

**HANDBOOK FOR GRADUATE STUDENTS**

**IN**

**BIOCHEMISTRY AND MOLECULAR BIOLOGY**

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<b>I. INTRODUCTION</b>	

Most of the information you need as a student enrolled in the Pennsylvania State University Graduate School is contained in the *Bulletin for Graduate Degree Programs* and the *Thesis Guide*. *The Handbook for Graduate Students in Biochemistry and Molecular Biology* supplements the *Bulletin* and *Thesis Guide* by providing interpretation and amplification as well as bringing to your attention matters that are not dealt with in the *Bulletin*. It includes information relating to your appointment and to the operational and administrative aspects of the Biochemistry and Molecular Biology graduate program.

The Ph.D. degree in Biochemistry and Molecular Biology is a research degree. The goals of the graduate program are to provide you with the academic background and laboratory experience that allow you to develop into an independent and productive research scientist having

1. the ability to recognize and define significant problems and to design the proper experiments through which the problems can be solved;
2. the ability to assess the time and effort required for solving a problem;
3. the ability to communicate the resulting scientific advances in seminars and in papers published in appropriate research journals;
4. the ability to operate as a member of a research community, in which the productivity of the entire group depends on proper handling of common research facilities (equipment, library, etc.); and
5. the breadth of interest and confidence required to be an active and productive scientist throughout a career which will extend well into the 21st century.

Your program of training will include required courses, seminars, research and research conferences, and examinations, all of which are designed to help you develop the above traits.

## II. CHOICE OF AN ADVISOR

In your first year, until you have selected a permanent advisor, the First Year Graduate Advisor will serve as temporary advisor. After that, your primary source of non-course work instruction and advice is your thesis research advisor. To assist you in selecting a research area and research advisor, several activities are scheduled.

**A. Faculty Research Talks:** Survey of research interests of members of the Graduate Faculty in Biochemistry or Molecular Biology. During your first year, faculty members will give synopses of their research programs. You are encouraged to use this opportunity to inquire into the types of projects available to new students entering the lab during the following year.

**B. Laboratory Rotations:** At least four rotations in different labs will occur during your first year. These consist of: one assigned and one chosen 'techniques' rotation in the Fall semester (one in a lab that emphasizes biochemical approaches and the other in a lab that emphasizes molecular/genetic approaches; each about 6 weeks in length); one rotation in the Spring semester in a lab of your choice; and one 4 to 6 week rotation in a lab of your choice during the Summer after successful completion of your Candidacy exam. Ideally, a small learning project will be undertaken in each rotation. If it seems necessary, you may undertake additional rotations with permission of the Department Chairman. To schedule the rotations you choose, contact faculty members of interest to make suitable arrangements

and confirm your selection with the First Year Graduate Advisor. Scheduling rotations early helps ensure that you will be able to rotate in your preferred labs.

You will be required to present two oral talks (approximately 15 minutes in length) on your rotations during your first year. One talk will be presented near the end of Fall semester and cover one of the two rotations undertaken in the Fall. The other will be presented near the end of Spring semester and covers the work from your Spring rotation. The head of the laboratories in which students rotated will be invited to attend along with the First Year Graduate Advisor and members of the Academic Standards Committee. Successful completion of these two reports will serve to satisfy the spoken English requirement of the Graduate School (see Appendix).

**C. Seminars, Research Meetings, Journal Clubs:** A variety of seminars, research meetings, and journal clubs provide additional information for your decision concerning thesis research area and advisor. The Biochemistry and Molecular Biology, Cell Biology, Microbiology, Neuroscience, Cellular and Molecular Physiology, Pharmacology, and Anatomy programs host outside seminar speakers throughout the academic year. Within the Department of Biochemistry and Molecular Biology, research meetings are held weekly. Their dates and times are normally posted, and they are almost always open to all interested people. Attendance at the weekly Biochemistry and Molecular Biology seminar series (currently Monday afternoon) is mandatory.

