

DEPARTMENT OF MOLECULAR AND STRUCTURAL BIOCHEMISTRY GRADUATE STUDENT GUIDELINES

2016-2017

I. ADMISSION TO THE DEPARTMENT

The Graduate Admissions Committee reviews applications for admittance to the Department's graduate programs. In addition to the on-line application form, the Department requires undergraduate transcripts, GRE general test scores, three letters of recommendation, and a statement of research interest. TOEFL scores are required of all foreign students. Factors influencing the admission decision also include the college/university selected for undergraduate study, the level of academic courses undertaken, achievement in these courses, undergraduate research experience, and personal interviews. Advanced GRE subject tests are not required but may be helpful in making the final decision for international students.

- A. Based upon the stated criteria, an applicant may be admitted to the Masters or Ph.D. program. Almost all students admitted to the Department's graduate program are Ph.D. candidates.
- B. Students admitted to the Ph.D. program may eventually decide that a Masters Degree program is more appropriate. Such individuals, upon recommendation of both their thesis advisor and advisory committee, may change from the Ph.D. to the Masters program.
- C. Students admitted as Masters candidates may eventually decide to pursue a Ph.D. through the Ph.D. program. These individuals may do so by formally reapplying to the Graduate Admissions Committee for admission to the Department's Ph.D. program.

II. ORIENTATION FOR NEW GRADUATE STUDENTS

- A. New students will meet with the Department Head and Director of Graduate Programs before the start of classes for a brief orientation. New students, in consultation with the Department's Director of Graduate Programs and/or the Graduate Admissions Committee, will decide upon the appropriate graduate classes for their 1st semester. The graduate secretary will assist new students in registering for the selected courses.
- B. The graduate secretary will give each new student a list of Department's research faculty. Within the first 2 weeks of the semester, new students will set up 30-45 minute meetings with every member of the listed faculty to acquaint themselves with the research programs in the Department. Each faculty member will sign the student's form at the conclusion of the meeting. Once completed, these forms are returned to

the graduate secretary and placed in the student's file. New students are encouraged to complete these interviews in a timely fashion as their laboratory rotations may not begin until the student has met with all research faculty.

- C. The Director of Graduate Programs and the Graduate Admissions Committee will serve as the student's temporary advisory committee until a research laboratory and thesis advisor is chosen by the student. Until the establishment of a student's thesis committee, the Director of Graduate Programs and Graduate Admissions Committee will monitor the progress of new students and meet with them if deemed necessary to discuss their academic and research/rotation progress. New students are strongly encouraged to meet with the Department Head, Director of Graduate Programs, members of the Graduate Admissions Committee, or faculty teaching the selected graduate courses if questions arise or if they encounter difficulties in their graduate course work and/or research.

III. GRADUATE DEGREE REQUIREMENTS

The Department of Molecular and Structural Biochemistry offers three graduate degrees, the Doctor of Philosophy, the Master of Science, and the Master of Biochemistry. All three degree programs require the successful completion of core curriculum, participation in Biochemistry seminars, and a final comprehensive examination of their degree work. In addition, the Doctor of Philosophy and Master of Science degrees require the successful completion of a thesis based upon an original research investigation as well as experience in teaching. Students entering the graduate programs are expected to have adequate background in organic chemistry, physics, calculus, physical chemistry, biochemistry and molecular biology. Highly qualified students deficient in some areas may be admitted to graduate study but are expected to correct such deficiencies by completing appropriate undergraduate courses early in their career. The course requirements for each degree program are detailed below.

A. **Doctor of Philosophy**

The following core courses of graduate study are required for all Ph.D. candidates:

BCH 701	Macromolecular Structure (3 credits) - Fall
BCH 703	Macromolecular Synthesis and Regulation (3 credits) - Fall
BCH 705	Molecular Biology of the Cell (3 credits) - Spring
BCH 870	Laboratory Rotation (3-4 credits) - Fall and Spring
BCH 801	Biochemistry Seminar (1 credit) - Fall and Spring
BCH 885	Biochemistry Teaching Experience (1-3 credits) - Fall or Spring

In addition to the core requirements, the Department requires two advanced courses in biochemistry/chemistry/molecular biology. Such course work may be taken outside the Department's advanced course offerings. Advanced course work will be selected with the advice of the thesis committee. Other course work may be prescribed by the student's thesis committee based upon the student's research and career goals as well as academic background. Previous graduate course work in appropriate areas completed at other institutions may be counted towards

the required course work. This curriculum has been designed so that formal course work can be completed by the end of the third semester of graduate study. On average, completion of a Ph.D. in Biochemistry, including thesis research (BCH 899), requires approximately five years.

