



# GRADUATE OVERVIEW

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# Graduate Overview

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## Application & Admission

### Admission Requirements

Admission into the Biochemistry and Biomedical Sciences M.Sc. program requires a minimum of a B.Sc. with B+ average (8.5/12) in Biochemistry. Students with a Chemistry, Molecular Biology, Medicine, Microbiology or Physics degree are also eligible for admission.

While most students are admitted to our programs as MSc students, undergraduates having exceptional grades (consistent A to A+ average in all four years of study) and research experience may be considered for **direct admission to our PhD program**. Students may request consideration for admission by this route by emailing the Assistant Chair, Graduate Education, ([Dr. Justin Nodwell](#)) or Graduate Secretary ([Lisa Kush](#)). Decisions are made by the graduate recruitment committee in direct consultation with the student.

Students applying to our program who already hold a MSc degree from another institution can be admitted directly into the PhD program **subject to approval from our admissions panel**. Such students are required to take a qualifying exam, similar in structure and content to a transfer exam within their first 9 months of graduate school. In some cases, the admissions panel will recommend students holding a MSc be admitted to the program as a Master's student. All students who enter into the MSc program have an opportunity to transfer directly into the PhD program once here and established in the lab.

### Application Procedure

The School of Graduate Studies at McMaster University uses an online graduate application system (SynApps). To submit an online application, you must first create an account using your email address as your username. It normally takes 30-45 minutes to complete an online application.

Application Procedure: <http://www.mcmaster.ca/graduate/applic.htm>

The online application system is located at <https://gradapplication.mcmaster.ca/account/instructions.asp>

### Admission Process

Biochemistry and Biomedical Sciences Graduate program will assemble all of your documentation into one file.

1. Initial assessments of completed applications are conducted around the middle of March and students will be informed of our decision as soon as possible. The Department Admissions Committee will review applications weighing many factors including the applicant's scholastic record, letters of recommendation, letter of intent, prior performance in laboratory research, and often personal interviews.
2. Acceptance into our Graduate Program is conditional on reaching a mutually agreeable student-supervisor agreement, therefore we strongly encourage students to contact faculty members and to visit our department to discuss possible research projects.
3. The department will send all favourable applications to the School of Graduate Studies for final approval.
4. An official letter of admission will be sent from the School of Graduate Studies. Applicants may be accepted conditionally before completing their present degree.
5. Successful applicants are required to accept or decline this offer of admission within the specified time by completing an on-line response form.

## Supervisor Selection

The most important step on the road to graduate studies is choosing a supervisor. While we assume that many applicants will already have an idea of what they want to study and/or which faculty member they want to work with, we know that many applicants have not made this decision at the time of application. We therefore have a system of **laboratory rotations** for new students. In their first semester as graduate students, rotating students work in three different labs in the department for one month each and choose their home lab at the end of this time. Students should indicate on their application form whether they wish to take advantage of this system or whether they have already settled on a supervisor. Note that in order to opt out of the rotations program, the student's prospective supervisor has to have agreed to take them up front. Students choosing the rotations system choose three rotation labs once they've been accepted to the program.

We encourage any interested candidates to contact prospective faculty members to inquire about possible openings at any time, before or after submitting their application.

## Required Documents

The following items are required before your online application will be considered complete.

- **ONE** official transcript of academic work completed to date, sent directly from the issuing institution. If the final transcript does not show that a completed degree has been conferred, an official copy of your diploma is also required.

- **TWO** Confidential Reports from instructors most familiar with your academic work. Recommendations must be provided directly from the instructors. Downloadable Confidential Reports: [Word](#) [PDF](#)
- If English is not your native language, an official copy of your TOEFL score, or other evidence of competency in English is required. A minimum TOEFL (iBT) score of 92 (580 on the paper-based TOEFL test or 237 on the computer-based TOEFL test) or IELTS "Academic Version" with overall score of 6.5 (5.5 minimum score in each section). Our institution code is 0936 and department code is 34.
- Statement of Interest – Please include a one-page summary describing your research experience (including co-op work, honours project, summer work, etc), why you wish to pursue graduate studies in our program and the areas of research that interest you.

*All documents should be sent directly to:*

**Lisa Kush**

McMaster University

Department of Biochemistry & Biomedical Sciences

1200 Main Street West

Health Sciences Centre, Room 4N59

Hamilton, Ontario

L8N 3Z5 Canada

## Application Fees

Applications must be accompanied by the required \$90 application fee. **This fee is non-refundable and must be paid in Canadian dollars by means of a credit card payment or a cheque (or world money order) drawn on a Canadian bank made payable to McMaster University.** Cheques (or world money order) drawn on Canadian banks should also include a \$15 processing fee for a total of \$105. If you pay the application fee by cheque or world money order, please send the cheque (or world money order) to the following address:

School of Graduate Studies

McMaster University

Gilmour Hall, Room 212

1280 Main Street West

Hamilton, Ontario Canada L8S 4L8

Your application will not be considered for admission until your cheque (or world money order) has been received.