**D. Selection of a Research Advisor:** You are expected to draw from the above experiences in addition to classroom experiences in choosing your research advisor. To enable you to collect as much information as possible, the actual selection will take place after completion of all laboratory rotations. At that time, you will submit your first, second, and third choices for research advisor to the First Year Graduate Advisor. The Advisor's recommendation will be forwarded to the Chair of the Department of Biochemistry and Molecular Biology, who will make the final disposition. Your choices are not restricted to the laboratories in which you have rotated; any faculty member within the department who is able to take a student may be chosen (see Appendix 2). You are encouraged to approach a faculty member early in the first year if you think you may want to choose that faculty member as your thesis advisor. Ultimately, assignments will be based on the ability of the faculty member to accept students, the faculty member's approval and available departmental resources.

**E. The Thesis Committee:** Once you have a Thesis Advisor, you and your advisor will nominate your thesis committee. The names of the members of the committee will then be submitted to the Department Chair and the Graduate School. This must be done before the end of the Fall semester of the second year.

**III. REQUIREMENTS FOR A PH.D.** The following requirements and procedures are specified for "typical" students. Certain exceptions can be made with the consent of the advisor and the department. Students with questions should consult with their thesis committees; prior to selection of a thesis committee students with questions should consult the Academic Standards Committee.

#### **A. Courses (Ph.D.)**

##### **1. Required courses**

Biochemistry I (BCHEM 502)  
Biochemistry II C& D (BCHEM 597C & BCHEM 597D)  
Genetic Analysis (BCHEM 520)

Cell Biology (CMBIO 540)  
Molecular Biology (BCHEM 503)  
Kinetics & Mechanisms of Enzyme Reactions (BCHEM 597A)  
Macromolecular Equilibria (BCHEM 597 B)  
Colloquium (BCHEM 590), each semester until you have passed your  
comprehensive exam  
One elective course of at least 2 credits

**2. Additional elective courses.** Participation in such courses requires the approval of the Thesis Advisor and (where necessary) the course instructor.

**3. Time Sequence:** Biochemistry I (BCHEM 502) and Genetic Analysis (BCHEM 520) are taken during the Fall semester of the first year. In addition during this semester, you will work in two different laboratories in the Department, spending about 6 weeks in each. The goal is to introduce you to different laboratory techniques (physical, biochemical, and molecular biological). To satisfy this requirement, you will register for Individual Studies (BCHEM 596) for 2 credits.

Biochemistry II C & D (BCHEM 597 C & D), Molecular Biology (BCHEM 503) and Cell Biology (CMBIO 540) are taken in the Spring semester of the first year. Kinetics & Mechanisms of Enzyme Reactions (BCHEM 597A) and Macromolecular Equilibria (BCHEM 597 B) are taken in the Fall of the second year. Electives may also be taken during the second year. You are responsible for participating in Colloquium (BCHEM 590) each semester until your comprehensive examination has been successfully completed, even if in one semester, because of course credit limitations, you are unable to register for the course. Registration for Research should be as follows: until you pass the Comprehensive Examination - BCHEM 600; after you pass the Comprehensive Exam - BCHEM 601.

The preceding is the normal sequence. It may be altered for students with special requirements and to allow for variations in course offerings.

**4. Presentation of Research Results:** You are expected to make a presentation of your research at least once a year to inform your Thesis Committee of your progress and to provide the committee members with an opportunity to make suggestions as to the direction of the project. This presentation may be made as a regular departmental research seminar, or it may be given specially to the committee. In either case, you are responsible for making sure that the presentation occurs and for informing the committee members of the time and place of the presentation.

**5. Publication:** It is expected that a student will have at least one paper accepted for publication in a major peer-reviewed scientific journal prior to their thesis defense.

