

# CLINICAL AND TRANSLATIONAL SCIENCE (CTS) – PH.D. DEGREE

- Felicity T. Enders, Ph.D., *Program Director*
- Marina Walther Antonio, Ph.D., *Associate Program Director*

## Admission

### Appointment Requirements

To be considered for admission to the Ph.D. program, applicants must:

1. Hold a bachelor's degree from an accredited college or university with a minimum 3.0 grade point average based on a 4.0 scale and supply the official transcript.
  - a. It is strongly recommended that candidates have completed at least one year of coursework, with demonstrated competence (B average or above), in the following undergraduate courses: biology, calculus, chemistry and physics.
  - b. In addition, foundation courses in biochemistry, molecular biology, cell biology and physiology are highly recommended. Biomedical Engineering and Physiology students are encouraged to have courses in quantitative science and engineering (e.g., signal processing, computer science, instrumentation).
2. Foreign applicants must demonstrate proof of English language proficiency to be considered for an appointment. This can be satisfied via the Test of English as a Foreign Language (TOEFL), or via other method as described on the English Language Proficiency Attestation.
3. Each track may establish additional requirements.
4. Applications will only be considered for review if they are submitted within the application submission window of September 1 – December 1 each year, for appointment in the following academic year.

Authority to make appointments rests with the Mayo Clinic Graduate School of Biomedical Sciences Education Committee. Falsifying or omitting information on or accompanying the application may disqualify an applicant from admission or subject a student to dismissal. The application and supporting documents become the property of MCGSBS upon receipt. The average number of years to degree is 5.2.

Inquiries regarding admission to the MCGSBS Ph.D. Program should be sent to this inquiry form (<https://college.mayo.edu/academics/biomedical-research-training/contact/>).

## Admissions/Financial Support

- PhD students are fully supported through a guaranteed internal fellowship for five years, eliminating the need to identify a faculty member to provide financial support. The annual base stipend for PhD students funded by Mayo Clinic for the 2024-2025 academic year is \$40,000, deposited electronically bi-monthly in the student's bank of choice. The annual tuition fee is waived in full (\$27,000).
- 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, external fellowships and/or internal scholarships.

- Students are appointed for five years with designated program start and end dates.
- 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.
- Training must be completed within a maximum of seven years, regardless of funding availability.
- Students who enter MCGSBS with pre-awarded Mayo department/division funding will continue under the terms of any such arrangements throughout the duration of their PhD training.

## Transfer Credits

A total of 21 credits may be transferred into the Ph.D. Program. For more details, see the Credit Transfer and Waiver Policy on the MCGSBS Policies and Procedures intranet site.

## Course Work

The curriculum for the Predoctoral degree consists of **68 credits**, which can include a maximum of 24 Research credits. (Matriculants prior to 2020 have 42 credit requirement, not counting Research credit.)

Code	Title	Hours
<b>MGS</b>		
MGS 5000	Foundational Skills	1
MGS 5010	Rigor, Reproducibility, and Experimental Design	1
MGS 5020	Statistics for Biomedical Research <sup>1</sup>	1
MGS 5030	Core Concepts in Genome Dynamics, Biochemistry, and Cellular Biology	3
MGS 6000	Responsible Conduct of Research	1
MGS 5050	Critical Thinking and Scientific Writing <sup>1</sup>	2
MGS 5051	Critical Thinking and Scientific Writing, Part II	1
<b>Lab Rotations <sup>2, 3</sup></b>		
6 credits maximum, a minimum of 3 rotations		
MGS 5102	Ph.D. Laboratory Rotation	2
MGS 5107	Ph.D. Laboratory Rotation	2
MGS 5108	Ph.D. Laboratory Rotation	2
<b>Track Requirements</b>		
CTSC 5020	Regulatory Issues in Clinical Research	1
CTSC 5070	Introduction of Community Engagement - What Every Researcher Should Know	1
CTSC 5080	Introduction to Health Disparities	1
CTSC 5100	Academic Publishing	1
CTSC 5300	Foundations of Epidemiology <sup>4</sup>	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 5720	Clinical Trials Design and Conduct	1
CTSC 6100	Mechanisms of Human Disease	3
CTSC 6110	CTS Works in Progress (max 1 cr) <sup>5</sup>	1
CTSC 6120	Case Studies in Translation	2
CTSC 6130	CTS Journal Club (max 1 cr) <sup>5</sup>	1

### Research

MGS 6890	Predocutorial Research (3 cr./qtr x maximum 8 terms) <sup>6</sup>	24
<b>Advanced Coursework</b>		
Select 11 credits <sup>7</sup>		11
<b>Total Hours</b>		<b>68</b>

<sup>1</sup> M.D.-Ph.D. students may exclude these in accordance with M.D.-Ph.D. requirements.