## Application Deadlines

**March 1-** Admission for September 2009. Students are encouraged to meet this early deadline to be eligible for all entrance awards and scholarships.

**May 31-** Final date for submission.

September 30- Final date for January 2010 admission.

Our graduate program usually starts in September; however it is possible to start in January or May. For more information, contact [Lisa Kush](#).

## Courses

The graduate courses offered by the Department cover a broad range of biochemistry. In addition, courses in other departments/programs, notably Biology, Chemistry, Medical Sciences and Physics and Astronomy may be allowed for graduate credit. Students must consult with their supervisor when selecting courses. The courses are subsequently approved by our Graduate Admissions Committee.

\*Note: 700 Level chemistry courses equal one-quarter credit.

### Course Offerings (2009-2010)

The following [700-level courses](#) (half course credit) are available to graduate students only:

#### **\*710 – Special Topics in Proteins**

**Instructor: Joaquin Ortega (Term 1)**

In this course, we will discuss the potential and applicability of cryo-electron microscopy (cryo-EM) as a structural biology technique. From the structure of ribosome intermediates in the process of translation to the structure of viruses, cryo-EM has played an instrumental role in our current understanding of protein function. In addition, cryo-EM is an ideal tool to study the structure and function of proteins in the context of physiologically relevant macromolecular assemblies or even the entire cell. The course will provide several lectures on the principals of cryo-electron microscopy and image processing and the students will be also expected to present a major research paper in this field.

#### **\*711 – Special Topics in Bacterial Cell Surfaces**

**Instructor: Lori Burrows (Term 2)**

A combination of lectures, inquiry and journal club formats will be used to examine current research in the area of bacterial cell surfaces. Topics that will be covered include surface macromolecules (lipopolysaccharide, capsules, peptidoglycan, teichoic acids); secretion and motility systems; trafficking of proteins to specific compartments (the Sec, Tat, Lol systems, Omp85, sortases); and signal transduction (chemotaxis, two-component regulators). Students will be evaluated through assessment of written and oral presentations.

#### **\*711 - Special Topics in Microscopy and Photonics**

**Instructor: Tony Collins, David Andrews (Term 2)**

A wide variety of topics in Biophotonics will be introduced in this one-term course. Each Student will explore an assigned topic in biophotonics, with a view to providing a broader understanding of the use of biophotonics in a range of research questions.

#### **720 - Colloquium - Scientific Communication**

**Instructor: Justin Nodwell, Alba Guarne (Terms 1 & 2)**

The aim of this course is a detailed examination of the student's own area of research. Students will prepare a review article describing the current state of their

field in the format employed by the journal "Trends in Biochemical Sciences". In addition to this, students will give a seminar on their research, including necessary background information in the course of the Departmental Seminar Series. Following that, the student will answer questions from selected faculty members.

#### **\*723 - Topics in Molecular Biology**

Critical examination of classic and current papers in molecular biology with the object of giving students practice in presenting and discussing research material. (Given in alternate years with Biology \*723).

#### **730 - Computational Biochemistry**

**Instructor: Boris Zhorov (Term 2)**

This course will provide a brief introduction to biochemical databases, biological data mining and tools for sequence analysis. This will be followed by more detailed description of computational methods of molecular modeling, ligand docking, and analysis of ligand-receptor interactions. Facilities of the Educational Computing Lab will be used to train students on applying WWW resources of biological information and molecular modeling software in a biomedical lab.

## **Education**

#### **750 - Principles and Practices of University Teaching**

This course includes both discussion of the literature (using a problem-based learning approach) and practical workshops on topics such as lecturing, working in small groups, course design, test construction, and teaching dossiers. For more information visit the website: <http://www.mcmaster.ca/>.

## **600-Level Courses**

The following 600-level courses (half course credit) offered for graduate credit consists of the corresponding 400-level undergraduate course plus additional work, usually in the form of a written assignment.

#### **6E03 - Recombinant DNA Technology and Gene Expression**

**Instructors: M. Bhatia, B. Doble and C. Wynder (Term 1)** - Recombinant DNA techniques: theory and application to the study of gene function and evolution and to disease diagnostics and gene therapy. Current concepts of gene regulation at different levels.

#### **6EE3 - Advanced Topics in Gene Expression**

**Instructor: B. Trigatti and R. Truant (Term 2)** - A critical study of the literature from recent primary manuscripts on gene regulation and inter-regulatory pathways. Emphasis is on the molecular and cellular biology of multiple pathways that interact to affect phenomena in biology and disease.