## **B. Seminars and Journal Clubs**

Students shall attend all departmental seminars; they are a very valuable part of your education. First year students are also encouraged to attend the various group journal clubs and group research meetings in the Department. Advanced students must attend those journal clubs and research meetings related to their area of research. All students are encouraged to attend seminars offered by other programs and departments.

## **C. English Competency Requirement**

The Graduate School requires that all graduate students must be certified as competent in both written and spoken English. Both requirements must be met before the student may take his or her Comprehensive Examination. The details of these requirements for the Department of Biochemistry and Molecular Biology are given in Appendix 1.

#### **D. Examinations (Ph.D.)**

There are three examinations for the Ph.D. degree: the written Candidacy Examination taken at the end of the first year; the Comprehensive Examination taken before the end of the fifth semester; and the oral, Ph.D. thesis defense.

**1. Candidacy Examination:** The purpose of the Candidacy Exam is to measure general knowledge in biochemistry and in molecular biology. Admission to candidacy for the Ph.D. occurs upon successful completion of the written candidacy exam and demonstration of research potential and maintenance of no less than a 3.0 GPA in academic courses. (Neither Colloquium nor Research grades are a part of this average.) The written exam is given to students at the end of their first year of study (usually over a two-day time period near the end of May or beginning of June) and must be taken before the end of the third semester. The exam consists of 12 questions. The answers will be graded pass, marginal pass, or fail. To pass the exam, the candidate must receive passing grades on at least eight questions, of which no more than four may be marginal pass. If you do not pass, you may be given the opportunity to take it a second time, usually six weeks later. Should you fail the exam twice you will not be allowed to continue in the Ph.D. program. You may, at that time, with the consent of the department, be offered the option of terminating upon completion of the requirements for a M.S. degree.

**2. Comprehensive Examination:** The purpose of the Comprehensive Examination is to assess the student's ability to design and interpret experiments. This examination must be taken prior to completion of the fifth semester. For the examination, you will prepare a research proposal on a topic unrelated to your thesis research or to any other ongoing or planned research in the laboratory in which you work. Before you prepare your proposal, the topic must be approved by members of the committee. You should submit to them a short (one page) statement of the question to be addressed, including an abstract and specific aims. You should schedule a committee meeting to consider the proposed topic. This meeting should take place within one week of abstract submission. If the topic is not acceptable you may be asked to prepare a modified statement.

The completed proposal is strictly limited to 20 pages, double-spaced (12 point font) and should be prepared in a style compatible with the format requirements of a major funding agency (e.g., NIH or NSF). Copies of successful proposals are available in the departmental library. Consult the appendix on the comprehensive exam at the end of this document for suggestions about preparing your proposal. The completed proposal must be submitted to the doctoral committee at least 2 weeks in advance of the examination. At the examination the student will present a brief discussion of the proposed work and answer questions raised by the members of the doctoral committee. Visual aids (slides, transparencies, powerpoint) may be used, but should be limited to serving as aids to communication. Elaborate visual aids do not substitute for knowledge or intellectual rigor. If your performance is not satisfactory, the exam can be retaken at a date set by the committee (usually approximately six weeks after the first one). If you fail the second exam, you will be asked to either withdraw without a degree or to change to an M.S. degree program.

#### **E. Ph.D. Thesis and Thesis Defense**

**1. Thesis Preparation:** The thesis work of a student must be described in a single integrated document. The format of the thesis must conform to the regulations set out in the Thesis Guide published by the thesis office of the graduate school. Although listed as a possible option in the Thesis Guide, reprints may not be included as part of the thesis.

The Graduate School has adopted the policy statement reproduced below. This policy emphasizes that students must submit a final draft of their thesis to their committee before the scheduled examination date. Our interpretation of "final" means that the thesis is complete and grammatically correct. It need not have been typed on thesis paper. Adherence to this policy will enable committee members to request substantive revisions *before* the defense. We adhere to this policy and require submission of the thesis three weeks before the oral examination.

