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

11.12 Geography (183)

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Chair — T.R. Moore

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

Professors
P.G. Brown; B.A.(Haverford), M.A., Ph.D.(Col.) *(joint appt. with McGill School of Environment and Natural Resource Sciences)*
T.R. Moore; B.Sc.(Swansea), Ph.D.(Aberd.)
N.T. Roulet; B.Sc., M.Sc.(Trent), Ph.D.(McM.)

Associate Professors
G.L. Chmura; B.Sc.(Mass.), M.Sc.(R.I.), Ph.D.(L.S.U.)
O.T. Coomes; B.Sc.(U.Vic.), M.A.(Tor.), Ph.D.(Wis.)
G.O. Ewing; M.A.(Glas.), M.A., Ph.D.(McM.)
M.F. Lapointe; B.Sc., M.Sc.(McG.), Ph.D.(Br.Col.)
J.E. Lewis; M.A.(Ind.), Ph.D.(Ill.)
T.C. Meredith; B.E.S.(Wat.), M.Sc., Dip.Cons.(Lond.), Ph.D.(Camb.)
L. Müller-Wille; Dr.phil.(Münster)
W.H. Pollard,; B.A., M.Sc.(Guelph), Ph.D.(Ott.)
G.W. Wenzel; M.A.(Manit.), Ph.D.(McG.)

Assistant Professors
W.M. Brown; B.A.(St.M.), M.A., Ph.D.(McM.)
C.A. Kull; B.A.(Dart.), M.A.(Colo.), M.Sc.(Yale), Ph.D.(Berkeley)
R.E. Sieber; B.Sc.(Mich. St.), M.P.A.(W. Mich.), Ph.D.(Rutgers) *(joint appt. with McGill School of Environment)*

The Department of Geography offers programs in both Arts and Science. To avoid duplication, course descriptions that are of special interest to Arts students appear in the Geography entry in the Faculty of Arts section. Many Science students choose to take some of these courses. All B.A. programs in Geography (including Urban Systems) are listed in the Faculty of Arts entry, beginning on page 95**.**

Geography is the study of physical environments and human habitats. It deals with people and places. It covers issues such as global warming and climate change, regional economic disparities, urban transportation, native land claims and permafrost problems. Both a physical and a social science, it provides a unique opportunity to obtain a broad exposure to modes of analysing the many environmental and locational problems of contemporary society.

The World Commission on Environment and Development has identified the evidence and possible consequences of currently widespread land use practices which cannot be sustained. Geography is an integrative discipline concerned with the relations between culture systems and resource bases. Students interested in understanding, or working towards the resolution of, the environmental "crisis" should select courses which deal with (1) the dynamics of natural systems (courses in the physical geography of terrestrial, atmospheric and hydrological systems); (2) the dynamics of human systems (courses in cultural, social, economic, political and urban geography); (3) the context of development and land use changes; and (4) practical skills such as Geographical Information Systems, cartography, remote sensing, image analysis and resource management.

Students may pursue programs focusing on urban systems, the geography of economic development, people and their natural environment, the geography of living systems. The interdisciplinary Minor in Environment is also available to students in Arts or Science. Students planning to enter a program in Geography should telephone (514) 398-4111 for an appointment with an adviser and should consult the *Department of Geography Undergraduate Handbook,* which is available from the departmental office.

Graduates find employment in a wide range of industrial and commercial activities, as well as in government and education. Others pursue graduate work in geography or urban planning.

PREREQUISITES

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

MINOR PROGRAM IN GEOGRAPHY (expandable into the B.Sc. Major in Geography) (18 credits) [MARS Program Code 6-450000]

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

This Minor permits no overlap with any other programs.

Required Courses (12 credits)

183-203	(3)	Environmental Systems
183-216	(3)	Geography of the World Economy
183-217	(3)	The Canadian City
183-302	(3)	Environmental Analysis and Management: Problems and Policy

Complementary Courses (6 credits)
6 credits of Geography courses at the 300 and 400 level.

B.Sc. MINOR IN GEOGRAPHICAL INFORMATION SYSTEMS (18 credits) [MARS Program Code 6-450300]

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

Required Courses (15 credits)

183-201	(3)	Geographic Information Systems 1
183-306	(3)	Geographic Information Systems 2
183-307	(3)	Socioeconomic Applications of GIS
183-308	(3)	Principles of Remote Sensing
183-506	(3)	Perspectives on Geographic Information Analysis

Complementary Course (3 credits)
one course to be chosen from:

183-535	(3)	Remote Sensing Methods
183-551	(3)	Environmental Decisions
409-505	(3)	GIS in Planning
195-414	(3)	Applications of Remote Sensing
308-420	(3)	Files and Databases
308-557*	(3)	Fundamentals of Computer Graphics*

*Note prerequisites

B.Sc. MAJOR PROGRAM IN GEOGRAPHY (58 credits) [MARS Program Code 1-450000]

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

Required Courses (22 credits)

183-201	(3)	Geographic Information Systems 1
183-203	(3)	Environmental Systems
183-216	(3)	Geography of the World Economy
183-217	(3)	The Canadian City
183-272	(3)	Landforms & Environmental Systems
183-302	(3)	Environmental Analysis and Management
183-351	(3)	Quantitative Methods in Geography
183-290	(1)	Local Geographical Excursion (In 2001 reserve Sept. 28-30)

Complementary Courses (36 credits)
3 credits of statistics chosen from:

166-350	(3)	Statistics in Social Research
177-373	(3)	Biostatistical Analysis
189-203	(3)	Principles of Statistics
204-204	(3)	Introduction to Psychological Statistics

3 credits from GIS techniques:
183-306 (3) Geographic Information Systems 2
183-308 (3) Principles of Remote Sensing
12 credits from systematic physical geography:
183-305 (3) Soils and Environment
183-321 (3) Climatic Environments
183-322 (3) Environmental Hydrology
183-350 (3) Ecological Biogeography
183-372 (3) Running Water Environments
3 credits from field courses:
183-495 (3) Field Studies - Physical Geography
183-496 (3) Regional Geographical Excursion
183-497 (3) Plant Ecology of Coastal Waters
183-499 (3) Subarctic Field Studies: Schefferville
(Field course availability is determined each year in February.)

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

B.Sc. HONOURS PROGRAM IN GEOGRAPHY (67 credits)
[MARS Program Code 2-450000]

The Honours program is designed to provide specialized systematic training in physical geography. The student must maintain marks of B or higher and must complete a 6-credit research paper. Honours students are encouraged to participate in 500-level seminars with graduate students, but it is not advisable to take more than one in a semester.

Required Courses (31 credits)
22 credits of introductory courses
(see B.Sc. Major program in Geography)
9 credits of research and thesis courses:
183-381 (3) Evolution of Geography
183-491D,N (6) Honours Research and Reading

Complementary Courses (36 credits)
from the same list as for the B.Sc. Major Program in Geography.

ENVIRONMENTAL STUDIES COURSES

See the McGill School of Environment section for other courses that may be relevant to Geography programs.

COURSE DESCRIPTIONS

All courses have limited enrolment.

To avoid duplication, course descriptions that are of special interest to Arts students appear in the Geography entry in the Arts section 11.20**. Many Science students choose to take some of these courses.**

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

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

● Denotes courses not offered in 2001-02.

● **183-190A ENVIRONMENTAL PERSPECTIVES.** (1) (FYS – for first year, non-Geography students only, maximum 25.)

183-199A PEOPLE, PLACE AND ENVIRONMENT. (3) (FYS – for first year students only, maximum 25. Closed to Geography Majors.) Geography studies the complex but crucial relationships between people and their physical and socio-cultural environments. The course is constructed around field trips and preparatory seminars which provide an opportunity for students to learn about a variety of physical environments and their utilisation.

183-200A GEOGRAPHICAL PERSPECTIVES ON WORLD ENVIRONMENTAL PROBLEMS. (3) (3hours)

183-201A GEOGRAPHIC INFORMATION SYSTEMS 1. (3) (3 hours and lab) An introduction to Geographic Information Systems. The systematic management of spatial data. The use and construction of maps. The use of microcomputers and software for mapping and statistical work. Air photo and topographic map analyses. (Title change awaiting University approval)

183-203A ENVIRONMENTAL SYSTEMS. (3) (3hours) (Not open to B.A. students in Freshman year.) An introduction to system-level interactions among climate, hydrology, soils and vegetation at the scale of drainage basins, including the study of the global geographical variability in these land-surface systems. The knowledge acquired is used to study the impact on the environment of various human activities such as deforestation and urbanisation.

183-205B GLOBAL CHANGE: PAST, PRESENT AND FUTURE. (3) (3 hours) An examination of global change, from the Quaternary Period to the present day involving changes in the physical geography of specific areas. Issues such as climatic change and land degradation will be discussed, with speculations on future environments.

183-210 GLOBAL PLACES AND PEOPLES. (3) (3hours)

183-216A GEOGRAPHY OF THE WORLD ECONOMY. (3) (3hours)

183-217B THE CANADIAN CITY. (3) (3hours)

183-272B LANDFORMS & ENVIRONMENTAL SYSTEMS. (3) (3 hours) Introduction to the study of landforms as products of geomorphic and geologic systems acting at and near the Earth's surface. The process geomorphology approach will be used to demonstrate how landforms of different geomorphic settings represent a dynamic balance between forces acting in the environment and the physical properties of materials present.

183-290A LOCAL GEOGRAPHICAL EXCURSION. (1 credit) (Open to first-year Geography Major and Honours students only. Not open to students who have taken 183-199.) Introduction to landscape interpretation and geographical site analysis in physical and human geography. A three-day fall excursion with preparatory and concluding seminars. September 28-30, 2001.

● **183-300B HUMAN ECOLOGY IN GEOGRAPHY.** (3) (3hours) (Prerequisite: 183-203 or 151-202 or 177-111)

● **183-301A GEOGRAPHY OF NUNAVUT.** (3) (3hours)

183-302B ENVIRONMENTAL ANALYSIS AND MANAGEMENT: PROBLEMS AND POLICY. (3) (3 hours) (Prerequisite: 183-203 or permission of instructor.) An ecological analysis of the physical and biotic components of natural resource systems. Emphasis on scientific, technological and institutional aspects of related environmental management. Study of the use of Canadian biological resources and of the impact of industrial processes. Students develop dossiers and assess applied research methods.

183-305A SOILS AND ENVIRONMENT. (3) (2hours and laboratory) (Prerequisite: 183-203 or introductory course in biology or geology.) Discussion of the major properties of soils; soil formation, classification and mapping; land capability assessment; the role and response of soils in natural and disturbed environments (e.g. global change, ecosystem disturbance).

183-306B GEOGRAPHIC INFORMATION SYSTEMS 2. (3) (2 hours and laboratory) (Prerequisite: 183-201) Formal introduction to a computer-based Geographical Information System (GIS). Topics will focus on map analysis and on transforming and displaying spatial data. GIS will be used by students to solve problems in both physical and human geography.

183-307B SOCIOECONOMIC APPLICATIONS OF GIS. (3) (2 hours and laboratory) (Prerequisites: 183-201, 189-203 or equivalent)

183-308A PRINCIPLES OF REMOTE SENSING. (3) (3 hours and laboratory periods) (Restriction: Not open to students who have taken or are taking 195-308.) A conceptual view of remote sensing and the underlying physical principles are presented. Ground-based and satellite systems and the 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.

183-309A GEOGRAPHY OF CANADA. (3) (3hours)

183-311B CANADA – A GEO-ECONOMIC PERSPECTIVE. (3) (3 hours) (Prerequisite 183-216 or permission of the instructor.)

183-315A URBAN TRANSPORTATION GEOGRAPHY. (3) (3hours) (Prerequisite 183-217 or permission of instructor.)

183-316B POLITICAL GEOGRAPHY. (3) (3hours)

183-321B CLIMATIC ENVIRONMENTS. (3) (3hours) (Prerequisite: 183-203 or 195-210 or permission of the instructor.) Scope of climatology, physical, dynamic and applied. The Earth/atmosphere system, radiation and energy balances, governing meteorological processes. Movement and circulation of the atmosphere on a local and global scale. Resulting weather systems.

183-322B ENVIRONMENTAL HYDROLOGY. (3) (3hours) (Prerequisite: 183-203 or equivalent) Quantitative, experimental study of the principles governing the movement of water at or near the Earth's surface and how the research relates to the chemistry and biology of ecosystems.

● **183-323B GEOGRAPHY OF EUROPE'S NORTH.** (3) (3hours)

183-331A URBAN SOCIAL GEOGRAPHY. (3) (3 hours) (Prerequisite: 183-216 or 217 or permission of instructor.)

183-350A ECOLOGICAL BIOGEOGRAPHY. (3) (3hours) (Prerequisite: 183-302 or 177-205) The study of the patterns of distribution of organisms in space and time with emphasis on plant communities. Ecological, geographical, historical and anthropological factors affecting these distribution patterns will be discussed. Particular consideration is given to methods for description and classification of plant communities.

183-351A QUANTITATIVE METHODS IN GEOGRAPHY. (3) (3hours) (Prerequisite: Mathematics 189-203 or permission of instructor.) (Note: Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on pag e351.) Multiple regression and correlation, logit models, discrete choice models, gravity models, facility location algorithms, survey design, population projection.

● **183-370A PROTECTED AREAS.** (3) (3 hours) (Prerequisite: 177-208 or 183-203 or 344-205.)

183-372A RUNNING WATER ENVIRONMENTS. (3) (3hours) (Prerequisites: 183-203 and 183-272, or 170-200 and 170-202) The course focuses on the physical habitat conditions found in streams, rivers, estuaries and deltas. Based on the laws governing flow of water and sediment transport, it emphasizes differences among these environments, in terms of channel form, flow patterns, substrate composition and mode of evolution. Flooding, damming, channelisation, forestry impacts.

183-381A EVOLUTION OF GEOGRAPHY. (3) (3hours)

● **183-398T FIELD STUDIES IN HUMAN GEOGRAPHY.** (3) (3hours) (Prerequisite: Any introductory human geography course; or by permission of the instructor.)

● **183-404B ENVIRONMENTAL MANAGEMENT.** (3) (3 hours) (Prerequisite: 183-302 or permission of instructor.)

● **183-407B CONTEMPORARY ISSUES IN GEOGRAPHY.** (3) (3 hours)

183-408A GEOGRAPHY OF DEVELOPMENT. (3) (3hours) (Prerequisite: 183-216 or permission of instructor.)

183-410B GEOGRAPHY OF UNDERDEVELOPMENT: CURRENT PROBLEMS. (3) (3 hours) (Prerequisite: 183-216 or permission of instructor.)

183-424A PLACE, PEOPLE & CULTURE: EUROPE. (3) (3 hours) (Prerequisite: 6 credits from any of History, Art History, Anthropology, Philosophy, Political Science, Sociology or permission of instructor) (Change in credit weight and hours from 6 to 3 awaiting University approval.)

● **183-470C WETLANDS.** (3) (3 hours and field trips) (Prerequisites: one from 183-305, 183-322, 372-210, 336-217; and one from 183-350, 177-208/308, 367-460, 367-358)

183-490A,B,G,T INDEPENDENT STUDIES IN GEOGRAPHY. (3) (Open to U3 Geography Major students only.) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) Research or reading projects permitting independent study under the guidance of a staff member specializing in the field of interest. A project must be arranged with an instructor *before* registration.

183-491D,N HONOURS RESEARCH AND READING. (6) (Prerequisite: 183-381) (For U3 B.A. and B.Sc. Honours and Joint Honours Geography students.) Supervised reading, research and preparation of an undergraduate thesis under the direction of a member of staff.

183-492D,N JOINT HONOURS RESEARCH AND READING. (3) (Only for those U3 Joint Honours students in Geography who opt to enrol in a parallel course in another department.)

183-494A URBAN FIELD STUDIES. (3) (Prerequisites: 200-level courses in GIS, statistics, and urban geography, and 183-331B)

183-495C FIELD STUDIES - PHYSICAL GEOGRAPHY. (3) (2-week field school) (Prerequisites: 6 credits from the following list of Systematic Physical Geography courses: 183-305, 183-321, 183-322, 183-350, 183-372) Field research projects in physical geography. Held locally in Monteregian or Eastern Township regions. The course is organised around field projects designed to formulate and test scientific hypotheses in a physical geography discipline. May summer session. Preregistration in Department required by March 15.

183-496B REGIONAL GEOGRAPHICAL EXCURSION. (3) (Prerequisites: 183-290 and permission of instructor.)

183-497A ECOLOGY OF COASTAL WATERS. (3) (Restriction: location in New Brunswick. Students must register for a full semester of studies in the Huntsman program.) (Prerequisite: 183-203 or 170-200 and 183-350 or 177-208 or 344-205) Study of ecology of coastal habitats such as salt marshes, rocky coasts, mud-flats, and shallow water environment of Eastern Canada. Emphasis on processes and factors critical to sustaining resources harvested from coastal ecosystems. (Course title, prerequisite, restriction and description revision awaiting University approval)

183-498B HUMANS IN TROPICAL ENVIRONMENTS. (3) (6 hours lecture for 4 weeks, 3 hours seminar, 2 hours laboratory, 8 hours conference) (Restriction: Location in Panama. Student must register for a full semester of studies in Panama.) (Prerequisites: 144-218, 189-203 or equivalents.) Focus on understanding of inter-relations between humans and neotropical environments represented in Panama. Study of contemporary rural landscapes, their origins, development and change. Impacts of economic growth and inequality, social organization, and politics on natural resource use and environmental degradation. Site visits and field exercises in peasant/colonist, Amerindian, and plantation communities.

183-499T SUBARCTIC FIELD STUDIES IN GEOGRAPHY: SCHEFFERVILLE. (3) (Prerequisite: 183-203 or 301) An introduction to the geography of the subarctic with emphasis on the application of field methods in physical and/or human geography. The course will be given in 2002 at the McGill Subarctic Research Station, Schefferville, during ten days in late August. Preregistration in Department required by March 15. MARS registration by first week in July.

183-500A GEOGRAPHY OF REGIONAL IDENTITY. (3) (3hours) (Restriction: Graduate students and final year undergraduates and/or those who have taken 183-408A.)

183-501A MODELLING ENVIRONMENTAL SYSTEMS. (3) (1.15 hours lecture, 0.58 hours seminar, 0.69 hours project, 0.58 hours laboratory) (Restriction: open only to U2 or U3 students who have completed six or more credits from courses at the 300 level of Atmospheric and Oceanic Sciences, Biology, Chemistry, Earth and Planetary Sciences, Geography, Natural Resource Sciences, or a McGill School of Environment domain, or permission of the instructor.) (Prerequisites: 189-139 or 189-140, 189-141, and 189-203, or equivalent.) (Enrolment limited to 20 students by availability of workstations.) Most problems in environmental science deal with weak relationships and poorly defined systems. Model development and simulation will be used in this course to help improve understanding of environmental systems. Simulation of environmental systems is examined, focusing on problem definition, model development and model validation.

● **183-502A GEOGRAPHY OF NORTHERN DEVELOPMENT.** (3) (3 hours) (Prerequisite: 183-301 or 436, or permission of instructor.)

● **183-504A INDUSTRIAL RESTRUCTURING – THE GEOGRAPHIC IMPLICATIONS.** (3) (Prerequisites: 183-311 or permission of instructor.)

183-505B GLOBAL BIOGEOCHEMISTRY. (3) (2 hours and research) (Prerequisite: 183-305 and permission of instructor.) An examination of the storage, transfers and cycling of major elements and substances, with an emphasis on the global scale and the linkages between the atmosphere, hydrosphere, lithosphere and biosphere.

183-506B PERSPECTIVES ON GEOGRAPHIC INFORMATION ANALYSIS. (3) (2hours and laboratory) (Prerequisite: 183-201 and 306 and permission of instructor.) Examination of a range of applications in automated processing of spatial data. Discussion will focus on both theoretical and practical aspects of Geographic Information Systems. Topics such as resource data base structure, methods of spatial interpolation and data quality and errors are covered. The application of Geographic Information Systems such as GRASS and digital image processing routines are used to answer questions in geographical research. Individual student projects will be emphasized.

183-508A RESOURCES, PEOPLE AND POWER. (3) (3 hours) (Prerequisite: 183-408 or 183-410 or permission of instructor.)

183-510B HUMID TROPICAL ENVIRONMENTS. (3) (3hours) (Prerequisite: 183-203 or equivalent and written permission of the instructor.)

● **183-513A BEHAVIOURAL GEOGRAPHY.** (3) (3hours) (Prerequisite: a course in introductory statistics.)

● **183-522B ADVANCED ENVIRONMENTAL HYDROLOGY.** (3) (2 hours and 1 tutorial) (Prerequisite: 183-322, or permission of instructor.)

● **183-523B ADVANCED CLIMATOLOGY.** (3) (3 hours) (Prerequisite: a previous course in climatology or meteorology, and written permission of the instructor.)

● **183-535B REMOTE SENSING METHODS & INTERPRETATION.** (3) (3 hours) (Prerequisite: 183-308 and written permission of instructor.)

183-536B PERIGLACIAL AND PERMAFROST ENVIRONMENTS. (3) (3 hours) (Prerequisite: 183-272 and any 300-level geomorphology course approved by instructor.) Study of the unique geomorphic aspects of periglacial and permafrost environments. The focus will be on processes in cold climates, the impact of human activity on permafrost landscapes and potential impacts of climatic change.

● **183-537B ADVANCED FLUVIAL GEOMORPHOLOGY.** (3) (Prerequisites: permission of instructor.)

183-550A QUATERNARY PALEOECOLOGY. (3) (2hours, laboratory and seminar) (Prerequisite: course in ecology or biogeography, or permission of instructor.) Examination of landscape and ecosystem response to climatic change; addressing persistent problems in Pleistocene and Holocene paleoecology: episodes of temporary warming and cooling, locations of glacial refugia and sea level change. Principles and methods of Quaternary paleoecology and paleoclimatological reconstruction.

183-551A ENVIRONMENTAL DECISIONS. (3) (2 hours seminar, 1 hour tutorial) (Prerequisites: 183-302, 183-306 or equivalents)

11.13 Immunology Interdepartmental Honours Program

The Honours Program in Immunology is offered by three Departments: Biochemistry, Microbiology and Immunology, and Physiology. The program is a demanding one which will prepare the student for graduate work in immunology.

All admissions to the Honours program will be after completion of the U1 year, and a student must have obtained a U1 GPA of 3.20. Admission to U3 requires a GPA of 3.20 in U2. Students who do not maintain Honours standing must transfer their registration to a program in one of three participating Departments.

For graduation in the Honours program, the student must complete a minimum of 90 credits, and achieve a CGPA of not less than 3.20. In addition, the five Immunology courses (528-314B, 507-503A, 528-414A, 552-419D, 552-513A) must be passed with a grade not less than B.

U1 students who are interested in the program are advised to register in either the Faculty or Major program in Biochemistry or Physiology, or the Major program in Microbiology and Immunology. U1 students should inform their advisers of their intent to enter the Honours Immunology Program in U2.

Students wishing to enter the program must apply in writing by April 1 to:

Dr. M. Baines, Department of Microbiology and Immunology, Room 404, Lyman Duff Medical Sciences Building, 3775 University Street, Montreal, QC, H3A 2B4. Telephone (514) 398-4443 or (514) 398-3928; mgbaines@microimm.mcgill.ca

or Dr. W.S. Lapp, Department of Physiology, Room 1137, McIntyre Medical Sciences Building, 3655 Promenade Sir-William-Osler, Montreal, QC, H3G 1Y6. Telephone (514) 398-4328 or (514)398-4327); wlapp@physio.mcgill.ca

All candidates will be interviewed for admission if demand exceeds the number of available places. Enrolment is limited.

INTERDEPARTMENTAL HONOURS PROGRAM IN IMMUNOLOGY (77 credits) [MARS Program Code 2-590500] (Program revisions awaiting University approval)

U1 Required Courses (20 credits)

177-200A	(3)	Molecular Biology
177-201B	(3)	Cell Biology and Metabolism
or 507-212B	(3)	Molecular Mechanisms of Cell Function
180-212A,B	(4)	Organic Chemistry I
180-222A,B	(4)	Organic Chemistry II
180-203A	(3)	Survey of Physical Chemistry
or 180-204A,B	(3)	Physical Chem./Biol. Sci. I
552-209A	(3)	Mammalian Physiology I

U1, U2 or U3 Required Course (3 credits)

177-373A	(3)	Biostatistical Analysis
or 189-203A	(3)	Principles of Statistics I
or 204-204A,B	(3)	Introduction to Psychological Statistics

U1 Complementary Courses (6 credits)
Selected from:

528-211A	(3)	Biology of Microorganisms
528-212A	(2)	Laboratory in Microbiology
177-202B	(3)	Basic Genetics
177-205B	(3)	Biology of Organisms
177-304A	(3)	Evolution
189-204B	(3)	Statistics II
504-214A	(3)	Systematic Human Anatomy
504-261A*	(4)	Introduction to Dynamic Histology

*students must take this course in U1 or U2

U2 Required Courses (15 credits)

507-311A	(3)	Metabolic Biochemistry
507-312B	(3)	Biochemistry of Macromolecules
528-314B	(3)	Immunology
507-300D	(6)	Laboratory in Biochemistry
or 528-386D	(6)	Laboratory in Microbiology

U2 Complementary Courses (9 credits)
one of:

504-261A	(4)	Introduction to Dynamic Histology
528-211A	(3)	Biology of Microorganisms
552-210B	(3)	Mammalian Physiology II

plus 6 credits selected from:

177-314A	(3)	Molecular Biology of Oncogenes
177-300A	(3)	Molecular Biology of the Gene
552-210B	(3)	Mammalian Physiology II

180-302A,B	(3)	Organic Chemistry III
189-222A,B	(3)	Calculus III
189-315A,B	(3)	Ordinary Differential Equations
or 177-309A	(3)	Mathematical Models in Biology
528-323A	(3)	Microbial Physiology
528-324A	(3)	Fundamental Virology
546-300B	(3)	Human Disease
549-300A	(3)	Drug Action
549-301B	(3)	Drugs and Disease
549-303B	(3)	Toxicology
552-311A	(3)	Intermediate Physiology I
552-312B	(3)	Intermediate Physiology II
552-313B	(3)	Intermediate Physiology III

U3 Required Courses (18 credits)

528-414A	(3)	Advanced Immunology
507-503B	(3)	Immunochemistry
552-419D	(9)	Project & Seminar in Immunology
552-513B	(3)	Cellular Immunology

U3 Complementary Courses (6 credits)

6 credits selected from:

177-520B	(3)	Gene Activity in Development
507-404B	(3)	Biophysical Chemistry
507-450A	(3)	Protein Structure and Function
507-454A	(3)	Nucleic Acids
507-458B	(3)	Membranes & Cellular Signaling
or 504-458B	(3)	Membranes & Cellular Signaling
552-531B	(3)	Topics in Applied Immunology
552-552B	(3)	Cellular & Molecular Physiology
528-413B	(3)	Parasitology
528-465A	(3)	Bacterial Pathogenesis and Host Defences
528-466B	(3)	Viral Pathogenesis and Host Defences
528-509B	(3)	Seminars on Inflammatory Processes
549-503A	(3)	Drug Design and Development 1
549-504B	(3)	Drug Design and Development 2

11.14 Management Minor Program

The Minor in Management allows Science students to include courses in their undergraduate program that will help prepare them for a career in management. The Minor in Technological Entrepreneurship described in section 11.29 is available to Science students.

Enrolment in this program is restricted. At the time of application, a CGPA greater than 2.50 is required and at least one course toward the Minor program must have been completed with a grade of C or better.

Application procedures will be announced in September. Please consult the Student Affairs Office Website, http://www.mcgill.ca/artscisao.

Students who are not formally registered for the Minor but who nevertheless complete all its requirements may apply to have the Minor approved during their last term.

Students who were registered in 1996-97 or earlier should consult the Minor adviser in the Student Affairs Office regarding their program requirements.

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

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

MINOR PROGRAM IN MANAGEMENT (24 credits)

Required Courses (9 credits)

280-211	(3)	Introduction to Financial Accounting
280-293	(3)	Managerial Economics
189-203	(3)	Principles of Statistics I

or its equivalent as authorized by the Faculty of Science.

Students majoring in certain programs, for example in Mathematics, cannot take 189-203 but must take 189-324 instead. (Note: Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on page 351.)

Complementary Courses (15 credits)

3 credits from:

280-213	(3)	Introduction to Management Accounting
280-341	(3)	Finance I
280-382	(3)	International Business

3 credits from:

280-222	(3)	Organizational Behaviour
280-320	(3)	Managing Human Resources
280-352	(3)	Marketing Management I

3 credits from:

280-360	(3)	Social Context of Business
280-373	(3)	Operations Research
280-423	(3)	Organizational Policy

6 credits from:

any approved 300- or 400-level Management courses for which the prerequisites, if any, have been met.

11.15 Mathematics and Statistics (189)

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Montreal, QC H3A 2K6

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Chair — Kohur GowriSankaran

Emeritus Professors

Michael Barr; A.B., Ph.D.(Penn.) *(Peter Redpath Emeritus Professor of Pure Mathematics)*
Jal R. Choksi; B.A.(Cantab.), Ph.D.(Manc.)
Joachim Lambek; M.Sc., Ph.D.(McG.), F.R.S.C. *(Peter Redpath Emeritus Professor of Pure Mathematics)*
Arak M. Mathai; M.Sc.(Kerala), M.A., Ph.D.(Tor.)
William O.J. Moser; B.Sc.(Manit.), M.A.(Minn.), Ph.D.(Tor.)
V. Seshadri; B.Sc., M.Sc.(Madras), Ph.D.(Oklahoma)
John C. Taylor; B.Sc.(Acad.), M.A.(Queen's), Ph.D.(McM.)

Professors

William J. Anderson; B.Eng., Ph.D.(McG.)
William G. Brown; M.A.(Col.), B.A., Ph.D.(Tor.)
Marta C. Bunge; M.A., Ph.D.(Penn.)
Henri Darmon; B.Sc.(McG.), Ph.D.(Harv.)
Stephen W. Drury; M.A., Ph.D.(Cantab.)
Kohur GowriSankaran; B.A., M.A.(Madras), Ph.D.(Bombay)
Jacques C. Hurtubise; B.Sc.(Montr.), Ph.D.(Oxon.)
Niky Kamran; B.Sc., M.Sc.(Brussels), Ph.D.(Wat.)
Olga Kharlampovich; M.A.(Ural State), Ph.D.(Leningrad), Dr.of Sc.(Steklov Institute)
Michael Makkai; M.A., Ph.D.(Bud.)
Sherwin A. Maslowe; B.Sc.(Wayne State), M.Sc., Ph.D.(Calif.)
Charles Roth; M.Sc.(McG.), Ph.D.(Hebrew
Karl Peter Russell; Vor.Dip.(Hamburg), Ph.D.(Calif.
Georg Schmidt; B.Sc.(Natal), M.Sc.(S.A.), Ph.D.(Stan.)
George P.H. Styan; M.A., Ph.D.(Col.)
Kwok Kuen Tam; M.A., Ph.D.(Tor.)
Luc Vinet; B.Sc., M.Sc., Ph.D.(Montr.), Doctorat 3^{e} cycle (Paris VI) *(joint appt. with Physics)*
David Wolfson; M.Sc.(Natal), Ph.D.(Purdue)
Keith J. Worsley; B.Sc., M.Sc., Ph.D.(Auckland)
Jian-Ju Xu; B.Sc., M.Sc.(Beijing), M.Sc., Ph.D.(Renss.)
Sanjo Zlobec; M.Sc.(Zagreb), Ph.D.(Northwestern)

Associate Professors

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Ivo Klemes; B.Sc.(Tor.), Ph.D.(Cal.Tech.)
John P. Labute; B.Sc.(Windsor), M.A., Ph.D.(Harv.)
Bohdan Lawruk; M.Sc., Ph.D.(Lwow)
James G. Loveys; B.A.(St.M.), M.Sc., Ph.D.(S.Fraser)
Roger Rigelhof; B.Sc.(Sask.), M.Sc.(Wat.), Ph.D.(McM.)
Neville G.F. Sancho; B.Sc., Ph.D.(Belf.)

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Martin J. Gander; M.S.(ETH), M.S., Ph.D.(Stan.)
Eyal Z. Goren; B.A., M.S., Ph.D.(Hebrew)
Dmitry Jakobson; B.Sc. (M.I.T.), Ph.D.(Princeton)
Dietmar Leisen; B.Sc.(Mainz), M.Sc., Ph.D.(Bonn) *(joint appt. with Management)*
John A. Toth; B.Sc., M.Sc.(McM.), Ph.D.(M.I.T.)
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Associate Members
Luc P. Devroye *(Computer Science),* P.R.L. Dutilleul *(Plant Science),* Leon Glass *(Physiology),* Jean-Louis Goffin *(Management),* James A. Hanley *(Epidemiology & Biostatistics)*, Lawrence Joseph *(Epidemiology & Biostatistics),* Michael Mackey *(Physiology),* Lawrence A. Mysak *(A.O.S.),* Prakash Panangaden *(Computer Science),* James O. Ramsay *(Psychology),* George Alexander Whitmore *(Management)*

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Thomas Fox; B.A.(Oakland), M.Sc., Ph.D.(McG.)
Victor Havin; M.Sc., Ph.D.(Leningrad)
M. Ram Murty; B.Sc.(Car.), Ph.D.(M.I.T.) F.R.S.C.
Brian Rowley; B.Sc.(Wat.), M.Sc., Ph.D.(McG.)
Robert A. Seely; B.Sc.(McG.), Ph.D.(Cantab)

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

The two principal divisions of mathematics are pure mathematics and applied mathematics. The pure mathematician is interested in abstract mathematical structures and in mathematics as an intellectual enterprise. The primary concern may not be with its utilitarian aspects or with the current needs of science and technology, although many problems in pure mathematics have developed from the sciences.

