

BIOMEDICAL SCIENCES

The Department specializes in scientific disciplines which are basic to human and veterinary medicine. Within this context, the research activities of the faculty are focused under the general umbrella of biomedical science and biotechnology. The MBS, MSc and PhD programs provide emphasis in one of the department's seven major fields:

- Reproductive Biology and Development
- Cellular and Molecular Basis of Health & Disease
- Cancer Biology
- Cardiovascular Physiology
- Stem Cell Biology and Regenerative Medicine
- Biomedical Toxicology and Pharmacology
- Neuroscience

The department also participates in the Doctor of Veterinary Science (DVSc) program.

Administrative Staff

Chair

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Graduate Faculty

This list may include Regular Graduate Faculty, Associated Graduate Faculty and/or Graduate Faculty from other universities.

Craig D. Bailey

B.Sc., PhD Queen's - Associate Professor
Graduate Faculty

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DVM Poland, M.Sc., PhD Saskatchewan - Associate Professor
Graduate Faculty

Peter D. Conlon

B.Sc., M.Sc. McGill, DVM, PhD Guelph - Professor
Graduate Faculty

Brenda Coomber

B.Sc., MSc Guelph, PhD Toronto - Professor Emerita
Associated Graduate Faculty

Giannina Descalzi

BA Guelph, M.Sc., PhD Toronto - Assistant Professor
Graduate Faculty

Laura Favetta

B.Sc. Milan, PhD Guelph - Associate Professor
Graduate Faculty

W. J. Brad Hanna

B.Sc., DVM, M.Sc., PhD Guelph - Associate Professor
Graduate Faculty

Ronald Johnson

B.Sc., DVM Guelph, PhD Michigan State, Dip. ACVCP - Professor
Graduate Faculty

Bettina E. Kalisch

B.Sc., M.Sc., PhD Queen's - Associate Professor
Graduate Faculty

Jibran Khokhar

B.Sc. Queen's, PhD Toronto - Assistant Professor, Western University
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W. Allan King

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Associated Graduate Faculty

Thomas Koch

DVM Copenhagen, PhD Guelph - Associate Professor
Graduate Faculty

Jonathan LaMarre

DVM, PhD Guelph - Professor
Graduate Faculty

Neil J. MacLusky

B.Sc. Leeds, PhD London - Professor
Graduate Faculty

Pavneesh Madan

B.V.Sc. & AH, M.V.Sc. India, PhD British Columbia - Professor
Graduate Faculty

Tami Martino

B.Sc. McMaster, M.Sc. PhD Toronto - Professor
Graduate Faculty

Gabriela Mastromonaco

B.Sc., M.Sc. Toronto, PhD Guelph - Senior Director, Toronto Zoo
Associated Graduate Faculty

Roger A. Moorehead

B.Sc., PhD McMaster - Professor
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Anthony Mutsaers

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Samantha Payne

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Melissa Perreault

B.Sc., M.Sc., PhD McMaster - Associate Professor
Graduate Faculty

James J. Petrik

M.Sc., PhD Western Ontario - Professor
Graduate Faculty

W. Glen Pyle

B.Sc. Guelph, PhD Tennessee - Professor
Graduate Faculty

Tarek M. Saleh

B.Sc., PhD Western Ontario - Professor and Chair
Graduate Faculty

Matthew Vickaryous

B.Sc., M.Sc. Calgary, PhD Dalhousie - Professor
Graduate Faculty

Alicia Viloria-Petit

B.Sc., M.Sc. Venezuela, PhD Toronto - Associate Professor
Graduate Faculty

MBS Program

Admission Requirements

Applicants should have an Honours baccalaureate degree in the Biological Sciences or a Doctor of Veterinary Medicine degree (or the equivalent) with a minimum 'B+' standing in the final two years of study. Letters of reference from two individuals who can adequately evaluate the academic and research capabilities of the applicant must be provided with the application. In addition, a short statement of the applicant's area of interest and career goals is required to assist in the selection of faculty advisors. Students may be admitted into the Fall, Winter, or Summer semester. Provisional acceptance may be granted to students who do not meet this 'B+' standard if there is additional evidence that the applicant is capable of successfully completing the graduate program (e.g., outstanding letters of recommendation, or evidence of prior relevant work or research experience). Transfer to regular status will normally be recommended when the student obtains a minimum grade of 'A-' in their first two graduate course and displays current research ability to their advisory committee. These courses will be credited to the degree program.