#### THE STATE OF THE DOCTORAL THESIS AT THE TIME OF THE FINAL ORAL EXAMINATION

“Both the thesis director and the student are responsible for assuring the completion of a draft of the thesis and for adequate consultation with members of the thesis committee well in advance of the oral examination. Major revisions to the thesis should be completed before this examination. The dissertation should be in its final draft, with appropriate notes, bibliography, tables, etc., at the time of the oral examination; both the content and style should be correct and polished by the time that this final draft of the thesis is in the hands of the committee.” (Quoted from the *Pennsylvania State University Graduate Handbook*)

**2. Thesis Seminar:** Each Ph.D. candidate must present his/her thesis work in a public seminar. Ordinarily, the thesis seminar will be scheduled to take place immediately prior to the thesis defense. However, the student must consult with all thesis committee members one week before the scheduled seminar, to ensure that the thesis is suitable for presentation to the department. If the thesis does not receive this preliminary approval, the defense and the seminar must be postponed until the issues of concern to the committee have been satisfactorily addressed.

**3. Ph.D. Thesis Defense:** This is your final required examination. As the title indicates, you present an oral summary of your research and answer questions raised by the committee or by visitors. After the examination, the committee will decide whether you have passed. If the defense was not acceptable, the committee must decide whether you should repeat it within a fixed period of time, whether more work is needed, or whether it is not Ph.D. quality.

#### F. Evaluation of Your Progress

"Normal progress" toward the Ph.D. degree is defined by:

1. Selection of the Thesis Advisor by the end of the first year.
2. Maintenance of a GPA of 3.0 in academic courses (excluding colloquium and research) is required for continuation of graduate studies. If at the end of the first year your GPA is below 3.0, you may be asked to withdraw from the Ph.D. program.
3. Passage of the Candidacy Exam at the end of year one.

4. Selection of the thesis committee by the end of the fall semester of the second year.
5. Satisfaction of the English Competency requirements.
6. Passage of the Comprehensive Exam by the end of the fifth semester.
7. Satisfactory progress in research. Your committee should be kept aware of your progress so that they can evaluate it. Therefore, you should meet with your committee at the end of the second year and annually thereafter to inform the committee of the research you have done and research difficulties that might have arisen. Among other things, these meetings provide the committee with an opportunity to make suggestions concerning the work.

NOTE: The student is responsible for adhering to the implied time-table.

### **G. Graduate Research Assistantships for Ph.D. Students**

**1. Appointment Period:** Financial support for your degree program terminates as of five years after your entrance. Extensions beyond this period may be obtained with permission of the student's thesis committee and the department chairman.

**2. Outside Fellowships:** Predoctoral fellowships are available every year. A fellowship awarded in competition is an important asset to the student's record. Various agencies administer the fellowships. Directories that may be helpful are the following:

Financial Aids for Higher Education (Oreon Keeslar)

Annual Register of Grant Support (Marquis Academic Media)

Educational Financial Aids (American Association of University Women)

A Selected List of Major Fellowship Opportunities and Aids to Advanced Education for U.S. Citizens (National Science Foundation)

Consult with your advisor for further information regarding grants and fellowships.

**3. Support for Student Travel to Scientific Meetings:** Departmental funds (up to \$400 per student) may be available to defray, in part, the costs of attending a scientific meeting to present the student's own research results. Students who have passed the candidacy exam and who have not previously received this travel support are eligible to apply. An application for support identifying the meeting, its location, dates, registration fees, and providing the title, author list, abstract, and (if available) abstract number, should be submitted to the Academic Standards Committee well in advance of the meeting. This application should be accompanied by a memo from the research advisor indicating that s/he is in agreement with the request for funds.

## **IV. SOME PRACTICAL POINTS**

**A. Paycheck:** As a Graduate Assistant you will receive a stipend check each month. College of Medicine policy requires that stipends be paid by direct deposit to your account in a local bank.

