

# CALIFORNIA INSTITUTE OF TECHNOLOGY



## ***GRADUATE STUDENT INFORMATION***

**2011**

***Graduate Option in  
BIOCHEMISTRY & MOLECULAR BIOPHYSICS***

**DIVISIONS OF BIOLOGY & CHEMISTRY**

# INFORMATION FOR GRADUATE STUDENTS IN THE BIOCHEMISTRY & MOLECULAR BIOPHYSICS OPTION (BMB)

revised September 13, 2011

## Introduction

This short handbook is a compilation of information about various aspects of the graduate program for the Ph.D. in Biochemistry & Molecular Biophysics (BMB) at Caltech, providing more detail than the *Institute Catalog*. It is intended as a reference source that can be used whenever questions arise about policies and practices relevant to the program.

## Administration of the Graduate Program

The following persons share responsibility for administering the BMB Option:

- Doug Rees is Executive Officer for the BMB Option, and his duties in that position involve general oversight of our program.
- Rob Phillips is the BMB Option Representative. The Option Representative is the person who the Dean of Graduate Studies considers to be responsible for the BMB option, and who is therefore authorized to sign petitions, candidacy forms, etc. The Option Representative is also responsible for planning the financial support arrangements for each student, and is the person to seek out if you have unusual problems that are not resolved through discussions with your advisor, advisory committee, or other colleagues.
- The Admissions Committee for the BMB Option consists of Doug Rees, Rob Phillips, Bil Clemons, André Hoelz, Dianne Newman and Shu-ou Shan. Responsibilities include organizing student recruitment and coordinating the admissions processes.
- Alison Ross coordinates the administrative aspects of the BMB Option. Duties include details of financial support including payroll, admissions, publications, website maintenance, and records for BMB graduate students.
- Paul Sternberg is Program Director for our NIH training grant in Cellular and Molecular Biology. He is responsible for monitoring the progress of students who are receiving support from this grant, to ensure that they are making normal progress towards completion of the Ph.D.

Ultimate responsibility for your education rests with the Chairs of the Divisions of Biology and Chemistry, Stephen Mayo and Jacqueline Barton, and with the Dean of Graduate Students, Joseph Shepherd. You should consider them to be available as resources if you need help beyond that provided by the others involved in the graduate program.

Together, these individuals advise the Option Representative on policies for the graduate program in Biochemistry and Molecular Biophysics (BMB).

## **Administrative Policies Related to Requirements for the Ph.D. Degree**

### *Advisory Committees*

Upon arrival, incoming students meet with the Option Representative and Option Coordinator, who will assist the student in organizing rotations through several laboratories, and will also look at a student's past record and decide what additional course work is desirable. Both will counsel and oversee the student's progress upon admission to the graduate program.

### *Required Courses*

BMB students are required to complete six advanced courses (100 level or higher, at least 9 units each). In the first year of graduate study, the course requirement consists of a sequence of three core courses covering topics in macromolecules and molecular assemblies: structural principles (**BMB/Bi/Ch 170a**), biophysical methods (**BMB/Bi/Ch 170b**), and case studies (**BMB/Bi/Ch 170c**). These courses will expose the student to contemporary issues in biochemistry and molecular biophysics, and to the tools and methods that are essential for research in this area. In consultation with their adviser, students are expected to take three additional advanced courses in the first and second years. The course program should reflect a balance between the students' need for a broad scientific foundation and the requirements for greater depth of understanding in the specific area of research. Bi250a (Topics in Molecular and Cellular Biology) is required to become eligible for the Cell and Molecular Biology Training Grant.

All courses used to satisfy the course requirement must be passed with a grade of B or higher, and must be taken for grades unless the course is only offered pass/fail. The course requirement must be completed before a student can be admitted to candidacy.

### *GPA*

Students must maintain a GPA of 3.0 at all times. In the event that a student's GPA falls below a 3.0, they will be placed on academic probation. Admittance to Candidacy requires a GPA of 3.0 or higher.

