

# MASTER OF SCIENCE NEUROSCIENCE AND SPECIALIZATION PATHOLOGY AND EXPERIMENTAL MEDICINE

*Please note that admission to the Master of Science Neuroscience and Specialization Pathology and Experimental Medicine is suspended until further notice.*

## 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: Pathology and Experimental Medicine
- 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 objective of the Pathology and Experimental Medicine collaborative program is to provide graduate students with the knowledge and skills to examine the basic mechanisms of disease pathology, and to develop new strategies for prevention and treatment. The degree awarded specifies

the primary program and indicates "specialization in Pathology and Experimental Medicine."

## 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 Human and Molecular Genetics (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/](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](mailto:grad.med@uottawa.ca)**

**Twitter | Faculty of Medicine ([https://  
twitter.com/uOttawaMed/](https://twitter.com/uOttawaMed/))**

**Youtube | Faculty of Medicine  
([https://www.youtube.com/channel/  
UCP2nDlrjFEetyfMiOmle2HA/](https://www.youtube.com/channel/UCP2nDlrjFEetyfMiOmle2HA/))**

**Flickr | Faculty of Medicine  
([https://www.flickr.com/photos/  
uottawamed/](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 ([https://www.uottawa.ca/graduate-studies/  
programs-admission/apply/specific-requirements/](https://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%).

Note: International candidates must check the admission equivalencies ([https://www.uottawa.ca/graduate-studies/  
international/study-uottawa/admission-equivalencies/](https://www.uottawa.ca/graduate-studies/international/study-uottawa/admission-equivalencies/)) for the diploma they received in their country of origin.

- Demonstrate a good academic performance in previous studies as shown by official transcripts, research reports, abstracts or any other documents demonstrating research skills.
- 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.
- Be sponsored into the collaborative program by a faculty member, normally the thesis supervisor, who must be a member of the Pathology and Experimental Medicine 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.

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/](http://www.uottawa.ca/graduate-studies/students/general-regulations/)) in effect 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 Pathology and Experimental Medicine. 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/](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.
- Three confidential letters of recommendation
  - Two from professors who have known you and are familiar with your work.
  - One from a professor who is willing and available to act as thesis supervisor.

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.

## 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:

MED 8166 Professionalism and Professional Skills

3 course units from: 3 Units

NSC 5102 Cellular and Molecular Neuroscience

NSC 5104 Systems Neuroscience

3 course units from: 3 Units

BCH 8107 Advanced Topics in Lipid Metabolism and Disease

CMM 5001 The Pathological Basis of Disease

CMM 5105 Introduction to Cancer Biology

CMM 5315 Cellular and Molecular Basis of Cardiovascular Function/Dysfunction

CMM 8105 Advanced Topics in Cancer Biology

NSC 8101 Advanced Topics in Neuropathology

PME 8112 Cell Biology and the Molecular Basis of Pathological Phenotypes

### Seminars: <sup>1</sup>

NSC 8324S Seminar for MSc Students 3 Units

PME 5367 Seminar

### Thesis:

THM 7999 Master's Thesis <sup>2,3</sup>

Note(s)

1

The seminar courses involve the presentation of a seminar and regular attendance at the departmental seminars.

2

Presentation and defence of a thesis on a topic in Pathology and Experimental Medicine based on original research carried out under the supervision of a professor who is a member of the Pathology and Experimental Medicine collaborative program. At least one of the thesis examiners must be a member of the Pathology and Experimental Medicine collaborative program.

3

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 at the University of Ottawa

Located in the heart of Canada's capital, a few steps away from Parliament Hill, the University of Ottawa ranks among Canada's top 10 research universities. Our research is founded on excellence, relevance and impact and is conducted in a spirit of equity, diversity and inclusion.

Our research community thrives in four strategic areas:

- Creating a sustainable environment
- Advancing just societies
- Shaping the digital world
- Enabling lifelong health and wellness

From advancing healthcare solutions to tackling global challenges like climate change, the University of Ottawa's researchers are at the forefront of innovation, making significant contributions to society and beyond.

