Neuroscience

The Department of Cellular and Molecular Medicine is located in the Faculty of Medicine and offers graduate programs leading to the degrees of Master of Science (MSc) and Doctor of Philosophy (PhD) in Neuroscience.

The department is located at the Health Sciences Center of the University of Ottawa. Through its cross-appointed and adjunct members, the Department has research affiliations with the following Institutes: the Loeb Research and University of Ottawa Heart Institutes at the Ottawa Hospital (Civic Campus), the Royal Ottawa Hospital, the Canadian Red Cross, Health Canada, National Research Council and the Department of National Defense.

The programs help students develop their theoretical knowledge as well as their capacity for critical analysis. This is achieved through reading and critiquing the scientific literature, conducting experiments in the laboratory, analyzing the data and results generated, and presenting their results in the form of research seminars or posters. The programs prepare candidates for a variety of careers in teaching and research both within and outside of academia.

Graduates of the program will acquire autonomy in conducting research and in preparing scholarly publications and grant applications. A comprehensive set of courses, state-of-the-art research facilities and outstanding research opportunities ensure a career in neuroscience.

The Department is a participating unit in the collaborative program in Human and Molecular Genetics and in Pathology and Experimental Medicine at the master's and doctoral levels.

The doctoral program participates in the Combined MD / PhD Program, which allows students to graduate with both a PhD in Neuroscience and an MD. For more information please see the website of the Faculty of Medicine.

Most of the courses in these programs are offered in English. Research activities can be conducted either in English, French or both, depending on the language used by the professor and the members of his or her research group.

In accordance with the University of Ottawa regulation, students have a right to produce their work, their thesis, and to answer examination questions in French or in English.

The programs are governed by the general regulations of the Faculty of Graduate and Postdoctoral Studies (FGPS).

Programs

- Master of Science Neuroscience
- Master of Science Neuroscience Specialization in Human and Molecular Genetics
- Master of Science Neuroscience Specialization in Pathology and Experimental Medicine
- Doctorate in Philosophy Neuroscience
- Doctorate in Philosophy Neuroscience Specialization in Human and Molecular Genetics
- Doctorate in Philosophy Neuroscience Specialization in Pathology and Experimental Medicine

Professors

ABULROB, ABEDELNASSER, Adjunct Professor
Therapeutic drug delivery & targeting to the central nervous system; mechanisms of cellular endocytosis/transcytosis; nano-biotechnology; in vivo molecular imaging; drug pharmacokinetics & pharmacodynamics

Akimenko, Marie-Andree, Cross-appointment
Genetic control of fin development and regeneration in zebrafish
Albert, Paul, Cross-appointment
*Molecular mechanisms of autoreceptor desensitization*

Béïque, Jean-Claude, Assistant Professor

Bennett, Steffany, Full Professor
*Neuroregeneration; degeneration; apoptosis; stem cells; Gap junctions; Alzheimer's; transgenic mouse models; Neural Regeneration; Lipidomics*

Bergeron, Richard

Blier, Pierre, Cross-appointment
*Psychopharmacology*

Boet, Sylvain, Assistant Professor

Bulman, Dennis

Chen, Hsiao-Huei

Colavita, Antonio, Cross-appointment
*Genetic analysis of Axon branching in C. elegans*

Corbett, Dale, Full Professor
*Stroke and Neuroplasticity*

Da Silva, Jean, Cross-appointment
*Imaging blood flow; metabolism and signal transduction pathways with positron emission tomography*

Gee, Stephen, Associate Professor
*Molecular mechanisms of receptor and ion channel organization at synapses; role of dystrophin-associated proteins in signal transduction and in pathogenesis of muscular dystrophies*

Hakim, Antoine, Cross-appointment
*Delineating the signalling pathways which control neuronal death*

Jasmin, Bernard, Full Professor
*Regulation of gene expression and role of the cytoskeleton in organizing postsynaptic membrane domains*

Knott, Verner

Kothary, Rashmi, Cross-appointment

Lagace, Diane, Assistant Professor

Longtin, Andre, Cross-appointment
*Nonlinear dynamics, stochastic dynamics, biological physics and mathematical biology.*