The applied mathematician is more interested in how mathematics can be used to study some aspects of the world. Mathematicians are engaged in the creation, study and application of advanced mathematical methods relevant to scientific problems. Statistical science and methodology today is concerned with phenomena in which there is a background of uncertainty arising from inherent variability and the investigator is obliged to arrive at decisions from limited data. A key tool in statistics is probability.

Some of the fields in which pure mathematicians work are algebra, analysis, geometry, topology, number theory and foundations. Applied mathematics which once referred to the application of mathematics to such disciplines as mechanics and fluid dynamics, has currently assumed a much broader meaning and embraces such diverse fields as communication theory, theory of optimization, theory of games and numerical analysis.

Mathematics offers many vocational possibilities. Such fields as teaching, computing, applied statistics and actuarial science offer opportunities for B.Sc. graduates. Opportunities to do original research in pure and applied mathematics are available in universities and research institutions. Employment is to be found in financially or technologically oriented business firms. The Department of Mathematics and Statistics through its various programs attempts to provide courses to suit the diverse interests within mathematics and statistics.

The Honours Program in Mathematics demands of the student a talent for abstraction in addition to a high level of competence in the use of mathematical tools. This program is intended for students who plan to work in an area where mathematical innovations may be needed. It is almost essential for students contemplating a career in mathematical research.

The Major Program involves the same subjects as the Honours Program but is less demanding in terms of abstraction. It is designed primarily for students who will need mathematical tools in their work but whose creative activity will involve applications of mathematics to other areas. Within the framework of the Mathematics Major, various combinations of courses are suggested to meet the needs of different students. These include course suggestions for secondary school teachers, careers in management, and for careers in industry, government or actuarial sciences.

It is possible for Major students to include a number of Honours courses in their programs. This will be an advantage for those students who plan to use their mathematics in graduate studies.

Students interested in a less intensive mathematics program linked to other disciplines are advised to consider the available Faculty Programs.

In planning their programs students are advised to seriously consider developing some depth in another discipline – preferably one for which mathematics has some relevance and use. Mathematics has been closely linked to areas such as computer science, physics and engineering but has recently come to play an increasingly important role in fields such as biology, linguistics, management and psychology. Students should consider completing the requirements for Minor programs such as those available in Cognitive Science, Computer Science and Statistics.

Students considering programs in Mathematics and Statistics should contact the Department to arrange for academic advising.

The student's attention is called to the fact that a B.Com. degree with a Major in Mathematics is available from the Faculty of Management. In addition the Faculty of Music offers the B.Mus. degree with Honours in Theory with Mathematics Option.

An industrial internship year is available to students enrolled in some Mathematics 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 the Faculty of Engineering section 2.8 for further information on IYES.

MINOR PROGRAM IN MATHEMATICS (24 credits)
[MARS Program Code 6-630000]
(Program revisions awaiting University approval)

The Minor may be taken in conjunction with any primary program in the Faculty of Science (other than programs in Mathematics). Students should declare their intention to follow the Minor in Mathematics at the beginning of the penultimate year and should obtain approval for the selection of courses to fulfill the requirements for the Minor from the Departmental Chief Adviser (or delegate).

It is strongly recommended that students in the Minor Program take 189-323. The remaining credits may be freely chosen from the required and complementary courses for Majors and Honours students in Mathematics, with the obvious exception of courses that involve duplication of material. Alternatively up to six credits may be allowed for appropriate courses from other departments.

All courses counted towards the Minor must be passed with a grade of C or better.

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

Required Courses (9 credits)

189-222	(3)	Calculus III
189-223*	(3)	Linear Algebra
189-315	(3)	Ordinary Differential Equations

*189-223 may be replaced by 189-235 and 189-236. In this case the complementary credit requirement is reduced by three.

Complementary Courses (15 credits)
To be selected from the required and complementary courses for Majors and Honours students in Mathematics, with 189-323 strongly recommended; alternatively up to 6 credits may be allowed for appropriate courses from other departments.

MINOR PROGRAM IN STATISTICS (24 credits)
[MARS Program Code 6-630200]
(Program revision awaiting University approval)

The Minor may be taken in conjunction with any primary program in the Faculty of Science. Students should declare their intention to follow the Minor in Statistics at the beginning of the penultimate year and must obtain approval for the selection of courses to fulfil the requirements for the Minor from the Departmental Chief Adviser (or delegate).

All courses counted towards the Minor must be passed with a grade of C or better. Generally no more than six credits of overlap are permitted between the Minor and the primary program. However, with an approved choice of substantial courses the overlap restriction may be relaxed to nine credits for students whose primary program requires 60 credits or more and to 12 credits when the primary program requires 7 2credits or more.

Required Courses (15 credits)
189-222 (3) Calculus III
189-223* (3) Linear Algebra
189-323 (3) Probability Theory
or 189-356 (3) Probability
189-324 (3) Statistics
or 189-357 (3) Statistics
189-423 (3) Regression and Analysis of Variance
*189-223 may be replaced by 189-235 and 189-236. In this case the complementary credit requirement is reduced by three.

Complementary Courses (9 credits)
selected from:
189-447 (3) Stochastic Processes
189-523 (4) Generalized Linear Models
189-525 (4) Sampling Theory & Applications
189-556 (4) Mathematical Statistics I
189-557 (4) Mathematical Statistics II
166-504 (3) Quantitative Methods of Social Research I
166-505 (3) Quantitative Methods of Social Research II
180-593 (3) Statistical Mechanics
183-351 (3) Quantitative Methods
198-362 (3) Statistical Mechanics
198-559 (3) Advanced Statistical Mechanics

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

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

FACULTY PROGRAMS

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

FACULTY PROGRAM IN BIOLOGY AND MATHEMATICS See page 368 in the Biology section for complete program information.

FACULTY PROGRAM IN CHEMISTRY AND MATHEMATICS See page 377 in the Chemistry section for complete program information.

FACULTY PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE (54 credits) [MARS Program Code 4-632500]
27 credits in Mathematics and 27 credits in Computer Science

Required Courses (48 credits)
189-222 (3) Calculus III
189-223* (3) Linear Algebra
189-315 (3) Ordinary Differential Equations
189-317 (3) Numerical Analysis
189-323 (3) Probability Theory
189-324 (3) Statistics
189-343 (3) Discrete Mathematics & Applied Algebra
or 189-240 (3) Discrete Structures & Computing
308-202** (3) Introduction to Computing 1
308-203** (3) Introduction to Computing 2
308-206 (3) Intro to Software Systems
308-251 (3) Data Structures and Algorithms
308-273 (3) Intro. to Computer Systems
308-302 (3) Programming Languages and Paradigms
308-310 (3) Comp. Systems and Organization
308-420 (3) Files and Databases
308-530 (3) Formal Languages
*189-223 may be replaced by 189-235 and 189-236. In this case the complementary credit requirement is reduced by three.
**308-202 and 308-203 may be replaced by 308-250 with an additional three credits at the 300 level.

Complementary Courses (6 credits)
selected from:
189-314 (3) Advanced Calculus
189-318 (3) Mathematical Logic
189-327 (3) Matrix Numerical Analysis
189-328 (3) Computability & Mathematical Linguistics
189-407 (3) Dynamic Programming
189-417 (3) Mathematical Programming
308-305 (3) Computer System Architecture

FACULTY PROGRAM IN MATHEMATICS, STATISTICS AND COMPUTER SCIENCE (54 credits)
[MARS Program Code 4-635100]

Required Courses (30 credits)
189-222 (3) Calculus III
189-223* (3) Linear Algebra
189-315 (3) Ordinary Differential Equations
189-323 (3) Probability Theory
189-324 (3) Statistics
189-423 (3) Regression and Analysis of Variance
308-202** (3) Introduction to Computing 1
308-203** (3) Introduction to Computing 2
308-251 (3) Data Structures and Algorithms
308-273 (3) Intro. to Computer Systems
*189-223 may be replaced by 189-235 and 189-236. In this case the complementary credit requirement is reduced by three.
**308-202 and 308-203 may be replaced by 308-250 with an additional three credits at the 300 level.

Complementary Courses (24 credits)
at least 6 credits selected from:
189-314 (3) Advanced Calculus
189-317 (3) Numerical Analysis
189-318 (3) Mathematical Logic
189-319 (3) Partial Differential Equations
189-327 (3) Matrix Numerical Analysis
189-328 (3) Computability & Mathematical Linguistics
189-343 (3) Discrete Mathematics & Applied Algebra
189-407 (3) Dynamic Programming
189-417 (3) Mathematical Programming
at least 6 credits in Statistics selected from:
189-329 (3) Theory of Interest
189-447 (3) Stochastic Processes
189-523 (4) Generalized Linear Models
189-525 (4) Sampling Theory and Applications
at least 6 credits in Computer Science selected from:
308-206 (3) Intro to Software Systems
308-302 (3) Programming Languages and Paradigms
308-305 (3) Computer System Architecture
308-310 (3) Comp. Systems and Organization
308-420 (3) Files and Databases
308-530 (3) Formal Languages

FACULTY PROGRAM IN MATHEMATICS, CHEMISTRY AND PHYSICS (56 credits) [MARS Program Code 4-631200]

Required Courses (47 credits)
180-201 (3) Modern Inorganic Chemistry I
or 180-281 (3) Inorganic Chemistry I
180-204 (3) Physical Chem./Biol. Sci. I
or 180-213 (3) Physical Chemistry I
180-212 (4) Organic Chemistry I
180-214 (3) Physical Chem./Biol. Sci. II
180-222 (4) Organic Chemistry II
189-222 (3) Calculus III
189-223 (3) Linear Algebra
189-314 (3) Advanced Calculus
189-315 (3) Ordinary Differential Equations
189-319 (3) Partial Differential Equations
198-230 (3) Dynamics of Simple Systems
198-232 (3) Heat and Waves
198-241 (3) Signal Processing
198-340 (3) Electricity and Magnetism
308-202 (3) Introduction to Computing 1

Complementary Courses (9 credits)
3 credits in Physics, 200 level or higher
6 credits in Mathematics, Chemistry or Physics, chosen in consultation with the adviser.

MAJOR PROGRAM IN MATHEMATICS (54 credits)
[MARS Program Code 1-630000]
(Program revisions awaiting University approval)

Students entering the Major program are normally expected to have completed 189-133, 189-140 and 189-141 or their equivalents. Otherwise they will be required to make up any deficiencies in these courses over and above the 54credits of required courses.

Major students who have done well in 189-242 and 189-235 are urged to consider, in consultation with their adviser and the instructors concerned, entering the Honours stream by registering for 189-251 and 189-255.

Guidelines for Selection of Courses in the Major Program

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

Students interested in computer science are advised to choose courses from the following 189-317, 189-318, 189-327, 189-328, 189-343, 189-407, 189-417 and to complete the Computer Science Minor.

Students interested in probability and statistics are advised to take 189-324, 189-407, 189-423, 189-447, 189-523, 189-525.

Students interested in applied mathematics should take 189-317, 189-319, 189-324, 189-326, 189-327, 189-407, 189-417.

Students considering a career in secondary school teaching are advised to take 189-318, 189-328, 189-338, 189-339, 189-346, 189-348.

Students interested in careers in business, industry or government are advised to select courses from the following list: 189-317, 189-319, 189-327, 189-329, 189-407, 189-417, 189-423, 189-447, 189-523, 189-525.

Required Courses (27 credits)
189-222 (3) Calculus III
189-235 (3) Algebra I
189-236 (3) Linear Algebra I
189-242 (3) Analysis I
189-243 (3) Real Analysis
189-314 (3) Advanced Calculus
189-315 (3) Ordinary Differential Equations
189-316 (3) Functions of a Complex Variable
or 189-249 (3) Advanced Calculus
189-323 (3) Probability Theory

Complementary Courses (27 credits)
21 credits selected from the following list, with at least 6 credits selected from:
189-317 (3) Numerical Analysis
189-324 (3) Statistics
189-343 (3) Discrete Mathematics & Applied Algebra
the remainder of the 21 credits to be selected from:
189-318 (3) Mathematical Logic
189-319 (3) Partial Differential Equations
189-320 (3) Differential Geometry
189-326 (3) Nonlinear Dynamics and Chaos
189-327 (3) Matrix Numerical Analysis
189-328 (3) Computability & Mathematical Linguistics
189-329 (3) Theory of Interest
189-338 (3) History and Philosophy of Mathematics
189-339 (3) Topics in the Foundations of Mathematics
189-346 (3) Number Theory
189-348 (3) Topics in Geometry
189-407 (3) Dynamic Programming
189-417 (3) Mathematical Programming
189-423 (3) Regression and Analysis of Variance
189-447 (3) Stochastic Processes
189-523 (4) Generalized Linear Models
189-525 (4) Sampling Theory and Applications
6 additional credits in Mathematics or related disciplines selected in consultation with the adviser.

JOINT MAJOR PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE (72 credits)
[MARS Program Code 1-632500]

Required courses (48 credits)
189-222 (3) Calculus III
189-235 (3) Algebra I
189-236 (3) Linear Algebra I
189-242 (3) Analysis I
189-315 (3) Ordinary Differential Equations
189-317 (3) Numerical Analysis
189-318 (3) Mathematical Logic
189-323 (3) Probability Theory
308-206 (3) Intro to Software Systems
308-250* (3) Introduction to Computer Science
308-251 (3) Data Structures and Algorithms
308-273 (3) Intro. to Computer Systems
308-302 (3) Programming Languages and Paradigms
308-310 (3) Comp. Systems and Organization
308-330 (3) Theoretical Aspects of Computer Science
308-360 (3) Algorithm Design Techniques

* Students with no basic knowledge of any high level programming language (e.g. Fortran, Basic, Pascal, C, C++, Java) may take 308-202 and have it count as a complementary course in Computer Science.

Complementary Courses (24 credits)
12 credits from the set of courses recommended for a Major or Honours Program in Mathematics, excluding 189-240 and 189-340.
12 credits from the set of courses recommended for a Major or Honours Program in Computer Science.

JOINT MAJOR PROGRAM IN PHYSIOLOGY AND MATHEMATICS See page 421 in the Physiology section for complete program information.

HONOURS PROGRAMS

The minimum requirement for entry into the Honours program is that the student has completed with high standing the following courses: 189-133, 189-140, 189-141, or their equivalents. In addition, a student who has not completed the equivalent of 189-222 must take it in the first term without receiving credits towards the credits required in the Honours program.

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

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

HONOURS PROGRAM IN MATHEMATICS (60 credits)
[MARS Program Code 2-630000]
(Program revision awaiting Unversity approval)

Required Courses (45 credits)
189-235 (3) Algebra I
189-242 (3) Analysis I
189-248 (3) Advanced Calculus I
189-251 (3) Algebra II
189-255 (3) Analysis II
189-325 (3) Ordinary Differential Equations
189-354 (3) Analysis III
189-355 (3) Analysis IV
189-356 (3) Probability
189-357 (3) Statistics
189-370 (3) Algebra III
189-371 (3) Algebra IV
189-380 (3) Differential Geometry
189-375 (3) Differential Equations
or 189-574 (4) Ordinary Differential Equations
189-466 (3) Complex Analysis

Complementary Courses (15 credits)
15 credits to be selected from the following:
308-250* (3) Introduction to Computer Science
308-251 (3) Data Structures and Algorithms
*308-250 may be preceded by 308-202

further Honours Mathematics courses, of which 189-470 is encouraged;

non-Honours Mathematics courses (other than 189-242, 189-235), for which no Honours equivalent exists (these count for half of their credits);

certain Honours level courses in other departments; with credit weight determined by the Department of Mathematics and Statistics.

HONOURS PROGRAM IN APPLIED MATHEMATICS
(68 credits) [MARS Program Code 2-630300]
(Program revisions awaiting University approval)

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

Required Courses (39 credits)
189-235 (3) Algebra I
189-242 (3) Analysis I
189-248 (3) Advanced Calculus I
189-251 (3) Algebra II
189-255 (3) Analysis II
189-325 (3) Ordinary Differential Equations
189-356 (3) Probability
189-357 (3) Statistics
189-375 (3) Differential Equations
189-387 (3) Numerical Analysis
189-466 (3) Complex Analysis
or 189-249 (3) Advanced Calculus II
308-251 (3) Data Structures and Algorithms
308-250* (3) Introduction to Computer Science
*308-250 may be preceded by 308-202

Complementary Courses (29 credits)
at least 6 credits selected from:
189-354 (3) Analysis III
189-355 (3) Analysis IV
189-370 (3) Algebra III
189-371 (3) Algebra IV
189-380 (3) Differential Geometry

at least 9 credits selected from:
189-376 (3) Chaos and Nonlinear Dynamics
189-397 (3) Matrix Numerical Analysis
189-470 (3) Honours Project
189-487 (3) Mathematical Programming
189-523 (4) Generalized Linear Models
189-525 (4) Sampling Theory and Applications
189-555 (4) Fluid Dynamics
189-556 (4) Mathematical Statistics I
189-557 (4) Mathematical Statistics II
189-560 (4) Optimization
189-561 (4) Analytical Mechanics
189-574 (4) Ordinary Differential Equations
189-575 (4) Partial Differential Equations
189-579 (4) Numerical Differential Equations
189-585 (4) Integral Equations and Transforms
189-586 (4) Applied Partial Differential Equations

and the following, for which **half credit only** may be counted:
189-407 (3) Dynamic Programming
189-423 (3) Regression and Analysis of Variance
189-447 (3) Stochastic Processes

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

HONOURS PROGRAM IN PROBABILITY AND STATISTICS
(63 credits) [MARS Program Code 2-630400]
(Program revisions awaiting University approval)

All Honours students are encouraged to take 189-325, 189-387, 189-423 and 189-447.

Students primarily interested in probability should include courses 189-325, 189-375 and 189-447 in their program.

Students primarily interested in statistics should include 189-423, 189-447, 189-523,189-524 and 189-525 in their program.

Required Courses (46 credits)
189-235 (3) Algebra I
189-242 (3) Analysis I
189-248 (3) Advanced Calculus I
189-249 (3) Advanced Calculus II
or 189-466 (3) Complex Analysis
189-251 (3) Algebra I
189-255 (3) Analysis II
189-354 (3) Analysis III
189-356 (3) Probability
189-357 (3) Statistics
189-556 (4) Mathematical Statistics I
189-557 (4) Mathematical Statistics II
189-587 (4) Advanced Probability Theory I
189-589 (4) Advanced Probability Theory II
308-250* (3) Introduction to Computer Science
*308-250 may be preceded by 308-202

Complementary Courses (17 credits)
selected from:
189-325 (3) Ordinary Differential Equations
189-355 (3) Analysis IV
189-375 (3) Differential Equations II
189-387 (3) Numerical Analysis
189-397 (3) Matrix Numerical Analysis
189-470 (3) Honours Project
189-523 (4) Generalized Linear Models
189-524 (4) Nonparametric Statistics
189-525 (4) Sampling Theory and Applications

and the following, for which **half credit only** may be counted:
189-423 (3) Regression and Analysis of Variance
189-447 (3) Stochastic Processes

JOINT HONOURS PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE (72 credits)
[MARS Program Code 3-632500]

Students must consult an Honours adviser in both departments.

Required Courses (39 credits)
189-235 (3) Algebra I
189-242 (3) Analysis I
189-248 (3) Advanced Calculus I
189-251 (3) Algebra II
189-255 (3) Analysis II
308-206 (3) Intro to Software Systems
308-250* (3) Introduction to Computer Science
308-251 (3) Data Structures and Algorithms
308-273 (3) Intro. to Computer Systems
308-302 (3) Programming Languages and Paradigms
308-310 (3) Comp. Systems and Organization
308-330 (3) Theoretical Aspects of Computer Science
308-506 (3) Advanced Analysis of Algorithms
* Students with no basic knowledge of any high level programming language (e.g. Fortran, Basic, Pascal, C, C++, Java) are advised to take 308-202 before 308-250. In this case 308-202 counts as an elective.

Complementary Courses (33 credits)
21 credits in Mathematics,
at least 12 credits selected from:
189-354 (3) Analysis III
189-355 (3) Analysis IV
189-356* (3) Probability
189-370 (3) Algebra III
189-371 (3) Algebra IV
189-387 (3) Numberical Analysis

The remaining credits selected from honours courses given by the Department of Mathematics and Statistics.

*Students with appropriate background in probability may substitute 189-587 for 189-356 and must then also register for 189-355.

12 credits in Computer Science, selected from:
308-303 (4) Advanced Programming Techniques
308-304 (3) Object-oriented Design
308-305 (3) Computer System Architecture
308-335 (3) Software Engineering Methods

400-level and 500-level Computer Science courses with the exception of 308-431 and 308-506.

JOINT HONOURS PROGRAM IN MATHEMATICS AND PHYSICS See page 416 in the Physics section for complete program information.

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

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

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

COURSE DESCRIPTIONS

All courses have limited enrolment.

Note: When this Calendar went to press final information was not yet available on which courses at the 400 and 500 levels would be given in 2001-02. Consult the Department of Mathematics and Statistics for up-to-date information on these courses.

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

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

● Denotes courses not offered in 2001-02.

★ Denotes courses offered only in alternate years.

Note A: 189-133, 189-139, 189-140, 189-141, 189-150 and 189-151 are not open to students who have taken or are taking 189-130 or 189-131 (Mathematics for Management I and II, for descriptions see page 294), except by permission of the Department of Mathematics and Statistics.

189-112A,B FUNDAMENTALS OF MATHEMATICS. (3) (Not open to students who have taken CEGEP course 201-101.) (Open only to those students who are deficient in a pre-calculus background.) Equations and inequalities, graphs, relations and functions, exponential and logarithmic functions, trigonometric functions and their use, mathematical induction, binomial theorem, complex numbers.

189-133A,B VECTORS, MATRICES AND GEOMETRY. (3) (Prerequisite: a course in functions.) (Not open to students who have taken 189-221 or CEGEP objective 00UQ or equivalent. See also Note A.) Systems of linear equations, matrices, inverses, determinants; geometric vectors in three dimensions, dot product, cross product, lines and planes; introduction to vector spaces, linear dependence and independence, bases; quadratic loci in two and three dimensions.

189-139A,B CALCULUS. (4) (3 hours lecture; 2 hours tutorial) (Prerequisite: a course in functions.) (Not open to students who have taken 189-120 or CEGEP objective 00UN or equivalent. This course is intended for students with no previous knowledge of Calculus; it is not open to students who have had one term of College level Calculus. See also Note A.) (Students continue in 189-141.) Review of functions and graphs. Limits, continuity, derivative. Differentiation of elementary functions. Antidifferentiation. Applications. Password required.
Note: Each Tutorial section is enrolment limited.

189-140A,B CALCULUS I. (3) (3 hours lecture, 1hour tutorial) (Prerequisite: High School Calculus.) (Not open to students who have taken 189-120, 189-122, 189-139 or CEGEP objective 00UN or equivalent. See also Note A.) Review of functions and graphs. Limits, continuity, derivative. Differentiation of elementary functions. Antidifferentiation. Applications.
Note: Each Tutorial section is enrolment limited.

189-141A,B CALCULUS II. (4) (3hours lecture; 2hours tutorial) (Not open to students who have taken 189-121 or CEGEP objective 00UP or equivalent. See Note A.) (Prerequisites: 189-139 or 189-140 or 189-150) The definite integral. Techniques of integration. Applications. Introduction to sequences and series.
Note: Each Tutorial section is enrolment limited.

189-150A CALCULUS A. (4) (3hours lecture, 2hours tutorial) (Students with no prior exposure to vector geometry are advised to take 189-133 concurrently. Intended for students with high school calculus who have not received six advanced placement credits.) (Not open to students who have taken CEGEP objective 00UN or equivalent. See also Note A.) (189-150 and 189-151 cover the material of 189-139, 189-140, 189-141, 189-222.) Functions, limits and continuity, differentiation, L'Hospital's rule, applications, Taylor polynomials, parametric curves, functions of several variables.
Note: Each Tutorial section is enrolment limited.

189-151B CALCULUS B. (4) (3 hours lecture; 2 hours tutorial) (Prerequisite: 189-150.) (Not open to students who have taken CEGEP objective 00UP or equivalent. See also Note A.) Integration, methods and applications, infinite sequences and series, power series, arc length and curvature, multiple integration.
Note: Each Tutorial section is enrolment limited.

● **189-199A CHAOS, FRACTALS AND COMPLEXITY.** (3) (FYS - for first year students only, maximum 25)

189-203A,B PRINCIPLES OF STATISTICS I. (3) (No calculus prerequisites.) (This course is intended for students in all disciplines and is not open to students in Mathematics programs; or to students who have taken or are taking 189-324.) (Note: Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on page351 .) Examples of statistical data and the use of graphical means to summarize the data. Basic distributions arising in the natural and behavioural sciences. The logical meaning of a test of significance and a confidence interval. Tests of significance and confidence intervals in the one and two sample setting (means, variances and proportions).

189-204B PRINCIPLES OF STATISTICS II. (3) (Prerequisite: 189-203 or equivalent. No calculus prerequisites.) (This course is intended for students in all disciplines and is not open to students in Mathematics programs; or to students who have taken or are taking 189-324.) (Note: Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on page 351.) The concept of degrees of freedom and the analysis of variability. Planning of experiments. Experimental designs. Polynomial and multiple regressions. Statistical computer packages (no previous computing experience is needed). General statistical procedures requiring few assumptions about the probability model.

● **189-211B PRACTICAL METHODS OF MATHEMATICS.** (3) (Prerequisite: 189-111 or CEGEP 101 or consent of instructor.) (Not open to students in the Faculty of Science, students in Mathematics or Computer Science programs or students who have taken or are taking any of 189-240, 189-343, 189-363 or any statistics course.)

189-222A,B CALCULUS III. (3) (Prerequisite: 189-141. Familiarity with vector geometry or Corequisite: 189-133) (Not open to students who have taken CEGEP course 201-303 or 189-150, 189-151 or 189-227.) Taylor series, Taylor's theorem in one and several variables. Review of vector geometry. Partial differentiation, directional derivative. Extreme of functions of 2 or 3 variables. Parametric curves and arc length. Polar and spherical coordinates. Multiple integrals.

189-223A,B LINEAR ALGEBRA. (3) (Prerequisite: 189-133 or equivalent.) (Not open to students in Mathematics programs nor to students who have taken or are taking 189-236, 189-247 or 189-251. It is open to students in Faculty Programs.) Review of matrix algebra, determinants and systems of linear equations. Vector spaces, linear operators and their matrix representations, orthogonality. Eigenvalues and eigenvectors, diagonalization of Hermitian matrices. Applications.

189-235A ALGEBRA I. (3) (3 hours lecture; 1 hour tutorial) (Prerequisite: 189-133 or equivalent.) Sets and relations. Rings and fields. Integers, rationals, real and complex numbers; modular arithmetic. Polynomials over a field. Divisibility theory for integers and polynomials. Linear equations over a field. Introduction to vector spaces.

189-236B LINEAR ALGEBRA I. (3) (Prerequisite: 189-235) Continuation of the topics of 189-235. Linear mappings. Matrix representation of linear mappings. Determinants. Eigenvectors and eigenvalues. Diagonalizable operators. Cayley-Hamilton theorem. Bilinear and quadratic forms. Inner product spaces, orthogonal diagonalization of symmetric matrices. Canonical forms.

189-240A DISCRETE STRUCTURES AND COMPUTING. (3) (Corequisites: 189-133 and 189-222. For Major and Honours students in Computer Science only. Others only with the instructor's permission.) Abstractly defined mathematical structures. Mathematical induction. Sets, relations and functions. Combinatorics; graphs; recurrences; generating functions. Lattices, Boolean algebras.

189-242A ANALYSIS I. (3) (Prerequisite: 189-141) A rigorous presentation of sequences and of real numbers and basic properties of continuous and differentiable functions on the real line.

189-243B REAL ANALYSIS. (3) (Prerequisite: 189-242) Infinite series; series of functions; power series. The Riemann integral in one variable. A rigorous development of the elementary functions.

189-247B LINEAR ALGEBRA. (3) (Prerequisite: 189-133 or equivalent. Intended for Honours Physics and Engineering students.) (Not open to students who have taken or are taking 189-236, 189-223 or 189-251.) Matrix algebra, determinants, systems of linear equations. Abstract vector spaces, inner product spaces, Fourier series. Linear transformations and their matrix representations. Eigenvalues and eigenvectors, diagonalizable and defective matrices, positive definite and semidefinite matrices. Quadratic and Hermitian forms, generalized eigenvalue problems, simultaneous reduction of quadratic forms. Applications.

189-248A ADVANCED CALCULUS I. (3) (Prerequisites: 189-133 and 189-222 or consent of Department. Intended for Honours Mathematics, Physics and Engineering students.) (Not open to students who have taken or are taking 189-314.) Partial derivatives; implicit functions; Jacobians; maxima and minima; Lagrange multipliers. Scalar and vector fields; orthogonal curvilinear coordinates. Multiple integrals; arc length, volume and surface area. Line integrals; Green's theorem; the divergence theorem. Stokes' theorem; irrotational and solenoidal fields; applications.

189-249B ADVANCED CALCULUS II. (3) (Prerequisite: 189-248. Intended for Honours Physics and Engineering students.) (Not open to students who have taken or are taking 189-316.) Functions of a complex variable; Cauchy-Riemann equations; Cauchy's theorem and consequences. Taylor and Laurent expansions. Residue calculus; evaluation of real integrals; integral representation of special functions; the complex inversion integral. Conformal mapping; Schwarz-Christoffel transformation; Poisson's integral formulas; applications.

189-251B ALGEBRA II. (3) (Prerequisites: 189-235 or permission of the Department.) (Not open to students who are taking or have taken 189-247.) Linear maps and their matrix representation. Determinants. Canonical forms. Duality. Bilinear and quadratic forms. Real and complex inner product spaces. Diagonalization of self-adjoint operators.

189-255B ANALYSIS II. (3) (Prerequisites: 189-242 or permission of the Department.) Series of functions including power series. Riemann integration in one variable. Elementary functions.

189-314A,B ADVANCED CALCULUS. (3) (Prerequisites: 189-133, 189-222.) (Not open to students who have taken or are taking 189-248.) Derivative as a matrix. Chain rule. Implicit functions. Constrained maxima and minima. Jacobians. Multiple integration. Line and surface integrals. Theorems of Green, Stokes and Gauss.

189-315A,B ORDINARY DIFFERENTIAL EQUATIONS. (3) (Prerequisite: 189-222. Corequisite 189-133.) (Not open to students who have taken or are taking 189-325.) First order ordinary differential equations including elementary numerical methods. Linear differential equations. Laplace transforms. Series solutions.

189-316A FUNCTIONS OF A COMPLEX VARIABLE. (3) (Prerequisites: 189-314 and 189-243.) (Not open to students who have taken or are taking 189-249.) Algebra of complex numbers, Cauchy-Riemann equations, complex integral, Cauchy's theorems. Taylor and Laurent series, residue theory and applications.

189-317A NUMERICAL ANALYSIS. (3) (Prerequisites: 189-222, 308-202 or equivalents.) Error analysis. Interpolation. Numerical solutions of equations by iteration. Numerical integration. Introduction to numerical solutions of differential equations. Programming assumed. Some lab work necessary.

189-318A MATHEMATICAL LOGIC. (3) (Not open to students who are taking or have taken 107-210.) Propositional calculus, truth-tables, switching circuits, natural deduction, first order predicate calculus, axiomatic theories, set theory.

189-319B PARTIAL DIFFERENTIAL EQUATIONS. (3) (Prerequisites: 189-223 or 189-236, 189-314, 189-315) First order equations, geometric theory; second order equations, classification; Laplace, wave and heat equations, Sturm-Liouville theory, Fourier series, boundary and initial value problems.

★**189-320A DIFFERENTIAL GEOMETRY.** (3) (Prerequisites: 189-236 or 189-223 or 189-247, and 189-314 or 189-248) Review of Euclidean geometry. Local theory of plane and space curves: the Frenet formulas. Local theory of surfaces: the first and second fundamental forms, the shape operator, the mean and Gaussian curvatures, surfaces of revolution with prescribed curvature, ruled

and developable surfaces. Geodesic curves on surfaces of revolution. The Gauss-Codazzi equations, rigidity.

189-323A,B PROBABILITY THEORY. (3) (Prerequisites: 189-141 or equivalent. Intended for students in Science, Engineering and related disciplines, who have had differential and integral calculus.) (Not open to students who have taken or are taking 189-356.) Sample space, events. Conditional probability, independence. Bayes' theorem with applications. Random variables, univariate distributions. Mathematical expectation, moment generating function. The binominal, Poisson, exponential, normal and other distributions. Joint distributions, transformation of variables. The weak law of large numbers. Sampling distributions, chi-squared, student-t, F variables. The central limit theorem.

