

PhD or MA in Physiology or Biophysics

Boston University Chobanian & Avedisian School of Medicine offers programs leading to the PhD or MA in Physiology or Biophysics. Each program stresses laboratory training and original research performed under the direction of a faculty member, as well as satisfactory performance in graduate coursework.

In the first and second years of both the PhD and MA programs, a [core curriculum](#) of Foundations in Biomedical Sciences courses is supplemented with biophysics and physiology. The program emphasizes flexibility and individual choice. In the first year, students do research rotations in the laboratories of 2–3 (MA) or 3–4 (PhD) [faculty members](#) to gain firsthand knowledge of a variety of research areas.

At the end of the first year, students select a degree advisor and continue research toward the MA or PhD degree. In the second year students continue to take courses and PhD students must pass a qualifying exam. Throughout their training, students also participate in a weekly department seminar series and report their research progress annually at a student seminar day.

Learning Outcomes

All students graduating with the **PhD in Physiology or Biophysics** from the School of Medicine are expected to:

- Generate an original body of work in the biomedical sciences that reflects critical thinking and independent thought.
- Demonstrate competencies in advanced research skills.
- Develop the ability to communicate in both written and oral methods within their chosen field of expertise with both specialists and nonexperts.
- Demonstrate a commitment to professional development and continued learning in their chosen field.

All students graduating with the **MA in Physiology or Biophysics** from the School of Medicine are expected to:

- Generate an original body of work or a library thesis in physiology or biophysics that reflects critical thinking and independent thought.
- Demonstrate competencies in research skills or library research skills.
- Develop the ability to communicate through written documents within their chosen field of expertise with both specialists and nonexperts.
- Demonstrate a commitment to professional development and continued learning in their chosen field.

Purpose and Background

The Department, under the aegis of Dr. Venetia Zachariou as chair, brings together active faculty members to provide excellence in research and graduate education. Research interests in the department span the modern areas of cellular physiology and molecular biophysics, with strong concentrations in structural biology, vision research, muscle physiology, neurophysiology, and the biology and physical chemistry of proteins, lipids, and lipoproteins. Faculty members are nationally and internationally recognized as leaders in their areas of research. The department provides flexible graduate programs with pathways either leading toward a degree in physiology or in biophysics. The department offers these two programs in a strong, collegial environment to encompass and promote the diverse overlapping research of all members of the department.

The goal of our programs in Physiology or Biophysics is to produce graduate students who understand the thermodynamic, chemical, electrical, and structural aspects of biological systems at the atomic level and in the context of the cell and organism. The training across scientific and medical disciplines provides graduates the advantage of learning physiology and biophysics in the context of the regulation of homeostasis and pathogenicity of the cell, and of the organism as a whole. Graduates will be able to communicate and collaborate effectively with a broad range of disciplines ranging from medical personnel to chemists, engineers, and physicists.

A set of required core courses will be taken by the students in the first and/or second year that will lead to a level of understanding of the two disciplines necessary for a degree in physiology or biophysics. After completing the core course requirements, students have flexibility to choose

the appropriate additional coursework for their interests, within the guidelines set out below. The courses for first-year students are chosen with the guidance of members of the Student Admissions & Affairs Committee (SAAC), and in the second year with input from their PhD or MA advisor. Students who successfully complete the program are awarded either a PhD or an MA in Physiology or in Biophysics.

Similar Paths for PhD, MD/PhD, and Post-MA PhD students

Requirements for PhD and MD/PhD students are similar. Students in the PhD program take their qualifying examination in their second year. MD/PhD students enter after completing the second-year Medical Curriculum and are therefore treated as post-MA students with a lower course and credit requirement (32 versus 64 total credits), and take their qualifying exam at the end of their first year in the program.

Transfer and post-MA students are handled on a case-by-case basis, but may be able to take the qualifying examination at the end of their first year.

In all cases, post-MA students are able to choose a suitable set of courses tailored to their backgrounds and research interests, with input from the SAAC during the first year and from their advisor in following years.

The MA Programs

MA programs in Physiology or Biophysics are offered. In some cases, a qualified MA student may subsequently apply to the Program in Biomedical Sciences (PiBS) PhD program. This decision is dependent on the student's application and acceptance into the PiBS umbrella program through the PiBS admissions process.

An MA requires 32 credit hours (paid for by the student) and requires either a literature-based dissertation or a short laboratory-based dissertation with two readers from within the department.

