

MOLECULAR BIOPHYSICS, PHD

Molecular Biophysics

The Program in Molecular Biophysics (PMB) was established in 1990 and has evolved continuously over the years to provide its student participants with training in both the fundamental principles of biophysics and contemporary advances in the field. Over 35 faculty members of 12 departments throughout the University offer opportunities for learning in diverse and changing areas of research. The carefully designed set of courses and intensive laboratory work integrate various aspects of molecular biophysics into a dynamic curriculum. PMB spans the Medical School and Homewood campuses, and the program is also described in the KSAS PMB catalog page.

Johns Hopkins has long been a leading, world-renowned research institution. The Hopkins biophysics community is known for its collaborative and congenial atmosphere. Students are encouraged to forge innovative paths by seeking the advice of other biophysicists and forming collaborations that enhance their research. PMB is committed to making the resources of experiment, theory, and computation available to its scientists. In keeping with an institution of its caliber, many technology hubs and instrumentation facilities are available to Hopkins researchers.

PMB students who matriculated through Fall 2024 and joined laboratories at the School of Medicine or the Bloomberg School of Public Health transferred their registration to the School of Medicine. Students who matriculate in Fall 2025 or later will remain registered at KSAS, even if they join laboratories on the School of Medicine campus.

Admission Requirements

The Program in Molecular Biophysics is a cross-school program with participant laboratories on the School of Medicine campus and the Arts and Sciences and Engineering campus. The program encourages applications from students who have majored in biological sciences, biochemistry, chemistry, engineering, and physics. Backgrounds in related disciplines are welcomed as well.

The program derives its strength from participants with diverse interests. PMB students come from a range of undergraduate disciplines and, therefore, some may require additional courses or tutorials to round out their basic training. Individual needs can be interwoven into the required curriculum. Optimal background includes general chemistry, organic chemistry, physical chemistry, two semesters of college-level physics, biochemistry or molecular biology, and calculus or a high-level math course.

Financial Support

All PMB students receive 5 years of guaranteed funding support in the form of full tuition coverage, stipend or salary, and medical/dental/vision health premium coverage consistent with the Collective Bargaining Agreement (<https://provost.jhu.edu/education/graduate-and-professional-education/phd-union/collective-bargaining-agreement/>).

Students are encouraged to apply for external sources of funding such as National Science Foundation Predoctoral Fellowships and NIH Predoctoral Fellowships. PMB students have an excellent record of success in pursuing these opportunities.

How to Apply

Please use the Johns Hopkins University online application, selecting Biophysics under the School of Arts & Sciences. Supplementary materials (three letters of recommendation, transcripts, optional GRE scores, and a statement of purpose) should be submitted along with the main application using the Johns Hopkins Arts & Sciences SLATE admissions portal. For more information, please visit KSAS PMB Admissions.

The deadline for receipt of complete applications is December 1. Promising applicants will be invited to a Visiting Weekend to meet with faculty on both campuses, talk with students, and have a look around Baltimore.

Visit the website at pmb.jhu.edu. Please email questions to pmb@jhu.edu.

Program Requirements

Major Research Areas

Protein Folding & Dynamics, Membranes & Membrane Proteins, DNA-Protein Interactions, Structural Biology & Prediction, RNA Biophysics, Enzymes & Metabolic Pathways, Computation & Theory, Protein Design & Evolution, Single-Molecule Studies.

Requirements for the Ph.D.

Required Courses

The methods and tools of biophysics are drawn from physics, chemistry, biology, mathematics and computer science. Consequently, the curriculum is correspondingly broad and rigorous. Four required courses form the core of the PMB curriculum: Physical Chemistry of Biological Macromolecules, Introduction to Computing in Biology, Proteins & Nucleic Acids, Proteins & Nucleic Acids 2, and Modules in Molecular Biophysics. These courses, completed in year 1, provide a conceptual framework for understanding energetics, dynamics, structure and interactions at the molecular level, practical experience in computational analysis, and exposure to the current frontiers of biophysical research. Additional courses taken in year 2 are Biophysics Writing Workshop, Savvy Science Seminars I, and Savvy Science Seminars II.