189-324A,B STATISTICS. (3) (Prerequisite: 189-323 or equivalent.) (Not open to students who have taken or are taking 189-357.) (Note: Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on pag e351.) The notion of a random sample. Sampling distributions, with reference to those related to the normal; chi-squared, F and t (review). Point estimation. Hypothesis testing, the notion of power function. Likelihood-ratio tests. Contingency tables, goodness-of-fit. Some nonparametric procedures. Regression and the method of least squares, analysis of variance, one-way and two-way classifications.

189-325A,B ORDINARY DIFFERENTIAL EQNS. (3) (Prerequisite: 189-222. Intended for Honours Mathematics, Physics and Engineering programs.) (Not open to students who have taken 189-261, 189-315.) First and second order equations, linear equations, series solutions, Frobenius method, introduction to numerical methods and to linear systems, Laplace transforms, applications.

★189-326A NONLINEAR DYNAMICS AND CHAOS. (3) (Prerequisites: 189-222, 189-223) (Not open to students who have taken or are taking 189-376.) Linear systems of differential equations, linear stability theory. Nonlinear systems: existence and uniqueness, numerical methods, one and two dimensional flows, phase space, limit cycles, Poincare-Bendixson theorem, bifurcations, Hopf bifurcation, the Lorenz equations and chaos.

● **189-327B MATRIX NUMERICAL ANALYSIS.** (3) (Prerequisites: 189-223 or 189-236. Corequisite: 189-317)

★189-328B COMPUTABILITY AND MATHEMATICAL LINGUISTICS. (3) Calculability on an infinite abacus is compared with recursive functions and Turing machines. Categorial, context-free, generative and transformational grammars are studied for formal and natural languages, with some emphasis on English and French morphology. Machines for generating and recognizing sentences are discussed.

189-329B THEORY OF INTEREST. (3) (Prerequisite: 189-141) Simple and compound interest, annuities certain, amortization schedules, bonds, depreciation.

189-338A HISTORY AND PHILOSOPHY OF MATHEMATICS. (3) Egyptian, Babylonian, Greek, Indian and Arab contributions to mathematics are studied together with some modern developments they give rise to, for example, the problem of trisecting the angle. European mathematics from the Renaissance to the 18th century is discussed in some detail.

● **★189-339B TOPICS IN THE FOUNDATIONS OF MATHEMATICS.** (3) (Prerequisites: 189-235, 189-318)

189-340B ABSTRACT ALGEBRA AND COMPUTING. (3) (Prerequisites: 189-240, 189-223 (or -236)) (For Major and Honours students in Computer Science only. Others only with the instructor's permission.) Basic number theory: divisibility, Euclid's algorithm, congruences, Fermat's "little" theorem, primality testing, factorization. Commutative rings: basic definitions, (integers), gaussian integers, polynomial rings, euclidean rings, finite fields. Groups: symmetry groups, permutation groups. Additional topics.

189-343B DISCRETE MATHEMATICS AND APPLIED ALGEBRA. (3) (Prerequisites: 189-236, 308-202) Basic combinatorics, introductory graph theory, matching, elementary group theory and symmetry, directed graphs and networks, modular arithmetic and its applications.

● **★189-346B NUMBER THEORY.** (3) (Prerequisite: 189-235 or consent of instructor.)

189-348A TOPICS IN GEOMETRY. (3) (Prerequisite: Previous course in Mathematics.) Selected topics – the particular selection may vary from year to year. Topics include: isometries in the plane, symmetry groups of frieze and ornamental patterns, equidecomposibility, non-Euclidean geometry and problems in discrete geometry.

189-354A ANALYSIS III. (3) (Prerequisite: 189-255 or equivalent) Introduction to metric spaces. Multivariable differential calculus, implicit and inverse function theorems.

189-355B ANALYSIS IV. (3) (Prerequisite: 189-255 or equivalent) Lebesgue measure on R^n and integration, convergence theorems, Fubini's theorem. Further topics in metric spaces. Introduction to L^p spaces, Fourier series.

189-356A PROBABILITY. (3) (Prerequisite: 189-255 or 189-243) (Not open to students who have taken or are taking 189-323.) Basic combinatorial probability. Introductory distribution theory of univariate and multivariate distributions with special reference to the Binomial, Poisson, Gamma and Normal distributions. Characteristic functions. Weak law of large numbers. Central limit theorem.

189-357B STATISTICS. (3) (Prerequisite: 189-356 or equivalent) (Not open to students who have taken or are taking 189-324.) Data analysis. Estimation and hypothesis testing. Power of tests. Likelihood ratio criterion. The chi-squared goodness of fit test. Introduction to regression analysis and analysis of variance.

189-370A ALGEBRA III. (3) (Prerequisite: 189-251) Introduction to monoids, groups, permutation groups; the isomorphism theorems for groups; the theorems of Cayley, Lagrange and Sylow; structure of groups of low order. Introduction to ring theory; integral domains, fields, quotient field of an integral domain; polynomial rings; unique factorization domains.

189-371B ALGEBRA IV. (3) (Prerequisite: 189-370) Introduction to modules and algebras; finitely generated modules over a principal ideal domain. Field extensions; finite fields; Galois groups; the fundamental theorem of Galois theory; application to the classical problem of solvability by radicals.

189-375A DIFFERENTIAL EQUATIONS. (3) (Prerequisites: 189-247 or 189-251 or equivalent, 189-248 or equivalent, 189-325) First order partial differential equations, geometric theory, classification of second order linear equations, Sturm-Liouville problems, orthogonal functions and Fourier series, eigenfunction expansions, separation of variables for heat, wave and Laplace equations, Green's function methods, uniqueness theorems.

★189-376A CHAOS AND NONLINEAR DYNAMICS. (3) (Prerequisites: 189-222, 189-223) (Intended primarily for Honours students. Not open to students who have taken or are taking 189-326.) This course consists of the lectures of 189-326 together with a special project or projects assigned after consultation between the instructor and the student.

● **★189-377B NUMBER THEORY.** (3) (Prerequisite: Enrolment in Mathematics Honours program or consent of instructor.)

189-380B DIFFERENTIAL GEOMETRY. (3) (Prerequisites: 189-251 or 189-247, and 189-248 or 189-314) In addition to the topics of 189-320, topics in the global theory of plane and space curves, and in the global theory of surfaces are presented. These include: total curvature and the Fary-Milnor theorem on knotted curves, abstract surfaces as 2-d manifolds, the Euler characteristic, the Gauss-Bonnet theorem for surfaces.

189-387A NUMERICAL ANALYSIS. (3) (Prerequisites: 189-222 and 308-202 or 308-250 or equivalent, or consent of instructor.) (Intended primarily for Honours students.) This course consists of the lectures of 189-317 together with a special project or projects assigned after consultation between the instructor and student.

● **189-397B MATRIX NUMERICAL ANALYSIS.** (3) (Prerequisites: 189-251, 189-387 or consent of instructor.)

● **★189-407B DYNAMIC PROGRAMMING.** (3) (Prerequisites: 308-202; 189-223 or 189-236, 189-314, 189-315 and 189-323)

189-417A MATHEMATICAL PROGRAMMING. (3) (Prerequisites: 308-202, and 189-223 or 189-236, and 189-314 or equivalent.) An introductory course in optimization by linear algebra, and calculus methods. Linear programming (convex polyhedra, simplex method, duality, multi-criteria problems), integer programming, and some topics in nonlinear programming (convex functions, optimality conditions, numerical methods). Representative applications to various disciplines.

189-420A,B INDEPENDENT STUDIES IN MATHEMATICS. (3) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) Reading projects permitting independent study under the guidance of a staff member specializing in a subject where no appropriate course is available. Arrangements must be made with an instructor and the Chair before registration. Password required.

189-423A REGRESSION AND ANALYSIS OF VARIANCE. (3) (Prerequisites: 189-324, and 189-223 or 189-236) Least-squares estimators and their properties. Analysis of variance. Linear models with general covariance. Multivariate normal and chi-squared distributions; quadratic forms. General linear hypothesis: F-test and t-test. Prediction and confidence intervals. Transformations and residual plot. Balanced designs.

★189-437A MATHEMATICAL METHODS IN BIOLOGY. (3) (Prerequisites: 189-315 or 189-325, and 189-323 or 189-356, a CEGEP or higher level computer programming course.) The formulation and treatment of realistic mathematical models describing biological phenomena through such qualitative and quantitative mathematical techniques as local and global stability theory, bifurcation analysis and phase plane analysis. Numerical simulation. Concrete and detailed examples will be drawn from molecular, cellular and population biology and mammalian physiology.

★189-447B STOCHASTIC PROCESSES. (3) (Prerequisites: 189-323) Random walk on the integers and gambler's ruin problem; the Galton-Watson branching process; Markov chains and their applications in the physical and social sciences; birth and death processes and their applications to biological growth problems and queueing systems.

189-466A COMPLEX ANALYSIS. (3) (Prerequisite: 189-354) Functions of a complex variable, Cauchy-Riemann equations, Cauchy's theorem and its consequences. Uniform convergence on compacta. Taylor and Laurent series, open mapping theorem, Rouché's theorem and the argument principle. Calculus of residues. Fractional linear transformations.

189-470A,B HONOURS PROJECT. (3) (Prerequisites: appropriate second year honours courses with approval of coordinator.) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) The student will be assigned a project supervisor and a project topic at the beginning of the semester. The project will consist of a written report including a literature survey and will be tested by an oral examination. Password required.

189-480A,B INDEPENDENT STUDIES IN MATHEMATICS. (3) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) Reading projects permitting independent study under the guidance of a staff member specializing in a subject where no appropriate course is available. Arrangements must be made with an instructor and the Chair before registration. Password required.

189-487A MATHEMATICAL PROGRAMMING. (3) (Prerequisites: 189-248, 189-251 and 308-202 or 189-250 or equivalent.) Intended primarily for honours students. This course consists of the lectures of 189-417 together with a special project or projects assigned after consultation between the instructor and the student.

★189-488A SET THEORY. (3) (Prerequisites: 189-251 or 189-255 or permission of instructor.) Axioms of set theory. Operations on sets. Ordinal and cardinal numbers. Well-orderings, transfinite induction and recursion. Consequences of the axiom of choice. Boolean algebras. Cardinal arithmetic. Topics include: Linear orderings, trees. Infinite combinatorics, partition calculus. Set-theoretic aspects of point-set topology. Descriptive set-theory. Stationary sets. Set-theoretic principles going beyond the basic axiom system.

189-523B GENERALIZED LINEAR MODELS. (4) (Prerequisite: 189-423 or 513-697.) (Not open to students who have taken 189-426.) Modern discrete data analysis. Exponential families, orthogonality, link functions. Inference and model selection using analysis of deviance. Shrinkage (Bayesian, frequentist viewpoints). Smoothing. Residuals. Quasi-likelihood. Sliced inverse regression. Continency tables: logistic regression, log-linear models. Censored data. Applications to current problems in medicine, biological and physical sciences. GLIM, S, software.

189-524A NONPARAMETRIC STATISTICS. (4) (Prerequisite: 189-324 or equivalent.) (Not open to students who have taken 189-424.) Distribution free procedures for 2-sample problem: Wilcoxon rank sum, Siegel-Tukey, Smirnov tests. Shift model: power and estimation. Single sample procedures: Sign, Wilcoxon signed rank tests. Nonparametric ANOVA: Kruskal-Wallis, Friedman tests. Association: Spearman's rank correlation, Kendall's tau. Goodness of fit: Pearson's chi-square, likelihood ratio, Kolmogorov-Smirnov tests. Statistical software packages used.

189-525B SAMPLING THEORY & APPLICATIONS. (4) (Prerequisite: 189-324 or equivalent) (Not open to students who have taken 189-425.) Simple random sampling, domains, ratio and regression estimators, superpopulation models, stratified sampling, optimal stratification, cluster sampling, sampling with unequal probabilities, multistage sampling, complex surveys, nonresponse.

189-555A FLUID DYNAMICS. (4) (Prerequisites: 189-315 and 189-319 or equivalent) Kinematics. Dynamics of general fluids. Inviscid fluids, Navier-Stokes equations. Exact solutions of Navier-Stokes equations. Low and high Reynolds number flow.

189-556A MATHEMATICAL STATISTICS I. (4) (Prerequisite: 189-357 or equivalent) Probability and distribution theory (univariate and multivariate). Exponential families. Laws of large numbers and central limit theorem.

189-557B MATHEMATICAL STATISTICS II. (4) (Prerequisite: 189-556) Sampling theory (including large-sample theory). Likelihood functions and information matrices. Hypothesis testing, estimation theory Regression and correlation theory.

189-560B OPTIMIZATION. (4) (Prerequisite: Undergraduate background in analysis and linear algebra, with instructor's approval.) Classical optimization in n variables. Convex sets and functions, optimality conditions for single-objective and multi-objective nonlinear optimization problems with and without constraints. Duality theories and their economic interpretations. Optimization with functionals. Connections with calculus of variations and optimal control. Stability of mathematical models. Selected numberical methods.

189-561A ANALYTICAL MECHANICS. (4) (Prerequisites: 189-354 and 189-380 or instructor's approval.) Basic differential geometry. Lagrangian formulation: Euler-Lagrange equations, Noether's theorem, applications. Hamiltonian formalism: symplectic forms and Legendre transformation, symmetry and conserved quantities, completely integrable systems, Poisson brackets.

189-564A ADVANCED REAL ANALYSIS I. (4) (Prerequisites: 189-354, 189-355 or equivalents.) Review of theory of measure and integration; product measures, Fubini's theorem; L^p spaces; basic principles of Banach spaces; Riesz representation theorem for C(X); Hilbert spaces; part of the material of 189-565B may be covered as well.

189-565B ADVANCED REAL ANALYSIS II. (4) (Prerequisite: 189-564) Continuation of topics from 189-564. Signed measures, Hahn and Jordan decompositions. Radon-Nikodym theorems, complex measures, differentiation in R^n, Fourier series and integrals, additional topics.

189-566B ADVANCED COMPLEX ANALYSIS. (4) (Prerequisites: 189-466A, 189-564A) Simple connectivity, use of logarithms; argument, conservation of domain and maximum principles; analytic continuation, monodromy theorem; conformal mapping; normal families, Riemann mapping theorem; harmonic functions, Dirichlet problem; introduction to functions of several complex variables.

189-570A HIGHER ALGEBRA I. (4) (Prerequisite: 189-371 or equivalent) Review of group theory; free groups and free products of groups. Sylow theorems. The category of R-modules; chain conditions, tensor products, flat, projective and injective modules. Basic commutative algebra; prime ideals and localization, Hilbert Nullstellensatz, integral extensions. Dedekind domains. Part of the material of 189-571B may be covered as well.

189-571B HIGHER ALGEBRA II. (4) (Prerequisites: 189-570 or consent of instructor.) Completion of the topics of 189-570. Rudiments of algebraic number theory. A deeper study of field extensions; Galois theory, separable and regular extensions. Semi-simple rings and modules. Representations of finite groups.

● **189-574A ORDINARY DIFFERENTIAL EQUATIONS.** (4) (Prerequisites: 189-325, 189-354)

189-575B PARTIAL DIFFERENTIAL EQUATIONS. (4) (Prerequisite: 189-375) A continuation of topics introduced in 189-375.

189-576A GEOMETRY AND TOPOLOGY I. (4) (Prerequisite: 189-354) Basic point-set topology, including connectedness, compactness, product spaces, separation axioms, metric spaces. The fundamental group and covering spaces. Simplicial complexes. Singular and simplicial homology. Part of the material of 189-577B may be covered as well.

189-577B GEOMETRY AND TOPOLOGY II. (4) (Prerequisite: 189-576) Continuation of the topics of 189-576A. Manifolds and differential forms. De Rham's theorem. Riemannian geometry. Connections and curvatures 2-Manifolds and imbedded surfaces.

189-578A NUMERICAL ANALYSIS. (4) (Prerequisites: A first course in numerical analysis with programming and a background in real and complex analysis, with Instructor's approval.) Errors in computation, vector and matrix norms. Iteration methods for roots in R^n and the complex plane. Interpolation including osculating and spline interpolation. Numerical differentiation and integration including Romberg and Gaussian methods and the Peano theorem. Matrix calculations with condition numbers and error bounds. Band matrices, eigenvalue calculations and applications to boundary value problems.

189-579B NUMERICAL DIFFERENTIAL EQUATIONS. (4) (Prerequisites: a background in ordinary and partial differential equations as well as numerical analysis, with instructor's approval.) Basic error analysis. Numerical solution of initial and boundary value problems for ordinary differential equations; simple, multiple shooting methods and finite difference methods. Finite difference methods for partial differential equations: parabolic, hyperbolic and elliptical equations, consistency, convergence and stability of numerical schemes. Explicit and implicit methods, alternating direction explicit and alternating direction implicit methods.

189-585A INTEGRAL EQUATIONS AND TRANSFORMS. (4) Integral transforms. Introduction to the theory of Hilbert spaces. Fredholm and Volterra integral equations; exact and approximate solutions. Equations with Hermitian kernels. Hilbert Schmidt theorem and consequences. Representation formulas for the solutions of initial and boundary value problems. Green's functions. Applications.

189-586B APPLIED PARTIAL DIFFERENTIAL EQUATIONS. (4) (Prerequisites 189-316, 189-375 or equivalent.) Linear and nonlinear partial differential equations of applied mathematics. Classification and appropriate partial initial and/or boundary conditions for elliptic, hyperbolic and parabolic equations. Method of characteristics for first-order systems and quasi linear equations. Transform methods. Introduction to generalized functions. Special techniques for finding exact solutions of nonlinear equations.

189-587A ADVANCED PROBABILITY THEORY I. (4) (Prerequisite: 189-356 or equivalent and approval of instructor.) Probability spaces. Random variables and their expectations. Convergence of random variables in L^p. Independence and conditional expectation. Introduction to Martingales. Limit theorems including Kolmogorov's Strong Law of Large Numbers.

189-589B ADVANCED PROBABILITY THEORY II. (4) (Prerequisites: 189-587 or equivalent.) Characteristic functions: elementary properties, inversion formula, uniqueness, convolution and continuity theorems. Weak convergence. Central limit theorem. Additional topic(s) chosen (at discretion of instructor) from: Martingale Theory; Brownian moiton, stochastic calculus.

● **189-591A MATHEMATICAL LOGIC I.** (4) (Prerequisites: 189-488 or equivalent or consent of instructor.)

189-592B MATHEMATICAL LOGIC II. (4) (Prerequisites: 189-488 or equivalent or consent of instructor.) Introduction to recursion theory; recursively enumerable sets, relative recursiveness. Incompleteness, undecidability and undefinability theorems of Gödel, Church, Rosser and Tarski. Some of the following topics: Turing degrees, Friedberg-Muchnik theorem, decidable and undecidable theories.

11.16 Microbiology and Immunology (528)

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

Telephone: (514) 398-3915
Facsimile: (514) 398-7052
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Website: http://www.microimm.mcgill.ca

Chair — Greg J. Matlashewski

Professors
Nicholas H. Acheson; A.B.(Harv.), Ph.D.(Rockefeller)
Zafer Ali-Khan; B.Sc.(Bilar), M.Sc.(Karachi), Ph.D.(Tulane)
Malcolm G. Baines; B.Sc., M.Sc., Ph.D.(Queen's)
James W. Coulton; B.Sc.(Tor.), M.Sc.(Calg.), Ph.D.(W.Ont.)
Michael S. Dubow, B.Sc.(SUNY), M.A., Ph.D.(Ind.)
John Hiscott; B.Sc., M.Sc.,(W.Ont.), Ph.D.(N.Y.)
Jack Mendelson; M.Sc.(Roch.), M.D.,C.M.(McG.), F.R.C.P.(C.)
Robert A. Murgita; B.Sc.(Me.), M.S.(Vt.), Ph.D.(McG.)
Michael J.H. Ratcliffe; B.A.(Glas.), Ph.D.(Imp.Coll.)
Hugh G. Robson; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C.)
Mark A. Wainberg; B.Sc.(McG.), M.Sc., Ph.D.(Col.)

Associate Professors
Dalius J. Briedis; B.A., M.D.(Johns H.)
Andre Dascal; D.C.S.(McG.), M.D.(Montr.)
Greg J. Matlashewski; B.Sc.(C'dia), Ph.D.(Ott.)
Trevor Owens; B.Sc., M.Sc.(McG.), Ph.D.(Ott.)

Assistant Professors
Sylvie Fournier; Ph.D.(Montr.)
Hervé Le Moual; Ph.D.(Montr.)
Gregory T. Marczynski; B.Sc., Ph.D.(Illinois)
David Portnoy; B.Sc.(Sir G.Wms.), M.D.(Liège)
Joseph Portnoy; B.Sc., M.D.C.M., M.Sc.(McG.)
Pierre René; B.A., M.D.(Sher.)

Associate Members
Institute of Parasitology: Gaeton Faubert, Paula Ribeiro
Division of Exp. Medicine: Clement Couture
Microbiology & Immunology: Lawrence Kleiman
Medicine: Marcel Behr, Vivian Loo, J.Dick Maclean, Mark A. Miller, Marianna Newkirk, C. Kirk Osterland, Roger G.E. Palfree, Joyce E. Rauch, Bernard Turcotte, Brian J. Ward
Neuroimmunology: Amit Bar-Or
Neurology & Neurosurgery: Jack Antel
Pathology: Gerarld Prud'homme
Oncology: Antonis E. Koromilas, Stephane Richard
Surgery: Nicholas V. Christou, A. Robin Poole

Adjunct Professors
Albert Descoteaux: B.Sc., M.Sc.(Montr.), Ph.D.(McG.)
Patrick Hugo; B.Sc., M.Sc., Ph.D.(McG.)

George Kukolj; B.Sc., Ph.D.(McG.)
Peter Lau; Ph.D.(Ottawa)
Clement Rioux; B.Sc., M.Sc.(Laval), Ph.D.(Guelph)
Rafick-P. Sekaly; B.A.(Stanislas), B.Sc., M.Sc.(Montr.), Ph.D.(Lausanne)

Affiliated Centre:
Centre for Host Resistance, Montreal General Hospital, 1650 Cedar Avenue, Montreal, QC H3G 1A4.
Telephone: (514) 398-8038. Director: E. Skamane

Microbiology is the study of microorganisms such as bacteria, viruses, unicellular eukaryotes, and parasites. Microorganisms play an important role in human and animal disease, food production (bread, cheese, wine), decay and spoilage, contamination and purification of water and soil. Microbiologists study these tiny, self-replicating machines to understand the basic principles of life: growth, metabolism, cell division, control of gene expression, response to environmental stimuli. Microbiologists are also concerned with controlling or harnessing microorganisms for the benefit of people, by isolating antibiotics or producing vaccines to protect against disease, and by developing and perfecting microorganisms for industrial uses.

Immunology is the study of the molecular and cellular basis of host resistance and immunity to external agents such as pathogenic microorganisms. Immunologists study the mechanisms by which the body recognizes foreign antigens, generates appropriate antibodies to an enormously diverse spectrum of antigens, and sequesters and kills invading microorganisms. Their discoveries lead to vaccination against disease, transfusions and organ transplants, allergies, cancer, autoimmune diseases and immune-deficiency diseases such as AIDS. Antibodies may soon be used in conjunction with antibiotics or chemical agents as specific "magic bullets" to diagnose disease and attack microbes and cancers.

The disciplines of microbiology and immunology are natural partners in research, and both fields use the modern methods of cell biology, molecular biology and genetics to study basic life processes. The members of the Department of Microbiology and Immunology perform research on microbial physiology and genetics, microbial pathogenesis, molecular virology, cellular and molecular immunology, and parasitology. Students registered in the Department therefore are exposed to these related areas and receive an excellent background in basic biology and chemistry as well as in the more applied areas of biotechnology and medicine.

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

Notes on admission to Microbiology and Immunology programs. Please note that enrolment to Microbiology and Immunology programs is limited to a total of 120 students per year. Students seeking admission to the Faculty, Majors and Honours programs must have completed 177-111A, 177-112B, 180-110A or 180-111B, 180-120A or 180-121A, 189-112A/B, 189-139A/B or 189-140A/B,198-101A/B and 198-102A/B or their equivalent with an overall average of at least of 65% (B-). Students transferring from other programs may be admitted with a B- average up to the maximum program capacity of 120 students. Applicants not admitted will be placed on a waiting list and will be considered should vacancies occur. Application deadline for U0 or transfer students from other departments and faculties is April 20. Students who want to transfer to Microbiology and Immunology should consider taking 528-211A as a complementary course.

An Undergraduate Handbook, containing detailed course descriptions, a listing of faculty research interests, and information on careers in microbiology and immunology, is available from the Student Affairs Office in room 511 of the Lyman Duff Building and on the web at: http://www.microimm.mcgill.ca.

All students (U1, U2, U3) must meet with an adviser prior to registration. For an appointment, telephone (514) 398-3915.

FACULTY PROGRAM IN MICROBIOLOGY AND IMMUNOLOGY (57 credits)

The Faculty Program is intended to offer a basic education in microbiology and immunology to undergraduate students who wish greater flexibility to choose a substantial number of courses from other departments or faculties within the University.

U1 Required Courses (18 credits)

528-211A	(3)	Biology of Microorganisms
528-212A	(2)	Laboratory in Microbiology
177-200A	(3)	Molecular Biology
177-201B	(3)	Cell Biology and Metabolism
or 507-212B	(3)	Molecular Mechanisms of Cell Function
177-202B	(3)	Basic Genetics
180-212A,B	(4)	Organic Chemistry I

U1, U2 or U3 Required Course (3 credits)

177-373A	(3)	Biostatistical Analysis
or 189-203A	(3)	Principles of Statistics I
or 204-204A,B	(3)	Introduction to Psychological Statistics

U2 Required Courses (15 credits)

528-314B	(3)	Immunology
528-323A	(3)	Microbial Physiology
528-324A	(3)	Fundamental Virology
528-386D	(6)	Laboratory in Microbiology & Immunology

U3 Complementary Courses (6 credits)

6 credits selected from:

528-387B	(3)	Applied Microbiology and Immunology
528-413B	(3)	Parasitology
528-414A	(3)	Advanced Immunology
528-465A	(3)	Bacterial Pathogenesis and Host Defences
528-466B	(3)	Viral Pathogenesis and Host Defences
528-509B	(3)	Seminars on Inflammatory Processes

U1, U2 or U3 Complementary Courses (15 credits)

15 credits selected from:

177-300A	(3)	Molecular Biology of the Gene
177-314A	(3)	Molecular Biology of Oncogenes
180-203A	(3)	Survey of Physical Chemistry
or 180-204A,B	(3)	Intro. to Physical Chemistry/Biol.Science
180-222A,B	(4)	Organic Chemistry II
180-302A	(3)	Organic Chemistry III
202-505B	(3)	Selected Topics in Biotechnology
504-261A	(4)	Introduction to Dynamic Histology
504-262B	(3)	Intro. Molecular and Cellular Biology
504-365A	(3)	Cell Biology of the Secretory Processes
504-458B	(3)	Membranes & Cellular Signalling
or 507-458B	(3)	Membranes & Cellular Signalling
507-311A	(3)	Metabolic Biochemistry
507-312B	(3)	Biochemistry of Macromolecules
507-450A	(3)	Protein Structure and Function
507-454A	(3)	Nucleic Acids
507-458B	(3)	Membranes & Cellular Signalling
516-504A	(3)	Biology of Cancer
528-387B	(3)	Applied Microbiology and Immunology
528-413B	(3)	Parasitology
528-414A	(3)	Advanced Immunology
528-465A	(3)	Bacterial Pathogenesis and Host Defences
528-466B	(3)	Viral Pathogenesis and Host Defences
528-509B	(3)	Seminars on Inflammatory Processes
546-300B	(3)	Human Disease
549-300A	(3)	Drug Action
549-301B	(3)	Drugs and Diseases
552-209A	(3)	Mammalian Physiology I (timetable conflict with 528-324A, if taken should be in U1 or U3)
552-210B	(3)	Mammalian Physiology II

MAJOR PROGRAM IN MICROBIOLOGY AND IMMUNOLOGY (67 credits)

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

U1 Required Courses (25 credits)
as for the Faculty Program, plus:

180-222A,B	(4)	Organic Chemistry II
180-203A	(3)	Survey of Physical Chemistry
or 180-204A,B	(3)	Physical Chem./Biol. Sc. I

U1, U2 or U3 Required Statistics Courses (3 credits)
as for the Faculty Program

U2 Required Courses (21 credits)
as for the Faculty program, plus

507-311A	(3)	Metabolic Biochemistry
507-312B	(3)	Biochemistry of Macromolecules

U3 Required Courses (9 credits)

528-413B	(3)	Parasitology
528-465A	(3)	Bacterial Pathogenesis and Host Defences
528-466B	(3)	Viral Pathogenesis and Host Defences

Complementary Courses (9 credits)
9 credits selected from:

177-300A	(3)	Molecular Biology of the Gene
177-314A	(3)	Molecular Biology of Oncogenes
180-302A	(3)	Organic Chemistry III
202-505B	(3)	Selected Topics in Biotechnology
504-261A	(4)	Introduction to Dynamic Histology
504-262B	(3)	Intro. Molecular and Cellular Biology
504-458B	(3)	Membranes & Cellular Signaling
or 507-458B	(3)	Membranes & Cellular Signaling
504-365A	(3)	Cell Biology of the Secretory Process
507-450A	(3)	Protein Structure and Function
507-454A	(3)	Nucleic Acids
516-504A	(3)	Biology of Cancer
528-387B	(3)	Applied Microbiology and Immunology
528-414A	(3)	Advanced Immunology
528-509B	(3)	Seminars in Inflammatory Processes
546-300B	(3)	Human Disease
549-300A	(3)	Drug Action
549-301B	(3)	Drugs and Diseases
552-209A	(3)	Mammalian Physiology I (timetable conflict with 528-324A, if taken should be in U1 or U3)
552-210B	(3)	Mammalian Physiology II

HONOURS PROGRAM IN MICROBIOLOGY AND IMMUNOLOGY (73 required credits)

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

Students intending to apply to Honours must follow the Major program in U1 and U2 and must obtain a CGPA of at least 3.30 at the end of their U2 year. For graduation in Honours, students must pass all required courses with a C or better, and achieve a sessional GPA of at least 3.10 in the U3 year.

U1 Required Courses (25 credits)
as for the Major Program

U1, U2 or U3 Required Statistics Courses (3 credits)
as for the Faculty Program

U2 Required Courses (21 credits)
as for the Major program

U3 Required Courses (21 credits)
as for the Major Program, plus:

528-502D	(12)	Honours Research

Complementary Courses (3 credits)
3 credits selected from:

177-520B	(3)	Gene Activity in Development
202-505B	(3)	Selected Topics in Biotechnology
504-458B	(3)	Membranes & Cellular Signalling
or 507-458B	(3)	Membranes & Cellular Signalling
507-404B	(3)	Biophysical Chemistry
507-450A	(3)	Protein Structure and Function
507-454A	(3)	Nucleic Acids
507-455B	(3)	Neurochemistry
528-414A	(3)	Advanced Immunology
528-509B	(3)	Seminars in Inflammatory Processes
549-562A	(3)	General Pharmacology I
549-563B	(3)	General Pharmacology II

INTERDEPARTMENTAL HONOURS PROGRAM IN IMMUNOLOGY

The Departments of Biochemistry, Microbiology and Immunology and Physiology offer an interdepartmental Honours program in Immunology. Students interested in immunology may choose between this Honours program and the Honours program of the Department of Microbiology and Immunology.

Details of this program may be found in section 11.13 or by consulting Professor Baines in the Department of Microbiology and Immunology, Room 404, telephone (514) 398-4443 or 3928 or mgbaines@microimm.mcgill.ca

COURSE DESCRIPTIONS

All courses have limited enrolment.

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

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

528-211A BIOLOGY OF MICROORGANISMS. (3) (3 hours of lecture) (Corequisite: 177-200A) A general treatment of microbiology bearing specifically on the biological properties of microorganisms. Emphasis will be on procaryotic cells. Basic principles of immunology and microbial genetics are also introduced.

528-212A LABORATORY IN MICROBIOLOGY. (2) (3hours of laboratory, 1 hour of conference) (Corequisite: 528-211A) This laboratory course is designed to complement 528-211A. Sessions introduce general techniques peculiar to the handling of microorganisms.

528-314B IMMUNOLOGY. (3) (3 hours of lecture) (Prerequisite: 177-200A and 177-201B or 507-212B) An introduction to the immune system, antigens, antibodies and lymphocytes. The course will cover the cellular and molecular basis of lymphocyte development and mechanisms of lymphocyte activation in immune responses.

528-323A MICROBIAL PHYSIOLOGY. (3) (3 hours of lecture) (Prerequisites: 528-211A) An introduction to the composition and structure of microbial cells, the biochemical activities associated with cellular metabolism and how these activities are regulated and coordinated. The course will have a molecular and genetic approach to the study of microbial physiology.

528-324A FUNDAMENTAL VIROLOGY. (3) (3hours of lecture) (Prerequisites: 528-211A, 177-200A, 177-201B or 507-212B) A study of the fundamental properties of viruses and their interactions with host cells. Bacteriophages, DNA- and RNA-containing animal viruses, and retroviruses are covered. Emphasis will be on phenomena occurring at the molecular level and on the regulated control of gene expression in virus-infected cells.

