THE UNIVERSITY OF CHICAGO

DEPARTMENT OF BIOCHEMISTRY & MOLECULAR BIOLOGY

GRADUATE STUDENT HANDBOOK

2006 – 2007

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INTRODUCTION TO THE DEPARTMENT

Welcome to the Department of Biochemistry and Molecular Biology at The University of Chicago. Our Department offers training for careers in biochemistry and molecular biophysics. Research encompasses all areas of modern biochemistry, ranging from chemical biology to molecular endocrinology, with an emphasis on structural biology, biophysics, and RNA biochemistry applied to a wide range of biological topics. Our Department is distinguished by its intellectual rigor and collaborative style. The interdisciplinary nature of the Department is further accentuated by the recent formation of the Institute for Biophysical Dynamics, which brings together biological and physical scientists to pursue common research goals.

This booklet is to help you become familiar with our department, and our graduate program. We hope that it will help you get started. Good luck!

DEPARTMENTAL STAFF FOR STUDENT AFFAIRS

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REQUIREMENTS AND POLICIES FOR GRADUATE STUDENTS IN BIOCHEMISTRY AND MOLECULAR BIOLOGY

Most graduate students in the Department of Biochemistry and Molecular Biology study for the Ph.D. Degree, although a Master's degree is also offered. A Ph.D. program requires generally 4 to 6 years of study. The first year is spent in course work and small research projects in several laboratories to become acquainted with the department. Also during the first year there are many opportunities to attend and participate in departmental invited seminars and the Graduate Student Seminar Series. After the qualifying exam at the end of the first year, students choose a research advisor, carry out their Ph.D. research, write and orally defend a thesis. Throughout your graduate career, your research advisor, the department chair, your graduate student advisor, and the student program administrator are ready to help you do your work and complete your degree.

Each student is required to take a minimum of 9 graded courses. One research rotation (BCMB 39900) will count as one of the 9 courses. A written report of this research elective must be submitted to the instructor and Lisa Alvarez. Of the nine courses only 30400, 32300, 31600 and 31200 are required. Two additional courses (BCMB 31900 – Introduction to Faculty Research, affectionately called "Faculty All Stars" and BCMB 31800 – Current Seminar Topics in Biochemistry and Molecular Biology) are required. BCMB 31900 is not for credit; however, BCMB 31800 is for ½ a credit. Each student is required to be a Teaching Assistant for a total of two quarters in their second and third years of residence.

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1. ***Full-time Residence*** - Students must enroll in courses totaling 300 units of credit during each of the first three quarters subsequent to matriculation at Chicago. Both first-year and more senior students receive the official holidays of the University and four weeks vacation per year. Time off during interim period is counted as vacation. If more time off is required students must petition the Curriculum Committee for a leave of absence.

2. ***Course Requirements*** **-** Students must complete the BMB core curriculum [Protein Fundamentals (BCMB 30400), Structure and Function of Membrane Proteins (BCMB 32300), Molecular Biology (BCMB 31200) and Cell Biology (BCMB 31600)]. Elective courses and research rotations (see below) to fulfill full-time residence requirements are to be chosen during consultation with the student's advisor or Curriculum Chair, from among many offered by BMB and other departments.

3. ***Research Rotations*** **-** Students must complete research rotations with at least two faculty members (one of whom must be a member of BMB) within their first four quarters in residence; the summer quarter ending the first academic year may be split into two research rotations if the student so desires. Each rotation lasts ten weeks, coinciding with the academic year. Two rotations, of 5-7 weeks each, can be performed during the summer quarter.

4. ***Grade Requirements*** **-** Students must receive the letter grade A, B, or C in all courses completed while a student at the University and must maintain a cumulative B average (3 on a 4 point system) at all times. Students who do not maintain a B average will not be considered a student in "good standing" and will be placed on academic probation. Any grade recorded as "I" (incomplete) must be replaced by a standard letter grade by the close of the next academic quarter.

5. ***Academic Standing*** – To be designated as being in "good standing", students must maintain a B average and complete all departmental requirements on schedule. A student not in good standing may be placed on academic probation, may be restricted from registering for subsequent quarters of study, or may be asked to leave the program. Students that have been placed on academic probation a second time may, at the Curriculum Committee's discretion, be asked to leave the program.

6. ***BMB Seminars*** **-** Students must attend all scheduled BMB seminars throughout their stay in graduate school; attendance at other seminars is encouraged.

7. ***Teaching Assistantships*** **-** Students are required (by rules of the Biological Sciences Division) to serve twice as teaching assistants. Students are encouraged to complete this requirement within their second and third year of residence. Students are also encouraged to enroll in the TA Training Course (BSD 500, completion of which currently takes the place of one of the two teaching assistantship requirements). Multiple teaching opportunities exist for more senior graduate students to participate (with extra remuneration) in teaching programs once the teaching assistant requirement has been met. Students must have the approval of the Graduate Student Advisor (prior to choosing a laboratory for thesis research) or their thesis advisor (after choosing a research laboratory) before they agree to serve as a teaching assistant in any course.

