



Washington

WASHINGTON · UNIVERSITY · IN · ST · LOUIS

Biology & Biomedical Sciences

ACADEMIC PROGRAM GUIDELINES

**Program in
Biochemistry**

Biochemistry Ph.D. Program at Washington University in St. Louis

Program Director:

Dr. John Cooper

office: 416 McDonnell Medical Sciences Building

phone: 314-362-3964

email: jcooper@cellbiology.wustl.edu

Graduate Student Coordinator:

Ms. Melissa Torres

office: 534 Medical Library/phone: 314-362-3364

email: torresm@dbbs.wustl.edu

Biochemistry Steering Committee:

Peter Burgers	362-3872	burgers@biochem.wustl.edu
Peter Chivers	362-1496	chivers@biochem.wustl.edu
Tom Ellenberger	747-8893	tome@biochem.wustl.edu
Bill Frazier	362-3348	frazier@wustl.edu
Kathleen Hall	362-4196	kathleenhal@gmail.com
Joe Jez	935-3376	jjez@danforthcenter.org
John Majors	362-1135	majors@biochem.wustl.edu
Helen Piwnica-Worms	362-6812	hpiwnica@cellbiology.wustl.edu

Web Site: <http://www.biochem.wustl.edu/>

Overview

Washington University has a century-long tradition of excellence in biochemistry research and education. A number of faculty, students and fellows associated with the university have been awarded the Nobel Prizes for research in biochemistry and closely related fields. These include Edward Doisy (1943), Carl and Gerty Cori (1948), Arthur Kornberg (1959), Severo Ochoa (1959), Alfred Hershey (1969), Earl Sutherland (1971), Daniel Nathans (1978), Paul Berg (1980) and Edwin Krebs (1992). Currently, the School of Medicine ranks third in the nation in the amount of research funding received from the National Institutes of Health. Washington University pioneered inter-departmental graduate education by establishing the Division of Biology and Biomedical Sciences in 1973. The Biochemistry Ph.D. Program now involves 67 faculty members from 14 departments in the School of Medicine and the School of Arts and Sciences.

Research in biochemistry utilizes the concepts and approaches of chemistry to understand the molecular basis of biological processes. Fundamental chemical principles and techniques are used to understand the stability and specificity of macromolecular interactions as well as their mechanisms of

Biochemistry Ph.D. Program Guidelines

action in processes such as DNA replication, signal transduction and gene regulation. The complexity of the biology makes the application of chemical principles challenging for the biochemist. The focus of much biochemical research is on the molecular description of biological processes. Receptor-ligand interactions, macromolecular stability and assembly, enzyme catalysis and ion channel activity are of particular interest, since these are central to the function and regulation of biological systems. Studies of the kinetics and energetics of molecular interactions and the structure and dynamics of the macromolecules involved provide the main experimental avenues to obtain a molecular description of biological processes.

The main goal of the Biochemistry Ph.D. Program is to equip students with the knowledge and skills required to be an effective research scientist, including (i) the ability to propose, discuss and critically evaluate ideas, (ii) the mastery of fundamental information and concepts in biochemistry and closely allied fields, (iii) the ability to conceive hypotheses and design experiments to test these hypotheses, (iv) the technical skill to conduct and analyze experiments, and (v) the ability to communicate scientific findings in an effective manner, both in written and oral form.

Graduate training is formally divided into two stages: pre-candidacy and candidacy. Students usually complete the requirements for candidacy by the end of the second year (or first graduate year for MSTP students). The requirements for candidacy include coursework, 3 laboratory rotations, a one-semester teaching assistantship, and the preliminary exam. Once the student becomes a candidate for the Ph.D. degree, training consists of directed thesis research under a mentor of the student's choosing with guidance from a thesis committee. Students are encouraged to complete and defend their Ph.D. dissertations by the end of the fifth year.

Course Requirements

Chemistry and Physics of Biological Molecules (BIO 5357)
Biochemistry Student Seminar (Bio 5466)
Advanced elective (from approved course list)
Journal clubs (3 credits)
Ethics and Research Science (Bio 5011)

2 courses from the following:

Organic Chemistry III (Chem 451)
Bioorganic Chemistry (Chem 453)
Nucleic Acids and Protein Synthesis (Bio 548)
Molecular Cell Biology (Bio 5068)
Immunology (Bio 5051)
Macromolecular Interactions (Bio 5312)
Cellular Neurobiology (Bio 5571)

For the first semester of the first year, Biochemistry students take two courses plus a laboratory research rotation.

The advanced elective can be any 400 level or above course offered through Arts & Sciences upon consultation with the Biochemistry Steering Committee at advising.