Advanced Departmental Graduate Courses (typically offered every other year)

BCH 760	Protein Crystallography and Macromolecular Modeling	3 credits
BCH 761	Advanced Molecular Biology of the Cell	3 credits
BCH 770	Enzyme Kinetics and Mechanisms	3 credits

B. Master of Science

Students in the Master of Science graduate program are required to take the three biochemistry core courses and biochemistry seminar. Additional advanced courses may be recommended or required by the student's thesis committee, but a total of 18 hours of graded credit are required for the degree. The Master of Science is a research degree and students are required to defend their thesis research in a final oral examination. In addition, the Graduate School requires a minimum of 30 credit hours. Students pursuing a Master of Science degree should consult the Graduate Catalog for additional details concerning the specific requirements of the Graduate School.

C. Master of Biochemistry

Those students interested in a non-research Master of Biochemistry degree should consult the Graduate Catalog and Director of Graduate Programs for degree requirements. A total of 30 credits are required including BCH 701, 703, 705, 801, and two advanced courses in biochemistry/chemistry/molecular biology.

D. Graduate Minor in Biochemistry

A graduate minor in Biochemistry for both Masters and Ph.D. students requires completion of nine credit hours of biochemistry at the 500 level or above and must include at least two biochemistry graduate core courses (BCH 701, 703, 705).

IV. ACADEMIC PERFORMANCE

Graduate students are expected to meet the minimum academic requirements of both the Graduate School and the Department of Molecular and Structural Biochemistry.

A. Graduate School Requirements

Graduate students are expected to maintain an overall GPA of 3.0 or higher. Students will receive a notice of academic warning if their GPA falls below 3.0 and they have accumulated less than nine credit hours towards his/her graduate program. If a student has attempted between nine and eighteen credit hours and earned a GPA of less than 3.0, the student is placed on academic probation. A student's graduate program is terminated if he/she has 18 or more credit hours and has a GPA of less

than 3.0. Students receiving an academic warning or academic probation may not hold an assistantship.

B. Molecular and Structural Biochemistry Department Requirements

Graduate students are expected to maintain an overall minimum GPA of 3.0. A minimum acceptable grade of B- is required in each of the biochemistry core courses. If a student receives a letter grade of less than B- in a core course, he/she must retake that course and earn a B- or better. Two grades of less than B- in the biochemistry core courses, including two unacceptable grades in the same core course, will result in termination of the student from the Department's graduate program. If a student's GPA falls below the minimum 3.0, he/she will have not more than 2 semesters to raise the GPA back to the minimum 3.0 by taking graduate courses in or outside the department at the 500 level or above (excluding BCH 553 and BCH 555).

V. LABORATORY ROTATIONS

- A. Laboratory rotations provide new Ph.D. students with valuable exposure to a variety of experimental techniques and areas of research as well as an opportunity to directly participate in the research areas that are of most interest to the student. The experiences gained during the rotations are intended to aid the student in choosing a thesis advisor and project.
- B. New Ph.D. students may begin rotations after they have met the research faculty and completed and returned the rotation form to the Graduate Secretary. All students are expected to complete three laboratory rotations by the end of their second semester. The first rotation is begun early in the first semester. The second rotation must be started by December 1st and the third rotation must begin by March 1st. Laboratory rotations typically extend beyond a minimum 7 week period in order to complete a defined set of experiments or complete a small project. A student may do more than the mandatory three rotations in order to select a laboratory for thesis research. However, all laboratory rotations are to be completed by the end of the second semester. Students should inform the Director of Graduate Programs or the graduate secretary of their laboratory selection before beginning each rotation.
- C. During the laboratory rotation period, the student will participate in on-going research activities as a full member of the group, working under the direction of one or more designated members of the research group, participating in laboratory meetings, etc. Students are expected to spend a minimum of 15 hrs per week in the lab with the realization that their time involvement must be flexible to accommodate the open-ended nature of laboratory research. The specific project(s) in which the student participates will be determined by the faculty member of the research group.
- D. Upon completion of the rotation, the faculty member will complete a rotation evaluation form obtained from the graduate secretary. The faculty member and rotating student will meet to discuss the student's rotation experience and each will

sign the student's evaluation form. It is the responsibility of the student to make certain this evaluation form is completed and given to the graduate secretary for deposit in the student's file.