8. ***Qualifying Examination*** **-** The Qualifying Examination in BMB consists of a written research proposal that is prepared and submitted during the summer quarter of the first year (the fourth quarter in residence). Students (including MSTP students interested in joining BMB) will be permitted to take the Qualifying Examination only after all course and grade requirements have been met. The exam consists of a concise written research proposal and an oral defense of the proposal. Students are expected to demonstrate their ability to 1) identify a scientific problem, 2) propose experiments to address the problem, 3) interpret potential outcomes from the experiments, and 4) frame the question and results in a broader scientific context. In addition, students are evaluated on their ability to clearly convey their ideas in the written proposal and to orally defend the proposal. Two outcomes of the examination are possible. In the first outcome, a student can receive a pass that applies to both the written proposal and the oral examination. In the second outcome, a student will not receive a pass. Any student who does not pass the exam will have the opportunity to respond to the committee's concerns and either revise portions of the exam or re-write the proposal as indicated by the committee. In these cases, students will need to write a cover letter addressing the concerns of the committee and the changes that have been made. In addition, students will have to orally re-defend the revisions with part or all of the exam committee. If a student is asked to re-write and re-defend the entire proposal, an additional faculty member will be added to the exam committee. For continuation in the program, students must successfully complete the qualifying exam by the end of the fifth quarter of full-time residence as a graduate student in Biochemistry and Molecular Biology*.; a third attempt is not permitted.* Detailed guidelines for preparation of the research proposal is available from Lisa Alvarez in the document entitled "How to prepare your Research Proposal for the Qualifying Examination in Biochemistry and Molecular Biology."

9. ***Choosing a Thesis Advisor and Research Laboratory*** **-** Students are expected to choose a thesis advisor and research laboratory within one month after passing their Qualifying Examination; they are required to do so by the end of the fifth quarter of full-time residence in the program. Although students are encouraged to choose a thesis advisor from the faculty of BMB, they may choose an advisor who is a member of any relevant degree-granting unit. It should be understood that choosing a thesis advisor and research laboratory involves the consent of both parties, and that all such arrangements must be approved by the Curriculum Committee. Thesis advisors must agree to support graduate students performing satisfactory thesis research (by payment of stipend and tuition) should training grant funds not be available or after training grant funds have been applied to the student's predoctoral research training.

10. ***Thesis Committee and First Thesis Committee Meeting*** **-** Students (with the advice of their thesis

advisor and the approval of the Chair of the Curriculum Committee) must name a Thesis Advisory Committee by the last week of February of their second year and hold their first thesis committee meeting by the end of Spring quarter of their second year. It is the student's responsibility to obtain the agreement of faculty members to serve on the committee before submitting the list for approval. The Thesis Advisory Committee must have a total of four members (including the thesis advisor), at least two of who are members of BMB. The written thesis proposal should be submitted by the fourth week of the Spring quarter of the second year. The oral presentation will be scheduled at that time and should be completed by the last week of the Spring quarter of his/her second year. A Chair of the Committee who is a member of BMB and who is someone other than the thesis advisor must be chosen by the agreement of committee members at the time of the first meeting.

For each committee meeting the student should give an oral presentation designed to last a maximum of 45 minutes that highlights the written report and covers the essentials of the proposal—the background and significance, scientific aims, experimental design, project status and a time-line for the remainder of the experiments. The first committee meeting should set the stage for the thesis project. Much of the time should be given to developing the background and significance, scientific aims, experimental design and time-line. The committee will critically evaluate the merits and feasibility of the research project at this time.

The **background and significance** section should address several questions. What broad area of science does the research address and why is it important? What are the major unanswered questions in the field of study and why are they important? Where is the field now and how will the proposed research impact it? The **experimental design** should include the limitations of the proposed approach and what plans are given to address them. In addition, potential hurdles should be noted. The **conclusion** should include a discussion on how the proposed research will further the field in particular and science in general, assuming a successful outcome.

11. ***Second and Subsequent Thesis Committee Meetings*** **-** Thesis Committee meetings must be held every six months and not more than nine months apart. Once a student receives notification that he/she is due to have a Thesis Committee Meeting, he/she will have 30 days from the date of notification to arrange the meeting. If the graduate program administrator has not been notified of the date within the 30 days, the graduate program administrator will schedule the meeting for the student. Students are expected to provide a written 1-2 page outline of their progress, goals and directions to members of their thesis committee **one week** prior to each meeting.

Subsequent committee meetings should emphasize results and update the progress on the project. Changes in the project should be presented and justified. At the penultimate committee meeting members will reach a consensus that the research has satisfactorily addressed the specific aims of the project. At this point, the student can begin writing their thesis. In between the formal meetings the committee members will be available as a resource for the student.

Once a thesis committee has been established, its composition can be changed only by petitioning the Curriculum Committee. Such changes may be necessitated by differing circumstances, including a shift in experimental focus of the candidate or unavailability of a faculty member.