<sup>2</sup> The track education committee will guide students to a minimum of one rotation each in laboratory-based translational research (wet bench); patient-based translational research (human studies, clinical trials, CRU-based); and population-based translational research (epidemiology, statistics, health outcomes, biomedical ethics, community engagement).

<sup>3</sup> M.D.-Ph.D. students satisfy this requirement with three one-month full-time rotations.

<sup>4</sup> Students focusing on patient or community-based research will be encouraged to take CTSC 5370 Introduction to Epidemiology (2 credits) instead of CTSC 5300 Foundations of Epidemiology.

<sup>5</sup> Students gain credit only for quarters in which they present. Minimum one credit required.

<sup>6</sup> Must enroll every quarter once a thesis laboratory is selected for remainder of program. Directed research projects under the supervision of a faculty mentor.

<sup>7</sup> Sixty-eight credits are required for graduation. In addition to the core and track requirements, courses should be selected after consultation between the student, their mentor, and the program director/associate program director. Depending on the student's area of concentration (laboratory, patient or population-based translational science) additional advanced courses will be selected from either CTSC track courses or MCGSBS core courses in the basic science disciplines.

## Qualifying Exams and Thesis Research

### Written Qualifying Examination (WQE)

The written qualifying examination tests your breadth of biomedical knowledge, as well as your analytical and critical reasoning skills. This examination must be completed before the end of your second year in the program. The CTS predoctoral programs education coordinator will assist you with the examination timeline.

The purpose of the Written Qualifying Examination (WQE) is to evaluate student's PhD thesis project. The examination will be in the format of a project proposal pulling components from the NIH F30 grant for dual degree candidates (MD/PhDs), the F31 grant for doctoral trainees (PhDs), other equivalent grant appropriate upon approval.

In general, the proposal-based examination consists of documents that demonstrate the following:

- The ability to identify a substantive proposal topic
- The ability to formulate valid and testable hypotheses
- The ability to identify the importance of and justification for the proposed research, by preparing a comprehensive review of related research literature and presenting the proposed project in that context
- The ability to prepare a sound research plan that includes both appropriate techniques and approaches suitable for the testing of the hypotheses and alternative strategies and hypotheses

- The ability to articulate an understanding of clinical and translational science and team science as it relates to proposed research

These courses must be completed before you take the exam:

Code	Title	Hours
MGS 6000	Responsible Conduct of Research	1
MGS 5050	Critical Thinking and Scientific Writing	2
MGS 5051	Critical Thinking and Scientific Writing, Part II	1
CTSC 5020	Regulatory Issues in Clinical Research	1
CTSC 5300	Foundations of Epidemiology	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

### Oral Qualifying Examination (OQE)

For the oral qualifying examination, students submit a written thesis proposal and defend their thesis research proposal to the Oral Qualifying Exam Committee. The proposal should summarize the goals, methods, and rationale for the research project. The specific guidelines for the form of this proposal are available from the CTS predoctoral education coordinator. This proposal must be submitted to the oral qualifying exam committee at least one week prior to the examination. The oral examination is composed of two or three parts. The first part will be an oral presentation by the student of their proposal; the second part will be a discussion between the student and the committee about this proposal.

If there were any conditional elements or weaknesses identified at the time of the written qualifying exam, the committee may then add a third part to the examination which will include a wide-ranging discussion of either the area of deficiency or course work material covered by the student during the first two years. Students will be notified after their written qualifying examination whether this third component should be expected during the oral qualifying exam.

### Pre-Thesis Advisory Committee (Pre-TAC)

CTS students are strongly advised to form a pre-TAC by the end of their first year after their mentor selection to support their experiential training. This will prepare students for the formation of their formal TAC. The pre-TAC will help the student and mentor identify key team members for an official TAC and formulate specific aims that will form the basis of the student's thesis proposal moving forward.