Maler, Leonard, Full Professor
*Regulation of neurotransmission*

Martina, Marzia, Adjunct Professor

Merali, Zulfiquar, Full Professor
*Regulation of ingestive behavior; interactions between stress and the immune system*

Ngsee, Johnny, Cross-appointment
*Molecular basis of synaptic transmission vesicle membrane trafficking protein structure and function*

Park, David, Cross-appointment
*Mechanisms of neuronal death*

Renaud, Léo, Cross-appointment
*Neurotransmitters; electrophysiology, hypothalamus, amino acids; neuropeptides*

Schlossmacher, Michael

Slack, Ruth, Cross-appointment
Adenovirus-mediated gene transfer in post-mitotic neurons: role of p53 in apoptosis

Staines, William, Full Professor
*Neurochemistry of brain disorders; neuronal development*

Stanimirovic, Danica, Adjunct Professor
*Blood brain barrier in vitro; role of non-neuronal cells in neurodegeneration*

Tiberi, Mario, Cross-appointment
*Molecular basis of dopamine receptor regulation*

Tremblay, François

Tsai, Eve, Cross-appointment
*Spinal cord repair strategies; axonal regeneration; MRI imaging of spinal cord tracts in humans and animals; and clinical outcomes after spine surgery*

Zhang, Wandong

Zhang, Xia

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**Admission**

**Doctorate**

Admission to the graduate program in neuroscience is governed by the general regulations of the FGPS. Applications are evaluated based on the following criteria:

- Be the holder of a master's degree in science with a minimum average of B+ (75%) calculated in accordance with the FGPS guidelines.
- Demonstrate a good academic performance in previous studies as shown by official transcripts, research reports, abstracts or any other documents demonstrating research skills.
- Provide at least two confidential letters of recommendation from professors who have known the applicant and are familiar with the student work.
- Provide a statement of purpose indicating the career goals and the interests in the proposed research area.
- Identify at least one professor who is willing and available to act as thesis supervisor.

**Transfer from Master’s to PhD Program**

Outstanding students enrolled in the MSc program may be allowed to transfer to the PhD program without being required to write a master's thesis provided they meet the following conditions:

- Satisfactory progress in the research program.
- Written recommendation by the supervisor and the advisory committee.
- Approval by the graduate studies committee.

The transfer must take place within sixteen months of initial enrollment in the master's. Following transfer, all of the requirements of the doctoral program must be met: the doctoral seminar (NSC8325), six units of course work (including either NSC5102 or NSC5104), the comprehensive exam (NSC9998) and the thesis (NSC9999).
Collaborative Program in Human and Molecular Genetics at the Doctoral Level

The Department of Cellular and Molecular Medicine is a participating unit in the collaborative program in Human and Molecular Genetics at the master’s and doctoral levels. This program has been established for students wishing to include an interdisciplinary component in Human and Molecular Genetics as part of their degree in Neuroscience.

Students should indicate in their initial application for admission that they wish to be accepted into the collaborative program. To be accepted, the thesis director must be a member of the collaborative program. Students are normally informed about their acceptance into the collaborative program at the same time as being informed about their admission into the primary program. For further details, see the Human and Molecular Genetics program.

Collaborative Program in Pathology and Experimental Medicine at the Doctoral Level

The Department of Cellular and Molecular Medicine is a participating unit in the collaborative program in Pathology and Experimental Medicine at the master’s and doctoral levels. This program has been established for students wishing to include an interdisciplinary component in Pathology and Experimental Medicine as part of their degree in Neuroscience.

Students should indicate in their initial application for admission that they wish to be accepted into the collaborative program. To be accepted, the thesis director must be a member of the collaborative program. Students are normally informed about their acceptance into the collaborative program at the same time as being informed about their admission into the primary program. For further details, see the Pathology and Experimental Medicine program.

Program Requirements

Doctorate

PhD in Neuroscience

Successful completion of compulsory course MED8166 Professionalism and Professional Skills.

