

DOCTORATE IN PHILOSOPHY CELLULAR AND MOLECULAR MEDICINE AND SPECIALIZATION PATHOLOGY AND EXPERIMENTAL MEDICINE

This program is currently under revision. At this time, we are not accepting applications.

Summary

- Degree offered: Doctorate in Philosophy (PhD)
- Registration status option: Full-time
- Language of instruction:
 - French
 - English

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

- Primary program: PhD in Cellular and Molecular Medicine
- Collaborative specialization: Pathology and Experimental Medicine
- Program option (expected duration of the program):
 - with thesis (16 full-time terms; 64 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 programs prepare candidates for a variety of careers in teaching and research both within and outside of academia. During training, the student will develop a critical approach to published work and to his own work. Graduates acquire an excellent knowledge of their chosen field and a general understanding of the areas related to their own particular research project. They must demonstrate research skills and credibility as professionals in their area of research.

The Department is a participating unit in the collaborative programs in Bioinformatics (at the master's level), in Human and Molecular Genetics (at the master's and doctoral levels), 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 Cellular and Molecular Medicine and an MD. For more information please see the website of the Faculty of Medicine (<http://www.med.uottawa.ca/md-phd/eng/>).

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

Most research groups in the Department are part of a research centre. These centres include the Centre for Neuromuscular Disease, the Kidney Research Centre, and the Centre for Research in Biopharmaceuticals. Members of the Department are involved in three main research fields:

- Growth and development
- Pharmacology
- Physiology

Other Programs Offered Within the Same Discipline or in a Related Area

- 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)
- Master of Science Neuroscience (MSc)
- Master of Science Neuroscience Specialization in Human and Molecular Genetics (MSc)
- Master of Science Neuroscience Specialization in Pathology and Experimental Medicine (MSc)
- 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 Neuroscience (PhD)
- Doctorate in Philosophy Neuroscience Specialization in Human and Molecular Genetics (PhD)
- Doctorate in Philosophy Neuroscience 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 academic regulations (<https://www.uottawa.ca/about-us/leadership-governance/policies-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/UCP2nDlrjFEetyfMiOmle2HA/>)

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 (<https://www.uottawa.ca/graduate-studies/programs-admission/apply/specific-requirements/>) webpage.

To be eligible, candidates must:

- Have a master's degree in science (with a background in biology, biochemistry, human kinetics, pharmacology, physiology or biopharmaceutical sciences) with a minimum average of B+ (75%).

Note: International candidates must check the 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 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. Most of the courses in these programs are offered in English.

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/>) in effect for graduate studies.
- Candidates must apply to the primary program and indicate in their application for admission to the PhD program in Cellular and Molecular Medicine 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/>) 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.

Fast-Track from Master's to PhD

Students enrolled in the master's program in Cellular and Molecular Medicine at the University of Ottawa may be eligible to fast-track directly into the doctoral program without writing a master's thesis, provided the following conditions are met:

- Successful completion of the seminar and all the core courses required for the master's program.
- Satisfactory progress in the research program.
- Written recommendation by the supervisor and the advisory committee.
- Approval by the graduate studies committee.

Notes:

- The transfer must take place within sixteen months of initial enrollment in the master's.
- The minimal admission average requirements for the doctoral program must also be met.
- Following the transfer, all of the requirements of the doctoral program must be met: the doctoral seminar (CMM 8325S), six units of course work, the comprehensive exam (CMM 9998) and the thesis (THD 9999).

Program Requirements Doctorate with Collaborative Specialization

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

Students must meet the following requirements for the doctorate with collaborative specialization:

Compulsory Courses:

MED 8166	Professionalism and Professional Skills	
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	
3 optional course units in cellular and molecular medicine (CMM) at the graduate level		3 Units
Seminars:		
CMM 8325S	Seminars II ¹	3 Units
PME 8367	Seminar	
Comprehensive Examination:		
CMM 9998	Comprehensive Examination (PhD) ²	
Thesis:		
THD 9999	Doctoral Thesis ^{3, 4}	

Note(s)

1

The seminar course involves the presentation of a seminar and regular attendance at the approved departmental seminars.

2

Successful completion of a comprehensive examination in the form of a written research proposal followed by an oral examination.

3

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.

4

Students are responsible for ensuring they have met all of the thesis requirements (<http://www.uottawa.ca/graduate-studies/students/theses/>).

Minimum Requirements

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.

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/bb/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://uoss.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

Not all of the listed courses are given each year. The course is offered in the language in which it is described.

CMM 5001 The Pathological Basis of Disease (3 crédits / 3 units)

Introductory course for non-medical graduate students in Life Sciences. This course will consist of a brief introduction to pathology describing the manifestation of disease at the macroscopic and microscopic level. This will be followed by (i) a description of various types of microscopy and methodology; (ii) concepts in flow cytometry, tissue/cell fractionation; (iii) histo-/cytochemistry and immunohisto-/cytochemistry; (iv) normal cells and tissues; (v) organs; (vi) the general pathology of cells and tissues including hypertrophy, aplasia, atrophy, hyperplasia, metaplasia, dysplasia, neoplasia, storage diseases, extracellular space pathologies, necrosis and apoptosis. Blood vessel and cardiac pathologies will be covered as well as concepts in neuropathology, organ/system specific pathologies and genetic diseases.