### **6H03 - Molecular Biology of Cancer**

**Instructors: G. Wright and N. Magarvey (Term 1)** - Cancer at the molecular and cellular level. Topics include: properties of cancer cells; activation of proto-oncogenes; function of oncoproteins; transgenic mouse models of human cancer; and tumour viruses.

### **6J03 - Biochemical Immunology**

**Instructors: M. McDermott (Term 1)** - *This course is administered by the Bachelor of Health Sciences (Honours) Program.* This advanced course applies small group based learning to immunological problems. Topics concern development of immunoassays, resistance to infection and immunity in health and disease.

### **6N03 - Molecular Membrane Biology**

**Instructors: R. Epand and R. Bishop (Term 2)** - Properties and structures of membranes, molecular components of biological membranes and their interactions, strategies for signal transduction cascades, hormones, receptors.

### **6S03 - Introduction to Molecular Biophysics**

**Instructor: P. Higgs (Term 1)** - *This course is administered by the Department of Physics and Astronomy.* A presentation of recent contributions made to the fields of molecular and cell biology by the use of physical approaches. Topics include physical properties of biomolecules, protein folding, molecular motors, cell motion and cell adhesion. Emphasis on the critical evaluation of current research literature.

### **6Y03 - Genomes and Evolution**

**Instructor: P. Higgs (Term 2)** - Molecular evolution and comparative analysis of genomes. Bacterial evolution, phylogenetics, origins of eukaryotes. Organelles and their genomes. Comparison of the human genome with other species. Use of microarrays and proteomics.

## **Courses Removed**

(NOT OFFERED IN 2009-2010 BUT POSSIBLY IN 2010-2011)

### **\*711 - The Molecular Biology of Glucose Metabolism**

This course will focus on recent developments in the molecular biology of glucose transport and metabolism with special focus on disorders associated with diabetes mellitus and insulin resistance. Enrollment limited to 10 students.

### **\*711 - Special Topics in Protein/Nucleic Acid Interactions**

This course will focus on 1) the nature of interactions that govern nucleic interactions with themselves as well as with proteins, 2) molecular strategies used in nature to achieve desired outcomes such as specificity and, 3) new and older (proven) methods for analyzing nucleic acid interactions.

### **\*711 - Special Topics in Bacterial Pathogenesis**

Advanced and contemporary topics in bacterial pathogenesis will be examined using current research papers. Example topics include: bacterial secretion systems, avoidance of innate immunity, bacterial toxins, the evolution of bacterial virulence and new research techniques in host-pathogen interaction studies.

### **\*707 - Mechanism of Enzyme Action**

Sequence of molecular events occurring during catalysis by enzymes. Nature of

intermediates and active site residues. Possible factors involved in rate-acceleration. Enzyme kinetics.

**\*727 - Proteins: Protein Structure Determination using NMR and X-ray Crystallographic Techniques: Theory and Practice**

Critical examination of classic and current papers in structural biology. The course will cover methods and challenging techniques often used to investigate the structure, dynamics and interactions of proteins and protein complexes, as well as, providing students the opportunity to practice their presentation and discussion skills.

**708 - Signal Transduction: Receptors, G-proteins, Target Enzymes and Second Messengers (same as Medical Sciences \*708)**

The topics covered will include the mechanisms of activation of the nicotinic cholinergic receptor, G-protein-coupled receptors, G-proteins, adenylyl and guanylyl cyclases, phospholipase C and phosphoinositide 3-kinases and the roles of cAMP, cGMP, inositol phosphates, Ca<sup>2+</sup>, diacylglycerol and 3-phosphoinositides as second messengers. The targets of these second messengers will also be discussed. The course will be based on recent review articles and important current papers. After six sessions, with faculty lectures and student presentations, the students will spend 5 weeks of inquiry on a related topic and each write a paper for evaluation by faculty and for presentation in summary in a symposium.

**709 - Signal Transduction: Dynamic Mechanism of Action of Growth Factors and Nuclear Receptors**

The topics covered will include: Ras and GTP binding protein families, MAP kinase cascades; T-cell and B-cell activation; nuclear receptors for steroid and thyroid hormones. The course will be based on recent review articles and important current papers.

**710 - Special Topics in Biophysics**

This course will focus on recent advances in Molecular Biophysics, with the objective of showing how different techniques and approaches coming from the Physical Sciences can contribute to the field of Biochemistry. A special emphasis will be placed on single molecule techniques and on techniques available through the new Biophotonic Imaging Facility. Every week a recent paper will be discussed in class, both for its scientific significance and for its technical aspects. Students will be assessed based on a presentation done in class. \*DETAILED SYLLABUS

**\*711 - Special Topics in Molecular Biology**

The course will focus on recent developments in the molecular biology of glucose transport and metabolism with special focus on disorders associated with diabetes mellitus and insulin resistance. Enrollment limited to 10 students. Contact the Biochemistry and Biomedical Sciences Department for permission.