Six units of graduate courses including either NSC5102 or NSC5104 or equivalent, approved by the Department.

Enrollment in the seminar course (NSC8325S), which involves the presentation of a seminar and regular attendance at the departmental seminars.

Successful completion of a comprehensive examination (NSC9998) in the form of either a defended MRC-style grant application or an oral examination on selected topics within the field.

Successful presentation and defense of a thesis (NSC9999) based on original research carried out under the direct supervision of a research faculty member in the Department.

NOTE: The Department may require students to take additional courses, depending on their backgrounds.

Collaborative program in Human and Molecular Genetics

The student is responsible for fulfilling both the participating unit requirements for the primary program and the requirements for the collaborative program.

Six units of courses, three units of which must be from the student’s primary program and three of which must be HMG units.

Enrollment in the seminar course, presentation of one seminar and active participation in the seminar series in the student’s primary program.

Presentation and successful defence of a thesis based on original research carried out under the direct supervision of a member of the collaborative program.
Master's candidates intending to transfer directly to the doctoral program must meet the conditions set by their primary program. Course selection is subject to the approval of the HMG program director.

Collaborative program in Pathology and Experimental Medicine

The requirements of both the primary program and those of the collaborative program must be met. The requirements specific to the collaborative program are as follows:

- One course (3 units) in the primary program.
- One Pathology and Experimental Medicine specialization course (3 units).
- Successful completion of the Pathology and Experimental Medicine seminar course.
- Successful completion of the Comprehensive Examination as required by the respective primary program.
- Preparation and defense of a thesis under the supervision of a professor who is a member of the Pathology and Experimental Medicine program. The thesis must be relevant to the focus of the Pathology and Experimental Medicine program. At least one of the examiners must be a member of the Pathology and Experimental Medicine collaborative program.

Duration of the program

The requirements of the program are usually fulfilled within four years. The maximum time permitted is six years from the date of initial enrollment in the program, or seven years in the case of the students transferring from the master’s to the doctorate.

Residence

All students must complete a minimum of six terms (sessions) of full-time enrollment. In the case of transfer students, the residency period is nine full-time terms (sessions) from the initial enrollment in the program.

Minimum standards

The passing grade in all courses is C+. Students who fail two courses (equivalent to 6 units), the thesis proposal, or the comprehensive exam or whose research progress is deemed unsatisfactory are required to withdraw.

Thesis Advisory Committee

During the first term (session) of the program, a thesis advisory committee (TAC) is formed for the candidate. The Committee’s membership will be determined by the specific interests of the candidate. It will be composed of the supervisor and 2-3 additional professors. At least one member of the thesis committee, in addition to the supervisor, must be from the Faculty of Medicine. The TAC is responsible for guiding the student throughout the program, including course selection, the comprehensive examination, thesis proposal, and thesis defense.

A meeting between the student and the Thesis Advisory Committee will take place at least once per term (session). The thesis examining board may include members who are not part of the TAC.

Courses

**MED8166 PROFESSIONALISM AND PROFESSIONAL SKILLS**
Basic professional skills related to academic integrity, proper referencing techniques, avoidance of plagiarism, professional etiquette, public speaking, time and stress management, conflict management, teamwork, knowing when and how to access student support services. Compulsory for all students enrolled in master’s or doctoral programs at the Faculty of Medicine. Graded S/NS (Satisfactory/Not satisfactory).

**NSCS5102 CELLULAR AND MOLECULAR NEUROSCIENCE** (3 units)
The molecular and cellular properties of neurons. Emphasis to be placed on the molecular basis of electrical activity of neurons and chemical synaptic transmission.
NSC5104 SYSTEMS NEUROSCIENCE (3 units)
Structure and function of representative components of the nervous system to be presented in an integrated and comprehensive manner, emphasizing a reductionist approach to the study of neural networks and their behavioural output. Prerequisites: PHS 3240 or equivalent or permission of the program director.

