12 Academic Programs and Courses

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: 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.(Brist.), M.R.C.S., L.R.C.P., F.R.S.C.
H. Warshawsky; B.Sc.(Sir G.Wms), M.Sc., Ph.D.(McG.)

Professors
Alain Beaudet; M.Sc., Ph.D., M.D.(Montr.) *(joint appt. 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. Brawer; B.S.(Tufts), Ph.D.(Harv.)
M. Burnier; M.D.,M.Sc.,Ph.D.(Brazil) *(joint appt. 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 appt. with Medicine)*
Charles E. Smith; D.D.S., Ph.D.(McG.) *(joint appt. with Dentistry)*

Associate Professors
Orest W. Blaschuk; B.Sc.(Winn.), M.Sc.(Manit.), Ph.D.(Tor.) *(joint appt. with Surgery)*
Eugene Daniels; M.Sc., Ph.D.(Man.)
Samuel David; Ph.D.(Man.) *(joint appt. with Neurology & Neurosurgery)*
Paul F. Lasko; A.B.(Harv.), Ph.D.(M.I.T) *(joint appt. with Biology)*
Marc D. McKee; B.Sc., M.Sc., Ph.D. (McG) *(joint appt. with Dentistry)*
Alfredo Riberio-da-Silva; M.D., Ph.D.(Oporto) *(joint appt. with Pharmacology and Therapeutics)*
Hojatollah Vali; B.Sc., M.Sc., Ph.D.(Munich) *(joint appt. with Earth and Planetary Sciences)*

Assistant Professors
Chantel Autexier; B.Sc.(C'dia), Ph.D.(McG.)
Philip Barker; B.Sc.(S.Fraser), Ph.D.(Alta.) *(joint appt. with Neurology & Neurosurgery)*
Michael T. Greenwood; B.Sc.,M.Sc.(C'dia), Ph.D.(McG) *(joint appt. with Medicine)*
Timothy Kennedy; B.Sc.(McM.), M.Phil, Ph.D.(Columbia) *(joint appt. with Neurology & Neurosurgery)*
Antonis E. Koromilas; B.Sc., Ph.D.(Aristotelian U., Greece) *(joint appt. with Oncology)*
Nathalie Lamarche; B.Sc., Ph.D.(Montr.)
Peter McPherson; B.Sc.(Manit.), Ph.D.(Iowa)*(William Dawson Scholar) (joint appt. with Neurology & Neurosurgery)*
John F. Presley; B.A., Ph.D.(Texas)
Jackson G. Snipes; Ph.D., M.D.(Vanderbilt) *(joint appt. with Neuropathology)*
Wayne Sossin; S.B.(M.I.T.), Ph.D.(Stan.) *(joint appt. with Neurology & Neurosurgery)*
Stefano Stifani; Ph.D.(Rome), Ph.D.(Alta.) *(joint appt. with Neurology & Neurosurgery)*
Dominique Walker; B.Sc., Ph.D.(Geneva) *(joint appt. with Psychiatry)*
Gary E. Wild; B.Sc., Ph.D., M.D.,C.M.(McG.) *(joint appt. with Medicine)*

Adjunct Professors
Daniel Cyr; B.Sc., M.Sc.(C'dia), Ph.D.(Manit.)
Jacques Drouin; B.Sc., D.Sc.(Laval)
Sadayuki Inoue; M.Sc., Ph.D.(Hok. U.)
André Nantel; B.Sc., M.Sc.(Laval), Ph.D.(Chapel Hill)
David Y. Thomas; B.Sc.(Brist.); M.Sc., Ph.D.(Lond.)

The Department of Anatomy and Cell Biology offers courses which deal with cell biology, histology, embryology, neuroanatomy, and gross anatomy. The Honours Program is designed as the first phase in the training of career cell and molecular biologists. This is the most desirable path for entry into graduate studies in Anatomy and Cell Biology since only a few additional courses are required for the Ph.D. degree which therefore consists almost entirely of basic research. The Major and Faculty programs offer decreasing levels of specialization in Anatomy and Cell Biology but with a broader base in other biological sciences. These programs also form a sound background for graduate studies in Anatomy and Cell Biology, or for further professional training in schools of medicine, dentistry and other health sciences. A B.Sc. in Anatomy and Cell Biology provides an excellent preparation for technical and administrative positions in laboratories of universities, research institutions, hospitals and pharmaceutical and biotechnological industries.

The Department is equipped to perform cell fractionation, protein purification, recombinant DNA technology, micro-injection of molecules into single cells, cytochemical, immunocytochemical and fluorescent analysis and electron microscopy, proteomics and genomics. The Department has a well-equipped centre for electron microscopy as well as a centre for confocal and immunofluorescence.

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

FACULTY PROGRAM IN ANATOMY AND CELL BIOLOGY
(57 credits)

Required Courses (39 credits)

ANAT 212	(3)	Molecular Mechanisms of Cell Function
ANAT 214	(3)	Systemic Human Anatomy
ANAT 261	(4)	Introduction to Dynamic Histology (must be taken in U1)
ANAT 262	(3)	Introductory Molecular & Cell Biology
ANAT 321	(3)	Circuitry of the Human Brain
BIOL 200	(3)	Molecular Biology
BIOL 202	(3)	General Genetics
CHEM 212*	(4)	Organic Chemistry 1
CHEM 222*	(4)	Organic Chemistry 2
PHGY 209	(3)	Mammalian Physiology 1
PHGY 210	(3)	Mammalian Physiology 2
MATH 203*	(3)	Principles of Statistics 1
or PSYC 204	(3)	Introduction to Psychological Statistics
or BIOL 373	(3)	Biostatistical Analysis

* If the equivalents to these courses were passed in CEGEP, they are not required for the Anatomy and Cell Biology programs, and may not be re-taken at McGill. Students must take the equivalent number of credits in Elective Courses to satisfy the total credit requirement for their degree.

Complementary Courses (18 credits)
9 credits selected from:

ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cell Biology of the Secretory Process
ANAT 381	(3)	Experimental Basis of Embryology
ANAT 458	(3)	Membranes and Cellular Signaling

9 credits selected from biologically oriented courses (BOC) in the following list:
BIOL 300, BIOL 301, BIOL 303, BIOL 306, BIOL 313, BIOL 314, BIOL 357, BIOL 370, BIOL 389, BIOL 468, BIOL 475, BIOL 516, BIOL 518, BIOL 520, BIOL 522, BIOL 524, BIOL 530, BIOL 531, BIOL 532, BIOL 551, BIOL 572, BIOL 588;
ANAT 322, ANAT 365, ANAT 381, ANAT 432, ANAT 541;

BIOC 311, BIOC 312, BIOC 450, BIOC 454, BIOC 455, BIOC 503;
BIOT 505;
EXMD 401, EXMD 502, EXMD 503, EXMD 504, EXMD 506, EXMD 507, EXMD 508, EXMD 509, EXMD 510, EXMD 511, EXMD 512D;
MIMM 314, MIMM 323, MIMM 324, MIMM 386D1/MIMM 386D2, MIMM 387, MIMM 413, MIMM 414, MIMM 465, MIMM 466, MIMM 509;
NEUR 310; NUTR 307; PATH 300;
PHAR 300, PHAR 301, PHAR 562,PHAR 563;
PHGY 311, PHGY 312, PHGY 313, PHGY 423, PHGY 444, PHGY 451, PHGY 502, PHGY 508, PHGY 513, PHGY 515, PHGY 516, PHGY 517, PHGY 518, PHGY 520, PHGY 531, PHGY 552, PHGY 556; PSYT 500.

MAJOR PROGRAM IN ANATOMY AND CELL BIOLOGY
(68 credits)

Required Courses (59 credits)
all Faculty Program required courses, plus:

ANAT 322	(3)	Neuroendocrinology
ANAT 365	(3)	Cell Biology of the Secretory Process
ANAT 381	(3)	Experimental Basis of Embryology
ANAT 458	(3)	Membranes and Cellular Signaling
BIOL 301	(4)	Cell and Molecular Laboratory
MIMM 314	(3)	Immunology
PHGY 212D1	(1)	Introductory Physiology Lab
PHGY 212D2	(1)	Introductory Physiology Lab

Complementary Courses (9 credits)
9 credits of biologically oriented courses (BOC), as defined in the Faculty Program.

HONOURS PROGRAM IN ANATOMY AND CELL BIOLOGY
(80 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 (77 credits)
all Major Program required courses, plus:

ANAT 432	(9)	Research Project: Anatomical Science
ANAT 541	(3)	Cell and Molecular Biology of Aging
BIOC 311	(3)	Metabolic Biochemistry
BIOC 312	(3)	Biochemistry of Macromolecules

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

COURSE DESCRIPTIONS

Admission is guaranteed for all students enrolled in programs in the Department of Anatomy and Cell Biology for which the course in question is a required course.

Please note: courses may have been rescheduled or new courses added after this Calendar went to press. Students preparing to register are advised to consult the 2002-2003 Class Schedule on the Web at http://www.mcgill.ca/minerva-students for the most up-to-date information.

The Class Schedule includes the term(s), days, and times when courses will be offered, as well as class locations and names of instructors.

The schedule of courses to be offered in Summer 2003 will be available on the website in January 2003.

The course credit weight is given in parentheses after the title. Term(s) offered (Fall, Winter, Summer) may appear after the credit weight to indicate when a course would normally be taught. Please check the Class Schedule to confirm this information.

ANAT has replaced 504 as the prefix for Anatomy and Cell Biology courses.

All courses have limited enrolment.

● Denotes courses not offered in 2002-03.

★ Denotes courses taught only in alternate years.

ANAT 205 ASTROBIOLOGY. (3) (Winter) (3 hours lecture) (Not open to students who have taken or are taking EPSC 205) Astrobiology is the search for the origin, evolution and destiny of life in the universe. The course will provide insight into the formation and evolution of habitable worlds, the evolution of life and the biogeochemical cycles in the Earth's oceans and atmosphere, and the potential for biological evolution beyond an organism's planet of origin.

ANAT 212 MOLECULAR MECHANISMS OF CELL FUNCTION. (3) (Winter) (Prerequisite: BIOL 200) (Not open to students who have taken or are taking BIOC 212 or BIOL 201) An introductory course describing the biochemistry and molecular biology of selected key functions of animal cells, including: gene expression; mitochondrial production of metabolic energy; cellular communication with the extra-cellular environment; and regulation of cell division.

ANAT 214 SYSTEMIC HUMAN ANATOMY. (3) (Fall) (2 hours lectures, 2 hours practical tutorial) (Open to students in biological sciences) Introduction to the gross anatomy of the various organ systems of head, neck and trunk regions of the human body. Practical tutorials include studies of prepared specimens, use of the anatomical museum and audio-visual materials. This course is limited in size. Selection of students (other than those requiring the course as part of their program) will be made after the first lecture. (Admission is guaranteed for all students enrolled in programs in the Department of Anatomy and Cell Biology for which ANAT 214 is a required course.

ANAT 261 INTRODUCTION TO DYNAMIC HISTOLOGY. (4) (Fall) (3 hours lectures, 2 hours laboratory) (Must be taken in U1 by students in Anatomy and Cell Biology programs) (Open to students in biological sciences and others by special permission) An introduction to light and electron microscopic anatomy in which cell and tissue dynamics will be explored in the principal tissues and organs of the body.

ANAT 262 INTRODUCTORY MOLECULAR AND CELL BIOLOGY. (3) (Winter) (3 hours lecture) (Corequisites: ANAT 212 or BIOL 201) (Open to students in biological sciences and others by special permission) The architectural, functional and temporal continuity of organelles and the cytoskeleton of mammalian cells is introduced as well as their functional integration in the phenomena of exocytosis, endocytosis, protein trafficking and cell motility and adhesion.

ANAT 315 REGIONAL ANATOMY/LIMBS AND BACK WITH DISSECTION. (4) (Fall) (2 hours lectures, 4 hours laboratory) (Open to students in Physical and Occupational Therapy; and to Honours students in Anatomy and Cell Biology, with permission of instructor.) A dissection course in regional human gross anatomy of the skeleton, joints, muscles and neurovascular structures of the limbs and back.

ANAT 316 HUMAN VISCERAL ANATOMY. (2) (Winter) (2 hour lecture, 2 hours laboratory) (Prerequisite: ANAT 315) (Open to students in Physical and Occupational Therapy, and to others by special permission) The gross anatomy of the various organ systems of the human body, with emphasis on those aspects of greatest relevance to physical and occupational therapists. Laboratories include studies of prepared specimens, use of the anatomical museum and audiovisual materials.

ANAT 321 CIRCUITRY OF THE HUMAN BRAIN. (3) (Fall) (2 hour lectures, 2 hours laboratory/tutorial) (Prerequisite: at least one 3-credit university level course in biology or psychology) This course

explores the functional organization of the human brain and spinal cord. The course focuses on how neuronal systems are designed to subserve specific motor, sensory, and cognitive operations.

● ▭ ★ **ANAT 322 NEUROENDOCRINOLOGY.** (3) (Winter) (2 hours lectures, 1 hour conference) (Prerequisites: ANAT 261 and ANAT 321)

★ **ANAT 365 CELL BIOLOGY: SECRETORY PROCESS.** (3) (Fall) (2 hours lectures, 2 hours conference) (Prerequisites: ANAT 261, BIOL 200, BIOL 201) An intensive study of the processes of protein secretion and cell membrane biogenesis. Emphasis on morphological aspects of the above processes, and on the major techniques which have provided experimental evidence, namely, subcellular fractionation, cytochemistry and quantitative electron microscope radioautography.

● ★ **ANAT 381 EXPERIMENTAL BASIS OF EMBRYOLOGY.** (3) (Winter) (2 hours lectures, 2 hours laboratory or conference) (Prerequisites: ANAT 214, ANAT 261, or by special permission)

ANAT 432 RESEARCH PROJECT: ANATOMICAL SCIENCE. (9) (Fall and Winter and Summer) (Minimum 4 days per week in Fall term or Winter term; 5 days per week in Summer term.) (For students in the Honours program. The course may also be taken, with special permission, by students in Anatomy Major and Faculty programs as well as by students of other Departments.) An intensive exposure to individually supervised, original research in anatomical sciences. A variety of methods, including electron microscopy, cytochemistry, immunolabeling, radioautography, and cell fractionation and biochemical analysis are applied to basic problems in cell biology. A substantial written report, followed by an oral presentation and defence are required. Students should consult the course coordinators several weeks before registration.

ANAT 432D1 RESEARCH PROJECT: ANATOMICAL SCIENCE. (4.5) (Fall) (Minimum 2 days per week.) (Students must also register for ANAT 432D2) (No credit will be given for this course unless both ANAT 432D1 and ANAT 432D2 are successfully completed in consecutive terms) (ANAT 432D1 and ANAT 432D2 together are equivalent to ANAT 432) See ANAT 432 for course description.

ANAT 432D2 RESEARCH PROJECT: ANATOMICAL SCIENCE. (4.5) (Winter) (Minimum 2 days per week.) (Prerequisite: ANAT 432D1) (No credit will be given for this course unless both ANAT 432D1 and ANAT 432D2 are successfully completed in consecutive terms) (ANAT 432D1 and ANAT 432D2 together are equivalent to ANAT 432) See ANAT 432 for course description.

ANAT 458 MEMBRANES AND CELLULAR SIGNALING. (3) (Winter) (3 hours lectures) (Prerequisites: BIOC 212, ANAT 262, one of PHGY 201, PHGY 209 or BIOL 205; one of BIOL 312 or ANAT 365; BIOC 311 recommended) (Not open to students who are taking or who have taken BIOC 458) An integrated treatment of the properties of biological membranes and of intracellular signaling, including the major role that membranes play in transducing and integrating cellular regulatory signals. Biological membrane organization and dynamics; membrane transport; membrane receptors and their associated effectors; mechanisms of regulation of cell growth, morphology, differentiation and death.

ANAT 541 CELL AND MOLECULAR BIOLOGY OF AGING. (3) (Winter) (2 hours lecture, 2 hours conference) (Prerequisites: ANAT 261, ANAT 262, or by special permission) This course will focus on how the complex aging process can be studied by modern cell and molecular approaches. Topics will include discussion on animal model systems for aging, gene regulation controlling the aging process and age-dependent diseases.

12.2 Atmospheric and Oceanic Sciences (ATOC)

Burnside Hall, Room 945
805 Sherbrooke Street West
Montreal, QC H3A 2K6

Telephone: (514) 398-3764
Fax: (514) 398-6115
Internet: undergradinfo.aos@mcgill.ca
Website: http://zephyr.meteo.mcgill.ca

Chair — Charles A. Lin

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)*
Isztar I. Zawadzki; B.Sc.(Buenos Aires), M.Sc., Ph.D.(McG.)

Associate Professors
Peter Bartello; M.Sc., Ph.D.(McG.) *(joint appt. with Mathematics and Statistics)*
John R. Gyakum; B.Sc.(Penn.), M.Sc., Ph.D.(M.I.T.)
Man Kong (Peter) Yau; S.B., S.M., Sc.D.(M.I.T.)
David Straub; B.S., M.S.(SW Louisiana), Ph.D.(Wash)

Assistant Professor
Parisa Ariya; B.Sc., Ph.D.(York) *(William Dawson Scholar) (joint appt. with Chemistry)*
Frédéric Fabry; B.Sc., M.Sc., Ph.D.(McG.) *(joint appt. with McGill School of Environment)*

Lecturer
Alan P. Schwartz

Adjunct Professors
Gilbert Brunet, R.Grant Ingram, René Laprise, Stéphane Laroche

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 (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 2.9 for further information on IYES.