The Path of a Graduate Student

On joining the department, students follow a path of requirements with specific coursework dependent on their concentration in either Physiology or Biophysics. Students with a

concentration in Physiology are required to take at least one course in Biophysics and students with a concentration in Biophysics take at least one course in Physiology.

Seminar Courses (GMS BY 871, 872 or GMS PH 841, 842; 2 credits per semester)

In the second and subsequent years, all students in the department participate in the Special Topics Seminar course, aimed at developing the student's ability to read the scientific literature and present the merits and/or deficits of a current research paper to other students and a proctoring faculty member. The students use a whiteboard and computer for their presentations. This component of the course meets for one hour each week, as specified by the faculty member proctoring the class. Typically, all students present at least once each semester, and possibly more often, based on the number of enrolled students. Additionally, students are taught to write grants, research papers, and more general scientific articles such as "News and Views" on papers from the current literature. An important complement to the student presentations is required attendance at the Department Seminar Series where the students are exposed to cutting-edge research by outstanding speakers.

All graduate students in the department enroll in this course each semester for the duration of their degree program, earning 2 graded credits per semester.

The faculty member who teaches this course is rotated after each semester, to allow a fresh viewpoint and area of expertise to be covered. The Chair of the SAC, with input from the Program Steering Committee, selects 6–8 faculty who are interested in teaching this course on a rotating basis.

Student Seminars

In years 3–5, or starting with the spring term after the qualifying examination has been completed, all PhD candidates will present a 20–30-minute seminar on their dissertation research. These seminars form a logical extension of the departmental Seminar Series and the Special Topics course and take place on a specified Student Seminar Day (or days) scheduled in April or May. Predissertation committee members for a presenting student take notes on the quality of the presentation and meet with the student within 2–3 days, on either a one-to-one basis or in small groups with other committee members, to provide feedback with the goal of improving the student's presentation skills.

Student Poster Presentations

Students who have completed their qualifying exams present a poster during Russek Day in the spring of each year, to improve their organization and presentation skills. In addition, students are encouraged to enter their posters in the Scholars' Day poster competition held at the Boston University Charles River Campus. Students are encouraged to attend local and national meetings to present their research.

Student Individual Development Plans and Professional Development

Students, together with Student Affairs committee members, each create an individual development plan that is updated at least annually. The Professional Development and Postdoctoral Affairs office provides monthly workshops, lectures, and panel discussions, which students are encouraged to attend as they progress through the program.

Course Requirements

Incoming PhD and MA students are required to take either five or three modules, respectively, from the Foundations in Biomedical Sciences curriculum, including Protein Structure, Cell Dynamics, Genetics and Genomics, Mechanisms of Cell Communication, and Cellular Physiology (FC 711, 712, 713, 714, and 717 for PhD; FC 711, 713, and 714 for MA). To allow flexibility for the breadth of the fields of physiology and biophysics, yet ensure a working knowledge of both, students are required to take a minimum of one physiology course and one biophysics course.

The acceptable biophysics courses are:

- BY 760 A Macromolecular Assemblies: Protein-Protein, Protein-Nucleic Acid, and Membrane Protein Assemblies (2 cr)
- BY 760 B Macromolecular Assemblies: Lipid-Protein Assemblies (2 cr)
- BY 771 B Foundations of Structural Biology: Computation, Thermodynamics, Spectroscopy, and NMR (2 cr)
- PH 771 A Foundations of Structural Biology: Structure Determination by Crystallography and Electron Microscopy (2 cr)

The acceptable physiology courses are:

- FC 717 Physiology of Specialized Cells (3 cr)
- PH 730 Human Physiology A (4 cr)
- PH 731 Human Physiology B (4 cr)

Elective coursework is chosen jointly by the student and their advisor or dissertation committee. To achieve a balanced curriculum for all students, Graduate Medical Sciences PhD degree requirements include a *minimum* of 24 credits in formal coursework, or 12 credits for the post-MA. It is expected, although not required, that the formal coursework credits are acquired prior to the qualifying examination at the end of the second year. Beyond 24 coursework credits, students are encouraged to informally audit courses following consultation with their dissertation committee. Post-MA students who have already taken an appropriate graduate-level course in the core curriculum are permitted to substitute an elective or electives in the first semester.