VI. SELECTION OF A THESIS ADVISOR

Upon completion of laboratory rotations and by the end of the second semester of graduate study, students will select a thesis advisor. This selection is made based upon mutual agreement of both the student and selected faculty advisor. Students selecting an advisor should take into account not only the area of research interest and laboratory environment, but also the availability of funding and other factors which will impact the student's chances of successfully completing his/her thesis research. The Department requires that the selected research advisor have at least one year of stipend support for the incoming student. Graduate students will then inform the Director of Graduate Programs and Department Head of their selection.

VII. GRADUATE ADVISORY COMMITTEE

North Carolina State University awards graduate degrees in Biochemistry upon recommendation of the Biochemistry faculty and the student's graduate advisory committee. Recipients of the Masters of Science degree should demonstrate a reasonable and comprehensive mastery of biochemistry and the chosen field of research investigation. Recipients of the Ph.D. degree should possess not only a mastery of biochemistry and their chosen field of research study, but also the ability to undertake independent, original and scholarly work at the highest levels. Therefore, the Ph.D. is not awarded simply upon completion of a stated amount of course work, but rather upon demonstration of competence as an able and independent research scientist.

- A. Immediately upon selection of a thesis advisor, a Graduate Advisory Committee for the student will be selected by the student in consultation with the thesis advisor. Within several months, the Graduate Advisory Committee will meet to formulate a plan of graduate study consistent with the student's research and career goals. This plan of work will then be submitted to the Graduate School for approval. It is the responsibility of the student to insure that this plan of work is approved and signed by members of the Graduate Advisory Committee and submitted to the Graduate School in a timely fashion. ***The Graduate Advisory Committee should assemble, formulate the plan of work, and then submit the plan of work to the Graduate School before the end of the student's third academic semester.***
 1. For Ph.D. students, the Graduate Advisory Committee must have at least 3 Biochemistry faculty members (only one of whom may be an adjunct or associate faculty member) and at least one member from outside the department. The student's thesis advisor will serve as the chair or co-chair of

the committee. The Biochemistry department does not require that the student have a minor concentration for the Ph.D. degree.

2. For Masters students, the committee shall consist of 3 Biochemistry faculty members of which one can be an adjunct or associate faculty member of the Biochemistry Department. The thesis advisor will serve as chair or co-chair of the committee.
- B. Graduate students will meet with their Graduate Advisory Committee on an annual basis to discuss the student's progress in course work and laboratory research. This annual meeting must take place before June 1st of each academic year. It is the responsibility of the student to see that these annual meetings are scheduled and completed within the expected time frame. Students who fail to have this annual meeting will be considered as “not having made satisfactory progress towards their degree” and their reappointment for the next academic year will be in jeopardy. At this meeting, the student will summarize his/her research accomplishments in the past year and outline goals and plans for the coming year. For Ph.D. students in the early years of their graduate study, this meeting should include a discussion of a possible timetable for scheduling their Ph.D. preliminary exams. For those students who anticipate the completion of their Ph.D. or M.S. research in the next year, there should be a clear statement of what experiments will be carried to complete their thesis research. For students completing their research, this plan should also include the scheduling of a departmental seminar during the upcoming academic year to be given as one of the Biochemistry Department's regularly scheduled weekly seminars. At the annual meeting, a standard form (Annual Review Summary) will be completed and signed by each member of the Graduate Advisory Committee. A copy of this form can be obtained from the Graduate Secretary. Graduate students are responsible for collecting these signed forms from individual committee members, making copies to be distributed to each member of the Graduate Advisory Committee, and giving the original copies to the Graduate Secretary for placement in the student's file.
- C. Graduate students should first address any concerns pertaining to their academic or research programs to their Graduate Advisory Committees. Problems which cannot be resolved satisfactorily may be referred to the Director of Graduate Programs, Graduate Admissions Committee or Department Head. As a final resort, a student may contact the Dean of the Graduate School.

