**Master of Science Neuroscience Specialization in Human and Molecular Genetics**

**Summary**
- Degree offered: Master of Science (MSc)
- Registration status option: Full-time
- Language of instruction:
  - French
  - English

Note: Most of the courses in this program are offered in English.

- Primary program: MSc in Neuroscience
- Collaborative specialization: Human and Molecular Genetics
- Program option (expected duration of the program):
  - with thesis (6 full-time terms; 24 consecutive months)
- Academic units: Faculty of Medicine (http://med.uottawa.ca/en), Department of Cellular and Molecular Medicine (http://med.uottawa.ca/cellular-molecular).

**Program Description**
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 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.

**Collaborative Program Description**
The Faculty of Medicine offers a collaborative program in Human and Molecular Genetics at the master’s and doctoral levels. The primary graduate programs in Biochemistry (BCH), Cellular and Molecular Medicine (CMM) and Neuroscience (NSC) collaborate in offering the specialization. The degree awarded specifies the primary program and indicates "specialization in Human and Molecular Genetics."

Members of the program include scientists with interest and expertise in the following areas: developmental genetics, neuromuscular disease, microbial genetics, host resistance, cancer biology, aging, development of novel molecular therapeutics, gene therapy, growth and development, auto-immune diseases, molecular biology of viruses, bacteria and parasites, genetic epidemiology, retinal development and disease, animal models of human disease, molecular aspects of signal transduction.

**Main Areas of Research**
The Department of Cellular and Molecular Medicine 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 Ottawa Hospital Research Institute (OHRI), the University of Ottawa Heart Institutes at the Ottawa Hospital (Civic Campus), the Institute of Mental Health Research (IMHR) at the Royal Ottawa Hospital, the Children’s Hospital of Eastern Ontario (CHEO) Research Institute, Elizabeth Bruyere Hospital, and the National Research Council.

**Other Programs Offered Within the Same Discipline or in a Related Area**
- Master of Science Neuroscience (MSc)
- Master of Science Neuroscience Specialization in Pathology and Experimental Medicine (MSc)
- Master of Science Cellular and Molecular Medicine (MSc)
- Master of Science Cellular and Molecular Medicine Specialization in Bioinformatics (MSc)
- Master of Science Cellular and Molecular Medicine Specialization in Human and Molecular Genetics (MSc)
- Master of Science Cellular and Molecular Medicine Specialization in Pathology and Experimental Medicine (MSc)
- Doctorate in Philosophy Neuroscience (PhD)
- Doctorate in Philosophy Neuroscience Specialization in Human and Molecular Genetics (PhD)
- Doctorate in Philosophy Neuroscience Specialization in Pathology and Experimental Medicine (PhD)
- Doctorate in Philosophy Cellular and Molecular Medicine (PhD)
- Doctorate in Philosophy Cellular and Molecular Medicine Specialization in Human and Molecular Genetics (PhD)
- Doctorate in Philosophy Cellular and Molecular Medicine Specialization in Pathology and Experimental Medicine (PhD)

**Fees and Funding**
- Program fees: The estimated amount for university fees (https://www.uottawa.ca/university-fees) associated with this program are available under the section Finance your studies (http://www.uottawa.ca/graduate-studies/programs-admission/finance-studies).

International students enrolled in a French-language program of study may be eligible for a differential tuition fee exemption (https://www.uottawa.ca/university-fees/differential-tuition-fee-exemption).

- To learn about possibilities for financing your graduate studies, consult the Awards and financial support (https://www.uottawa.ca/graduate-studies/students/awards) section.
Notes

• Programs are governed by the general regulations (http://www.uottawa.ca/graduate-studies/students/general-regulations) in effect for graduate studies.
• In accordance with the University of Ottawa regulation, students have the right to complete their assignments, examinations, research papers, and theses in French or 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.

Program Contact Information
Graduate Studies Office, Faculty of Medicine (https://med.uottawa.ca/graduate-postdoctoral)
451 Smyth Road, Room RGN 2016
Ottawa, Ontario, Canada
K1N 6N5

Tel.: 613-562-5215
Email: grad.med@uottawa.ca

Twitter | Faculty of Medicine (https://twitter.com/uOttawaMed)
Youtube | Faculty of Medicine (https://www.youtube.com/channel/UCP2nDlrjFEEtymOmlZe2HA)
Flickr | Faculty of Medicine (https://www.flickr.com/photos/uottawamed)

Admission Requirements
For the most accurate and up to date information on application deadlines, language tests and other admission requirements, please visit the specific requirements (http://www.uottawa.ca/graduate-studies/programs-admission/apply/specific-requirements) webpage.