528-386D LABORATORY IN MICROBIOLOGY & IMMUNOLOGY. (6) (1 hour lecture, 6 hours laboratory, 1 hour follow-up) (Prerequisites: 528-211A, 528-212A. Corequisites: 528-314B, 528-323A, 528-324A) A series of illustrative exercises in bacterial classification, bacterial and viral molecular genetics and immunological

techniques. The objective is to provide a practical introduction to microbiological and immunological research and technology.

528-387B APPLIED MICROBIOLOGY AND IMMUNOLOGY. (3) (Prerequisite: 528-211A) The ability to select and manipulate genetic material has lead to unprecedented interest in the industrial applications of procaryotic and eucaryotic cells. Beginning in the 1970s the introduction of and subsequent refinements to recombinant DNA technology and hybridoma technology transformed the horizons of the biopharmaceutical world. This course will highlight the important events that link basic research to clinical/commercial application of new drugs and chemicals.

528-413B PARASITOLOGY. (3) (Prerequisite: 528-314B or equivalent – 504-261A is strongly recommended) A study of the biology, immunological aspects of host-parasite interactions, pathogenicity, epidemiology and molecular biological aspects of selected parasites of medical importance. Laboratory will consist of a lecture on techniques, demonstrations and practical work.

528-414A ADVANCED IMMUNOLOGY. (3) (3hour lecture) (Prerequisite: 528-314B) An advanced course serving as a logical extension of 528-314B. The course will integrate molecular, cellular and biochemical events involved in the ontogeny of the lymphoid system and its activation in the immune response. The course will provide the student with an up-to-date understanding of a rapidly moving field.

528-465A BACTERIAL PATHOGENESIS AND HOST DEFENCES. (3) (3 hours of lecture) (Prerequisites: 528-211A, 528-314B, 528-323A, or the permission of the instructor) Organized by the McGill Centre for the Study of Host Resistance. This course focuses on the interplay of the host and the pathogen. The cellular and molecular basis of the host defense mechanism against infections will be considered in relationship to the virulence factors and evasion strategies used by bacteria to cause disease.

528-466B VIRAL PATHOGENESIS AND HOST DEFENCES. (3) (3 hours of lecture) (Prerequisites: 528-211A, 528-324A, 528-314B) A study of the biological and molecular aspects of viral pathogenesis with emphasis on the human pathogenic viruses including the retroviruses HIV and HTLV-1; herpes viruses; papilloma viruses; hepatitis viruses; and new emerging human viral diseases. These viruses will be discussed in terms of virus multiplication, gene expression virus-induced cytopathic effects and host immune response to infection.

528-502D HONOURS RESEARCH PROJECT. (12) (More than 15 hours per week for an independent research project) (U3 Honours students and Majors students are eligible. Required CGPA: 3.30 or higher.) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) An information meeting about the course is held annually in February for students who intend to apply for registration. Subject to the availability of space and resources, professors in the Department of Microbiology and Immunology provide research opportunities for registrants in this course. Students present their research findings in a seminar and a final written report is required. Because this is a 12 credit course, students are expected to devote at least 40% of their academic effort towards their research.

528-509B SEMINARS ON INFLAMMATORY PROCESSES. (3) (3hours of seminar) (Prerequisite: 528-314B. Corequisite: 552-513A or 528-414A) This course concentrates on the non-specific aspects of the immune response, an area which is not adequately covered by the other immunology courses presented at the university. Interactions between guest researchers (from McGill and other universities) and students will be furthered. This course will be given in conjunction with the Division of Experimental Medicine.

11.17 Music

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

Telephone: (514) 398-4535
Fax: (514) 398-8061
Website: http://www.music.mcgill.ca

Department of Theory — W. Woszczyk *(Chair)*

Department of Performance — G. Foote *(Chair)*

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

SCIENCE MINOR IN MUSIC PROGRAM (24 credits)
[MARS Program Code 6-666500]
(Program revisions awaiting University approval)

Required Courses (9 credits)

210-285D	(3)	Introduction to Musical Styles
211-210A or B	(3)	Tonal Theory and Analysis I*
211-211A or B	(3)	Tonal Theory and Analysis II*

* Students must take a diagnostic placement examination before registering for this course. If the appropriate level is not achieved on the examination, students will be required to register for Melody and Counterpoint 211-110A (3 credits) and/or Elementary Harmony and Analysis 211-111B (3 credits). These courses may *not* be counted toward the 24-credit Music Minor program.

Complementary Courses (15 credits)

Music History, Literature or Performance Practice (3 credits)
a course with a 214- prefix at the 300 level – see list of courses in the Faculty of Music section; an historical performance practice course with a 215-prefix may be taken with Departmental permission.

Music Courses (12 credits)
12 credits from courses with a 211- or 214- prefix at the 300 level, or any other course from the following list of additional courses .

Complementary Course List

198-224A	(3)	Physics and Psychophysics of Music
198-225B	(3)	Musical Acoustics
211-301A	(3)	Modal Counterpoint I
211-302B	(3)	Modal Counterpoint II
211-303A	(3)	Tonal Counterpoint I
211-304B	(3)	Tonal Counterpoint II
211-310A	(3)	Mid & Late 19th-C.Theory & Analysis
or 211-327D	(4)	19th-Century Analysis
211-311B	(3)	20th-Century Theory and Analysis
or 211-427D	(4)	20th-Century Analysis
211-522D	(6)	Advanced Counterpoint
211-523D	(6)	Advanced Harmony
211-528A or B	(3)	Schenkerian Techniques
213-230D	(4)	The Art of Composition
213-260A	(2)	Instruments of the Orchestra
213-261B	(2)	Elementary Orchestration
214-220A or B	(3)	Women in Music
214-3xx		Music History complementary (maximum of 3 credits)
216-201A or B	(3)	Introduction to Music Technologies
216-202A,B	(3)	Fundamentals of New Media
216-301A	(3)	Music and the Internet
216-302A	(3)	New Media Production I
216-303B	(3)	New Media Production II
222-205A or B	(3)	Psychology of Music
222-207A or B	(3)	Sociology of Music
243-xxx		Ensembles (maximum of 4 credits; registration contingent upon ensemble audition)

SCIENCE MINOR IN MUSIC TECHNOLOGY (24 credits)
[Program registration done by Student Affairs Office]

Enrolment in the Minor in Music Technology program is highly restricted. Application forms will be available from the Department of Theory Office of the Faculty of Music (Room E220, Strathcona Music Building, 555 Sherbrooke Street West) from February 1, 2001 and must be completed and returned to that office by May 15, 2001. No late applications will be accepted and no students will be admitted to the Minor in January.

Students will be selected on the basis of their previous background or experience in music technology and/or sound recording, their computer programming skills, their expressed interest in the program, and their Cumulative Grade Point Average. Successful applicants will be notified June 1, 2001.

A B.Sc. with a Major in Computer Science and Music Technology is currently under development. Students interested in such a program are invited to contact Professor Gerald Ratzer in the School of Computer Science regarding the program, or Professor Philippe Depalle in the Faculty of Music regarding the Music Technology component.

Required Courses (24 credits)

198-224A	(3)	Physics and Psychophysics of Music
198-225B	(3)	Musical Acoustics
214-342A or B	(3)	History of Electroacoustic Music
216-202A	(3)	Fundamentals of New Media
216-203B	(3)	Introduction to Digital Audio
216-301A or B	(3)	Music and the Internet
216-302A	(3)	New Media Production I
216-303B	(3)	New Media Production II

COURSES

All courses have limited enrolment.

The following courses are offered by the Faculty of Music as electives for students in the Faculties of Arts, Science, and Education. They are also open to students from other faculties. For a complete listing of the offerings of the Faculty, consult the Faculty of Music section. Music courses not listed below may be taken by qualified students from other faculties providing they obtain permission from the relevant department in the Faculty of Music and from the Associate Dean of their own faculty.

Please consult the Faculty of Music for timetable information.

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

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

● Denotes courses not offered in 2001-02.

LIST I

No music prerequisites, other than those listed under a specific course, are required. **Courses in List I may not be credited toward the B.A. or B.Sc. Music programs.**

Students who have completed a course with a 211- teaching unit number from List II or who have Matriculation Music or McGill Conservatory Theory Secondary V or its equivalent may not register for 210-201 or 210-202.

210-201A,B BASIC MATERIALS OF WESTERN MUSIC I. (3) (3 hours) A combination of elementary theory and ear training (sightsinging and aural recognition), and basic piano skills. Topics include: notation of pitch and rhythm, intervals, scales and modes, concept of key, triads and seventh chords, introductory melody and accompaniment writing.

210-202A,B BASIC MATERIALS OF WESTERN MUSIC II. (3) (3 hours) (Prerequisite: 210-201A,B or permission of instructor.) Integrated course in music theory with creative applications of acquired skills. Analysis and writing: concepts of melodic organization, elementary harmonic progressions, two-part contrapuntal techniques, fundamental formal procedures, examination of popular song and jazz. Development of individual skills: intermediate sightsinging, aural recognition, keyboard techniques, small group performance in class.

210-211A,B THE ART OF LISTENING. (3) (3 hours) An introduction to the major forms and styles in Western music from the baroque to the present, with emphasis on guided listening in the classroom. The ability to read music is not a prerequisite.

Not all of the following courses in List I will be offered in 2001-02; for an up-to-date listing, please consult the final 2001-02 Faculty of Music timetable.

Students who read music and have an instrumental or vocal background may proceed directly to courses at the 300 level.

210-374A OR B SPECIAL TOPICS IN MUSIC. (3) (3hours) A course whose topics will correspond to special historical events and their associated musical, political, and cultural contexts.

● **210-384A OR B ROMANTICISM & THE PIANO.** (3) (3 hours) (Prerequisite: 210-201 or 210-211 or permission of instructor.)

210-385A OR B MUSIC OF THE AVANT-GARDE. (3) (3hours) (Prerequisite: 210-201 or 210-211) Explorations into post-1945 sound environments; new timbres (Berio and Crumb); "technological" music (electronic and computer music); minimalism (Glass); new aesthetics (Cage); the World Soundscape Project (Schafer); global trends (cross-cultural influences; the New Romanticism; multimedia; protest music).

210-387A OR B THE OPERA. (3) (3 hours) (Prerequisite: 210-201 or 210-211) A survey of opera from c.1600 to the present. Opera as ritual, opera as spectacle, opera as catharsis, opera as business, opera and its literary models. The continuing relevance of the operatic experience today.

● **210-389B THE SYMPHONY AND CONCERTO.** (3) (3hours) (Prerequisite: 210-201 or 210-211)

210-392A,B POPULAR MUSIC AFTER 1945. (3) (3 hours) (Prerequisite: 210-201 or 210-211 or permission of instructor.) An historical survey of major artists, genres, and styles in the most widespread traditions of postwar commercial music. The course will include practice in techniques of listening, discussion of the shaping institutions of commercial music, and consideration of the interaction of musical style and culture.

210-393B INTRODUCTION TO JAZZ. (3) (3hours) (Prerequisite: 210-201 or 210-211 or permission of instructor. Open only to non-Music majors.) A survey of the development of jazz from its late 19th-century origins in America to the present day, with an introduction to musical concepts relevant to the genre and consideration of sociocultural issues.

List II

The courses in this list are intended for students who have at least high school matriculation music or the equivalent. Students who do not have the formal music prerequisites require the permission of the Chair of the Department of Theory to register for any of these courses.

THEORY

For course descriptions, please consult the Faculty of Music section 8.1**.**

Note: Students not in the B.A. or B.Sc. Music programs are not required to take the corequisites for the following courses. However, students intending later to enter either the B.A. Major Concentration or the B.Mus. program would then be required to sit placement tests in Musicianship and Keyboard Proficiency and may be required to take these courses.

211-110A MELODY AND COUNTERPOINT. (3) (4 hours) (Prerequisite: Matriculation Music or McGill Conservatory Theory Secondary V or its equivalent. Corequisites: 212-129 and -170 or permission of co-ordinator or instructor.)

211-111B ELEMENTARY HARMONY AND ANALYSIS. (3) (4hours) (Prerequisite: 211-110. Corequisites: 212-131 and 212-171)

211-210A,B TONAL THEORY AND ANALYSIS I. (3) (3 hours) (Prerequisites: 211-110 and 111. Corequisite: 212-229. Prerequisite or corequisite: 212-171)

211-211A,B TONAL THEORY AND ANALYSIS II. (3) (3 hours) (Prerequisite: 211-210. Corequisite: 212-231.

Unless otherwise indicated the following courses are prerequisites to 300-, 400- and 500- level theory courses: 211-211 or 213-240 AND 212-231 AND 212-171.

211-310A MID & LATE 19TH-C. THEORY & ANALYSIS. (3) (3 hours)

211-311B 20TH-CENTURY THEORY AND ANALYSIS. (3) (3 hours) (Prerequisite: 211-310)

HISTORY

For course descriptions, please consult the Faculty of Music section 8.4.

214-184A HIST. SURVEY (MEDIEVAL, RENAISS., BAROQ.). (3) (3 hours) (Corequisites: 211-110 and 212-129 OR permission of instructor)

214-185B HIST. SURVEY (CLASS., ROMANTIC, 20TH-C.). (3) (3 hours) (Corequisites: 211-111 and 212-131 OR permission of instructor)

● **214-220B WOMEN IN MUSIC.** (3) (3 hours) (Prerequisite: none)

Unless otherwise indicated the following courses are prerequisites to 300- and 400- level history courses: 214-184 and 214-185 AND 211-211 or 213-240 AND 212-231.

Not all history courses will be offered in 2001-02; for an up-to-date listing, please consult section 8.4 the final 2001-02 Faculty of Music timetable.

MUSIC TECHNOLOGY

216-202A,B FUNDAMENTALS OF NEW MEDIA. (3) (3 hours) (Prerequisites: none) (Open only to students in Music Technology, including those in Minor Programs, and students in Sound Recording, and Composition.) Combining theory and practice, the course covers the areas of MIDI, sound/image/MIDI sequencing, sampling, mixing, soundfile processing and editing, elementary music systems programming, and use of the Internet for sound/music/image.

216-203B INTRODUCTION TO DIGITAL AUDIO. (3) (3 hours) (Prerequisite: 216-202A) An introduction to the theory and practice of digital audio. Topics include: sampling theory; digital sound synthesis methods (additive, subtractive, summation series); sound processing (digital mixing, delay, filters, reverberation, sound localization); software-based samplers; real-time sound processing; interactive audio systems. Hands-on exercises are included.

216-301A OR B MUSIC AND THE INTERNET. (3) (3 hours) (Prerequisite: 216-201A OR 216-202A) (Not open to students in B.Mus. Honours in Music Technology.) Technologies and resources of the Internet (access tools, data formats and media) and Web authoring (HTML) for musicians; locating, retrieving and working with information; putting information online; tools for music research, music skills development, technology-enhanced learning, music productivity, and promotion of music and musicians. Evaluation of Internet music resources.

216-302A NEW MEDIA PRODUCTION I. (3) (3 hours) (Prerequisite: 216-201A OR 216-202A) (Not open to students in B.Mus. Honours in Music Technology.) Methods and techniques for producing and modifying musical and audiovisual content in new media applications. Media formats: audiovisual sequences (QuickTime), CD-ROMs and interactive CD-ROMs, DVD, surround sound audio. Also covered: software-based synthesis and sampling, techniques for image scanning, audio capture, content manipulation, media compression and format conversion.

216-303B NEW MEDIA PRODUCTION II. (3) (3 hours) (Prerequisite: 216-301A) (Not open to students in B. Mus. Honours in Music Technology.) A continuation of 216-302A. Students produce new media objects of increasing complexity and scope, integrating several types of content.

Music Ensembles

Science students in the Science Minor in Music Program may, with the permission of the instructor and the Associate Dean of their own Faculty, participate in one of the following ensembles in a given year. Auditions are held starting the week prior to the beginning of classes in September and continuing during that first week and, in the case of the McGill Symphony Orchestra (243-497A,B), in early January for the winter term. The schedule and requirements for these auditions are available at the end of June from the Department of Performance office (514) 398-4542. Normally both the A and B sections of an ensemble are taken in the same academic year.

The deadline for withdrawing from ensembles is the end of the second week of classes in any term.

For ensemble policies and course descriptions, please consult the Faculty of Music sections 6.1 ?? and section 8.9.

243-489A,B WOODWIND ENSEMBLES. (1 plus 1 credit) (2-3 hours) (Prerequisite: audition)

243-490A,B MCGILL WINDS. (2 plus 2 credits) (4-6 hours) (Prerequisite: audition)

243-491A,B BRASS ENSEMBLES. (1 plus 1 credit) (2-3 hours) (Prerequisite: audition)

243-493A,B CHORAL ENSEMBLES. (2 plus 2credits) (4 hours) (Prerequisite: audition) Students enroling in Choral Ensembles will be assigned to one of the following groups:
Section 01 Chamber Singers
Section 02 Concert Choir
Section 03 University Chorus
Section 04 Women's Chorale

243-494A,B CONTEMPORARY MUSIC ENSEMBLE. (2 plus 2 credits) (4 hours) (Prerequisite: audition)

243-495A,B JAZZ ENSEMBLES. (2 plus 2credits) (3-4 hours) (Prerequisite: audition)

243-496A,B OPERA STUDIO. (4 plus 4 credits) (3-6 hours) (Prerequisite: audition)

243-497A,B ORCHESTRA. (2 plus 2credits) (6-7 hours) (Prerequisite: audition.)

243-499A,B STRING ENSEMBLES. (1 plus 1 credit) (2-3 hours) (Prerequisite: audition) N.B. Guitar ensemble is restricted to Performance Majors only.
Section 01 Chamber Music
Section 02 Bass Ensemble
Section 03 Guitar Ensemble

11.18 Neurology and Neurosurgery (531)

COURSE LECTURERS

Associate Professor
Wayne Sossin; S.B.(M.I.T.), Ph.D.(Stan.) *(joint appt. with Anatomy & Cell Biology) Course Co-ordinator*

Assistant Professors
Timothy Kennedy; B.Sc.(McM.), M.Phil, Ph.D.(Columbia) *(joint appt. with Anatomy & Cell Biology)*
Peter McPherson; B.Sc.(Manit.), Ph.D.(Iowa) *(joint appt. with Anatomy & Cell Biology)*
David Ragsdale; B.S.(Ill.); Ph.D.(Calif.)

It is the brain that makes us what we are, and understanding how the brain works and how it is affected by disease is a major goal of Neuroscience. Neuroscience is both pure science, offering challenging basic research pursuits, as well as medical science, with important clinical applications. The approach to problems in Neuroscience has roots in many of the basic sciences including biology, biochemistry, pharmacology, physiology, and psychology. Powerful techniques of molecular biology, biochemistry, and genetics have revealed new molecules, given insight to how gene expression is controlled, and allowed the identification of defective genes responsible for diseases of the nervous system. Neuronal and glial cells are studied in the context of adult or developing nervous systems, and how neural networks are formed and maintained. Signalling and information transfer within and between cells are investigated by studying individual cells and their synaptic

connections, or through research on complex neuronal circuitry. Higher neural functions are explored by mapping neural architecture, through the study of specific systems with sophisticated physiological and imaging techniques, and by investigations of the neurobiological mechanisms of behaviour.

The Department of Neurology and Neurosurgery sponsors an undergraduate course in Neuroscience, and additional undergraduate courses are offered in the Departments of Biology, Pharmacology, Biochemistry, Psychology, Physiology, and Anatomy and Cell Biology. Graduate studies are a very large component of the Department of Neurology and Neurosurgery. The curriculum for graduate degrees in Neurology and Neurosurgery is provided in the Faculty of Graduate Studies and Research Calendar. Inquiries should be directed to the Graduate Program Coordinator, Montreal Neurological Institute, 3801 University Street, Montreal, H3A 2B4.

COURSE DESCRIPTION

All courses have limited enrolment.

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

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

531-310B CELLULAR NEUROBIOLOGY. (3) (2lectures each week) (Prerequisite or corequisite; 177-200A and 177-201B, or 552-209A, or 552-210B) A survey of the functional organization of nerve cells, signalling in the nervous system, and principles of neural development. Topics include cell polarity, neurotransmitters, neurotrophins, receptors and second messengers, cell lineage, guidance of axon outgrowth, and nerve regeneration. Emphasis will be placed on analysis of neurons at the molecular level.

11.19 Neuroscience

Minor Program in Neuroscience

Program Coordinator:
Professor Ellis Cooper, Department of Physiology
McIntyre Medical Sciences Building, Room 1127
Email: ecooper@med.mcgill.ca
Telephone: (514) 398-4334

Neuroscience is a multidisciplinary science devoted to the understanding of the nervous system. The brain is one of the most complex systems in the universe, and understanding how it functions is among the most challenging questions in science. Scientists are investigating the brain at many levels, from the molecules at synapses to complex forms of behaviour, with diverse approaches ranging from genetic, biochemical, anatomical, physiological, embryological and psychological. In addition, scientists are investigating the nervous system of many different animals, from simple invertebrates to humans. These wide-ranging investigations are providing a clearer understanding of how neurons work; how they communicate with one another; how they are organized into local or distributed networks; how the connections between neurons are established and change with experience; how neuronal functions are influenced by drugs, nutrients, toxins, and disease states. As a result, we are gaining deeper insights into the neural basis of mental activity, as well as developing new therapeutic approaches to alleviate neurological and psychological diseases.

MINOR PROGRAM IN NEUROSCIENCE (24 credits)
[MARS Program Code 6-668200]
(Program revisions awaiting University approval)

The Minor Program in Neuroscience is a program designed for undergraduate students interested in how the nervous system functions. The program consists of courses from the departments of Anatomy and Cell Biology (504), Biochemistry (507), Biology (177), Neurology and Neurosurgery (531), Pharmacology and Therapeutics (549), Physiology (552), Psychiatry (555), and Psychology (204). The Minor is composed of 24 credits, 18 of which must be selected from two of the five topic areas listed below. Twelve credits of the 18 must be at the 400/500 level and from at least two different departments. A maximum of 6 credits can be counted both for the student's primary program and for the Minor Program in Neuroscience, where appropriate.

All course selections for the Minor Program in Neuroscience must be approved by the Program Coordinator.

Complementary Courses (24 credits)
6 credits selected from:

204-308A	(3)	Behavioural Neuroscience 1
or 177-306A	(3)	Neurobiology and Behaviour
or 552-311A	(3)	Intermediate Physiology I
504-321A	(3)	Circuitry of the Human Brain
531-310B	(3)	Cellular Neurobiology

18 additional credits:
9 credits each from 2 of the 5 areas listed below, 6 credits in each area must be from 400- or 500-level courses

Neurobiology and Behaviour

177-306A	(3)	Neurobiology and Behaviour
177-389B	(3)	Laboratory in Neurobiology
204-318B	(3)	Behavioural Neuroscience 2
552-311A	(3)	Intermediate Physiology I
177-530B	(3)	Neural Basis of Behaviour
177-531A	(3)	Neurobiology of Learning & Memory
204-427B	(3)	Sensorimotor Behaviour
204-505A	(3)	The Psychology of Pain
204-522B	(3)	Neurochemical Basis of Behaviour
552-556B	(3)	Topics in Systems Neuroscience
555-500B	(3)	Advances in the Neurobiology of Mental Disorders

Molecular and Developmental Neurobiology

504-321A	(3)	Circuitry of the Human Brain
531-310B	(3)	Cellular Neurobiology
552-311A	(3)	Intermediate Physiology I
177-532B	(3)	Developmental Neurobiology Seminars
177-588A	(3)	Molecular/Cellular Neurobiology
507-455B	(3)	Neurochemistry
552-451A	(3)	Advanced Neurophysiology

Neurophysiology

177-389B	(3)	Laboratory in Neurobiology
504-322B	(3)	Neuroendocrinology
552-311A	(3)	Intermediate Physiology I
177-531A	(3)	Neurobiology of Learning & Memory
177-588A	(3)	Molecular/Cellular Neurobiology
204-427B	(3)	Sensorimotor Behaviour
552-451A	(3)	Advanced Neurophysiology
552-520B	(3)	Ion Channels
552-556B	(3)	Topics in Systems Neuroscience

Neuropsychology

177-306A	(3)	Neurobiology and Behaviour
204-311A	(3)	Human Cognition and the Brain
204-318B	(3)	Behavioural Neuroscience 2
504-321A	(3)	Circuitry of the Human Brain
504-322B	(3)	Neuroendocrinology
204-410B	(3)	Special Topics in Neuropsychology
204-470A	(3)	Memory and Brain
204-505A	(3)	The Psychology of Pain
204-522B	(3)	Neurochemical Basis of Behaviour
204-526A	(3)	Advances in Visual Perception

Neuropharmacology

549-300A	(3)	Drug Action
549-301B	(3)	Drug and Disease
555-301B	(3)	Issues in Drug Dependence
504-321A	(3)	Circuitry of the Human Brain
552-311A	(3)	Intermediate Physiology I
507-455B	(3)	Neurochemistry
552-451A	(3)	Advanced Neurophysiology
555-500B	(3)	Advances in the Neurobiology of Mental Disorders
552-520B	(3)	Ion Channels
549-562A	(3)	General Pharmacology I
177-588A	(3)	Molecular/Cellular Neurobiology

11.20 Nursing (576)

For a complete listing of Nursing courses and their descriptions, consult the School of Nursing website (http://www.nursing.mcgill.ca) or refer to the Health Sciences Calendar.

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

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

All courses have limited enrolment.

576-308A ISSUES IN WOMEN'S HEALTH. (3) (Prerequisite: Introductory Psychology or Sociology or permission of the instructor.) (Complementary course for the Women's Studies and Social Studies of Medicine Concentrations.) Exploration of a wide range of topics on the health of women. Topics include use of health care system, poverty, roles, immigration, body image, lesbian health, and violence against women. Additional topics vary by year. A Health Science elective open to students in the Faculties of Arts, Science, and Medicine.

576-309B WOMEN'S REPRODUCTIVE HEALTH. (3) (Prerequisite: Introductory Psychology or Sociology or permission of the instructor.) (Restriction: not open for credit to students who have taken 576-308 prior to September 1997.) (Complementary course for the Women's Studies and Social Studies of Medicine Concentrations.) Concepts of health and medicalization. Canadian and international perspectives. Topics include contraception, abortion, infertility, menstruation, menopause, new reproductive technologies, prenatal care, childbirth. Additional topics vary by year. A Health Science elective open to students in the Faculties of Arts, Science, and Medicine.

11.21 Nutrition (382)

Please see the School of Dietetics and Human Nutrition entry beginning on page 444 in the Faculty of Agricultural and Environmental Sciences section for further information about the School's other courses, programs and academic staff. This information includes a Minor Program in Human Nutrition which can be taken by Science students.

All courses have limited enrolment.

382-307A HUMAN NUTRITION. (3) (Prerequisites: 180-212 and 177-201 or equivalents.) (Credit cannot be obtained for both 382-307 and 382-207.) Cellular and organismal aspects of nutrition with emphases on biochemical and physiological roles of carbohydrates, lipids, proteins, minerals and vitamins in disease prevention and promotion of optimal health.

11.22 Pathology (546)

All courses have limited enrolment.

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

546-300B HUMAN DISEASE. (3) (Prerequisites: 177-200A, 177-201B or 507-212B, 552-209A. Pre- or co-requisite: 552-210B.) Provides a fundamental understanding of the diseases prevalent in North America, for upper level students in the biological sciences. Includes: general responses of cells and organ systems to injury; assessment of individual diseases by relating the causes, symptoms, diagnosis, treatment and prevention to the primary biological abnormalities in each disorder.

11.23 Pharmacology and Therapeutics (549)

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

Telephone: (514) 398-3623
Website: http://www.pharma.mcgill.ca

Chair — Nigel Bunnett

Vice-Chair — Radan Capek

Professors
Radan Capek; M.D., Ph.D.(Prague)
Paul B.S. Clarke; M.A.(Cantab.), Ph.D.(Lond.)
Brian Collier; B.Sc., Ph.D.(Leeds)
A. Claudio Cuello; M.D.(Buenos Aires), M.A., D.Sc.(Oxon.) *(on leave)*
Barbara Hales; M.Sc.(Phil. Coll. of Pharmacy and Science), Ph.D.(McG.)
Peter J. McLeod; M.D.(Manit.), F.R.C.P.(C.)
John B. Richardson; B.Sc., M.D.C.M., L.M.C.C., F.R.C.P., Ph.D.(McG.)
Bernard Robaire; B.A.(Calif.), Ph.D.(McG.)
Theodore Sourkes; Ph.D. (Cornell)
Moshe Szyf; M.Sc., Ph.D.(Hebrew U.)
Daya R. Varma; M.D.(Lucknow), Ph.D.(McG.)

Associate Professors
Guillermina Almazan; Ph.D.(McG.)
Nigel Bunnett; M.Sc.(Leeds), Ph.D.(Cambridge)
Barbara Esplin; M.D.(Warsaw)
Dusica Maysinger; Ph.D.(Los Angeles)
Stanley Nattel; B.Sc., M.D.,C.M.(McG.)
Ante L. Padjen; M.D., M.Sc., D.Sc.(Zagreb);
Alfredo Ribeiro-da-Silva,; M.D., Ph.D.(Oporto) *(joint appt. with Anatomy & Cell Biology)*
H. Uri Saragovi; Ph.D.(Miami)
Betty I. Sasyniuk; B.S.P., Ph.D.(Man.)
Jacquetta Trasler; M.D.C.M., Ph.D.(McG.)
Edith A. Zorychta; B.Sc.(F.X.), M.Sc., Ph.D.(McG.)

Associate Members
Moulay Alaoui-Jamali; Ph.D.(Sorbonne)
Gerald Batist; M.D.,C.M.(McG.)
Claude De Montigny; M.D., Ph.D.(Montr.), F.R.C.P.(C)
Pierre Fiset; M.D.(Laval), F.R.C.P.S.(C).
Serge Gauthier, M.D.(Montr.)
Yogesh C. Patel; M.D.(Otago), Ph.D.(Monash)
Roger Prichard; B.Sc., Ph.D.(N.S.W.)
Remi Quirion; M.Sc., Ph.D.(Sher.)
Allan Tenenhouse; B.Sc., M.D.,C.M., Ph.D.(McG.)

Adjunct Professors
Paul Albert; Ph.D.(Harv.)
Sylvain Chemtob; M.D.(Montr.), Ph.D.(McG.)
Yves De Koninck; Ph.D.(McG.)
Lorella Garofalo; Ph.D.(McG.)
Joseph Mancini; M.Sc., Ph.D.(McG.)
Kathleen Metters; Ph.D.(London)
George S. Robertson; Ph.D.(Dal.)

Pharmacology is the science which deals with all aspects of drugs and their interactions with living organisms. Thus, it involves the physical and chemical properties of drugs, their biochemical and physiological effects, mechanisms of action, pharmacokinetics, and therapeutic and other uses. Since the word "drug" encompasses all chemical substances that produce an effect on living cells, it is evident that pharmacology is a very extensive subject. Pharmacology is a multi-disciplinary science. It has developed its own set of principles and methods to study the mode of the action of drugs, but it has also utilized many techniques and approaches from various disciplines including biochemistry, physiology, anatomy and molecular biology, as well as others. Pharmacology can be subdivided into a number of different areas such as neuropharmacology, molecular biology, reproductive pharmacology, endo-

crine pharmacology, receptor pharmacology, cardiovascular pharmacology, toxicology, developmental pharmacology, autonomic pharmacology, biochemical pharmacology, and therapeutics.

Training in pharmacology is conducted at both the undergraduate and graduate levels. Because of its breadth, students may be attracted to the subject from a variety of viewpoints; this includes those completing a Bachelor's degree in any number of basic science disciplines, such as biology, zoology, chemistry, physics, biochemistry, microbiology, anatomy and physiology. At the undergraduate level, seven lecture courses are offered. A course involving research projects in pharmacology is also available to provide the student with the opportunity to get first-hand experience in a pharmacology research laboratory. These courses should provide students with knowledge concerning the actions of drugs on living systems and insight into approaches to basic pharmacological research.

MINOR PROGRAM IN PHARMACOLOGY (24 credits)
[MARS Program Code 6-680000]

The Minor Program in Pharmacology is intended for students registered in a complementary B.Sc. program who are interested in a focused introduction to specialized topics in pharmacology to prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes. Students should declare their intent to enter the Minor Program in Pharmacology at the beginning of their U2 year. They must consult with, and obtain the approval of, the Coordinator for the Minor Program in the Department of Pharmacology and Therapeutics.

All courses in the Minor Program must be passed with a minimum grade C or better. Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program.

Required Courses (9 credits)

549-300A	(3)	Drug Action
549-562A	(3)	General Pharmacology I
549-563B	(3)	General Pharmacology II

Complementary Courses (15 credits)
6 credits, one of the following sets:

177-200A	(3)	Molecular Biology
and 177-201B	(3)	Cell Biology and Metabolism
or 507-212B	(3)	Molecular Mechanisms of Cell Function

OR

552-209A	(3)	Mammalian Physiology I
and 552-210B	(3)	Mammalian Physiology II

9 credits, chosen from

549-301B	(3)	Drugs and Diseases
549-303B	(3)	Principles of Toxicology
549-503A	(3)	Drug Design and Development 1
549-504B*	(3)	Drug Design and Development 2
549-599A,B,D,T	(6)	Research Projects in Pharmacology

* can be taken with 549-503A only.

COURSE DESCRIPTIONS
All courses have limited enrolment.