NSC5106 MOLECULAR PSYCHIATRY (3 units)
Study of genetic and neurochemical bases of mental illnesses using transgenic and gene knockout mouse models, animal behavioural paradigms, in vivo imaging. Gene therapy approaches in psychiatry; influence of environmental stressors. Prerequisites: PHS 3240 or BIO 3170/BIO 3570 or PSY 3301/PSY 3701 or equivalent or permission of the program director.

NSC7100 NEUROTRANSMISSION AND NEUROMODULATION (3 units)
Molecular and cell biology of neurotransmission including the identity, actions and mechanisms of neurotransmitters and neuromodulators. Use of computer simulations to explore the complex interactions between synaptic input and the electrical architecture of neurons.

NSC7999 THÈSE DE MAÎTRISE / MSc THESIS

NSC8103 DEVELOPMENTAL NEUROSCIENCE (3 units)
Fundamental concepts of development of the nervous system with an emphasis on those aspects unique to this tissue type. Topics to include control of proliferation and differentiation, axonal outgrowth and pathfinding, synaptogenesis and formation of neuronal maps, neuronal plasticity, growth factor action and neural regeneration.

NSC8104 COMPUTATIONAL NEUROSCIENCE (3 units)
Basic concepts of sensory-motor processing from the cellular level of excitable membranes and synaptic signalling mechanisms to the emergent properties of complex neural networks.

NSC8105 MOLECULAR BIOLOGY AND THE NEURON (3 units)
Emphasis on how signal transduction regulates neuronal function. Topics to include the role of the cytoskeleton in neuronal function, membrane sorting in exocytosis and endocytic pathways, metabotropic and ionotropic receptor signaling, signaling by the GTP-binding proteins, plasma membrane and vesicular transporters, role of protein-protein interactions in the regulation of neuronal signaling, and genomic and proteomic approaches to study neuronal signaling.

NSC8106 MECHANISMS OF NEUROLOGICAL DISEASE (3 units)
Current knowledge of select neuropathologies with emphasis on the underlying genetics and biochemistry of these conditions. Examination of some fundamental cellular processes important for understanding neurological diseases.

NSC8324 SEMINAR FOR MSc STUDENTS
All graduate students enrolled in the MSc program or who have been admitted to a PhD program without an MSc must participate in these seminars for one year. Two seminars must be presented by each student during the year.

NSC8325 SEMINAR FOR PhD STUDENTS
All graduate students enrolled in the PhD program must participate in these seminars for one year during their doctoral or post MSc training. Two seminars must be presented by each student during the year: one on an assigned subject, the other on his or her research project.

NSC8340 NEUROMUSCULAR FUNCTION AND DYSFUNCTION (3 units)
Topics to be covered include factors controlling muscle- and synapse-specific gene expression, regulation of myogenesis and muscle cell growth, formation of the neuromuscular junction, motor neuron - muscle interactions, the role of the cytoskeleton in organization of post-synaptic domains, functional role of ion channels in muscle, molecular genetics of neuromuscular disease. Prerequisite: CMM 5340 or equivalent

NSC9998 EXAMEN DE SYNTHÈSE (DOCTORAT) / COMPREHENSIVE EXAM (PhD)

NSC9999 THÈSE DE DOCTORAT / PhD THESIS

HMGB106 CLINICAL CYTOGENOMICS (3 units)
Comprehensive review of the basic principles and technologies in cytogenomics and their clinical application for diagnostic and prognostic purposes. Registrations may be limited depending on enrolment. Prerequisite: Permission of the course coordinator.

HMGB107 CLINICAL BIOCHEMICAL GENETICS (3 units)
Presentation of the biomechanical and molecular bases of inborn errors of metabolism. The course consists of a series of lectures followed by
student discussion of a related paper assigned the previous week. Registrations may be limited depending on enrolment. Prerequisite: Permission of the course coordinator.

**HMG8108 CLINICAL MOLECULAR GENETICS** (3 units)
Comprehensive review of all aspects of clinical molecular genetics acquainting students with clinical applications of various molecular technologies. Registrations may be limited depending on enrolment. Prerequisite: Permission of the course coordinator.