Biochemistry, Biophysics, & Structural Biology, PhD

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Degree Requirements

Biochemistry, Biophysics, & Structural Biology

The Biochemistry, Biophysics, & Structural Biology Program is a graduate training program at WashU, housed under the Roy and Diana Vagelos Division of Biology and Biomedical Sciences (DBBS).

The Biochemistry, Biophysics & Structural Biology (BBSB) Program brings together scientists who aim to understand biological systems ranging from single molecules to whole organisms at the level of chemical transformations and molecular interactions. Our students investigate diverse topics including protein dynamics, the molecular mechanisms of nucleic acid and cytoskeletal motors, membrane-bound ion channels, metabolic enzymes, immunological signaling, and much more. Learning more about how these molecules function leads to insights into a variety of biological contexts including host-pathogen interactions, cancer, metabolic regulation, immunological signaling, DNA-repair, and muscle function to name a few. BBSB faculty on both campuses share ties with DBBS programs such as Microbiology, Immunology, and Plant and Microbial Biosciences. The BBSB program encompasses three interrelated research areas:

- **Biochemistry** uses the concepts and approaches of chemistry to understand the molecular basis of biological processes. Biochemical studies include enzymology, metabolism, DNA replication, cell signaling, and drug discovery. Insights from these studies may shed light on fundamental biological processes as well as mechanisms of disease, new drug treatments, and new diagnostics.
- **Biophysics** brings together elements of biology, chemistry, physics, and mathematics to describe and understand biological processes. It is a fusion of scientific cultures: the systems and processes of biochemistry and computational and molecular biology are joined with the principles and quantitative laws of physical chemistry. The goal is to develop a quantitative and predictive understanding of biology at a detailed molecular level.
- **Structural Biology** seeks a mechanistic understanding of macromolecular function through molecular structure and dynamics. X-ray diffraction, cryo-electron microscopy, and nuclear magnetic resonance are among the tools used by structural biologists, whose insights address important questions throughout biology and medicine at Washington University.

Doctoral Candidacy

To earn a PhD at Washington University, a student must complete all courses required by their department; maintain satisfactory academic progress; pass certain examinations; fulfill residence and Mentored Experience Requirements; write, defend, and submit a dissertation; and apply to graduate via Workday Student. For the details of doctoral degree general requirements in Arts & Sciences, including an explanation of Satisfactory Academic Progress, students should review the Doctoral Degree Academic Information page of the Arts & Sciences *Bulletin.*

Program Requirements

- **Total Units Required:** 36 credits
- **Degree Length:** 7 years
  - Students are expected to maintain satisfactory academic progress in accordance with academic milestones. Students entering their seventh year in the program will receive a warning letter with regard to reaching their stated degree length. Students entering their eighth year in the program will be required to obtain permission from the Associate Dean of Graduate Education.
  - **Note:** Students must be enrolled in 9 graduate credits each semester to retain full-time status. As students complete their course work, if enrolled in fewer than 9 graduate credits, they must enroll in a specific Arts & Sciences graduate course that will show 0 units but does count as full-time status. Students should connect with their department to ensure proper enrollment prior to Add/Drop.
  - Continued support is guaranteed for the duration of the student's graduate studies, provided that they maintain satisfactory progress toward completion of the degree.
- **Grade Requirement:** Required courses generally consist of four to nine courses in areas fundamental to the student's program. Students are expected to maintain a B average in graduate courses.

Required Courses

DBBS Required Courses

- BIOL 5098 Graduate Research Fundamentals
- BIOL 5011 Ethics and Research Science

BBSB Specific Requirements

- BIOL 5357 Chemistry and Physics of Biomolecules
- Four semesters of BIOL 5469 Biochemistry, Biophysics, and Structural Biology Seminar

Students complete a peer review seminar series in which they present their current work and receive feedback on both their science and their presentation.

9 Credit Hours of Advanced Electives

Courses must be offered through DBBS or through the Chemistry, Physics, or Mathematics departments as 5000-level or above graduate courses unless otherwise approved by program directors. MSTP students may use their medical courses to satisfy this requirement.

Three Journal Clubs

DBBS and WashU have journal clubs on a variety of topics aligned with student interests. Participating students present at least once per semester for credit and will receive feedback. Students are encouraged to continue participation in journal clubs throughout their graduate experience.

Laboratory Rotations

Selecting a thesis advisor is the most important decision a student makes in graduate school. To help each student make an informed, thoughtful choice, the Division builds in flexibility to explore options. Students usually participate in three lab rotations during their first year. Additional rotations can be arranged, and rotation lengths are flexible. Students usually begin their thesis research by the end of their first year.

Scientific Scholarship

Keeping abreast of scientific developments is critical for faculty and students alike. The Division offers many ways to stay current. More than 15 weekly biology seminars provide excellent opportunities to meet outstanding scientists from outside Washington University. Several annual symposia bring internationally recognized speakers to campus. Journal clubs meet weekly for students, postdoctoral fellows, and faculty to present and discuss current scientific literature. A number of Interdisciplinary Research Pathways allow students to enhance their PhD program. Program retreats allow for informal interaction among students and faculty. The Division also provides funds for each student for professional development.

Qualifying Examinations

Progress toward the PhD is contingent upon the student passing examinations that are variously called *preliminary, qualifying, general, comprehensive,* or *major field exams.* The qualifying process varies according to the program. In some programs, it consists of a series of incremental, sequential, and cumulative exams over a considerable time. In others, the exams are held during a relatively short period of time. Exams may be replaced by one or more papers. The program, which determines the structure and schedule of the required examinations, is responsible for notifying the Office of Graduate Studies, Arts & Sciences, of the student's outcome, whether successful or unsuccessful.