**\*711 - Special Topics in Biomolecular Science**

The course will focus on the emerging research area of Chemical Genetics. Students will be active participants in reviewing and synthesizing the literature in this area. Students will be evaluated based on class presentations of journal articles and on a proposal for research in the area in chemical genetics.

### **\*712 - Special Topics in Membrane Biochemistry**

Bacterial cell envelope biogenesis represents one of the most important and challenging problems in contemporary biochemistry. Bacterial cell surface molecules provide signatures for host innate immune receptors that recognize pathogens and trigger the inflammatory response. Consequently, essential bacterial cell surface molecules reveal pathways for the development of anti-inflammatory agents in addition to major classes of antibiotics. This course will explore the molecular principles that govern the biosynthesis, export, and assembly of key bacterial cell surface molecules with the aim of revealing themes that are ubiquitous in bacteria and higher organisms.

### **713 - Enzyme Catalytic Mechanisms**

An examination of enzymes' catalytic strategies, including strategies for promoting catalysis, enzymatic intermediates, co-factors as well as the methods used to probe mechanism. Examples from the current literature will be used to demonstrate each concept.

### **725 - Molecular Mechanisms of Membrane Functions**

The molecular basis of the biological activity of membranes at an advanced level. Topics include: bioenergetics, transport, membrane biogenesis and turnover, signal transduction, cell surface interactions and membrane disorders.

### **727 - Proteins**

Protein structure determination using x-ray crystallographic techniques: theory and practice.

# Requirements

\* A student whose work is unsatisfactory may at any time be required to withdraw from the program.

## M.Sc.

A candidate for the M.Sc. degree is required to spend at least one calendar year in full-time study at McMaster University. The candidate is required to complete satisfactorily not fewer than one full graduate course (which must be at the 700-level). The candidate must also present a thesis which will embody the results of original research. The thesis must be defended in an oral examination. The candidate will be required to participate in the departmental seminar program designed to hone lecturing and presentation skills. The Master's program student will have committee meeting intervals of 6 months, with close supervision ensured by the graduate committee chosen by the student and his/her supervisor. The Biochemistry and Biomedical Sciences Master's program of study is intensive and thesis research driven, with a goal of publication in respected peer-review journals by the second year of study.

Students who enter our graduate program with a B.Sc. may proceed directly into the Biochemistry Ph.D. program in approximately 12 months without writing up a Master's thesis. To do this, students are required to undertake a transfer exam. This can occur any time after the student's first committee meeting but must occur by 18 months of their admission to the program. After review, the department will recommend to the Committee on Graduate Admissions one of the following:

- \* Admission to Ph.D. studies following completion of the requirements for the Master's degree;
- \* Admission to the Ph.D. studies without having completed a Master's program;
- \* Not proceed with Ph.D. studies but complete the Master's degree.

## Ph.D.

Our Ph.D. program is tailored to maximize student productivity and learning through basic research. Our philosophy is that the most important goal of a higher degree is to become an expert in a specific field while maintaining sufficient breadth of knowledge to succeed after leaving graduate school. This includes publication in respected peer-reviewed journals, applications for study scholarships, oral and written presentation skills. Our graduates typically secure top-level international post-doctoral fellowships or have industry placements in leading biotechnology and pharmaceutical research companies world wide.

Completion of the Ph.D. degree is normally limited to **SIX** years from initial registration at the M.Sc (for students who take the transfer exam) and **FOUR** years for those registering directly in Ph.D.

Students applying to our program who already hold a M.Sc. degree from another institution can be admitted directly into the Ph.D. program subject to approval from our admissions panel. Such students are required to take an exam, identical in

structure and content to the transfer exam within their first 9-12 months in graduate school.

PhD Candidates must:

- Give **two departmental seminars**, one of which will be a component of the comprehensive examination 18-20 months after starting PhD studies.
- Present the student's thesis which must embody the results of their original research and give evidence of a high degree of scholarship. The candidate will defend this thesis in a final oral examination at the end of graduate study.

## MD./Ph.D.

The MD/PhD program will be offered in an integrated format with specific blocks of time provided for activities either in full- or part-time studies in either program. There will be opportunity for flexibility in the arrangement of student curriculum, if requested and/or deemed appropriate, but that is at the discretion of the MD/PhD Program Committee.

MD program fulfillment (in the MD/PhD program): The new MD curriculum, electives and clerkship periods. Horizontal electives (optional in current MD program, not optional in the MD/PhD program) must be completed during graduate research block (3 years). A minimum of 80 hours in horizontal electives must be completed satisfactorily.

PhD program fulfillment (in the MD/PhD program): Time will be allowed for attendance at regular research group meetings while in the MD curriculum. Attendance at MD/PhD program group meetings (faculty and students) will be held a minimum of 3 times annually. In addition, students must complete the requirements noted below in the relevant graduate program.