VIII. TEACHING REQUIREMENT

Each Ph.D. student has a minimum teaching requirement of one semester, but often the assignment is for two semesters. M.S. students are encouraged to teach if the opportunity is available. Both Ph.D. and M.S. students will receive up to 3 hours of non-graded credit for their teaching experience.

IX. GRADUATE STUDENT SUPPORT

The Biochemistry Department will make every effort to support all qualified students enrolled in the Ph.D. program under the guidelines outlined below. Students enrolled in the Master of Science program are not supported by the Department. Students in good standing will be supported by a combination of departmental funds (research and teaching assistantships) and funds from sponsored research programs (NIH, NSF, USDA, as well as other federal and private funding agencies). Graduate students are encouraged to consider applying for support from other institutional programs, institutional training grants, and private and federal pre-doctoral fellowship programs. The Biochemistry Faculty consider on a regular basis the funding levels for graduate student assistantships which include the stipend itself, health insurance, tuition, and fees. The faculty will make every effort to maintain competitive stipend levels for graduate student assistantships. Typically, new Ph.D. students are supported by departmental funds for not longer than one year, after which the individual research advisor supports the student from their sponsored research programs.

X. GRADUATE STUDENT AWARDS

The Biochemistry Faculty will make annual awards to selected graduate students in recognition of their excellence in research and teaching. The four annual awards are:

- A. The Anne A. J. Work Award given in recognition of outstanding graduate achievement in research by women in Biochemistry at North Carolina State University.
- B. The A. R. Main - Becton Dickinson Award given in recognition of outstanding graduate achievement in research in Biochemistry at North Carolina State University.
- C. The Samuel B. Tove Award given in recognition of outstanding graduate achievement in teaching in Biochemistry at North Carolina State University.
- D. The Borroto-Esoda Graduate Award given in recognition each semester to a graduate student to attend and present at a prominent scientific meeting or conference.

XI. MASTER OF SCIENCE FINAL EXAMINATION

A candidate for the Master of Science degree must pass a comprehensive oral examination to demonstrate to their Graduate Advisory Committee a reasonable mastery of their research field. This examination will take place upon completion of the thesis research and preparation and submission of the thesis to the student's Graduate Advisory Committee.

XII. Ph.D. PRELIMINARY AND FINAL EXAMINATIONS

In accordance with Graduate School requirements, successful completion of a Ph.D. program requires the student to pass both preliminary exams and a final exam or thesis defense. The Ph.D. preliminary exam consists of a written examination followed by an oral examination and is required for admittance to Ph.D. candidacy. The form of the written and oral preliminary exam is a research proposal as outlined below. The final oral examination or thesis defense will follow successful completion of a student's thesis research and submission of the Ph.D. thesis to the student's Graduate Advisory Committee. Successful completion of Ph.D. graduate study in the Department of Molecular and Structural Biochemistry requires one, first author, peer-reviewed, research publication. In addition, graduating students are required to present the student's thesis research at a regularly scheduled, departmental Thursday afternoon seminar.

XIII. Ph.D. PRELIMINARY WRITTEN AND ORAL EXAMINATIONS

The Ph.D. preliminary exam (admittance to Ph. D. candidacy) consists of two parts; the written exam followed by an oral examination. In the Department of Molecular and Structural Biochemistry, both portions of the preliminary exam are accomplished with the student writing an original, hypothesis-driven, research proposal (written exam) followed by an oral defense of that proposal (oral exam). The Ph.D. preliminary examination process is initiated by the student when the Ph.D. thesis committee feels that the student's academic and research progress has been satisfactory and the student is ready to write an original research proposal. Ideally, these exams are completed by the end of the student's second year of graduate school, but should be completed no later than the end of the fall semester of their third year (fifth semester – this is typically the case for most students). Students taking the preliminary exam will have already chosen a laboratory for their Ph.D. research and established a Ph.D. thesis committee with the graduate school. Students should have no more than 2 courses remaining to complete their schedule of planned course work that has been approved by both their thesis committee and the Graduate School.