Program Requirements

Students may wish to focus their Master of Biomedical Sciences in a range of subject areas, including:

1. Reproductive Biology and Development;
2. Cellular and Molecular Basis of Health and Disease;
3. Cancer Biology;
4. Cardiovascular Physiology;
5. Stem Cell Biology and Regenerative Medicine;
6. Biomedical Toxicology and Pharmacology; and
7. Neuroscience.

The research projects are varied in topic and scope and may involve: molecular, cellular, or developmental aspects of tissue or animal differentiation and growth; physiological, morphological, or biomechanical investigations of normal function or disease processes in a variety of organs and tissues; or pharmacological mechanisms related to therapy and drug toxicity. Research projects may also involve pedagogical research related to teaching in the biomedical sciences. Practicum experiences, also varied in topic and nature, expose students to real-world applications of their areas of study, and connect them

with employers in government agencies, consulting firms, research organizations, etc.

Students must obtain at least an overall weighted average of 'B-' in prescribed courses. The number of course credits prescribed will not be fewer than 4.0 credits. As part of their studies, all MBS students must complete either a research project through BIOM*6900 Research Project in Biomedical Sciences or an applied practicum through BIOM*6910 Practicum in Biomedical Sciences. The remaining courses selected will depend on the student's prior experience and the nature of the research project or practicum. All students are required to present a poster seminar as a component of BIOM*6900 Research Project in Biomedical Sciences or BIOM*6910 Practicum in Biomedical Sciences. The program is completed when all components of BIOM*6900 Research Project in Biomedical Sciences or BIOM*6910 Practicum in Biomedical Sciences have been submitted and the related written report is deemed appropriate by the student's Advisory Committee.

MSc Program

Admission Requirements

Applicants should have an Honours baccalaureate degree in the Biological Sciences or a Doctor of Veterinary Medicine degree (or the equivalent) with a minimum 'B+' standing in the final two years of study. Letters of reference from two individuals who can adequately evaluate the academic and research capabilities of the applicant must be provided with the application. In addition, a short statement of the applicant's research interests and career goals, is required to assist in the selection of faculty advisors. Students may be admitted into the Fall, Winter or Summer semester. Provisional acceptance may be granted to students who do not meet this 'B+' standard if there is additional evidence that the applicant is capable of successfully completing the graduate program (e.g., outstanding letters of recommendation, or evidence of prior relevant work or research experience). Transfer to regular status will normally be recommended when the student obtains a minimum grade of 'A-' in their first two graduate course and displays current research ability to their advisory committee. These courses will be credited to the degree program.

Program Requirements

Students may wish to focus their MSc degree in one of the following fields:

1. Reproductive Biology and Development;
2. Cellular and Molecular Basis of Health and Disease;
3. Cancer Biology;
4. Cardiovascular Physiology;
5. Stem Cell Biology and Regenerative Medicine;
6. Biomedical Toxicology and Pharmacology; and
7. Neuroscience.

The research project may involve: molecular, cellular or developmental aspects of tissue or animal differentiation and growth; physiological, morphological or biomechanical investigations of normal function or disease processes in a variety of organs and tissues; or pharmacological mechanisms related to therapy and drug toxicity.

Students must obtain at least an overall weighted average of 'B-' in prescribed courses. The number of graduate course credits prescribed will not be fewer than 1.5 credits. Prescribed and additional courses are selected by the student in consultation with the student's advisory committee. The courses selected will depend on the student's prior

experience and the nature of the research project. Although not required, students are strongly encouraged to take BIOM*6100 Research Proposal in Biomedical Sciences. The student must also prepare and defend an acceptable thesis and meet the Department's minimum scientific communication requirement. The minimum scientific communication requirement is one conference presentation (oral or poster) at a suitable Regional, National or International scientific conference. If this requirement has not been achieved, written justification must be provided to the Department of Biomedical Sciences Graduate Program Committee outlining the reasons why these requirements have not been achieved. The Chair of the Department of Biomedical Sciences Graduate Program Committee will provide a written response outlining the decision of the Graduate Program Committee to either grant or reject the request that the defence proceed even though the minimum scientific communication requirement has not been completed. All students are required to present two departmental seminars during their program. The thesis research proposal, developed by the student in consultation with the advisor, must receive approval from the supervisory committee no later than the end of the second semester of the program. The program is completed by the successful oral defence of a written thesis.