MINOR PROGRAM IN ATMOSPHERIC SCIENCE (18 credits)

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

Required Courses (15 credits)

ATOC 214	(3)	Intro. to the Physics of the Atmosphere
ATOC 215	(3)	Weather Systems and Climate
ATOC 219	(3)	Intro to Atmosp. Chemistry
or CHEM 219		
ATOC 308	(3)	Principles of Remote Sensing
or GEOG 308		
ATOC 315	(3)	Water in the Atmosphere

Complementary Course (3 credits)

ATOC 402	(3)	Atmosphere-Ocean Transports
or ATOC 540	(3)	Synoptic Meteorology 1

MAJOR PROGRAM IN ATMOSPHERIC SCIENCE (61 credits)

Required Courses (49 credits)

ATOC 214	(3)	Intro. to the Physics of the Atmosphere
ATOC 215	(3)	Weather Systems and Climate
ATOC 308	(3)	Principles of Remote Sensing
or GEOG 308		
ATOC 315	(3)	Water in the Atmosphere
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 257	(3)	Experimental Methods 1
COMP 208	(3)	Computers in Engineering

Complementary Courses (12 credits)

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

MATH 203	(3)	Principles of Statistics 1
or MATH 323	(3)	Probability Theory
and MATH 324	(3)	Statistics

3 credits selected from:

PHYS 333	(3)	Thermal & Statistical Physics
PHYS 340	(3)	Electricity and Magnetism

3 - 6 credits ordinarily selected from:

GEOG 522	(3)	Advanced Environmental Hydrology
MATH 317	(3)	Numerical Analysis
MATH 319	(3)	Partial Differential Equations
ATOC 414	(3)	Applications of Remote Sensing
ATOC 419	(3)	Adv. in Chem. of Atmosphere
or CHEM 419		
ATOC 515	(3)	Turbulence
PHYS 241	(3)	Signal Processing
PHYS 248	(3)	Physics of Energy
PHYS 331	(3)	Mechanics
PHYS 340	(3)	Electricity and Magnetism
PHYS 342	(3)	Electromagnetic Waves
PHYS 332	(3)	Physics of Fluids
or MECH 331	(3)	Fluid Mechanics 1

JOINT MAJOR PROGRAM IN ATMOSPHERIC SCIENCE AND PHYSICS (70 credits)

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)

ATOC 214	(3)	Intro. to the Physics of the Atmosphere
ATOC 215	(3)	Weather Systems and Climate
ATOC 308	(3)	Principles of Remote Sensing
or GEOG 308		
ATOC 315	(3)	Water in the Atmosphere
ATOC 512	(3)	Atmospheric and Oceanic Dynamics
ATOC 513	(3)	Waves and Stability
ATOC 540	(3)	Synoptic Meteorology 1
ATOC 541	(3)	Synoptic Meteorology 2
ATOC 546	(1)	Current Weather Discussion
PHYS 230	(3)	Dynamics of Simple Systems
PHYS 232	(3)	Heat and Waves
PHYS 257	(3)	Experimental Methods 1
PHYS 258	(3)	Experimental Methods 2
PHYS 331	(3)	Mechanics
PHYS 333	(3)	Thermal and Statistical Physics
PHYS 339	(3)	Measurements Laboratory
PHYS 340	(3)	Electricity and Magnetism
PHYS 342	(3)	Electromagnetic Waves
PHYS 446	(3)	Quantum Physics
MATH 222	(3)	Calculus 3
MATH 223	(3)	Linear Algebra
MATH 314	(3)	Advanced Calculus
MATH 315	(3)	Ordinary Differential Equations

Complementary Course (3 credits)

PHYS 434	(3)	Optics
or PHYS 439	(3)	Laboratory in Modern Physics

HONOURS PROGRAM IN ATMOSPHERIC SCIENCE (70 credits)

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)

ATOC 214	(3)	Intro. to the Physics of the Atmosphere
ATOC 215	(3)	Weather Systems and Climate

ATOC 308 (3) Principles of Remote Sensing
or GEOG 308
ATOC 315 (3) Water in the Atmosphere
ATOC 480 (3) Honours Research Project
ATOC 512 (3) Atmospheric and Oceanic Dynamics
ATOC 513 (3) Waves and Stability
ATOC 530 (3) Climate Dynamics 1
ATOC 540 (3) Synoptic Meteorology 1
ATOC 541 (3) Synoptic Meteorology 2
ATOC 546 (1) Current Weather Discussion
MATH 222 (3) Calculus 3
MATH 223 (3) Linear Algebra
MATH 314 (3) Advanced Calculus
MATH 315 (3) Ordinary Differential Equations
MATH 319 (3) Partial Differential Equations
PHYS 230 (3) Dynamics of Simple Systems
PHYS 232 (3) Heat and Waves
PHYS 257 (3) Experimental Methods 1
COMP 208 (3) Computers in Engineering

Complementary Courses (12 credits)
3-6 credits to satisfy a statistics requirement, usually:
MATH 203 (3) Principles of Statistics 1
or MATH 323 (3) Probability Theory
and MATH 324 (3) Statistics

3 credits selected from:
PHYS 333 (3) Thermal and Statistical Physics
PHYS 340 (3) Electricity and Magnetism
3-6 credits ordinarily selected from:
GEOG 522 (3) Advanced Env. Hydrology
MATH 317 (3) Numerical Analysis
ATOC 414 (3) Applications of Remote Sensing
ATOC 419 (3) Adv. in Chem. of Atmosphere
or CHEM 419
ATOC 515 (3) Turbulence
PHYS 241 (3) Signal Processing
PHYS 248 (3) Physics of Energy
PHYS 331 (3) Mechanics
PHYS 340 (3) Electricity and Magnetism
PHYS 342 (3) Electromagnetic Waves
PHYS 332 (3) Physics of Fluids
or MECH 331 (3) Fluid Mechanics 1

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 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)
ATOC 512 (3) Atmospheric & Oceanic Dynamics
ATOC 513 (3) Waves and Stability
ATOC 530 (3) Climate Dynamics 1
ATOC 531 (3) Climate Dynamics 2
ATOC 540 (3) Synoptic Meteorology 1
ATOC 541 (3) Synoptic Meteorology 2

Complementary Courses (12 credits)
6 credits selected from:
ATOC 308 (3) Principles of Remote Sensing
or GEOG 308
ATOC 315 (3) Water in the Atmosphere
ATOC 414 (3) Applications of Remote Sensing
ATOC 419 (3) Adv. in Chem. of Atmosphere
or CHEM 419

6 credits ordinarily selected from:
GEOG 522 (3) Advanced Env. Hydrology
MATH 317 (3) Numerical Analysis
MATH 319 (3) Partial Differential Equations
ATOC 515 (3) Turbulence
PHYS 331 (3) Mechanics
PHYS 340 (3) Electricity and Magnetism
PHYS 342 (3) Electromagnetic Waves
PHYS 332 (3) Physics of Fluids
or MECH 331 (3) Fluid Mechanics 1

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 2.9 in the Faculty of Engineering section.

Major in Atmospheric Science
Honours in Atmospheric Science

COURSE DESCRIPTIONS

Please note: courses may have been rescheduled or new courses added after this Calendar went to press. Students preparing to register are advised to consult the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/minerva-students for the most up-to-date information.

The Class Schedule includes the term(s), days, and times when courses will be offered, as well as class locations and names of instructors.

The schedule of courses to be offered in Summer 2003 will be available on the website in January 2003.

The course credit weight is given in parentheses after the title. Term(s) offered (Fall, Winter, Summer) may appear after the credit weight to indicate when a course would normally be taught. Please check the Class Schedule to confirm this information.

ATOC has replaced 195 as the prefix for Atmospheric and Oceanic Sciences courses.

All courses have limited enrolment.

● Denotes courses not offered in 2002-03.

★ Denotes courses taught only in alternate years.

ATOC 199 FYS: WEATHER, CLIMATE, HISTORY. (3) (Winter) (2 hours lectures; 1 hour seminar) (Open only to newly admitted students in U0 or U1, who may take only one FYS. Students who register for more than one will be obliged to withdraw from all but one of them) (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 Europe will be used as an example for study. Methods to establish linkage between weather, climate and history.

ATOC 210 INTRODUCTION TO ATMOSPHERIC SCIENCE. (3) (Fall and Winter) (3 hours lectures) (Open to all students except those who have taken ATOC 214) 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.

ATOC 214 INTRODUCTION: PHYSICS OF THE ATMOSPHERE. (3) (Fall) (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.

ATOC 215 WEATHER SYSTEMS AND CLIMATE. (3) (Winter) (3 hours lectures) (Prerequisite: CEGEP Physics or permission of the instructor) Laws of motion, geostrophic wind, gradient wind. Sur-

face 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".

★ **ATOC 219 INTRODUCTION TO ATMOSPHERIC CHEMISTRY.** (3) (Winter) (3 hours lectures) (Prerequisite: CEGEP DEC in Science or permission of instructor) (Not open to students who have taken CHEM 219, CHEM 419 or ATOC 419) (Offered in odd years. Students should register in CHEM 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.

ATOC 220 INTRODUCTION TO OCEANIC SCIENCES. (3) (Fall and Winter) (3 hours lectures) (Not open to sudents who have taken EPSC 360 or EPSC 560) 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.

● **ATOC 230 CLIMATE AND CLIMATE CHANGE.** (3) (3 hours lectures) (Prerequisite: CEGEP Physics or GEOG 203)

ATOC 250 NATURAL DISASTERS. (3) (Fall) (3 hours lectures) (Not open to students who have taken or are taking EPSC 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.

ATOC 308 PRINCIPLES OF REMOTE SENSING. (3) (Fall) (3 hours lectures) (Not open to students who have taken or are taking GEOG 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.

● **ATOC 310 PHYSICAL OCEANOGRAPHY.** (3) (Winter) (3 hours lectures) (Prerequisite: ATOC 220, MATH 141 or equivalent. Not open to students who have taken EPSC 360)

ATOC 315 WATER IN THE ATMOSPHERE. (3) (Fall and Winter) (3 hours lectures) (Prerequisite: ATOC 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.

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

● **ATOC 400D1 INDEPENDENT STUDY OF AN ENVIRONMENTAL PROBLEM.** (1.5) (Restricted to students taking a joint program in Atmospheric and Environmental Science or with permission of Department)

● **ATOC 400D2 INDEPENDENT STUDY OF AN ENVIRONMENTAL PROBLEM.** (1.5)

ATOC 402 ATMOSPHERE-OCEAN TRANSPORTS. (3) (Fall) (3 hours lectures) (Prerequisite: MATH 222) The role of the atmosphere and oceans in redistributing chemical, physical and biological quantities such as heat, nutrients and pollutants. Overview of flow regimes, from global to turbulence scales, advection and diffusion processes; Reynolds averaging and turbulence; the effect of the Earth's rotation, stratospheric transport of pollutants, oceanic CO_2 transports.

ATOC 414 APPLICATIONS OF REMOTE SENSING. (3) (Winter) (3 hours lectures) (Prerequisite: ATOC 308 or GEOG 308) A more quantitative version of some topics covered in ATOC 308 with emphasis on the contribution of remote sensing to atmospheric and oceanic sciences. Basic notions of radiative transfer and applications of satellite and radar data to mesoscale and synoptic-scale systems are discussed.

★ **ATOC 419 ADVANCES IN CHEMISTRY OF THE ATMOSPHERE.** (3) (Winter) (3 hours lectures) (Prerequisites: CHEM 213, CHEM 273, MATH 222 and MATH 315 or equivalents, or permission of instructor) (Not open to students who have taken CHEM 419, CHEM 619, and ATOC 619) (Offered in odd years. Students should register in CHEM 419 in even years) Selected areas of atmospheric chemistry from field and laboratory to theoretical modelling are examined. The principles of atmospheric reactions (gas, liquid and heterogeneous phases in aerosols and clouds) and issues related to chemical global change will be explored.

ATOC 480 HONOURS RESEARCH PROJECT. (3) (Restricted to U3 Honours students) The student will carry out a research project under the supervision of a member of the staff. The student will be expected to write a report and present a seminar on the work.

ATOC 512 ATMOSPHERIC AND OCEANIC DYNAMICS. (3) (Fall) (3 hours lectures) (Prerequisite: Permission of instructor) Introduction to the fluid dynamics of large-scale flows of the atmosphere and oceans. Stratification of atmosphere and oceans. Equations of state, thermodynamics and momentum. Kinematics, circulation, and vorticity. Hydrostatic and quasi-geostrophic flows. Brief introduction to wave motions, flow over topography, Ekman boundary layers, turbulence.

ATOC 513 WAVES AND STABILITY. (3) (Winter) (3 hours lectures) (Prerequisite: Permission of instructor) Linear theory of waves in rotating and stratified media. Geostrophic adjustment and model initialization. Wave propagation in slowly varying media. Mountain waves; waves in shear flows. Barotropic, baroclinic, symmetric, and Kelvin-Helmholtz instability. Wave-mean flow interaction. Equatorially trapped waves.

ATOC 515 TURBULENCE IN ATMOSPHERE AND OCEANS. (3) (3 hours lectures) (Prerequisite: ATOC 512 or permission of instructor) Application of statistical and semi-empirical methods to the study of geophysical turbulence. Reynolds' equations, dimensional analysis, and similarily. The surface and planetary boundary layers. Oceanic mixed layer. Theories of isotropic two- and three-dimensional turbulence: energy and enstrophy inertial ranges. Beta turbulence.

ATOC 530 CLIMATE DYNAMICS 1. (3) (Fall) (3 hours lectures) (Prerequisite: Permission of instructor) (Restricted to Graduate students and final-year Honours Atmospheric Science students. Others by special permission.) Introduction to the components of the climate system. Review of paleoclimates. Physical processes and models of climate and climate change.

ATOC 531 CLIMATE DYNAMICS 2. (3) (Winter) (3 hours lectures) (Prerequisite: Permission of instructor) (Restricted to Graduate students and final-year Honours Atmospheric Science students. Others by special permission.) The general circulation of the atmosphere and oceans. Atmospheric and oceanic general circulation models. Observations and models of the El Niño and Southern Oscillation phenomena.

ATOC 540 SYNOPTIC METEOROLOGY 1. (3) (Fall) (2 hours lectures; 2 hours laboratory) (Prerequisite: Permission of instructor) Analysis of current meteorological data. Description of a geostrophic, hydrostatic atmosphere. Ageostrophic circulations and hydrostatic instabilities. Kinematic and thermodynamic methods of computing vertical motions. Tropical and extratropical condensation rates. Barotropic and equivalent barotropic atmospheres.

● **ATOC 541 SYNOPTIC METEOROLOGY 2.** (3) (Winter) (2 hours lectures; 2 hours laboratory) (Prerequisite: ATOC 512 and ATOC 540 or permission of instructor)

ATOC 546 CURRENT WEATHER DISCUSSION. (1) (Winter) (2 hours) (Prerequisite: ATOC 540 or permission of instructor) (Restricted to Graduate students and final-year Honours Atmospheric Science students. Others by special permission.) Half-hour briefing on atmospheric general circulation and current weather around the world using satellite data, radar observations, conventional weather maps, and analyses and forecasts produced by computer techniques.

ATOC 550 SPECIAL TOPICS IN METEOROLOGY AND OCEANOGRAPHY. (1) (Fall) (1 hour lecture) (Prerequisite: Permission of instructor) (Restricted to Graduate students and final-year Honours Atmospheric Science students. Others by special permission.) Lectures and seminars on special topics such as hydrology, agricultural meteorology, the limits of predictability, planetary atmospheres, atmospheric and oceanic pollution, coastal currents, and research reviews.

● **ATOC 551 SPECIAL TOPICS IN METEOROLOGY AND OCEANOGRAPHY.** (1) (Winter) (1 hour lecture) (Prerequisite: Permission of instructor) (Restricted to Graduate students and final-year Honours Atmospheric Science students. Others by special permission.) Seminars on special topics as in ATOC 550.

● **ATOC 558 NUMERICAL METHODS AND LABORATORY.** (3) (Winter) (1 hour lecture; 4 hours laboratory) (Prerequisite: Permission of instructor) (Restricted to Graduate students and final-year Honours Atmospheric Science students. Others by special permission.)

● **ATOC 568 OCEAN PHYSICS.** (3) (Winter) (3 hours lectures) (Prerequisite: ATOC 512 or permission of instructor) (Restricted to Graduate students and final-year Honours Atmospheric Science students. Others by special permission.)

12.3 Biochemistry (BIOC)

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Montreal, QC H3G 1Y6

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Fax: (514) 398-7384
Email: maureen.caron@mcgill.ca
Website: http://www.medicine.mcgill.ca/biochem

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
Rhoda Blostein; B.Sc., M.Sc., Ph.D.(McG.) *(joint appt. with Medicine)*
Nicole Beauchemin; B.Sc., M.Sc., Ph.D.(Montr.) *(joint appt. with Oncology)*
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.) F.R.S.C. *(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.)
Morag Park; B.Sc.,Ph.D.(Glasgow) *(William Dawson Scholar) (joint appt. with Oncology)*
Gordon C. Shore; B.Sc.(Guelph), Ph.D.(McG)
Joseph Shuster; B.Sc.(McG.), Ph.D.(Calif.), M.D.(Alta.) *(joint appt. 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 appt. with Oncology)*
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 appt. 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 appt. with Oncology)*
Jerry Pelletier; B.Sc., Ph.D.(McG.)