A. Guidelines for the Written Examination

1. Each faculty member will designate areas of research that are closely related to their laboratory's research program. These areas will be off limits as proposal topics for students working in that research laboratory.
2. There are two submission cycles per academic year with the written proposals due for evaluation by the Biochemistry Faculty on October 1st and March 15th. If these dates fall on a weekend, proposals are due the following Monday.
3. To begin the writing process, the students will prepare and submit to their Preliminary Examination Committee (PEC) two potential research topics. The PEC will consist of the student's Ph.D. thesis committee (3 Biochemistry Faculty and one outside faculty member) and two additional Biochemistry

Faculty appointed by the Director of Graduate Programs. Each proposal topic submitted to thesis committee only and will be accompanied by a brief description (at least a half page but no more than one page) of the proposed research. Considering the deadlines for submission of the final written proposal, an appropriate time for submission of potential proposal topics and meeting with the thesis committee is early August and early January. The thesis committee will confer with the student and then select one of the submitted topics for proposal preparation. If both topics are acceptable to the thesis committee, then the student may select either one for proposal preparation. If both submitted topics are declined by the thesis committee, then two new topics must be submitted.

4. Next, the student will prepare and submit to the PEC (this is thesis committee and the two additional Biochemistry Faculty members as defined in XIII.A.3) a one page proposal abstract outlining the background and significance of the problem and the specific aims of the proposed research. There should be a minimum of two specific aims but not more than three. This abstract should include appropriate references (not included in the one page abstract limit).
5. Students must meet with their PEC to discuss their submitted abstract. At that meeting, the PEC will decide and notify the student that the submitted abstract is acceptable or not acceptable.
6. Once the abstract is accepted by the PEC, the student will have 3 weeks from that acceptance date to write their research proposal and submit the final version to the Director of Graduate Programs (electronic copy). The October 1st and March 15th deadlines are firm and no proposals will be accepted after these dates. If the three weeks for proposal preparation is completed before the October 1st/March 15th deadlines, the student will submit the final proposal to the Director of Graduate Programs at the end of the 3 week time period and ahead of the October 1st / March 15th deadlines. It is the responsibility of the PEC to make certain that students adhere to the 3 week limit for proposal preparation.
7. The entire faculty of the Department of Molecular and Structural Biochemistry will constitute the proposal evaluation committee. The Director of Graduate Programs will notify the students before October 15th and April 1st, respectively, of the faculty's vote and the proposal's status. The faculty will meet to discuss the proposals and vote upon the "pass/fail" status of each submission. A majority vote of the faculty is required to accept a student's proposal and award a "pass" for the written portion of the Ph.D. preliminary exam.
8. If a student is unsuccessful in passing the written portion of the Ph.D. preliminary exam, he or she is allowed to submit a second proposal for consideration in the following cycle. Failure to pass the written exam a

second time will result in termination of the student's Ph.D. program. Often the student has completed enough credit hours in courses and research at this stage of his or her graduate studies to earn an MS degree.

B. Research Proposal Format

For submission of the final written proposal, the following guidelines must be followed. Failure to follow these guidelines will result in the committee's rejection of the proposal and delay of the exam process until the next cycle of proposal evaluations.

1. General Guidelines

Proposal Submission. Electronic (doc or pdf) copy sent to the Director of Graduate Programs.

Page Limits and Text. Proposals are limited to 20 pages (double-spaced on 8½ x 11-inch paper) including abstract/specific aims, figures, and tables but not references. Type is no less than 12-point font New Times Roman (i.e., no more than 15 characters per inch / 6 lines per inch / 23 lines per page) and in easily readable text, however 10-point font is acceptable for figure legends and tables. All figures and tables are included in the 20 page limit. All margins must be at least 1 inch and all pages must be numbered consecutively starting with the abstract page.

Readability. The submitted version should be easy to read. Reviewers evaluating proposals are likely to respond unfavorably to poorly written or badly organized proposals. Be advised that concise descriptions are better than a verbose text that approaches the page limits. Subheadings are particularly helpful in organizing the text and aiding the reviewer in reading the proposal.

