

THE GRADUATE PROGRAM OF THE DEPARTMENT OF MOLECULAR MICROBIOLOGY AND IMMUNOLOGY

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The Department of Molecular Microbiology and Immunology and Immunology (DMMI) offers a graduate program in molecular microbiology and immunology leading to a Ph.D. degree. Our goal is to graduate exceptionally well-trained professionals who possess the background and experience for a career in a research institution, academe, or biotechnology. The Department reflects the strength and diversity of its faculty through a unifying focus of the study of host-pathogen interactions with areas of interest including: viral pathogenesis, immunology, vaccinology, biodefense, and cancer gene therapy. Molecular and cellular biology along with genetics and animal models form the intellectual and technical basis for the research.

Although each Ph.D. candidate will have a least one major mentor, the responsibility for the education of each student ultimately lies with faculty of the Department as a whole.

I. PREREQUISITES

A Bachelor of Science or Masters degree is required including course work in physics, calculus, organic chemistry, and the biological sciences.

II. CRITERIA FOR THE PH.D. DEGREE

A. Course Work (48 hrs)

1. First Year

1st Semester

BBS-G501	5 hrs	Basic Biomedical Sciences I
BBS-G502	4 hrs	Special Topics in Basic Biomedical Sciences I
BBS-G592	1 hr	Basic Biomedical Science Colloquium
BBS-G597	2 hrs	Introduction to Basic Biomedical Research

2nd Semester

BBS-G503	5 hrs	Basic Biomedical Sciences II
BBS-G504	4 hrs	Special Topics in Basic Biomedical Sciences II
BBS-G597	2 hrs	Introduction to Basic Biomedical Research
BBS-G592	1 hr	Basic Biomedical Science Colloquium
BBS-G510	0 hrs	Ethics for Research Scientists

Summer

RMI610	3 hrs	Applied Biostatistics for Medical Sciences
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2. Second Year

1st Semester

MB-G665	3 hrs	Basic Immunobiology
MB-G635	3 hrs	Virology
MB-G691	0-1 hrs	MMI Journal Club
MB-G692	0-1 hrs	MMI Colloquium

2nd Semester

****	2-4 hrs	Electives
MB-G691	0-1 hrs	MMI Journal Club
MB-G692	0-1 hrs	MMI Colloquium

3. Third Year

1st Semester

MB-G691	0-1 hrs	MMI Journal Club
MB-G692	0-1 hrs	MMI Colloquium
xxxxx	2-4 hrs	Electives*

2nd Semester

MB-G691	0-1 hrs	MMI Journal Club
MB-G692	0-1 hrs	MMI Colloquium
xxxxx	2-4 hrs	Electives*

4. Subsequent Years

MB-G691	0-1 hrs	MMI Journal Club
MB-G692	0-1 hrs	MMI Colloquium
MB-G699	12 hrs	Dissertation Research
xxxxx	2-4 hrs	Electives*

*Electives:

These can be any Advanced Topics courses offered by any department. Electives may be taken at any time in the student's graduate program, however at least 48 hours of course work must be taken over the course of the Ph.D. In the second year, the graduate committee advises the student and his/her mentor to make a tentative plan for meeting the course requirements before the 4th year of graduate school (see course listing below).

B. Laboratory Research

Students will choose a mentor and join his/her laboratory, typically in the summer following the first year. Biomedical research is to be conducted under the guidance of the mentor and other faculty. *Laboratory research forms the core of the student's training.*

C. Preliminary Degree Examination

The Preliminary Degree Examination must be taken before the end of the summer session of the second year. The examination is composed of an oral component. The MMI faculty have each prepared an outline of essential and basic material that the student will be tested on during the preliminary exam. This exam allows weaknesses and deficiencies in the student's training to be identified, which then can be corrected. A committee of 5 faculty members will oversee the exam. A pass in this examination requires a majority vote of the committee. Should the student fail, a second exam will be taken prior to January of the third year. A third examination is granted only under extraordinary circumstances, and only upon the approval of 3/4 of the primary faculty. The last opportunity to take the exam will be the end of the summer session of the 3rd year. Successful completion of the Preliminary Degree Examination is required to continue as a student in good standing in the graduate program of the Department of Molecular Microbiology and Immunology. Failure to either pass the examination or take it in a timely manner may be grounds for dismissal of the student from the Departmental graduate program.