Assistant Professor
Imed Gallouzi; Matrise, DEA, Ph.D.(Montpellier,France)

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 Hallett *(Computer Science)*; 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
Prabhat Arya *(NRC, Ottawa)*; Michael Cordingley *(Boehringer-Ingelheim);* Mirek Cygler *(B.R.I.);* Jacques Drouin *(Clin. Res. Inst.);* Feng Ni *(B.R.I.);* Donald Nicholson *(Merck Frosst);* Maureen D. O'Connor-McCourt *(B.R.I.);* Arnim Pause *(Boehringer Ingelheim Canada);* Enrico Purisima *(B.R.I.);* Sophie Roy*(Merck Frosst);* Andrew C. Storer *(B.R.I.);* Marc Therrien *(Clin. Res. Inst.);* Andre Veillette*(Clin. Res. Inst.);* Alice Vrielink *(Univ. of California, Santa Cruz);* Lee A. Wall *(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 fulfill 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)

U1 Required Courses (16 credits)

BIOC 212 (3) Molecular Mechanisms of Cell Function
BIOL 200 (3) Molecular Biology
BIOL 202 (3) Basic Genetics
CHEM 204 (3) Physical Chem./Biol. Sci. 1
CHEM 222 (4) Organic Chemistry 2

U1 Complementary Courses (9 credits)

6 credits selected from:
PHGY 209 (3) Mammalian Physiology 1
PHGY 210 (3) Mammalian Physiology 2
MIMM 211 (3) Biology of Microorganisms
BIOL 205 (3) Biology of Organisms

3 credits selected from:
BIOL 373 (3) Biostatistical Analysis
COMP 202 (3) Introduction to Computing 1
PSYC 204 (3) Introduction to Psychological Statistics
MATH 222 (3) Calculus 3

U2 Required Courses (15 credits)

BIOC 300D1 (3) Laboratory in Biochemistry
BIOC 300D2 (3) Laboratory in Biochemistry
BIOC 311 (3) Metabolic Biochemistry
BIOC 312 (3) Biochemistry of Macromolecules
CHEM 302 (3) Organic Chemistry 3

U2 Complementary Courses (3 credits)

3 credits selected from:
BIOL 303 (3) Developmental Biology
BIOL 313 (3) Structure and Function of Cells
CHEM 352 (3) Structural Organic Chemistry
CHEM 382 (3) Organic Chemistry of Natural Products
MIMM 314 (3) Immunology
ANAT 262 (3) Introductory Molecular and Cell Biology

U3 Complementary Courses (12 credits)

at least 3 credits selected from:
BIOC 450 (3) Protein Structure and Function
BIOC 454 (3) Nucleic Acids

the remaining credits selected from the following list or the above:
BIOC 404 (3) Biophysical Chemistry
BIOC 455 (3) Neurochemistry
BIOC 458 (3) Membranes and Cellular Signaling
ANAT 261 (4) Introduction to Dynamic Histology
BIOL 205 (3) Biology of Organisms
BIOL 300 (3) Molecular Biology of the Gene
BIOL 303 (3) Developmental Biology
BIOL 304 (3) Evolution
BIOL 314 (3) Molecular Biology of Oncogenes
CHEM 214 (3) Physical Chem./Biol. Sci. 2
CHEM 257D1 (2) Introductory Analytical Chemistry
CHEM 257D2 (2) Introductory Analytical Chemistry
CHEM 352 (3) Structural Organic Chemistry
CHEM 362 (2) Advanced Organic Chemistry Lab.
CHEM 382 (3) Organic Chemistry of Natural Products
CHEM 402 (3) Advanced Bio-organic Chemistry
CHEM 572 (3) Synthetic Organic Chemistry
MIMM 211 (3) Biology of Microorganisms
MIMM 314 (3) Immunology
PHAR 300 (3) Drug Action
PHAR 301 (3) Drugs and Disease
PHGY 209 (3) Mammalian Physiology 1
PHGY 210 (3) Mammalian Physiology 2

MAJOR PROGRAM 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)

BIOC 212 (3) Molecular Mechanisms of Cell Function
BIOL 200 (3) Molecular Biology
BIOL 202 (3) Basic Genetics
CHEM 204 (3) Physical Chem./Biol. Sci. 1
CHEM 222 (4) Organic Chemistry 2
CHEM 257D1 (2) ntroductory Analytical Chemistry
CHEM 257D2 (2) Introductory Analytical Chemistry

U1 Complementary Courses (9 credits)

6 credits, selected from:
PHGY 209 (3) Mammalian Physiology 1
PHGY 210 (3) Mammalian Physiology 2
MIMM 211 (3) Biology of Microorganisms
BIOL 205 (3) Biology of Organisms

3 credits selected from:
BIOL 309 (3) Math. Models in Biology
BIOL 373 (3) Biostatistical Analysis
COMP 202 (3) Introduction to Computing 1
MATH 203 (3) Principles of Statistics
MATH 222 (3) Calculus 3
PSYC 204 (3) Intro to Psychological Stats

U2 Required Courses (23 credits)

all Faculty Program U2 Required Courses, plus:
CHEM 214 (3) Physical Chem./Biol. Sci. 2
CHEM 362 (2) Advanced Organic Chemistry Lab.
ANAT 262 (3) Intro. Molecular & Cell Biology

U2 Complementary Courses (3 credits)

3 credits selected from:
BIOL 303 (3) Developmental Biology
BIOL 313 (3) Structure and Function of Cells
CHEM 352 (3) Structural Organic Chemistry
CHEM 382 (3) Organic Chemistry of Natural Products
MIMM 314 (3) Immunology

U3 Required Courses (6 credits)

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

U3 Complementary Courses (6 or 9* credits)

at least 3 credits selected from:
BIOC 404 (3) Biophysical Chemistry
BIOC 455 (3) Neurochemistry
BIOC 458 (3) Membrames and Cellular Signalling
BIOC 460* (6) Advanced Lab in Biochemistry
BIOC 503 (3) Immunochemistry

the remainder, if any, to be selected from the following list:
BIOL 300 (3) Molecular Biology of the Gene
BIOL 303 (3) Developmental Biology
BIOL 304 (3) Evolution
BIOL 313 (3) Structure and Function of Cells
BIOL 314 (3) Molecular Biology of Oncogenes
CHEM 352 (3) Structural Organic Chemistry
CHEM 382 (3) Organic Chemistry of Natural Products
CHEM 402 (3) Advanced Bio-organic Chemistry
CHEM 552 (3) Physical Organic Chemistry
CHEM 572 (3) Synthetic Organic Chemistry
EXMD 502 (3) Advanced Endocrinology 1
EXMD 503 (3) Advanced Endocrinology 2
MIMM 314 (3) Immunology
MIMM 324 (3) Fundamental Virology
PHAR 300 (3) Drug Action
PHAR 301 (3) Drugs and Disease
PHGY 311 (3) Intermediate Physiology 1

PHGY 312 (3) Intermediate Physiology 2

* Students who are given special permission to take BIOC 460 are required to complete 9 credits of complementary courses in U3.

HONOURS PROGRAM 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 BIOC 311 and BIOC 312 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)
as for the Major Program U1

U1 Complementary Courses (9 credits)
as for the Major Program U1

U2 Required Courses (23 credits)
as for the Major Program U2

U2 Complementary Courses (3 credits)
as for the Major Program U2

U3 Required Courses (15 credits)

BIOC 404	(3)	Biophysical Chemistry
BIOC 450	(3)	Protein Structure & Function
BIOC 454	(3)	Nucleic Acids
BIOC 460	(6)	Advanced Lab in Biochemistry

U3 Complementary Courses (6 credits)
at least 3 credits selected from:

BIOC 455	(3)	Neurochemistry
BIOC 458	(3)	Membranes and Cellular Signaling
BIOC 491	(6)	Independent Research
BIOC 503	(3)	Immunochemistry

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

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 304	(3)	Evolution
BIOL 313	(3)	Structure and Function of Cells
BIOL 314	(3)	Molecular Biology of Oncogenes
CHEM 352	(3)	Structural Organic Chemistry
CHEM 382	(3)	Organic Chemistry of Natural Products
CHEM 402	(3)	Advanced Bio-organic Chemistry
CHEM 552	(3)	Physical Organic Chemistry
CHEM 572	(3)	Synthetic Organic Chemistry
EXMD 502	(3)	Advanced Endocrinology 1
EXMD 503	(3)	Advanced Endocrinology 2
MIMM 314	(3)	Immunology
MIMM 324	(3)	Fundamental Virology
PHAR 300	(3)	Drug Action
PHAR 301	(3)	Drugs and Disease
PHGY 311	(3)	Intermediate Physiology 1
PHGY 312	(3)	Intermediate Physiology 2

ADVISERS

New students interested in Biochemistry should call (514) 398-7266 for information regarding academic advising.

Returning Students must schedule an advising appointment directly with the academic adviser assigned to them in their first year in Biochemistry.

INTERDEPARTMENTAL HONOURS PROGRAM IN IMMUNOLOGY The Departments of Biochemistry, Microbiology and Immunology, and Physiology offer an Immunology Interdepartmental Honours Program, see section 12.13.

COURSE DESCRIPTIONS

Please note: courses may have been rescheduled or new courses added after this Calendar went to press. Students preparing to register are advised to consult the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/minerva-students for the most up-to-date information.

The Class Schedule includes the term(s), days, and times when courses will be offered, as well as class locations and names of instructors.

The schedule of courses to be offered in Summer 2003 will be available on the website in January 2003.

The course credit weight is given in parentheses after the title. Term(s) offered (Fall, Winter, Summer) may appear after the credit weight to indicate when a course would normally be taught. Please check the Class Schedule to confirm this information.

BIOC has replaced 507 as the prefix for Biochemistry courses.

All courses have limited enrolment.

● Denotes courses not offered in 2002-03.

BIOC 212 MOLECULAR MECHANISMS OF CELL FUNCTION. (3) (Winter) (Prerequisite: BIOL 200) (A non-terminal course intended to be followed by BIOC 311; BIOC 312 in the U2 year. Not open to students who have taken or are taking BIOL 201 or ANAT 212) An introductory course describing the biochemistry and molecular biology of selected key functions of animal cells, including: gene expression; mitochondrial production of metabolic energy; cellular communication with the extra-cellular environment; and regulation of cell division.

BIOC 300D1 LABORATORY IN BIOCHEMISTRY. (3) (Fall) (1 lecture and one 6-hour lab per week) (Prerequisites: BIOL 200 and BIOL 201 or BIOC 212, CHEM 222; CHEM 257D1/CHEM 257D2 recommended. Corequisites: BIOC 311 and BIOC 312. Not open to students who have taken or are taking BIOL 301.) (For students in Biochemistry programs, others with permission of instructor) (Students must also register for BIOC 300D2) (No credit will be given for this course unless both BIOC 300D1 and BIOC 300D2 are successfully completed in consecutive terms) A comprehensive course in modern biochemical techniques involving properties of enzymes, metabolism, fractionation of organelles from mammalian cells and molecular biology.

BIOC 300D2 LABORATORY IN BIOCHEMISTRY. (3) (Winter) (Prerequisite: BIOC 300D1) (No credit will be given for this course unless both BIOC 300D1 and BIOC 300D2 are successfully completed in consecutive terms) See BIOC 300D1 for course description.

BIOC 311 METABOLIC BIOCHEMISTRY. (3) (Fall) (Prerequisites: BIOL 200, BIOL 201 or BIOC 212, CHEM 222) The generation of metabolic energy in higher organisms with an emphasis on its regulation at the molecular, cellular and organ level. Chemical concepts and mechanisms of enzymatic catalysis are also emphasized. Included: selected topics in carbohydrate, lipid and nitrogen metabolism; complex lipid and biological membranes; hormonal signal transduction.

BIOC 312 BIOCHEMISTRY OF MACROMOLECULES. (3) (Winter) (Prerequisites: BIOC 311, BIOL 200, BIOL 201 or BIOC 212) Gene expression from the start of transcription to the synthesis of proteins, their modifications and degradation. Topics covered: purine and pyrimidine metabolism; transcription and its regulation; mRNA processing; translation; targetting of proteins to specific cellular sites; protein glycosylation; protein phosphorylation; protein turnover; programmed cell death (apoptosis).

BIOC 404 BIOPHYSICAL CHEMISTRY. (3) (Winter) (Prerequisites: CHEM 204, CHEM 214 or equivalent) (Not open to students who have taken 180-404) Hydrodynamic and electrophoretic methods for separation and characterization of macromolecules. Optical

and magnetic resonance spectroscopy of biopolymers, and applications to biological systems.

BIOC 450 PROTEIN STRUCTURE AND FUNCTION. (3) (Fall) (Prerequisites: BIOC 311, BIOC 312 and/or sufficient organic chemistry. Intended primarily for students at the U3 level) Primary, secondary, tertiary and quaternary structure of enzymes. Active site mapping and site-specific mutagenesis of enzymes. Enzyme kinetics and mechanisms of catalysis. Multienzyme complexes.

BIOC 454 NUCLEIC ACIDS. (3) (Fall) (Prerequisites: BIOC 311, BIOC 312 or permission of instructor) Chemistry of RNA and DNA, transcription and splicing of RNA and their control; enzymology of DNA replication. Special topics on transgenics, genetic diseases and cancer.

BIOC 455 NEUROCHEMISTRY. (3) (Winter) (Prerequisites: BIOC 311, BIOC 312 or permission of instructor) Covers biochemical mechanisms underlying central nervous system function. Introduces basic neuroanatomy, CNS cell types and morphology, neuronal excitability, chemically mediated transmission, glial function. Biochemistry of specific neurotransmitters, endocrine effects on brain, brain energy metabolism and cerebral ischemia (stroke). With examples, where relevant, of biochemical processes disrupted in human CNS disease.

BIOC 458 MEMBRANES AND CELLULAR SIGNALING. (3) (Winter) (Prerequisites: BIOC 212, ANAT 262; one of PHGY 201, PHGY 209 or BIOL 205; one of BIOC 312 or ANAT 365; and BIOC 311 or permission of instructors) (This course is also listed as ANAT 458. Not open to students who have taken or are taking ANAT 458 or BIOC 456) An integrated treatment of the properties of biological membranes and of intracellular signaling, including the major role that membranes play in transducing and integrating cellular regulatory signals. Biological membrane organization and dynamics: membrane transport; membrane receptors and their associated effectors; mechanisms of regulation of cell growth, morphology, differentiation and death.

BIOC 460 ADVANCED LAB IN BIOCHEMISTRY. (6) (Fall) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) Students will select one project, employing advanced as well as standard biochemical techniques, to be performed in a research laboratory in the Department. Each student will also write a research-review paper with the advice of a professor and perform student projects in the teaching laboratory.

BIOC 491 INDEPENDENT RESEARCH. (6) (Winter) (Registration by departmental permission only) (Prerequisite: BIOC 460) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) Individual work on a project to be performed in a research laboratory.

BIOC 503 IMMUNOCHEMISTRY. (3) (Winter) (Prerequisites: BIOC 311, BIOC 312) This course, presented in lecture format, emphasizes the molecular, genetic and structure function events that occur in the humoral immune response. Interleukins and other mediators of inflammation, a field in which rapid changes are occurring, are discussed. The clinical significance of fundamental biochemical findings is described.

12.4 Biology (BIOL)

Stewart Biological Sciences Building, Room W4-7
1205 Avenue Docteur Penfield
Montreal, QC H3A 1B1

Telephone: (514) 398-6400
Fax: (514) 398-5069
Website: http://www.mcgill.ca/Biology/biology1.htm

Chair — Paul F. Lasko

Emeritus Professors
Clark Fraser; O.C., B.Sc.(Acadia), M.Sc., Ph.D., M.D.(McG.), D.Sc.(Acadia), F.R.C.P.(C), F.R.S.C. *(Molson Emeritus Professor of Genetics) (joint appt. with Human Genetics)*
Sarah P. Gibbs; A.B., M.S.(C'nell), Ph.D.(Harv.), F.R.S.C. *(Macdonald Emeritus Professor of Botany)*
John B. Lewis; B.Sc., M.Sc., Ph.D.(McG.)
Gordon A. Maclachlan; B.Sc.(Sask.), Ph.D.(Manit.)*(Macdonald Emeritus Professor of Botany)*
Barid B. Mukherjee; B.Sc.(Calc.), M.S.(Brig.Young), Ph.D.(Utah) *(joint appt. with Human Genetics)*
Rolf Sattler; B.Sc.(Tubingen), Ph.D.(Munich), F.R.S.C.

Professors
Graham A.C. Bell; B.A., D.Phil.(Oxon.), F.R.S.C. *(James McGill Professor) (Molson Professor of Genetics)*
Gregory G. Brown; B.Sc.(Notre Dame), Ph.D.(N.Y.)
A. Howard Bussey; B.Sc., Ph.D.(Brist.), F.R.S.C.
Robert L. Carroll; B.S.(Mich.), M.A., Ph.D.(Harv.), F.R.S.C. *(Strathcona Professor of Zoology)*
Ronald Chase; A.B.(Stan.), Ph.D.(M.I.T.)
Rajinder S. Dhindsa; B.Sc., M.Sc.(Punj.), Ph.D.(Wash.)
Donald L. Kramer; B.Sc.(Boston Coll.), Ph.D.((Br.Col.)
Paul F. Lasko; A.B.(Harv.), Ph.D.(M.I.T.) *(joint appt. with Anatomy & Cell Biology)*
Martin Lechowicz; B.A.(Mich. State), M.S., Ph.D.(Wis.)
Ronald J. Poole; B.Sc., Ph.D.(Birm.)
Rima Rozen; B.Sc., Ph.D.(McG.) *(James McGill Professor)*
Daniel J. Schoen; B.Sc., M.Sc.(Mich.), Ph.D.(Calif.) *(Macdonald Professor of Botany)*

Associate Professors
Thomas Bureau; B.Sc.(Calif.), Ph.D.(Texas)*(William Dawson Scholar) (on leave)*
Siegfried Hekimi, M.Sc., Ph.D.(Geneva)
Louis Lefebvre; B.Sc., M.A., Ph.D.(Montr.)
Robert L. Levine; B.Sc.(Brooklyn), M.Sc., Ph.D.(Yale)
Yutaka Nishioka; B.A., M.A.(Tokyo), Ph.D.(Col.)
Gerald S. Pollack; M.A., Ph.D.(Prin.)
Catherine Potvin; B.Sc., M.Sc.(Montr.), Ph.D.(Duke)
Neil M. Price; B.Sc.(New Br.), Ph.D.(Br.Col.)
Joseph Rasmussen; B.Sc., M.Sc.(Alta.), Ph.D.(Calg.)
Beat Suter; Dip., Ph.D.(Zür)
Candace S. Waddell; B.A.(Virginia), Ph.D.(UCSF)*(on leave)*

Assistant Professors
Joseph A. Dent; B.Sc., Ph.D.(Colo.)
Frédéric Guichard; B.Sc.(Montr.), Ph.D.(Laval)
Christian Hardtke; M.Sc., Ph.D.(Munich)
Andrew Hendry; B.Sc.(Vic.,B.C.) M.Sc., Ph.D.(Wash.)
Kevin McCann; B.A.(Dart), M.Sc., Ph.D.(Guelph)
Laura Nilson; B.A.(Colgate), Ph.D.(Yale) *(Canada Research Chair in Developmental Genetics)*
Richard Roy; B.Sc.(Bishop's), Ph.D.(Laval)
Monique Zetka; B.Sc., Ph.D.(Br.Col.)