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

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

549-300A DRUG ACTION. (3) (Prerequisites: 177-200A and 177-201B or 507-212B, 552-209A and 552-210B or permission of instructor.) This course covers the fundamental principles of pharmacology and toxicology. Frequently encountered drugs are used as a focus to illustrate sites and mechanisms of action, distribution, metabolism, elimination and adverse effects.

549-301B DRUGS AND DISEASE. (3) (Prerequisites: 177-200A, 177-201B or 507-212B, 552-209A and 552-210B and 549-300A or permission of instructor.) This course further explores the basic principles of pharmacology as illustrated by drugs used in the treatment of disease. Emphasis is placed on drugs used for diseases prevalent in North America.

549-303B PRINCIPLES OF TOXICOLOGY. (3) (Prerequisites: 177-200A, 177-201B or 507-212B, 552-209A and 552-210B.) Fundamental mechanisms by which toxic compounds damage a biological system (organelle, cell, organ, organism, ecosystem). Detection and quantification of toxicity and risk/benefit analysis are considered. Selected agents of current risk to human health or the environment are used as examples are evaluated in depth.

549-503A DRUG DESIGN AND DEVELOPMENT 1. (3) (Prerequisites: 180-302, 177-200, 177-201, 507-212, 549-300, 549-301, 549-303 or permission of coordinator.) (Not open to students who are taking or have taken 180-503.) 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 180-503.) Interdisciplinary course in drug design and development covering chemistry, mechanisms of action and steps in drug development, principles and problems in drug design.

549-504B DRUG DESIGN AND DEVELOPMENT 2. (3) (Prerequisite: 549-503/180-503) (U3 and graduate students. Students can register only with permission of coordinators.) (Not open to students who are taking or have taken 180-504.) Interdisciplinary course in drug design and development in which teams of 2-4 students select a lead chemical compound, design the analogues, propose the preclinical and clinical studies, present possible untoward effects, and reasons for drug (dis)approval.

549-562A GENERAL PHARMACOLOGY I. (3) (Prerequisites: 552-209A and 552-210B, 177-200A and 177-201B or 507-311A and 507-312B or equivalent.) (Restrictions: Open to U3 students with permission of instructors, and students registered in the Minor Pharmacology Program.) Principles of pharmacology as illustrated by current issues with an emphasis on the nervous system will be discussed. Drugs classified by their molecular target of action, their mechanism of action, and possibly a rationale for therapeutic use will be presented. Students will be required to examine and interpret scientific data, to write a paper and participate in small group discussions.

549-563B GENERAL PHARMACOLOGY II. (3) (Prerequisites: 552-209A and 552-210B, 177-200A and 177-201B or 507-311A and 507-312B or equivalent.) (Restrictions: Open to U3 students with permission of instructors, and students registered in the Minor in Pharmacology Program.) Selected topics of basic interactions between chemicals and biological systems. Actions of drugs at the molecular and cellular levels. Principles of drug development. Chemotherapy of infections and of cancer. Toxicology and pharmacokinetics/dynamics. Drug metabolism.

549-599A,B,C,D,L,T RESEARCH PROJECTS IN PHARMACOLOGY. (6) (Pre- or co-requisite 549-562A and 549-563B or 549-300A and 549-301B.) (Restrictions: Open to U3 students with permission of instructors, and students registered in the Minor Pharmacology Program. Students should consult instructors 3 - 4 weeks before registration. Students may not register (via MARS) without prior approval of the course co-ordinator(s).) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) This course involves individual research work. Students select a project under the supervision of a staff member. Areas of interest include toxicology, endocrine, developmental, cardiovascular, reproductive and neuropharmacology. This course requires a minimum of 6 hours per week for the full year course (D), and a minimum of 12 hours per week for the half year course (A,B) to be spent in the laboratory and/or library.

11.24 Physics (198)

Rutherford Physics Building, Room 108
3600 University Street
Montreal, QC H3A 2T8

Telephone: (514) 398-6485
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Email: secretariat@physics.mcgill.ca
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Chair — J. Barrette

Emeritus Professors
M.P. Langleben; B.Sc., M.Sc., Ph.D.(McG.), F.R.S.C.
E.R. Pounder; B.Sc., Ph.D.(McG.), F.R.S.C *(William C. Macdonald Emeritus Professor of Physics)*
R.T. Sharp; B.Sc., M.Sc., Ph.D.(McG.)
Martin J. Zuckermann; M.A., D.Phil.(Oxon.), F.R.S.C. *(William C. Macdonald Emeritus Professor of Physics)*

Post-Retirement
Andreas P. Contogouris; B.A.(Athens), Ph.D.(C'nell)
Jonathan K.P. Lee; B.Eng., M.Sc., Ph.D.(McG.)
David G. Ryan; B.Sc., M.Sc.(Queen's), Ph.D.(Birm.)

Professors
Jean Barrette; B.Sc., M.Sc., Ph.D.(Montr.)
Clifford P. Burgess; B.Sc.(Waterloo), Ph.D.(Texas)
John E. Crawford; B.A., M.A.(Tor.), Ph.D.(McG.)
Subal Das Gupta; B.A., M.Sc.(Calc.), Ph.D.(McM.)
Nicholas DeTakacsy; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)
Martin Grant; B.Sc.(P.E.I.), M.Sc., Ph.D.(Tor.)
Hong Guo; B.Sc.(Sichuan), M.Sc., Ph.D.(Pitt.)
Richard Harris; B.A.(Oxon.), D.Phil.(Sus.)
Harry C.S. Lam; B.Sc.(McG.), Ph.D.(M.I.T.) *(E. Rutherford Professor of Physics)*
Shaun Lovejoy; B.A.(Cantab.), Ph.D.(McG.)
Tommy S.K. Mark; B.Sc., M.Sc., Ph.D.(McG.)
Robert B. Moore; B.Eng., M.Sc., Ph.D.(McG.)
Robert Myers; B.Sc.(Wat.), M.A., Ph.D.(Prin.)
Popat M. Patel; B.Sc., M.Sc.(Manc.), Ph.D.(Harv.)
Douglas G. Stairs; B.Sc., M.Sc.(Queen's), Ph.D.(Harv.) *(William C. Macdonald Professor of Physics)*
John O. Strom-Olsen; B.A., M.S., Ph.D.(Cantab.)
Mark Sutton; B.Sc., M.Sc., Ph.D.(Tor.)
John M. Trischuk; B.Eng.(McG.), Ph.D.(Cal. Tech.)

Associate Professors
François Corriveau; B.Sc.(Laval), M.Sc.(U.B.C.), Docteur Sc.Nat.(Zär)
Charles Gale; B.Sc.(Ott.), M.Sc., Ph.D.(McG.)
Peter Grutter; Dipl., Ph.D.(Basel) *(William Dawson Scholar)*
David Hanna; B.Sc.(McG.), M.A., Ph.D.(Harv.)
Kenneth J. Ragan; B.Sc.(Alta.), Ph.D.(Geneva)
Dominic H. Ryan; B.A., Ph.D.(Trin.Coll.)

Assistant Professor
James M. Cline; B.Sc.(Calif.), M.Sc., Ph.D.(Cal Tech.)

Lecturers
Z. Altounian; B.Sc., M.Sc.(Cairo), Ph.D.(McM.)
F. Buchinger; M.Sc., Dr.(Mainz)

Associate Members
R. Davies *(Atmospheric & Oceanic Sciences),*
B.C. Eu *(Chemistry),* G. Fallone *(Radiation Oncology),*
M. Mackey *(Physiology),* E. Podgorsak *(Radiation Oncology),*
D. Ronis *(Chemistry)*

Curator (Rutherford Museum and McPherson Collection)
M. Cohen; B.Sc., Ph.D.(Lond.), F.Inst.P., A.R.C.S.

Physics is in many ways the parent of the other natural sciences and its discoveries and laws continually affect their development. Its range and scope extend in space and time from subnuclear particles to the universe itself. The subfields of physics such as mechanics, thermodynamics, electricity, atomic physics and quantum mechanics, to mention but a few, permeate all other scientific disciplines. People trained in physics are employed in industry, government, and educational systems where they find many challenges as teachers, researchers, administrators and in the rapidly developing area of scientific business.

The two main undergraduate programs in Physics at McGill are the Honours and the Major.The Honours program is highly specialized and the courses are very demanding.This program is appropriate for students who wish to make an in-depth study of the subject in preparation for graduate work and an academic or professional career in physics. The Joint Honours in Mathematics and Physics is an even more specialized and demanding program, intended for students who wish to develop a strong basis in both mathematics and physics in preparation for graduate work and a professional or academic career. Although the program is optimized for theoretical physics, it is broad enough and strong enough to prepare students for further study in either experimental physics or mathematics. High standing in CEGEP or Freshman-year mathematics and physics is a requirement for admission to these Honours programs.

The Major program, on the other hand, offers a broad training in classical and modern physics and yet leaves room for the student to take a meaningful sequence of courses in other areas. It is intended primarily for students who wish to pursue careers in fields for which physics provides a basis. However this program also provides a preparation for graduate studies, especially if a student chooses, in consultation with the departmental adviser, a number of Honours Physics courses in the U2 and U3 years.

There are also a number of other Major programs: Atmospheric Sciences and Physics, Physics and Computer Science, Physics and Geophysics, and Physiology and Physics, offered jointly with other departments, and a Minor program in Electrical Engineering, available only to students in the Physics Major program. In addition, there is a Minor in Physics, a Faculty program in Physics and a Joint Faculty program in Mathematics, Chemistry and Physics, which provide a broad base for students less interested in a specialized education. Almost all the Physics programs can be combined with an Internship Year, as part of the University's IYES program, which provides experience in an industrial or government laboratory as part of the degree program.

For those interested in a career as a high school science teacher, the concurrent program leading to both a B.Sc. and a B.Ed. degree provides two Physics options. Both of these combine physics courses from the Major program with Education courses. They are, respectively, the Major program in Chemistry and Physics for Teachers, and the Major program in Mathematics and Physics for Teachers. (For details, see the Science for Teachers section.)

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

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

Courses 198-200A, 198-204A,B and 198-224A are designed for students from faculties other than Science (such as Arts and Music) and have no prerequisites as such, although a reasonable knowledge of high-school level algebra, geometry and trigonometry is desirable.

The block of numbers 198-205A, 198-206A, 198-207A and 198-208A has been reserved for a series of courses "Introduction to Selected Topics in Physics". These courses, of one credit each, will introduce topics in physics which are of current interest. Topics given under numbers 198-205 or 198-206 will have CEGEP Physics* as prerequisite; those given under number 198-208 will have no Physics prerequisite. The topics will vary from year to year. For further information, enquire at the Department of Physics.

All other 200-level courses are designed primarily for Science students and assume successful completion of CEGEP level physics* and mathematics programs. The phrase "Prerequisite CEGEP Physics*" has been inserted to make this point clear. Stu-

dents who have not included Calculus III in their CEGEP program, should register in the first term of the U1 year for Mathematics 189-222.

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

**CEGEP objectives 00UR, 00US, 00UT or equivalent .*

SCIENCE FRESHMAN PROGRAM

Students entering McGill with a Québec CEGEP profile in Science will normally begin their programs in Physics with courses at the 200 level.

Students without this profile will normally take courses 198-131A and 198-142B if they have previously taken physics at the high school level and will be taking differential calculus concurrently with 198-131A and integral calculus concurrently with 198-142B. Those students who have not previously taken physics at the high school level and who intend to do programs in the Biological Sciences may instead take courses 198-101A and 198-102B. All students are expected to have reasonable fluency in algebra, geometry and trigonometry at the high school level. If this is not the case, then Mathematics 189-112A should be taken concurrently with 198-101A. Those for whom this is not necessary are advised to take 189-139A concurrently with 198-101A.

MINOR PROGRAM IN PHYSICS (18 credits)
[MARS Program Code 6-720000]

The 18-credit Minor permits no overlap with any other programs. It contains no Mathematics courses, although many of the courses in it have Math pre- or co-requisites. It will, therefore, be particularly appropriate to students in Mathematics, but it is also available to any Science student with the appropriate mathematical background.

Students in certain programs (e.g. the Major in Chemistry) will find that there are courses in the Minor which are already part of their program, or which they may not take for credit because of a substantial overlap of material with a course or courses in their program. After consultation with an adviser, such students may complete the Minor by substituting any other physics course(s) from the Major or Honours Physics programs.

Required Course (3 credits)
198-257A (3) Experimental Methods I

Complementary Courses (15 credits)
15 credits to be selected as follows:
198-230A (3) Dynamics of Simple Systems
or 198-251A (3) Classical Mechanics I
198-271A,B (3)
or 198-260A (3) Relativity and Modern Physics
or 198-214 (3) Astrophysics
or 198-225B (3) Musical Acoustics
198-232B (3) Heat and Waves
or 198-253A (3) Thermal Physics
198-258B (3) Experimental Methods II
or 198-241B (3) Signal Processing
198-340A (3) Electricity and Magnetism
or 198-350A (3) Electromagnetism

FACULTY PROGRAM IN PHYSICS (54 credits)
[MARS Program Code 4-720000]
Required Courses (36 credits)
198-230A (3) Dynamics of Simple Systems
198-232B (3) Heat and Waves
198-257A (3) Experimental Methods I
198-258B (3) Experimental Methods II
198-333B (3) Thermal and Statistical Physics
198-340A (3) Electricity and Magnetism
198-436B (3) Modern Physics
198-446A (3) Quantum Physics
189-222A,B (3) Calculus III
189-223A,B (3) Linear Algebra
189-314A,B (3) Advanced Calculus
189-315A,B (3) Ordinary Differential Equations

Complementary Courses (18 credits)
at least 3 credits selected from:
198-241B (3) Signal Processing
198-434B (3) Optics
198-439A (3) Lab in Modern Physics
the remainder selected from:
198-328A (3) Electronics
198-331B (3) Mechanics
198-339B (3) Measurements Laboratory
198-342B (3) Electromagnetic Waves
186-320A (3) Elementary Earth Physics
189-316B (3) Functions of a Complex Variable
189-317A (3) Numerical Analysis
189-319B (3) Partial Differential Equations
308-202A,B (3) Introduction to Computing 1

JOINT FACULTY PROGRAM IN MATHEMATICS, CHEMISTRY AND PHYSICS See page 399 in the Mathematics and Statistics entry for complete program information.

MAJOR PROGRAM IN PHYSICS (60 credits)
[MARS Program Code 1-720000]
(Program revisions awaiting University approval)

U1 Required Courses (21 credits)
198-230A (3) Dynamics of Simple Systems
198-232B (3) Heat and Waves
198-257A (3) Experimental Methods I
198-258B (3) Experimental Methods II
189-222A (3) Calculus III
189-223A (3) Linear Algebra
198-241B (3) Signal Processing

U2 Required courses (24 credits)
198-328A (3) Electronics
198-331B (3) Mechanics
198-333B (3) Thermal & Statistical Physics
198-339B (3) Measurements Laboratory
198-340A (3) Electricity and Magnetism
198-342B (3) Electromagnetic Waves
189-314A (3) Advanced Calculus
189-315B (3) Ordinary Differential Equations

U3 Required Courses (15 credits)
198-434B (3) Optics
198-436B (3) Modern Physics
198-439A (3) Lab in Modern Physics
198-446A (3) Quantum Physics
198-449B (3) Project Laboratory

JOINT MAJOR PROGRAM IN PHYSICS AND GEOPHYSICS
(68 credits) [MARS Program Code 1-720400]
(Program revisions awaiting University approval)

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

U1 Required Courses (29 credits)
198-230A (3) Dynamics of Simple Systems
198-232B (3) Heat and Waves
198-257A (3) Experimental Methods I
198-258B (3) Experimental Methods II
186-203B (3) Structural Geology I
186-210A (3) Introduction to Mineralogy
186-231E (2) Field School I
189-222A (3) Calculus III
189-223A (3) Linear Algebra
189-314B (3) Advanced Calculus

U2 Required Courses (18 credits)
198-339B (3) Measurements Laboratory
198-340A (3) Electricity and Magnetism
186-320B (3) Elementary Earth Physics
186-350B (3) Tectonics
189-315A (3) Ordinary Differential Equations
189-319B (3) Partial Differential Equations

U2 or U3 Required Courses (6 credits)
186-330B (3) Earthquakes & Earth Structure
186-510B (3) Geodynamics and Geomagnetism

U3 Required Courses (15 credits)
198-331B (3) Mechanics
198-332B (3) Physics of Fluids
198-333B (3) Thermal & Statistical Physics
198-342B (3) Electromagnetic Waves
198-446A (3) Quantum Physics

JOINT MAJOR PROGRAM IN ATMOSPHERIC SCIENCE AND PHYSICS Students should consult undergraduate advisers in both departments. See page 361 in the Atmospheric and Oceanic Sciences section for complete program information.

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

JOINT MAJOR IN PHYSICS AND COMPUTER SCIENCE
(66 credits) [MARS Program Code 1-720300]

The Joint Major in Physics and Computer Science is designed to give motivated students the opportunity to combine the two fields in a way that will distinguish them from the B.Sc.'s in either field by itself. The two disciplines complement each other, with physics providing an analytic problem-solving outlook and basic understanding of nature, while computer science enhances the ability to make practical and marketable applications, in addition to having its own theoretical interest. Graduates of this program may be able to present themselves as being more immediately useful than a pure physics major, but with more breadth than just a programmer. They will be able to demonstrate their combined expertise in the Special Project course which is the centerpiece of the final year of the program.

U1 Required Courses (21 credits)
189-222A,B (3) Calculus III
189-223A,B (3) Linear Algebra
189-240A (3) Discrete Structures and Computing
198-230A (3) Dynamics of Simple Systems
198-257A (3) Experimental Methods I
198-258B (3) Experimental Methods II
308-250A (3) Introduction to Computer Science

U2 Required Courses (24 credits)
189-314A,B (3) Advanced Calculus
189-315A,B (3) Differential Equations
198-232B (3) Heat and Waves
198-241B (3) Signal Processing
308-251A,B (3) Data Structures and Algorithms
308-302A,B (3) Programming Languages and Paradigms
308-350A (3) Numerical Computing
308-360A (3) Algorithm Design Techniques

U3 Required Courses (21 credits)
189-323A,B (3) Probability Theory
198-331B (3) Mechanics
198-339B (3) Measurements Laboratory
198-340A (3) Electricity and Magnetism
198-446A (3) Quantum Physics
198-489B (3) Special Project
308-557B (3) Fundamentals of Computer Graphics

JOINT MAJOR PROGRAM IN PHYSIOLOGY AND PHYSICS
See pag e421 in the Physiology section for complete program information.

The Major program in Physiology and Physics provides a firm basis for graduate work in Bio-physics and other interdisciplinary fields involving the physical and biological sciences.

HONOURS PROGRAM IN PHYSICS (78 credits)
[MARS Program Code 2-720000]
(Program revisions awaiting University approval)

Students entering this program for the first time should have high standing in mathematics and physics. In addition, a student who has not completed the equivalent of 189-222 must take it in the first term without receiving credits toward the 78 credits required in the Honours program.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C, may not register in the Honours program the following year, or graduate with the Honours degree, except with the permission of the Department.

U1 Required Courses (27 credits)
198-241B (3) Signal Processing
198-251A (3) Classical Mechanics I
198-257A (3) Experimental Methods I
198-258B (3) Experimental Methods II
198-260A (3) Relativity and Modern Physics
189-247B (3) Linear Algebra
189-248A (3) Advanced Calculus I
189-249B (3) Advanced Calculus II
189-325B (3) Ordinary Differential Equations

U2 Required Courses (24 credits)
198-253A (3) Thermal Physics
198-350A (3) Electromagnetism
198-357A (3) Quantum Physics I
198-359B (3) Lab in Modern Physics
198-362B (3) Statistical Mechanics
198-451B (3) Classical Mechanics
198-457B (3) Quantum Physics II
189-375A (3) Differential Equations

U3 Required Courses (6 credits)
198-551A (3) Quantum Theory
198-352A (3) Electromagnetic Waves

U3 Complementary Courses (21 credits)
6 credits selected from:
198-459D (6) Honours Research Project
198-469A (3) Lab in Modern Physics II
198-479B (3) Honours Project Lab
15 credits selected from:
198-332B (3) Physics of Fluids
198-434B (3) Optics
198-514B (3) General Relativity
198-557A (3) Nuclear Physics
198-558A (3) Solid State Physics
198-559A (3) Advanced Statistical Mechanics
198-562B (3) Electromagnetic Theory
198-567B (3) Particle Physics
or other 3-credit course approved by the Department of Physics

JOINT HONOURS PROGRAM IN MATHEMATICS AND PHYSICS (81 credits) [MARS Program Code 3-634500]
(Program revisions awaiting University approval)

This is a specialized and demanding program intended for students who wish to develop a strong basis in both Mathematics and Physics in preparation for graduate work and a professional or academic career. Although the program is optimized for theoretical physics, it is broad enough and strong enough to prepare students for further study in either experimental physics or in mathematics.

The minimum requirement for entry into the program is completion with high standing of the usual CEGEP courses in physics and in mathematics. In addition, a student who has not completed the equivalent of 189-222 must take it in the first term without receiving credits toward the 8 1credits required in the Joint Honours program.

To remain in the Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GPA in the required and complementary courses, and a grade of C or better in each required or complementary course.

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

U1 Required Courses (27 credits)
198-241B (3) Signal Processing
198-251A (3) Classical Mechanics I
198-257A (3) Experimental Methods I
198-258B (3) Experimental Methods II
198-260A (3) Relativity and Modern Physics
189-248A (3) Advanced Calculus I
189-249B (3) Advanced Calculus II
189-325B (3) Ordinary Differential Equations
189-235A (3) Algebra I

U1 Complementary Course (3 credits)
3 credits selected from:
189-251B (3) Algebra II
189-247B (3) Linear Algebra

U2 Required Courses (27 credits)
198-253A (3) Thermal Physics
198-350A (3) Electromagnetism
198-357A (3) Quantum Physics I
198-362B (3) Statistical Mechanics
198-451B (3) Classical Mechanics
198-457B (3) Quantum Physics II
189-242A (3) Analysis I
189-255B (3) Analysis II
189-375A (3) Differential Equations

U3 Required Courses (12 credits)
198-352A (3) Electromagnetic Waves
198-359B (3) Lab in Modern Physics
189-354A (3) Analysis III
189-380B (3) Differential Geometry

U3 Complementary Courses (12 credits)
3 credits selected from:
189-370A (3) Algebra III
189-355B (3) Analysis IV
6 credits selected from:
198-514B (3) General Relativity
198-551A (3) Quantum Theory
198-557A (3) Nuclear Physics
198-558A (3) Solid State Physics
198-559A (3) Advanced Statistical Mechanics
198-562B (3) Electromagnetic Theory
198-567B (3) Particle Physics
3 credits in Honours Mathematics

MINOR PROGRAM IN ELECTRICAL ENGINEERING
(23 or 2 5credits) [Program registration done by Student Affairs Office]

The Minor program does not carry professional recognition. Only students who satisfy the requirements of the Major in Physics are eligible for this Minor. Students registered for this option cannot count 198-241 towards the requirements of the Major in Physics, and should replace this course by another Physics or Mathematics course. Students who select 304-334 in the Minor cannot count 198-328 towards the requirements of the Major in Physics, and should replace this course by another Physics or Mathematics course.

Required Courses (17 or 19 credits)
304-200 (3) Fundamentals of Electrical Engineering
304-210 (5) Circuit Analysis
304-303 (3) Signals and Systems
304-330 (3) Electronic Circuits
304-305 (3) Probability and Random Signals
or 304-334 (5) Electronic Circuits II

Complementary Courses (6 credits)

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

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

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

COURSE DESCRIPTIONS

All courses have limited enrolment.

The names of course instructors are listed on the Course Timetable available on ***info*McGill** via the Web http://www.mcgill.ca/students/courses/ or check the Department's Web page http://www.physics.mcgill.ca.

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

NOTE: In general, Honours courses are indicated when the fifth character of the six digit course number is 5 or higher.

● Denotes courses not offered in 2001-02.
★ Denotes courses offered only in alternate years

198-101A INTRODUCTORY PHYSICS – MECHANICS. (4) (3hours lectures; 2 hours laboratory; tutorial sessions) (Not open to students taking or having taken 198-131A, CEGEP objective 00UR or equivalent.) The object of this course is to give the students a basic understanding of the principles of physics, illustrating these, where possible, with current examples of their use in biology and medicine. (Laboratory sections have limited enrolment.)

198-102B INTRODUCTORY PHYSICS – ELECTROMAGNETISM. (4) (3 hours lectures; 2 hours laboratory; tutorial sessions) (Prerequisite: 198-101. Corequisite: 189-139) (Not open to students taking or having taken 198-142B, CEGEP objective 00UR or equivalent.) Electric field and potential. D.C. circuits and measurements. Capacitance. Magnetic field and induction. A.C. circuits Semiconductor devices and their application. Electromagnetic waves. (Laboratory sections have limited enrolment.)

These courses, 101A and 102B together satisfy the minimum requirement in physics for Medical School.

198-109D GENERAL PHYSICS LABORATORY. (2) (2hours laboratory) (Not open to students who have taken or are taking 198-101 or 198-102.) The laboratory component of 198-101A and 198-102B. May be taken only by students who have completed the lecture component but not the laboratory of 198-101 and 198-102.

198-119D GENERAL PHYSICS LABORATORY. (2) (3 hours laboratory) The laboratory component of 198-131A and 198-142B. This course may be taken only by students who have completed the lecture components of these courses but not the laboratory.

198-131A MECHANICS AND WAVES. (4) (3 hours lectures; 1 hour tutorial, 3 hours laboratory in alternate weeks; tutorial sessions) (Corequisite: 189-139A) (Not open to students taking or having taken 198-101A, CEGEP objective 00UR or equivalent.) The basic laws and principles of Newtonian mechanics; oscillations and waves. (Laboratory sections have limited enrolment.)

198-142B ELECTROMAGNETISM & OPTICS. (4) (3hours lectures, 3 hours laboratory in alternate weeks; tutorial sessions) (Prerequisite: 198-131A. Corequisite: 189-141B) (Not open to students taking or having taken 198-102B, CEGEP objective 00UR or equivalent.) The basic laws of electricity and magnetism; geometrical and physical optics. (Laboratory sections have limited enrolment.)

198-200A SPACE, TIME & MATTER. (3) (3 hours lectures) (Not open to students in a Physics program.) A nonmathematical, conceptual look at physics, beginning with the idea of space and time, continuing with the historical development of Newtonian mechanics of celestial motion, electricity and magnetism, ether and light, Einstein's special and general theories of relativity, quantum mechanics, matter and antimatter, cosmology and the big bang.

198-204A,B PLANETS, STARS & GALAXIES. (3) (3hours lectures; 3 evening periods for star identification and use of telescopes.)

(Not open to students who have taken or are taking 198-214A.) An elementary astronomy course for non-science students (see "Science for Arts Students" in the Arts section) and for science students not taking a Physics program.

198-208A TOPICS IN PHYSICS. (1 credit; 2 hours lectures, first six weeks) (Not open to students in Physics programs.) Topic for 2001-02: The Safe Use of Nuclear Radiation.

198-214A ASTROPHYSICS. (3) (Prerequisite: CEGEP Physics.) (Not open to students who have taken or are taking 198-204A,B.) An introduction to astrophysics with emphasis placed on methods of observation and current models. Stellar radiation and detectors, stellar classification systems, structures and evolution. Pulsars, quasars, black holes. Galaxies, large scale structure of the university, cosmology.

198-224A PHYSICS & PSYCHOPHYSICS OF MUSIC. (3) (3hours lectures) (Designed for students in the Faculty of Music but suitable for students with an interest in music, and how it is perceived.) An introduction to physics and psychophysics of music with demonstrations of the relevant phenomena and the theories explaining them. Pitch, loudness and timbre in the context of the physics properties of the human ear. The basic physics of music production including modes of oscillation of mechanical systems, resonance, feedback, transmission and reflection of sound. The human voice. Modern methods of sound production using electrical analogue devices and digital computers. Room reverberation and acoustics.

198-225B MUSICAL ACOUSTICS. (3) (3 hours lectures) (Prerequisites: CEGEP physics or both 189-112 and 198-224A) (Designed for students in music who have interests in sound recording and reproduction and also suitable for students in science with an interest in music.) Physical acoustics with applications to music. Resonators and radiators, acoustic impedance. Acoustic properties of strings, bars, membranes, pipes and horns. Application to selected musical instruments. Direction characteristics of sound sources. Room acoustics.

198-230A DYNAMICS OF SIMPLE SYSTEMS. (3) (3 hours lectures) (Prerequisite: CEGEP physics. Corequisite: Mathematics 189-222A) (Not open to students taking or having passed 198-251A.) Translational motion under Newton's laws; forces, momentum, work/energy theorem. Special relativity; Lorentz transforms, relativistic mechanics, mass/energy equivalence. Topics in rotational dynamics. Noninertial frames.

198-232B HEAT AND WAVES. (3) (3 hours lectures) (Prerequisite: 198-230A) (Not open to students taking or having passed 198-253B.) First and second laws of thermodynamics, kinetic theory of gases, optical interference, polarization, electro-optics, physics of microscopic systems.

● **198-240B COMPUTERS FOR PHYSICS.** (3) (2hours lectures, 3 hours laboratory) (Prerequisite 198-230A or 198-251A) (Restricted to students in first year Honours and Majors physics or by permission of instructor.)

198-241B SIGNAL PROCESSING. (3) (2hours lectures; 3hours laboratory alternate weeks) (Prerequisite: CEGEP physics) Linear circuit elements, resonance, network theorems, diodes, transistors, amplifiers, feedback, integrated circuits.

198-242B ELECTRICITY & MAGNETISM. (2) (2 hours lectures) (Prerequisites CEGEP Physics, 189-222A,B) Properties of electromagnetic fields, dipole and quadropole fields and their interactions, chemical binding of molecules, electromagnetic properties of materials, Maxwell's equations and properties of electromagnetic waves, propagation of waves in media.

198-251A CLASSICAL MECHANICS I. (3) (3 hours lectures) (Prerequisite: CEGEP physics. Corequisite: 189-222A) (Not open to student taking or having taken 198-230A.) Newton's laws, work and energy, angular momentum. Harmonic oscillator, forced oscillations. Inertial forces, rotating frames. Central forces, centre of mass, planetary orbits, Kepler's laws.

● **198-253A THERMAL PHYSICS.** (3) (3 hours lectures) (Prerequisite: CEGEP physics. Corequisite: 189-222A,B) (Not open to students taking or having taken 198-232B.)

198-257A EXPERIMENTAL METHODS I. (3) (6 hours of laboratory and classroom work) (Co-requisite: 198-230A or 198-251A) Introductory laboratory work and data analysis as related to mechanics, optics and thermodynamics. Introduction to computers as they are employed for laboratory work, for data analysis and for numerical computation. Previous experience with computers is an asset, but is not required.

198-258B EXPERIMENTAL METHODS II. (3) (6 hours of laboratory and classroom work) (Prerequisite: 198-257A) Advanced laboratory work and data analysis as related to mechanics, optics and thermodynamics. Computers will be employed routinely for data analysis and for numerical computation, and, particularly, to facilitate the use of Fourier methods.

● **198-259D LAB IN MECHANICS, HEAT & OPTICS.** (3) (3 hours) (Prerequisite: CEGEP physics. Corequisite: 198-230A or 198-251A and 198-232B or 198-253B.)

198-260A RELATIVITY AND MODERN PHYSICS. (3) (3hours lectures. Corequisite: 189-222A.) History of special relativity; Lorentz transformations: kinematics and dynamics; transformation of electric and magnetic forces; introduction to topics in modern physics.

198-328A ELECTRONICS. (3) (2 hours lectures; 3 hours laboratory) (Prerequisite: 198-241B or permission of instructor.) Semiconductor devices, basic transistor circuits, operational amplifiers, combinatorial and sequential logic, integrated circuits, analogue to digital converters. The laboratory component covers design, construction and testing of basic electronic circuits. (Prerequisite revision awaiting University approval)

198-331B MECHANICS. (3) (3 hours lectures) (Prerequisite: 198-230A. Corequisite: 189-315A,B) (Not open to students having passed 198-451A.) Forced and damped oscillators, Newtonian mechanics in three dimensions, rotational motion, Lagrangian mechanics, small vibrations, normal modes. Introduction to Hamiltonian mechanics.

198-332B PHYSICS OF FLUIDS. (3) (3 hours lectures) (Prerequisites: 198-230A, 189-223A, 189-314B, 189-315B) The physical properties of fluids. The kinematics and dynamics of flow. The effects of viscosity and turbulence. Applications of fluid mechanics in biophysics, geophysics and engineering.

198-333B THERMAL & STATISTICAL PHYSICS. (3) (3 hours lectures) (Prerequisite:198-232B) (Not open to students taking or having passed 198-362B.) Introductory equilibrium statistical mechanics. Quantum states, probabilities, ensemble averages. Entropy, temperature, Boltzmann factor, chemical potential. Photons and phonons. Fermi-Dirac and Bose-Einstein distributions; applications.

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

198-339B MEASUREMENTS LABORATORY. (3) (6 hours) (Prerequisite: 198-241B) Introduction to modern techniques of measurement. The use of computers in performing and analysing experiments. Data reduction, statistical methods, report writing. Extensive use of computers is made in this laboratory; therefore some familiarity with computers and computing is an advantage.

