



# **ACADEMIC PROGRAM GUIDELINES**

## **Program in Computational and Molecular Biophysics**

# Computational and Molecular Biophysics Ph.D. Program at Washington University in St. Louis

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## Overview

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Graduate training in experimental and computational molecular biophysics at Washington University is offered by the Program in Computational and Molecular Biophysics in the Division of Biology and Biomedical Sciences. The Program is administered by a Faculty Steering Committee that oversees graduate training.

Overall the program is designed to provide the student with the multiple skills required to be an effective research scientist, including (i) an ability to propose, discuss, and critically evaluate ideas, (ii) an understanding of important concepts in molecular biophysics (iii) an ability to conceive experiments that will test hypotheses, (iv) the technical skill to conduct experiments, and (v) an ability to explain experiments and concepts effectively, in both written and oral presentations. The goal of the Program is to provide students with the best possible training for careers as research scientists in molecular biophysics.

Graduate training formally is divided into two stages: pre-candidacy and candidacy. Students usually complete the requirements for candidacy, which include courses and a qualifying examination, during their second year. Once the student becomes a candidate for a Ph.D. degree, training consists of

directed thesis research under a mentor of the student's choosing. Students meet with their thesis committee at least once per year to discuss research progress. Students are encouraged to complete and defend their dissertations no later than the end of their fifth year.

## Anticipated timelines of student progress

### Ph.D. program

Year	Semester	Major activities
1	Late Summer, Fall	Arrive between June 1 and August 15; orientation in the third week of August. Meet with Program Director and Steering Committee members; plan rotations and coursework. Begin first rotation. Take core curriculum course Chemistry and Physics of Biological Molecules (Bio 5325) and take one elective course. Journal Club (just attend, not register).
	Spring - Summer	Winter: Second rotation. Spring: Third rotation. Take core curriculum course Macromolecular Interactions (Bio 5312). Take Biophysics Graduate Student Seminar (Bio 5314). Take one advanced elective course. Summer: Choose thesis advisor and begin thesis research.
2	Fall	Complete advanced elective course requirements. Take special topics course as interests dictate. Journal Club. Teaching Assistantship (or Spring). Submit topic for qualifying exam by Oct. 1. November 19 <sup>th</sup> – Full QE proposal due to Committee Chair
	Spring - Summer	Take Biophysics Graduate Student Seminar (Bio 5314). Take Ethics (Bio 5011). Journal Club. Complete qualifying exam by Jan 30. Choose a thesis committee and schedule a pre-proposal or proposal meeting no later than 6 months after passing qualifying exam.
3	Fall	Complete thesis proposal 6 months after QE no later than Dec. 31. Thesis research.
	Spring - Summer	Attend Biophysics Graduate Student Seminar (Bio 5314) Thesis research with annual committee updates.
4		Thesis research with annual committee updates.
5		Complete and defend thesis.

## MSTP program

Year	Semester	Major activities
1	Late Summer - Fall	Orientation. Meet with MSTP and Steering Committee to plan course work. Take core curriculum courses as described for PhD above. Take one advanced elective course. Journal Club (just attend, not register). Choose thesis advisor by September 1 and begin thesis research. Teaching Assistantship (Fall or Spring).
	Spring - Summer	Take one advanced elective course. Take core curriculum courses as described for PhD above. Take Biophysics Graduate Student Seminar (Bio 5314) Take special topics courses as interests dictate. Journal Club. Submit topic for qualifying exam by June 30. August 19 <sup>th</sup> – Full QE proposal due to Committee Chair
2	Fall	Complete qualifying exam by October 30. Complete special topics courses / advanced electives requirements. Journal Club. Choose a thesis committee.
	Spring - Summer	Take Ethics (Bio 5011). Take Biophysics Graduate Student Seminar (Bio 5314). Thesis proposal by March 1.
3	Fall	Thesis research with annual committee updates.
	Spring - Summer	Attend Biophysics Graduate Student Seminar (Bio 5314). Complete and defend thesis.
4		Return to Medical School.