Associate Members
Sal Carbonetto *(MGH),* Hugh J. Clarke *(RVH.),* Pierre Drapeau *(MGH),* Robert Dunn *(Neuroscience),* Michael Ferns *(Neurology & Neurosurgery),* David Green *(Redpath Museum),*
Kenneth Hastings *(MNI)*, Paul Holland *(MNI)*, Roberta Palmour *(Allan Memorial Institute)*, David Rosenblatt *(Paediatrics),*
Guy Rouleau *(MGH),* Charles R. Scriver *(Paediatrics),*
Teruko Taketo *(RVH),* Harriet S. Tenenhouse *(Paediatrics),*
David Y. Thomas *(Biochemistry)*

Adjunct Professors
Eldrige Birmingham *(STRI)*
Wing Cheung *(DNA Landmarks)*
Wayne Hunte *(U. West Indies)*
Benoit S. Landry *(DNA Landmarks)*
William F. Laurance *(STRI)*
Malcolm S. Whiteway; B.Sc.(Dal.), Ph.D.(Alta.) *(NRC Lab)*

Biology is the study of living things at the molecular, cellular and organismal levels. It deals with fundamental questions such as the origin and evolution of plants and animals, interactions between living organisms and their environment, mechanisms of embryonic development, structure and function of the living cell and its organelles, molecular basis of inheritance, biochemical and genetic basis of human diseases, and the operation of the brain and the nervous system. The study of biology also has vast prac-

tical applications. The knowledge, methods and concepts developed through research in the various fields of biology are applied extensively in agriculture, medicine, biotechnology, genetic engineering, environmental protection and wildlife management.

The Department of Biology offers two Faculty Programs, a Major Program, an Honours Program, a Minor Program and a Minor Concentration in Science for Arts students. The details of these programs are given below.

The prerequisites for Biology programs include, in addition to the minimum requirements for admission to the Faculty of Science, an additional Biology and one course in Organic Chemistry. Students who have a DEC in Science but lack either of these courses must take them as extra requirements. It is advisable to take the additional CEGEP Biology in advance, if possible. The two Biology courses together prepare students for the Biology Program at McGill. Note that an introductory course in Cell and Molecular Biology (BIOL 112) is offered in the summer at McGill.

The programs in Biology offer students an opportunity to specialize in more than one area of biology and provide them with a broad training in biology as compared to the more specialized programs in Biochemistry, Microbiology, Physiology and Anatomy. A B.Sc. degree in Biology, therefore, prepares students for a wide range of employment opportunities, including entry to professional schools in medicine, veterinary science, dentistry, agriculture, nursing, education and library science. It also provides solid background for those interested in careers related to environmental protection, wildlife management, biotechnology and genetic engineering. A B.Sc. degree in Biology can also lead to post-graduate studies and research careers in universities, research institutes, hospitals, and industrial or governmental laboratories.

The Department of Biology has well-equipped teaching and research laboratories and its academic staff members, research associates, post-doctoral fellows and graduate students carry out research in areas of molecular biology, human genetics, ecology, animal behaviour, developmental biology, neurobiology, marine biology, plant biology, and evolution. Its teaching and research resources are extended by the Redpath Museum; the Montreal Children's, Jewish General, Montreal General, Royal Victoria and Shriners Hospitals; Macdonald Campus; Montreal Neurological Institute; and the Sheldon Biotechnology Centre. For courses taught in the field, the stations at the Gault Nature Reserve, the Morgan Arboretum, the Bellairs Research Institute in Barbados, the Huntsman Marine Science Centre in New Brunswick, and the Smithsonian Tropic Research Institute in Panama are used. In addition, field stations near Lake Memphremagog and at Schefferville in northern Quebec are available for research projects.

The courses listed below are not described in any great detail. To provide more information, the Department has prepared a "Blue Book" (sold in the Biology Department, Room W4/8), entitled Department of Biology Undergraduate Programs 2002-2003, which describes in detail the content of each course and the level at which it is given, the aims and methods used, lectures, references, grading procedures, etc. The book also contains more information on registration, counselling, committee structure and the research interests and facilities which are represented in the Department. The book is also available on the Web at http://www.mcgill.ca/Biology/undindex.htm.

Inquiries about undergraduate programs should be directed to the Undergraduate Affairs Office, in Room W4/8, Stewart Biological Sciences Building, telephone (514) 398-7045.

MINOR PROGRAM IN BIOLOGY (24 credits)

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)
BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 202 (3) Basic Genetics
BIOL 205 (3) Biology of Organisms
BIOL 208 (3) Introduction to Ecology
BIOL 304 (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. These programs offer students an opportunity to specialize in more than one area of biology, to broaden the scope of their scientific background. These 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. 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 or 55 credits)

Required Courses (18 credits)
BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 202 (3) Basic Genetics
BIOL 205 (3) Biology of Organisms
BIOL 208 (3) Introduction to Ecology
BIOL 304 (3) Evolution

Complementary Courses (36 or 37 credits)
18 or 19 credits of Biology courses, including
3 or 4 credits selected from:
BIOL 206 (3) Methods in Biology of Organisms
BIOL 301 (4) 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)

Required Courses (21 credits)
MATH 133 (3) Vectors, Matrices and Geometry
MATH 222 (3) Calculus 3
MATH 223 (3) Linear Algebra
MATH 315 (3) Ordinary Differential Equations
MATH 323 (3) Probability Theory
MATH 324 (3) Statistics
COMP 202 (3) Introduction to Computing 1

Complementary Courses (36 credits)
21 credits in Biology including
12 credits selected from:
BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 202 (3) Basic Genetics
BIOL 205 (3) Biology of Organisms
BIOL 206 (3) Methods in Biology of Organisms
BIOL 208 (3) Introduction to Ecology
PHGY 209 (3) Mammalian Physiology 1
PHGY 210 (3) Mammalian Physiology 2
and 9 credits selected from:
BIOL 303 (3) Developmental Biology
BIOL 304 (3) Evolution
BIOL 306 (3) Neurobiology and Behaviour
BIOL 307 (3) Behavioural Ecology/Sociobiology
BIOL 324 (3) Ecological Genetics

BIOL 370 (3) Human Genetics Applied
BIOL 473 (3) Ecology of Aquatic Invertebrates
BIOL 520 (3) Gene Activity in Development
BIOL 530 (3) Neural Basis of Behaviour
BIOL 531 (3) Neurobiology Learning Memory
6 credits of any other Biological Sciences courses
9 credits of Mathematics
including at least 3 credits selected from:
BIOL 309 (3) Mathematical Models in Biology
PHYS 413 (3) The Physical Basis of Physiology
and at least 3 credits selected from:
MATH 314 (3) Advanced Calculus
MATH 317 (3) Numerical Analysis
MATH 319 (3) Partial Differential Equations
MATH 327 (3) Matrix Numerical Analysis
MATH 407 (3) Dynamic Programming
MATH 423 (3) Regression and Analysis of Variance
MATH 447 (3) Stochastic Processes
MATH 525 (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 (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)
BIOL 200 (3) Molecular Biology
BIOL 201 (3) Cell Biology and Metabolism
BIOL 202 (3) Basic Genetics
BIOL 205 (3) Biology of Organisms
BIOL 206 (3) Methods in Biology of Organisms
BIOL 208 (3) Introduction to Ecology

U2 or U3 Required Courses (7 credits)
BIOL 301 (4) Cell and Molecular Laboratory
BIOL 304 (3) Evolution

U2 or U3 Complementary Courses (9 credits)
9 credits selected from:
BIOL 300 (3) Molecular Biology of the Gene
BIOL 303 (3) Developmental Biology
BIOL 305 (3) Diversity of Life
BIOL 306 (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:
BIOL 300, BIOL 301, BIOL 303, BIOL 373, BIOL 551
CHEM 222, CHEM 203 or CHEM 204 and CHEM 214

Other suggested courses:
BIOL 314, BIOL 471D1/BIOL 471D2, BIOL 477, BIOL 478, BIOL 516, BIOL 518, BIOL 520, BIOL 524 or BIOL 544

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 discipline Neurobiology, 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:
BIOL 306, BIOL 389, BIOL 530, BIOL 531, BIOL 532, BIOL 588

Other suggested courses:
Anatomy and Cell Biology ANAT 321, ANAT 322
Biochemistry BIOC 455
Biology BIOL 300, BIOL 303, BIOL 373 or equivalent, BIOL 471D1/BIOL 471D2, BIOL 477, BIOL 478
Neurology/Neurosurgery NEUR 310
Pharmacology PHAR 562
Physiology PHGY 451, PHGY 520, PHGY 556
Psychiatry PSYT 500
Psychology PSYC 311, PSYC 318, PSYC 342, PSYC 410, PSYC 422, PSYC 470

HUMAN GENETICS CONCENTRATION

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

Key courses:
BIOL 301, BIOL 370, BIOL 373, BIOL 468, BIOL 475, BIOL 516 or BIOL 520

Other suggested courses:
Biology BIOL 314, BIOL 471D1/BIOL 471D2, BIOL 477, BIOL 478, BIOL 551
Chemistry CHEM 222, CHEM 203 or CHEM 204 and CHEM 214
Biochemistry BIOC 311, BIOC 450
Microbiology and Immunology MIMM 314

EXPERIMENTAL PLANT BIOLOGY CONCENTRATION

Research interests span modern molecular genetics, plant physiology and biochemistry, plant ecology and genetics, plant morphogenesis, and the adaptation and evolution of plant form and function. Research is carried out in the field and in the Department's large, excellent controlled environment facilities. The importance of adaptation to climate and the use of plants for food, chemicals, pharmaceuticals and materials underlie research using biotechnology and quantitative methods to improve cultivated plants and understand natural plant populations.

Key courses:
BIOL 300, BIOL 303, BIOL 305, BIOL 357, BIOL 358

Other suggested courses:
BIOL 373, BIOL 465, BIOL 471, BIOL 477, BIOL 478, BIOL 522, BIOL 526, BIOL 555L

EVOLUTIONARY BIOLOGY CONCENTRATION

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

Key courses:
BIOL 305, BIOL 307, BIOL 324, BIOL 331, BIOL 352, BIOL 471D1/BIOL 471D2, BIOL 477 or BIOL 478, BIOL 555, BIOL 562, BIOL 570, BIOL 572

Other suggested courses in Organismal Biology:
BIOL 327, BIOL 335, BIOL 350, BIOL 351, BIOL 358

Macdonald Campus:
Natural Resource Sciences WILD 420

Genetics and Development: BIOL 300, BIOL 303

Ecology and Behaviour: BIOL 309

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:
BIOL 305, BIOL 306, BIOL 307, BIOL 331 or BIOL 334 or another field course with a significant behavioural component.

Other suggested courses:
BIOL 377, BIOL 471D1/BIOL 471D2, BIOL 477, BIOL 478

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 WILD 420), amphibians and reptiles (BIOL 327) and marine mammals (BIOL 335) include a significant amount of behaviour. Prof. A. Baker of the Psychology Department is willing to advise students on selection of relevant psychology courses on perception, learning, and motivation.

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 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 ecology and evolutionary biology and underlie all work in resource utilization and conservation biology.

Key course:
BIOL 305

Other suggested courses:
BIOL 240, BIOL 324, BIOL 327, BIOL 331 or BIOL 334, BIOL 335, BIOL 341, BIOL 350, BIOL 351, BIOL 352, BIOL 353, BIOL 358, BIOL 373, BIOL 437, BIOL 465, BIOL 471D1/BIOL 471D2, BIOL 477 or BIOL 478, BIOL 555, BIOL 560

Macdonald Campus:
Zoology ZOOL 307, ZOOL 312, ZOOL 313, ZOOL 316, ZOOL 424
Plant Science PLNT 356, PLNT 451
Entomology ENTO 440
Natural Resource Sciences WILD 402, WILD 420

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 BIOL 331 and/or other field courses should be considered as vital to all concentrations in this area.

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:
Biology BIOL 305, BIOL 331 or BIOL 334, BIOL 350
Computer Science COMP 202 or COMP 273

Other suggested courses:
Biology BIOL 307, BIOL 324, BIOL 327, BIOL 345, BIOL 432, BIOL 441 or BIOL 542, BIOL 535
Geography GEOG 302

Macdonald Campus:
Plant Science PLNT 451
Natural Resource Sciences WILD 420

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:
Biology BIOL 305, BIOL 331 or another field course, BIOL 432, BIOL 441 or BIOL 542, BIOL 560
Computer Science COMP 202 or COMP 273

Other suggested courses:
Biology BIOL 307
Geography GEOG 305, GEOG 306, GEOG 308, GEOG 332
Macdonald Campus
Zoology ZOOL 315

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:
BIOL 305, BIOL 335, BIOL 351, BIOL 437, BIOL 441, BIOL 542

Other suggested courses:
Biology BIOL 331, BIOL 334, BIOL 432, BIOL 560
Earth and Planetary Sciences EPSC 542

Atmospheric and Oceanic Sciences ATOC 220, ATOC 512, ATOC 550, ATOC 561

For students intending to proceed to graduate work, one independent studies course (BIOL 471D1/BIOL 471D2, BIOL 477 or BIOL 478) is recommended. Because of the importance of numerical analyses in all fields of Ecology, courses in Biometry (e.g. BIOL 373) and Computer Science (COMP 202 or COMP 273) are recommended.

HONOURS PROGRAM 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 3.20 and approval of a 9 or 12-credit Independent Studies proposal (see listing of BIOL 479 and BIOL 480 for details). For an Honours degree, a minimum CGPA of 3.20 in the U3 year and adherence to the program as outlined below are the additional requirements.

U1 Required Courses (18 credits)
as for the Major program

U2 and U3 Required Courses (10 credits)

BIOL 301	(4)	Cell and Molecular Laboratory
BIOL 304	(3)	Evolution
BIOL 373	(3)	Biostatistical Analysis

U2 and U3 Complementary Courses (27 credits)
9 credits selected from:

BIOL 300	(3)	Molecular Biology of the Gene
BIOL 303	(3)	Developmental Biology
BIOL 305	(3)	Diversity of Life
BIOL 306	(3)	Neurobiology and Behaviour

18 credits in Biology at the 300 level or higher

U3 Required Courses (13 or 16 credits)
either:

BIOL 499D1	(2)	Honours Seminar in Biology
BIOL 499D2	(2)	Honours Seminar in Biology
BIOL 479D1	(4.5)	Independent Studies in Biology
BIOL 479D2	(4.5)	Independent Studies in Biology

or:

BIOL 480D1	(6)	Independent Studies in Biology
BIOL 480D2	(6)	Independent Studies in Biology

Courses open to non-biologists

Many aspects of biology interest humanists and scientists specializing in other disciplines. Therefore, several courses are offered to students with little or no background in biology. These are either CEGEP equivalent courses (BIOL 111 and BIOL 112), service courses (BIOL 373), or general interest courses such as BIOL 115 and BIOL 210.

COURSE DESCRIPTIONS

Please note: courses may have been rescheduled or new courses added after this Calendar went to press. Students preparing to register are advised to consult the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/minerva-students for the most up-to-date information.

The Class Schedule includes the term(s), days, and times when courses will be offered, as well as class locations and names of instructors.

The schedule of courses to be offered in Summer 2003 will be available on the website in January 2003.

The course credit weight is given in parentheses after the title. Term(s) offered (Fall, Winter, Summer) may appear after the credit weight to indicate when a course would normally be taught. Please check the Class Schedule to confirm this information.

BIOL has replaced 177 as the prefix for Biology courses.

All courses have limited enrolment.

● Denotes courses not offered in 2002-03.

★ Denotes courses offered only in alternate years.

BIOL 101 ORGANISMAL BIOLOGY LABORATORY (1) (Fall) (3 hours laboratory) (Exclusion: BIOL 111) Laboratory component of BIOL 111. May be taken only by transfer students who have completed elsewhere the lecture component but not the laboratory of BIOL 111 and only with permission of the Associate Dean (Academic and Student Affairs) of Science.

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

BIOL 111 PRINCIPLES: ORGANISMAL BIOLOGY. (3) (Fall) (2 lectures and 3 hours laboratory) (Prerequisite: none. Exclusions: CEGEP objective 00UK or equivalent; BIOL 115) (May require departmental approval.) 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.

BIOL 112 CELL AND MOLECULAR BIOLOGY. (3) (Winter) (2 lectures and 3.5 hours laboratory/seminar) (Prerequisite: none. Exclusions: CEGEP objective 00XU or equivalent; BIOL 115) (May require departmental approval.) The cell: ultrastructure, division, chemical constituents and reactions. Bioenergetics: photosynthesis and respiration. Principles of genetics and the molecular basis of inheritance. Serves as a prerequisite for BIOL 200 and BIOL 201 and as an alternative to CEGEP Cell Biology. Attendance at first lab is mandatory to confirm registration in the course.

BIOL 115 ESSENTIAL BIOLOGY. (3) (Winter) (3 lectures) (Prerequisites: none. Restricted to non-Science students; not open to students who have had BIOL 111, BIOL 112, or equivalents) An introduction to biological science that emphasizes the manner in which scientific understanding is achieved and evolves and the influence of biological science on society. Topics will include cell structure and function, genetics, evolution, organ physiology, ecology and certain special topics that change from year to year.

BIOL 200 MOLECULAR BIOLOGY. (3) (Fall) (3 lectures, 1 hour tutorial) (Prerequisite: BIOL 112 or equivalent. Corequisite: CHEM 212 or equivalent) The physical and chemical properties of the cell and its components in relation to their structure and function. Topics include: protein structure, enzymes and enzyme kinetics; nucleic acid replication, transcription and translation; the genetic code, mutation, recombination, and regulation of gene expression.

BIOL 201 CELL BIOLOGY AND METABOLISM. (3) (Winter) (3 lectures, 1 hour tutorial) (Prerequisite: BIOL 200. Exclusion: BIOC 212 and ANAT 212) This course introduces the student to our modern understanding of cells and how they work. Major topics to be covered include: photosynthesis energy metabolism and metabolic integration; plasma membrane including secretion, endocytosis and contact mediated interactions between cells; cytoskeleton including cell and organelle movement; the nervous sytem; hormone signalling; the cell cycle.

BIOL 202 BASIC GENETICS. (3) (Winter) (3 hours lecture, 1 hour conference optional) (Prerequisite: BIOL 200. Exclusion 177-274) Introduction to basic principles, and to modern advances, problems and applications in the genetics of higher and lower organisms with examples representative of the biological sciences.