To be eligible, candidates must:

• Have an honours bachelor's degree with a minimum admission average of B+ (75%).
• Demonstrate a good academic performance in previous studies as shown by official transcripts, research reports, abstracts or any other documents demonstrating research skills.
• Pay the $100 ($CDN non-refundable) application fee.
• Identify at least one professor who is willing to supervise your research and thesis.
  • We recommend that you contact potential thesis supervisors as soon as possible.
  • To register, you need to have been accepted by a thesis supervisor.
  • The supervisor's name is required at the time of application.
• The thesis director must be a member of the collaborative program.

Language Requirements
Applicants must be able to understand and fluently speak the language of instruction (French or English) in the program to which they are applying. Proof of linguistic proficiency may be required.

Applicants whose first language is neither French nor English must provide proof of proficiency in the language of instruction.

Language tests recognized by the University of Ottawa:
• TOEFL: 600 (paper-based) – 100 (internet-based); or
• IELTS: 7.0 Overall – 7.0 Individual (paper-based or internet-based); or
• An equivalent language test (http://www.uottawa.ca/graduate-studies/programs-admission/apply/required-documents).

Note: Candidates are responsible for any fees associated with the language tests.

Notes

• The admission requirements listed above are minimum requirements and do not guarantee admission to the program.
• Admissions are governed by the general regulations (http://www.uottawa.ca/graduate-studies/students/general-regulations) in place for graduate studies.
• Candidates must apply to the primary program and indicate in their application for admission to the master's program in Neuroscience that they wish to be accepted into the collaborative specialization in Human and Molecular Genetics. 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. To be admitted to the collaborative program, candidates must also be accepted in the primary program.

Documents Required for Admission
In addition to the documents required (http://www.uottawa.ca/graduate-studies/programs-admission/apply/required-documents) for graduate and postdoctoral studies, candidates must submit the following documents:

• A resume
• A statement of purpose
  Letter outlining your professional goals and proposed research area.
• Two confidential letters of recommendation from professors who have known the applicant and are familiar with the student’s work. You are strongly encouraged to contact your referee(s) prior to submitting your application in order to confirm their email address and their availability to complete your letter of recommendation.

• Transcripts from all universities attended:
  • You must submit official transcripts from all the universities you have attended. This applies to all courses and programs at any university you attended, including regular programs (completed or not), exchanges, letters of permission, online or correspondence courses, courses taken as a special student or visiting student, etc.
  • If the transcript and degree certificate are not in English or French, a certified translation (signed and stamped/sealed) must be submitted.

Note: Documents that are not required for admission will not be consulted, conserved or returned to the student. These documents will be destroyed according to our administrative procedures.

Information about how to apply to this program is available under the Apply Now (http://www.uottawa.ca/graduate-studies/programs-admission/apply/#apply-now) section.

Students should complete and submit their online application with supporting documentation (if applicable) by the deadline indicated above.

Program Requirements

Master’s with Collaborative Specialization

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

Students must meet the following requirements for the master’s with collaborative specialization:

Compulsory Courses (NSC):
MED 8166 Professionalism and Professional Skills 0 Unit
3 course units from:
NSC 5102 Cellular and Molecular Neuroscience 3 Units
NSC 5104 Systems Neuroscience

Compulsory Courses (HMG):
3 elective course units in human and molecular genetics (HMG) at the graduate level

Seminar:
NSC 8324S Seminar for MSc Students 2 3 Units

Thesis:
NSC 7999 MSc Thesis 3, 4 0 Unit

Note(s)
1 Course selection is subject to the approval of the HMG program director.
2 The seminar course involves the presentation of a seminar and regular attendance at the departmental seminars.
3 Presentation and successful defence of a thesis on a topic in Human and Molecular Genetics based on original research carried out under the direct supervision of a member of the collaborative program.
4 Students are responsible for ensuring they have met all of the thesis requirements (http://www.uottawa.ca/graduate-studies/students/theses).

Fast-Track from Master’s to PhD

Students enrolled in the master’s program in Neuroscience at the University of Ottawa may be eligible to fast-track directly into the doctoral program without writing a master’s thesis. For additional information, please consult the “Admission Requirements” section of the PhD program.

Minimum Requirements

The passing grade in all courses is C+.

Students who fail two courses (equivalent to 6 units), the thesis proposal, or whose research progress is deemed unsatisfactory are required to withdraw.

Research

Research Fields & Facilities

Located in the heart of Canada’s capital, a few steps away from Parliament Hill, the University of Ottawa is among Canada’s top 10 research universities.

uOttawa focuses research strengths and efforts in four Strategic Areas of Development in Research (SADRs):

• Canada and the World
• Health
• e-Society
• Molecular and Environmental Sciences

With cutting-edge research, our graduate students, researchers and educators strongly influence national and international priorities.

Research at the Faculty of Medicine

“The Faculty of Medicine has a long history of conducting both basic and clinical research of the highest quality. Many of our high profile research projects are conducted in partnership with affiliated-teaching hospitals and research institutes. These partnerships lead to biomedical discoveries that have a significant impact on health care. In the process they educate the next generation of Canadian scientists. Our research activity also attracts significant investment, which stimulates the Ottawa economy.”