### *Rotations*

In consultation with the Option Representative and individual professors, students will choose three laboratories in which to do short (10-12 week) research projects during their first year of residence. These laboratory rotations are designed to provide the student with an introduction to different areas of biochemistry. Research

advisors are normally selected at the end of the first year. It is possible to waive some or all of the rotations by petitioning the Option Graduate Study Committee.

#### *Qualifying Examination and Admission to Candidacy*

By the end of the sixth term of residency (spring term of the second year), the student will take an oral examination to assess mastery of the field of biochemistry and to evaluate research progress. Students will receive a Candidacy package with the exam forms and instructions from the Option Coordinator. All forms must be returned to the Option Coordinator at least two weeks prior to the exam.

The student is responsible for finding a date, time, and location for the exam. A Candidacy Examination Committee will be assembled by the student in consultation with his/her thesis advisor. The committee should consist of the student's thesis advisor and three or four BMB faculty members (faculty outside of the BMB option may also be members of the committee), and is chaired by a faculty member other than the student's advisor.

As part of this examination, each student will submit:

- A written research report summarizing the progress in their research. Please plan a presentation length of approximately 20 minutes.
- An original research proposition in a field *outside* the student's chosen field of research. The committee chair should be contacted early in the Winter term to discuss the idea for the outside proposal in order to insure that the topic itself is acceptable. An oral presentation is not required.

At the time of the proposal defense, the candidacy exam form will be completed by the Exam Committee indicating whether or not the student had demonstrated the capacity to do research. This evaluation will include, but will not be restricted to, consideration of the following:

- The motivation to think about complex problems, and devise creative approaches to solving them
- The motivation to find out what is going wrong with experiments when they don't work and to fix them
- Patience
- Perseverance in the face of difficulty and frustration
- The motivation to work hard
- A commitment to science as a high priority in life
- The capacity to become *engaged* in a problem
- The capacity to identify the most important aspect of a problem and the discipline to maintain experimental focus on the issue

Guidelines for the evaluation of such proposals are attached (See Attachment #1).

When the student advances to candidacy upon successful completion of the exam, the Exam Committee will become the Thesis Advisory Committee and will meet with the student once a year to evaluate research progress. This committee will also serve as the Ph.D. Thesis Examination Committee.

In the event that there is inadequate evidence for the capacity to do research, the student may petition to allow postponement of admission to candidacy, for a period of up to six months (until December of the third year of study). Both the Thesis Advisory Committee and the Option Representative must approve the petition. If there is a disagreement between the student and major professor (thesis advisor), the student may elect to switch to a different laboratory for the remaining six-month period to demonstrate the capacity to do research. Additional postponements beyond the end of the third year of study in the BMB Option would not be allowed except in extraordinary extenuating circumstances such as extended medical leave (i.e., the student must either be admitted to candidacy or asked to leave graduate school).

#### *Thesis Advisory Committee meetings*

All graduate students in the BMB Option are required to hold yearly meetings with their thesis committee. These meetings are to be held by 15 June of each year. If a meeting is not held in any given year, the student will be prevented from registering for the subsequent fall term. Compliance with this policy will be monitored by submission of a form that contains the signatures of the thesis committee members present at each meeting, and submitting the completed document to the Option Coordinator. Exceptions to this policy, which can be granted only by the Option Representative, will be granted only in extraordinary circumstances.

#### *Meeting requirements*

For students who have passed their candidacy exam, the purpose of the annual thesis committee meeting is for students to get feedback on their experiments and future plans, so students should plan their presentation accordingly. Students should spend only a few minutes on background (1-2 slides), then present experimental results. Show as much data as possible, especially for experiments that are not working, because your committee members may have helpful suggestions. Bring relevant notebooks to the meeting and be prepared to show data that has not yet been made into slides. If you have published a paper in the last year, please forward it to your committee members before the meeting, however, do not spend a lot of time summarizing it. This meeting's purpose is to get feedback on your current experiments and your planned experiments, not to discuss experiments that have already worked. Please plan on presentation lengths of approximately 30 minutes (or not more than 20 slides).

#### *Meeting format*

- At the beginning of the meeting, you will be asked to leave the room briefly while your thesis advisor and committee members discuss your progress.