BIOL 205 BIOLOGY OF ORGANISMS. (3) (Winter) (3 hours lecture, optional conference hour) (Prerequisites: BIOL 200, BIOL 208/308. Corequisite: BIOL 201 or BIOC 212 or permission of co-ordinator) Unified view of form and function in organisms from all five kingdoms. Focus on the principal functions that all organisms must achieve to ensure their survival.

BIOL 206 METHODS IN BIOLOGY OF ORGANISMS. (3) (Fall) (1 lecture and 4 hours laboratory) (Prerequisite: BIOL 111 or equivalent) Introduction to methods used in organismal biology, including ecological sampling, use of keys, measurements, use of statistics and computers in numerical analysis, microbiological methods, basic

histological techniques, use of microscopes and library searching procedures. Lecture and Field trip in week one.

BIOL 208 INTRODUCTION TO ECOLOGY. (3) (Fall) (2 hours lecture, 1 hour tutorial) (Prerequisite: BIOL 111 or CEGEP equivalent) This course introduces the basic principles and applications of population, community, and ecosystem ecology.

BIOL 210 PERSPECTIVES OF SCIENCE. (3) (Fall) (3 hours lecture) This course is an introduction to the thinking, language and practices of scientists. Its objective is to bridge the gap between science and the humanities, and in particular to allow students enrolled in the Minor Concentration in Science for Arts to pursue their interests in specific scientific disciplines.

BIOL 240 MONTEREGIAN FLORA. (3) (Summer) (Prerequisite: BIOL 111 or permission) (Not open to students who have taken BIOL 358 or PLNT 358) Field studies emphasizing sight-recognition of ferns, fern allies, conifers and flowering plants of the St. Lawrence River Valley, and the use of plant keys for species identification. Taught for two weeks at the Gault Nature Reserve; contact instructor well in advance for specific dates, logistics.

BIOL 300 MOLECULAR BIOLOGY OF THE GENE. (3) (Fall) (3 hours lecture, optional conferences) (Prerequisites: BIOL 200, BIOL 201) A survey of current knowledge and approaches in the area of gene structure and function. Topics include: gene isolation and characterisation, gene structure and replication, mechanism of gene expression and its regulation in pro- and eukaryotes.

BIOL 301 CELL AND MOLECULAR LABORATORY. (4) (Fall or Winter) (1 lecture and one 6-hour laboratory) (Prerequisites: BIOL 200, BIOL 201. BIOL 206 recommended. Exclusion: BIOC 300.) (Requires departmental approval.) A practical introduction to laboratory techniques. Focus is on the experimental methods used to develop fundamental biological principles. Techniques involving enzyme characterization, DNA isolation and manipulation and genetic analysis are covered. metabolism and regulation of cell systems are analyzed and by which biological macro-molecules are purified and characterized.

BIOL 303 DEVELOPMENTAL BIOLOGY. (3) (Winter) (3 lectures and optional 1 hour conference) (Prerequisites: BIOL 200 and BIOL 201. Corequisite: BIOL 202) A consideration of the fundamental processes and principles operating during embryogenesis. Experimental analyses at the molecular, cellular, and organismal levels will be presented and analyzed to provide an overall appreciation of developmental phenomena.

BIOL 304 EVOLUTION. (3) (Fall) (3 hours lecture) (Prerequisite: BIOL 205 or BIOL 208/308 or ENVR 202) This course will show how the theory of evolution by natural selection provides the basis for understanding the whole of biology. The first half of the course describes the process of selection, while the second deals with evolution in the long term.

BIOL 305 DIVERSITY OF LIFE. (3) (Winter) (2 lectures and 1 three-hour laboratory) (Prerequisite: BIOL 205 or BIOL 208/308 or ENVR 202) This course will describe biological diversity in phylogenetic and ecological contexts, in populations and ecosystems, and from local to global scales. The practical classes will cover the relevant phylogenetic, ecological and statistical techniques needed to measure and analyze biodiversity.

BIOL 306 NEUROBIOLOGY AND BEHAVIOUR. (3) (Fall) (3 hours lecture) (Prerequisites: BIOL 201, BIOL 205) Mechanisms of animal behaviour; ethology; cellular neurophysiology, integrative networks within nervous systems; neural control of movement; processing of sensory information.

BIOL 307 BEHAVIOURAL ECOLOGY/SOCIOBIOLOGY. (3) (Winter) (2 hours lecture and 1 hour conference) (Prerequisites: BIOL 205, BIOL 208/308 or permission) The relationship between animal behaviour and the natural environment in which it occurs. This course introduces the subject of ecology at the level of the individual organism. Emphasis on general principles which relate to feeding, predator avoidance, aggression, reproduction and parental care of animals including humans.

BIOL 309 MATHEMATICAL MODELS IN BIOLOGY. (3) (Fall) (2 hours lecture) (Prerequisite: Elementary calculus. An additional course in calculus is recommended) Application of finite difference and differential equations to problems in cell and developmental biology, ecology and physiology. Qualitative, quantitative and graphical techniques are used to analyze mathematical models and to compare theoretical predictions with experimental data.

BIOL 313 STRUCTURE AND FUNCTION OF CELLS. (3) (Winter) (2 hours lecture, 3 hours seminar) (Prerequisites: BIOL 200, BIOL 201 or BIOC 212.) The functional organization of prokaryotic and eukaryotic cells. Topics include methods used for studying cells, evolution of the eukaryotic cell, structure and function of the major cellular organelles, and analysis of cellular processes such as cell motility, intracellular transport, secretion, endocytosis, mitosis, cell-to-cell communication and cell recognition.

BIOL 314 MOLECULAR BIOLOGY OF ONCOGENES. (3) (Fall) (3 hours lecture per week) (Prerequisites: BIOL 200; BIOL 201 or BIOC 212) The genes that cause cancer are altered versions of genes 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.

★ **BIOL 324 ECOLOGICAL GENETICS.** (3) (Fall) (2 hours lecture, 1 seminar) (Prerequisite: BIOL 202) This course presents evolutionary genetics within an ecological context. The course covers theoretical topics together with relevant data from natural populations of plants and animals.

BIOL 327 HERPETOLOGY. (3) (Fall) (2 hours lecture; 3 hours laboratory) (Prerequisite: BIOL 205) Principles of biology as exemplified by amphibians and reptiles. Topics include: adaptation, social behaviour, reproductive strategies, physiology, biomechanics, ecology, biogeography and evolution. Laboratories will emphasize structure, systematics and identification of local and world herpetofauna as well as field methods.

BIOL 331 ECOLOGY/BEHAVIOUR FIELD COURSE. (3) (Fall) (Prerequisites: BIOL 206; BIOL 208/308) (Preregistration in March and April. See Prof. Lechowicz) A 12-day Field Course just before the fall term, with a project report to be prepared early in the fall term. Methods of sampling natural populations of animal and plant species in fresh water and terrestrial habitats. Estimating population size. Testing hypotheses in nature. Energy flow determinations and behavioural ecology.

BIOL 334 APPLIED TROPICAL ECOLOGY (3) (Winter) (Prerequisites: BIOL 208/308 and permission) relevant to agriculture, forestry, fisheries and conservation of natural resources. Field component taught at the University's Bellairs Research Institute in Barbados, for two weeks in early May. The course is organized in a series of small-group field projects of 2-3 days each. Interested students should contact the Undergraduate Office and fill out an application form.

BIOL 335 MARINE MAMMALS. (3) (Summer) (Prerequisite: BIOL 205) Biology of marine mammals with special emphasis on seals and whales of the Bay of Fundy. Taught at the Huntsman Marine Science Centre, St. Andrews, N.B., for three weeks in August. The course combines lectures, laboratory exercises, field trips, and individual projects. See S. Gabe, W4/8.

BIOL 341 HISTORY OF LIFE. (3) (Winter) (3 hours lecture) (Prerequisite: BIOL 304/204 or permission) The origin, history, and nature of life from 3.5 billion years ago to the present, within the context of physical and biological changes in the Earth's environment. Topics: origin of life, radiation of multicellular organisms; invasion of land by plants and animals; rise and extinction of dinosaurs; origin of modern biota.

BIOL 350 INSECT BIOLOGY AND CONTROL. (3) (Fall) (Exclusion: ENTO 330) A lecture course designed to introduce insect structure, physiology, biochemistry, development, systematics, evolution, ecology and control. The course stresses interrelationships and integrated pest control.

● **BIOL 351 THE BIOLOGY OF INVERTEBRATES.** (3) (Winter) (2 hours lecture; 3 hours laboratory) (Prerequisites: BIOL 304/204, BIOL 205 or permission)

● ★ **BIOL 352 VERTEBRATE EVOLUTION.** (3) (Winter) (2 hours lecture, 3 hours laboratory) (Prerequisites: BIOL 304/204 or permission)

BIOL 357 PLANT PHYSIOLOGY. (3) (Fall) (3 hours lecture) (Prerequisites: BIOL 200 and BIOL 201 or permission) Advanced introduction to plant physiology. Study of processes that maintain day-to-day life of the plant and processes underlying plant development. Role of phytohormones, light and temperature on plant growth and development. Plant responses to environmental stresses. Application of modern techniques of tissue culture and molecular biology for agricultural benefits.

BIOL 358 CANADIAN FLORA. (3) (Fall) (2 hours lecture, 3 hours laboratory) (Prerequisite: BIOL 111 or equivalent) Practical training in plant identification combined with an emphasis on major plant families and species important in temperate boreal, and arctic regions. Four days of required, pre-semester field excursions; contact the instructor well in advance of the course.

BIOL 370 HUMAN GENETICS APPLIED. (3) (Winter) (3 hours lecture; 1 hour conference optional) (Prerequisites: BIOL 200 and BIOL 201, BIOL 202) A contemporary view of what genetics can do when applied to human beings.

BIOL 373 BIOMETRY. (3) (Fall) (2 hours lecture and 2 hours laboratory per week) (Prerequisite: MATH 112 or equivalent) (Note: BIOL 373 may preclude credit for other statistics courses. See "Course Overlap" under "Faculty Degree Requirements") Elementary statistical methods in biology. The aim of this course is to introduce students to the analysis of biological data. Emphasis is placed on the assumptions behind statistical tests and models. The course is designed to give a student the ability to intelligently use the statistical techniques typically available on computer packages such as SYSTAT or SPSS. Preference given to Biology students; laboratory sections assigned at term's start.

BIOL 377 INDEPENDENT STUDIES IN BIOLOGY. (3) (Fall, Winter or Summer) (Open to U2 or U3 Biology students only) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) For course details, see BIOL 477.

BIOL 389 LABORATORY IN NEUROBIOLOGY. (3) (Winter) (1 hour lecture; 5 hours laboratory) (Prerequisites: BIOL 306 or PHGY 311 or PSYC 308 or NEUR 310 or permission) Provides experience in the methods of neurobiological research; experiments include extracellular and intracellular recording from nerve cells, electrical stimulation, and the study of neuro-behavioural problems.

BIOL 413 READING PROJECT. (1) (Fall or Winter) (3 hours independent work) (Prerequisites: BIOL 200, BIOL 201, BIOL 202, BIOL 205, BIOL 208/308, BIOL 304/204) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) Under the guidance of an instructor with the relevant expertise, the student explores the literature on a special topic and develops a written review in scientific format. Registration form required as for BIOL 477.

BIOL 432 LIMNOLOGY. (3) (Fall) (2 hours lecture; 3 hours laboratory) (Prerequisites: BIOL 206 and/or permission) A study of the physical, chemical and biological properties of inland waters, with emphasis on their functioning as systems.

● ★ **BIOL 437 ADVANCED INVERTEBRATE ZOOLOGY.** (3) (Fall) (Prerequisite: BIOL 351 or permission)

● ★ **BIOL 441 BIOLOGICAL OCEANOGRAPHY.** (3) (Winter) (2 hours lecture, 3 hours laboratory/conference) (Prerequisites: BIOL 208/ 308 or permission)

BIOL 465 CONSERVATION BIOLOGY. (3) (Winter) (3 hours lecture) (Prerequisite: BIOL 208/308) (Not open to students who have taken 177-365) Discussion of relevant theoretical and applied issues in conservation biology. Topics: biodiversity, population viability analysis, community dynamics, biology of rarity, extinction, habitat fragmentation, social issues.

BIOL 468 TOPICS ON THE HUMAN GENOME. (3) (Winter) (3 hours lecture) (Prerequisites BIOL 202, BIOL 300, BIOL 370, or permission) Cellular and molecular approaches to characterization of the human genome.

BIOL 471 INDEPENDENT STUDIES IN BIOLOGY. (6) (Summer) (Open only to U3 Biology students) (Prerequisite: BIOL 206 or BIOL 301 or other suitable laboratory course) (Projects must be arranged individually with a staff member of the Biology Department and a form from Ms. A. Comeau, Room W4/8, Stewart Building, must be completed to receive credit for the course) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) Research or reading projects, permitting independent study under the guidance of a staff member in the Biology Department specializing in the field of interest. A written report is required and a copy must be submitted to Ms. Comeau.

BIOL 471D1 INDEPENDENT STUDIES IN BIOLOGY. (3) (Fall) (Students must also register for BIOL 471D2) (No credit will be given for this course unless both BIOL 471D1 and BIOL 471D2 are successfully completed in consecutive terms) (BIOL 471D1 and BIOL 471D2 together are equivalent to BIOL 471) See BIOL 471 for course description.

BIOL 471D2 INDEPENDENT STUDIES IN BIOLOGY. (3) (Winter) (Prerequisite: BIOL 471D1) (No credit will be given for this course unless both BIOL 471D1 and BIOL 471D2 are successfully completed in consecutive terms) (BIOL 471D1 and BIOL 471D2 together are equivalent to BIOL 471) See BIOL 471 for course description.

BIOL 475 HUMAN BIOCHEMICAL GENETICS. (3) (Winter) (3 hours lecture) (Prerequisites: BIOL 202 and BIOL 300) This "topics course" explores several major groups of human mutations through investigations of genes which affect collagen, globin function, immunity, etc. The course emphasizes the contribution of studies on humans to understanding of gene organization, expression and function.

BIOL 477 INDEPENDENT STUDIES IN BIOLOGY. (3) (Fall, Winter or Summer) (Open only to U3 Biology students) (Prerequisite: BIOL 206 or BIOL 301 or other suitable laboratory course. Projects must be arranged individually with a staff member of the Biology Department and a form from Ms. Comeau, Room W4/8, Stewart Building, must be completed to receive credit for the course) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) Research or reading projects, permitting independent study under the guidance of a staff member in the Biology Department specializing in the field of interest. A written report is required and a copy must be submitted with the mark to Ms. Comeau.

BIOL 478 INDEPENDENT STUDIES IN BIOLOGY. (3) (Fall, Winter or Summer) (Prerequisite: BIOL 206 or BIOL 301 or other suitable laboratory course. Projects must be arranged individually with a staff member of the Biology Department and a form from Ms. Comeau, Room W4/8, Stewart Building, must be completed to receive credit for the course) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) Research or reading projects, permitting independent study under the guidance of a staff member in the Biology Department specializing in the field of interest. A written report is required and a copy must be submitted with the mark to Ms. Comeau.

BIOL 479D1 INDEPENDENT STUDIES IN BIOLOGY. (4.5) (Fall) (8-12 hours per week research project and related seminars) (Restricted to Biology Honours students. Projects must be arranged individually with, and accepted by a staff member of the Biology Department) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) (Students must also register for BIOL 479D2) (No credit will be given for this course unless both BIOL 479D1 and BIOL 479D2 are successfully completed in consecutive terms) The major objective of the course is to provide an introduction to the design, execution

and reporting of research. The quality of projects is examined by at least two members of the Biology Department.

BIOL 479D2 INDEPENDENT STUDIES IN BIOLOGY. (4.5) (Winter) (Prerequisite: BIOL 479D1) (No credit will be given for this course unless both BIOL 479D1 and BIOL 479D2 are successfully completed in consecutive terms) See BIOL 479D1 for course description.

BIOL 480D1 INDEPENDENT STUDIES IN BIOLOGY. (6) (Fall) (10-15 hours per week research project and related seminars) (Restriction and course description: as for BIOL 479) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) (Students must also register for BIOL 480D2) (No credit will be given for this course unless both BIOL 480D1 and BIOL 480D2 are successfully completed in consecutive terms)

BIOL 480D2 INDEPENDENT STUDIES IN BIOLOGY. (6) (Winter) (Prerequisite: BIOL 480D1) (No credit will be given for this course unless both BIOL 480D1 and BIOL 480D2 are successfully completed in consecutive terms) See BIOL 480D1 for course description.

BIOL 499D1 HONOURS SEMINAR IN BIOLOGY. (2) (Fall) (Students must also register for BIOL 499D2) (No credit will be given for this course unless both BIOL 499D1 and BIOL 499D2 are successfully completed in consecutive terms) (BIOL 499D1 and BIOL 499D2 together are equivalent to BIOL 499) Honours students in Biology attend a selected series of guest speaker seminars of general interst and prepare reports. In addition, students give a seminar on their research.

BIOL 499D2 HONOURS SEMINAR IN BIOLOGY. (2) (Winter) (Prerequisite: BIOL 499D1) (No credit will be given for this course unless both BIOL 499D1 and BIOL 499D2 are successfully completed in consecutive terms) (BIOL 499D1 and BIOL 499D2 together are equivalent to BIOL 499) See BIOL 499D1 for course description.

● ★ **BIOL 505 DIVERSITY AND SYSTEMATICS SEMINAR.** (3) (Winter) (3 hours seminar) (Prerequisites: BIOL 304/204, BIOL 305, or permission)

BIOL 516 GENETICS OF DEVELOPMENT. (3) (Winter) (3 hours lecture) (Prerequisites: BIOL 202, BIOL 300, BIOL 303; permission) (Not open to students who have taken 177-416) This course aims to examine problems, theories, and experimental evidence on several concepts of mammalian developmental processes at molecular to organogenesis levels. Most topics are in the mouse model system, where various techniques for genetic manipulation are available.

BIOL 518 EUKARYOTIC CELL GENETICS. (3) (Winter) (2 hours seminar) (Prerequisite: BIOL 300 and permission) This course is designed for advanced undergraduate and graduate students. Readings from recent journal articles and reviews. Variable topics, including: cell differentiation, function of oncogenes and anti-oncogenes, growth regulation and cell cycle, gene transfer, recombination, mobile genetic elements, regulation of gene expression, cellular and viral replication, signal transduction.