Biochemistry Ph.D. Program Guidelines

Because of overlap with the medical school curriculum, MSTP students in the Biochemistry Program may take Bio 5357 or 5068 during the first medical school year in place of Molecular Foundations of Medicine. This option reduces the number of graduate courses that MSTP students take during the first graduate school year.

During the course of graduate studies, students take five credits of special topics courses, tutorials, or journal clubs. Two of these credits will be earned in the Graduate Student Seminar course. The purpose of this requirement is three-fold: (i) to provide close student-faculty interactions in a format that is less didactic than standard courses; (ii) to allow students to study current research topics in greater 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 involves coaching in oral presentation.

For journal clubs, a student will receive one credit for regular participation and for giving one presentation. A journal club must be on the University Course Listings.

A grade of B- or better in each course, with an overall GPA of at least 3.0, is one of the requirements to achieve candidacy, and a GPA of 3.0 must be maintained in order to remain in good academic standing.

Advising

Timely and good advice can be very important to graduate students. Students in the Biochemistry Program 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.

Faculty Advisors: The Biochemistry Steering Committee advises students until the thesis proposal is approved. Each student will meet with members of the committee just prior to the beginning of each semester to discuss options and to register for courses. To register, drop or add courses, students must obtain the signature of a steering committee member. In addition, each student is assigned an individual faculty advisor. The advisor is available to help students plan laboratory rotations and select courses. Once a student has completed a thesis proposal, the thesis committee assumes responsibility for advising. However, students may continue to consult with their previous advisors as they see fit.

Student Mentors: The upper-level students may act as mentor and serve as a first source for answers to many questions but also may encourage the student to meet with a faculty advisor when appropriate.

Laboratory Research Rotations

At the beginning of the first semester, students plan laboratory rotations with the help of their advisors. In general, students complete three laboratory rotations, each typically three months long, by the end of their first year in the program. At that time, they select a thesis mentor and join that laboratory for the duration of their graduate training. Students are urged to discuss possible rotation projects with their advisors 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.) The student should develop an outline of the proposed work with the faculty member. The Division Office provides students with a

Biochemistry Ph.D. Program Guidelines

Rotation Form for this purpose. The form should be completed by the student with the rotation mentor's help and returned to the Coordinator 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 laboratory rotations is to broaden the student's research experience and to expose them 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-to-four month period to meet particular research objectives.* Students may choose to end a rotation early if necessary or desirable, but only after discussion with the rotation mentor and faculty advisor.

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

Development of teaching skills is an important component of graduate training. Each student in the Biochemistry Program participates in a formal graduate or undergraduate course as a Teaching Assistant for one semester. Every effort is made to assign students to courses which are appropriate to their backgrounds and interests and to ensure that students receive significant first-hand experience of teaching in a formal classroom setting. Normally, teaching is done during the first or second semester of the second year in graduate school.

Preliminary Examination

The main purpose for the preliminary examination is to determine if the student has mastered basic knowledge and concepts and has acquired critical thinking skills in order to qualify for candidacy. Second, the exam will provide the student with experience in preparing a research proposal and defending it before a committee. The knowledge and skills measured by this exam are critically important for a successful career in academia, industry or government. Therefore, the preliminary exam has an important role in the training of a Ph.D. scientist, and the exercise of preparing for this exam benefits the student in a unique way.

There are two exams, one written and one oral. The written exam is on coursework, and students take it after their first year. The oral exam is based on an original research proposal, and is taken by the end of the second year.

For Biochemistry students, the only course that everyone is required to take is the Chemistry and Physics of Biological Molecules. The content of that course will be the basis of the written exam, but several chapters of the Berg "Biochemistry" will be assigned as well, to complement the course material. **This exam will be taken in May of the first year.** The exam is pass/fail. If required, a second exam will be taken a month later.

Biochemistry Ph.D. Program Guidelines

The second part of the exam is based on an original research proposal. The proposal will consist of (i) a written research proposal within a student's general area of interest; the proposal follows the guidelines for a postdoctoral fellowship application to the NIH (15-page limit, type no smaller than 12 point), (ii) a 30-minute oral presentation of the proposal to an examining committee, and (iii) questions from the committee regarding the proposal and its basic underpinnings.

The proposal must focus on a topic that differs significantly from research in the student's thesis lab with respect to the system under study, the major techniques used and the questions being addressed. Students can consult members of the Steering Committee in selecting a topic. A one-page description of the proposed topic must be submitted to the Student Coordinator **no later than February 1 of the second year (May 31 of first graduate year for MSTP)** and must include a bibliography with titles. Ph.D. students must **complete the qualifying exam by June 1 of the second year (August 31 for MSTP)**. The Student Coordinator will send your topic to the Steering Committee for approval.

The Steering Committee will appoint a preliminary 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 with the proposed topic(s) by February 1 of the second year. A form for this is available from the Student Coordinator. A student's thesis advisor will not be appointed to the examining committee.