Candidates must successfully complete the equivalent of three 700-level graduate half courses (credit for satisfactory completion of MD horizontal electives are provided within the graduate program such that only 3 courses are required).

Please refer to [Comprehensive](#) for information regarding the comprehensive examination and the submission and defence of a research thesis.

## *Requirements*

- 4 year Honours B.Sc. or BHSc with a minimum academic standing of 10.5/12 (on the McMaster scale) or 3.8 on a 4 point scale in the final two years of the Bachelor's degree study in courses relevant to the program. Prospective Biochemistry & Biomedical Sciences students require an undergraduate degree in biochemistry; however, students in chemistry, molecular biology, medicine, microbiology or physics may also be admissible.
- Acceptance to the McMaster MD program. MD applicants must apply through OMSAS for Medical admissions, achieve a high score in the autobiographical submission, and complete the MMI exercise in April. Unsuccessful MD/PhD candidates would continue in the regular admissions process for the MD program.

- Acceptance to the PhD program in Biochemistry & Biomedical Sciences offered through the School of Graduate Studies.
- Acceptable interview.
- Demonstrated excellence in research project record or experience in undergraduate studies, or in a graduate program.
- Two academic references. Referees should address suitability for an MD/PhD program; one reference must be from the supervisor from an undergraduate research project or thesis.
- Separate statement submitted by the applicant regarding their suitability, motivation, and career plans in MD/PhD studies.
- Identification of a faculty member who agrees to supervise the student.

# Thesis Evaluation

## *M.Sc.*

An M.Sc. thesis may be submitted for defense at any time once the supervisor has approved the thesis. The thesis will be examined by a committee of four members (including the supervisor). Normally the supervisor will act as chair of the defense committee. The thesis will be defended by the candidate in an oral examination before this committee. Acting on behalf of the chair, the time of the defense will be set by the Graduate Secretary; normally this will be about two weeks after the completed thesis has been submitted to the department. After a successful defense, the candidate must make any necessary corrections and submit the thesis to the School of Graduate Studies for binding.

## *Ph.D.*

Before preparing the final version of a PhD thesis, the student must receive formal permission to write from his/her supervisory committee members.

The final oral examination will be chaired by a university representative and the committee contains two members from other departments and the supervisory committee members.

## Online Thesis Defence Submission System (TDS)

\*NOTE: Microsoft Windows 2000/XP and Internet Explorer are required to access this system.

TIMELINE: Approximately 8 weeks to schedule a PhD Defence.

- Student submits thesis title, estimate thesis submission date.  
<http://sgs-admission/ThesisDef/>
- TDS sends an email to supervisor to begin external nomination form.
- Supervisor suggests external examiners.
- TDS sends email to committee members to approve external nominees.
- Email sent to chair to approve external nomination form.
- Student will receive email to request defence date/time  
**\*PLEASE CONTACT LISA TO SCHEDULE DATE.**
- Student (after consultation with supervisory committee) submits proposed oral defence date and time.
- Student submits 3 copies of thesis to Graduate Studies (GH-212) and provide copies to each committee member.

- TDS sends email to committee members to approve date/time of defence. Graduate Studies will confirm the chair, plus the internal and external examiners.

## Thesis Binding (MSc and PhD)

Your corrected thesis, on **20 pound bond paper** must be submitted to the School of Graduate Studies for binding (Gilmour Hall, Room 212).

**MSc = 5 copies**

**PhD = 6 copies**

- one copy for student
- one copy for department
- one copy for Supervisor
- two copies for the University Library
- one copy for National Library - PhD

The "**Final Thesis Submission Sheet**" signed by the supervisor must accompany the final submission of the thesis following a successful defense.

The "**License to McMaster University**" sheet must be signed and handed in at the time of submission for binding.

Place all copies in **SEPARATE ENVELOPES** marked with:

- Name
- Student number
- Degree
- Number of copies (i.e. 1 of 5, 2 of 5, etc)

**Cost: \$25 per copy**

Charges must be paid at time of submission by cash, cheque, MasterCard, Visa or interact if handed in at reception.

If you have any questions regarding thesis submission, you may contact the Thesis Coordinator at [gthesis@mcmaster.ca](mailto:gthesis@mcmaster.ca) or (905) 525-9140, ext. 23680.

# Course Requirements

- M.Sc. Two one-semester 700-level graduate courses.
- Ph.D. There is no formal course requirement for doctoral students. Those students who wish to do so may participate in any relevant course offerings in BBS or other departments.

Students must complete courses with at least B- standing. Supervisory committees may require a student to take courses in addition to those prescribed by departmental regulations. Students may take 600-level courses however these do not count towards degree requirements. Under normal circumstances a student who fails to obtain B- in a prescribed course is asked to withdraw from the program. Those allowed to remain in the program must either repeat or replace the failed course. A failing grade in a prescribed course remains on the transcript.