## Course requirements

Biophysics students are required to complete the following courses

- Chemistry and Physics of Biological Molecules (BIO 5357)
- Macromolecular Interactions (BIO 5312)
- Molecular Biophysics Student Seminar (BIO 5314)
- Ethics and Research Science (BIO 5071)
- Journal clubs and special topics courses (5 credits)
- Two advanced electives

During the course of graduate studies, students in the Program take five credits of special topics courses, tutorials, or journal clubs. Two of these credits will be earned in the Graduate Student Seminar. The purposes of this requirement are (i) to provide close student-faculty interactions in a format that is less didactic than standard lecture courses; (ii) to allow students to study current research topics in great depth; and (iii) to provide students with a mechanism to learn the skills of public speaking and seminar presentation. Thus, a large component of these courses includes coaching in oral presentation.

Participation in journal club is strongly encouraged throughout all years of graduate training. Normally a student will receive one credit in a journal club for regular participation and a presentation. A journal club must either be in the University Course Listings or on an approved list maintained by the Steering Committee. Special topics courses are organized by one or several faculty on a specific research topic. *Students are encouraged to approach faculty with proposals for special topics courses.*

A grade of B- or better in each course, with an overall GPA of 3.0, is a requirement in

order to remain in good academic standing.

## **Advising**

Timely and good advice often can be very important to graduate students. Students in the Program in Computational and Molecular Biophysics should take advantage of advice from a number of sources, both informally from faculty and students and more formally from appointed advisors that meet with the student at appropriate intervals.

### **Student Mentors**

Each first-year student is assigned a student from the second- or third-year class to act as a mentor. The student mentor may serve as a first source for answers to many questions but also may encourage the student to meet with a faculty advisor when appropriate.

### **First-Year Advising**

The Steering Committee advises first-year students until they choose a thesis lab. The choice of a thesis lab normally occurs after rotations are completed, ordinarily by the end of the first year. Each student is assigned an advisor on the Steering Committee. To register or to drop or add courses, students must obtain their advisor's signature. The advisor is available to help students choose rotations as well as classes. In addition to individual advising sessions, students meet with the Steering Committee once a semester to discuss progress and address any questions the student may have.

### **Advising After the First Year**

The Steering Committees will meet with any student who has not yet completed a thesis proposal no less than once a semester, although an individual advisor may be appointed to advise each student. These meetings will usually occur just before the beginning of each semester. Once a student has completed a thesis proposal, meetings with the Steering Committee ordinarily cease and the thesis committee assumes responsibility. However, students should consult with previously assigned advisors as they see fit.

## **Research lab rotations**

At the beginning of the first semester (or, optionally, during the first summer), students, with the advice of their advisors and the Steering Committee, plan laboratory rotations. In general, students complete three laboratory rotations, each three months long, by the summer of their first year in the program, at which time they select a thesis mentor. Students are urged to discuss possible rotation projects with as many potential advisors as possible, before making their selections. (Students are prohibited from conducting rotations in laboratories where they have been previously employed. However, previous employment would not prevent the student from pursuing thesis work in such a laboratory.) Also, before deciding on a particular laboratory, the student should develop an outline of the proposed work with the faculty member. The Division Office provides students with a Rotation Form for this purpose. The form should be completed by the student with the rotation mentor's help and returned to the Division Office at the start of each rotation. A second part of the form is completed at the end of the rotation to provide the Steering Committee with an evaluation of the rotation experience.

The purpose of the rotations is to broaden the student's research experience and to expose the student to available opportunities before a thesis preceptor is selected. *It should be recognized by both student and rotation mentor that significant research accomplishment is not a requirement for a successful rotation, nor should the rotation be*

*prolonged significantly beyond the normal three-month period to meet particular research objectives. Students may choose to end a rotation at any time, should they find it desirable to move on to the next rotation.*

During the rotation, the student should take advantage of the one-on-one relationship with the faculty member to discuss science as it is carried out in the lab, and to evaluate together the approach to research. Students should explore these contacts carefully during rotations, mindful that selection of a good mentor who will provide the personal instruction required to master experimental science is the most important decision they will make in graduate school.

