

# M.D. – PH.D. PROGRAM

The M.D.-Ph.D. program is a highly competitive dual degree program for students with exceptional academic records and previous research experience. Both the M.D. and Ph.D. degrees may be earned in an integrated seven-to eight-year program.

- Lisa A. Schimmenti, M.D., Co-Director, MN
- S. John Weroha, M.D., Ph.D., Co-Director, MN
- Leland S. Hu, M.D., Director, AZ

## Admissions/Financial Support

Students who are accepted into the M.D.-Ph.D. program are provided a fellowship with stipend, tuition, and fees. The stipend is provided by Mayo Clinic Alix School of Medicine (MCASOM) while the student is in the M.D. portion of training. MCGSBS provides up to four years of funding for the Ph.D. portion of the program. Extensions in the Ph.D. program beyond four years must be financially supported by the mentor. MCASOM and MCGSBS tuition and fees are provided by a full fellowship for students accepted into this combined M.D.-Ph.D. program, with satisfactory performance.

- Appointment and funding are conditional on remaining actively enrolled in the program, continuously meeting the qualifications, standards and requirements of the program and track.
- Funding may consist of graduate school, medical school, external fellowships and/or internal scholarships.
- If required training exceeds the appointment length, a request for extension may be made for consideration. All extension requests require graduate school approval and funding to cover all student costs during the extension period are typically paid by the student's mentor.
- The PhD and MD training must be completed within a maximum of ten years, regardless of funding availability.

Students follow the Mayo Clinic Alix School of Medicine (MCASOM) curriculum for 18 months. The United States Medical Licensing Examination (USMLE) Step 1 exam must be taken by the end of 24 months (within 6 months of the end of M1/M2) and a passing score documented before entry into the Ph.D. phase of the program, unless granted an exception. Students then begin Mayo Clinic Graduate School of Biomedical Sciences (MCGSBS) training. The advanced course work in the track and thesis research are undertaken and usually completed in three to four years. During the final two years, students complete the MCASOM curriculum.

The elements of the Ph.D. training for students enrolled in the M.D.-Ph.D. program are generally the same as those for non-M.D.-Ph.D. candidates, except for laboratory rotations and track electives. M.D.-Ph.D. students are required to take the following courses:

## MGS Courses

Code	Title	Hours
MGS 5010	Rigor, Reproducibility, Experimental Design, and Data Management	1
MGS 5000	Foundational Skills	1
MGS 6000	Responsible Conduct of Research	1
MGS 5051	Critical Thinking and Scientific Writing, Part II	1
Statistics <sup>1</sup>		

CTSC 5590	Foundations of Statistics in Clinical and Translational Research
CTSC 5600	Introduction to Statistics in Clinical and Translational Research

<sup>1</sup> Choose one of the following options. Students must complete a minimum of 1 credit of statistics courses.

## Intermediate and Advanced Quantitative Biology Courses

2 courses required. Not required for BMPEP.

Code	Title	Hours
BMB 6100	Macromolecular Structure and Dynamics	2
CTSC 5400	Introduction to Bioinformatics Concepts and Core Technologies for Individualized Medicine Approaches	1
CTSC 5600	Introduction to Statistics in Clinical and Translational Research	3
CTSC 5602	Introduction to Utilizing Statistical Software in Clinical and Translational Research	1
CTSC 5610	Statistics in CTR: Linear Regression Concepts, Interpretation, and Statistical Software	3
CTSC 5650	Advanced Statistics in CTS Research: Survival Analysis with Statistical Software	1
CTSC 5740	Systematic Reviews and Meta-Analysis	2
CTSC 6160	Genomic Analysis and Data Interpretation for Rare and Undiagnosed Diseases	2
MPET 6450	Applied Data Science and Artificial Intelligence in Pharmacology	2
MPET 6813	Tutorial in Systems Pharmacology	2

## M.D.-Ph.D. Selectives - both required

Code	Title	Hours
MDPH 5150	Grant Writing for MD-PhD Students	1
MDPH 5200	Critical Reading Skills for MD-PhD Students	2

## Weekly M.D.-Ph.D. Conference

Required to register each year during the Ph.D. phase of the program (1 credit/year for 4 years).