**SCHOOL OF GRADUATE STUDIES RESEARCH ETHICS COURSE** - ALL students are required to take the "Academic Integrity and Research Ethics Course" to fulfill their degree requirements. The course consists of a lecture and a written quiz and students must be present for the duration of the course to be eligible to write the quiz. Students who miss the lecture, or fail the quiz, must re-take the course at the next opportune time. Students must register for the course (SGS 101#) on-line through SOLAR. No 'walk-ins' will be accepted!

**BIOCHEMISTRY AND BIOMEDICAL SCIENCES RESEARCH ETHICS COURSE:** The department holds a one-day departmental workshop on research ethics, data presentation and scientific integrity. This is held in December and is mandatory for all first year graduate students.

## Seminar Presentation

Full participation in the departmental seminar program is a requirement of the graduate program; learning to communicate the results of basic research is an integral part of graduate education. Of particular importance is the exposure of students to the broad range of topics, especially those outside the candidates own area of specialization. A total of **three** seminars are required for PhD students and **one** for MSc students. Students who enter directly into the PhD program are required to present **two** seminars.

- The **first seminar** will normally be given 13 to 16 months after initial registration in the M.Sc. program. Since students are at a relatively early stage in their studies at this time, seminars are expected to be relatively short. 20-25 minutes with 5-10 minutes for questions is the norm.
- The **second seminar** is required 5 to 8 months after transfer/registration in the Ph.D. program. At this point, most students have made significant progress on their project and can give a longer presentation – typically 30-45 minutes.
- The **third seminar** will normally be given concomitant with the student's comprehensive examination. This seminar should put a large body of research into as broad a context as possible. The student is expected to link their research into an integrated 'story' as much as possible and can expect to speak for 45-50 minutes with 10-15 minutes for questions

Students should prepare their seminars in advance and practice in front of some of their peers and supervisor at least once before going before the department. Students will receive feedback from faculty and other graduate students immediately following each seminar and a graded record will be kept by the department.

## Committee Meetings

Students and their supervisors must identify two faculty members to serve, with the supervisor, as the student's supervisory committee. The purpose of the committee is to regularly assess and challenge the student's progress. Students newly admitted to our M.Sc. program must meet with their supervisory committee at least three times during their first eighteen months in the program. Ph.D. students must meet with their committee at least once a year. Additional committee meetings can be scheduled at the request of the student or the supervisor.

The department must forward a committee report to the School of Graduate Studies after each meeting. It is the responsibility of the supervisor and student to ensure that these meetings take place and are officially recorded by completing a Supervisory Committee Report form. If an unsatisfactory rating is given by a committee member, the supervisor will confer with our Department Assistant Chair of Graduate Education to decide what further course of action to take. Two 'unsatisfactory' grades in a row will generally result in the student's dismissal from the graduate program.

It is the responsibility of the student to reserve audio-visual equipment and collect the form before the meeting. Students should also call a supervisory committee meeting any time they have academic problems or difficulties with their research.

### GUIDELINES FOR SUPERVISORY COMMITTEE MEETINGS

#### **\*First Meeting (4-6 months after registration in program)**

The first supervisory committee meeting must be held within 4-6 months of registration in the graduate program. The goal of this initial meeting is to determine whether the student has a well-defined project and whether they are making the necessary effort to become well-versed in the background literature to their field. We expect all students to attempt to master this material within their first year of graduate school. At this first meeting, the student should also have made some basic progress towards their research goals although it is recognized that this may be of a preliminary nature.

#### **\*Second Meeting (9-12 months)**

The second committee meeting takes place between 9 and 12 months after arrival in the program and it is expected that the student will have made further progress in digesting the literature that is relevant to their field and to have made headway in their research.

#### **\*Third Meeting (18-20 months)**

The third committee meeting takes place by 18 to 20 months after starting the program. The purpose of this meeting is to decide what the student needs to do to complete a M.Sc. thesis. Alternatively, if the student wishes to do so and has the support of their supervisor, he/she may obtain permission to proceed to the transfer examination for entry into the Ph.D. program.

### **Committee Report**

For each committee meeting students must write a short report summarizing their project and the most recent progress they have made. This report should be ~10 pages double-spaced, typewritten, including references and appendices. Diagrams or figures portraying models, hypotheses and data are very strongly encouraged and do not count towards the total page number. The report must be submitted to committee members at least one week prior to the meeting. These reports are not just a summary of work done to date, but also a training tool for proper scientific writing and grammar skills. Students are expected to provide a brief summary of the research field relevant to the thesis, the central hypothesis of the thesis, any experimental progress to date, future proposed experiments, and short and long term goals. The standards of this written document and the data figures should be thesis quality.