D. Oral Examination

The Oral Examination will be taken before spring break of the 3rd year, and is composed of written and oral components. The written component is called the *Major Proposal*. The Major Proposal should be written in a grant-style format (e.g. AHA Predoctoral grant) and contain preliminary data developed by the student. The student will be **required** to submit their application to a funding agency in the format of that agency. Since some grants are targeted to students early in the program and other grants are targeted to mature students, the time when the grant is submitted is flexible and will depend on the circumstances of the student; however, the grant application must be submitted within six months following the Oral Examination. The student's mentor and the examining committee for the Preliminary Degree Examination will make judgments about when and where the grant application should be submitted.

The *Major Proposal* will be presented to a committee of the Graduate Faculty which includes the students' mentor as Chairman, plus four other faculty members, two of which may have primary appointments outside of the Department. The student is examined orally on the proposal and the area of research. At least three votes of approval are required to pass the examination. If the student fails the examination, the examination committee plus the Dean of the Graduate School must approve a second attempt. A third attempt is rarely approved, and is considered by the Dean of the Graduate School only upon unanimous recommendation of the examining committee. This exam must be successfully completed by the end of the summer session of the 4th year.

E. Dissertation (12 hrs)

a. Dissertation Committee.

This committee includes the student's mentor (as Chairman) and two members of the Graduate Faculty, usually drawn from faculty who served on the Preliminary Degree Examination Committee. An outline of the proposed dissertation must be submitted to, and gain approval from, the Dissertation Committee within 1 month of successful completion of the Oral Examination. Thereafter the Dissertation Committee will meet quarterly to review and critique the research progress.

Students are encouraged to interact with the members of their committee on an informal basis frequently throughout the year.

In the event that a student finds it necessary to make a major change(s) in their proposed dissertation research, they are required to prepare a proposal outlining the changes and call a meeting of their Dissertation Committee at the time that the changes are made.

b. Application for the Ph.D. degree.

Within one month following successful completion of the Oral Examination, the student files with the Dean of the Graduate School candidacy papers including a formal outline setting forth the title and subject matter of the proposed dissertation. If the proposed research is to involve laboratory animals, the Animal Care Committee of the University must review and approve the research design. If the proposed research involves human subjects, the research design and any informed consent materials must be submitted to the Institutional Review Board for approval. The Ph.D. candidacy papers, research outline, recommendation of the Dissertation Committee, and any required research design approvals are submitted to the Graduate Dean who informs the student in writing of his/her advancement of Ph.D. Candidacy.

F. Annual Research Progress Report¹

All students are required to submit a Progress Report one week prior to their annual spring research seminar (MB-G 692, Microbiology Colloquium).

1. Goals

- a. Encourage students to periodically review their data from the perspective of integrating them into a publishable work.
- b. Alert students when specific weaknesses in their performance are detected, and provide support and assistance in rectifying them.
- c. Provide students with a clear and reliable yardstick by which to measure their progress toward completion of their dissertation research.
- d. Ensure that the dissertation is completed in a timely fashion.

¹ from the Department of Biochemistry and Molecular Biology

2. Achievement of Goals

- a. Students will prepare a written progress report of no more than four double-spaced, typed pages (minimum 11 point font, 0.5 in. margins), including figures. This report should include:
 - i. A short paragraph reviewing the background of the project.
 - ii. A list of the original specific aims, posed as hypotheses being tested.