- You will then give your presentation (plan an ~20 minute presentation, with allow ample time for questions), after which you will leave the room again.
- After you return, the chair of your committee will summarize any recommendations the committee members have for your thesis work.

### *Progress towards your degree*

A graduate student who is making "normal progress" towards a Ph.D. degree can expect to continue as a registered student with full financial support. Normal progress should result in final selection of a laboratory in which to carry on your thesis research before the end of your first year in residence, passage of the qualifying examination in May of your second year, and completion of your Ph.D. within five years. However, we recognize that performing high-quality research is difficult, and that exceptions to these desired norms are sometimes necessary. In particular, extension of study beyond the fifth year is becoming increasingly common. Although your research should be planned for completion within five years, extension into the sixth year may be necessary if there are unexpected setbacks or delays in the research. Extension of graduate study beyond that necessary to complete a respectable Ph.D. thesis—simply to allow a student whose work has gone well to accumulate more publications—is not encouraged.

Institute regulations (as stated in the [Institute Catalog](#)) require that you petition the Dean of Graduate Study for permission to enroll in your sixth year or beyond or if you have not been admitted to candidacy after three years. These petitions require the approval of the Option Representative for BMB, which will be given only if there is a positive recommendation from your Thesis Advisor. Petitions to extend registration for both Ph.D. and Candidacy are located [here](#).

A faculty member who is supervising graduate students is expected to be informed about the progress being made by each of his/her students. In any case where a faculty member believes that a student is making less than normal progress, it is that faculty member's responsibility to communicate that opinion to the student, and to the Option Representative. Most faculty members will also want to commend their students when things are going well and reassure them when progress is slow, but within the normal range, etc.

One of the important functions of our system of initial Advisory Committees and Thesis Advisory Committees is to provide an opportunity for a wider evaluation of a student's work in any case where a student feels that his/her supervising faculty member's judgment of less than normal progress is unfair or incorrect. However, this system can only work if the supervising faculty member behaves responsibly in communicating concerns to the student, and if the student takes the initiative to involve the Advisory Committee, either by discussions with individual committee members or by meeting as a group. A more formal operation of this system occurs at the time of admission to candidacy for the Ph.D. degree and at the time of the final Ph.D. examination. However, the system is intended to function to prevent any surprises at these meetings.

A student may at any time apply to the Graduate Office to obtain an MS degree in addition to the Ph.D. program. This might be advisable in any case where even the slightest question arises about a student's ability to carry on research to obtain a Ph.D. degree. The requirements for the MS degree in Biochemistry and Molecular Biophysics are successful completion of the three core courses and three optional courses (a minimum of 135 units; all of which are from 100+ numbered courses) and a GPA of at least 3.0. For more information, contact the Graduate Office.

In a more positive vein, it needs to be emphasized that the primary function of the Thesis Advisory Committee is constructive guidance toward the timely completion of the Ph.D. program, to supplement the guidance provided by a student's faculty supervisor. For this purpose, you should meet with your Thesis Advisory Committee sometime during your fourth year for an interim review of your progress.

During your fifth year, there should ideally be a meeting with the Thesis Advisory Committee at approximately the time that the experimental work for the thesis is completed and you are ready to actually write the thesis. This is an especially important meeting, at which the committee members should satisfy themselves that the research results, when presented in detail, are likely to produce an acceptable thesis. The plan for the organization of the written thesis should also be approved. If the end of the fifth year is approaching, and it appears likely that continuation of study and research beyond the fifth year will be necessary, the meeting with the Thesis Advisory Committee must result in the preparation of a specific plan, approved by the committee, outlining what needs to be done to complete the thesis and when it should be expected to be done. This plan must be submitted to the Option Representative along with the [petition form](#) requesting permission to register beyond the fifth year.

In any cases where extension beyond the sixth year is anticipated, each request for extension must again be based on approval by the Thesis Advisory Committee for a specific plan for completion of the Ph.D. In these cases, the committee should also consider whether financial support for the student should be continued, and make a recommendation to the Option Representative.