Volet / Course Component: Cours magistral / Lecture

CMM 5101 Special Topics in Reproductive and Developmental Biology (3 units)

In-depth study of current topics in reproductive and developmental biology, with emphasis on state-of-the art molecular and cell biology techniques as well as their applications to reproductive diseases. Topics may include assisted reproductive technologies, embryonic stem cells, contraception, endocrine disruptors, reproductive toxicology, and transgenics.

Course Component: Lecture
Previously CMM 8300.

CMM 5102 Ion Channels: Cellular and Molecular Aspects of Membrane Functions (3 units)

A study of the diversity, molecular structure, structure-function relationship, electrophysiological characteristics and physiological roles of different ion channels in excitable and non-excitable cells. The channels that are studied include the sodium, potassium, calcium and chloride channels.

Course Component: Lecture
Previously CMM 8350.

CMM 5103 The molecular and pathophysiological basis of kidney disease and hypertension (3 units)

Lecture and seminar course with emphasis on translational aspects of biomedical research towards a better understanding of the molecular and pathophysiological mechanisms of human kidney disease as related to vascular dysfunction. Topics to include: basic structure and physiology of the kidney; the endothelium in hypertension and chronic kidney disease; aldosterone in hypertension and kidney disease; acute kidney injury – impact on the renal vasculature; the sympathetic nervous system in patients with hypertension and chronic kidney disease; preclinical models of renal diseases - towards translation to humans; the glomerular filtration barrier - hemodynamic & non-hemodynamic mechanisms of injury.

Course Component: Lecture
Previously CMM 8355.

CMM 5105 Introduction to Cancer Biology (3 units)

An introduction to the biology of cancer. Major topics in cancer biology include the following: tumor suppression/oncogenes; apoptosis in cancer; cell immortalization and senescence; genomic instability; multistep tumorigenesis/inflammation in cancer; biology of angiogenesis; rational therapies.

Course Component: Lecture

CMM 5111 Computational Cell Biology (3 units)

Emphasis is on providing students with the background knowledge and the tools needed to develop and analyze models of cellular processes. Topics include modelling enzyme kinetics, signal transduction pathways, and gene regulatory networks, using differential equations, nonlinear dynamics, and stochastic processes.

Course Component: Lecture

Permission of the Department is required.

CMM 5210 Mammalian Physiology (6 units)

Course Component: Lecture

CMM 5302 Comprehensive Pharmacology I (3 units)

Extensive coverage of pharmacodynamics, pharmacokinetics, and the pharmacology of the autonomic and central nervous system. Courses CMM 5301, CMM 5302 cannot be combined for units.

Course Component: Lecture

CMM 5303 Comprehensive Pharmacology II (3 units)

Extensive coverage of the pharmacology of antibiotic and anti-inflammatory drugs, of chemotherapeutic agents, and of the cardiovascular and gastro-intestinal systems. Courses CMM 5301, CMM 5303 cannot be combined for units.

Course Component: Lecture

CMM 5304 Introduction to Developmental Biology (3 units)

Concepts in development and signalling pathways during development including formation of the germ layers; establishment of the body axis and principles of segmentation; patterning and homeobox genes; neurogenesis; axonal and neuronal guidance; stem cell concepts; germ cells; animal models in developmental biology.

Course Component: Lecture

CMM 5311 Physiology and Pathophysiology of Energy Metabolism and Muscle Functions (3 units)

Advanced comprehensive training in mammalian and human physiology with emphasis on pathophysiology. Topics include: neural and endocrine control of the hypothalamus-hypophysis axis; role of pancreas, adipose tissue and skeletal muscle in carbohydrate and lipid metabolism; cellular and molecular aspects of muscle contraction and fatigue in cardiac and skeletal muscle.

Course Component: Lecture

CMM 5313 Physiology and Pathophysiology of the Reproductive, Renal and Gastrointestinal Systems (3 units)

Advanced comprehensive training in mammalian and human physiology with emphasis on pathophysiology. Topics covered include reproductive physiology, molecular and bulk transport processes in the renal system, enteric control of the gastrointestinal tract.

Course Component: Lecture

CMM 5315 Cellular and Molecular Basis of Cardiovascular Function/Dysfunction (3 units)

Mechanism of failing heart and cardiovascular system, its associated functions and associated conditions. Therapies for restoring function. Topics include: regulation of heart development, cell signaling, cellular and molecular mechanisms of atherosclerosis and heart disease, hormonal regulation, hypertension, bioenergetics, cardiovascular genomics and genetics, cell therapy, and regenerative medicine.

Course Component: Lecture

CMM 5326 Experimental Preparations and Animal Models (3 units)

Applied and theoretical course intended to give the potential researcher basic surgical skills. Lectures followed by demonstrations and/or practical exercises.