### 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 (<https://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/crb/b/eng/>)
- Canadian Partnership for Stroke Recovery (<https://canadianstroke.ca/>)
- Kidney Research Centre (<http://www.ohri.ca/centres/KRC/default.asp>)
- University of Ottawa Skills and Simulation Centre (<http://uossc.ca/>)
- Medical Devices Innovation Institute
- Ottawa Institute of Systems Biology (<http://med.uottawa.ca/oisb/>)
- University of Ottawa Brain and Mind Research Institute (<http://www.uottawa.ca/brain/>)

For more information, refer to the list of faculty members and their research fields on **Uniweb**.

**IMPORTANT: Candidates and students looking for professors to supervise their thesis or research project can also consult the website of the faculty or department (<https://www.uottawa.ca/study/graduate-studies/academic-unit-contact-information/>) of their program of choice. Uniweb does not list all professors authorized to supervise research projects at the University of Ottawa.**

## 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 6101 Consciousness: An Interdisciplinary Perspective from Neuroscience, Philosophy and Psychology (3 units)

This interdisciplinary course addresses two fundamental questions in the study of the mind: 1) what is consciousness? 2) Can we explain the emergence and operation of this central feature of human life by analyzing the brain?

**Course Component:** Lecture

### NSC 6300 Seminars

**Course Component:** Lecture

### 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

Permission of the Department is required.

### NSC 8101 Advanced Topics in Neuropathology (3 units)

General histopathological responses of central and peripheral nervous tissue to pathological stimuli including hypoxic-ischemic, traumatic, inflammatory/infectious, demyelinating and toxic. Emerging topics in neurology and neuropathology including the following: the pathology and pathogenesis of protein-based neurodegenerative disorders, the emerging family of RNA-mediated neurological disorders, mendelian and non-mendelian genetic diseases of the nervous system (including the role of microRNA in neurological disease), advances in diseases of skeletal muscle, advances in the molecular pathogenesis of Central Nervous System tumours, and advances in metabolic/mitochondrial/storage diseases.

**Course Component:** Lecture

### 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 8107 NEURAL CONTROL OF METABOLISM (3 units)

Examination of how the brain controls metabolism and how metabolic disorders affect brain function. Topics include the brain's control of food intake, glucose homeostasis and energy expenditure. Examination of the effects of mental states on metabolic homeostasis, the relationship between neurogenesis and metabolism, neurovascular coupling in brain metabolism, and genetic risk in metabolic syndromes.

**Course Component:** Lecture

Prerequisite: NSC 5102 or NSC 5104

**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 post-synaptic 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

**PME 5367 Seminar**

Presentation of one poster during the Research Day organized by the Pathology and Experimental Medicine collaborative program. Active participation in the annual Pathology Research Day of the Department of Pathology and Laboratory Medicine. Poster evaluated by Pathology and Experimental Medicine program faculty members. Graded S (Satisfactory) / NS (Not satisfactory).

**Course Component:** Seminar

**PME 8112 Cell Biology and the Molecular Basis of Pathological Phenotypes (3 units)**

Molecular principles of cell biology, with a focus on the mechanisms of disease. Disorders in cell biological processes that underlie many pathological phenotypes, such as intracellular transport, mitochondrial dynamics, cell biology of the nucleus and the regulation of the cytoskeleton. Emphasis on emerging experimental techniques, including functional assay design, fluorescence microscopy (multi-photon, confocal, assays like Fluorescence Resonance Energy Transfer (FRET), Fluorescence Lifetime Imaging Microscopy (FLIM), Fluorescence Recovery After Photobleaching (FRAP), photoactivation and uncaging) and electron microscopy. Participants will have hands-on experience and will work to apply these techniques to their own research problems by rotation through participating laboratories. The experiments performed by the students during the course will be assembled into a manuscript-style paper for submission at the end of the term to be graded by the course co-ordinator. Enrolment is limited to 10 students and preference will be given to students whose projects are related directly to these concepts and techniques.

**Course Component:** Lecture

**PME 8367 Seminar**

Presentation of one poster during the Research Day organized by the Pathology and Experimental Medicine collaborative program. Active participation in the annual Pathology Research Day of the Department of Pathology and Laboratory Medicine. Poster evaluated by Pathology and Experimental Medicine program faculty members. Graded S (Satisfactory) / NS (Not satisfactory).

**Course Component:** Seminar