## **Teaching requirement**

Effective communication of information and concepts is a critical skill for biomedical research scientists. While much of the teaching that scientists engage in is through one-on-one interactions with individuals in the laboratory, all scientists must be able to deliver lectures to a wide audience (from peers in the field to neophytes with a limited understanding of the nuances of the topic), and scientists in faculty positions will often teach courses to undergraduate and graduate students. Therefore, DBBS students must demonstrate the ability to effectively communicate complex ideas and concepts to groups of individuals at various levels of understanding. To develop these critical communication skills, DBBS students will:

- Complete the TA orientation and three approved workshops offered by the Teaching Center by the end of the 2<sup>nd</sup> year of graduate studies
- Serve as a Teaching Assistant in a DBBS-approved graduate or undergraduate course for 1 or 2 semesters. The TA assignment will include giving lectures and/or leading lab sessions. The TA is usually completed in the 2<sup>nd</sup> year of graduate studies.
- Deliver a minimum of four oral presentations at journal clubs, seminars, scientific conferences, and retreats. Presentations given as part of a TA assignment, lab meetings or thesis committee meetings will not satisfy this requirement.

## **Qualifying examination**

The purpose of the qualifying examination is twofold. First, the examination will determine if the student has acquired sufficient knowledge and ability to think critically to qualify for candidacy. Second, the exam will provide the student with an opportunity to practice preparing a research proposal.

The exam will be conducted in 2 parts: 1) the defense of the grant proposal and 2) general knowledge based on the students course work they have taken in their first, second and third semester.

### **Format of the qualifying examination**

The qualifying examination consists of a written research proposal focused on a molecular biophysics project within a student's general area of interest but outside of their developing thesis project and related work investigated in the lab of their thesis mentor. The proposal should involve hypothesis-driven research; i.e., posing and testing specific questions about a scientific problem. The proposal shall be comprised of the following sections:

1. **Title Page (1 page):** Include your name, exam committee members, oral exam date and location.
2. **Specific Aims (1 page):** Clearly and succinctly articulate the hypothesis to be assessed, the particular experiments (aims) that will be undertaken to address the hypothesis, and the expected outcomes of these aims and their relationship to the hypothesis.
3. **Background and Significance (2-3 pages):** This section should clearly present the scientific significance of the problem chosen for investigation, provide the exam committee with sufficient material to understand the proposed hypothesis and aims, and present evidence that the hypothesis is reasonable and the proposed aims are feasible.
4. **Research Strategy (4-5 pages):** This section should provide details of the proposed aims, expected outcomes and their relationship to the hypothesis, and caveats and alternative approaches for testing the hypothesis.

**Please note:** The total page limit for items **3** and **4** combined should not exceed **7 pages**. All **Figures** and their legends and **Tables** should be embedded in the document and count towards the page limit.

5. **References (no page limit):** The proposal should be referenced with appropriate scientific citations. Use a format that lists authors as well as the titles of the papers, e.g. *Cell* format. In addition, 5 primary references should be annotated with a few sentence description of the critical relationship of the work to the proposed hypothesis or aims.
6. **Margin and Fonts:** Margins should not be LESS than one-half of an inch. Allowable fonts shall be no smaller than Times font size 12, or Georgia or Arial font size 11.

The proposal is accompanied by a 30 minute oral presentation to the examining committee. The presentation is followed by questions from the committee about the proposal and about basic concepts and fundamental knowledge relevant to the research proposal and the student's chosen area of study.

The proposal must focus on a topic that differs significantly from research in the student's thesis lab in relation to the following three aspects: 1) the system under study, 2) the major techniques used, and 3) the questions being addressed. Students can consult the Steering Committee to select a topic.