**B. Taxation of Stipend:** This is determined by governmental agencies.

**C. Vacation/Leaves of Absence:** Students are entitled to up to 20 working days of vacation per year. Approval for a leave of absence will be considered by the student's Thesis Advisor and committee with final permission given by the Department Chair.

## V. MASTER'S DEGREE (M.S.) REQUIREMENTS

**A. Purpose:** To provide students with advanced training in Biochemistry and Molecular Biology.

**B. Credit and course requirements:** Students obtaining an M.S. degree in Biochemistry and Molecular Biology must complete course work as described in the General Information section of The Pennsylvania State University *Graduate Degree Programs Bulletin*, with guidance from the First Year Graduate Advisor or their Thesis Advisor. A minimum of 30 credits is required; 20 or more must be earned at Penn State. At least 6 of the credits must be in thesis research. The research carried out must represent an original contribution. It is anticipated that the research will require a year of full time work in addition to the time required for taking courses.

1. For an M.S. Degree in Biochemistry and Molecular Biology, the student must have: 30 credits of graduate work and maintain at least a 3.0 grade point average. Of the 30 credits, 18 credits must be in courses of which 16 must be in the required courses listed in the next item. At least 6 thesis research credits (BCHEM 600/610) are required. A letter grade may be given for no more than six research credits. There may be no missing or deferred grades, and the program must be completed within 8 years of admission.

2. The courses must be in the 500 level series. The following courses or their equivalent are required: Biochemistry I (BCHEM 502; 3 credits), Molecular Biology (BCHEM 503; 3 credits), Genetic Analysis (BCHEM 520; 3 credits), Cell Biology (CMBIO 540; 3 credits), Colloquium (BCHEM 590; 2 credits), Biochemistry II C (BCHEM 597C; 2 credits) and Research (BCHEM 600/610; 6 credits). Additional elective courses are chosen by the student in consultation with their Thesis Advisor and/or committee. A course in statistics is recommended.

3. Results of the research may be presented as a thesis describing the student's independent research, the style of which must conform to the regulations set out in the Thesis Guide published by the thesis office of the graduate school, or, alternatively, the student may submit a written research manuscript prepared in the JBC or ASM format or a published paper, authored or co-authored by the candidate, that describes the candidate's research. The thesis, manuscript or published paper must be approved by the student's thesis committee.

**C. Advisor:** The research advisor must be a faculty member of the Department of Biochemistry and Molecular Biology. To enhance the breadth of the student's educational experience, the advisor must not be, or have been a full-time employer of the student within the past year. To select a research mentor, submit your first, second, and third choices to the First Year Graduate Advisor. The Advisor's recommendation will be forwarded to the Chair of the Department of Biochemistry and Molecular Biology, who will make the final disposition.

**D. The Master's Degree Committee:** The committee will be made up of at least three faculty members of the Department of Biochemistry and Molecular Biology, selected by the student. This selection must be approved by the Academic Standards Committee.

**E. Financial support:** No financial support is provided for work towards an M.S. degree. If a student in the Ph.D. program decides to shift to the M.S. program, s/he will no longer be provided with financial support. Students are encouraged to seek extramural support for their M.S. interval.

## **VI. M.D./PH.D. REQUIREMENTS (Department of Biochemistry and Molecular Biology)**

**A. Medical students entering medical school in the M.D./Ph.D program** are subject to the requirements of that program.

**B. Medical students desiring a Ph.D. in Biochemistry and Molecular Biology and who enter the graduate program after two years of medical school** will be considered one by one on their individual merit.

Assuming students show a strong performance in all relevant academic courses and the medical board examination then:

1. The medical board examination will serve as the student's Candidacy Examination. For students who performed poorly on the medical board examination, a specially constructed Candidacy Exam will be given.
2. Beyond the medical courses, the student is required to take the Kinetics & Mechanisms of Enzyme Reactions (BCHEM 597A; 2 credits) and Macromolecular Equilibria (BCHEM 597 B; 2 credits) courses. Other courses in addition to these may be recommended by the student's committee.
3. In the summer between the first and second years of medical school, the student will do rotations through three different research laboratories in the Department of Biochemistry and Molecular Biology. At the end of these rotations, the student will choose a research advisor (see p. 4).
4. Aside from the normal research/thesis requirements, the students must participate in Colloquium and must prepare and defend, as usual, a research proposal for the Comprehensive Examination.