The Qualifying Examination

Success in science requires that students be able to express their thoughts both verbally and in written form. The necessary verbal skills are developed through participation in the Special Topics Seminar course and by giving presentations in yearly research seminars at the Student Seminar Day(s), laboratory group meetings, predissertation meetings, and the dissertation defense seminar. Written skills are developed in required coursework and in the writing of papers and the dissertation. This process begins with writing a research proposal using the NIH National Research Service Award (NRSA) or American Heart Association Research Training Grants and Fellowships format, to fulfill the written qualifying exam requirement.

The qualifying examination is given at the end of the second semester within the second year for PhD students. MD/PhD, post-MA, and some transfer students in the PhD program have the option of taking the qualifying examination at the end of the second semester of the first year. Administration of the qualifying examination will be overseen by the SAAC. Program faculty members serve on the qualifying examination committees on a rotating basis. The two-part exam consists of:

1. For the written qualifying examination, students write a research proposal that correlates with, but may or may not include, their planned dissertation research. This document is judged by three members of the SAAC committee for the student's understanding of the relevant scientific literature and ability to propose testable scientific hypotheses.

2. An oral examination where the student is assigned three current research papers to read and is subsequently tested on their understanding of the material in front of an examining committee. This committee is comprised of five program faculty members. Papers are chosen by the committee and given to the students two to three weeks in advance of the oral examination. Dissertation advisors will not participate in the oral defense of students who are pursuing a PhD in their laboratory.

Both the written and oral portion of the qualifying exam must be passed in order for a student to continue in the PhD program. Students who fail either the oral or the written portion of the exam (or both) can retake that portion of the exam once in order to achieve a passing score. MA students do not take the qualifying examination.

Dissertation

Predissertation Meetings

After the student has passed the qualifying exam, a predissertation committee of at least five members must be established in the fall of that year and submitted to the SAAC. Students submit their dissertation proposal in grant form to the members of the committee two weeks before the first predissertation committee meeting. At least one member from outside the department, and preferably from a different institution, should be included in the final dissertation committee. An external committee member is not required for predissertation meetings, which will be held about every 10–12 months or at least three times prior to graduation.

Dissertation Defense

The PhD dissertation defense consists of a public seminar followed by a closed-door dissertation defense with a minimum of five committee members, including one member from outside the department.

Program Resources

All members of the faculty of the Department participate in the graduate programs in Physiology or Biophysics. The faculty have well-funded research programs and extensively equipped

individual laboratories for carrying out research in cellular physiology and biophysics. In addition, the department maintains core facilities in molecular biology, spectroscopy, X-ray crystallography, NMR, and structural electron microscopy that will be used by students carrying out their research.

Admission

Recruitment directly into the Program in Biomedical Sciences is the route of entry for PhD students, and MA candidates apply directly to our programs in Physiology or in Biophysics.

There is no strict formula for acceptance to the programs, and many factors go into the Admissions Committee's decisions. The programs seek students from a wide range of backgrounds including physics, chemistry, biochemistry, biology, and medical sciences.

For acceptance into the program, students should have outstanding grades in a rigorous curriculum, and applicants should have completed organic chemistry, physics, and physical chemistry courses. The GRE general test and subject tests are not required. Foreign students are required to take the TOEFL. We are especially interested in candidates with research experience. Finally, the letters from the applicant's references are extremely important, as is the applicant's personal statement. Underrepresented minorities are encouraged to apply.

Administration

The Chair of the Department is the director of the graduate programs and has the ultimate responsibility for administering the graduate programs in Physiology or Biophysics. A Program Steering Committee oversees the graduate programs and advises the Chair of the Student Admissions & Affairs Committee (SAAC) on specific needs of the programs. Steering Committee members select faculty members to serve on the SAAC and oversee the appointment of committees that deal with developing new courses along with the review and updating of existing courses.

The Steering Committee and the SAAC Chair work jointly to supervise the appointment of faculty to run the departmental seminar series and plan the departmental retreat. Student Seminar Days are organized by faculty members who are running the department seminar series in a given year.

The Student Admissions & Affairs Committee (SAAC)

The SAAC oversees the day-to-day operations of the graduate programs, including: student recruitment, admissions, orientation, rotations, assignment of dissertation advisors, and administering the qualifying examinations. The SAAC is comprised of 5–7 faculty members who adequately represent the diverse research interests within the department.

The SAAC serves many roles in the department. The SAAC is charged with overseeing student affairs and academic standing, curriculum development, and administering the qualifying examination. The SAAC is also available to help with student problems and to mediate issues between students and advisors.