BIOL 520 GENE ACTIVITY IN DEVELOPMENT. (3) (Winter) (3 hours lecture and discussion) (Prerequisites: BIOL 300 and BIOL 303 or permission) (Not open to students who have taken 177-420) An analysis of the role and regulation of gene expression in several models of eukaryotic development. The emphasis will be on critical evaluation of recent literature concerned with molecular or genetic approaches to the problems of cellular differentiation and determination. Recent research reports will be discussed in conferences and analyzed in written critiques.

★ **BIOL 522 PLANT MOLECULAR BIOLOGY SEMINAR.** (3) (Winter) (2 hours seminar, 1 hour tutorial per week) (Prerequisite: BIOL 300 or permission) This course deals with current topics in plant development, with particular emphasis on genetic and molecular approaches. This advanced course will include readings from the primary literature, as well as oral presentations and a written NSERC-styled grant proposal.

BIOL 524 TOPICS IN MOLECULAR BIOLOGY. (3) (Fall) (Prerequisite: BIOL 300, BIOL 303 or permission) Recent literature in the fields of molecular genetics and molecular biology. Topics include: signal transduction, cell function, genetic diseases in eukaryotes.

★ **BIOL 530 NEURAL BASIS OF BEHAVIOUR.** (3) (Winter) (1 hour lecture, 2 hours seminar) (Prerequisite: BIOL 306 or PHGY 311 or PSYC 308) (Not open to students who have taken 177-430) This course examines neural mechanisms underlying behaviour. Topics will be introduced by a lecture, supplemented by a review article. This will be followed by student seminars and/or discussions. Topics will vary according to current literature, but will likely include communication, visual behaviour, escape, orientation, neurogenetics and locomotion.

BIOL 531 NEUROBIOLOGY LEARNING MEMORY. (3) (Fall) (3 hours lecture and discussion) (Prerequisite: BIOL 306 or permission) (Not open to students who have taken 177-431) Properties of nerve cells that are responsible for learning and memory. Recent advances in the understanding of neurophysiological, biochemical and structural processes relevant to neural plasticity. Emphasis on a few selected model systems involving both vertebrate and invertebrate animals.

BIOL 532 DEVELOPMENTAL NEUROBIOLOGY SEMINAR. (3) (Winter) (1 hour lecture, 2 hours seminar) (Prerequisites: BIOL 303 and BIOL 306 or permission) Discussions of all aspects of nervous system development including pattern formation, cell lineage, pathfinding and targetting by growing axons, and neuronal regeneration. The basis for these discussions will be recent research papers and other assigned readings.

● **BIOL 535 POLITICAL ECOLOGY.** (3) (Winter) (3 hour seminar) (Prerequisite: BIOL 208/308 or permission of instructor)

★ **BIOL 542 MARINE BIOLOGY.** (3) (Winter) (2 hours lecture, 1 laboratory or conference) (Prerequisite: BIOL 208, BIOL 308 or permission) An introduction to marine benthic communities. Topics include structure and dynamics of hard and soft bottom communities; bioturbation, feeding strategies and trophodynamics; ecology of seagrass, mangrove and coral reef ecosystems; marine pollution.

● ★ **BIOL 544 GENETIC BASIS OF LIFE SPAN.** (3) (Fall) (1 hour lecture, 2 hours seminar) (Prerequisites: BIOL 202, BIOL 300; BIOL 303 recommended or permission) (Not open to students who have taken 177-444)

BIOL 551 MOLECULAR BIOLOGY: CELL CYCLE. (3) (Fall) (3 hours lecture) (Prerequisites: BIOL 200, BIOL 201, BIOL 300) (Not open to students who have taken 177-451) Cytological studies, biochemical and genetical information are integrated to explain molecular form and function in the eukaryotic cell. The mitotic cell cycle and its coordination with cell growth and division; maintenance of cellular architecture, protein targeting, self-assembly of macromolecular complexes, organelle biogenesis, and DNA replication and segregation are examined.

BIOL 553 NEOTROPICAL ENVIRONMENTS. (3) (Winter) (24 hours lecture and 36 hours field work over a 4-week period) (Prerequisites: HISP 218, MATH 203, and BIOL 208/308, or equivalents, and permission of Program Coordinator. Corequisites: ENVR 451, GEOG 498 and ABEN 450) (Not open to students who have taken 177-453) (Restriction: location in Panama. Students must register for a full semester of studies in Panama) Ecology revisited in view of tropical conditions. Exploring species richness. Sampling and measuring biodiversity. Conservation status of ecosystems, communities and species. Indigenous knowledge.

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

● **BIOL 560 AQUATIC CONSERVATION.** (3) (Fall) (2 lecture hours, 1 conference) (Prerequisites: BIOL 208/308 and BIOL 465/365 or permission) (Not open to students who have taken 177-460).

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

● ★ **BIOL 572 MOLECULAR EVOLUTION.** (3) (Fall) (4 hours lecture/seminar) (Prerequisite: BIOL 300) (Not open to students who have taken 177-472)

BIOL 588 MOLECULAR/CELLULAR NEUROBIOLOGY. (3) (Fall) (1 1/2 hours lecture, 1 1/2 hours seminar) (Prerequisite: BIOL 300 and BIOL 306 or permission) Discussion of fundamental molecular mechanisms underlying the general features of cellular neurobiology. An advanced course based on lectures and on a critical review of primary research papers.

12.5 Biotechnology (BIOT)

Sheldon Biotechnology Centre
Lyman-Duff Building

Telephone: (514) 398-3998

Program Supervisor
Professor Hugh P.J. Bennett; B.A.(York), Ph.D.(Brun.)

Biotechnology, the science of understanding, selecting and promoting useful organisms and specific gene products for commercial and therapeutic purposes, is the success story of this generation. It demands a broad comprehension of biology and engineering as well as detailed knowledge of at least one basic subject such as molecular genetics, protein chemistry, microbiology, or chemical engineering.

The Minor Program in Biotechnology is offered by the Faculties of Engineering and of Science, and students combine the Minor with the regular departmental Major (or Honours or Faculty) program. The Minor emphasises an area relevant to biotechnology which is complementary to the main program.

Students should identify their interest in the Biotechnology Minor to their departmental academic adviser and to the Program Supervisor of the Minor and, at the time of registration for the U2 year, should declare their intent to embark on the Minor. Before registering for the Minor, and with the agreement of the academic adviser, students must submit their course list to the Program Supervisor who will certify that the student's complete program conforms to the requirements for the Minor. Students should ensure that they will have fulfilled the prerequisite requirements for the courses selected.

GENERAL REGULATIONS

To obtain the Minor in Biotechnology the students must:

a) satisfy the requirements both for the departmental program and for the Minor.
b) complete 24 credits, 18 of which must be exclusively for the Minor program.
c) obtain a grade of C or better in the courses presented for the Minor.

MINOR PROGRAM IN BIOTECHNOLOGY (24 credits)

PROGRAM FOR STUDENTS IN THE FACULTY OF SCIENCE*

Required Courses (15 credits)

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

Complementary Courses (9 credits)
selected from courses outside the department of the main program, these may be taken from those listed as required courses for Engineering students. Alternatively, or in addition, courses may be taken from the lists below; in which case, at least three courses must be taken from one area of concentration as grouped.

* as 18 credits must be applied exclusively to the Minor, approved substitutions must be made for any of the specified courses which are part of the student's main program.

PROGRAM FOR STUDENTS IN THE FACULTY OF ENGINEERING*

Required Courses (12 credits)

CHEE 200	(3)	Intro to Chemical Engineering
CHEE 204	(3)	Chemical Manufacturing Processes
CHEE 474	(3)	Biochemical Engineering
BIOT 505	(3)	Selected Topics in Biotechnology

Complementary Courses (12 credits)
selected from courses outside the department of the main program, these may be taken from those listed as required courses for Science students. Alternatively, or in addition, courses may be taken from the lists below; in which case, at least three courses must be taken from one area of concentration as grouped.

* as 18 credits must be applied exclusively to the Minor, approved substitutions must be made for any of the specified courses which are part of the student's main program.

Biomedicine

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

Chemistry

CHEM 382	Organic Chemistry of Natural Products
CHEM 402	Advanced Bio-organic Chemistry
CHEM 552	Physical Organic Chemistry

Immunology

ANAT 261	Introduction to Dynamic Histology
BIOC 503	Immunochemistry
PHGY 513	Cellular Immunology
MIMM 314	Immunology
MIMM 414	Advanced Immunology

Management*

ECON 208	Microeconomics Analysis and Applications
MGCR 211	Introduction to Financial Accounting
MGCR 341	Finance 1
MGCR 352	Marketing Management 1
MGCR 472	Operations Management

* These courses may not also be used for a Management Minor, nor for complementary, by Engineering students.

Microbiology

MIMM 323	Microbial Physiology
MIMM 324	Fundamental Virology
MIMM 413	Parasitology
MIMM 465	Bacterial Pathogenesis and Host Defenses
MIMM 466	Viral Pathogenesis and Host Defenses

Molecular Biology (Biology)

BIOL 300	Molecular Biology of the Gene
BIOL 314	Molecular Biology of Oncogenes
BIOL 520	Gene Activity in Development
BIOL 551	Molecular Biology: Cell Cycle
BIOL 524	Topics in Molecular Biology

Molecular Biology (Biochemistry)

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

Physiology

PHGY 517	Artificial Internal Organs
PHGY 518	Artificial Cells and Biotechnology
PHAR 562	General Pharmacology 1
PHAR 563	General Pharmacology 2
EXMD 401	Physiology and Biochemistry of Endocrine Systems
EXMD 502	Advanced Endocrinology, Part 1
EXMD 503	Advanced Endocrinology, Part 2

Plant Biology

BIOL 357	Plant Physiology
BIOL 526	Plants and Extreme Environments

Pollution*
CIVE 225 Environmental Engineering
CIVE 430 Water Treatment and Pollution Control
CIVE 526 Solid Waste Management
CIVE 553 Stream Pollution and Control
CHEE 471 Industrial Water Pollution Control
* These courses may not also be used for a Environmental Engineering Minor by Engineering students.

General
MIME 310 Engineering Economy

COURSE DESCRIPTION

Students preparing to register are advised to consult the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/minerva-students for the most up-to-date information.

BIOT has replaced 202 as the prefix for Biotechnology courses.

All courses have limited enrolment.

BIOT 505 SELECTED TOPICS IN BIOTECHNOLOGY. (3) (Fall) (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.

12.6 Chemistry (CHEM)

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

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

Departmental Office: Room 322. Telephone: (514) 398-6999
Student Advisory Office: Room 304. Telephone: (514) 398-3653

Chair — R. Bruce Lennox

Emeritus Professors
Byung Chan Eu; B.Sc.(Seoul), Ph.D.(Brown)
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.(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
Ian S. Butler; B.Sc., Ph.D.(Brist.), F.C.I.C., C.Chem., F.R.S.C.(U.K.)
Tak-Hang Chan; B.Sc.(Tor.), M.A., Ph.D.(Prin.), F.C.I.C., F.R.S.C. *(Tomlinson Professor of Chemistry)*
Masad J. Damha; B.Sc., Ph.D.(McG.)
Adi Eisenberg; B.S.(Worcester Polytech.), M.A., Ph.D.(Prin.), F.C.I.C. *(Otto Maass Professor of Chemistry)*
Patrick G. Farrell; B.Sc., Ph.D., D.Sc.(Exe.)
Denis F.R. Gilson; B.Sc.(Lond.), M.Sc., Ph.D.(U.B.C.), F.C.I.C.
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.)
Robert H. Marchessault; B.Sc.(Loyola), Ph.D.(McG.), D.Sc.(C'dia), F.R.S.C. *(E.B. Eddy Professor of Industrial Chemistry)*
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.)

Associate Professors
Mark P. Andrews; B.Sc., M.Sc., Ph.D.(Tor.)
Bruce Arndtsen; B.A.(Car.), Ph.D.(Stan.)
David H. Burns; B.Sc.(Puget Sound), Ph.D.(Wash)
William C. Galley; B.Sc.(McG.), Ph.D.(Calif.)
Ashok K. Kakkar; Ph.D.(Wat.)
Romas Kazlauskas; B.Sc.(Clev.St.), Ph.D.(M.I.T.)
Joan F. Power; B.Sc., Ph.D.(C'dia)
Linda Reven; B.A.(Car.), Ph.D.(Ill.)

Assistant Professors
Parisa Ariya; B.Sc., Ph.D.(York) *(William Dawson Scholar) (joint appt. with Atmospheric & Oceanic Sciences)*
Krine Auclair; B.Sc.(U.Q.A.C.), Ph.D.(Alta.)
Christopher J. Barrett; B.Sc., M.Sc., Ph.D.(Queen's)
James Gleason; B.Sc.(McG.), Ph.D.(Virginia)
Hanadi Sleiman; B.Sc.(A.U.B.), Ph.D.(Stan.)
Paul Wiseman; B.Sc.(St.F.X.), Ph.D.(W.Ont.) *(joint appt. 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 & Metallurical Engineering)*
K. Gehring *(Biochemistry)*
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.
Youla Tsantrizos; B.Sc., Ph.D.(McG.)
Ivor Wharf; B.Sc., Ph.D.(Lond.), A.R.C.S., D.I.C.
Robert Zamboni; B.Sc., Ph.D.(McG.)

PAPRICAN Adjunct Professors
Dimitris Argyropoulos; B.Sc.(South Bank Poly.), Ph.D.(McG.)
Derek G. Gray; B.Sc.(Belf.), M.Sc., Ph.D.(Man.), F.C.I.C.
R. St. John Manley; B.Sc., Ph.D.(McG.), D.Sc.(Uppsala)
Theo G.M. van de Ven; Kand. Doc.(Utrecht), Ph.D.(McG.)

Office for Chemistry and Society

The Office for Chemistry and Society is dedicated to the promotion of critical thinking and the presentation of practial scientific information to the public, educators and students in an accurate and responsible fashion. The Office answers queries from the public as well as from the media, with a view towards establishing scientific accurary. The Office also offers a variety of educational and interesting presentations on scientific topics and its members contribute to a number of courses under the umbrella of "The World of Chemistry".

Director
Joseph A. Schwarcz; B.Sc., Ph.D.(McG.)

Members
Ariel Fenster; L. ès S., D.E.A.(Paris), Ph.D.(McG.)
David N. Harpp; A.B.(Middlebury), M.A.(Wesleyan), Ph.D.(N.Carolina), F.C.I.C.*(William C. Macdonald Professor of Chemistry)*

Chemistry is both a pure science, offering a challenging intellectual pursuit and an applied science whose technology is of fundamental importance to the economy and society. Modern chemists seek an understanding of the structure and properties of atoms and molecules to predict and interpret the properties and transformations of matter and the energy changes that accompany those transformations. Many of the concepts of physics and mathematics are basic to chemistry, while chemistry is of fundamental importance to many other disciplines such as the biological and medical sciences, geology, metallurgy, etc.

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 304, Otto Maass Chemistry Building, or see http://www.mcgill.ca/chemistry/advising.

PRE-PROGRAM REQUIREMENTS

Students entering from the Freshman program must have included CHEM 121/CHEM 111 or CHEM 120/CHEM 110, BIOL 111 or BIOL 112, MATH 140/MATH 141, PHYS 131/PHYS 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 discipline if students wish to be eligible for admission to the Ordre des chimistes du Québec. Students from outside Québec or transfer students should consult the academic adviser.

A computer science course, either COMP 102 or COMP 202, will be required during U1 for students who have no previous introduction to computer *programming.* Students are required to contact their adviser on this matter. Completion of Mathematics MATH 222 and MATH 315 during U1 is strongly recommended. Physics PHYS 242 should be completed during U-2.

Chemistry Majors and Honours Programs
Required Courses (56 credits)

CHEM 212*	(4)	Organic Chemistry 1
CHEM 213	(3)	Physical Chemistry 1
CHEM 222*	(4)	Organic Chemistry 2
CHEM 273	(1)	Chemical Kinetics
CHEM 277	(3)	Classical Methods of Analysis
CHEM 281	(3)	Inorganic Chemistry 1
CHEM 302	(3)	Organic Chemistry 3
CHEM 345	(3)	Molecular Properties & Structure 1
CHEM 355	(3)	Molecular Properties & Structure 2
CHEM 363	(2)	Physical Chemistry Lab
CHEM 365	(2)	Statistical Thermodynamics
CHEM 367	(3)	Instrumental Analysis 1
CHEM 377	(3)	Instrumental Analysis 2
CHEM 381	(3)	Chemistry of Transition Elements
CHEM 392	(3)	Integrated Inorganic/organic Lab
CHEM 393	(2)	Physical Chemistry Lab 2
MATH 133*	(3)	Vectors, Matrices and Geometry
MATH 222*	(3)	Calculus 3
MATH 315	(3)	Ordinary Differential Equations
PHYS 242	(2)	Electricity & Magnetism

* asterisks denote courses with CEGEP equivalents

HONOURS PROGRAM IN CHEMISTRY (74 credits)

Required Courses (56 credits)
56 credits as listed above

Complementary Courses (18 credits)
6 credits of research:

CHEM 470	(6)	Research Project
or CHEM 480	(3)	Research Project
and CHEM 490	(3)	Research Project

and 12 credits of additional Chemistry courses:
6 credits of which must be at the 300 level or higher, and
6 credits of which must be at the 400 level or higher

Note: 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 BIO-ORGANIC OPTION (78 credits)

The Bio-organic Option of Honours in Chemistry consists of the requirements for Honours in Chemistry with replacement of PHYS 242 by BIOL 200 and BIOL 201, and replacement of the 6 complementary credits of Chemistry at the 300 level with 6 credits chosen from the following: BIOL 202, BIOL 301, CHEM 402, MIMM 211, MIMM 314, MIMM 323, PHGY 201, PHGY 202, PHGY 209, PHGY 210.

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

HONOURS IN CHEMISTRY: ENVIRONMENTAL CHEMISTRY OPTION (77 credits)

The Environmental Chemistry Option of Honours in Chemistry consists of the requirements for Honours in Chemistry with replacement of 6 complementary credits of Chemistry at the 300 level or higher and 6 credits at the 400 level or higher by CHEM 219, CHEM 307, CHEM 419 plus 6 credits chosen from the following: CHEM 352, CHEM 575, CHEM 597, EPSC 542, ATOC 220.