198-340A ELECTRICITY AND MAGNETISM. (3) (3 hours lectures) (Prerequisites: CEGEP physics, Mathematics 189-222A,B, 189-223A,B. Corequisites: 189-314A, 189-315A or equivalent. Not open to students who have passed 198-242B or 198-350A.) The electrostatic field and scalar potential. Dielectric properties of matter. Energy in the electrostatic field. Methods for solving problems in electrostatics. The magnetic field. Induction and inductance.

Energy in the magnetic field. Magnetic properties of matter. Maxwell's equations. A vector treatment.

198-342B ELECTROMAGNETIC WAVES. (3) (3 hours lectures) (Prerequisites: 198-340A or 198-242A,B, Mathematics 189-314A,B, 189-315A,B) (Not open to students having passed 304-357A.) Maxwell's equations. The wave equation. The electromagnetic wave, reflection, refraction, polarization. Guided waves. Transmission lines and wave guides. Vector potential. Radiation. The elemental dipole; the half-wave dipole; vertical dipole; folded dipoles; Yagi antennas. Accelerating charged particles.

198-350A ELECTROMAGNETISM. (3) (3 hours lectures) (Prerequisites: 189-248A,B, 189-325B. Honours students, or permission of the instructor.) (Not open to students having taken 198-340A.) Fundamental laws of electric and magnetic fields in both integral and differential form.

198-352A ELECTROMAGNETIC WAVES. (3) (3 hours lectures) (Prerequisite: 198-350A. Honours students, or permission of the instructor.) Vector and scalar potentials; plane waves in homogeneous media; refraction and reflection; guided waves; radiation from simple systems; dipole and quadrupole radiation; introduction to fields of moving charges; synchrotron radiation; Bremsstrahlung.

198-357A QUANTUM PHYSICS I. (3) (3 hours lectures) (Honours students or permission of instructor.) (Not open to students taking or having passed 198-446A.) Experimental basis for quantum mechanics; wave-packets; uncertainty principle. Hilbert space formalism. Schrodinger equation: eigenvalues and eigenvectors: applications to 1-d problems including the infinite and finite potential wells and the harmonic oscillator. Tunneling. Time independent perturbation theory.

198-359B LABORATORY IN MODERN PHYSICS. (3) (6hours) (Corequisite: 198-457B. Honours students or permission of instructor.) Advanced level experiments in modern physics stressing quantum effects and some properties of condensed matter. (Prerequisite revision awaiting University approval)

198-362B STATISTICAL MECHANICS. (3) (3 hours lectures) (Prerequisites: 189-248B or equivalents, 198-253B. Honours students, or permission of the instructor.) (Not open to students taking or having taken 198-333B.) Quantum states and ensemble averages. Fermi-Dirac, Bose-Einstein and Boltzmann distribution functions and their applications.

★198-413A THE PHYSICAL BASIS OF PHYSIOLOGY. (3) (3 hours lectures) (Prerequisite: 189-315A,B, or 189-325B, and permission of the instructor.) (Intended for Major or Honours students in Physics, Physiology, Physiology and Physics, or Mathematics and others with permission.) Analytic and computer simulation techniques are used to examine the role of nonlinearities and time delays in determining the dynamic behaviour of physiological control systems and their relation to normal and pathophysiological states. Examples drawn from the control of respiration, cellular proliferation and differentiation, biochemical feedback networks, thermoregulatory mechanisms, and neural feedback.

198-434B OPTICS. (3) (3 hours lectures) Geometrical optics, wave optics, lasers, Fourier transform spectroscopy, holography, optical data processing, stellar interferometry.

198-436B MODERN PHYSICS. (3) (3 hours lectures) (Prerequisite: 198-446A) (Not open to students in Honours Physics or in Joint Honours in Mathematics and Physics.) One electron atoms, radiation, multielectron atoms, molecular bonds. Selected topics from condensed matter, nuclear and elementary particle physics.

198-439A LABORATORY IN MODERN PHYSICS. (3) (6hours) (Prerequisite: 198-339B. Corequisite: 198-446A.) (Not open to students with credit in 198-359B except with permission of instructor.) Advanced level experiments in modern physics stressing quantum effects and some properties of condensed matter.

198-446A QUANTUM PHYSICS. (3) (3 hours lectures) (Prerequisite: 198-230A and 198-232B, or 198-251A) (Not open to students taking or having taken 198-357A or 198-457B.) de Broglie waves, Bohr atom. Schroedinger equation, wave functions, observables. One dimensional potentials. Schroedinger equation in three dimensions. Angular momentum, hydrogen atom. Spin, experimental consequences.

198-449B PROJECT LABORATORY. (3) (6 hours) (Prerequisite: 198-328A, 198-439A) Supervised project work in an area related to material covered in upper year courses.

198-451B CLASSICAL MECHANICS. (3) (3hours lectures) (Prerequisite: 198-251A. Honours students, or permission of instructor.) (Not open to students having taken 198-331B.) Rigid bodies, angular momentum, gyroscope, moment of inertia, principal axes, Euler's equations. Coupled oscillations and normal modes. Lagrangian mechanics and applications. Hamiltonian mechanics. Topics in advanced analytical mechanics.

198-457B QUANTUM PHYSICS II. (3) (3hours lectures) (Honours students or permission of instructor.) (Not open to students having taken 198-446A.) Angular momentum and spin operators. Operator methods in quantum mechanics. Coupling of spin and angular momenta. Variational principles and elements of time dependent perturbation theory (the Golden Rule). Solution of the Schrodinger equation in three dimensions. Applications to the hydrogen and helium atoms and to simple problems in atomic and molecular physics.

198-459D HONOURS RESEARCH PROJECT. (6) (6 hours) (Honours students or permission of instructor.) (Not open to students taking the sequence 198-469A/198-479B.) An experimental project, supervised by members of staff, on some topic related to the ongoing research in the department.

198-469A LAB IN MODERN PHYSICS II. (3) (6hours) (Honours students, or permission of instructor) (Prerequisite: 198-359B) (Not open to students taking 198-459D.) Advanced level experiments in modern physics stressing quantum effects and some properties of condensed matter. Continuation of 198-359B.

198-479B HONOURS PROJECT LAB. (3) (6hours) (Honours students, or permission of instructor) (Prerequisite 198-469A) (Not open to students taking 198-459D.) Supervised project work in an area related to material covered in upper year courses.

198-489B SPECIAL PROJECT. (3) (6 hours) (Only open to students in their final year of the Joint Major in Physics and Computer Science after consultation with the adviser(s) for the program.) A project incorporating aspects of both physics and computer science, under the joint supervision of the two departments. The Physics aspect may be either laboratory-based or theoretical in nature. The Computational aspect will involve the development and implementation of algorithms arising from the investigation.

198-514B GENERAL RELATIVITY. (3) (3 hours lectures) (Honours students, or permission of the instructor.) Transition from special to general relativity. Non-Euclidian geometry. The basic laws of Physics in co-variant form, Einstein's equations. Gravitational waves; neutron stars; black holes; cosmology.

198-534A NANOSCIENCE AND NANOTECHNOLOGY. (3) (Prerequisites: 180-334, 198-334 or permission of instructor. Corequisites: one of 180-345, 198- 357, or 198-446 or permission of instructor. Not open to students who have taken or are taking 180-534.) Topics include scanning probe microscopy, chemical selfassembly, computer modeling, and microfabrication/micromachining.

198-551A QUANTUM THEORY. (3) (3 hours lectures) (Honours students, or permission of the instructor.) General formulation, scattering theory, WKBJ approximation, time-dependent perturbation, theory and applications, angular momentum, relativistic wave equations.

198-557A NUCLEAR PHYSICS. (3) (3 hours lectures) (Honours students, or permission of the instructor.) General nuclear properties, nucleon-nucleon interaction and scattering theory, radioactivity, nuclear models, nuclear reactions.

198-558A SOLID STATE PHYSICS. (3) (3 hours lectures) (Honours students, or permission of the instructor.) Properties of crystals, lattice vibrations and thermal properties of insulators, free electron model and band structure, semi-conductors, metals, optical properties.

198-559A ADVANCED STATISTICAL MECHANICS. (3) (3hours lectures) (Honours students, or permission of the instructor.) Self averaging and central-limit theorem; thermodynamic fluctuations; ensemble theory; surface roughening; broken symmetry and Goldstone's theorem; phase transitions; mean-field, Landau and Ornstein-Zernicke theory; Monte Carlo method; molecular dynamics; scaling; renormalization group; epsilon expansion; non-equilibrium theory.

198-562B ELECTROMAGNETIC THEORY. (3) (3 hours lectures) (Honours students, or permission of the instructor.) Electrostatics, dielectrics, magnetostatics, timevarying fields, relativity, radiating systems, fields of moving charges.

198-567B PARTICLE PHYSICS. (3) (3 hours lectures) (Honours students, or permission of the instructor.) Survey of elementary particles; hadrons, leptons and hardrons' constituents (quarks). Invariance principles and conservation laws. Detectors and accelerators. Phenomenology of strong, electomagnetic and weak interactions.

11.25 Physiology (552)

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Chair — Alvin Shrier

Emeritus Professors
G. Melvill Jones; B.A., M.A., M.B., B.Ch., M.D.(Cantab.)
Kresmir Krnjevic; O.C., B.Sc., Ph.D., M.B., Ch.B.(Edin.), F.R.S.C.

Professors
Catherine Bushnell; B.A.(Maryland), Ph.D.(American U.) (*Harold Griffith Professor of Anaesthesia) (joint appt. with Dentistry)*
Thomas M.S. Chang; B.Sc., M.D., C.M., Ph.D.(McG.), F.R.C.P.(C)
Monroe W. Cohen; B.Sc., Ph.D.(McG.)
Ellis J. Cooper; B.Eng.(Sir G.Wms.), M.Sc.(Surrey), Ph.D.(McM.)
Mony M. Frojmovic; B.Sc., Ph.D.(McG.)
Leon Glass; B.S.(Brooklyn), Ph.D.(Chic.)
Phil Gold; C.C., B.Sc., M.Sc., Ph.D., M.D.,C.M.(McG.), F.R.C.P.(C.), F.R.S.C. *(joint appt. with Medicine)*
David Goltzman; B.Sc., M.D.,C.M.(McG.) *(Antoine G. Massabki Professor of Medicine) (joint appt. with Medicine)*
John Hanrahan; Ph.D.(U.B.C.)
James L. Henry; B.Sc.(Tor.), M.Sc., Ph.D.(W.Ont.)
Robert E. Kearney; B.Eng., M.Eng., Ph.D.(McG.) *(joint appt. with Biomedical Engineering)*
Wayne S. Lapp; M.S.A.(Tor.), Ph.D.(McG.)
Mortimer Levy; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C) *(joint appt. with Medicine)*
Michael Mackey; B.A., Ph.D.(Wash.)
Jacapo P. Mortola; M.D.(Milan)
John Orlowski; B.Sc.(McG.), M.Sc., Ph.D.(Queen's)
Premsyl Ponka; M.D., Ph.D.(Prague)
Alvin Shrier; B.Sc.(C'dia), Ph.D.(Dal.) *(Hosmer Professor of Physiology)*
Douglas G.D. Watt; M.D., Ph.D.(McG.)

Associate Professors
Kathleen Cullen; B.Sc.(Brown), Ph.D.(Chicago
Riaz Farookhi; B.Sc., M.Sc.(M.I.T.), Ph.D.(Tufts)
Mladen Glavinovic; B.Sc.(Zagreb), M.Sc.(Tor.), Ph.D.(McG.) *(joint appt. with Anaesthesia Research)*
Michael Guevara; B.Sc., M.Eng., Ph.D.(McG.)
Sheldon Magder; M.D.(Tor.) *(joint appt. with Medicine)*
Ursula Stochaj; Ph.D.(Cologne)
Teresa Trippenbach; M.D., Ph.D.(Warsaw)
Ann Wechsler; B.A.(Tor.), M.Sc., Ph.D.(McG.)
Peter Weldon; B.Sc., Ph.D.(McG.)
John White; B.Sc., M.Sc.(Car.), Ph.D.(Harv.)

Associate Members
Anaesthesia: Steven Blackman;
Dentistry: James Lund;
Medicine: Albert Aguayo, Andrey Cybulsky, Samuel O. Freedman, Abraham Fuks, Claude Gagnon, Raymonde Gagnon, Harry Goldsmith, Geoffrey Hendy, Max Katz, Peter Macklem, James Martin, Shree Mulay, Mariana Newkirk, Barry Posner, Shafaat Rabbani, Ian Shrier, J. Enrique Silva, Alan Sniderman, Mary Stevenson, Simon Wing, Hans Zingg;
Neurology & Neurosurgery: Massimo Avoli, Charles Bourque, Sal T. Carbonetto, Pierre Drapeau, Daniel Guitton, Michael Rasminsky;
Otolaryngology: Bernard Segal;
Pediatrics: Immanuela Moss;
Psychiatry: Bernardo Dubrovsky, Christina Gianoulakis;
Univ. of Montreal, Medicine: Alex Grassino

Adjunct Professors
John Milton, Chicago
Serge Rossignol, Montreal
Malmur R.I. Sairam, Montreal

Physiology has its roots in many of the basic sciences including biology, chemistry, mathematics, and physics. Physiology overlaps with other biomedical sciences such as anatomy, biochemistry, pathology and pharmacology, and with psychology and biomedical engineering, and is one of the prime contributors of basic scientific knowledge to the clinical medical sciences.

Members of the Department of Physiology at McGill are engaged in studies dealing with molecules, single cells, or entire systems in a variety of vertebrates, including man. A wide range of interest and expertise is represented, including cardiovascular, respiratory, gastrointestinal and renal physiology, the physiology of exercise, neurophysiology, endocrinology, immunology, biophysics and biomathematics. Some faculty members have formal or informal links with the departments of mathematics, physics, electrical engineering, chemistry and clinical departments (medicine, surgery, pediatrics, neurology, obstetrics, psychiatry, anesthesia), reflecting and reinforcing the close ties between physiology and other disciplines.

Graduates at the B.Sc. level have found rewarding careers in teaching, in secondary schools and CEGEPs, government service, and laboratory technical assistance, such as in pharmaceutical houses, hospitals, and institutions of higher learning. Moreover, physiology provides an excellent background for medicine, dentistry or other postgraduate work, in such fields as physiology, experimental medicine, pharmacology, biochemistry or physiological psychology.

The programs offered in Physiology differ in their orientation but they all have a common core of material covering cardiovascular, respiratory, gastrointestinal and renal physiology, neurophysiology, endocrinology and immunology. The specified U1 courses are identical for all programs except the Joint Major Programs in Physiology and Physics, Physiology and Mathematics, and the Joint Honours Program in Immunology and thus afford the student maximal flexibility before deciding on a particular program to follow in U2 and U3.

Academic advising is compulsory. All new students to the Department, Freshman and CEGEP, **must** see an adviser upon entering the program. Contact the Undergraduate Coordinator at (514) 398-3689 for more information.

Returning students are required to consult with their advisers during the advising period for returning students, and regularly throughout the year. It is important that graduating students have their record checked by their adviser at the beginning of their final year.

PLEASE NOTE:
Complementary courses are not electives. The difference between Complementary courses and Required courses is that Complementary courses are defined as offering an element of choice, however small that choice may be. **Students may choose from the two (or more) courses specified within Complemen-**

tary Course segments of a program description, but ONLY from those. For further information, refer to "Course Nomenclature" on page30 of this Calendar.

FACULTY PROGRAM IN PHYSIOLOGY (54 credits)
[MARS Program Code 4-750000]

If not previously taken 180-212A,B Organic Chemistry I must be completed in addition to the 54 program credits.

Required Courses (33 credits)

552-209A	(3)	Mammalian Physiology I
552-210B	(3)	Mammalian Physiology II
552-212D	(2)	Introductory Physiology Lab
552-311A	(3)	Intermediate Physiology I
552-312B	(3)	Intermediate Physiology II
552-313B	(3)	Intermediate Physiology III
552-314A	(3)	Integrative Neuroscience
177-200A	(3)	Molecular Biology
177-202B	(3)	Basic Genetics
177-301A,B	(3)	Cell and Molecular Laboratory
180-222A,B	(4)	Organic Chemistry II

Complementary Courses (21 credits)
6 credits selected from:

177-201B	(3)	Cell Biology and Metabolism
or 507-212B	(3)	Molecular Mechanisms of Cell Function
177-373A	(3)	Biostatistical Analysis
or 177-309A	(3)	Mathematical Models in Biology

6 credits selected from physiology courses – see approved list in Department.

9 credits selected from science courses – see approved list in Department.

MAJOR PROGRAM IN PHYSIOLOGY (63-64 credits)
[MARS Program Code 1-750000]

The Major Program includes, in addition to some intensive studies in Physiology, a strong core content of related biomedical and physical sciences. Admission to the Major Program will be in U2, upon completion of the U1 required courses, and in consultation with the student's adviser.

If not previously taken 180-212A,B Organic Chemistry I must be completed in addition to the 63-64 program credits.

U1 Required Courses (18 credits)

552-209A	(3)	Mammalian Physiology I
552-210B	(3)	Mammalian Physiology II
552-212D	(2)	Introductory Physiology Lab
177-200A	(3)	Molecular Biology
177-202B	(3)	Basic Genetics
180-222A,B	(4)	Organic Chemistry II

U2 and U3 Required Courses (18 credits)

552-311A	(3)	Intermediate Physiology I
552-312B	(3)	Intermediate Physiology II
552-313B	(3)	Intermediate Physiology III
552-314A	(3)	Integrative Neuroscience
177-301A,B	(3)	Cell and Molecular Laboratory
507-311A	(3)	Metabolic Biochemistry

Complementary Courses (27-28 credits)
12-13 credits selected from:

177-201B	(3)	Cell Biology and Metabolism
or 507-212B	(3)	Molecular Mechanisms of Cell Function
177-373A	(3)	Biostatistical Analysis
or 177-309A	(3)	Mathematical Models in Biology
180-203A	(3)	A Survey of Physical Chemistry
or 180-204A,B	(3)	Physical Chem./Biol. Sci. I
504-214A	(3)	Systemic Human Anatomy
or 504-261A	(4)	Introduction to Dynamic Histology

9 credits selected from physiology courses – see approved list in Department

6 credits selected from science courses – see approved list in Department

JOINT MAJOR PROGRAM IN PHYSIOLOGY AND MATHEMATICS (71 credits) [MARS Program Code 1-725400]

U1 Required Courses (14 credits)

552-212D	(2)	Introductory Physiology Lab
189-222A,B	(3)	Calculus III
189-247A,B	(3)	Linear Algebra
or 189-223A,B	(3)	Linear Algebra
177-200A	(3)	Molecular Biology
177-309A	(3)	Mathematical Models in Biology

U1 Complementary Courses (15 credits)
9 credits selected from:

552-209A	(3)	Mammalian Physiology I
and 552-210B	(3)	Mammalian Physiology II
or 552-201A	(3)	Human Physiology:Control Systems
and 552-202B	(3)	Human Physiology:Body Functions
177-201B	(3)	Cell Biology and Metabolism
or 507-212B	(3)	Molecular Mechanisms of Cell Function

6 credits selected from:

189-248A	(3)	Advanced Calculus I
or 189-314A,B	(3)	Advanced Calculus
189-325A,B	(3)	Ordinary Differential Equations
or 189-315A,B	(3)	Ordinary Differential Equations

U2 Required Courses (24 credits)

552-311A	(3)	Intermediate Physiology I
552-312B	(3)	Intermediate Physiolgoy II
552-313B	(3)	Intermediate Physiology III
552-314A	(3)	Integrative Neuroscience
189-242A	(3)	Analysis I
189-243B	(3)	Real Analysis
189-323A	(3)	Probability Theory
189-326A	(3)	Nonlinear Dynamics and Chaos

U3 Required Courses (15 credits)

552-461D	(6)	Experimental Physiology
189-319B	(3)	Partial Differential Equations
189-324B	(3)	Statistics
399-519A	(3)	Analysis of Biomedical Systems & Signals

U3 Complementary Course (3 credits)

198-413A	(3)	The Physical Basis of Physiology
or 189-437A	(3)	Mathematical Methods in Biology

JOINT MAJOR PROGRAM IN PHYSIOLOGY AND PHYSICS
(77 credits) [MARS Program Code 1-725500]
(Program revisions awaiting University approval)

This program provides a firm foundation in physics, mathematics and physiology. It is appropriate for students interested in applying methods of the physical sciences to problems in physiology and allied biological sciences.

U1 Required Courses (17 credits)

552-212D*	(2)	Introductory Physiology Lab
198-230A	(3)	Dynamics of Simple Systems
198-232B	(3)	Heat and Waves
198-257A	(3)	Experimental Methods I
198-258B	(3)	Experimental Methods II
189-222A,B	(3)	Calculus III

U1 Complementary Courses (12 credits)

552-209A	(3)	Mammalian Physiology I
and 552-210B*	(3)	Mammalian Physiology II
or 552-201A	(3)	Human Physiology: Control Systems
and 552-202B	(3)	Human Physiology: Body Functions
189-223A	(3)	Linear Algebra
or 189-247A	(3)	Linear Algebra

* The corequisite 177-200A, 177-201B is waived for this program.

U2 Required Courses (21 credits)

552-311A	(3)	Intermediate Physiology I
552-312B	(3)	Intermediate Physiology II
552-313B	(3)	Intermediate Physiology III
552-314A	(3)	Integrative Neuroscience
198-328A	(3)	Electronics
198-339B	(3)	Measurements Laboratory
189-326A	(3)	Nonlinear Dynamics and Chaos

U2 Complementary Course (6 credits)

189-315A	(3)	Ordinary Differential Equations
or 189-325B	(3)	Ordinary Differential Equations
189-314B	(3)	Advanced Calculus
or 189-248A	(3)	Advanced Calculus I

U3 Required Courses (15 credits)

552-461D	(6)	Experimental Physiology
198-333B	(3)	Thermal & Statistical Physics
198-340A	(3)	Electricity and Magnetism
198-446A	(3)	Quantum Physics
399-519A	(3)	Analysis of Biomedical Systems and Signals

U3 Complementary Courses (6 credits)

198-413A	(3)	The Physical Basis of Physiology
or 189-437A	(3)	Mathematical Methods in Biology

3 credits to be approved by Physiology and Physics

HONOURS PROGRAM IN PHYSIOLOGY (71 credits)
[MARS Program Code 2-750000]

All admissions to the Honours program will be in U2, and the student must have a U1 GPA of 3.30, with no less than a B in 552-209A and 210B. Admission to U3 requires a U2 CGPA of 3.20 with no less than a B in U2 Physiology courses. Decisions for admission to U3 will be heavily influenced by student standing in U2 courses.

The Department reserves the right to restrict the number of entering students in the Honours programs. Students who do not maintain Honours standing may transfer their registration to the Major Program in Physiology.

The deadline to apply to the Honours Program is June 1. Application forms are available in McIntyre 1021. Students should include in their letters telephone numbers where they can be reached during the last week of August. Students are responsible for picking up their letters of decision in McIntyre 1021 no later than one week before classes start.

Graduation: To graduate from the Honours Physiology Program the student will have a CGPA of 3.20 with a mark no less than a B in all Physiology courses.

If not previously taken 180-212A,B Organic Chemistry I must be completed in addition to the 71 program credits.

Required Courses (56 credits)

552-209A	(3)	Mammalian Physiology I
552-210B	(3)	Mammalian Physiology II
552-212D	(2)	Introductory Physiology Lab
552-311A	(3)	Intermediate Physiology I
552-312B	(3)	Intermediate Physiology II
552-313B	(3)	Intermediate Physiology III
552-314A	(3)	Integrative Neuroscience
552-351B	(3)	Research Techniques in Physiology
552-359D	(1)	Tutorial in Physiology
552-459D	(6)	Physiology Seminar
552-461D	(6)	Experimental Physiology
177-200A	(3)	Molecular Biology
177-202B	(3)	Basic Genetics
177-301A,B	(3)	Cell and Molecular Laboratory
180-222A,B	(4)	Organic Chemistry II
504-261A	(4)	Introduction to Dynamic Histology
507-311A	(3)	Metabolic Biochemistry

Complementary Courses (15 credits)
9 credits selected from:

177-201B	(3)	Cell Biology and Metabolism
or 507-212B	(3)	Molecular Mechanisms of Cell Function
177-373A	(3)	Biostatistical Analysis
or 177-309A	(3)	Mathematical Models in Biology
180-203A	(3)	A Survey of Physical Chemistry
or 180-204A,B	(3)	Physical Chem./Biol. Sci. I

6 credits selected from physiology courses – see approved list in Department.

INTERDEPARTMENTAL HONOURS PROGRAM IN IMMUNOLOGY The Departments of Biochemistry, Microbiology and Immunology, and Physiology offer an Interdepartmental Honours Program in Immunology. Physiology students interested in the program should contact Dr. W.S. Lapp. Details of this program may be found in section 11.13.

COURSE DESCRIPTIONS
All courses have limited enrolment.

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

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

For more detailed information about courses and programs consult the Department's website.

● Denotes courses not offered in 2001-02.

★ Denotes courses offered in alternate years only

552-100A THE BODY MATTERS. (3) (3-hour seminar per week) (Not open to students who have taken or are taking 552-201, 552-202, 552-209, 552-210, or 552-211.) Designed for anyone with an interest in exercise, the course covers the principles of medicine and physiology as they apply to current lifestyles. Topics will include how and why injuries occur, the effects of exercise on the body, and general health considerations such as "Does exercise prevent or promote osteoarthritis?".

● **552-198A FEEDBACK & RHYTHMS IN PHYSIOLOGY.** (3) (3 hours seminar) (FYS – for first year students only, maximum 25.) (Corequisite: 189-140)

● **552-199A HISTORY OF GENETIC ENGINEERING.** (3) (3 hours seminar per week) (FYS - for first year students only, maximum 20.)

552-201A HUMAN PHYSIOLOGY: CONTROL SYSTEMS. (3) (3hours lecture weekly) (Prerequisites: collegial courses in biology or anatomy, and in chemistry and physics; with 180-212 or equivalent, as a pre- or co-requisite.) (For students in Physical and Occupational Therapy, Nursing, and others with permission of the course coordinator.) (Not open to students who have taken 552-209A.) Physiology of body fluids, blood, nerve and muscle, peripheral nerves, central nervous system, special senses, autonomic nervous system, defense mechanisms.

552-202B HUMAN PHYSIOLOGY: BODY FUNCTIONS. (3) (3 hours lecture weekly) (Prerequisites: collegial courses in biology or anatomy and in chemistry and physics; with 180-212 or equivalent, as a pre- or co-requisite.) For students in Physical and Occupational Therapy, Nursing, Education, and others with permission of the course coordinator.) (Not open to students who took 552-201A in 1976-77 or earlier, or 552-210B.) Physiology of the cardiovascular, respiratory, excretory, endocrine, and digestive systems; organic and energy metabolism; nutrition; exercise and environmental stress.

552-201A and 552-202B are companion courses and it is recommended that they be taken in that sequence; under special circumstances they may be taken in separate years or in the reverse sequence.

552-209A MAMMALIAN PHYSIOLOGY I. (3) (3 hours lectures weekly) (Prerequisites: as for 552-201A and 552-202B. Pre- or co-requisites: 177-200A, 177-201B or 507-212B) (Not open to students who have taken 552-211D or 552-201A.) (For students in the Faculty of Science, and other students by permission of the instructor.) The course covers the physiology of body fluids, blood, body defense mechanisms, peripheral and central nervous system, muscle. Students must be prepared to attend evening (19:00 - 20:00) class tests.

552-210B MAMMALIAN PHYSIOLOGY II. (3) (3 hours lectures weekly) (Prerequisites: as for 552-201A and 552-202B. Pre or co-requisite: 177-200A) (Not open to students who have taken 552-211D or 552-202B.) (For students in the Faculty of Science, and other students by permission of the instructor.) (Although 552-210B may be taken without the prior passing of 552-209A, students should note that they may have some initial difficulties because of lack of familiarity with some basic concepts introduced

in 552-209A.) The course covers the physiology of the autonomic nervous system; cardiovascular, respiratory, digestive and renal systems; and of physical exercise. Students must be prepared to attend evening (19:00 -20:00) class tests. Tutorials are given from 18:00 to 19:00 hours. (Description revision awaiting University approval)

552-212D INTRODUCTORY PHYSIOLOGY LAB. (2) (One 3-hour lab and one 1-hour lecture every second week) (Corequisites: 552-209A and 552-210B.) (Required for Physiology students enrolled in 552-209A and 552-210B. Open to Honours and Major students from some other departments.) (For students in a Physiology program, 552-212D should be taken concurrently with 552-209A and 552-210B.) Exercises illustrating fundamental principles in physiology: blood, neurophysiology, smooth muscle; cardiovascular, respiratory, endocrine, exercise and renal physiology. (Description revision awaiting University approval)

552-311A INTERMEDIATE PHYSIOLOGY I. (3) (3 hours of lectures per week; 1-3 hours optional lab/demonstration/tutorial arranged for a maximum of 3 afternoons per term.) (Prerequisite: 552-209A and 552-210B or equivalent, or permission of the instructor.) In-depth presentation of experimental results and hypotheses on cellular communication in the nervous system and the endocrine system.

552-312B INTERMEDIATE PHYSIOLOGY II. (3) (3 hours of lectures per week; 1-3 hours optional lab/demonstration/tutorial arranged for a maximum of 3 Wednesday afternoons per term) (Prerequisites: 552-209A and 552-210B or equivalent, 552-311A or permission of the instructor.) In-depth presentation of experimental results and hypotheses underlying our current understanding of topics in immunology, kidney function and respiration explored beyond the introductory level.

552-313B INTERMEDIATE PHYSIOLOGY III. (3) (3 hours of lectures per week; 1-3 hours optional lab/demonstration/tutorial arranged for a maximum of 3 Wednesday afternoons per term) (Prerequisites: 552-209A and 552-210B or equivalent, 552-311A or permission of the instructor.) In-depth presentation of experimental results and hypotheses underlying our current understanding of the physiology of the cardiovascular system; blood physiology including hemostasis and thrombosis; transport of fluids and cells; general cell kinetics and regulation, and gastrointestinal physiology.

552-314A INTEGRATIVE NEUROSCIENCE. (3) (3 hours of lectures per week) (Prerequisites: 552-209A and 552-210B) In depth presentation of experimental results and hypotheses underlying our current understanding of how single neurons and ensembles of neurons encode sensory information, generate movement, and control cognitive functions such as emotion, learning, and memory, during voluntary behaviours.

552-351B RESEARCH TECH. IN PHYSIOLOGY. (3) (2hour lecture and 3 hour lab weekly) (Prerequisites: 552-209, 552-210 and 552-311. Corequisites: 552-312 and 552-313.) (Restricted to Honours Physiology students.) The course provides an overview of common research methods in Physiology, including critical analysis and practical experience with some of the methods. Topics include research ethics, data analysis, membrane biophysics, radioimmunoassay, ion sensitive dyes, immunocytochemistry, localization techniques, protein, cell sorting, and molecular biology. (Description revision awaiting University approval)

552-359D TUTORIAL IN PHYSIOLOGY. (1) (Prerequisites: 552-209A and 552-210B or equivalent. Corequisites: 552-311, 552-312 and 552-313. Enrolment restricted to Honours Physiology students.) The course consists of regularly scheduled meetings between each individual student and a chosen staff member, to consider current problems in biomedical research and to develop background for a research project to be carried out in U3. Brief written summaries of each meeting are required.

552-419D PROJECT & SEMINAR IN IMMUNOLOGY. (9) (15-18hours lab, 1 hour seminar weekly.) (Enrolment restricted to U3 Honours Immunology students.) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) Individual research projects in Immunology under the guidance of staff members in the three participating departments: Physiology, Biochemistry, and Microbiology and Immunology. The students will meet to discuss their research projects in a seminar format during the winter term. They will be evaluated on their laboratory and seminar performance and written report. (Credit weight, hours and description revisions awaiting University approval)

● **552-423A PHYSIOLOGICAL DYNAMICS.** (3) (Prerequisite: 552-209A and 552-210B or equivalent, and 177-309 or 189-315, or permission of the instructor.)

● ★**552-444A THEORETICAL ELECTROPHYSIOLOGY.** (3) (3 hours lecture/seminar per week) (Prerequisites: 552-209A and 552-210B or equivalent; 177-309A or 189-315A,B.) (Offered in even numbered years.)

552-451A ADVANCED NEUROPHYSIOLOGY. (3) (3 hours lecture) (Prerequisite: 552-311A or equivalent and 177-301B.) (Password required.) Topics of current interest in neurophysiology including the development of neurons and synapses, physiology of ionic channels, presynaptic and postsynaptic events in synaptic transmission and neuronal interactions in CNS function.

552-459D PHYSIOLOGY SEMINAR. (6) (2 hours seminar) (Prerequisite: permission of instructors.) (Required course for U3 Honours students. Password required.) Discussion of topics in mammalian, cellular and molecular physiology. Students will be required to write one essay and make at least one oral presentation per term. A final course essay is required.

552-461D EXPERIMENTAL PHYSIOLOGY. (6) (Permission of the instructor required. Password required.) (This course is a requirement for U3 students in the Honours Physiology program, the Major Program in Physiology and Mathematics, and the Major program in Physiology and Physics, and is open to a limited number of other U3 Physiology students.) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) Individual project work under the supervision of Departmental Staff members.

