcgill.ca

Cognitive Science is the multi-disciplinary study of cognition in humans and machines. The goal is to understand the principles of intelligence with the hope that this will lead to better understanding of the mind and of learning, and to the development of intelligent devices that constructively extend human abilities.

   The Minor in Cognitive Science is intended to supplement and support Major or Honours programs in Computer Science, Linguistics, Philosophy, or Psychology. Students wishing to enrol in this Minor must register with the Program Director.

MAJOR PROGRAM IN SOFTWARE ENGINEERING
(72 to 74 credits) (Subject to Ministry of Education approval)
(Program revision awaiting University approval)

Complementary Courses (18 credits)

**JOINT MAJOR PROGRAM IN MATHEMATICS AND
COMPUTER SCIENCE** See in the Mathematics and
Statistics section for complete program information.

**JOINT MAJOR PROGRAM IN PHYSICS AND COMPUTER
SCIENCE** See in the Physics section for complete pro-
gram information.

308-412	(3)	Software for e-commerce
308-420	(3)	Files and Databases
308-424	(3)	Artificial Intelligence 1
308-433	(3)	Personal Software Engineering
308-505	(3)	High-Performance Computer Architecture
308-520	(4)	Compiler Design
308-524	(3)	Theoretical Found. of Prog. Lang.
308-535	(3)	Computer Networks
308-560	(3)	Graph Algorithms and Applications
308-566	(3)	Discrete Optimization
308-575	(3)	Fundamentals of Distributed Algorithms

HONOURS PROGRAM IN COMPUTER SCIENCE (72 credits)

Honours students must maintain a CGPA of 3.00 and must have at least this average upon graduation as well.

Required Courses (45 credits)
all Major Program required courses, plus
308-400A,B (3) Technical Project and Report

Complementary Courses (27 credits)
24 credits from Major Program complementary courses
3 credits from Major Program complementary courses in Mathematics

JOINT HONOURS PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE See page 401 in the Mathematics and Statistics section for complete program information. Students must consult an Honours adviser in both Departments.

MINOR IN COGNITIVE SCIENCE Students following Major or Honours programs in Computer Science may want to consider the Minor in Cognitive Science.

INTERNSHIP PROGRAMS – INTERNSHIP YEAR FOR ENGINEERING AND SCIENCE (IYES)

The following programs are also available with an Internship component. For more information, please see section 2.8 in the Faculty of Engineering section.

Major in Computer Science
Honours in Computer Science

COURSE DESCRIPTIONS

All courses have limited enrolment.
    The names of course instructors are listed on the Course Timetable available on *info***McGill** via the Web http://www.mcgill.ca/students/courses/.
    The course credit weight is given in parentheses after the title.

● Denotes courses not offered in 2001-02.

Students are strongly recommended to consult *info***McGill** for the latest course offerings.

Notes:

A. A student cannot receive credit for both 308-202 and 308-208. 308-202 is intended as a general introductory course, while 308-208 is intended for students interested in scientific computations. The credits for either of these courses will not count towards the 60-credit Major in Computer Science.

B. 308-203 and 308-250 are considered to be equivalent from a prerequisite point of view, and may not both be taken for credit. Computer Science Major and Honours students are strongly advised to take 189-240 with 308-250 but before 308-251.

C. A student cannot receive credit for both 308-330 and 308-530.

D. A student cannot receive credit for 308-102 if it is taken concurrently with, or after any of the following: 308-202, 308-203, 308-208, or 308-250.

E. 308-431 is restricted to B.Eng. students in Electrical and Computer Engineering. A student cannot receive credit for both 308-431 and 308-251, or for both 308-431 and 308-360 or 308-405.

F. Management students may not receive credit for both 308-202 and 635-300. Likewise, they may not receive credit for both 308-203 and 635-301. In addition, Management students may not receive credit for 308-102.

G. This course is restricted to students registered in the following programs: Major and Honours in Computer Science, Joint Major in Mathematics and Computer Science, Joint Major Physics and Computer Science, Major in Software Engineering, Bachelor in Software Engineering, Joint Honours in Mathematics and Computer Science, Honours Program in Applied Mathematics, Honours Program in Mathematics, Honours Program in Probability and Statistics, Minor Concentration in Foundations of Computing, Minor Concentration in Computer Science, and Major Concentration in the Foundations of Computing.

H. Students registered in the following programs may NOT take this course: Major and Honours in Computer Science, Joint Major in Mathematics and Computer Science, Joint Major Physics and Computer Science, Major in Software Engineering, Bachelor in Software Engineering, Joint Honours in Mathematics and Computer Science, Honours Program in Applied Mathematics, Honours Program in Mathematics, and Honours Program in Probability and Statistics.