Program-specific information: After taking the first year of classes and selecting a laboratory, students will develop and defend an independent research project of their own design in the qualifying exam (QE). During this process, which has both a written and oral component, students identify important gaps in knowledge based on primary literature, develop clear hypotheses, and devise quantitative experiments to test said hypotheses. Following a successful QE defense, students will identify and finalize their committee and complete their thesis proposal by December 31 of Year 3.

Mentored Experience Requirements

Doctoral students at Washington University must complete a department-defined Mentored Experience. The Mentored Experience Requirement is a doctoral degree requirement that is notated on the student's transcript when complete. Each department has an established Mentored Experience Implementation Plan in which the number of units that a student must earn through Mentored Teaching Experience(s) and/or Mentored Professional Experience(s) is defined. The Mentored Experience Implementation Plans outline how doctoral students within the discipline will be mentored to achieve competencies in teaching at basic and advanced levels. Some departments may elect to include Mentored Professional Experiences as an avenue for completing some units of the Mentored Experience Requirement. Doctoral students will enroll in ASGS 8005, 8010, or 8015 Mentored Teaching Experience - Assistant in Instruction; ASGS 8020 Mentored Teaching Experience - Mentored Independent Teaching; or ASGS 8120 Mentored Professional Experience to signify their progression toward completing the overall Mentored Experience Requirement for the degree.

The Doctoral Dissertation

A Research Advisory Committee (RAC) must be created no later than the end of the student's third year; departments may set shorter timelines (e.g., by the end of the student's second year) for this requirement. As evidence of the mastery of a specific field of knowledge and of the capacity for original scholarly work, each candidate must complete a dissertation that is approved by their RAC.

A Title, Scope & Procedure Form for the dissertation must be signed by the committee members and by the program chair. It must be submitted to the Office of Graduate Studies, Arts & Sciences, at least six months before the degree is expected to be conferred or before the beginning of the fifth year of full-time enrollment, whichever is earlier.

A Doctoral Dissertation Guide and a Dissertation Template that give instructions regarding the format of the dissertation are available on the website of the Office of Graduate Studies, Arts & Sciences. Both should be read carefully at every stage of dissertation preparation.

The Office of Graduate Studies, Arts & Sciences, requires each student to make the full text of the dissertation available to the committee members for their review at least one week before the defense. Most degree programs require two or more weeks for the review period; students should check with their faculty.

The Dissertation Defense

Approval of the written dissertation by the Research Advisory Committee (RAC) is strongly recommended before the student can orally defend the dissertation. The Doctoral Dissertation Committee that examines the student during the defense consists of at least five members. Normally, the members of the RAC also serve on the Doctoral Dissertation Committee. The dissertation committee is then additionally augmented to ensure that the following criteria are met:

1. Three of the five members (or a similar proportion of a larger committee) must be full-time Washington University in St. Louis faculty members or, for programs involving Washington University in St. Louis-affiliated partners, full-time members of a Washington University in St. Louis-affiliated partner institution. All members must be authorized to supervise PhD students and have appropriate expertise in the proposed field of study. One of these three members must be the PhD student's primary thesis advisor, and one may be a member of the emeritus faculty.
2. All other committee members must be active in research/scholarship and have appropriate expertise in the proposed field of study whether at Washington University in St. Louis, at another university, in government, or in industry.
3. At least one of the five members must bring expertise outside of the student's field of study to the committee, as judged by the relevant department/program and approved by the Office of Graduate Studies, Arts & Sciences.

The approval processes outlined in the RAC section of the Doctoral Council bylaws also apply to the doctoral dissertation committee, including approval of each dissertation committee by the Office of Graduate Studies, Arts & Sciences.

The student is responsible for making the full text of the dissertation accessible to their committee members for their review in advance of the defense according to program rules. Washington University in St. Louis community members and guests of the student who are interested in the subject of the dissertation are normally welcome to attend all or part of the defense but may ask questions only at the discretion of the committee chair. Although there is some variation among degree programs, the defense ordinarily focuses on the dissertation itself and its relation to the student's field of expertise.

Attendance by a minimum of four members of the Doctoral Dissertation Committee, including the committee chair and an outside member, is required for the defense to take place. This provision is designed to permit the student's defense to proceed in case of a situation that unexpectedly prevents one of the five members from attending. Students should not plan in advance to only have four members in attendance. If four members cannot attend, the defense must be rescheduled. The absence of all outside members or of the committee chair also requires rescheduling the defense.

Students, with the support of their Doctoral Dissertation Committee chair, may opt to hold their dissertation defense in person or by utilizing a virtual or hybrid format.

Submission of the Dissertation

After the defense, the student must submit an electronic copy of the dissertation online to the Office of Graduate Studies, Arts & Sciences. The submission website requires students to choose among publishing and copyrighting services offered by ProQuest's ETD Administrator. Students are asked to submit the Survey of Earned Doctorates separately. The degree program is responsible for delivering the final approval form, signed by the committee members at the defense and then by the program chair or director, to the Office of Graduate Studies, Arts & Sciences. Students who defend their dissertations successfully have not yet completed their PhD requirements; they finish earning their degree only when their electronic dissertation submission has been accepted by the Office of Graduate Studies, Arts & Sciences.