### **Preliminary Exam: Key Deadlines**

**PhD Student Deadlines** for topic submission and completion are as follows:  
October 1st – Specific Aims Due

October 15th – Specific Aims Approved  
November 19th – Full Proposal Due to Committee Chair  
Week of December 1st – Feedback given to Student from the Chair  
December/January – Exams are scheduled  
7 Days before the Oral exam – Revised Full Proposal Due

**MSTP Student Deadlines** for topic submission and completion are as follows:

June 30 – Specific Aims Due  
July 15th – Specific Aims Approved  
August 19th – Full Proposal Due to Committee Chair  
Week of September 1st – Feedback given to Student from the Chair  
October – Exams are scheduled  
7 Days before the Oral exam – Revised Full Proposal Due

The Steering Committee will appoint a qualifying examination committee composed of at least four Division members, based on the topic proposed and student nominations. Names of examiners nominated by the student should be submitted to the Steering Committee with the proposed topic(s). A student's thesis advisor will not be appointed to the examining committee. Two members of the Steering Committee will serve on the qualifying exam committee, one of whom will serve as chair.

During the week of December 1st the chair of the Committee will give the student critiques for the written document. The student is encouraged to communicate primarily with the chair for follow-up discussion as appropriate. The student is also free to solicit input from the thesis advisor or other faculty. The revised written proposal should be distributed to the entire qualifying examination committee no later than one week before the oral exam. No qualifying examinations shall meet unless all committee members are present.

Questions allowable during the examination include those directly related to the proposal, those that comprise background material leading to the proposal, and those that are judged to constitute appropriate general knowledge for a Computational and Molecular Biophysics student.

#### **Passing/failing the qualifying examination**

Once the proposal is distributed, the exam must be held and the examining committee must either pass or fail the student. The pass/fail decision for the qualifying exam will be a binary one based on a majority vote of the committee after the exam is complete. The chair will discuss the result of the exam to the student after the committee has deliberated. A passing grade may include a recommendation for remedial action but may not be contingent upon such action. A critique of the written and oral proposal will be given by the chair of the committee after completion of the exam.

For students who fail the qualifying exam, the chairperson will write a summary report to the student (copied to the Director of the Program) summarizing the deficiencies of the exam. If there are deficiencies in the proposal or in its defense of the proposal, these will be summarized.

The Steering Committee may recommend that a student retake the exam only once and the second examination must take place within two - three months of the date of the first examination before a new committee, consisting of the chair of the previous committee and three new members.



If there are deficiencies in the written proposal, the student will rewrite the proposal in order to remedy these deficiencies and submit to the committee within 2 weeks from receiving feedback. The original committee will review the revised proposal and determine if the student has passed the written portion.

If there are deficiencies in the oral part of the exam, the steering committee will determine if a new committee is needed or if the original committee can still serve on the retake exam. Based on the recommendations of the QE committee the steering committee will determine what parts of the oral exam the student will need to focus on for the retake.

If a student fails both parts of the exam, the second exam will be identical to the first exam in that the new committee will receive the written proposal to review before the meeting, the student will make a 30 minute summary of the proposal to the committee and the committee will ask questions related to both the defense of the proposal as well as general knowledge. The Steering Committee will decide whether a new proposal should be prepared or the original proposal used again and will give the second examining committee specific instructions on subject areas that should be emphasized in the questioning.

Students who are assigned a second failing grade on either or both parts of the exam will be dismissed from graduate school. If the student feels that the action of the Steering Committee has been incorrect due to a procedural flaw in the examination process, the student may submit a written petition to the Chair of the Programs and Student Affairs Committee.

## **Thesis committee and proposal**

### **Purpose of the thesis committee**

The purpose of the thesis committee is to advise the student in his or her thesis research and to provide the student with a readily accessible source of advice and constructive criticism during the dissertation research. To achieve these goals, it is imperative that thesis committees meet early in a student's term and that they meet with the student at least once a year to offer suggestions and ascertain progress. The thesis committee should actively monitor the student's progress toward completion of a thesis by no later than the end of the student's fifth year. A thesis committee's ultimate responsibility is to act in the student's best interest, by ensuring that the research undertaken will lead to an acceptable dissertation and a Ph.D. degree.