- iii. A brief description of the work accomplished toward these aims in the previous year, as viewed from the perspective of integrating the data into a publication(s) in a peer-reviewed scientific journal.
 - What are the most important data and what conclusions can be drawn from them?
 - How do these data fit the original hypothesis?
 - What additional experiments/controls are needed to make a publishable story?
 - A list of any minor changes or adjustments needed in the original specific aims with a brief justification.
 - A realistic timetable of work to be accomplished in the following year.
- b. The Progress Report is submitted to the members of the faculty and to each member of the student's Dissertation Committee *at least one week* prior to the seminar. (If one or more members of the Dissertation Committee are from outside of DMMI, the student should invite them to attend their seminar.)
- c. At the seminar, students present their data and discuss the details of the written report with the faculty.
- d. After the seminar, all present faculty will meet to discuss the student's performance with the mentor. Each faculty member is expected to grade the student's performance in each of 11 areas, and provide the student with constructive suggestions for improvement.
 - i. The quality of the written report.
 - ii. Quality of the presentation.
 - iii. Suitability of timetable for the next year.
 - iv. Knowledge of the literature.
 - v. Ability to answer questions.
 - vi. Soundness of the conclusions drawn from the data.
 - vii. Treatment of alternative interpretations of the data.
 - viii. Ability to formulate research questions as hypotheses to be tested.
 - ix. Relevance of the data to the specific aims.
 - x. Ability to formulate research questions as hypotheses to be tested.
 - xi. Research productivity/completion of specific aims.
- e. Each faculty and Dissertation Committee member is expected to submit a completed evaluation form for the student's records. A majority of the total ratings of the dissertation committee must be "B" or better to attain a passing grade for the semester of "Dissertation Research". Prior to formation of a Dissertation Committee, the evaluation forms will be forwarded to the Graduate Program Directors who will synthesize a report. All evaluation forms and summary reports will be forwarded to the student and to the student's mentor.

- f. An “unsatisfactory” rating by the faculty, failure to submit an acceptable progress report on time, or failure to involve committee members when a major change in the dissertation research is made will automatically result in an unsatisfactory “Dissertation Research” grade for the semester and placement of the student on academic probation. The terms of the probation are:
 - i. The Dissertation Committee will meet quarterly with student until probation is terminated. The student will provide a written report (4-5 pages double-spaced) addressing progress toward the goals outlined in the previous meeting.
 - ii. Probation is terminated if a student attains a satisfactory grade during the following two quarters.
 - iii. Three consecutive quarters of unsatisfactory research progress grades will be cause for dismissal from the program. Dismissal will occur if a majority of the faculty so vote.

3. Expectations

- a. Skills in expository writing and oral presentation of data will be polished.
- b. Critical thinking skills and the ability to formulate testable hypotheses will be reinforced.
- c. Unsatisfactory performance will be identified for timely remedial action.
- d. Students will acquire the ability to develop realistic research timetables.
- e. Steady progress toward timely completion of dissertation research will be maintained.

G. The Ph.D. Dissertation

A dissertation is written according to the guidelines of the graduate school. Research in the dissertation is presented in a public seminar. Following the seminar, the Dissertation Committee examines the student orally on the dissertation. A majority vote of the committee is required to pass.

H. The Ph.D. Degree

The Graduate Faculty consider that a Ph.D. will be granted when the student has achieved an appropriate breadth and depth of knowledge, and when he/she has demonstrated the ability in an independent manner to define a question and to design and execute experiments whose unambiguous results answer the posed question. (We acknowledge that the student’s research has been directed in large part by his/her mentor, and we anticipate that the ability to conduct fully independent research will require postdoctoral training). We expect at least two or three publications in respected peer-reviewed journals, some with the student as the first author. The student will be encouraged to write at least one manuscript under supervision of his/her mentor. Each student will be considered on a case-by-case basis.

III. FIRST YEAR CORE GRADUATE COURSE DESCRIPTIONS

BBS-G501: Basic Biomedical Sciences I (5)

Prerequisites: Admission into the common first year biomedical sciences graduate program or permission of the Course Director. This intensive, multi-disciplinary lecture course is taught by faculty from all biomedical research programs of the medical school. The lecture topics include macro-molecular structure, shape and information; DNA, RNA and protein synthesis; genetics and control of gene expression; membranes and intracellular organelles; and pathways and control of carbohydrate metabolism. (Offered every Fall semester).