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

HONOURS WITH MATERIALS OPTION (77 credits)

The Materials Option of Honours in Chemistry consists of the requirements for Honours in Chemistry with replacement of the 6 credits at the 300 level or higher and the 6 credits at the 400 level or higher by CHEM 455 and CHEM 531, plus 9 credits chosen from the following: CHEM 543, CHEM 571, CHEM 585, CHEE 487, MIME 260, MIME 367.

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

MAJOR PROGRAM 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)
The Bio-organic Option of Major in Chemistry is the Honours program with Bio-Organic Option less the 6 credit Research Project and the 6 complementary credits at the 400 level or higher.

Attainment of the Major degree requires a CGPA of 2.00.

MAJOR IN CHEMISTRY: ENVIRONMENTAL CHEMISTRY OPTION (65 credits)

The Environmental Chemistry Option of Major in Chemistry is the 57 credits of Required Courses, to which are added CHEM 219, CHEM 307, CHEM 419.

Attainment of the Major degree requires a CGPA of 2.00.

MAJOR WITH MATERIALS OPTION (65 credits)

The Materials Option of Major in Chemistry is the 57 credits of Required Courses, to which are added CHEM 455, CHEM 531 plus 3 credits chosen from the following: CHEM 543, CHEM 571, CHEM 585, CHEE 487, MIME 260, MIME 367.

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 COMP 102 or COMP 202, will be required during U1 for students who have no previous introduction to computer programming.

FACULTY PROGRAM IN CHEMISTRY (52 credits)

CHEM 212, CHEM 222 or equivalent, CHEM 204 and CHEM 214, or CHEM 213 and CHEM 355, CHEM 201 or CHEM 281, CHEM 277, CHEM 301 or CHEM 381, CHEM 345, CHEM 367 and CHEM 377, CHEM 302; MATH 222, MATH 315; PHYS 242.

Nine additional credits from any of the following: CHEM 352, CHEM 363, CHEM 382, CHEM 355, CHEM 392, CHEM 393 and any 400-level courses in Chemistry for which the prerequisites are satisfied.

FACULTY PROGRAM IN CHEMISTRY AND BIOLOGICAL SCIENCES (54 credits)

CHEM 222, CHEM 204, CHEM 214, CHEM 257D1/ CHEM 257D2, CHEM 302, CHEM 352, CHEM 362, CHEM 382. BIOL 200 and BIOL 201, BIOL 205, BIOL 301, BIOL 304. Physics PHYS 242. Physiology PHGY 209, PHGY 210. Computer Science COMP 102 or COMP 202. Plus 3 approved credits.

FACULTY PROGRAM IN CHEMISTRY AND MATHEMATICS (52 credits)

CHEM 212, CHEM 222, CHEM 204 and CHEM 214 or CHEM 213 and CHEM 365, CHEM 281, CHEM 277, CHEM 345, CHEM 355. Physics PHYS 242. MATH 222, MATH 223, MATH 314, MATH 315, MATH 317, MATH 319, MATH 323, MATH 324.

Please refer to page 413 in the Mathematics and Statistics section for the Faculty program in Mathematics, Chemistry and Physics.

MINOR PROGRAM IN CHEMISTRY (18 credits)

A Minor in Chemistry which comprises 18 credits of chemistry courses taken at McGill, including CHEM 203, CHEM 212, CHEM 222, CHEM 281 and CHEM 257D1/CHEM 257D2. Substitutions for these by more advanced courses may be made at the discretion of the adviser.

MINOR IN CHEMICAL ENGINEERING

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.

The Minor requires 24 credits as follows: 7 credits in CHEE 200 and CHEE 204; at least one of CHEE 220 or CHEE 314; at least 13 credits from the following: MATH 314, CHEE 230, CHEE 315, CHEE 351, CHEE 370, CHEE 380, CHEE 438, CHEE 392 and 393, CHEE 452, CHEE 471, CHEE 472, CHEE 481, CHEE 487, and either CHEE 494D or CHEE 495D.

COURSE DESCRIPTIONS

Please note: courses may have been rescheduled or new courses added after this Calendar went to press. Students preparing to register are advised to consult the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/minerva-students for the most up-to-date information.

The Class Schedule includes the term(s), days, and times when courses will be offered, as well as class locations and names of instructors.

The schedule of courses to be offered in Summer 2003 will be available on the website in January 2003.

The course credit weight is given in parentheses after the title. Term(s) offered (Fall, Winter, Summer) may appear after the credit weight to indicate when a course would normally be taught. Please check the Class Schedule to confirm this information.

CHEM has replaced 180 as the prefix for Chemistry courses.

All courses have limited enrolment.

● Denotes courses not offered in 2002-03.

CHEM 110 GENERAL CHEMISTRY 1. (4) (Fall) (3 lectures and laboratory) (Prerequisites/corequisites: College level mathematics and physics or permission of instructor; CHEM 120 is not a prerequisite) (Not open to students who have taken or are taking CHEM 111. See "Course Overlap" under "Faculty Degree Requirements") (Each lab section is limited enrolment) A study of the fundamental principles of atomic structure, valence theory and periodic table.

CHEM 112 GENERAL CHEMISTRY LABORATORY. (1) (Fall) (2 1/2 hours laboratory) (Open only to entering students who have the lecture equivalent of CHEM 110) (Each lab section is limited enrolment) Illustrative experiments. Laboratory section of CHEM 110. New students will be issued lab sections in OM 1 on the first day of classes.

CHEM 120 GENERAL CHEMISTRY 2. (4) (Winter) (3 lectures and laboratory) (Prerequisites/corequisites: College level mathematics and physics, or permission of instructor: CHEM 110 is not a prerequisite) (Not open to students who have taken or are taking CHEM 121. See "Course Overlap" under "Faculty Degree Requirements") (Each lab section is limited enrolment) A study of the fundamental principles of physical chemistry.

CHEM 122 GENERAL CHEMISTRY LABORATORY. (1) (Winter) (2 1/2 hours laboratory) (Open only to entering students who have the lecture equivalent of CHEM 120) Illustrative experiments. Laboratory section of CHEM 120.

● **CHEM 150 WORLD OF CHEMISTRY: FOOD.** (3) (3 lectures) (No prerequisites) (Science students may take for credit only two of: CHEM 150, CHEM 160, CHEM 170, CHEM 180. These courses can be taken independently of each other)

● **CHEM 160 WORLD OF CHEMISTRY: TECHNOLOGY.** (3) (3 lectures) (No prerequisites) (Science students may take for credit only two of: CHEM 150, CHEM 160, CHEM 170, CHEM 180. These courses can be taken independently of each other)

CHEM 170 WORLD OF CHEMISTRY: DRUGS. (3) (Winter) (3 lectures) (No prerequisites) (Science students may take for credit only two of: CHEM 150, CHEM 160, CHEM 170, CHEM 180. These courses can be taken independently of each other) Aspects of drugs including drug history, over the counter drugs (e.g. aspirin, cough remedies, allergy preparations), and street drugs. Significant attention will be paid to prescription drugs such as heart remedies and antibiotics.

CHEM 180 WORLD OF CHEMISTRY: ENVIRONMENT. (3) (Fall) (3 lectures) (No prerequisites) (Science students may take for credit only two of: CHEM 150, CHEM 160, CHEM 170, CHEM 180. These courses can be taken independently of each other) Water, air pollution, sick-building syndrome, the chemistry of the car, energy (fossil fuel, nuclear), household products, quackery (18th century to the internet), computers and cosmetics.

CHEM 199 FYS: WHY CHEMISTRY? (3) (Fall) (2 lectures and 1 seminar) (Open only to newly admitted students in U0 or U1, who

may take only one FYS. Students who register for more than one will be obliged to withdraw from all but one of them.) (Maximum 25) A lecture/seminar course which is expected to deal with a) colour, from gemstones to lasers; b) microscopes that see atoms - with demonstrations; c) the atmosphere: the greenhouse effect, and acid rain, and d) scientific ethics in research and publication.

CHEM 201 MODERN INORGANIC CHEMISTRY 1. (3) (Fall) (3 lectures) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent. Not open to Honours or Majors in chemistry) (Not open to students who have taken or plan to take CHEM 281) Systematic survey of the chemistry of the main group elements and their compounds. Basic concepts of electronic structure, bonding and structure will be developed and applied to the understanding of common materials. Emphasis on elements such as oxygen, nitrogen, silicon and others in order to understand their role in our everyday lives.

CHEM 203 SURVEY OF PHYSICAL CHEMISTRY. (3) (Fall) (3 lectures) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent. Intended for students in biological science programs requiring only one course in physical chemistry) (Not open to students who have taken or are taking CHEM 204 or CHEM 213) A survey of the principles and methods of physical chemistry with emphasis on the use of biological examples. Topics will include thermodynamics, transport properties, kinetics, molecular structure and interactions, and spectroscopy.

CHEM 204 PHYSICAL CHEMISTRY/BIOLOGICAL SCIENCES 1. (3) (Fall and Winter and Summer) (3 lectures) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent and one full course in calculus) (Not open to students who have taken or are taking CHEM 203 or CHEM 213) Similar to CHEM 213. Emphasis on the use of biological examples to illustrate the principles of physical chemistry. The relevance of physical chemistry to biology is stressed.

CHEM 212 INTRODUCTORY ORGANIC CHEMISTRY 1. (4) (Fall and Winter and Summer) (3 lectures and laboratory) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent courses. Not open to students who have taken CEGEP objective 00XV or equivalent) (Each lab section is limited enrolment) A survey of reactions of aliphatic and aromatic compounds including modern concepts of bonding, mechanisms, conformational analysis, and stereochemistry.

CHEM 213 INTRODUCTORY PHYSICAL CHEMISTRY. (3) (Winter) (3 lectures) (Prerequisites: CHEM 110, CHEM 120 and Mathematics MATH 222 or equivalent) (Not open to students who have taken or are taking CHEM 203 or CHEM 204) Gas laws, kinetic theory. First law of thermodynamics, enthalpy, thermochemistry, bond energies. Second law of thermodynamics; the entropy and the free energy functions. Chemical and thermodynamic equilibrium states. Phase rule. Colligative properties of ideal solutions. Topics may include: chemical kinetics, electrochemistry and others.

CHEM 214 PHYSICAL CHEMISTRY/BIOLOGICAL SCIENCES 2. (3) (Winter) (3 lectures) (Prerequisites: CHEM 213 or CHEM 204) Emphasis is placed on the use of biological examples to illustrate the principles of physical chemistry. The relevance of physical chemistry to biology is stressed.

CHEM 217 GENERAL ANALYTICAL CHEMISTRY LAB 1. (1) (Fall) (3 hours) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent) Laboratory portion of an individualized program in analytical chemistry.

★ **CHEM 219 INTRODUCTION TO ATMOSPHERIC CHEMISTRY.** (3) (Winter) (3 lectures) (Prerequisite: CEGEP DEC in Science or permission of instructor) (Not open to students who have taken ATOC 219, CHEM 419, or ATOC 419) (Offered in even years. Students should register in ATOC 219 in odd 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.

CHEM 222 INTRODUCTORY ORGANIC CHEMISTRY 2. (4) (Fall and Winter and Summer) (3 lectures and laboratory) (Prerequisite: CHEM 212 or equivalent.) (Not open to students who have taken Chemistry 302 or equivalent at CEGEP.) Modern spectroscopic techniques for structure determination. The chemistry of alkyl halides, alcohols, ethers, carbonyl compounds and amines with special attention to mechanistic aspects. Special topics.

CHEM 224 ORGANIC CHEMISTRY LABORATORY 1. (1) (Fall and Winter and Summer) (4 hours laboratory) (Open only to students who have the lecture equivalent of CHEM 212) Illustrative experiments in organic chemistry. Laboratory section of CHEM 212.

CHEM 233 TOPICS IN PHYSICAL CHEMISTRY. (3) (Winter) ((3-0-6)) (For Chemical Engineers only) Introduction to chemical kinetics, surface and colloid chemistry and electrochemistry. The topics to be discussed will be of particular interest to students in chemical engineering.

CHEM 234 TOPICS IN ORGANIC CHEMISTRY. (3) (Fall and Winter and Summer) ((3-0-6)) (Prerequisite: CHEM 212 or equivalent) (For Chemical Engineers only) Modern spectroscopic techniques for structure determination. The chemistry of alkyl halides, alcohols, ethers, carbonyl compounds and amines with special attention to mechanistic aspects. Special topics.

CHEM 237 GENERAL ANALYTICAL CHEMISTRY LAB 2. (1) (Winter) (3 hours) (Prerequisite: CHEM 217) Laboratory portion of an individualized program in analytical chemistry.

CHEM 244 ORGANIC CHEMISTRY LABORATORY 2. (1) (Fall and Winter and Summer) (4 hours laboratory) (Prerequisite: CHEM 234 or equivalent) Laboratory section of CHEM 222.

CHEM 257D1 INTRODUCTORY ANALYTICAL CHEMISTRY. (2) (Fall) (1 lecture, 1 homework tutorial and 4 hours laboratory) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent.) (Not open to students who have taken or are taking CHEM 277.) (Each lab section is limited enrolment) (Students must also register for CHEM 257D2) (No credit will be given for this course unless both CHEM 257D1 and CHEM 257D2 are successfully completed in consecutive terms) A survey of analytical chemistry including the theory and practice of representative gravimetric, volumetric and instrumental methods.

CHEM 257D2 INTRODUCTORY ANALYTICAL CHEMISTRY. (2) (Winter) (Prerequisite: CHEM 257D1) (No credit will be given for this course unless both CHEM 257D1 and CHEM 257D2 are successfully completed in consecutive terms) See CHEM 257D1 for course description.

CHEM 273 CHEMICAL KINETICS. (1) (Winter) (1 lecture) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent. For Honours and Major Chemistry students. Other students with permission of instructor.) Order, molecularity, reaction mechanisms and rate constants. Determination of order, effect of temperature on rate, activated state theory. Collision theory. Reactions in solution, homogeneous catalysis, upper atmosphere kinetics, drug kinetics.

CHEM 277D1 ANALYTICAL CHEMISTRY. (1.5) (Fall) (2 lectures and 4 h laboratrory) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent. For Chemistry Honours and Majors students only.) (Not open to students who have taken or are taking CHEM 257.) (Each lab section is limited enrolment.) (Students must also register for CHEM 277D2) (No credit will be given for this course unless both CHEM 277D1 and CHEM 277D2 are successfully completed in consecutive terms) Qualitative and quantitative analysis. A survey of methods of analysis including theory and practice of semimicro qualitative analysis and representative gravimetric, volumetric and instrumental methods.

CHEM 277D2 ANALYTICAL CHEMISTRY. (1.5) (Winter) (Prerequisite: CHEM 277D1) (No credit will be given for this course unless both CHEM 277D1 and CHEM 277D2 are successfully completed in consecutive terms) See CHEM 277D1 for course description.

CHEM 281 INORGANIC CHEMISTRY 1. (3) (Fall) (3 lectures) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent. For Honours and Major Chemistry students) (Not open to students who have taken or plan to take CHEM 201) Basic concepts of electronic structure and molecular bonding will be

developed and applied to the understanding of common materials. Acid-base chemistry. Survey of the chemistry of the main group elements. Introduction to coordination and organometallic chemistry.

● **CHEM 301 MODERN INORGANIC CHEMISTRY 2.** (3) (3 lectures) (Prerequisites: CHEM 110 or CHEM 111 and CHEM 120 or CHEM 121 or equivalent) (Not open to students who have taken or plan to take CHEM 381) T

CHEM 302 INTRODUCTORY ORGANIC CHEMISTRY 3. (3) (Fall and Winter) (3 lectures) (Prerequisite: CHEM 222) Topics covered may include the following: aromatics and heterocyclics, carbanions, rearrangements, molecular orbital considerations, polymers and biomolecules.

CHEM 307 ANALYTICAL CHEMISTY OF POLLUTANTS. (3) (2 lectures and laboratory with field trips) (Prerequisites: One course in analytical chemistry) Description of current analytical practices in air and water pollution; critical evaluation of the reliability of the methods, with particular emphasis on interfering substances; rudiments of automated instrumentation; toxicological analysis as it relates to pollution.

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

CHEM 345 MOLECULAR PROPERTIES AND STRUCTURE 1. (3) (Fall) (3 lectures) (Prerequisites: CHEM 213 and MATH 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.

● **CHEM 350 EARTH, AIR, FIRE, WATER.** (3) (3 lectures) (Prerequisites: CHEM 212 or equivalent and CHEM 204 or equivalent)

CHEM 352 STRUCTURAL ORGANIC CHEMISTRY. (3) (Winter) (3 lectures) (Prerequisite: CHEM 302) Modern methods of structure determination, employing spectroscopic techniques; stereochemistry.

CHEM 355 MOLECULAR PROPERTIES AND STRUCTURE 2. (3) (Winter) (3 lectures) (Prerequisite: CHEM 345) A survey of the principles of electronic, vibrational and rotational spectroscopy. Magnetic resonance methods.

CHEM 362 ADVANCED ORGANIC CHEMISTRY LABORATORY. (2) (Fall and Winter) (4 hours) (Prerequisite or corequisite: CHEM 302. Not open to Honours or Majors in Chemistry) An advanced laboratory with experiments related to the theoretical principles and synthetic methods of modern organic chemistry.

CHEM 363 PHYSICAL CHEMISTRY LAB 1. (2) (Fall and Winter) (3 hours) (Prerequisites: CHEM 213 and CHEM 273) (Each lab section is limited enrolment) Selected experiments to illustrate physico-chemical principles.

CHEM 365 STATISTICAL THERMODYNAMICS. (2) (Winter) (2 lectures) (Prerequisite: CHEM 345) Molecular basis of thermodynamics with applications to ideal gases and simple solids. Topics to be covered will include: calculation of thermodynamic functions, chemical equilibrium constants, Einstein and Debye models of solids, absolute reaction rate theory, Debye-Hückel theory of strong electrolytes.