### **Constitution of the thesis committee**

Students choose their thesis committees upon completion of the Qualifying Exam. The thesis committee consists of four Divisional faculty members and the thesis preceptor. The University requires that the final dissertation defense committee be composed of five tenure-track faculty, including the thesis mentor. All members of the committee must be members of the Washington University faculty and must hold regular academic appointments in the University. At least three of the five members need to be affiliated with the student's program. The student and preceptor nominate these committee members subject to approval by the Program Director. The committee members are selected for their expertise in areas on which the research will touch, and for their willingness to contribute advice and meet at least once per year. The committee is chaired by a faculty member other than the thesis preceptor, and the chairperson should be designated in advance of the proposal, based on his or her willingness to be responsible for the committee's activities. The student and preceptor should view the committee

system as a source of objective criticism and expert advice. At the time of the thesis defense, the thesis committee serves as the defense committee. The addition of committee members or changes of committee composition should be made no later than six months before the defense date.

### **Thesis proposal**

*All students must propose their thesis within six months after passing the preliminary exam.* However, if a student feels a coherent proposal cannot be presented by that time, he or she may request permission from the Steering Committee to discuss informally the current project and likely future directions at the first meeting, as a Pre-Proposal meeting, and defer the formal proposal by no more than six months. A quorum of four members including the thesis advisor is needed for any pre-defense meeting. **A student must propose their thesis by the end of their fifth semester. If the proposal is not completed within six months of this deadline, the student will lose their good academic standing status and could be dismissed.**

The thesis proposal should include a statement of purpose and rationale for the project, an outline of the methods to be used and an assessment of their feasibility, a summary of the work performed to date, an idea of the potential outcome, and alternative plans for high risk portions of the project. Although these are all essential components of a proposal, it is not intended that the proposal be lengthy, and preliminary data, while desirable, need not be profuse or conclusive. A single-spaced proposal, with references, of five to ten pages is appropriate. This written document must be distributed to all committee members no later than one week prior to the meeting. The thesis proposal meeting provides a student with guidance in selecting appropriate research goals and is not a test that the student must pass or fail.

During the thesis proposal, emphasis should be given to the student's understanding of the research proposed and the likelihood that it will allow the student to produce a thesis in a timely manner. Toward this end, it is customary for the thesis advisor, although present, not to participate in the discussion except where specifically requested to do so by a thesis committee member. For both the proposal and for subsequent thesis committee meetings, the committee will meet briefly to prepare its recommendations with the student absent. On occasion, the committee may also choose to meet with the student with the thesis advisor absent.

### **Conflict of Interest**

Research funding from sources that have intellectual property interests in the research, or in which the PI has personal financial interest, may create a real or perceived conflict of interest, given the dual roles of the principal investigator in obtaining funding for the lab and as a mentor for graduate students. Issues of paramount importance are (i) the ability to publish results in a timely fashion; (ii) the ability to communicate research results openly, especially to members of the thesis committee; and (iii) academic rights to publish and speak freely, especially as related to a graduate student's thesis and defense.

#### *Statement of policy*

The following principles should apply to any situation involving a graduate student supported by funding that is associated with a confidentiality agreement:

- The limitations and nature of the confidentiality agreement must be fully disclosed to and approved by the student, the thesis committee, and the DBBS Associate Dean for Graduate Affairs;
- The confidentiality agreement must not place an unreasonable burden or delay in publication or reporting at scientific meetings;

- The confidentiality agreement must not delay the writing or defense of the thesis. The complete policy can be viewed at <http://www.dbbs.wustl.edu/curstudents/DBBSStudentPolicies/Pages/ConflictofInterestPolicy.aspx>.