### **Committee Meeting**

At the beginning of the meeting the student will give a 15-20 minute presentation. The presentation should provide the rationale of the project, a description of the experimental approaches being used an overview of progress, ongoing work, and future directions. The Committee will then discuss the project in detail with the student. Students receive a grade and specific recommendations in writing following each committee meeting. Often committee members will interrupt the students to request clarification or to initiate lines of questioning. In general the meetings are informal in nature but the expectations are high.

### **Subsequent Meetings - PhD**

Doctoral students must meet with their committee to review progress at least once a year. However, if desired or considered necessary by their supervisor, additional meetings may be arranged.

## **Transfer**

### **Goals and Outline of the Transfer Process**

The Department promotes the effective integration of graduate students into the research programs of its faculty members. Since these are ongoing programs with long-term objectives, it is for the benefit of the students and the research programs to integrate M.Sc. students intending to proceed to Ph.D. degrees into these long-term objectives as early as practical. In order for this to happen, a process has been established to assess M.Sc. students' academic and research ability and potential to carry out Ph.D. studies. Students who have demonstrated this ability may proceed directly to the Ph.D. program without writing up their Master's thesis provided the following conditions have been met.

The student has had his/her first supervisory committee meeting within 4 to 6 months of first registration and the committee approves the long-term strategy of the proposal as suitable for a Ph.D. project. At this meeting the committee will expect that the student has taken significant steps to master the literature relevant to his/her fields. Some preliminary progress at the bench is also expected. A second meeting held within 9 to 12 months of the student's first registration will serve to address any shortcomings identified during the first meeting. At this point it is anticipated that the student will have made significant progress in their bench work. The student must have a solid grasp of the literature relevant to his or her field at

this time in order to be eligible for the examination required for direct transfer to the Ph.D. program.

- The student must have completed two half graduate courses at the 700-level with a minimum B+ standing.
- The student must give at least one seminar in our departmental seminar program.
- The supervisory committee recommends that the student be considered for transfer based on his/her performance to-date within 18-20 months of first registration in the program.
- The transfer exam will take place within 20-24 months of the student's first registration.

### **Transfer Examination**

The transfer examination has three purposes. First, it tests the student's preparation for Ph.D. level research by determining whether they have mastered the theoretical background to their fields. Students will therefore be expected to have researched and read the publications that form the foundation of their field as well as the necessary background for the technology they intend to employ. Secondly, it will provide independent assessment of performance to-date and the student's ability to execute the longer-term strategy of the proposed Ph.D. research project. Thirdly, this exam will help reveal the student's strengths and weaknesses. While questioning in the transfer exams can be expected to be rigorous, students are not expected to have the correct answers for everything. A student coming out of this examination therefore will have had an independent evaluation of his/her project and background knowledge, and will have been made aware of areas in which he/she needs improvement. This last point may include the recommendation of specific course work.

### **Procedure**

Students will complete a proposal describing the research they intend to carry out towards their Ph.D. thesis. This written proposal must represent the student's own original work; the inevitable input of the supervisor notwithstanding, McMaster University policies on Academic Ethics and Academic Dishonesty apply.

The aim of this proposal is to describe the theoretical background to the project and outline the goals of the research. This document should illustrate that the student's goals have sufficient depth to form the basis of a Ph.D project and must clearly demonstrate the progress that the student has made during the first 18 months as a graduate student. This proposal is expected to be a major exercise in writing and should be interesting, concise and informative. It must be comprehensible by faculty members who are not necessarily experts in the field. This proposal should include an abstract of not more than 300 words, an introduction to the student's field and basic research direction, a summary of progress and a detailed discussion of the research to be carried out towards a Ph.D. It is important to explain and justify the approach being taken and include alternative approaches in the event that some plans do not work out as anticipated.

There is an absolute length limitation of 20 pages (double-spaced, 12 point font, not including figures or references). The first 2-3 pages should introduce the subject of the student's thesis. Following the introduction there should be a 2-3 page summary of the student's progress. The remaining 14-16 pages should explain the proposed

research. Students may subdivide each section in whatever manner they deem to be the most readily digested by the examining committee. References must conform to accepted ASM practices (see <http://www.journals.asm.org/misc/ifora.shtml>).

Preparation time for this proposal is limited. Students will be assigned a date for their transfer exam five weeks in advance of their exam (at least three months prior to anticipated Ph.D. start-date). The report must be presented to the Committee at least one week prior to the transfer meeting. Extensions will not normally be granted.

### **Transfer Meeting**

The student will give a 15-20 minute presentation outlining the major points of his/her proposal, including accomplishments to-date and the research proposed for the Ph.D. The exam will then consist of at least two rounds of questioning from each of the voting Committee members, and will deal with any and all aspects of the presentation and proposal. The total time for the questioning will not exceed two hours.