Research Plan. The research plan should include specific information needed for evaluation of the proposal. Be specific and informative, and avoid redundancies. Tables and figures must be included in the main body of the proposal rather than submitted in an appendix. When organizing sections 1-3 of the Research Plan, you should try to answer these questions:

- What do you intend to do?
- Why is the work important?
- What has already been done?
- How are you going to do the work?

2. Specific Guidelines

Title Page. The first page of the proposal should be the Title Page (not numbered). The Title Page should include the title of the proposal (not to exceed 75 characters, including the spaces and punctuation). Do not use abbreviations in the title unless absolutely necessary and choose a title that is specifically descriptive rather than general. The Title Page should include the name of the student and the following statement: “Research Proposal for the Ph.D. Preliminary Examination Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy.”

Abstract. The second page of the proposal and the first numbered page is the Abstract/Specific Aims. The Abstract is limited to two pages and should summarize for general scientific audiences the proposed research and outline the objectives, methodology, and significance to the proposed investigation. List the broad, long-term objectives and what the proposed research is intended to accomplish, e.g. to test a stated hypothesis or solve a specific problem. The Specific Aims of the proposal are included here (at least two and not more than three). The Abstract/Specific Aims page does not have to be identical to that presented to the Ph.D. thesis committee for approval but should follow closely the proposed investigation previously approved.

Background and Significance. There is no page limitation for this section but typically constitutes 4-6 pages of a 20 page proposal. Briefly sketch the background leading to the present proposal. Critically evaluate present knowledge and identify gaps that the proposal is intended to fill. Figures and schematic diagrams may be helpful in this section.

Research Design and Methods. Each Specific Aim listed in the Research Design and Methods section should be organized with the following subheadings. Try to answer the four questions posed above when organizing this section.

(i) **Rationale.** Briefly describe how the hypothesis is to be tested and how the experiments relate to the overall problem.

(ii) **Experimental Design.** Describe in sufficient detail to allow other scientists to evaluate your proposed experiments and procedures. The design should focus on how the experiments will answer specific questions posed in the hypothesis rather than detailed descriptions of the experimental methods. In addition, the design should describe how the data are analyzed and interpreted, including any limitations based on the proposed measurements. Key control experiments should be indicated and alternative approaches discussed. Alternative approaches should be prioritized and justified. While the student should be prepared to describe the experimental methods in an oral exam, details such as, temperature used for bacterial expression, amount of IPTG used for induction, times of induction, and recipes for buffers, should

not be stated in the proposal unless they are pertinent to examining the stated hypothesis.

(iii) Significance. Briefly describe how the results are important in the broader scope of the Aims, further the present knowledge of the field, and fill gaps in the field.

References. The list of references should correspond to the citations listed in the proposal by numerical appearance. Each literature citation should include the names of all authors, title of the article cited, book or journal, volume number, page numbers, and year of publication. There is no page limit for references cited and this section is not included in the 20 page limit.

C. Guidelines for the Oral Examination

1. The oral examination (defense of the research proposal) will be conducted after the written proposal has been accepted by the Biochemistry Faculty and the proposal has received a pass. This examination must be scheduled and completed before the end of the respective fall or spring semester.
2. The student and thesis advisor are responsible for scheduling the oral examination with the Biochemistry office and the Graduate School and obtaining the necessary forms for the examination committee to sign.
3. The oral examination committee will consist of the PEC. The student will be responsible for scheduling an oral examination time agreeable to all PEC members. During the oral defense, the student's introductory presentation is limited to 5 slides (no animation) to facilitate the exam process.
4. One of the Biochemistry Departmental Representatives of the PEC will serve as chair of the oral examination committee.
5. At the conclusion of the questioning period, the student will leave the room and the PEC (all 6 members with voting rights) will discuss the performance of the student and issue a grade of "pass/fail". A successful pass of the oral examination requires a majority vote of the PEC (4 out of 6).
6. If a student is unsuccessful in defending the submitted research proposal, the student is allowed to submit a second proposal for consideration in the following cycle. A student is allowed two attempts to successfully complete the preliminary exam before being denied admittance to Ph.D. candidacy. Often the student has completed enough credit hours in courses and research at this stage of his or her graduate studies to earn an MS degree.