### **Thesis committee meetings**

After the thesis proposal, thesis committees will meet with students no less than once a year. Scheduling of the meetings should be done by the student. The student must provide a written summary of progress and goals to the committee at least one week prior to the meeting. This document provides the platform for oral presentation of progress and problems and should include a time table of subsequent research. In the event that a student does not schedule timely meetings, the thesis committee chairperson will schedule thesis committee meetings. The thesis committee may choose to meet more often than once per year, if it finds more frequent meetings appropriate. After each meeting, the thesis committee chairperson will be responsible for ensuring that recommendations of the committee are communicated to the student.

## **Thesis defense**

The program is designed with the goal that students complete their thesis research and prepare, present, and defend a Ph.D. dissertation four to five years from the time they begin the program. The dissertation must be based upon an original investigation which results in a significant contribution to knowledge in molecular biophysics. Subject to approval of the thesis committee, the dissertation may include reprints of published work of which the student is the first author, but when published material is included, a prefatory introduction must describe the extent of the candidate's contribution to both the experimental work and the preparation of the manuscript. When published material constitutes a significant fraction of the dissertation, it is desirable that a separate Introduction which describes the background to the research and a Discussion which describes its significance be written for the dissertation itself.

In order to assure that the dissertation will meet with general approval of the thesis committee and to provide the required notice to the graduate school of the oral defense, the student will present an outline of the dissertation to the thesis committee six months before the defense date, and meet with the committee to discuss the outline and gain its approval. Once a date for the defense has been set, the Division Office should be notified promptly. The thesis committee must read and approve the dissertation prior to the oral defense. To allow adequate time for remedy of potential problems, a complete draft of the dissertation must be given to the thesis committee at least two weeks prior to the date of the defense. Unless otherwise requested by the student and advisor and agreed to by the thesis committee, the format of the defense will be a public seminar followed by a closed session with the entire thesis committee.

The thesis committee must read and approve the dissertation *prior to the oral defense*. To allow adequate time for remedy of potential problems, a *complete* draft of the dissertation must be given to the thesis committee *at least two weeks prior* to the date of the defense. Unless otherwise requested by the student and advisor and agreed to by the thesis committee, the format of the defense will be a public seminar followed by a closed session with the entire thesis committee.

## **Students' responsibility to meet program requirements**

Graduate students in the Program in Computational and Molecular Biophysics are responsible for completing the requirements of the program in a timely fashion. In particular, the requirements for courses, preliminary examinations, thesis proposals, and thesis committee meetings are important components of graduate training and should be regarded seriously. In the event that a student has trouble meeting any requirement, they should request consideration of their situation by the Steering Committee, which may agree to waive or delay the requirement.

## **Transfer to and from outside programs**

Students are free to transfer to the Program in Computational and Molecular Biophysics from any other program in the Division of Biology and Biomedical Sciences. Students who transfer will be expected to meet all of the normal requirements of the programs, although special exceptions may be granted in rare cases by the Steering Committee. Students also are free to transfer from the Program to an outside program, provided a qualifying examination committee has not recommended against the student continuing in the Ph.D. program and provided the student is in good academic standing, as defined by division guidelines. Transfer is accomplished most easily during the first year, but can be done at later times, if necessary.

## **MSTP students**

Students who join the Program in Computational and Molecular Biophysics from the Medical Scientist Training Program (MSTP) complete core courses, but MSTP students ordinarily do not take Molecular Cell Biology as it overlaps significantly with the courses in the M.D. curriculum. MSTP students generally meet all other requirements in the Program in Computational and Molecular Biophysics, except where requirements are waived by the Steering Committee. MSTP Students have earlier deadlines for the selection of a thesis mentor, the qualifying exam, and the thesis proposal.

## **Publications**

There is no specific requirement for publication to receive the Ph.D. However, high quality, peer-reviewed publications are an important determinant for a student's career. Similarly, the process of writing and submitting a manuscript and responding to reviewer critiques is an essential part of a student's training. Therefore, the publication record is one of several important and appropriate measures to be used by a thesis committee in evaluating a Ph.D. candidate. It is generally expected that students will have submitted and/or published one or more first author manuscripts in peer-reviewed journals at the time of the defense.

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