All PMB students complete a research course each fall, spring and summer until graduation. Students who joined the program before Fall 2025 and officially transferred to the School of Medicine must register for ME.100.801: Biophysics Research.

Code	Title	Credits
Courses taken in Year 1		
AS.250.649	Introduction to Computing in Biology	2
AS.250.689	Physical Chemistry of Biological Macromolecules	3
AS.250.685	Proteins & Nucleic Acids	3
ME.100.715	Proteins and Nucleic Acids II	3
ME.800.811	Introduction to Responsible Conduct of Research	1
or AS.360.625	Responsible Conduct of Research	
<i>Modules in Molecular Biophysics (short courses):</i>		7
AS.250.621	Cryo-EM Module	
AS.250.622	Statistics, Data Analysis, and Reproducibility	
AS.250.623	Macromolecular Simulation	
AS.250.625	Single Molecule Measurements	
AS.250.620	Optical Spectroscopy	
AS.250.624	NMR Spectroscopy	

Courses taken in Year 2 (when students have joined labs at SOM or Homewood)

AS.250.615	Biophysics Writing Workshop	1
AS.250.610	Savvy Science Seminars I	1
AS.250.611	Savvy Science Seminars II	1

All PMB students are required to serve as teaching assistants (TAs) for two semesters, usually performed in year 2. Teaching assignments are coordinated with the program director.

Elective Courses

One elective course is required and may be taken starting in year 2. Elective courses are chosen in consultation with a student's thesis advisor and must be approved by the PMB program director. A list of previously approved elective courses is available here.

Seminars and Additional Training

In addition to coursework, students attend weekly seminars and present one of their own in the third year. Also, students must fulfill an ethics requirement by taking a Responsible Conduct of Research course in year 1 (listed above), followed by an annual refresher workshop starting in year 2.

Research Rotations

The program aims to involve students in research projects from the start. First-year students complete three 7-to-10-week rotations in laboratories of their choosing. At the end of each rotation period, students present 10-minute talks with their rotation advisors, other faculty and students present. By summer of the first year, a student will have joined a research group and embarked on thesis research.

Oral Exam

Proficiency in molecular biophysics is tested formally with a Doctor of Philosophy Board Oral, a qualifying exam required university-wide, administered at the end of the second year. Tutorials and self-directed study provide alternative avenues for preparing for this evaluation.

Thesis Committee Meetings

Students are accepted to Ph.D. candidacy after successful completion of a qualifying oral exam at the end of the second year. Beginning in the fifth semester, students meet annually (semi-annually beyond year 4) with a faculty thesis review committee. The student and advisor should also meet to discuss matters related to the Individual Development Plan (IDP) required by the NIH, and complete the Student-Thesis Advisor Report.

Dissertation

Completion of an original investigation is required. Once thesis research is complete, students must defend their thesis before a final exam committee. The dissertation must be accepted by the program and the results considered worthy of publication by the referees. Students subsequently present a final thesis seminar open to the Johns Hopkins community.

Learning Outcomes

In the PMB, students are trained in the use of quantitative approaches to elucidate the physical bases of biological processes by

integrating experiment, theory, and computation. Upon completion of the Program, graduates will be able to do the following:

1. Demonstrate a deep understanding of core concepts at the nexus of physics, biochemistry, cell biology, and molecular biology.
2. Conduct independent and original research.
3. Develop and adhere to high standards for ethical and responsible conduct, scientific rigor, and reproducibility.
4. Build advanced skills for communication and teamwork.
5. Engage in career awareness and career exploration opportunities.
6. Establish high standards in leadership and citizenship to contribute to scientific discovery.
7. Advance the field of Biophysics.

The PMB Ph.D. equips students with the tools to ask questions about the physical and chemical bases for life. It provides training in both the fundamental principles of biophysics and contemporary advances in the field. The methods and tools of biophysics are drawn from physics, chemistry, biology, mathematics, and computer science. Students perform original research in one or more of the following areas: protein-DNA interactions; enzymes and metabolic pathways; membranes and membrane proteins; protein design and evolution; protein folding and dynamics; RNA biophysics; computation, theory, and prediction; single-molecule studies; and structural biology.