Medical students entering the graduate program at other times will have to be discussed individually. Once a student has started her/his research, financial support, the same as that given to all Biochemistry graduate students, will be provided for three years.

## APPENDIX 1

### Satisfaction of Graduate School Requirement in English Competency

#### The Written English Requirement:

Each student will be given, upon entering, a copy of Strunk and White *Elements of English Style* to serve as the model for acceptable English prose.

1. The Written English Requirement will be satisfied by a series of three written reports describing the two Fall and one Spring laboratory rotations during the first year.
2. A report is due two weeks after the conclusion of each rotation. It consists of a double-spaced, 3 to 5 page paper describing the experimental approach, results (positive and negative), and implications related to the rotation work. The suggested organization is to include a brief introduction, a methods section, and a results/discussion section. The report should be well organized and written carefully, with good prose and composition. The purpose of the report is to demonstrate scientific writing ability.
3. The final report will initially be evaluated by the rotation advisor. Following approval by the advisor, the Academic Standards Committee will evaluate the report. The rotation advisor or a member of the Academic Standards Committee will meet with the student to discuss evaluation of the report. Students who fail will be required to submit a revised, acceptable report.
4. If a student should fail two times, s/he must take an English writing course approved by the Academic Standards Committee. Any fees for the course are the student's responsibility. A grade of 'B' or better in this course will be viewed as satisfying the writing requirement.

#### The Spoken English Requirement

1. This requirement will be satisfied by the student's performance in the two oral reports presented describing the rotations during the first year (see **II. CHOICE OF AN ADVISOR 1. Faculty Research Talks** above).
2. A member of the Academic Standards Committee or the First Year Graduate Advisor will evaluate each presentation and provide comments to the student regarding their ability to make a presentation and answer questions in acceptable spoken English. If the presentation is deemed unacceptable, the student will revise the presentation and present it for re-evaluation.

## APPENDIX 2

**Graduate Faculty in Biochemistry and Molecular Biology that may accept students for the 2004-2005 academic year:** (ability to join a lab depends on resources available in the lab)

Dr. Maria C. Bewley\*

Dr. Judith S. Bond

Dr. Laura Carrel

Dr. Kristin A. Eckert

Dr. John M. Flanagan

Dr. Sergei A. Grigoryev

Dr. D. Channe Gowda

Dr. Anita K. Hopper

Dr. James E. Hopper

Dr. Ralph L. Keil

Dr. George I. Makhatadze

Dr. Gail L. Matters\*

Dr. Ira J. Ropson

Dr. Cara-Lynne Schengrund

Dr. Thomas Spratt

\*non-tenure track faculty who may accept students that are co-mentored by a tenured faculty member

**APPENDIX 3****DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY STUDENT SUMMARY**

Name \_\_\_\_\_ Student Number \_\_\_\_\_

Undergraduate School \_\_\_\_\_

Major \_\_\_\_\_ Degree \_\_\_\_\_ Date \_\_\_\_\_

GPA \_\_\_\_\_ Date Matriculated \_\_\_\_\_

GRE Scores: Verbal \_\_\_\_\_ Analytical \_\_\_\_\_ Quantitative. \_\_\_\_\_ Advanced \_\_\_\_\_

Degrees granted: M.S. \_\_\_\_\_ BS \_\_\_\_\_ Ph.D. \_\_\_\_\_

Written English Requirement \_\_\_\_\_

Spoken English Requirement \_\_\_\_\_

Date of candidacy examination (to be taken in June of the first year) \_\_\_\_\_

Evaluation \_\_\_\_\_

Lab Rotations \_\_\_\_\_ 1<sup>st</sup> \_\_\_\_\_ 2<sup>nd</sup> \_\_\_\_\_ 3<sup>rd</sup> \_\_\_\_\_ 4<sup>th</sup>