Students can request meetings with their Thesis Advisory Committee at other times, if particular problems arise. In addition, the student's faculty supervisor, or the Option Representative, can request that meetings be held if there are indications that more frequent monitoring would be valuable. This might include students who perform passably but not strongly on the qualifying examination, students who have been on leave of absence, and/or students whose work is erratic, perhaps indicating personal or motivational problems. However, such problems should be identified and resolved before admission to candidacy. The student's faculty advisor during the years before admission to candidacy has a particular responsibility to alert the student to any such problems at the earliest possible stage.

### *Completing the Ph.D.*

Requirements for the Ph.D. thesis and examination are determined by the Ph.D. examination committee that is appointed by the Dean of Graduate Study for each degree candidate. This committee is usually the same as the Thesis Advisory Committee, but this is not essential. The composition of the committee must be approved by the Option Representative. The committee usually has at least four members who are Institute faculty.

### The Ph.D. Thesis

The thesis is expected to demonstrate that the student has learned how to conceive, plan, and execute experimental and/or theoretical work that reveals new biological information and is comprised of a coherent body of novel scientific work. In addition, it must reveal a deep, broad, and rigorous understanding of the area of research to which the thesis is relevant. Development of new methods may be a major part of the work, but the successful use of these methods to attack important biochemical problems must also be accomplished.

The thesis is normally expected to contain work that should and will be published in appropriate research journals. However, there is no absolute rule requiring publication, and in rare cases a thesis committee may accept work that probably will not be published. An example of such a case would be that of a student whose work is "scooped" by progress in another laboratory, but where the work would otherwise be considered to constitute a solid thesis demonstrating the student's ability to carry out research.

The recommended format for a thesis is to have individual chapters written up in a form consistent with standard practice for publication of research papers. These chapters may be photocopies or typescripts of papers that have already been published or prepared for publication. Supplementary materials may be added as appendices to these chapters, or may be written as additional chapters, as appropriate. However, the option of writing the thesis as an independent document is also available to the student with the approval of the thesis committee. Detailed instructions on thesis preparation and the required forms are available from the [Graduate Office](#) and the [Caltech Library](#).

Regardless of the format chosen, the thesis must demonstrate the degree of knowledge of relevant work in the research field that is needed to place the research results in their proper context. This is normally accomplished by a scholarly introduction that reviews the research field more broadly than is appropriate for the introduction to a research paper, and by a concluding discussion chapter that assesses the results in relation to other past, present, and future work in the field.

In cases where all or part of the work submitted for the thesis has been carried out in collaboration with others, the thesis must contain explanatory notes detailing the individual contributions of the student and the student's collaborators. In cases where some of a student's work forms a minor part of collaborative work, publications

resulting from that work may be added to the thesis as appendices, or the student's contributions may be written up separately for inclusion in chapters of the thesis. However, the thesis is expected to be a thesis, with a unifying theme or themes, and not just an aggregation of unrelated pieces of research.

### The Final Ph.D. Examination

All Ph.D. candidates must present their work in a thesis seminar. As a matter of policy, a closed examination of the candidate by the thesis committee will be held immediately following the thesis seminar.

*Please note:* At the time of submission for approval to the Option Representative, a hard copy of the written thesis must accompany the *Petition for PhD Examination*. No exceptions will be made.

The purposes of the final Ph.D. examination are:

- (1) To expose any residual weaknesses in the thesis and arrange for thesis corrections. In the Biochemistry and Molecular Biophysics Option, we expect that students will meet with and discuss their work with members of their Thesis Advisory Committee throughout the years before the final examination, and that this process will eliminate any serious concerns that the members of the Ph.D. examination committee might have with the thesis research.
- (2) To allow the committee members to certify that the work constituting the thesis is quantitatively sufficient for the Ph.D. degree. Again, the basis for this determination will probably have been established by earlier discussions between the candidate and the members of the committee. It is difficult to specify universally useful standards for the quantity of work required for the Ph.D. However, it would probably be generally agreed that work that would not be sufficient for at least one substantial paper in a major research journal is not sufficient for a thesis.
- (3) To provide the committee members with an opportunity to satisfy themselves that the work presented in the thesis is actually the work of the candidate.
- (4) To assess, through oral examination following the thesis seminar, the breadth and depth of knowledge of the candidate relating to his/her field of interest.