I. This course is restricted to students registered in the following programs: Major and Honours in Computer Science, Minor in Computer Science, Joint Major in Mathematics and Computer Science, Joint Major Physics and Computer Science, Major in Software Engineering, Bachelor in Software Engineering, Joint Honours in Mathematics and Computer Science, Honours Program in Applied Mathematics, Honours Program in Mathematics, Honours Program in Probability and Statistics, Minor Concentration in Foundations of Computing, Minor Concentration in Computer Science, and Major Concentration in the Foundations of Computing.

J. This course is restricted to students registered in the following programs: Major and Honours in Computer Science, Minor in Computer Science, Joint Major in Mathematics and Computer Science, Joint Major Physics and Computer Science, Major in Software Engineering, Bachelor in Software Engineering, Joint Honours in Mathematics and Computer Science, Honours Program in Applied Mathematics, Honours Program in Mathematics, Honours Program in Probability and Statistics, Minor Concentration in Foundations of Computing, Minor Concentration in Computer Science, Major Concentration in the Foundations of Computing, and Minor in Cognitive Science.

K. This course is restricted to students registered in the following programs: Major and Honours in Computer Science, Joint Major in Mathematics and Computer Science, Joint Major Physics and Computer Science, Major in Software Engineering, Bachelor in Software Engineering, Joint Honours in Mathematics and Computer Science, Honours Program in Applied Mathematics, Honours Program in Mathematics, Honours Program in Probability and Statistics, Minor Concentration in Foundations of Computing, Minor Concentration in Computer Science, Major Concentration in Foundations of Computing, and Major in Computer Engineering.

L. This course is restricted to students registered in the following programs: Major and Honours in Computer Science, Minor in Computer Science, Joint Major in Mathematics and Computer Science, Joint Major Physics and Computer Science, Major in Software Engineering, Bachelor in Software Engineering, Joint Honours in Mathematics and Computer Science, Honours Program in Applied Mathematics, Honours Program in Mathematics, Honours Program in Probability and Statistics, Minor Concentration in Foundations of Computing, Minor Concentration in Computer Science, Major Concentration in Foundations of Computing, and Major in Computer Engineering.

M. 308-250 and 308-203 cannot both be taken for credit.

N. 308-202 cannot be taken for credit with or after 308-250.

308-421B DATABASE SYSTEMS. (3) (3 hours) (Prerequisites: 308-206, 308-251, 308-302) (For restrictions, see Note I.) The relational model of databases, an introduction to object-oriented concepts. Relational algebra, conceptual design of databases, concurrency control issues and databases. (Restriction revision awaiting University approval)

308-423B DATA COMPRESSION. (3) (3 hours) (Prerequisites: 308-251, 189-223, 189-323) Information Theory. Huffman, arithmetic and dictionary codes. Context Modelling. Lossy compression and quantization. Signal processing. Applications to text, image, speech, audio and video data.

308-424A ARTIFICIAL INTELLIGENCE 1. (3) (3 hours) (Prerequisites: 308-206, 308-251, 308-302) (For restrictions, see Not eJ.) Introduction to search methods in AI problems. Mechanical theorem-proving techniques, game playing by computers, the minimax and alpha-beta algorithms, and heuristic approaches to state space search problems. (Restriction revision awaiting University approval)

308-426B AUTOMATED REASONING. (3) (3 hours) (Prerequisites: 308-424; or 308-302 with 189-340.) Representing and reasoning with knowledge. The case for logics. Introduction to Logic Programming and, for example, PROLOG. Introduction to some Artificial Intelligence applications of Logic Programming: Meta-interpreters, Expert Systems and their implementation, Planning, Natural Language Processing, Machine Learning.

308-431A ALGORITHMS AND DATA STRUCTURES. (3) (3hours) (Prerequisites: 304-222 and 189-363.) (For restrictions, see Note E.) Advanced data structures: heaps, binary search trees, graphs, algorithmic analysis: space-time analysis, worst-case and expected complexity. Examples of searching sorting and merging. Algorithm design: divide-and-conquer, dynamic programming, greedy methods, backtracking. Algorithms: set manipulation, tree traversals. Memory management: hashing, dynamic storage allocation and garbage collection.

308-433A PERSONAL SOFTWARE ENGINEERING. (3) (3 hours) (Prerequisite: 308-335B.) This software engineering course teaches students how to develop, manage and improve their personal processes for developing software. Selected software development practices are introduced through 10 small programming exercises. The students then use these programs to analyse data on their personal performance, plan homework projects, and guide their process improvement.