Each student will work with a member of the Steering Committee on the context and form of the proposal. That faculty member will chair the examination. Members of the oral exam committee will include one other Steering Committee member, as well as two outside faculty, selected based on the subject matter of the proposal. The student is also free to solicit input from the thesis advisor or other faculty, excluding the 3 other members of the exam committee. The written examination should be distributed to the examination committee no later than one week before the oral exam. No preliminary examinations shall meet unless all committee members are present.

Preliminary Exam: Key Deadlines

	<u>Ph.D. students</u>	<u>MSTP students</u>
Submit one-page abstract and form to Coordinator	February 1 of second year	May 31 of first graduate year
Oral examination	by June 1 of second year	by September 1 of second year

Questions during the examination will include those directly related to the proposal and those that comprise background material leading to the proposal.

Once the exam is complete, the examining committee must make a binary decision of either pass or fail. A constructive critique of the written proposal will be provided 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 Program Director) summarizing the deficiencies of the exam. The Steering Committee

Biochemistry Ph.D. Program Guidelines

may recommend that a student retake the exam only once and the second examination must take place within three months of the date of the first examination. The new committee will consist of the chair of the previous committee and three new members. 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. If there are deficiencies in the proposal, the student may be asked to rewrite the proposal in order to remedy these deficiencies. The second exam will be identical in form 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 the defense of the proposal.

If a student fails the exam twice, any decision to dismiss the student or take other action will be made by the Biochemistry Steering Committee. The examining committee will restrict its deliberation and decision to the narrow issue of whether or not the student passes the examination in question.

Thesis Committee and Thesis Proposal

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 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.

Students should choose their thesis committees by the beginning of their third year (August/September). The thesis committee consists of five Division faculty members and the thesis mentor. The University requires that the final dissertation defense committee be composed of six tenured and/or research or tenure-track faculty. All members of the committee must be members of the Washington University faculty and must hold regular academic appointments in the University. The student and preceptor nominate these committee members subject to approval by the Program Director. The committee members are selected for their expertise in relevant research areas 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 mentor, 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.

*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 and defer the formal proposal by no more than six months. **A student must propose their thesis by the end of the 5th semester. If the proposal is not complete within 6***

Biochemistry Ph.D. Program Guidelines

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. One week prior to these meetings, the student must provide a written document to the committee outlining progress and future direction. A single-spaced proposal, with references, of five-to-ten pages is appropriate. The thesis proposal meeting provides a student with guidance in selecting appropriate research goals. It 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 proposed research 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.

After the proposal has been approved, thesis committees will meet with students no less than once a year. Scheduling of the meetings should be done by the student, who will also submit a written progress summary to the committee members no later than one week prior to the meeting. In the event that a student does not schedule timely meetings, the thesis committee chairperson will schedule the 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 and the Division Office.

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;

Biochemistry Ph.D. Program Guidelines

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 Conflict of Interest policy can be viewed at:

<http://www.dbbs.wustl.edu/dbbs/website.nsf/WV/D47E84300A563248862575BE006C522C?OpenDocument>

The Ph.D. Dissertation and Thesis Defense

The Biochemistry 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. For MSTP students, the time line for the graduate component is approximately one-to-two year less because of the partially interleaved curriculum. The dissertation must be based upon an original investigation which results in a significant contribution to knowledge in the field of biochemistry. Subject to approval of the thesis committee, the dissertation may include reprints of published work of which the student is the first author. When published material is included, an introductory statement 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 separate introduction (background) and discussion (significance) chapters be contributed by the student.

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 the dissertation *prior* to the oral defense. To allow adequate time for this and to remedy 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 Biochemistry Program are responsible for completing requirements 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 postpone or waive the requirement.

Transfer From and To Outside Programs

Students are free to transfer to the Biochemistry Program from any other program in the Division of Biology and Biomedical Sciences. Students who transfer will be expected to meet all of the normal

Biochemistry Ph.D. Program Guidelines

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 Biochemistry Program to an outside program. *A transfer to a different program can be made only if 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. Any student considering a program transfer should consult with the directors of the programs involved.

MSTP Students

Students who join the Biochemistry Program through the Medical Scientist Training Program complete the same requirements as Ph.D. students. However, every effort is made to eliminate redundancies in the curriculum and to streamline the program where possible. For example, Bio 5325 or 5068 can be substituted for Molecular Foundations of Medicine in the first year medical curriculum and taken at that time. Therefore, the first graduate year for MSTP students would normally consist of two courses in the fall and two in the spring. The prelim exam would then be completed by the end of the summer. The program is designed so that the graduate requirements (except thesis research and possibly special topics/journal clubs) can be completed by the end of the first full graduate year.

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.

Updated 2/2009