Code	Title	Hours
MDPH 5300	MD-PhD Conference	1

## Clinical Experience Elective Course

For M.D.-Ph.D. students in the research years to maintain focused clinical training.

Code	Title	Hours
MDPH 6100	MD-PhD Clinical Experience	0

## Post Graduate M.D.-Ph.D. Research Experience

For MD-PhD students who have completed all PhD coursework and thesis research, successfully defended, and completed the post-defense

requirements and would like to return to the laboratory to work on a new project with a new laboratory mentor or complete a promising project that was started with their original mentor. Duration is up to 16 weeks.

Code	Title	Hours
MDPH 6200	Senior Post Graduate MD/PhD Research Experience	1

## Track Requirements

M.D.- Ph.D. students must complete all track-required courses, journal clubs and seminars; however, there are exceptions allowed for track electives and MCGSBS laboratory rotations. As a result of these exceptions, M.D.-Ph.D. students are allowed to take fewer than the standard 68 credits.

- Track electives are fulfilled by preclerkship medical school coursework.
- Laboratory rotations are satisfied by completing 2 one-month, full-time rotations.

Code	Title	Hours
MDPH 5000	MD-PhD Laboratory Rotation	1
MDPH 5001	MD-PhD Laboratory Rotation	1
MDPH 5002	MD-PhD Laboratory Rotation	1

## Waived Requirements

Code	Title	Hours
MGS 5030	Core Concepts in Genome Dynamics, Biochemistry, Cellular Biology, and Physiology	3
MGS 5050	Critical Thinking and Scientific Writing	2
IMM 5100	Basic Graduate Immunology	3
CTSC 6100	Mechanisms of Human Disease	3
MPET 5808	Introduction to Molecular Pharmacology	4
NSC 6401	Practical Neuroanatomy	2

Students in the MD-PhD program are expected to make continuous and successful academic and professional progress toward graduation requirements for the Ph.D. degree. The concept of satisfactory progress mandates monitoring of a students' academic and professional performance through items including, but not limited to:

- Register for at least one course all terms throughout training
- Pass Written Qualifying Exam
- Submit Oral Qualifying Exam Committee Selection
- Pass Oral Qualifying Exam
- Submit Thesis Proposal (Data to be included in the Ph.D. thesis must be generated after admission to the Ph.D. program)
- Mentor Selection
- Thesis Advisory Committee (TAC) Selection
  - A member of the M.D.-Ph.D. Executive Committee must be a voting or non-voting member of the TAC.
- Complete Degree Program Form
- Submit application for a fellowship award (or equivalent) as defined in the Fellowship Application and Award Policy.
- Routine TAC meetings and Progress Reports, minimum every six months

- Completed final Progress Report reflecting TAC approval for defense must be received by the graduate school to be eligible for thesis defense and return to medical school.
- Individualized Development Plan completed and maintained throughout training
- Minimum of one peer-reviewed first-authored original paper accepted for publication (unless exception approved- see Publication Exception Request Procedure)
- Submit thesis per MCGSBS Thesis Guidelines for MD-Ph.D.
- Final Oral Exam/Thesis Defense
- Meet any program specific competencies as defined by track

Full details are included in the Academic Progress and Graduation Requirements for PhD Policy on the MCGSBS Policies and Procedures intranet site.

## Mentor Selection

Completion of lab rotations is required in order to allow students a variety of experiences to help decide on selecting an mentor and home laboratory for completion of their thesis research work during the remainder of their training. A Ph.D. student's mentor must have full graduate faculty privileges and must be selected timely after all required laboratory rotations have been completed. For more details see the Mentor Selection, Withdrawal and Transfer Policy on the MCGSBS Policies and Procedures intranet site. Once a mentor is selected, the student must register for MGS 6890 Predoctoral Research every term for which they will be given a grade of Satisfactory or Not Satisfactory by the mentor.

### Qualifying Examinations

The qualifying examinations are intended to test the student's fund of information in the sciences related to the chosen field of study and to evaluate the student's ability to reason critically.

## Written Qualifying Examination

The written qualifying examination will test the breadth of biomedical knowledge, and analytic and critical reasoning skills. The content and format of the examination is determined by each track. For more details, see the Written Qualifying Exam Procedure on the MCGSBS Policies and Procedures intranet site.