552-502B EXERCISE PHYSIOLOGY. (3) (Prerequisite: 552-311A, 552-312B, and 552-313B) Behaviour of physiological processes in response to physical effort, in areas such as structural basis of muscle contraction, thermoregulation during exercise, mechanics and energetics of muscle contraction, fuel utilization, fatigue, physiological adjustments during exercise and influence of training. (Description revision awaiting University approval)

552-508A ADVANCED RENAL PHYSIOLOGY. (3) (Prerequisite: 552-312B or the equivalent.) (Open to advanced undergraduate and graduate students.) Offered in conjunction with the Department of Medicine. Lectures and seminars will cover advanced concepts in selected areas of kidney physiology (glomerular and tubular function) as well as membrane and epithelial transport. Students will be expected to critically discuss selected experimental papers.

552-513B CELLULAR IMMUNOLOGY. (3) (4 hours lectures plus term paper) (Prerequisite: 528-314B, or permission of the instructor.) This course deals with cellular interactions, regulation and effector mechanisms of the normal immune response in relation to diseases and pathogenic processes. It is taught at an advanced level.

552-515A PHYSIOLOGY OF BLOOD I. (3) (2 hours lecture plus 1 hour seminar weekly) (Prerequisite: 552-313B or 552-312B or permission of the instructor.) Study of the cell and molecular physiology of hemostasis and its pathophysiology (bleeding and thrombosis). Emphases on molecular mechanisms regulating clot formation, fibrinolysis, and cell adhesion/aggregation. Experimental approaches and specific clinical disorders will be analyzed. Weekly discussions, and a major term paper.

552-516B PHYSIOLOGY OF BLOOD II. (3) (2hours lecture plus 1 hour seminar weekly) Bone marrow hematopoiesis, with emphasis on regulation of stem cell proliferation and differentiation along hematopoietic pathways. Formation and differentiation of red and white blood cells and some of the diseases associated with hemo-

topoiesis will be covered. Emphasis will be given to the molecular mechanisms involved in the normal and pathological conditions.

● **552-517B ARTIFICIAL INTERNAL ORGANS.** (3) (Prerequisite: permission of instructors. Password required.)

552-518A ARTIFICIAL CELLS & BIOTECHNOLOGY. (3) (Prerequisite: permission of instructors. Password required.) Physiology, biotechnology, chemistry and biomedical application of artificial cells, blood substitutes, immobilized enzymes, microorganisms and cells, hemoperfusion, and artificial kidneys, and drug delivery systems. 552-517B and 552-518A when taken together, will give a complete picture of this field. However, the student can select one of these.

● ★**552-520B ION CHANNELS.** (3) (1½ hour lecture, 1½ hour seminar) (Prerequisite: 552-311A) (Priority to Graduate and Honours students; others by permission of instructors. Password required.) (Offered in odd numbered years.)

552-531B TOPICS IN APPLIED IMMUNOLOGY. (3) (Permission of the instructor. U3 InterDept. Honours Immunology students and graduate students with strong immunology background i.e. 552-513A and 507-503B.) Seminar format course in which experts in immunologic mechanisms of resistance against a variety of infectious diseases, including AIDS, malaria, and tuberculosis oversee student moderators in their presentation of recent scientific literature in the field.

552-550A PHYSIOLOGY OF BONE. (3) (1 hour of lecture, 2 hours of seminar per week) (Prerequisites: 552-311A, and 177-202B or equivalent) (Restricted to U3 Physiology students, and graduate students in biomedical departments; others by permission of the instructor.) Students will develop a working knowledge of cartilage and bone. Discussion topics will include: molecular and cellular environment of bone; heritable and acquired skeletal defects; research models used to study metabolic bone disease.

552-552B CELLULAR & MOLECULAR PHYSIOLOGY. (3) (1hour lecture, 2 hours seminar weekly) (Prerequisite: 552-311A) (Preference will be given to Physiology Honours and Graduate students.) Discussions of recent significant advances in our understanding of the gene products involved in diverse cellular signalling pathways. Topics will include cell-surface hormone receptors, nuclear steroid hormone receptors, and ion channels and transporters. Students will present and critically evaluate experimental approaches, results and interpretations of selected research publications.

552-556B TOPICS IN SYSTEMS NEUROSCIENCE. (3) (Permission of the instructor required. Password required.) (Not open to students who have taken 552-456B.) Topics of current interest in systems neurophysiology and behavioural neuroscience including: the neural representation of sensory information and motor behaviours, models of sensory motor integration, and the computational analysis of problems in motor control and perception. Students will be expected to present and critically discuss journal articles in class.

11.26 Psychiatry (555)

Department of Psychiatry
Research & Training Building
1033 Pine Avenue West
Montreal, QC H3A 1A1

Telephone: (514) 398-4176

Chair — Joel Paris

Professors
Frances V. Abbott; B.Sc.(Trent), M.Sc., Ph.D.(McG.)
Patricia Boksa; B.Sc., Ph.D.(McG.)
Roberta Palmour; B.A.(Texas W.), Ph.D.(Texas)
Joel Paris; M.D.(McG.)
Gilbert Pinard; M.D.(Montr.)
Judes Poirier; B.Sc., Ph.D.(Montr.)
Simon Young; B.A.(Oxon.), M.Sc., Ph.D.(Lond.)

Associate Professors
Bernardo Dubrovsky; M.D.(Buenos Aires)
Kathryn Gill; Ph.D.(C'dia)
Alain Gratton; Ph.D.(C'dia)
Joseph Rochford; B.Sc., Ph.D.(C'dia)
Lalit Srivastava; B.Sc., Ph.D.(J. Nehru)
Dominque Walker; B.Sc., Ph.D.(Geneva) *(joint appt. with Anatomy & Cell Biology)*

Assistant Professor
Satyabrata Kar; Ph.D.(Lond.)

COURSES
All courses have limited enrolment.

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

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

555-199A MENTAL ILLNESS AND THE BRAIN. (3) (1 hour lecture and 2 hours seminar weekly) (FYS - for first year students only, maximum 25. No prerequisites.) This course will introduce the student to the fundamentals of neuroscience, and then use these principles to illustrate recent advances made on the biological causes of, and treatments for, mental disorders with a strong biological component: schizophrenia, depression, mania, anxiety disorders, obsessive-compulsive disorder, Alzheimer's and Parkinson's diseases and alcohol and drug abuse.

555-301B ISSUES IN DRUG DEPENDENCE. (3) (3hours) (Prerequisites: 552-201A or 552-209A or 552-210B or 204-100A or 177-201B or permission of instructor.) The phenomenology and epidemiology of the use and abuse of alcohol, nicotine, opiates, stimulants, sedatives and psychotomimetic agents are discussed in relation to current theoretical and experimental issues. The perspective is multidisciplinary and the intention is to develop an understanding the nature of the issues surrounding drug dependence.

555-500B NEUROBIOLOGY OF MENTAL DISORDERS. (3) (3 hours) (Prerequisites: 507-212B and 507-311A, or 507-312B, or 177-200A and 177-210B, or 552-311A, or 204-422B, or 204-308A and an upper level biological science course with permission of the instructors, or equivalent. Basic knowledge of cellular and molecular biology is required. Open to U3 and graduate students only. Strongly recommended for M.Sc. students in Psychiatry.) Current theories on the neurobiological basis of most well known mental disorders (e.g. schizophrenia, depression, anxiety, dementia). Methods and strategies in research on genetic, physiological and biochemical factors in mental illness will be discussed. Discussion will also focus on the rationale for present treatment approaches and on promising new approaches.

555-502A BRAIN EVOLUTION & PSYCHIATRY. (3) (Prerequisites: 177-115B or equivalent as authorized by instructor.) The course will focus on the transcendental importance of evolution of nervous systems for normal and pathological behavior. Studies of allomeric brain growth and recent evolutionary theories of brain organization as they relate to normal and abnormal behavior will be emphasized.

11.27 Psychology (204)

Stewart Biological Sciences Building, Room W8/1
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Chair — A.A.J. Marley

Emeritus Professors
Albert S. Bregman; M.A.(Tor.), Ph.D.(Yale)
Virginia I. Douglas; B.A.(Qu.), M.A., M.S.W., Ph.D.(Mich.)
George A. Ferguson; B.A.(Dal.), M.Ed., Ph.D.(Edin.), F.R.S.C.
Wallace E. Lambert; M.A.(Colgate), Ph.D.(N.Carolina), F.R.S.C.
Ronald Melzack; M.Sc., Ph.D.(McG.), F.R.S.C. *(E.P. Taylor Emeritus Professor of Psychology)*

Peter M. Milner; B.Sc.(Leeds), M.Sc., Ph.D.(McG.)

Professors
Frances E. Aboud; B.A.(Tor.), M.A., Ph.D.(McG.)
Irving M. Binik; B.A.(N.Y.U.), B.H.L.(Jewish Theological Seminary), M.A., Ph.D.(Penn.)
Keith B.J. Franklin; B.A., M.A.(Auck.), Ph.D.(Lond.)
Fred H. Genesee; B.A.(W.Ont.), M.A., Ph.D.(McG.)
A.A.J. Marley; B.Sc.(Birm.), Ph.D.(Calif.)
Debbie S. Moskowitz; B.S.(Kirkland), M.A., Ph.D.(Ct.)
David J. Ostry; B.A.Sc., M.A.Sc., Ph.D.(Tor.)
Laura Ann Petitto; B.S.(Ramapo St.), M.A.(N.Y.U.), Ph.D.(Harv.)
Michael Petrides; B.Sc., M.Sc.(Lond.), Ph.D.(Cantab.)
Robert O. Pihl; B.A.(Lawrence), Ph.D.(Ariz.)
James O. Ramsay; B.Ed.(Alta.), Ph.D.(Prin.)
Barbara B. Sherwin; B.A., M.A., Ph.D.(C'dia) *(James McGill Professor)*
Thomas R.Shultz; B.A.(Minn.), Ph.D.(Yale)
Yoshio Takane; B.L., M.A.(Tokyo), Ph.D.(N.Carolina)
Donald M. Taylor; B.A., M.A., Ph.D.(W.Ont.)
Norman M. White; B.A.(McG.), M.S., Ph.D.(Pitt.)
David C. Zuroff; B.A.(Harv.), M.A., Ph.D.(Conn.)

Associate Professors
A.G. Baker; B.A.(U.B.C.), M.A., Ph.D.(Dal.)
Mark Baldwin; B.A.(Tor.), M.A., Ph.D.(Waterloo)
Avi Chaudhuri; B.Sc., M.Sc.(Tor.), Ph.D.(Berk.)
Blaine Ditto; B.S.(Iowa), Ph.D.(Ind.)
Don C. Donderi; B.A., B.Sc.(Chic.), Ph.D.(C'nell)
Kevin Dunbar; B.A., M.A.(University College of Dublin), Ph.D.(Tor.)
Richard F. Koestner; B.A., Ph.D.(Roch.)
John Lydon; B.A.(Notre Dame), M.A., Ph.D.(Wat.)
Morton J. Mendelson; B.Sc.(McG.), A.M., Ph.D.(Harv.)
Matthew Lewis Shapiro; B.A., M.A., Ph.D.(Johns H.)
Frances E. Wilkinson; B.A.(McG.), M.A., Ph.D.(Dal.)

Assistant Professors
John R.Z. Abela; B.A.(Brown), M.A., Ph.D.(Penn.)
Baerbel Knaeuper; Diploma, Dr. phil. (U. of Mannheim), Dr. phil. habil. (Free University of Berlin)
Daniel J. Levitin; A.B.(Stan.), M.S., Ph.D.(Oregon)
Gillian A. O'Driscoll; B.A.(Wellesley), M.A., Ph.D.(Harv.)

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

Associate Members
Clinical Research Institute of Montreal: Terrance J. Coderre;
Douglas Hospital: HowardSteiger;
Family Medicine: Vilma Patel;
Montreal Neurological Institute: Barbara Jones, Marilyn Jones-Gotman, Brenda Milner, Robert Zatorre;
Psychiatry: Frances Abbott; Sharon Welner
Vision Research Unit (Opthomology): Curtis Baker, Robert Hess, Frederick A.A. Kingdom, Kathleen Mullen

Part-time Appointments
Ian F. Bradley; B.Sc., M.Sc.(Tor.), Ph.D.(Wat.)
James C. Macdougall; B.A.(Car.), M.A., Ph.D.(McG.)
Zbigniew Pleszewski; M.A., Ph.D.(U. of Poznan)
Zeev Rosberger; B.Sc.(McG.), M.A., Ph.D.(Conc.)
Yuriko Oshima-Takane; B.A., M.A.(Tokyo), Ph.D.(McG.)
Carol Schopflocher; B.A.(W.Ont.), M.A.(Queen's)
Y. Steinert; B.A.(Hebrew), Ph.D.(Montr.)
Camilo Zacchia; B.A.(McG.), M.S.(Florida State), Ph.D.(McG.)
Philip R. Zelazo; B.A.(Amer.Int'l.Coll.), M.S.(N.Carolina), Ph.D.(Wat.)

The Department of Psychology offers programs in both Arts and Science. Students planning to do a B.A. Honours, Major or Minor Concentrations should refer to the Faculty of Arts section 11.39 **for B.A. program information.**

Psychology is the scientific study of mind and behaviour. It is both a social and a biological science. As a social science, psychology studies social interactions. As a biological science, it regards humans as the product of evolution and so studies them in biological perspective, comparing and contrasting human behaviour with that of other species.

The data of psychology are collected within the psychological laboratory by the use of experimental methods in the study of behaviour, and outside the laboratory by systematic observation of the behaviour of humans and animals. The aim is to formulate general principles of perception, learning, motivation, cognition and social psychology that are relevant to different aspects of human life. Experimentation, laboratory techniques, observational procedures, measurement, and statistical methods are important tools of the psychologist.

Psychology has many interdisciplinary aspects. The study of psychological problems often involves knowledge drawn from other disciplines such as biology, physiology, linguistics, sociology, philosophy, and mathematics. For this reason a student with varied interests can frequently find a place for these in psychology.

Psychology is a young science so that explanations of the processes underlying observed phenomena are often theoretical and speculative. The major objectives of psychological study are to reduce the discrepancy between theory and fact and to provide better answers about why humans think and behave as they do.

Although a number of undergraduate courses in psychology have applied implications, applied training is not the purpose of the undergraduate curriculum. Its purpose is to introduce the student to an understanding of the basic core of psychological knowledge, theory, and method, regardless of questions of practical application.

The B.Sc. or B.A. with a Major or Honours degree in psychology is not a professional qualification. It does not qualify the individual to carry on professional work in psychology. In the Province of Québec the minimum requirement for membership in the Order of Psychologists, the professional association governing the work of psychologists in the province, is an M.A. or M.Sc. degree, or other equivalent degree. All students planning to practise in the Province of Québec will be examined on their proficiency in French before being admitted to the professional association. Undergraduate courses in psychology may prove of considerable value to students planning careers in professional fields other than psychology. These include but are not restricted to medicine, education, social work, human communication sciences, or business and industry.

Students who are interested in psychology as a career must pursue graduate studies. Persons who hold graduate degrees in psychology, usually the Ph.D., may find employment in universities, research institutes, hospitals, community agencies, government departments, large corporations, or may act as self-employed consultants. At the graduate level, psychology has many specialized branches including social psychology, physiological psychology, experimental psychology, clinical psychology, child psychology, industrial psychology, community psychology, educational psychology, and others.

Requirements for admission to graduate studies in psychology vary from one university to another and from one country to another. Nonetheless, both the Honours and Major degrees in psychology *may* qualify the student for admission to many graduate schools, provided that sufficiently high grades are obtained. During the U2 year, undergraduate students are strongly advised to verify the admission requirements of various graduate programs. This is to ensure that sufficient time is available for students to complete all necessary requirements for admission to their preferred graduate programs.

The essential differences between the Honours and the Major program are an emphasis on research methodology courses and practice in the Honours program, and that higher academic standards are required of Honours students. Honours students also have an opportunity to work in small groups closely with staff members.

INFORMATION MEETINGS FOR NEW STUDENTS

All new students entering the Psychology undergraduate program are required to attend an Information Meeting prior to registration. Students who have been accepted into a Bachelor of Science pro-

gram in Psychology must attend the meeting on August 29, 2001 at 13:00. The meeting will be held in Room S1/3 of the Stewart Biological Sciences Building. Students accepted into a Bachelor of Arts program must attend a separate information meeting. For details, consult the Psychology program listing in the Faculty of Arts section . At this meeting, Nicole Allard, the Academic Adviser, will explain the requirements of the Department's programs. Incoming students will have an opportunity to ask questions and receive advice on how to plan their courses. After this meeting students will make appointments for individual advising sessions, during which they will fill out their Study Plan form for registration.

(For students entering the Psychology program in the winter term 2002, there will be an Information Meeting on December 18th at 11:30 in Room N2/2D of the Stewart Biology Building).

Entering students must bring their letter of acceptance and a copy of their collegial transcript(s). They will also need this Calendar and a preliminary Timetable. Students will also find the Psychology Department Handbook helpful. This Handbook contains more detailed descriptions of Psychology courses, as well as providing guidelines for how students might pursue particular areas of interest.

The Psychology Department Handbook can be purchased for $3.00 (including tax) in Room N7/9, Stewart Biological Sciences Building. Out-of-town residents may have a copy mailed to them upon receipt of $3.00. Requests should be mailed to the Department of Psychology Adviser's Office, 1205 Avenue Docteur Penfield, Montreal, QC H3A 1B1. This handbook is also available on the Psychology department website, at http://www.psych.mcgill.ca/ugrad/ugradm.htm

MINOR PROGRAM IN PSYCHOLOGY (24 credits)
[MARS Program Code 6-810000]

A Minor program in Psychology is available to students registered in any B.Sc. program (other than Psychology). This program is intended to complement a student's primary field of study by providing a focused introduction to specialized topics in psychology. Students may declare their intent to follow a Minor program at the beginning of their U2 year. They must then consult with the Chief Academic Adviser of the Department of Psychology in order to obtain approval for their course selection. A separate Minor program exists for students registered in a program in the Faculty of Arts. Please consult the Psychology listing in the Faculty of Arts section for more information.

The Minor program for Science students requires the completion of 24 credits, of which no more than 6 may overlap with the primary program. All courses in the Minor program must be passed with a minimum grade of C. A prerequisite to the program is Psychology 204-204 or equivalent, see "Project Courses" on page 352.

Complementary Courses (24 credits)
at least 3, but no more than 6, credits selected from:
204-211 (3) Intro. Behavioural Neuroscience
204-212 (3) Perception
204-213 (3) Cognition
204-215 (3) Social Psychology
18-21 credits selected from among Psychology courses at the 300 level or above

FACULTY, MAJOR, HONOURS PROGRAMS IN PSYCHOLOGY

Recommended Background

It is expected that most students who enter a Major, Honours or Faculty Program in Psychology will have taken introductory psychology, biology and statistics at the collegial level. Recommended CEGEP courses include: Psychology 350-101 or 350-102 or equivalent, Biology CEGEP objective 00UK, 00XU or equivalent, Statistics (Mathematics) 201-307 or 201-337 or equivalent. Students must obtain a minimum grade of 75% in their CEGEP level statistics course. In the first year those students who have not taken the recommended collegial level statistics course, or those who have obtained a grade below 75%, must take Psychology 204-204. Those who have not taken the recommended collegial level biology must take 177-111A or 112B, and those who have not taken Introductory Psychology in college must take 204-100A.

Areas of Specialization:

The study of psychology covers many fields. To develop a breadth of understanding in psychology, students are expected to obtain knowledge beyond the introductory level in several areas of psychology. To ensure this requirement is met, Psychology courses are divided into six areas of specialization. Some courses are included in two or more areas of specialization. These courses may only be counted for credit in one area. The areas are listed below.

Cognitive Psychology
204-310 (3) Human Intelligence
204-311 (3) Human Cognition and the Brain
204-316 (3) Psychology of Deafness
204-341 (3) Psychology of Bilingualism
204-343 (3) Language Acquisition in Children
204-352 (3) Laboratory in Cognitive Psychology
204-353 (3) Laboratory in Human Perception
204-410 (3) Special Topics in Neuropsychology
204-413 (3) Cognitive Development
204-472 (3) Scientific Thinking and Reasoning
204-473 (3) Social Cognition and the Self
204-530 (3) Applied Topics in Deafness
204-532 (3) Cognitive Science

Health Psychology and Psychopathology
204-316 (3) Psychology of Deafness
204-332 (3) Introduction to Personality
204-337 (3) Intro: Abnormal Psychology 1
204-338 (3) Intro: Abnormal Psychology 2
204-408 (3) Principles of Cognitive Behaviour Therapy
204-412 (3) Deviations in Child Development
204-429 (3) Health Psychology
204-436 (3) Human Sexuality and its Problems
204-491 (6) Advanced Study in Behavioural Disorder
204-505 (3) The Psychology of Pain
204-530 (3) Applied Topics in Deafness
204-533 (3) International Health Psychology
204-534 (3) Community Psychology

Behavioural Neuroscience
204-308 (3) Behavioural Neuroscience 1
204-311 (3) Human Cognition and the Brain
204-318 (3) Behavioural Neuroscience 2
204-342 (3) Hormones and Behaviour
204-353 (3) Laboratory in Human Perception
204-410 (3) Special Topics in Neuropsychology
204-427 (3) Sensorimotor Behaviour
204-470 (3) Memory and Brain
204-505 (3) The Psychology of Pain
204-522 (3) Neurochemical Basis of Behaviour
204-526 (3) Advances in Visual Perception

Social and Personality
204-331 (3) Inter-Group Relations
204-332 (3) Introduction to Personality
204-333 (3) Personality and Social Psychology
204-351 (3) Research Methods in Social Psychology
204-414 (3) Social Development
204-471 (3) Human Motivation
204-473 (3) Social Cognition and the Self
204-474 (3) Interpersonal Relationships
204-534 (3) Community Psychology
204-535 (3) Advanced Topics in Social Psychology

Developmental
204-304 (3) Child Development
204-343 (3) Language Acquisition in Children
204-412 (3) Deviations in Child Development
204-413 (3) Cognitive Development
204-414 (3) Social Development
204-416 (3) Advanced Topics in Child Development

204-511 (3) Infant Competence
204-561 (3) Methods in Developmental Psycholinguistics

Research and Measurement
204-310 (3) Human Intelligence
204-336 (3) Measurement of Psych. Processes
204-351 (3) Research Methods in Social Psychology
204-352 (3) Laboratory in Cognitive Psychology
204-353 (3) Laboratory in Human Perception
204-403 (3) Modern Psychology in Historical Perspective
204-406 (3) Psychological Tests and Measurements
204-450 (6) Research Project and Seminar
204-451 (3) Human Factors Research and Techniques
204-492 (3) Seminar in Special Topics
204-493 (3) Seminar in Special Topics
204-495 (3) Psychology Research Project
204-510 (3) Statistical Analysis of Tests
204-531 (3) Structural Equation Models
204-536 (3) Correlational Techniques

B.Sc. FACULTY PROGRAM IN PSYCHOLOGY (54 credits)
[MARS Program Code 4-810000]

NOTE: Students in the Faculty of Science who select Arts courses must have a total of at least 54 credits in Science courses among the 90 credits for the B.Sc. degree. Students are expected to have whatever prerequisites are described in this Calendar.

A Faculty Program in Psychology is a sequence of courses which represents a lesser degree of specialization than a Major or an Honours program. A minimum grade of C is required in all 54 program credits.

U1 Required Courses (12 credits)
204-211 (3) Intro. Behavioural Neuroscience
204-212 (3) Perception
204-213 (3) Cognition
204-215 (3) Social Psychology
Note: 204-100A may be taken as a co-requisite with these basic courses.

Complementary Courses (42 credits)
12 credits of Psychology courses:
select 6 credits from each of two of the six areas of specialization

12 credits of Psychology courses, selected from:
courses at the 300 level or above, at least 6 of which must be at the 400 level or higher

18 credits, 9 of which must be at the 300 level or higher, selected from any departments within the University other than Psychology, consistent with regulations of the Faculty of Science.

B.Sc. MAJOR PROGRAM IN PSYCHOLOGY (54 credits)
[MARS Program Code 1-810000]

Students majoring in Psychology must obtain a minimum grade of C in all 5 4credits of the program. A grade lower than C may be made up by taking another equivalent course (if there is one), by successfully repeating the course, or by successfully writing a supplemental examination (if there is one).

A course can be considered to fulfill only one requirement. For example, if 204-413B is taken to satisfy part of the requirement for 9 complementary credits in psychology at the 400 level, it may not also be counted towards the completion of 6 credits in the Cognitive Psychology area of specialization.

U1 Required Courses (12 credits)
204-211 (3) Intro. Behavioural Neuroscience
204-212 (3) Perception
204-213 (3) Cognition
204-215 (3) Social Psychology
Note: 204-100A may be taken as a co-requisite with these basic courses.

U1 or U2 Required Course (3 credits)
204-305 (3) Statistics for Experimental Design

Complementary Courses (39 credits)
18 credits of Psychology courses: select 6 credits from each of three of the six areas of specialization.

9 credits of Psychology courses, selected from courses at the 400 or 500 level.

12 credits at the 300 level or higher, selected from Psychology, Anatomy, Biology, Biochemistry, Chemistry, Computer Science, Mathematics, Physiology, Psychiatry.

B.Sc. HONOURS PROGRAM IN PSYCHOLOGY (54 credits)
[MARS Program Code 2-810000]

Honours in Psychology prepares students for graduate study, and so emphasizes practice in the research techniques which are used in graduate school and professionally later on. Students are accepted into Honours at the beginning of their U2 year, and the two-year sequence of Honours courses continues through U3. Admission to Honours is selective. There is normally room for 25-30 new Honours students each year. Students with a cumulative grade point average of 2.80 or better are eligible to apply; however during the past several years it has been possible to accept a maximum of 30 students with averages above 3.50 based on a 27-30 graded credit program over 2 terms. Once in the Honours program, the student must obtain a GPA of 3.00 in the U2 year in order to continue in the program for U3. Students in the Honours program are required to complete a minimum of 27 graded credits per academic year (Fall and Winter semesters).

Applications can be obtained from the Undergraduate Office of the Department of Psychology, Room N7/9A, Stewart Biological Sciences Building. The applications must be completed and returned to the Undergraduate Office by August 15, 2001. Candidates will be advised of the Department's decision through a notice posted in front of the Undergraduate Adviser's Office, N7/9, before classes begin in September.

Students should note that awarding of the Honours degree will depend on both cumulative grade point average and a minimum grade of B on 204-380D, 480D, 481D. "First Class Honours" is awarded to students who obtain a minimum cumulative grade point average of 3.50 and a minimum CGPA of 3.50 in the three Honours courses of which 12 out of 18 credits (2 courses) received at least an A- grade. "Honours" is awarded to students with a minimum cumulative grade point average of 3.00 and a minimum CGPA of 3.00 on each of the three honours courses. Moreover, the awarding of the Honours degree normally requires completion of two full years of study, U2 and U3, in the Psychology Department. Exceptionally good students may be admitted for the U3 year only on the basis of their marks and research experience, however these students must complete 6 credits in each of three areas of specialization.

U1 Required Courses (12 credits)
204-211 (3) Intro. Behavioural Neuroscience
204-212 (3) Perception
204-213 (3) Cognition
204-215 (3) Social Psychology
Note: 204-100A may be taken as a co-requisite with these basic courses.

U1 or U2 Required Course (3 credits)
204-305 (3) Statistics for Experimental Design

U2 Required Course (6 credits)
204-380D (6) Honours Research Project and Seminar

U3 Required Courses (12 credits)
204-480D (6) Foundations of Modern Psychology
204-481D (6) Honours Thesis Research

Complementary Courses (21 credits)
12 credits of Psychology courses:
select 6 credits from each of two of the six areas of specialization

9 credits at the 30 0level or higher selected from:
Psychology, Anatomy, Biology, Biochemistry, Chemistry, Computer Science, Mathematics, Physiology, Psychiatry

COURSE DESCRIPTIONS

All courses have limited enrolment.

NOTE: Prerequisites: A basic introductory course in psychology is a prerequisite for all Psychology courses with the following exceptions: 204-100A, 204-204, 204-211, 204-212, 204-213, 204-215, 204-305. All courses are open to students other than Major and Honours students in Psychology provided the prerequisites are met and unless otherwise specified. Due to sabbatic leaves and other considerations some courses may not be given in a particular year.

For more detailed information about courses and programs in Psychology consult the Department's Website http://www.psych.mcgill.ca/courses/courses.htm or the Psychology Undergraduate Handbook which is on sale in the Departmental Advising Office, N7/9 Stewart Biological Sciences Building.

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

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

● Denotes courses not offered in 2001-02.

204-100A INTRODUCTION TO PSYCHOLOGY. (3) (2 lectures; 1 conference) (Not open to students who have passed an Introductory Psychology course in CEGEP: 350-101 or 350-102 or equivalent.) Introduction to the scientific study of mind and behavior. Learning, perception, motivation and thinking are explained in a way which emphasizes the continuity of human behavior and the behavior of other species, and which emphasizes the role of the central nervous system in organizing and regulating behavior.

204-204A,B INTRODUCTION TO PSYCHOLOGICAL STATISTICS. (3) (2 lectures, 1 conference) (Not open to students who have passed a CEGEP statistics course(s) with a minimum grade of 75%: Mathematics 201-307 or 201-337 or equivalent or the combination of Quantitative Methods 300 with Mathematics 300.) (**Note:** This course is a prerequisite for 204-305, 204-406, 204-310, 204-336.) (Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on page 351.) The statistical analysis of research data; frequency distributions; graphic representation; measures of central tendency and variability; elementary sampling theory and tests of significance.

204-211B INTRO. BEHAVIOURAL NEUROSCIENCE. (3) (2 lectures) (Prerequisite; 204-100A or equivalent.) An introduction to contemporary research on learning, memory and motivation, from behavioural, biological and evolutionary perspectives. Topics include: internal and external influences on behaviour, biological constraints on motivation and learning, conditioning and cognitive processes. Much of the material will be drawn from the experimental literature on research with animals.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-212A PERCEPTION. (3) (2 lectures, 1 conference) Perception is the organization of sensory input into a representation of the environment. Topics include: survey of sensory coding mechanisms (visual, auditory, tactile, olfactory, gustatory), object recognition, spatial localization, perceptual constancies and higher level influences.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-213B COGNITION. (3) (2 lectures, 1 conference) The study of human information processing. What is the nature of thought? How does it arise in the mind and brain? How can empirical research inform these questions? This course presents a survey of major topics and controversies in the study of cognition, emphasizing interdisciplinary approaches.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-215A SOCIAL PSYCHOLOGY. (3) (3lectures) (Not open to students who have taken 204-330A, 280-221 or 166-216) The course offers students an overview of the major topics in social psychology. Three levels of analysis are explored beginning with individual processes (e.g.,attitudes, attribution), then interpersonal processes (e.g., attraction, communication, love) and finally social influence processes (e.g., conformity, norms, roles, reference groups).
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-304A CHILD DEVELOPMENT. (3) (2 lectures, 1 conference) (Prerequisites: two courses from 204-211, 204-212, 204-213, and 204-215 or permission of the instructor.) (**Note:** This course is a prerequisite for 204-412, 204-413, 204-414, 204-416.) A basic introduction to developmental psychology. Various aspects of psychological development in children are considered, including prenatal development and infancy, perceptual and cognitive development, language acquisition, social and personality development and social interaction.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-305A,B STATISTICS FOR EXPERIMENTAL DESIGN. (3) (2 lectures; 1 conference) (Prerequisite: 204-204A,B or equivalent) (**Note:** This course is required of all students who propose to enter an Honours or Major program in Psychology.) (Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on page 351.) An introduction to the design and analysis of experiments, including analysis of variance, planned and post hoc tests and a comparison of anova to correlational analysis.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-308A BEHAVIOURAL NEUROSCIENCE 1. (3) (2lectures, 1 conference) (Prerequisite: 177-111 or 177-112 or 177-115 or equivalent.) (Not open to students who have taken or are taking 552-314.) The neural basis of mammalian behavior. Basic neuroanatomy, neurophysiology and neurochemistry. Sensory and motor systems. How the nervous system acquires and integrates information and uses it to produce behavior.

204-310A HUMAN INTELLIGENCE. (3) (2 lectures) (Prerequisite: 204-204 or any equivalent course.) An introduction to the measurement, structure, development, and correlates of human intelligence; the role of environment and heredity in its formation; social, cultural, and race differences will be explored.

204-311A HUMAN COGNITION AND THE BRAIN. (3) (2lectures, 1 conference) The course is an introduction to the field studying how human cognitive processes, such as perception, attention, language, learning and memory, planning and organization, are related to brain processes. The material covered is primarily based on studies of the effects of different brain lesions on cognition and studies of brain activity in relation to cognitive processes with modern functional neuroimaging methods.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

● **204-314B THINKING AND CONCEPTS.** (3) (2lectures) (Prerequisite 204-213)

● **204-316A PSYCHOLOGY OF DEAFNESS.** (3) (2lectures; 1 conference) (Prerequisite: 204-100 or equivalent or permission of instructor.) (Not open to students who have taken 204-457B.)

204-318B BEHAVIOURAL NEUROSCIENCE 2. (3) (2lectures, 1 conference) (Prerequisite: 204-308 or 204-311 or 177-306 or or 552-314.) Physiological bases of motivation including feeding and drinking, sexual and parental behaviour. Physiological processes in reinforcement and learning.