308-435B BASICS OF COMPUTER NETWORKS. (3) (3 hours) (Prerequisite: 308-310) (For restrictions, see Note I.) Exposition of the first four layers of the ISO model for computer network protocols. Socket programming. Network administration and configuration and Security issues. (Restriction revision awaiting University approval)

308-505A HIGH-PERFORMANCE COMPUTER ARCHITECTURE. (3) (3 hours) (Prerequisites: 308-302 and 308-305 or equivalent.) Basic principles and techniques in the design of high-performance computer architecture. Topics include memory architecture: cache structure and design, virtual memory structures; pipelined processor architecture: pipeline control and hazard resolution, pipelined memory structures, interrupt, evaluation techniques; vector processing; RISC vs. CISC architectures; general vs. special purpose architectures; VLSI architecture issues.

308-506B ADVANCED ANALYSIS OF ALGORITHMS. (3) (3hours) (Prerequisite: 308-330 or 308-360 or 308-405 or 308-431.) The study of computational complexity and intractability: Cook's Theorem, NP-completeness, oracles, the polynomial hierarchy, lower bounds, heuristics, approximation problems.

308-507A COMPUTATIONAL GEOMETRY. (3) (3 hours) (Prerequisite: 308-360 or 308-405 or equivalent or co-requisite 506.) Problems in computational geometry; worst-case complexity of geometric algorithms; expected complexity of geometric algorithms and geometric probability; geometric intersection problems; nearest neighbor searching; point inclusion problems; distance between sets; diameter and convex hull of a set; polygon decomposition; the

Voronoi diagram and other planar graphs; updating and deleting from geometric structures.

308-520A COMPILER DESIGN. (4) (3 hours, 1 hour consultation) (Prerequisites: 308-273 and 308-302.) The structure of a compiler. Lexical analysis. Parsing techniques. Syntax directed translation. Run-time implementation of various programming language constructs.Introduction to code generation for an idealized machine. Students will implement parts of a compiler.

308-522A MODELLING AND SIMULATION. (4) (3 hours) (Prerequisites: 308-251, 308-302, 308-350) Simulation and modeling processes, state automata, Petri Nets, state charts, discrete event systems, continuous-time models, hybrid models, system dynamics and object-oriented modeling.

308-524B THEORETICAL FOUND. OF PROG. LANG. (3) (3hours) (Prerequisite: 308-302, and 189-340 or 189-235) Operational and denotational semantics of programming languages. Equivalence theorems for first-order languages. Lambda calculus. Type-inference, typed lambda calculus. Polymorphism. Elements of domain theory and fixed-point induction.

308-525B FORMAL VERIFICATION. (3) (3 hours) (Prerequisites: 308-251, 308-310, 308-330 and 189-340) Propositional logic – syntax and semantics, temporal logic, other modal logics, model checking, symbolic model checking, binary decision diagrams, other approaches to formal verification.

308-526 PROBABILISTIC REASONING AND AI. (3) (3 hours) (Prereq-

Reliable and efficient algorithms for solution of equations, linear least squares problems, the singular value decomposition, the eigenproblem and related problems. Perturbation analysis of problems. Algorithms for structured matrices.

308-547A CRYPTOGRAPHY AND DATA SECURITY. (3) (3 hours) (Prerequisite: 308-360) (Restriction: Not open to students who have taken 308-647.) This course presents an in-depth study of modern cryptography and data security. The basic information theoretic and computational properties of classical and modern cryptographic systems are presented, followed by a cryptanalytic examination of several important systems. We will study the applications of cryptography to the security of systems.

308-557B FUNDAMENTALS OF COMPUTER GRAPHICS. (3) (3 hours) (Prerequisite: 189-223, and 308-251 or -302.) The study of fundamental mathematical, algorithmic and representational issues in computer graphics. The topics to be covered are: overview of graphics process, projective geometry, homogeneous coordinates, projective transformations, quadrics and tensors, line-drawing, surface modelling and object modelling reflectance models and rendering, texture mapping, polyhedral representations, procedural modeling, and animation.

308-558B FUND. OF COMPUTER VISION. (3) (3 hours) (Prerequisites: 308-206, 308-360, 189-222, 189-223) (Restriction: not open to students who have taken 308-766 before January 2001.) Biological vision, edge detection, projective geometry and camera modeling, shape from shading and texture, stereo vision, optical flow, motion analysis, object representation, object recognition, graph theoretic methods, high level vision, applications.

308-560A G

U2 and U3: HONOURS IN PLANETARY SCIENCES PROGRAM
(CGPA $\geq$ 3.20) (81 credits in total: 69 required, 12 complementary)
[MARS Program Code 2-480300]

186-570A COSMOCHEMISTRY

The Faculty of Science section is divided into two parts, for access to the second part click on the link below to return to the Front Page of the Calendar.