The examination is considered to be passed when four or more members of the committee approve the thesis and the candidate's performance in the examination.

## Other Policies, Resources, and Activities

There are both regular and irregular seminar series. Some of the regular seminars include,

Mondays at 4:00 pm, The Biophysics Lecture Series (BLS) and Bioengineering (BE) Seminars are held on Mondays in the Beckman Auditorium. Molecular, Cellular, and Developmental Biology seminars, and Inorganic Electrochemistry seminars are also held on Mondays.

Tuesdays at 4:00 pm, General Biology seminars, Student's Biology seminars (organized by graduate students), and Chemical Physics seminars (147 Noyes).

Wednesdays at 4:00 pm, Neurobiology seminars (24 Beckman) and Organic Chemistry seminars (147 Noyes).

Thursdays at 4:00 pm, Biochemistry seminars (147 Noyes).

Biology seminars are announced via "Biomail." To receive Biomail notices, you may sign up [here](#). Chemistry seminar announcements appear in the [Caltech Today Calendar](#), where personalized e-mail alerts may be established.

"BioLunch" (Bi251a,b,c) is a weekly seminar in Molecular, Cellular, and Developmental Biology, Immunology and Biochemistry. On Wednesday of each week, speakers from two laboratories discuss their research, either in their present lab, or for newly arrived postdocs, their thesis research. BioLunch is held at noon in Beckman Behavioral Biology, room 24. Participation in BioLunch is required of all students supported by the NIH Training Grant. In addition, all BMB and BI graduate students will be scheduled to speak at BioLunch during their second and fourth years. All notices regarding BioLunch are sent via Biomail.

Structural Biology joint group meetings are held on the final Wednesday of each month at 4 pm in 101 Schlinger and consist of one presentation by a member of a group interested in structural biology.

Micro Mornings are held the second Thursday of each month from 9:30 - 10:30 am in 101 Kerckhoff and feature two presentations from members of labs interested in microbiology.

"Neurolunch" is held the first Tuesday of each month during the school year in 24 BBB and features presentations by students and postdocs.

"New Student Orientation Seminars" are presentations by the faculty to the new graduate students in chemistry, biology and biochemistry. The Graduate Office in the Chemistry and Biology Divisions organize these seminars. In addition, the Biology Division has an annual weekend seminar retreat usually held in October. For more information, contact the Biology Division office.

### *Teaching*

Graduate teaching assistantships (GTAs) provide useful assistance in our instructional program, provide a significant source of funding for graduate students, and often provide valuable teaching experience. All students are expected to serve as GTAs for one quarter a year through their fourth year of residence. If you are finishing your Ph.D. before the end of your fourth year, we will adjust this requirement to make certain that teaching during your final year does not delay completion of your Ph.D. Please discuss this with the Option Representative when the situation arises.

Most incoming students will be assigned a GTA position in one of our introductory courses—Bi 1, Bi 8, Bi 10, Bi 12 or Ch 1, Ch 3, Ch 4—and will be expected to repeat this assignment during their second year. After that, the assignment to a particular course is usually based on its relevance to a student's major. These assignments are made by the Option Representative, usually during the summer, and if you have preferences for a GTA assignment to a particular course, you should indicate your preference to the Option Representative in June, or earlier.

### *Stipend checks*

Although we have a standard stipend level for all students, the sources of support vary from Training Grants and other fellowships, to GTA and GRA funds. All checks are issued at the end of the month.

### *Additional Financial Aid Assistance*

*Special needs allowances* to help defray dependent health care costs are available to students. To apply for a reimbursement, contact the Graduate Office for an application. Reimbursements are paid through Payroll on the next pay period following submission.

*Student Emergency Funds* are available to students who are faced with an emergency hardship that affects their ability to continue their studies. Examples of qualifying needs include but are not limited to:

- medical or dental bills not covered by insurance
- travel to a funeral or to attend to an important family matter
- loss from theft or fire
- loss of income or housing
- recovery from illness or accident

A student seeking a grant from the Student Emergency Fund to deal with an emergency hardship should write to the Dean of Graduate Studies to explain the situation and justify the amount sought.

