

BIOCHEMISTRY AND MOLECULAR BIOLOGY (BMB) – PH.D. DEGREE

- John R. Hawse, IV, Ph.D., *Program Director*
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Biochemistry and Molecular Biology Track:

- Biochemistry and Structural Biology (BSB)
- Cell Biology and Genetics (CBG)
- Cancer Biology (CB)

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 a 42 credit requirement, not counting Research credit.)

Code	Title	Hours
MGS		
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 ¹	3
MGS 6000	Responsible Conduct of Research	1
MGS 5050	Critical Thinking and Scientific Writing ¹	2
MGS 5051	Critical Thinking and Scientific Writing, Part II	1
Lab Rotations²		
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
Track Requirements		
BMB 5100	Chemical Principles of Biopolymer Systems	2
BMB 5150		2
BMB 5200	Biochemistry and Molecular Biology Works in Progress (1 cr./yr.) ³	2
BMB 6500	Biochemistry and Molecular Biology Journal Club (1 cr./yr.) ⁴	4
BMB 6900	Biochemistry and Molecular Biology Thesis Proposal	2
Advanced Coursework		
Select 16 credits ⁵		16

Research		
MGS 6890	Predoctoral Research (3 cr./qtr x minimum 8 terms) ⁶	24
Total Hours		68

- ¹ M.D.-Ph.D. students may exclude these in accordance with M.D.-Ph.D. requirements.
- ² M.D.-Ph.D. students satisfy this requirement with three one-month full-time rotations.
- ³ Two credits maximum. Students must attend all years enrolled in the program and present annually from Year 2 and on. At least 70% attendance is required.
- ⁴ Four credits maximum. Students must register for and participate in the BMB JC their first year in the program. In subsequent years, students may continue to participate in the BMB JC or substitute the BMB journal club for any other journal club offered within the graduate school in years 2-5 should a different journal club better align with their research projects. Courses to be selected in consultation with your thesis mentor.
- ⁵ Students may select from any courses approved for graduate credit regardless of the track that they fall under. Students are expected to work with their mentor and TAC members to select the most appropriate courses for their training.
- ⁶ Must enroll every quarter once a thesis laboratory is selected for remainder of program. Directed research projects under the supervision of a faculty mentor.

Lab Selection, Qualifying Exams and Thesis Research

Students are expected to complete their rotations and select the laboratory for their thesis studies within six months of joining the program.

Written Qualifying Exam

Written qualifying exam: Students take the written qualifying exam at the end of the first year. The exam is a one-day exam held at the beginning of July. The exam consists of demonstrating critical evaluation and understanding of two published primary research papers relevant to the broad field of Biochemistry and Molecular Biology as covered in the core courses MGS 5030, BMB 5100, and BMB 5150 as well as the elective courses, BMB 5400 and BMB 5000. Three sets of papers reflecting the three areas of emphasis of the track: BSB, CBG and CB, will be made available to the students three days before the exam. On the day of the exam, students are required to answer a series of specific questions associated with any two of the six papers. The questions will cover foundation of knowledge in addition to synthesis of concepts. The exam is prepared and graded by the faculty and an overall grade of 70% is required for successful completion of the exam.

Oral Qualifying Exam

Students are expected to take the oral qualifying exam by the end of their second year. This exam includes a thesis proposal and it is presumed that preliminary data in support of the project will be in hand. Concerns pertaining to the timing of this exam should be directed to BMB Track leadership. Before taking the exam, the student must prepare a final version of their thesis proposal and circulate it to their thesis committee at least two weeks before the examination. The thesis proposal serves as a springboard for faculty to probe the student's background knowledge, ability to propose and defend hypotheses, and design experiments to test

these hypotheses. The oral qualifying exam committee must conform to MGSBS requirements and be approved by the program director.

Thesis Proposal

The written thesis proposal matches the format of NIH F31 grants and, hence, is limited to 8 pages, including illustrations but not including references. In the student's own words, the proposal should outline the rationale for the proposed project and how it is to be executed. The proposal is subdivided into the following sections.

1. Abstract: Summary of your project (30 lines of text limit)
2. Specific Aims page: Describe briefly the aims of your project and hypotheses (1 page limit).
3. Research Strategy (6 page limit)
 - Significance: Put your project into context with what is known about this area of biology and show the importance of the questions you are asking (1-1.5 pages).
 - Innovation: How is the project you are proposing novel and groundbreaking (0.5-1 page).
 - Approach: Describe what you plan to do and how you plan to do it. Include preliminary data for each aim that sets the scene and supports your hypotheses (3.5-4.5 pages).

Reflecting the importance the track puts on the quality of this document and the role it plays in planning your thesis studies, 2 credits are given for preparing and defending the proposal (Registration in BMB 6900). All students are expected to submit an F31 or equivalent grant to the NIH or any other funding agency that they are eligible for. Any student unable to identify a mechanism for which they are eligible must submit the grant to the graduate school.

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. Elective options are not shown.

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 6000	Responsible Conduct of Research	1
MGS 5102	Ph.D. Laboratory Rotation	2
MGS 5030	Core Concepts in Genome Dynamics, Biochemistry, and Cellular Biology	3
Code Title Hours		
First Year - Fall Term		
BMB 5100	Chemical Principles of Biopolymer Systems	2
MGS 5107	Ph.D. Laboratory Rotation	2
MGS 5108	Ph.D. Laboratory Rotation	2
BMB 6500	Biochemistry and Molecular Biology Journal Club	1

Code	Title	Hours
First Year - Winter Term		

BMB 5150		
MGS 6890	Predoctoral Research	3

Code	Title	Hours
First Year - Spring Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Second Year - Summer Term		

MGS 5050	Critical Thinking and Scientific Writing	2
MGS 6890	Predoctoral Research	3

Code	Title	Hours
Second Year - Fall Term		

MGS 5050	Critical Thinking and Scientific Writing	2
MGS 6890	Predoctoral Research	3
BMB 5200	Biochemistry and Molecular Biology Works in Progress	1
BMB 6500	Biochemistry and Molecular Biology Journal Club	1

Code	Title	Hours
Second Year - Winter Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Second Year - Spring Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Third Year - Summer Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Third Year - Fall Term		

MGS 6890	Predoctoral Research	3
BMB 5200	Biochemistry and Molecular Biology Works in Progress	1
BMB 6500	Biochemistry and Molecular Biology Journal Club	1

Code	Title	Hours
Third Year - Winter Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Third Year - Spring Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Fourth Year - Summer Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Fourth Year - Fall Term		

MGS 6890	Predoctoral Research	3
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BMB 5200	Biochemistry and Molecular Biology Works in Progress	1
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BMB 6500	Biochemistry and Molecular Biology Journal Club	1
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Code	Title	Hours
Fourth Year - Winter Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Fourth Year - Spring Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Fifth Year - Summer Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Fifth Year - Fall Term		

MGS 6890	Predoctoral Research	3
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BMB 5200	Biochemistry and Molecular Biology Works in Progress	1
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BMB 6500	Biochemistry and Molecular Biology Journal Club	1
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Code	Title	Hours
Fifth Year - Winter Term		

MGS 6890	Predoctoral Research	3
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Code	Title	Hours
Fifth Year - Spring Term		

MGS 6890	Predoctoral Research	3
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