BBS-G502: Special Topics in Basic Biomedical Sciences I (4)

An intensive multi-disciplinary course designed for core biomedical graduate students. Course involves participation in small group exercises involving critical analysis of the scientific literature. (Offered every Fall semester).

BBS-G503: Basic Biomedical Sciences II (5)

An intensive multi-disciplinary course designed for all biomedical graduate students. A continuation of BBS-G501, the course topics include bioenergetics; control nitrogen metabolism; the cytoskeleton, extracellular matrix, and cell junctions; cell signaling and drug action; cell cycle, cancer, and development; integrated biology and the immune system. (Offered every Spring semester).

BBS-G504: Special Topics in Basic Biomedical Sciences II (4)

An intensive multi-disciplinary course designed for core biomedical students. Course involves participation in small group exercises involving critical analysis of scientific literature. (Offered every Spring semester).

BBS-G510: Ethics for Research Scientists (0)

Course covers a variety of topics relevant to the ethical aspects of conducting and reporting scientific investigations including general ethical principles, use of animals and human subjects in research, authorship, mentorship, conflicts of interest, and scientific misconduct. (Offered every Spring semester).

BBS-G592: Basic Biomedical Science Colloquium (1)

Students are introduced to the techniques of critical data analysis and formal scientific presentation through weekly colloquia. Faculty or senior students from the various biomedical science departments present in the fall semester, students present in the spring semester. Emphasis is placed on styles of presentation and techniques for effective communication. In the Spring semester, each student critically reviews and presents a topic from the current scientific literature at one of the weekly colloquia. All core program students are required to attend both the scientific presentation and a 10-15 minute discussion session that follows. (Offered every Fall and Spring semester).

BBS-G597: Introduction to Basic Biomedical Research (2)

Each semester is divided into six-week rotations in different research laboratories. Students are introduced to research problems currently under investigation and to advanced techniques employed in those studies. (Offered every Fall and Spring semester).

Purpose of laboratory rotations:

1. To acquaint the student with the research of members of the School of Medicine.
2. To learn contemporary techniques and approaches in research.

3. To gain hands-on experience in scientific research.
4. To learn to carry out a research project, including: formulating questions, learning background pertaining to the questions, planning the experiments to address the questions, “debugging” failed experiments, and analyzing the results.

The mentor will:

1. Assist the student in formulating a research question, recommend pertinent background reading and suggest approaches to be taken in addressing the question.
2. Assist the student in learning the necessary experimental techniques to be used in the research outlined above.
3. Guide the student in learning to analyze and “debug” experimental results, without actually doing this work for the student.
4. Encourage discussion. Discuss the project, background reading, and other issues raised with the student as appropriate.
5. Discuss his/her research interests with the student.
6. Introduce the student to other projects and techniques in the lab.
7. Guide the student through further reading as applicable.

The student will:

1. As a trainee scientist, welcome the opportunity to participate in research, whether or not the student intends to complete dissertation research in the rotation laboratory. Welcome the opportunity to learn new techniques and new areas of research.
2. Complete the recommended background reading, and be ready to apply the knowledge contained in that reading to the current research project. Expect to read independently for a lab rotation, as for any graduate course.
3. Invest hard work and critical thinking in the rotation project.
4. Demonstrate initiative in performing research. Ask questions. Carefully analyze the experimental results. Be critical. Learn to adjust the experimental techniques or approaches if the planned experiment fails. Learn to plan experiments based on longer-range goals and current results.
5. Be prepared to work outside of normal working hours when necessary to finish an experiment.

The student is graded for each.

RM I-610: Applied Biostatistics for Medical Sciences (3).

This course teaches the basic methods of biostatistical analysis employed in epidemiological and experimental biomedical research. It employs didactic lectures on statistical theory and problem sets to be performed by the students. (Offered Summer session).