PhD Program

Admission Requirements

Students entering the PhD program must show evidence of potential for independent, productive and original research. Admission to the PhD program generally requires completion of an MSc program with a research component, a minimum 'B+' average in the prescribed courses taken during the master's degree program, and strong recommendations from referees who have a sound knowledge of the student's strengths and weaknesses. In addition, a short statement of the applicant's research interests and career goals is required. In exceptional cases, where a candidate has demonstrated excellence in academic work and extraordinary ability to plan and initiate original research, transfer to the PhD program without completion of the MSc program may be recommended. This transfer must take place before the end of the fourth semester in accordance with university regulations. In all cases, students who do not hold an approved research-based MSc degree must register as MSc students regardless of their ultimate goals. Students may be admitted into the Fall, Winter or Summer semester. In those cases where the student is continuing their MSc research program into the PhD program, the student must clearly explain how the PhD research program represents a significant advance over that of the MSc.

Program Requirements

Students may undertake a PhD degree in aspects of

1. Reproductive Biology and Development;
2. Cellular and Molecular Basis of Health and Disease;
3. Cancer Biology;
4. Cardiovascular Physiology;
5. Stem Cell Biology and Regenerative Medicine;
6. Biomedical Toxicology and Pharmacology; and
7. Neuroscience.

Wherever appropriate, students are encouraged to incorporate the methodologies of more than one of these fields into their research project. The PhD program is research based and provides instructional opportunities and experiences that are intended to develop the student's

ability to formulate hypotheses and design and execute experiments or to conduct observational studies.

The PhD program offers opportunities for students to become investigators in veterinary and human-health-related sciences. Students will be expected to demonstrate the originality and skill needed to contribute to the knowledge base in a manner that transcends the mere acquisition of data. All students are required to present departmental seminars (one per annum). Students must also successfully complete a qualifying examination. Details of the qualifying examination which includes written and oral components can be found on the Department's website (<http://www.ovc.uoguelph.ca/biom/graduate/>) Successful completion of the qualifying examination is a prerequisite for continuation in the PhD program. The advisory committee is required to evaluate the student's research productivity periodically and to report on the student's progress to the Department Graduate Program Committee each semester in which the student is registered.

The PhD program culminates in the preparation, presentation and defence of the thesis, which contains a substantial component of original research. Preparation and defence of an acceptable thesis based on research data and hypotheses generated during the duration of the study are the main criteria used to assess the satisfactory completion of the PhD program. In addition the student must meet the Department's minimum scientific communication requirements. The minimum scientific communication requirements are two manuscripts which **must** at least have been submitted to a scientific journal prior to the student graduating with their PhD degree. One of these manuscripts **must** be based on the student's PhD research project and the student **must** be the first or senior author on this manuscript. The second manuscript may be either an original research manuscript or a review manuscript. The student is not required to be the first author on this manuscript but the manuscript must be generated during the student's tenure as a PhD candidate (i.e. the manuscript cannot be based on work performed while an undergraduate student or work presented in an MSc thesis). Students transferring from the MSc program to the PhD program can use any publications generated while enrolled in the graduate program of the Department of Biomedical Sciences. If these requirements have not been achieved, written justification must be provided to the Department of Biomedical Sciences Graduate Program Committee outlining the reasons why these requirements have not been achieved. The Chair of the Department of Biomedical Sciences Graduate Program Committee will provide a written response outlining the decision of the Graduate Program Committee to either grant or reject the request that the defence proceed even though the minimum scientific communication requirements have not been completed.

DVSc Program

The Department of Biomedical Sciences participates in the DVSc program offering specialization in clinical science. This program provides a balance between advanced training in the discipline, in-service training and a thesis research project.

Collaborative Specializations

Neuroscience

The Department of Biomedical Sciences participates in the MBS/MSc/PhD collaborative specialization in neuroscience. Please consult the Neuroscience (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/neuroscience/) listing for a detailed description of the MBS/MSc/PhD collaborative specialization.

One Health

The Department of Biomedical Sciences participates in the collaborative specialization in One Health. MSc and Doctoral students wishing to undertake thesis research or their major research paper/project with an emphasis on one health are eligible to apply to register concurrently in Biomedical Sciences and the collaborative specialization. Students should consult the One Health (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/one-health/) listing for more information.