The Transfer Committee will consist of the members of the Supervisory Committee, the Transfer Chair, and one additional member who has no direct connection with the student's Supervisory Committee. The Department Chair will normally appoint the Transfer Chair and the additional member. In the event that the Transfer Chair is the student's supervisor, the role of Chair will be delegated to another faculty member.

The Transfer Chair will have no voting privileges. The Transfer Chair will ensure that the exam is conducted in a fair manner in keeping with the objective of this document. In the event that a student is at a loss to answer a particular question, the Chair may ask the examiner for clarification or to move on to a more fruitful line of questioning.

Students should expect questioning to be thorough and far-ranging. Frequently, a correct answer will be followed up with a more difficult continuation in an attempt to plumb the depths of the student's knowledge. It is to be expected that most students will encounter at least some questions that they are unable to answer; it is particularly important therefore that the student is certain he/she always understands what is being asked.

### **Possible Recommendations**

- Proceed to Ph.D. studies without obtaining a Master's degree;
- Admission to Ph.D. studies but with concurrent completion of all requirements for a Master's degree within two months from the date of reclassification;
- Proceed with Ph.D. studies following completion of the Master's degree;
- Not proceed with Ph.D. studies but complete the Master's degree;
- Adjournment of the transfer meeting.

In the event deficiencies are identified in the course of the transfer examination which the Committee deems can be rectified in a timely manner, the Committee is empowered to adjourn, providing the student with a written copy of its concerns to be addressed. The Committee must be reconvened for a re-examination and to make a final determination, in no case later than 24 months after the first registration of the student in the graduate program.

After the examination, the Transfer Chair will inform the candidate and the Department Chair of the Committee's decision and the reason for it. Transfers will only become effective: September 1st, January 1st or May 1st.

## Qualifying exam for students admitted directly to Ph.D. Program

Students who enter our Ph.D. program directly with a M.Sc. degree or who, due to exceptional undergraduate performance were admitted without M.Sc. requirement, must take a qualifying exam that is identical in arrangement and procedure to the transfer exam. This exam must be held within 1 year of registration in the Ph.D. program. Successful completion of the qualifying exam is required for continuance as a Ph.D. candidate.

### Comprehensive

The comprehensive exam is a capstone event in the PhD program. It is given 18-24 months post entry into the PhD program when students are expected to have matured into experts in their field. The marking scheme is Pass, Pass with Distinction, or Fail and the examining committee consists of the student's supervisory committee members.

The exam consists of two components: 1) a departmental seminar and 2) a post seminar question period with members of the advisory committee chaired by the Departmental Comprehensive Chair.

**1) Seminar:** The seminar is normally presented in the weekly graduate student seminar slot. The intent is that the seminar is given in the form of a job presentation for students seeking a post-PhD placement. Therefore, the seminar should be 45-50 minutes in length and cover their research in a comprehensive fashion, clearly placing it in the context of their field.

**2) Question Period:** Following the seminar, normally on the same day (may be delayed in certain instances) the student and the advisory committee will retire for a question and answer session chaired by the student's supervisor. Students should be able to answer questions germane to their field of expertise, be comfortable with the fundamental aspects of the research they have performed and the general scientific context of their work. In general, they will oversee two rounds of questions from the committee. Feedback on the seminar content and presentation style may also be given.

**3) Timing of Re-Examination:** If a re-examination is necessary, it will normally take place within one month, but the actual timing will be determined on the basis of consideration of what is needed to correct the deficiencies. A second failure will necessitate withdrawal from the Ph.D. program.

# Tuition & Financial Aid

## Tuition

The tuition fees for graduate study at McMaster University are currently \$4,773 per year for Canadian citizens and permanent residents. Tuition for visa students is \$12,525 per year.

## Financial Aid

The Department provides financial support for candidates accepted into the graduate program in the form of a teaching assistantship and departmental research scholarship. M.Sc. students normally receive support for up to two years from the time of initial registration in the program, and Ph.D. students up to four years. All full-time graduate students are automatically considered for financial support. Current minimum levels of support are \$19,000 for M.Sc. and \$21,000 for Ph.D. students. Many of our students secure scholarships from Provincial or Federal granting agencies including in particular the Canadian Institutes for Health Research, National Science and Engineering Research Council and Ontario Graduate Scholarships.

### Departmental Entrance Scholarships and Research Awards

We are committed to recruiting the most qualified students to our graduate programs. As an incentive, we offer entrance scholarships over and above our normal graduate stipends to students who have external graduate awards at the time of registration. These awards are as follows:

- OGS \$4000
- NSERC \$6500

We also reward students for excellent performance once they are in the program. The following awards are conferred on an annual basis.

#### *Thomas Neilson Award \$1000*

- for excellent performance upon reclassification to PhD

#### *Publication Awards \$4000*

- for highly meritorious contributions \$3000
- to the scientific literature \$2000

#### *Karl Freeman Award*

- for the top student seminars