- Dr. Bernard Jasmin, Vice-Dean, Research

Facilities, Research Centres and Institutes at the Faculty of Medicine

• Centre for Neural Dynamics (http://www.neurodynamic.uottawa.ca)
• University of Ottawa Centre for Neuromuscular Disease (http://med.uottawa.ca/neuromuscular)
• Centre for Research in Biopharmaceuticals and Biotechnology (http://www.med.uottawa.ca/crbb/eng)
Courses

NSC 5102 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.
Course Component: Lecture

NSC 5104 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.
Course Component: Lecture

NSC 5106 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.
Course Component: Lecture

NSC 6300 Seminars

NSC 7100 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.
Course Component: Seminar

NSC 7999 Thèse de maîtrise / MSc Thesis

Volet / Course Component: Recherche / Research

NSC 8103 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.
Course Component: Lecture

NSC 8104 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.
Course Component: Lecture

NSC 8105 Molecular Biology of 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.
Course Component: Lecture

NSC 8106 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.
Course Component: Lecture

NSC 8324S Seminar for MSc Students (3 crédits / 3 units)
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.
Volet / Course Component: Séminaire / Seminar

NSC 8325S Seminar for PhD Students (3 crédits / 3 units)
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.
Volet / Course Component: Séminaire / Seminar

NSC 8340 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 the organization of postsynaptic domains, functional role of ion channels in muscle, molecular genetics of neuromuscular disease.
Course Component: Lecture
Prerequisite: CMM 5340 or equivalent.

NSC 9998 Examen de synthèse (doctorat) / Comprehensive Examination (Ph.D.)
Volet / Course Component: Recherche / Research

NSC 9999 Thèse de doctorat / PhD Thesis
Volet / Course Component: Recherche / Research

For more information, refer to the list of faculty members and their research fields on Uniweb (https://uniweb.uottawa.ca/#!arts/themes).
HMG 8103 Advanced Topics in the Molecular Biology of Human Diseases I (3 units)
Topics will be selected and representative of current developments in the field. The course consists of a repeated series of a 3 hour lecture by an expert in the field one week, followed by student presentations, discussions and critique of assigned papers on that topic the following week. Topics on selected diseases will focus on various aspects of cancer, apoptosis, disease gene identification and gene therapy. In the past these topics have included the molecular aspects of various cancers, spinal muscular atrophy, tissue regeneration, the discovery of disease genes, infectious disease (HIV) and gene therapy. Students will write a grant proposal and participate in mock grant review panels. Depending on enrolment, the course may be limited to HMG students only.
Course Component: Lecture
Prerequisite: Permission of the HMG program director.

HMG 8105 Advanced Topics in the Molecular Biology of Human Diseases II (3 units)
Topics will be selected and representative of current developments in the field. The course consists of a repeated series of a 3 hour lecture by an expert in the field one week, followed by student presentations, discussions and critique of assigned papers on that topic the following week. Topics on selected diseases will focus on various aspects of cancer, apoptosis, disease gene identification and gene therapy. In the past these topics have included the molecular aspects of various cancers, spinal muscular atrophy, tissue regeneration, the discovery of disease genes, infectious disease (HIV) and gene therapy. Students will write a grant proposal and participate in mock grant review panels. Depending on enrolment, the course may be limited to HMG students only.
Course Component: Lecture
Prerequisite: Permission of the HMG program director.

HMG 8106 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.
Course Component: Lecture
Prerequisite: Permission of the course coordinator.

HMG 8107 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.
Course Component: Lecture
Prerequisite: Permission of the course coordinator.

HMG 8108 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.
Course Component: Lecture
Prerequisite: Permission of the course coordinator.

HMG 8506 Cytogénomique clinique (3 crédits)
Revue exhaustive des principes de base et des techniques en cytogénomique et de leur application clinique à des fins diagnostiques et pronostiques. Les inscriptions peuvent être limitées selon la participation.
Volet : Cours magistral

HMG 8507 Génétique biochimique clinique (3 crédits)
Présentation des bases biochimiques et moléculaires des maladies innées du métabolisme. Les inscriptions peuvent être limitées selon la participation.
Volet : Cours magistral

HMG 8508 Génétique moléculaire clinique (3 crédits)
Revue exhaustive de tous les aspects de la génétique moléculaire clinique donnant aux étudiants des exemples des applications cliniques des différentes techniques en génétique moléculaire. Les inscriptions peuvent être limitées selon la participation.
Volet : Cours magistral

HMG 8600 Special Topics in Human and Molecular Genetics (3 crédits)
Current topics in molecular genetics, developmental genetics, cancer genetics, neurogenetics, population genetics, clinical genetics and other areas depending on available expertise and interest expressed. Offered alternate years subject to sufficient demand.
Volet : Cours magistral