CHEM 367 INSTRUMENTAL ANALYSIS 1. (3) (Fall) (2 lectures and 4 hours of laboratory) (Prerequisite: CHEM 257 or CHEM 277) (Each lab section is limited enrolment) An introduction to modern methods of instrumental analysis emphasizing chromatography and electrochemical methods. Analytical methods to be examined in detail include gas liquid chromatography, high performance liquid chromatography, flow injection analysis, and electrochemical methods. Laboratory exercises give the student practical exposure to these techniques.

CHEM 371 INORGANIC CHEMISTRY LAB. (2) (Fall and Winter) (4 hours) (Prerequisite: CHEM 362; prerequisite/corequisite: CHEM 381. Not open to students who have taken CHEM 392) Modular format incorporating self-paced and selfguided instructions. In consultation with the instructors, a program of experimental modules is chosen covering projects related to theoretical principles, synthetic techniques and those instrumental methods used in modern inorganic and organometallic chemistry.

CHEM 371D1 INORGANIC CHEMISTRY LAB. (1) (Fall) (Students must also register for CHEM 371D2) (No credit will be given for this course unless both CHEM 371D1 and CHEM 371D2 are successfully completed in consecutive terms) (CHEM 371D1 and CHEM 371D2 together are equivalent to CHEM 371) See CHEM 371 for course description.

CHEM 371D2 INORGANIC CHEMISTRY LAB. (1) (Winter) (Prerequisite: CHEM 371D1) (No credit will be given for this course unless both CHEM 371D1 and CHEM 371D2 are successfully completed in consecutive terms) (CHEM 371D1 and CHEM 371D2 together are equivalent to CHEM 371) See CHEM 371 for course description.

CHEM 377 INSTRUMENTAL ANALYSIS 2. (3) (Winter) (2 lectures and 4 hours of laboratory) (Prerequisite: CHEM 257 or CHEM 277) (Each lab section is limited enrolment) Spectroscopic methods of analysis will be studied with respect to fundamentals, operational aspects and instrument design. Topics will range from UV-visible to x-ray spectrometry. Methodologies will be evaluated with respect to their application in spectrometric systems. Laboratory automation will be studied and applied in the laboratory.

CHEM 381 CHEMISTRY OF TRANSITION ELEMENTS. (3) (Fall) (3 lectures) (Prerequisite: CHEM 281. For Honours and Major Chemistry students) (Not open to students who have taken or plan to take CHEM 301) The history of transition chemistry, coordination numbers and geometry, nomenclature and symmetry. Crystal field theory will be described and applied to problems in spectroscopy, magnetochemistry, thermodynamics and kinetics. Several aspects of organometallic and bioinorganic chemistry are also discussed.

CHEM 382 ORGANIC CHEMISTRY: NATURAL PRODUCTS. (3) (Winter) (3 lectures) (Prerequisite/corequisite: CHEM 302) Structure, synthesis, stereochemistry and biosynthesis.

CHEM 392 INTEGRATED INORGANIC/ORGANIC LAB. (3) (Fall and Winter) (4 hours) (Prerequisite/corequisites: CHEM 381 and CHEM 302. Advanced laboratory for Chemistry Honours and Major students. Students enrolled in CHEM 392 are strongly advised to choose the D option.) (Not open to students who have taken CHEM 362.) Modular format of self-paced and self-guided instruction. A program of modules is selected in consultation with the laboratory staff. The experimental modules consist of projects related to the theoretical principles, synthetic techniques and instrumental methods used in modern organic, inorganic and organometallic chemistry.

CHEM 392D1 INTEGRATED INORGANIC/ORGANIC LAB. (1.5) (Fall) (Students must also register for CHEM 392D2) (No credit will be given for this course unless both CHEM 392D1 and CHEM 392D2 are successfully completed in consecutive terms) (CHEM 392D1 and CHEM 392D2 together are equivalent to CHEM 392) See CHEM 392 for course description.

CHEM 392D2 INTEGRATED INORGANIC/ORGANIC LAB. (1.5) (Winter) (Prerequisite: CHEM 392D1) (No credit will be given for this course unless both CHEM 392D1 and CHEM 392D2 are successfully completed in consecutive terms) (CHEM 392D1 and CHEM 392D2 together are equivalent to CHEM 392) See CHEM 392 for course description.

CHEM 393 PHYSICAL CHEMISTRY LAB 2. (2) (Fall and Winter) (3 hours) (Prerequisite: CHEM 363) (Each lab section is limited enrolment.) Selected experiments to illustrate physico-chemical principles more advanced than those of CHEM 363.

CHEM 402 ADVANCED BIO-ORGANIC CHEMISTRY. (3) (Winter) (2 lectures, 1 hour seminar per week) (Prerequisite: CHEM 302) The application of advanced concepts of organic and physical chemistry to biological systems. The properties of amino acids, peptides, proteins, enzymes, nucleosides, etc., will be discussed and their relationship to biochemical reactions, the origins of life, coenzymes, template syntheses, neurochemistry, etc.

★ CHEM 419 ADVANCES IN CHEMISTRY OF ATMOSPHERE. (3) (Winter) (3 lectures) (Prerequisites: CHEM 213, CHEM 273, MATH 222 and MATH 315 (or equivalents), or permission of instructor) (Not open to students who have taken ATOC 419, CHEM 619, or ATOC 619) (Offered in even years. Students should register in ATOC 419 in odd years.) Selected areas of atmospheric chemistry from field and laboratory to theoretical modelling are examined. The principles of atmospheric reactions (gas, liquid and heterogeneous phases in aerosols and clouds) and issues related to chemical global change will be explored.

CHEM 455 INTRODUCTORY POLYMER CHEMISTRY. (3) (Fall) (Prerequisites: CHEM 213 and CHEM 273.) A survey course on the structure of polymers, kinetics and mechanisms of polymer and copolymer synthesis; characterization and molecular weight distributions; polymer microstructure, the thermodynamics of polymer solutions; the crystalline and amorphous states, rubber elasticity and structure-property relationships.

CHEM 462 GREEN CHEMISTRY. (3) (Fall) (3 lectures) (Prerequisites: CHEM 302 and CHEM 381) New reactions and methods which can be used for the production of chemicals from renewable feedstocks; the use of new environmentally benign solvents, catalysts and reagents; organic reactions in aqueous media and in supercritical carbon dioxide; bio-catalysis and bio-processes.

CHEM 470 RESEARCH PROJECT. (6) (Fall and Winter) (Prerequisite: registration by Departmental permission only) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) A course designed to give students research experience. The student will be assigned a project supervisor and a research project at the beginning of the session. The project will consist of a literature survey, experimental and /or theoretical work, a written research report and an oral examination.

CHEM 470D1 RESEARCH PROJECT. (3) (Fall) (Students must also register for CHEM 470D2) (No credit will be given for this course unless both CHEM 470D1 and CHEM 470D2 are successfully completed in consecutive terms) (CHEM 470D1 and CHEM 470D2 together are equivalent to CHEM 470) See CHEM 470 for course description.

CHEM 470D2 RESEARCH PROJECT. (3) (Winter) (Prerequisite: CHEM 470D1) (No credit will be given for this course unless both CHEM 470D1 and CHEM 470D2 are successfully completed in consecutive terms) (CHEM 470D1 and CHEM 470D2 together are equivalent to CHEM 470) See CHEM 470 for course description.

CHEM 480 RESEARCH PROJECT. (3) (Fall) (Prerequisite or Corequisite: CHEM 490. Registration by Departmental permission only.) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) A course designed to give Honours students research experience. The student will be assigned a project supervisor and a research project at the beginning of the session. The project will consist of a literature survey, experimental or theoretical work, a written research report and an oral examination.

CHEM 480D1 RESEARCH PROJECT. (1.5) (Fall) (Students must also register for CHEM 480D2) (No credit will be given for this course unless both CHEM 480D1 and CHEM 480D2 are successfully completed in consecutive terms) (CHEM 480D1 and CHEM 480D2 together are equivalent to CHEM 480) See CHEM 480 for course description.

CHEM 480D2 RESEARCH PROJECT. (1.5) (Winter) (Prerequisite: CHEM 480D1) (No credit will be given for this course unless both CHEM 480D1 and CHEM 480D2 are successfully completed in consecutive terms) (CHEM 480D1 and CHEM 480D2 together are equivalent to CHEM 480) See CHEM 480 for course description.

CHEM 490D1 RESEARCH PROJECT. (1.5) (Fall) (Prerequisite or Corequisite: CHEM 480. Registration by Departmental permission only) (Please see regulations concerning Project Courses, under "Project Courses" in the Faculty Degree Requirements section) (Students must also register for CHEM 490D2) (No credit will be given for this course unless both CHEM 490D1 and CHEM 490D2 are successfully completed in consecutive terms) A course designed to give Honours students research experience. The student will be assigned a project supervisor and a research project at the beginning of the session. The project will consist of a literature survey, experimental or theoretical work, a written research report and an oral examination.

CHEM 490D2 RESEARCH PROJECT. (1.5) (Winter) (Prerequisite: CHEM 490D1) (No credit will be given for this course unless both CHEM 490D1 and CHEM 490D2 are successfully completed in consecutive terms) See CHEM 490D1 for course description.

CHEM 503 DRUG DESIGN AND DEVELOPMENT 1. (3) (Fall) (Prerequisites: CHEM 302, BIOL 200, BIOL 201 or BIOC 212, PHAR 300 or PHAR 301 or PHAR 303 or permission of instructor) (U3 and graduate students. Students can register only with permission of coordinators. Priority: students registered in the Minor in Pharmacology) (Not open to students who are taking or have taken PHAR 503) Interdisciplinary course in drug design and development covering chemistry, mechanisms of action and steps in drug development, principles and problems in drug design.

CHEM 504 DRUG DESIGN AND DEVELOPMENT 2. (3) (Winter) (Prerequisite: CHEM 503 and permission of instructor) (U3 and graduate students. Students can register only with permission of coordinators) (Not open to students who are taking or have taken PHAR 504) Groups of 2-4 students with different backgrounds will form a team. Each team will select a lead compound, design the analogues, propose the preclinical and clinical studies, present possible untoward effects, and reasons for drug (dis)approval.

CHEM 531 CHEMISTRY OF INORGANIC MATERIALS. (3) (Winter) (3 lectures) (Prerequisite: CHEM 381) Structure, bonding, synthesis, properties and applications of covalent, ionic, metallic crystals, and amorphous solids. Defect structures and their use in synthesis of specialty materials such as electronic conductors, semiconductors, and superconductors, and solid electrolytes. Basic principles of composite materials and applications of chemistry to materials processing.

CHEM 534 NANOSCIENCE AND NANOTECHNOLOGY. (3) (Fall) (Prerequisites: CHEM 334 or PHYS 334 or permission of instructor. Corequisites: one of CHEM 345, PHYS 357, or PHYS 446 or permission of instructor) (Not open to students who have taken or are taking PHYS 534) Topics discussed include scanning probe microscopy, chemical self-assembly, computer modelling, and microfabrication/micromachining.

● CHEM 543 CHEMISTRY OF PULP AND PAPER. (3) (Fall) (2 lectures plus a reading/reserch project.

CHEM 547 LABORATORY AUTOMATION. (3) (Winter) (Two 1.5 hour lectures, lab) (Prerequisite: CHEM 377, equivalent or permission of instructor) Automation and data handling with respect to modern chemical laboratory instrumentation. Basic electronics, data acquisition, evaluation of laboratory needs, data processing methodologies.

CHEM 552 PHYSICAL ORGANIC CHEMISTRY. (3) (Fall) (Prerequisite: CHEM 302) The correlation of theory with physical measurements on organic systems; an introduction to photochemistry; solvent and substituent effects on organic reaction rates, etc.; reaction mechanisms.

CHEM 555 NMR SPECTROSCOPY. (3) (Fall) (3 lectures) (Prerequisite: CHEM 355 or equivalent) Interpretation of proton and carbon-13 nuclear magnetic resonance spectroscopy in one dimension for structural identification.

CHEM 556 ADVANCED QUANTUM MECHANICS. (3) (Fall) (3 lectures) (Prerequisites: CHEM 345 and PHYS 242) Quantum mechanical treatment of species of chemical interest. Introduction to perturbation theory, both time-dependent and time-independent. Treatment of the variational principle. Introduction to atomic

spectra. Chemical bonding in terms of both the valence bond and molecular orbital theory. Elementary collision theory. Interaction of radiation with molecules.

CHEM 567 CHEMOMETRICS: DATA ANALYSIS. (3) (Fall) (2 lectures amd 3 hours of laboratory) (Prerequisite: Linear Algebra and experience in some computer programming language) Topics covered include; factorial analysis of chemical spectra, pattern recognition from multisensor data, linear and nonlinear optimization for the determination of optimal reaction conditions molecular modeling, multisensor calibration, etc.

CHEM 571 POLYMER SYNTHESIS. (3) (Winter) (3 lectures) (Prerequisite: CHEM 302 or equivalent, or permission of instructor.) A survey of polymer preparation and characterization; mechanisms of chain growth, including free radical, cationic, anionic, condensation and transition metal-mediated polymerization, and the effects of these mechanisms on polymer architecture; preparation of alternating, block, graft and stereoblock copolymers; novel macromolecular structures including dendrimers and other nanostructures.

● **CHEM 572 SYNTHETIC ORGANIC CHEMISTRY.** (3) (3 lectures) (Prerequisite: CHEM 382)

CHEM 575 CHEMICAL KINETICS. (3) (Winter) (3 lectures) (Prerequisites: CHEM 273 and CHEM 213) Kinetic laws, measurement of reaction rates, transition state and collision theory. Elementary reactions in gas, solution and solid phases and on surfaces. Reaction mechanisms, laser techniques, molecular beams, chemiluminescence, explosions. Extensive use of computers to simulate the kinetic behaviour of chemical systems.

● **CHEM 576 QUANTUM CHEMISTRY.** (3) (Lecture and/or reading course) (Prerequisite: CHEM 345)

● **CHEM 577 ELECTROANALYTICAL CHEMISTRY.** (3) (Prerequisites: CHEM 367 and CHEM 377)

● **CHEM 581 INORGANIC TOPICS 1.** (3) (Prerequisite: CHEM 381)

CHEM 585 COLLOID CHEMISTRY. (3) (Winter) (Prerequisites: CHEM 273 and CHEM 345, MATH 223 and MATH 315, PHYS 241 and PHYS 242 or permission of instructor) Principles of the physical chemistry of phase boundaries. Electrical double layer theory; van der Waals forces; Brownian motion; kinetics of coagulation; electrokinetics; light scattering; solid/liquid interactions; adsorption; surfactants; hydrodynamic interactions; rheology of dispersions.

CHEM 587 TOPICS IN MODERN ANALYTICAL CHEMISTRY. (3) (Fall) (Prerequisites: CHEM 367 and CHEM 377) Current theories of aqueous and nonaqueous solutions, with application to analytical chemistry; recent advances in analytical techniques. Topics may include: chromatography; applications of kinetics, solvent extraction and thermal analysis, with emphasis on their theoretical basis.

CHEM 591 ADVANCED COORDINATION CHEMISTRY. (3) (Winter) (3 hours) (Prerequisite: CHEM 381) (For Honours and Major Chemistry students or with permission) In-depth treatment of advanced topics in coordination chemistry, such as bio-inorganic chemistry and transition metal catalysis and solid state inorganic chemistry.

CHEM 593 STATISTICAL MECHANICS. (3) (Winter) (2 lectures) (Research project) (Prerequisite: CHEM 345. Recommended: CHEM 355) Basic hypotheses of statistical thermodynamics; ideal monatomic, diatomic and polyatomic gases; Einstein and Debye models of solids; statistical theory of black-body radiation; Debye-Hückel theory of electrolyte solutions; absolute reaction rate theory of rate processes; theories of solutions.

CHEM 597 ANALYTICAL SPECTROSCOPY. (3) (Fall) (2 lectures; 3 hours lab) (Prerequisites: CHEM 367 and CHEM 377) The design and analytical use of spectroscopic instrumentation with respect to fundamental and practical limitations. Classical emission, fluorescence, absorption and chemical luminescence. Topics may include photo-acoustic spectroscopy, multielement analysis, X-ray fluorescence and modern multiwavelength detector systems.

12.7 Cognitive Science

Program Director — Professor James McGilvray

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.

MINOR PROGRAM IN COGNITIVE SCIENCE (27 credits)
[Program revisions are under consideration for September 2002. Go to http://www.mcgill.ca (Course Calendars) in July for details.]

Required Course (3 credits)
PSYC 532 (3) Cognitive Science

Complementary Courses (24 credits)
from outside of the student's home department, selected from the courses listed below.

Computer Science
COMP 424 (3) Artificial Intelligence 1
COMP 426 (3) Automated reasoning

Educational Psychology
EDPE 555 (3) Applied Cognitive Science

Linguistics
LING 321 (3) Linguistics Applied to Language Learning
LING 351 (3) Phonology 1
LING 360 (3) Syntax 1
LING 370 (3) Semantics 1
LING 440 (3) Morphology
LING 491 (3) Linguistic Theory 1
LING 530 (3) Phonology 2
LING 555 (3) Linguistic Theory & Language Acquisition
LING 571 (3) Syntax 2
LING 590 (3) Introduction to Neurolinguistics

Mathematics
MATH 318 (3) Mathematical Logic
MATH 328 (3) Computability and Mathematical Linguistics

Philosophy
PHIL 210 (3) Introduction to Deductive Logic
PHIL 306 (3) Philosophy of Mind
PHIL 310 (3) Intermediate Logic
PHIL 410 (3) Topics in Advanced Logic 1
PHIL 415 (3) Philosophy of Language
PHIL 419 (3) Epistemology
PHIL 506 (3) Seminar: Philosophy of Mind
PHIL 507 (3) Seminar: Cognitive Science

Psychology
PSYC 311 (3) Human Cognition and the Brain
PSYC 314 (3) Thinking and Concepts
PSYC 334 (3) Computer Simulation - Psych. Process.
PSYC 335 (3) Formal Models of Psych. Processes
PSYC 343 (3) Language Acquisition in Children
PSYC 352 (3) Laboratory in Cognitive Psychology
PSYC 353 (3) Laboratory in Human Perception
PSYC 413 (3) Cognitive Development
PSYC 470 (3) Memory and Brain
PSYC 472 (3) Scientific Thinking and Reasoning

The Faculty of Science is divided into four parts. All sections can be accessed from the Undergraduate Programs Calendar Front Page - click on the link at the bottom of the page.