Thesis advisor: \_\_\_\_\_

Doctoral committee (minimum of three from Dept. of Biochemistry and Molecular Biology)

\_\_\_\_\_

\_\_\_\_\_

Date of **comprehensive examination** (to be taken by the end of the third academic year) \_\_\_\_\_

Evaluation \_\_\_\_\_

Other Comments

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\*Requirements for the M.S. candidates are somewhat different from those of a Ph.D candidate (see Master's Degree Requirements).

Ph.D. Thesis Title:

\_\_\_\_\_

\_\_\_\_\_

Defense Date: \_\_\_\_\_

**APPENDIX 4**

## Further information about the Comprehensive Examination

The following information is provided by the faculty for the convenience of the student and is not a part of the formal regulations governing the Comprehensive Examination.

### Proposal Style:

It is recommended that the student become familiar with examples of research plans in grant applications to the NIH and/or NSF. The agencies maintain web pages with instructions to applicants, and published guides for the preparation of grant applications are available in the department library.

### Content of proposal:

Focus the proposal as narrowly as possible. In a proposal with too many aims, it is not possible to treat each at the necessary level of detail. Your goal will be to formulate the Specific Aims of your proposal so that they communicate the essence of the proposed experiments in a concise and logical manner.

A well-prepared proposal will achieve the following functions.

1. Identify a gap in our knowledge
2. Establish the significance of the gap
3. Propose a *testable* hypothesis that addresses the gap
4. Propose experiments that are both *necessary* and *sufficient* to test the hypothesis
5. Predict the most likely experimental outcomes
6. Discuss the implications of these outcomes for the hypothesis
7. Discuss the significance of each likely outcome to the existing gap in our knowledge
8. Identify any follow-up experiments that might be useful

### Oral presentation:

#### Powerpoint presentations are the current norm. However:

- Do not assume that you will be able to “look up” the answer to a question on your slides.
- Fancy graphics do not substitute for knowledge. Budget your preparation time accordingly.
- Remember that the regulations do not limit the range of topics that may be covered in the examination. In your preparation, treat the proposal as a point of departure and not the sole topic to be covered.

### Feedback from faculty.

After the examination, the student is encouraged to seek feedback from members of his/her committee.

Proposed as a guide for faculty at the comprehensive exam

## **Comprehensive Examination**

### **A. Proposal.**

Does the proposal identify a gap in our knowledge?

Does the proposal establish the significance of the gap?

Is an hypothesis proposed that addresses the knowledge gap?

Is the hypothesis amenable to experimental test?

Are the proposed experiments *necessary* to test the hypothesis?

Are the proposed experiments a *sufficient* test of the hypothesis?

Are the proposed experiments feasible?

### **B. Presentation/Oral exam**

Does the student predict likely experimental outcomes?

Are the implications of likely outcomes discussed?

Are follow-up experiments proposed?

### **C. General knowledge and preparation**

Is the student's knowledge of the scientific context of his/her proposal comprehensive?

**Is the student's technical/theoretical knowledge adequate?**

## **The Handbook and University Regulations**

The contents of this *Handbook* should be regarded solely as guidelines to Department of Biochemistry and Molecular Biology procedures. In exceptional cases, deviation from these guidelines may be approved by vote of the faculty of the Department of Biochemistry and Molecular Biology. The guidelines in this *Handbook* are not intended to supercede the University regulations described in the *Graduate Degree Programs Bulletin*; should any section of this *Handbook* conflict with the corresponding section of the *Bulletin*, the faculty will consider the regulations published in the *Bulletin* to be the governing authority. These guidelines are subject to revision by vote of the faculty of the Department of Biochemistry and Molecular Biology.