Course Component: Lecture

CMM 5341 Stem Cells (3 units)

Topics in stem cell biology which will include an in-depth look at the properties of embryonic and adult stem cell populations, tissue-specific stem cells (muscle, skin, neural, etc.), differentiation and reprogramming, the stem cell niche, induced pluripotent stem cells, and therapeutic advances using stem cell therapy.

Course Component: Lecture

CMM 5360 Imaging in Cell Biology (3 units)

Microscopy, biological imaging, and image generation. Overviews of common transmitted light, electron microscopic and epifluorescent techniques. Discussion of enhanced fluorescence microscopy and live cell imaging techniques, including image acquisition, processing and analysis with focus on quantitative and ethical issues.

Course Component: Lecture

CMM 5372 Cell Signalling and Hormone Action (3 units)

Topics will include the major cell signaling pathways and the action of steroid and non-steroid hormones. These signaling pathways will be discussed in the context of biological function and pharmacology.

Course Component: Lecture

CMM 7301 Directed Studies (3 units)

A program of study designed for a given student according to the student's educational requirements.

Course Component: Seminar

CMM 8103 Epithelial Cell Polarity (3 units)

Cell polarity with emphasis on tight junctions and Claudins (tight junction molecules). Topics include: the molecular basis of cell polarity and permeability barrier during development, organogenesis and disease including inflammatory disease and cancer.

Course Component: Lecture

CMM 8105 Advanced Topics in Cancer Biology (3 units)

Advanced study of recent developments in the field of cancer biology with emphasis on cellular and molecular aspects. Specific topics to be covered include: angiogenesis, apoptosis, cancer genetics, cell signaling, genetic instability, oncogenes and tumour suppressors.

Course Component: Lecture

CMM 8310 Current Topics in RNA Molecular Biology (3 units)

Properties, mechanisms associated with regulation and the function of RNAs and Ribonucleoprotein (RNPs) as well as RNA organisms. Current knowledge on RNA expression (synthesis, processing, transport and localization), the structure-function relationship and molecular mechanisms associated with RNAs and RNA genomes, RNA in evolution and in the origin of life, and RNA as therapeutic agents. Courses BCH 8310 and CMM 8310 cannot be combined for units.

Course Component: Lecture

Courses BCH 8310 and CMM 8310 cannot be combined for units.

CMM 8311 Current Topics in Transcriptional Regulation (3 units)

Topics will include chromatin structure and its impact on gene expression, protein: DNA interactions, the assembly of transcriptional complexes, and the control of gene expression in mammalian systems.

Course Component: Lecture

CMM 83241 Seminars I (Part 1 of 2)

Compulsory for one year for all students enrolled in the master's program. Presentation of two seminars or one seminar and one poster required during the year as well as regular attendance at the departmental seminar series. (Part 1 of 2)

Course Component: Seminar

CMM 83242 Seminars I (Part 2 of 2) (3 units)

Compulsory for one year for all students enrolled in the master's program. Presentation of two seminars or one seminar and one poster required during the year as well as regular attendance at the departmental seminar series. (Part 2 of 2)

Course Component: Seminar

Prerequisite: CMM 83241

CMM 8324S Seminars I (3 crédits / 3 units)

Compulsory for one year for all students enrolled in the master's program. Presentation of two seminars or one seminar and one poster required during the year as well as regular attendance at the departmental seminar series.

Volet / Course Component: Séminaire / Seminar

CMM 83251 Seminars II (Part 1 of 2)

Compulsory for all students enrolled in the doctorate program. Presentation of two seminars or one seminar and one poster required during the year as well as regular attendance at the departmental seminar series. (Part 1 of 2)

Course Component: Seminar

CMM 83252 Seminars II (Part 2 of 2) (3 units)

Compulsory for all students enrolled in the doctorate program. Presentation of two seminars or one seminar and one poster required during the year as well as regular attendance at the departmental seminar series. (Part 2 of 2)

Course Component: Seminar

Prerequisite: CMM 83251

CMM 8325S Seminars II (3 crédits / 3 units)

Compulsory for all students enrolled in the doctorate program. Presentation of two seminars or one seminar and one poster required during the year as well as regular attendance at the departmental seminar series.

Volet / Course Component: Séminaire / Seminar

CMM 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 organization of post-synaptic domains, functional role of ion channels in muscle, molecular genetics of neuromuscular disease.

Course Component: Lecture

CMM 8341 Cell Stress (3 units)

Topics will include cellular responses to cell stress and will include hypoxia, oxidative stress, ER stress, autophagy, apoptosis and aging.

Course Component: Lecture

CMM 8345 Special Topics in Gastroenterology (3 units)

Lectures, tutorials and seminar-discussion sessions, designed to provide advanced training in gastrointestinal function. Emphasis on pathophysiological mechanisms.

Course Component: Lecture

CMM 9998 Examen de synthèse (doctorat) / Comprehensive Examination (PhD)

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