Regenerative Medicine

The DVSc program participates in the collaborative specialization in Regenerative Medicine. DVSc students wishing to undertake thesis research with an emphasis on regenerative medicine are eligible to apply to register concurrently in the DVSc program and the collaborative specialization. Students should consult the Regenerative Medicine (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/regenerative-medicine/) listing for more information.

Toxicology

The Department of Biomedical Sciences participates in the master's/doctoral collaborative specialization in toxicology. The research and teaching expertise of these faculty include aspects of toxicology; they may serve as advisors for master's and doctoral students. Please consult the Toxicology (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/toxicology/) listing for a detailed description of the master's/doctoral collaborative specialization.

Courses

BIOM*6070 Pregnancy, Birth and Perinatal Adaptations Summer Only [0.50]

This course promotes understanding of the physiology of the placenta, and its role in fetal, perinatal and adult health. It is offered through videoconference involving University of Guelph, Queen's University and University of Waterloo. Parts are customized to student's interests within pregnancy physiology.

Restriction(s): Restricted to Biomedical Science students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6100 Research Proposal in Biomedical Sciences Fall and Winter Reg Required [0.50]

This is a 2 semester course (students must register for the course in each semester) focused on preparing students for their MSc defense while improving their critical thinking, oral communication skills and written communication skills. Students will submit a research proposal and present a seminar on their research proposal. Students will also write lay summaries on other student's seminars.

Restriction(s): Restricted to MSc Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6110 Research Methods in Biomedical Sciences Fall and Winter [0.50]

To provide a theoretical and practical introduction to common laboratory techniques for graduate students in Biomedical Sciences. The techniques offered will change with the demand in Biomedical Sciences. Examples of techniques that may be offered include RT-PCR, western blotting and immunohistochemistry. The theory and approach of each technique will be provided in lectures and hands-on training will be provided for each technique.

Restriction(s): Instructor consent required.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6130 Vertebrate Developmental Biology Unspecified [0.50]

The principles of vertebrate development are examined through lectures, discussions and practical exercises. Topics include aspects of gametogenesis, fertilization, implantation, embryonic and fetal development and experimental manipulation of embryos. Emphasis is on mammalian development and topics may vary depending on student needs and interests.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6160 Cellular Biology Unspecified [0.50]

An integrative course that examines aspects of cell biology in the context of recent research advancements. Topics are chosen based on student interest and faculty expertise and are explored through a combination of lectures, student seminars and group discussions.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6300 Cancer Biology: Basic Concepts and Research Tools Winter Only [0.50]

Directed to students pursuing cancer research and based on two 1.5-hour lectures and a 2-hour tutorial per week, the general aim of this course is to familiarize students with general concepts in cancer biology and the most commonly used methodologies in cancer research. Apart from improving students' general understanding of cancer biology, the course seeks to enhance critical thinking, writing and oral presentation skills by means of a seminar presentation, weekly tutorial discussions and the preparation of two literature reviews. Offered in conjunction with BIOM*4150. Extra work is required for graduate students.

Restriction(s): Credit may be obtained for only one of BIOM*4150 or BIOM*6300.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6310 Advanced Cancer Biology Fall Only [0.50]

This course explores advanced topics in cancer biology including cancer etiology, detection and screening and therapeutic strategies. Students will also critically evaluate the scientific literature as well as cancer related articles disseminated to the general public.

Restriction(s): Instructor consent required.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6400 Critical Thinking in Medical Research Fall Only [0.50]

This course will explore a variety of issues related to the scientific ideals and practical realities of research in the health sciences. Topics include critical thinking, critical appraisal of the medical literature (with emphasis on clinical trials), the principles of evidence-based medicine, and selected issues related to scientific integrity. Offered in conjunction with BIOM*3210 and BIOM*4210. Extra work is required for graduate students.