*Conference Travel Funds* are available through the Graduate Office to students who qualify. Requirements include advisor support and satisfactory academic standing.

The *Child Care Assistance Program* (CCAP) is available to students to help defray childcare costs. Awards are available to students with dependent children ages 10 and under. Please visit the [CCAP website](#) for information and application materials.

### *Health Services and Insurance*

Up-to-date information about Caltech health services and insurance, including the [Student Health Center](#) and [Student Counseling Center](#), is available through the [Graduate Office](#). Any questions concerning a [Medical Leave](#) should be referred to the Graduate Office.

### *Vacations*

The Institute policy is that graduate students are “entitled to two weeks” annual vacation (in addition to Institute holidays). Graduate students are expected to coordinate their vacation plans with their research advisors sufficiently far ahead of time to avoid conflicts at the last minute. In addition to the regularly scheduled Holidays, graduate students are also entitled to take time off during the Special Release days during the winter break. Students who are asked to work during this time are entitled to take an equal number of days off in the winter term, to be arranged in consultation with their research advisors.

### *Acknowledgments*

Please remember to acknowledge the source of your financial support on all of your publications resulting from work during your graduate program. For NIH trainees, the suggested format is “*This work was supported in part by a National Research Service Award (T32GM07616) from the National Institute of General Medical Sciences.*” (GM07616 is our Cellular and Molecular Biology training grant.) Contact the BMB Option coordinator if you do not have information pertaining to your funding source.

### *Biology and Chemistry Shop Facilities*

The biology student shop in room 327 Beckman Behavioral has basic machine tools and electronics equipment and is intended for fabrication and minor repairs of specialized devices used in individual research projects. It supplements the Divisional Electronics, Machine, and Equipment Repair Shops, in which the staff will do work for researchers. To use the student shop, check with Mike Walsh (237 BBB, ext. 6825). The chemistry student shop is located in the sub-basement of Church (room 09). Contact Mike Roy at x6057 to use the student shop, which is available for students during the week from 8:00 am -12:00 pm and 1:00 pm - 4:30 pm. For more details about facilities, please refer to the [Chemistry Facilities and Resources](#) and the [Biology Facilities and Resources Guide](#).

### *Stockrooms*

The Chemistry stockrooms are located in room 157 Crellin. The Biology stockrooms are located in 181 Alles and 127 Beckman Behavioral.

### *Mail boxes*

Mail boxes will be assigned in the north end of the first floor of Braun (147-75CH) until a research lab is selected, in which case the mail box will be moved to the appropriate building.

## Attachment #1

### *Guidelines for evaluating defense of the research proposition*

The point of this exercise is to encourage the student, in collaboration with his/her adviser, to think through as deeply as possible the series of experiments that would form the basis of a thesis research project. The following criteria are suggested to provide the students with an indication of what is expected of them and to guide faculty in evaluating both the research proposal and the out of field proposal for the qualifying exam in the second year:

- \* Has the student clearly defined the problem to be addressed?
- \* Has the student clearly explained the significance of the problem?
- \* Has the student become sufficiently familiar with the relevant field of research? Can he/she put the problem in context?
- \* Are the experimental questions to be asked laid out in a logical manner? Is their rationale clearly presented? Are the experiments and their controls adequately described?
- \* Has the student considered various possible outcomes of the experiments, and their interpretations?
- \* Has the student considered contingencies in case the experiments do not work (or yield uninterpretable results)?
- \* Based on his/her preliminary data, does the student have a feeling for the practicality of the experiments and their possible technical problems? (Relevant only to the research proposal).
- \* Does the student have a rough timetable for the proposed project? (Relevant only to the research proposal).

During the oral examination, the student can expect to be asked questions about general topics in biochemistry in addition to questions about the proposals.

The thesis advisory committee is encouraged to provide the student with constructive suggestions for the proposed project. In this way, the committee initiates an important ongoing role in helping to guide the student's research, not simply in evaluating the end product. However, the committee is also encouraged to base their evaluation as much as possible on the student's ability to formulate a scientific problem and to pose it in experimental terms, and to avoid biases that reflect their value judgments about the proposed research.