204-331B INTER-GROUP RELATIONS. (3) (2 lectures) (Prerequisite: 204-215) The course focuses on the social psychology of societal

groups such as racial minorities, aboriginal groups and women. The ideological biases of current theories is first established. This is followed by a review of current theories and finally current controversies are explored including new forms of racism and affirmative action.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-332B INTRODUCTION TO PERSONALITY. (3) (3lectures) (Prerequisite: 204-100A) This course examines some of the major theories of personality, e.g., those of Freud, Rogers, and Bandura. Empirical research inspired by these theories will also be examined. Topics include the nature of human motivation, the role of the self-concept, and the consistency and stability of personality.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-333A PERSONALITY AND SOCIAL PSYCHOLOGY. (3) (2 lectures) (Prerequisite: 204-215A) Human behavior is a product of both factors residing within the person and factors residing in one's environment (other individuals, relationships, groups, and momentary situations). The course will consider traditional approaches to person-situation interactions and a more dynamic approach based on recent research on goals and social cognition.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

● **204-334A COMPUTER SIMULATION - PSYCH. PROCESS.** (3) (3 hour lecture) (Prerequisites: 204-212, 204-213 and 308-202A,B; or permission of instructor.)

● **204-335A FORMAL MODELS OF PSYCH. PROCESSES.** (3) (3hour lecture) (Prerequisites: A basic understanding of mathematics, e.g. the contents of 189-112A,B, and of computer science, e.g. the contents of 308-202A,B or permission of instructor.)

● **204-336A MEASUREMENT OF PSYCH. PROCESSES.** (3) (3 lectures) (Prerequisites: 204-204 and Introductory Calculus)

204-337A INTRO: ABNORMAL PSYCHOLOGY 1. (3) (2lectures, 1 conference) (**Note:** This course is prerequisite for 204-338B.) A survey of the genetic, physiological and environmental origins of intellectual and emotional disorders.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-338B INTRO: ABNORMAL PSYCHOLOGY 2. (3) (2 lectures, 1 conference) (Prerequisite: 204-337A) (**Note:** This course is prerequisite for 204-491D.) An introduction to psychotic behaviour problems, character disorders and behaviour modification.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

● **204-341B PSYCHOLOGY OF BILINGUALISM.** (3) (2lectures) (Prerequisites: Introductory Psychology, and 204-340 or introduction to linguistics; or permission of instructor.)

204-342B HORMONES AND BEHAVIOUR. (3) (2lectures) (Prerequisite: 177-111A, 177-112B, 177-115B or equivalent) The role of hormones in organization of CNS function, as effectors of behaviour, in expression of behaviours and in mental illness.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-343B LANGUAGE ACQUISITION IN CHILDREN. (3) (2lectures plus conference) This course will examine the human capacities that make the profound feat of language acquisition possible. Topics will include analyses of empirical, methodological, and theoretical issues in language acquisition and will draw upon evidence from the cognitive neuroscience, psycholinguistic, linguistic and philosophical literatures.
Section 01 Limited to Psychology Major and Honours students
Section 02 Limited to Psychology Minor students
Section 03 Limited to non-Psychology students

204-351A RESEARCH METHODS IN SOCIAL PSYCHOLOGY. (3) (1 hour lecture, 6 hour lab and/or field work) (Prerequisite: 204-215A. Pre- or Co-requisite: 204-305. U2 level and above, and permission of instructor. Password required.) Designed to introduce students to the issues, strategies, and applications of various research methodologies in social psychology. Through demonstrations, exercises, and pilot studies, students will gain experience with lab and field methods using both correlational and experimental procedures. Classic and contemporary approaches will be examined. **Note:** Students will be admitted on the basis of a written application on forms available from the Department (Room N7/9). Applications must be submitted by August 15.

204-352B LABORATORY IN COGNITIVE PSYCHOLOGY. (3) (1hour lecture, weekly lab) (Prerequisite: 204-213 and permission of instructor. Password required.) This course will introduce students to the experimental techniques that are used in Cognitive Psychology. Different cognitive methodologies will be taught: reaction time, techniques for investigating recognition and recall, analyzing verbal protocols, and comparing subject performance to that of computer models. **Note:** Students will be admitted on the basis of a written application on forms available from the Department (Room N7/9). Applications must be submitted by August 15.

204-353B LABORATORY IN HUMAN PERCEPTION. (3) (1 hour lecture plus 3 hour lab) (Prerequisites: 204-212, U2 level or above, and permission of instructor. Password required.) Students will be introduced to standard psychophysical procedures and data analysis techniques, and will have the opportunity to design and carry out their own experiments. Research topics include: visual acuity, form and motion perception, and visual search. Evaluation based on individually written reports on lab experiments. **Note:** Students will be admitted on the basis of a written application on forms available from the Department (Room N7/9). Applications must be submitted by August 15.

204-380D HONOURS RESEARCH PROJECT AND SEMINAR. (6) (3 hour seminar) (For U2 honours students only. Password required.) Students prepare reports on various experimental areas. They also carry out research under the direction of staff members. Students present reports on progress and write a final research report.

204-403A MODERN PSYCHOLOGY IN HISTORICAL PERSPECTIVE. (3) (2 lectures) A survey of the scientific and ideological influences on psychology from its philosophical beginnings through the period of the schools to its modern situation.
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

204-406B PSYCHOLOGICAL TESTS AND MEASUREMENT. (3) (2 lectures) (Prerequisite: 204-204 or equivalent.) An introduction to the theory and practice of psychological measurement in health, educational, clinical and industrial/organizational settings. Attention to procedures for developing and validating assessment devices. Techniques include: intelligence tests, projective tests, questionnaires, structured interviews, rating scales, and behavioural/performance tests.
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

204-408A PRINCIPLES OF COGNITIVE BEHAVIOUR THERAPY. (3) (2 lectures) (Prerequisites: 204-337A and 204-211 or permission of instructor.) An introduction to the theory, research and practice of cognitive behaviour therapy. The experimental approach to understanding human behaviour is used to follow basic principles of learning and their clinical application. Certain psychiatric disorders such as alcoholism and depression are highlighted to illustrate how a behaviour therapist conceptualizes problems and formulates treatments.

204-410B SPECIAL TOPICS IN NEUROPSYCHOLOGY. (3) (2 lectures) (Prerequisites: 204-311 or 204-308. Knowledge of basic neuropsychology at the level covered in 204-311A is assumed.) This course will trace developments in human brain mapping and in cognitive neuroscience via readings from primary sources. Topics include the neural bases for perception, language, and memory,

and their relationship to structural and functional brain organization. Emphasis is placed on integrating knowledge from behavioral lesion experiments and functional activation studies.

204-412A DEVIATIONS IN CHILD DEVELOPMENT. (3) (2lectures, 1 conference) (Prerequisite: 204-304 or 204-337 or permission of instructor. Students will also require a basic knowledge of research design.)This course focuses on deviations in the perceptual, cognitive, social, and emotional development of children. Emphasis is placed on research exploring constitutional and environmental causes and symptoms associated with such disorders as depressive spectrum disorders, anxiety disorders, conduct disorder, autism, schizophrenia, attention deficit hyperactivity disorder, eating disorders, and substance abuse.
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

● **204-413A COGNITIVE DEVELOPMENT.** (3) (3 hours) (Prerequisite: 204-304A or 204-213 or equivalent.)

204-414B SOCIAL DEVELOPMENT. (3) (Prerequisites: 204-304A and 204-305) Advanced study of the development of social behaviour and social cognition in children. Topics include: socialization, attachment, aggression, exploration, role taking, communication, family and peer relations, self and person perception. The development of these social processes within the framework of three general theories of development: psychoanalytic, learning, and cognitive-developmental.
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

● **204-416B ADVANCED TOPICS IN CHILD DEVELOPMENT.** (3) (3 lectures) (Prerequisite: 204-304 or permission of instructor.)

● **204-427B SENSORIMOTOR BEHAVIOUR.** (3) (2lectures) (Prerequisite: 204-308A or permission of instructor.)

204-429B HEALTH PSYCHOLOGY. (3) (2 lectures, 1 conference) (Prerequisite: 204-337A or, in the case of advanced undergraduates, permission of instructor.) A survey of health psychology including a review of psychological factors involved in the development of physical illness. Assessment and intervention strategies for problems such as cardiovascular disease, cancer, diabetes, and headaches.
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

204-436A HUMAN SEXUALITY AND ITS PROBLEMS. (3) (Prerequisite: either 204-337A or permission of the instructor.) This course will deal with typical sexual behavior and its variations. Topics will include the history of sex research, the sexual response cycle, sexual dysfunction, gender identity, sexual orientation, etc. Current research and theory will be emphasized.
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

204-450D RESEARCH PROJECT AND SEMINAR. (6 credits) (Prerequisites: 204-204, 204-305 and permission of instructor. Password required) (Only for Major or special students in U3 who intend to proceed to graduate school.) Under supervision of an adviser approved by the Department, students design and carry out a research project. Students report their research in seminars throughout the year and in a final written report. **Note:** Students will be admitted on the basis of a written application on forms available from the Department (Room N7/9). Applications must be submitted by August 15.

204-451A HUMAN FACTORS RESEARCH AND TECHNIQUES. (3) (2 lectures; 1 lab) (Prerequisites: 204-204, 204-211, 204-212, 204-213, 204-215 and 204-305 or permission of instructor.) The application of psychology to the analysis and design of systems and products to increase efficiency and reduce the probability and risk of human error. Topics include: workload and vigilance, control-display relationships, task analysis, and workstation design.

● **204-470A MEMORY AND BRAIN.** (3) (3 hour lectures) (Prerequisites: 204-308 and 204-318 or 552-311 or 177-306)

204-471B HUMAN MOTIVATION. (3) (3 hour lectures) (Prerequisite: 204-215) The course focuses on integrating current goal-based and need-based theories of human motivation. Particular attention will be given to Baumeuster's (1998) Theory of self-regulation failure, and Deci and Ryan's (1991) Self-Determination Theory. The relevance of course material to applied issues in the domains of education, sports, and management is highlighted. (Course description revision awaiting University approval)
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

● **204-472B SCIENTIFIC THINKING AND REASONING.** (3) (2 lectures, 1 conference) (Prerequisites: U3 students only; 177-210 or at least 2 courses in the Faculty of Science at the 200 level.) (Open to Arts and Science students.)

204-473B SOCIAL COGNITION AND THE SELF. (3) (2 lectures) (Prerequisites: 204-215 and 204-331 or 204-333 or 204-474) (Not open to students who have taken 204-411B) This course examines the social psychological literature emphasizing a)social cognition – how people think about and make sense of their social experiences; and b) self theory – how people create and maintain a sense of identity. These frameworks will be applied to social psychological topics including close relationships, attitudes and self-esteem. (Prerequisite revision awaiting University approval)
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

204-474B INTERPERSONAL RELATIONSHIPS. (3) (Prerequisite: 204-215, 204-204, and 204-333 or permission of instructor.) Psychological science approach to interpersonal relationships. Organized in terms of the development of relationships, focusing first on impression formation as a platform for the development of relationships. Then we focus on close relationships, examining interpersonal constructs (intimacy, trust, commitment) and reconsidering social cognitive constructs (attributions, schemas) in an interpersonal context.

204-480D FOUNDATIONS OF MODERN PSYCHOLOGY. (6) (2 lectures) (For Honours students only.) Critical examination of the assumptions, concepts, ethics, empirical methods, and integrative ideas of modern psychology. Lectures, student presentations, and discussions.

204-481D HONOURS THESIS RESEARCH. (6) (9 hours. Research) (U3 Honours students only) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) Under the supervision of an adviser approved by the Department, students design and carry out a research project and report their results in the form of an undergraduate thesis.

204-491D ADVANCED STUDY IN BEHAVIOURAL DISORDERS. (6) (1-2 hours lecture or tutorial per week plus a field experience requirement.) (Prerequisites: 204-337A and 204-338B and permission of instructor. Password required) A critical examination of topics in abnormal and clinical psychology. Emphasis will be on analysis of theoretical positions and empirical findings as they relate to both etiology and treatment. **Note:** Students will be admitted on the basis of a written application on forms available from the Department (Room N7/9). Applications must be submitted by August 15.

204-492A/493B SEMINARS IN SPECIAL TOPICS. (3 credits each) (Restricted to U3 students. Password required.) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) These seminars are offered by special arrangement between interested Psychology staff and students. A student may not register in more than one of these seminars in an academic year. **Note:** A written proposal detailing the plans for the seminar must be approved by the Department Curriculum Committee before the student is permitted to register for this course. This proposal must be received by the Departmental Curriculum Committee well before the beginning of the term for which the seminar is proposed. Consult the Departmental Handbook for additional information.

204-495B PSYCHOLOGY RESEARCH PROJECT. (3) (Prerequisites: 30 credits of the Psychology program including 204-305A/B or equivalent statistics course and CGPA above 3.00. Password required.) (Restricted to U3 students.) (Not open to students reg-

istered in 204-380D, 204-481D or 204-450D.) (Please see regulations concerning Project Courses, section 2.6.2 in the Faculty Degree Requirements section.) Under the supervision of Psychology faculty, students carry out a research project and write a paper describing their results and relating it to the relevant literature. Registration is by special arrangement with Psychology staff, and project proposals must be approved by the Department before registration. For more information see the Psychology Department Handbook.

204-505A THE PSYCHOLOGY OF PAIN. (3) (2lectures; 1 conference) (Prerequisites: any two of the following: 204-308, 204-311, 204-318, 204-422, 504-321, 177-306, 552-314 or permission of instructor). An introduction to pain research and theory, with emphasis on the interactions of psychological, cultural and physiological factors in pain perception. The role of these factors in clinical pain and its management by pharmacological and non-pharmacological means will be discussed.
Section 01 Limited to Psychology students
Section 02 Limited to non-Psychology students

204-510A STATISTICAL ANALYSIS OF TESTS. (3) (3lectures) (Prerequisites: 204-305 or 204-435B, 204-406 or permission of instructor.) This course aims to introduce students interested in developing or appraising tests to the important statistical problems and modern techniques associated with testing data. Testing situations discussed will range from one-shot classroom tests through special purpose scales to the highly refined large scale tests such as the SAT.

● **204-511B INFANT COMPETENCE.** (3) (1, 3 hour seminar) (Prerequisites: 204-351 or 352 or 353 or 380D or 450D and permission of instructor.)

204-522B NEUROCHEMICAL BASIS OF BEHAVIOR. (3) (2 lectures) (Prerequisites: any two of the following 204-308, 204-311, 204-318, 504-321, 552-314, 177-306) (Restrictions: Not open to students who have taken or are taking 549-562A.) Anatomical, biochemical and physiological aspects of neurotransmitter systems in the brain, current theories of the function of these systems in normal and abnormal behaviour, and the actions of psychotropic drugs.

204-526A ADVANCES IN VISUAL PERCEPTION. (3) (2lectures) We examine in detail the structure of the visual system, and its function as reflected in the perceptual abilities and behaviour of the organism. Parallels are also drawn with other sensory systems to demonstrate general principles of sensory coding.

● **204-528 VULNERABILITY TO DEPRESSION.** (3) (Prerequisite: 204-337 or 204-412 or permission of instructor. Password required)

204-530A APPLIED TOPICS IN DEAFNESS. (3) (Prerequisite: 204-340 or 204-316 or equivalent. Co-requisite: 204-343 and permission of instructor.) Covers fundamental topics in deafness (sensory, perceptual, cognitive, social, linguistic, education and health issues) from an applied psychological perspective. Lectures and seminar presentations plus field work involving ASL/LSQ.

● **204-531B STRUCTURAL EQUATION MODELS.** (3) (one 2-hour lecture plus one lab) (Prerequisite: 204-435B, 204-651B, or equivalent, or permission of instructor.)

204-532A COGNITIVE SCIENCE. (3) (Prerequisites: Admission to the Cognitive Science Minor or permission of instructor. Students should ideally have some cognitive science background in at least two disciplines.) The multi-disciplinary study of intelligent systems. Problems in vision, memory, categorization, choice, problem solving, cognitive development, syntax, language acquisition, and rationality. Rule-based and connectionist approaches.

204-533A INTERNATIONAL HEALTH PSYCHOLOGY. (3) (Prerequisite: 204-305 and 204-215 or 204-429 or 204-304 or 151-227 and permission of instructor) (Password required.) The focus will be on health and illness in developing countries, in particular, on health problems (malnutrition, alcohol abuse, mental illness, family planning, and HIV) where psychosocial factors play a large role in the problem and the solution. Attempted solutions based on community participation, health education, non-governmental and international agencies will be discussed.

● **204-534A COMMUNITY PSYCHOLOGY.** (3) (Prerequisites: 204-337 and 204-338 or permission of instructor) (Open to Graduate students or U3 undergraduates in Psychology.)

● **204-535B ADVANCED TOPICS IN SOCIAL PYSCHOLOGY.** (3) (Prerequisites: 204-215, 204-333 and one additional course from the social and personality area of specialization, or 204-380D, and permission of instructor. Password required.)

204-536B CORRELATIONAL TECHNIQUES. (3) (Prerequisites: 204-204 and 204-305 or their equivalents, and 189-133 or equivalent and permission of instructor. Password required). The statistical analysis of relations among a number of variables in situations common in psychology, ecology, and other fields. Methods include regression analysis, principal components analysis, and other techniques for modelling the structure of correlation matrices.

● **204-561B METHODS IN DEVELOPMENTAL PSYCHOLINGUISTICS.** (3) (3hour lectures) (Prerequisites: 204-340, 204-343 and 204-305 or permission of instructor.)

11.28 Science for Teachers

Rutherford Physics Building
3600 University Street
Montreal, QC, H3A 2T8

Fax: (514) 398-8434
Email: bscbed@physics.mcgill.ca

Coordinator - Science — R. Harris

Coordinator - Education — B. Alters

The training and certification of school teachers has traditionally been the responsibility of the Faculty of Education and normally requires the completion of a Bachelor of Education.

The Faculties of Education and of Science have introduced a number of measures to make the B.Ed. degree as accessible as possible to Science students, subject to Ministry of Education regulations. Those who complete a B.Sc. which includes the Minor in Education (see below) will have completed a significant part of the requirements for the McGill B.Ed. degree, and should be able to complete the B.Ed. within one year after graduation from Science. Students without the Minor face a heavier load, but, in principle, can also complete their B.Ed. in a year. Students who decide to apply for admission to Education after obtaining a B.Sc. should be eligible for Advanced Standing credit; for details, see the Faculty of Education section "Advanced Standing/Transfer Credits" on page 188.

There is also another option for Science students which is intended as a very rigorous but rewarding alternative to taking the B.Sc. and the B.Ed. in sequence. The Concurrent B.Sc./B.Ed. program is specifically designed to train teacher/scientists. The program is rigidly structured and closely integrated so as to satisfy the academic requirements of both degrees.

Concurrency is an essential characteristic of the B.Sc./B.Ed.; it is not intended that the Science and Education components be taken separately and then combined. Normally students will be admitted to both components of the Concurrent Program simultaneously, but it is possible for Science students to opt into this program at any time during their B.Sc. program. However, because this is a concurrent program, both degrees must be granted at the same Convocation. It will not be possible to receive one degree first, and the other subsequently.

Students in the Concurrent Program may apply to transfer to either a conventional B.Sc. or a conventional B.Ed program. To do so, they must submit a Faculty Transfer Application to the appropriate Student Affairs Office. The decision will be based on their grades in the relevant component of the Concurrent Program. Students who do transfer to a conventional program may not transfer back to the Concurrent Program.

Students who receive an F or J in an Education Field Experience course are placed in unsatisfactory standing. Although they may complete their semester, they are required to withdraw from the Concurrent Program. However, they may apply to transfer to a conventional B.Sc. program as outlined above.

To be admitted, candidates must satisfy the admission requirements of both faculties.

Students who wish to be registered in the Concurrent Program must contact one of the coordinators through the Student Affairs Office of either faculty.

MINOR IN EDUCATION FOR SCIENCE STUDENTS (18 credits)
[MARS Program Code 6-282700]

Program Adviser —
Mrs. Cheryl Savage, Department of Integrated Studies, Faculty of Education

This Minor allows Science students to develop or explore an interest in Education without committing themselves to completing a B.Ed. degree. Only a few students are prepared to commit to a teaching career at the start of university, but many students see it as a viable option toward the end of their B.Sc. program. At that time, Science students who have taken the Minor in Education will have completed a substantial number of the necessary credits and might be able to complete a B.Ed. in as little as one additional year. For details, see Faculty of Education section 2.1.8.

The 18 credits for the Minor are the same courses approved by the Faculty of Science as Education electives within the Concurrent B.Sc./B.Ed.

Required Courses (12 credits)

411-405	(3)	Policy issues in Quebec Education
414-309	(3)	Exceptional Children
416-300*	(3)	Educational Psychology
455-402	(3)	Media, Technology and Education

* Students should consult the Program Adviser for clarification on the prerequisite for 416-300.

Complementary Courses (6 credits)

3 credits from:

423-400	(3)	Philosophical Foundations
415-398	(3)	Philosophy of Catholic Education

3 credits from:

455-410	(3)	Multi-cultural/Multi-racial Class
423-464	(3)	Intercultural Education
433-441	(3)	First Nations and Inuit Education

CONCURRENT B.SC./B.ED.PROGRAM (135 credits)

The two components of the Concurrent Program are the B.Ed. General Secondary Two-Subject Option Program and one of the B.Sc. Major Programs in Two Subjects for Teachers. These two components are described in what follows, including an identification of the elements that are counted towards the requirements of both degrees. These provisions are exceptional and apply exclusively to the Concurrent Program.

The following two-subject combinations have been approved for the Concurrent Program:

- biology and chemistry
- biology and geography
- biology and mathematics
- chemistry and physics
- mathematics and chemistry
- mathematics and physics.

BACHELOR OF EDUCATION GENERAL SECONDARY TWO-SUBJECT OPTION PROGRAM (120 credits)

The aim of the B.Ed. in Secondary Education is to prepare teachers for the secondary school level through a program of academic studies in two subject areas and professional studies centred on school-based practicum components supported by courses in pedagogy, curriculum and educational foundations. In the case of the Concurrent Program the two academic subjects must correspond to one of the six combinations listed above.

A full description of the B.Ed. Secondary Program can be found in the Faculty of Education section 5.1.1. In summary, it consists of the following:

Academic components (57 credits): in the present case these courses will be selected from the lists of required and complementary courses in the B.Sc. component of the Concurrent Program, and will count towards both degrees.

Professional components (57 credits): these include professional seminars, field experiences, foundation courses, pedagogy courses, and pedagogical support courses. The following 18 credits can be included as electives in the B.Sc. component of the Concurrent program, and will count towards both degrees: 411-405, 414-309, 416-300, 423-400, 455-402, and 455-410.

Electives (6 credits).

BACHELOR OF SCIENCE, MAJOR PROGRAM IN TWO SUBJECTS FOR TEACHERS (90 credits)

These B.Sc. programs are designed specifically as the Science component of the Concurrent B.Sc./B.Ed. Program. Six combinations of two science subjects are approved for the Concurrent Program. These combinations are chosen to reflect compulsory subjects taught in secondary schools and common pairings of subjects taught by secondary school teachers. They also honour the requirement of the Ministère de l'éducation to train teachers in two subjects, with the possibility of a third subject which supports or is related to the other two, since mathematics is a necessary support for physics and chemistry.

The general structure of these B.Sc. programs is as follows:

Required and complementary courses (64-67 credits). The details of these major programs are given below. Note that 57 of these credits can be counted towards the academic component of the B.Ed. program, but only for students in the Concurrent Program.

Elective courses (23-26 credits). These are electives from the B.Sc. perspective, but they must be suitably chosen if the student wishes to complete the Concurrent Program with the minimum of 135 credits. The following Education courses can count towards both the B.Sc. and the B.Ed. components of the Concurrent Program.

411-405	(3)	Policy issues in Quebec Education
414-309	(3)	Exceptional Children
416-300	(3)	Educational Psychology
423-400	(3)	Philosophical Foundations
or 415-398	(3)	Philosophy of Catholic Education
455-402	(3)	Media, Technology and Education
455-410	(3)	Multi-cultural/Multi-racial Class
or 423-464	(3)	Intercultural Education
or 433-441	(3)	First Nations and Inuit Education

MAJOR PROGRAM IN BIOLOGY AND CHEMISTRY FOR TEACHERS (65 credits)

Required Science courses (53 credits)

177-210	(3)	Perspectives of Science
189-222	(3)	Calculus III
189-203	(3)	Principles of Statistics I

Biology List A
Chemistry List A

Complementary Science courses (12 credits)
Biology List B
Geoscience List

MAJOR PROGRAM IN BIOLOGY AND GEOGRAPHY FOR TEACHERS (67 credits)

Required Science courses (43 credits)

177-210	(3)	Perspectives of Science
180-212*	(4)	Organic Chemistry
189-203	(3)	Principles of Statistics I

Biology List A
Geography List A

*Students who have the CEGEP equivalent of this course must replace it with an additional course chosen from Biology List B.

Complementary Science courses (24 credits)
Biology List C
Geography List B
Geoscience List

MAJOR PROGRAM IN BIOLOGY AND MATHEMATICS FOR TEACHERS (67 credits)
Required Science courses (49 credits)
177-210 (3) Perspectives of Science
180-212* (4) Organic Chemistry
Biology List A
Mathematics List A

*Students who have the CEGEP equivalent of this course must replace it with an additional course chosen from Biology List B.

Complementary Science courses (18 credits)
6 additional credits in Biology or related disciplines, at 300-level or above, approved by the Biology Department.
Mathematics List C
3 additional credits in either Mathematics or related disciplines, approved by the Mathematics Department, or in Biology or related disciplines, approved by the Biology Department.

MAJOR PROGRAM IN CHEMISTRY AND PHYSICS FOR TEACHERS (65 credits)
Required Science courses (62 credits)
177-210 (3) Perspectives of Science
Mathematics List B
Chemistry List A
Physics List A

Complementary Science courses (3 credits)
Geoscience List

MAJOR PROGRAM IN MATHEMATICS AND CHEMISTRY FOR TEACHERS (64-65 credits)
Required Science courses (47 credits)
177-210 (3) Perspectives of Science
Mathematics List A
Chemistry List A

Complementary Science courses (17-18 credits)
Mathematics List C
Chemistry List B

MAJOR PROGRAM IN MATHEMATICS AND PHYSICS FOR TEACHERS (66 credits)
Required Science courses (57 credits)
177-210 (3) Perspectives of Science
Mathematics List A
Physics List A and List B

Complementary Science courses (9 credits)
Mathematics List C

COURSE LISTS USED IN THE VARIOUS OPTIONS

Biology List A: (21 credits)
177-200 (3) Molecular Biology
177-201 (3) Cell Biology and Metabolism
177-202 (3) Basic Genetics
177-205 (3) Biology of Organisms
177-206 (3) Methods in Biology of Organisms
177-208 (3) Introduction to Ecology
177-301 (3) Cell and Molecular Laboratory

Biology List B: (9 credits)
to be selected from the following:
177-304 (3) Evolution
177-370 (3) Human Genetics Applied
552-201 (3) Human Physiology: Control Systems
or 552-209 (3) Mammalian Physiology I

Biology List C: (6 credits)
to be selected from the following:
177-465 (3) Conservation Biology
177-331 (3) Ecology / Behaviour Field Course
or 177-334 (3) Applied Tropical Ecology
or 177-336 (3) Marine Aquaculture
or 177-337 (3) Ecology and Behaviour of Fishes

Chemistry List A: (23 credits)
180-150 (3) World of Chem: Food
or 180-160 (3) World of Chem: Technology
or 180-170 (3) World of Chem: Drugs
or 180-180 (3) World of Chem: Environment
180-281 (3) Inorganic Chemistry I
180-381 (3) Chemistry of Transition Elements
180-212/222* (4) Organic Chemistry
180-257 (4) Analytical Chemistry
180-203/213* (3) Physical Chemistry
180-350 (3) Earth, Air, Fire, Water
or 180-307 (3) Environmental Analysis

*students who have the CEGEP equivalent of any one of these courses must replace it with one course chosen from the block 180-273 through 507-404 in List B (for 180-203/213) or from the block 180-302 through 180-402 (for 180-212/222).

Chemistry List B: (8 or 9 credits)
to be selected from the following, subject to the requirement that at least one course must include a laboratory.
180-273 (1) Chemical Kinetics
180-345 (3) Molecular Properties & Structure I
180-355 (3) Molecular Properties & Structure II
180-365 (2) Statistical Thermodynamics
180-363 (2) Physical Chemistry Lab.
180-393 (2) Physical Chemistry Lab. II
180-556 (3) Advanced Quantum Mechanics
507-404 (3) Biophysical Chemistry
180-367 (3) Instrumental Analysis I
180-377 (3) Instrumental Analysis II
180-567 (3) Chemometrics: Analysis of Chemical Data
180-302 (3) Organic Chemistry III
180-362 (2) Advanced Organic Chemistry Lab.
180-402 (3) Advanced Bio-Organic Chemistry
180-531 (3) Chemistry of Inorganic Materials
180-455 (3) Polymer Chemistry
180-591 (3) Advanced Coordination Chemistry
180-543 (2) Chemistry of Pulp & Paper
180-392 (3) Integrated Inorganic/Organic laboratory
186-210 (3) Introduction to Mineralogy
or 186-220 (3) Principles of Geochemistry
or 186-580 (3) Aqueous Geochemistry
or 186-542 (3) Chemical Oceanography

Geography List A: (12 credits)
183-201 (3) Geographic Information Systems I
183-203 (3) Environmental Systems
183-216 (3) Geography of the World Economy
183-272 (3) Landforms & Environmental Systems

Geography List B: (15 credits)
to be selected from the following:
183-200 (3) Geographical Perspectives on World Environmental Problems
183-302 (3) Environmental Analysis and Management: Problems and Policy
183-305 (3) Soils and Environment
183-321 (3) Climatic Environments
183-322 (3) Environmental Hydrology
183-350 (3) Ecological Biogeography
183-372 (3) Running Water Environments
183-408 (3) Geography of Unequal Development
183-410 (3) Geography of Underdevelopment: Current Problems
183-306 (3) Geographic Information Systems II
or 183-308 (3) Principles of Remote Sensing
183-495 (3) Field studies - Physical Geography
or 183-398 (3) Field studies in Human Geography
or 183-494 (3) Urban Field Studies
or 183-496 (3) Regional Geographical Excursion: Barbados
or 183-497 (3) Field studies in Geography: Coastal Marsh Plant Ecology
or 183-499 (3) Subarctic field studies in Geography: Schefferville

Geoscience List: (3 credits)
to be selected from the following:
186-200 (3) The Terrestrial Planets
186-201 (3) Understanding Planet Earth
186-320 (3) Elementary Earth Physics
195-210 (3) Introduction to Atmospheric Science
195-220 (3) Introduction to Oceanic Sciences
195-315 (3) Water in the Atmosphere

Mathematics List A: (21 credits)
189-222 (3) Calculus III
189-235 (3) Algebra I
189-236 (3) Linear Algebra I
189-314 (3) Advanced Calculus
189-315 (3) Ordinary Differential Equations
189-323 (3) Probability Theory
189-324 (3) Statistics

Mathematics List B: (15 credits)
189-203 (3) Principles of Statistics I
189-222 (3) Calculus III
189-223 (3) Linear Algebra
189-314 (3) Advanced Calculus
189-315 (3) Ordinary Differential Equations

Mathematics List C: (9 credits)
to be selected from the following
189-242 (3) Analysis I
189-243 (3) Real Analysis
189-317 (3) Numerical Analysis
189-318 (3) Mathematical Logic
189-338 (3) History and Philosophy of Mathematics
189-348 (3) Topics in Geometry
308-202 (3) Introduction to Computing 1
308-203 (3) Introduction to Computing 2

Physics List A: (21 credits)
198-230 (3) Dynamics of Simple Systems
198-232 (3) Heat and Waves
198-241 (3) Signal Processing
198-257 (3) Experimental Methods I
198-340 (3) Electricity and Magnetism
198-342 (3) Electromagnetic Waves
or 198-434 (3) Optics
198-446 (3) Quantum Physics

Physics List B: (12 credits)
198-258 (3) Experimental Methods II
198-342* (3) Electromagnetic Waves
or 198-434* (3) Optics
198-436 (3) Modern Physics
198-439 (3) Laboratory in Modern Physics

* Both of 198-342 and 198-434 are required for the Mathematics and Physics option.

11.29 Technological Entrepreneurship for Science Students

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

Also available to Science students is the Minor in Management described in section 11.14.

Enrolment in this program is restricted. Application procedures will be announced in September. Please consult the Student Affairs Office Website http://www. mcgill.ca/artscisao.

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

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

MINOR IN TECHNOLOGICAL ENTREPRENEURSHIP FOR SCIENCE STUDENTS (18 credits)
(Awaiting final University approval)

Required Courses (15 credits)
270-465 (3) Technological Entrepreneurship
270-466 (3) Technological Entrepreneurship Project
271-210 (3) Accounting for Managers
275-360 (3) Marketing of Technology
276-562 (3) Seminar in Organizational Strategies

Complementary Courses (3 credits)
one of the following courses:
280-320 (3) Managing Human Resources
272-321 (3) Leadership Power & Influence