Restriction(s): Instructor consent required. Credit may be obtained for only one of BIOM*3210, BIOM*4210 or BIOM*6400

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6490 Introduction to Drug Development Winter Only [0.50]

Drug development is the process of integrating scientific data from several disciplines in order to demonstrate efficacy and safety of the new chemical entity for regulatory approval. This course will provide an overview of the drug development process including preclinical and clinical aspects of drug development.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6570 Biochemical Regulation of Physiological Processes Unspecified [0.50]

This course focuses on the regulation of vertebrate physiological processes, such as electrolyte and water balance, temperature regulation, growth and energy metabolism, by hormones and other biological regulators that act through cellular receptors and intracellular biochemical-control pathways.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6601 Special Topics in Reproductive Biology and Biotechnology Unspecified [0.25]

Permits in-depth exploration of interdisciplinary aspects of biomedical research. Topics such as inflammation, reproductive immunology and neoplasia have been offered.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6602 Applied Reproductive Biotechnologies Fall and Winter Reg Required [0.50]

The production of embryos in the laboratory requires considerable manual dexterity and expertise as well as theoretical knowledge and problem-solving skills. This is a 2-semester course consisting of laboratory training in bovine in vitro embryo production, seminars, field trips, group discussions and the placement in IVF clinics.

Restriction(s): Instructor consent required.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6610 Vascular Biology Unspecified [0.50]

An interdisciplinary course in which the interrelationships between vascular proteins, cellular elements and the maintenance of vascular integrity are examined. Structural-functional relationships in vascular biology are explored through seminar presentations, group discussions and small group participation in problem based examples of vascular dysfunction.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6701 Special Topics in Development, Cell and Tissue Morphology Unspecified [0.25]

Permits further in depth study of developmental and morphological sciences.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6702 Special Topics in Development, Cell and Tissue Morphology Unspecified [0.50]

See BIOM*6701

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6712 Special Topics in Physiology and Biochemistry Unspecified [0.50]

This course involves an appropriate combination of an experimental procedure (or project), seminars, selected reading or a literature review outside the thesis subject, developed according to the student's requirements.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6721 Special Topics in Pharmacology-Toxicology Unspecified [0.25]

This course will comprise a combination of an experimental procedure (or project), seminars, selected reading or a literature review outside the thesis subject, developed based on the student's requirements. Topics could include clinical pharmacology/toxicology, pharmaco-epidemiology/economics, gerontological or perinatal pharmacology and toxicokinetics.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6722 Special Topics in Biomedical Pharmacology-Toxicology Unspecified [0.50]

See BIOM*6721

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6790 Drug Discovery: A Diversity Perspective Winter Only [0.50]

This course provides an overview of environmental chemical diversity and the role of human biological diversity in drug responses. Cultural aspects of drug use and the importance of diverse perspectives in pharmacology and toxicology will be highlighted. Students are expected to have already taken an undergraduate course in pharmacology (BIOM*3090 or equivalent).

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6800 Gene Expression in Health and Disease Winter Only [0.50]

This course presents the molecular concepts of gene expression and the functional consequences of abnormal expression in pathological conditions. The conceptual, methodological and applied aspects of gene expression will be illustrated through student and faculty seminars, written reports, group discussions, and debates.

Restriction(s): Restricted to Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6900 Research Project in Biomedical Sciences Summer, Fall, and Winter [1.00]

This course is a lab- or literature review-based, one-semester research project course for students in the course-based Master of Biomedical Sciences (MBS). As part of this course, students will complete a research paper and grant proposal pertaining to the research topic as well as a poster presentation of the project.

Restriction(s): Restricted to Master of Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6910 Practicum in Biomedical Sciences Summer Only [1.00]

This is a one-semester practicum project course for students in the Master of Biomedical Sciences (MBS) program. Students receive applied training by working in a host organization or agency for a 12- to 14-week period, focusing on a major project of significance to the host.

Restriction(s): Restricted to Master of Biomedical Sciences students.

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6920 Comparative Stem Cell Biology and Regenerative Medicine Winter Only [0.50]

The emerging field of translational regenerative medicine is explored in depth through a series of seminars, discussions, literature review and oral presentations. Specific topics include regenerative therapies for osteoarthritis, cell-based therapies in non-traditional model species, biomaterials, and novel therapeutic applications in veterinary medicine.

Restriction(s): Instructor consent required

Department(s): Department of Biomedical Sciences

Location(s): Guelph

BIOM*6930 Concepts in Human Regenerative Medicine Fall and Winter Reg Required [1.00]

This course provides a broad overview of the field of human regenerative medicine (RM), including cell-based disease models, emerging technologies, clinical applications and ethical, commercial and regulatory challenges to moving stem cell therapies from the lab to the clinic.

Restriction(s): Instructor consent required.

Department(s): Department of Biomedical Sciences

Location(s): Guelph