### Thesis Advisory Committee

The student, their thesis mentor and the CTS predoctoral program director/associate director will establish a formal TAC to monitor the student's thesis research progress. This should be established no later than the beginning of the student's second year. The student's adviser is chair of the committee. Students are required to meet with their thesis advisory committee at least once every six months. At the meetings, the student will present progress on his, her, or their thesis project. The committee will offer advice, and an evaluation of the student's progress will be discussed with the student at the end of the meeting.

### Thesis Proposal

Students must complete a written thesis proposal, presentation and thesis committee discussion of their proposal. This requirement may be accomplished during the oral qualifying examination or at a separate

committee meeting for this purpose. The student's TAC must be approved prior to this committee discussion.

## 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 thesis research will result in multiple publications. To graduate, students need to publish at least one original peer-reviewed paper on which they are first author.

*This is a suggested sequence based on a summer term start. Individual course plans may vary depending on true start date, program, and research interests. Be sure to confirm you have met your requirements using your degree planning tool. Course offerings may vary slightly. Current course offerings are posted in the course catalog.*

### Code Title Hours

#### First Year - Summer Term

MGS 5000	Foundational Skills	1
MGS 5010	Rigor, Reproducibility, and Experimental Design	1
MGS 5020	Statistics for Biomedical Research	1
MGS 5030	Core Concepts in Genome Dynamics, Biochemistry, and Cellular Biology	3
MGS 6000	Responsible Conduct of Research	1
MGS 5102	Ph.D. Laboratory Rotation	2

### Code Title Hours

#### First Year - Fall Term

CTSC 5080	Introduction to Health Disparities	1
CTSC 5100	Academic Publishing	1
CTSC 5300	Foundations of Epidemiology <sup>1</sup>	1
MGS 5107	Ph.D. Laboratory Rotation	2
MGS 5108	Ph.D. Laboratory Rotation	2

### Code Title Hours

#### First Year - Winter Term

CTSC 5020	Regulatory Issues in Clinical Research	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

### Code Title Hours

#### First Year - Spring Term

CTSC 5070	Introduction of Community Engagement - What Every Researcher Should Know	1
CTSC 6100	Mechanisms of Human Disease	3
MGS 6890	Predoctoral Research	3

### Code Title Hours

#### Second Year - Summer Term

CTSC 5370	Introduction to Epidemiology <sup>1</sup>	2
MGS 5050	Critical Thinking and Scientific Writing	2
MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Second Year - Fall Term

MGS 5051	Critical Thinking and Scientific Writing, Part II	1
MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Second Year - Winter Term

MGS 6890	Predoctoral Research	3
CTSC 5720	Clinical Trials Design and Conduct	1
CTSC 6120	Case Studies in Translation	2
Electives		3-5

### Code Title Hours

#### Second Year - Spring Term

MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Third Year - Summer Term

CTSC 6110	CTS Works in Progress <sup>2</sup>	1
MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Third Year - Fall Term

MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Third Year - Winter Term

MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Third Year - Spring Term

MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Fourth Year - Summer Term

MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Fourth Year - Fall Term

MGS 6890	Predoctoral Research	3
Electives		3-5

### Code Title Hours

#### Fourth Year - Winter Term

MGS 6890	Predoctoral Research	3
Electives		3-5

Code	Title	Hours
<b>Fourth Year - Spring Term</b>		
MGS 6890	Predoctoral Research	3
Electives		3-5

Code	Title	Hours
<b>Fifth Year - Summer Term</b>		
MGS 6890	Predoctoral Research	3
Electives		3-5

Code	Title	Hours
<b>Fifth Year - Fall Term</b>		
MGS 6890	Predoctoral Research	3
Electives		3-5

Code	Title	Hours
<b>Fifth Year - Winter Term</b>		
MGS 6890	Predoctoral Research	3
Electives		3-5

Code	Title	Hours
<b>Fifth Year - Spring Term</b>		
MGS 6890	Predoctoral Research	3
Electives		3-5

<sup>1</sup> *Students focusing on patient or community-based research will be encouraged to take CTSC 5370 – Introduction to Epidemiology (2 cr.) during Year 2, instead of CTSC 5300 – Fundamentals of Epidemiology (1cr).*

<sup>2</sup> *CTSC 6110 Works in Progress (1 cr.) – Completed during Year 3 or 4, students should only register in the quarter for which they are presenting.*