IV. REQUIRED COURSES FOR THE DMMI PH.D. PROGRAM

MB.G635: General Virology (3)

A survey course in animal and human virology covering the structure, assay and identification of viruses that infect animal cells. Virus lifecycle and replication strategies, and use of viruses as tools to investigate mechanisms of DNA replication, gene expression and cellular growth control. Discussion of major DNA and RNA virus families. Biological, biochemical and physical properties of oncogenic DNA and RNA tumor viruses and their interactions with cells. Role of oncogenes in

normal growth control and transformation. Molecular aspects of virus pathogenesis, including cellular inflammatory and immunological responses of host cells and organisms to virus infection. Epidemiology of acute infections and strategies for persistence including regulation of apoptosis and the cell cycle, and immune evasion. Concepts in vaccine development and antiviral therapy. (offered every Fall semester).

MB.G665: Basic Immunobiology (3)

A survey course that presents fundamental concepts in molecular and cellular immunology. Topics include mechanisms in innate immunity such as Toll-like receptors, chemokine and cytokine signaling, complement and cellular responses; the genetics, biochemistry and biology of antigen recognition structures and antigen processing; T and B cell development; lymphocyte activation and cell-cell interactions in adaptive immunity; and host immune responses in infection, allergy, and autoimmunity. Emphasis on experimental approaches and some review of current literature. (offered every Fall semester.)

MB.G691: Microbiology Journal Club (0-1)

Students present important research published in the biomedical literature in the Fall semester and present their own research in the Spring semester. Each DMMI student presents each semester. Required of all students every Fall and Spring semester that they are in the program.

The journal club schedule will be set at the end of August and each student will be expected to present on their date except for dire illness or family emergencies, but with the approval of the course master. Graduate students will be required to choose their papers one month in advance and discuss their choice with the course master. Journal clubs for graduate students will be evaluated according to the attached form.

All graduate students in the third year and beyond must give a research presentation. One week prior to their research presentation the student must circulate a research progress report to the Faculty (see above, section F).

Directly following research presentations by the graduate student, the Faculty and the student's Mentor will discuss, in the absence of the student, the positive and negative attributes of the presentation and research report. A record of the discussions will be placed in the student's file and, where appropriate, copies forwarded to the members on the student's dissertation committee. Within a week of the presentation, the Mentor will provide the student with an evaluation of the seminar presentation and of the research report. Colloquia for graduate students will be evaluated according to the attached form

MB.G692: Microbiology Colloquium (0-1)

Students attend the biweekly MMI seminar series and critique the scientific presentations. One or two meetings with the course master are held each semester to discuss scientific presentation skills. Students collectively invite and host one or more seminar speakers per semester. Required of all students every Fall and Spring semester that they are in the program.

V. RECOMMENDED ADVANCED TOPIC ELECTIVES FOR DMMI STUDENTS

MB.G624: Advanced Topics in Immunology (2-3)

Prerequisite: MB-G665. A discussion of research publications focused on topics of current importance in molecular and cellular immunology. These may include recombination in the Ig and TCR loci; signal transduction coupled to antigen and cytokine receptors; molecular aspects of intracellular pathways in antigen processing; ligand-receptor interactions in cell-cell communications; chemokine and cytokine networks and infection; role of T cell subsets in host

defense mechanisms; and immune mechanisms in pathogenesis of infectious disease. (Offered every Spring semester).

MB.G675: Immunology Journal Club (2)

An advanced topics literature survey. Students attend weekly presentations of current publications on topics in molecular and cellular immunology, vaccine development and gene therapy. Each student presents twice per semester. (Offered every semester).

MB-G697: Research Topics (0-3)

This is an advanced topics course taught by any one of the Faculty in the Department. It is designed for a class of several students who meet with the instructor once a week to discuss and analyze a research topic. Material is taken for current research papers published in leading research journals. The topic for the course is announced in the Schedule of Classes.

BCH-G623: Macromolecules: Structure, Function, and Interactions (4)

Prerequisites: BBS-G501, -G502, -G503, and G504. Students are guided through a series on self-directed problem-solving exercises and laboratory demonstrations covering concepts and methodology in the analysis of enzyme catalysis, protein-protein interactions, protein-nucleic acid interactions, and regulation of metabolism. Exercises include accessing and using primary sequence and 3-D structural data in experimental design and analysis. (Offered every Fall semester).