## Oral Qualifying Examination

Oral qualifying exam committee composition is determined collaboratively between student and student's mentor and requires approval of the program director and the school. All members must have graduate faculty privileges. For more details, see the Oral Qualifying Exam Committee Selection and Procedure on the MCGSBS Policies and Procedures intranet site.

## Thesis

### Thesis Advisory Committee

Ph.D. candidates are expected to submit to the MCGSBS office the composition of their Thesis Advisory Committee (TAC) within 90 days of selecting a mentor via the Thesis Advisory Committee Section eForm.

The TAC composition is determined collaboratively between student and student's mentor and requires approval of the program director and the school. The TAC must include a member of the M.D.-Ph.D. Executive Committee, either as a voting member or an ex-officio member.

For more details, see the TAC Member Selection and Documentation for PhD/MD-PhD Programs Procedure on the MCGSBS Policies and Procedures intranet site.

## Progress Meetings

The Thesis Advisory Committee must meet at minimum every six months from the date of committee approval. Documentation of student progress using a progress meeting report form, must be signed by all members of the Thesis Advisory Committee and submitted to MCGSBS administration. The report form template can be found on the PhD Program Forms intranet page.

## Thesis Proposal

A written thesis proposal, including presentation and thesis committee discussion of the proposal, is a requirement that may be accomplished during the oral qualifying examination or at a separate committee meeting for this purpose. The TAC must be approved prior to this committee discussion.

The Mayo Institutional Review Board must review all protocols for research involving the use of human subjects. It is the candidate's responsibility to secure approval of any such protocols before the research is undertaken.

## Preparation of Thesis

The thesis is the most important document that the Ph.D. candidate will prepare during the course of graduate study and is a record of the scientific accomplishments that justify the awarding of the degree. Consequently, MCGSBS has developed standards for its format and style, which should be closely followed. MCGSBS Thesis Guidelines for Ph.D. thesis are available on the MCGSBS intranet site under For Students/General Forms/Resources.

## Fellowship Award Submission

MD-PhD students must submit an application for extramural fellowship award or equivalent during their training. Students should be aware that F30 grants must be submitted before their 48<sup>th</sup> month in the program and that F31 grants must be submitted before their 36<sup>th</sup> month in the PhD phase per NIH rules. Students not eligible for submission through NIH should consider other options (AHA, American Epilepsy Society, MCGSBS Intramural Application, etc.) Submission of a fellowship application is a program requirement.

For more details, see the Fellowship Application and Award Policy on the MCGSBS Policies and Procedures intranet site.

## Publication Requirement

Ph.D. thesis research must make a substantial contribution to the biomedical literature and preparing work for publication is an important part of research training. The expectation is that student thesis research will result in multiple publications, with the requirement for graduation of a minimum of one peer-reviewed first-authored original paper accepted for publication. Students are required to indicate in publications their affiliation with and support from MCGSBS. Exceptions to the publication requirement must be submitted as a recommendation from the TAC with endorsement from the program director, and approval by the MCGSBS Education Committee. For more details, see the Publication Requirement Policy and Publication Exception Request Procedure on the MCGSBS Policies and Procedures intranet site.

## Final Oral Examination

The final oral examination will be scheduled after 1) the written qualifying and oral qualifying examinations have been passed, 2) MCGSBS has completed a graduation clearance audit confirming that all course and non-course requirements have been met, and 3) a TAC Progress Report is submitted to MCGSBS reflecting TAC approval that student is ready to defend. For more details, see the Final Oral Examination-Thesis Defense Procedure on the MCGSBS Policies and Procedures intranet site.

## Final Thesis Corrections

After the student has passed the final oral examination, the student has no more than 30 days from the defense date to complete all post-defense requirements, including final thesis corrections. The chair of the Thesis Advisory Committee must sign a form verifying the final corrections to the thesis have been made. MCGSBS will not certify completion of degree requirements until the final thesis has been submitted. If a student does not meet the thesis corrections deadline, they will be required to re-defend their thesis.

The final thesis is uploaded into ProQuest for publication with the option of adding a publication hold if needed. If a student does not wish to have their thesis published, they must submit a PDF version of the final thesis to the graduate school by their student end date.