BCH-G625: Preparation and Evaluation of Scientific Research Proposal

Lectures dealing with organization and evaluation of research proposals. Mentor-guided preparation of an NIH-style research proposal. Proposals are critiqued by faculty and students and are revised in light written critiques. (Offered every semester).

BCH-G628: Introduction to Genomics and Bioinformatics (2) Prerequisites: BBS-G501 and BBS-G502 or permission of instructor. This course introduces current practices in genomics and bioinformatics. Lecture topics include finding information in sequence and structure databases, protein motif and family classification, comparative genomics, and large-scale gene expression data analysis. Computer based exercises are coordinated with lecture topics. (Offered every Fall semester).

MB-G 698: Graduate Reading Course (1-3)

Individualized reading courses taught one on one with a student and any of the Department faculty. (Offered every semester).

MB.G531: Introduction to Research Techniques and Topics (1-3)

Students within the first year of their studies in the Department can spend a minimum of six weeks doing a research project with one or more Faculty members. Projects are designed to acquaint the student with a specific line of research and to help them learn techniques and develop research skills. (Offered every semester).

MB.G682: Advanced Topics in Virology and Cell Biology (1-3)

Prerequisite: MB.G635 or MB.G650. This course is taught by any one of the Faculty in the Department. Students meet with the instructor once a week to discuss and analyze a research topic in Virology or the relationship between viruses and their host cells. Material is taken from current research papers published in leading research journals. Topics for the course are selected by consensus of the students and Faculty member. (Offered every semester).

MB.G695: Special Study for Examinations (0)

MB.G699: Dissertation Research (0-6)

MB.G6CR.90: Doctor of Philosophy Degree Study (0) (summer only)

MMI Journal Club Evaluation

Name of Student: _____ Date: _____

Title of Talk: _____

1. The introduction to this talk, including motivation and/or significance of the topic, was:
Poor 1 2 3 4 5 6 7 8 9 10 Good Comments:

2. The experimental methods and results were presented:
Poor 1 2 3 4 5 6 7 8 9 10 Good Comments:

3. Were the slides or overhead projections of sufficient clarity?
Poor 1 2 3 4 5 6 7 8 9 10 Good Comments:

4. Was the relationship of the results to the conclusions clear, including other possible interpretations?
Poor 1 2 3 4 5 6 7 8 9 10 Good Comments:

5. How well did the student answer the questions?
Poor 1 2 3 4 5 6 7 8 9 10 Good Comments:

6. Was the organization of the talk logical?
Poor 1 2 3 4 5 6 7 8 9 10 Good Comments:

7. Was the talk paced so as to hold your interest?
Poor 1 2 3 4 5 6 7 8 9 10 Good Comments:

8. Did the speaker have distracting mannerisms which may be corrected?
Poor 1 2 3 4 5 6 7 8 9 10 Good Comments:

9. Additional comments:

10. Grade (For graduate students taking Journal Club for credit)
A A- B+ B B- C+ C C- F

Faculty signature: _____

**Department of Molecular Microbiology & Immunology
Annual Research Progress Report**

Name of Student: _____ Laboratory: _____

Years in Program: _____

Student Evaluation:

	Poor				Excellent
1. The quality of the written report	1	2	3	4	5
2. Quality of the presentation	1	2	3	4	5
3. Suitability of timetable for the next year	1	2	3	4	5
4. Knowledge of the literature	1	2	3	4	5
5. Ability to answer questions	1	2	3	4	5
6. Soundness of the conclusions drawn from the data	1	2	3	4	5
7. Treatment of alternative interpretations of the data	1	2	3	4	5
8. Ability to formulate research questions a hypotheses	1	2	3	4	5
9. Relevance of the data to the specific aims	1	2	3	4	5
10. Research productivity/completion of specific aims	1	2	3	4	5

11. Additional Comments: _____

12. Overall grade: A B+ B B- Unsatisfactory

13. Faculty Signature: _____