12. ***Penultimate Meeting with the Thesis Committee*** **-** After completing a significant body of experimental work, the student should seek permission from the thesis committee to write and defend his/her dissertation. **One week** prior to this meeting, the student is expected to submit an outline of his/her proposed dissertation to the committee members, including a list of ongoing experiments to be completed before the defense. All committee members must be present for this meeting. At the meeting, the mentor will review the student's overall progress in the program. The student is not present for this review. The student then summarizes finished or published work and provides details of any ongoing experiments to be completed for the dissertation. If the committee concurs that the student is ready to write and defend his/her thesis, the Chairperson will write a recommendation approving this action. The

recommendation may include specific guidelines for unfinished experiments as well as for the structure and content of the dissertation. Approval to write and defend the dissertation does not constitute its acceptance.

13. ***Reports of Thesis Committee Meetings*** - At the close of each Thesis Committee meeting, the Chair of the Committee must meet with the student to apprise him or her of the view of the Committee and of any problems or difficulties that might have become apparent. The Chair of the Committee must also write and submit a brief report of the Committee attesting to performance, committee recommendations, and so forth. **This report must be submitted to Lisa Alvarez, all members of the committee, and the student within one week of the meeting so that there will be no disagreement as to the conclusion of the meeting.** This report will become part of the student's permanent file, which the student is welcome to view at any time. In the event that unsatisfactory performance is identified, students may be asked by the Committee to undertake remedial activities to improve their standing.

14. ***Annual Training Progress Reports*** - Students will be asked to prepare brief annual progress reports of their activities that are necessary to ensure compliance with Training Grant guidelines for performance during the years of predoctoral research training.

15. ***Thesis Submission and Thesis Examination*** - Students must submit well-formatted, complete copies of their thesis to members of their Thesis Committee a **minimum of two weeks** prior to the date of their thesis examination. If the thesis is not turned in by one week prior to the defense, the defense will automatically be rescheduled. The examination will consist of a public seminar (about 45 min.) followed by a closed session involving only the student and members of the Committee. Students can pass the examination unconditionally, can pass the examination under certain conditions that might be set at the time, or can fail the examination. The Thesis Committee may ask for a second examination if the student's performance was considered unsatisfactory and may ask for corrections or changes to be made in the thesis. While the responsibility of making corrections or changes is often delegated to the student and his or her advisor, the Committee may ask to see the revised thesis before giving its final approval. Students must ensure that their thesis meets the guidelines and requirements of the Department and the University Office of Academic Publications. A final corrected version of a student's thesis must be submitted to and accepted by the Department and the Office of Academic Publications in a timely fashion (usually within two weeks after the thesis examination). Students must submit two copies of their thesis to the Office of Academic Publications. One copy is bound by the University and is placed in the library; the other copy is microfilmed and then is returned to the Department for its archives. Additional copies of the thesis may be requested by members of the Thesis Committee. Detailed guidelines for thesis preparation are available from Ms. Lisa Alvarez in the document entitled "How to Prepare Your Thesis for a Ph.D. Degree in Biochemistry and Molecular Biology."

16. ***Term of Predoctoral Research Training*** **-** While there is no maximal nor minimal term specified for completion of thesis research leading to the Ph.D. in BMB, students that have not had their penultimate meeting by the beginning of Autumn Quarter of their fifth year are required to petition the Curriculum Committee for continuance in the program. The petition must be in writing and must include: a current CV, Personal Statement, detailed summary of your research and accomplishments during your time as a graduate student in Biochemistry and Molecular Biology, and a outline of his/her proposed dissertation, including a list of ongoing experiments to be completed. Your petition will be considered incomplete and cannot be reviewed if any of the above are not provided. To ensure adequate progress, the Curriculum Committee will meet with students prior to acting upon their petitions for continuance. Tuition support is available through the sixth year of residence. Thereafter, students will be responsible for the cost of their tuition.

17. ***Leaves of Absence*** **-** Under unusual circumstances (usually involving personal difficulties), students

may request a leave of absence from their graduate studies. Petitions for leaves of absence must be submitted in writing to the Curriculum Committee for consideration. Such petitions must describe the relevant circumstances, the importance of the leave to the student, and a plan for returning to full time study and completion of requirements. Leaves of absence are generally approved for students in good standing who express sound reasons for their desire to enter out-of-residence status. Nevertheless, the Curriculum Committee may set certain limitations on a leave of absence and may identify a maximal term for the leave. In any case, a leave of absence can be approved for a period of no longer than 12 months. Students who will be out of residence for a longer period must petition the Committee annually for an extension of their leave. Students on an extended leave of absence may be required to fulfill additional course requirements. It should be understood that a leave of absence will not be approved indefinitely and that a leave may alter the ability of students to resume their research and financial support upon their return to academic residence.

18. ***Waiving Requirements*** **-** The Department expects that its predoctoral students will meet its requirements in a timely fashion. Under extenuating circumstances, students may petition the Curriculum Committee for a waiver of a requirement or for extension of a deadline. Such petitions must be in writing, must state the related background, and must explain why the request is being made. Petitions may be accepted (with a detailed schedule possibly being set for completion of responsibilities), or may be denied. The timely submission of a petition for waiver of a requirement, or for extension of a deadline, remains the student's responsibility.

19. ***Problems or difficulties*** **-** At various times during their stay in graduate school, students might experience a problem that concerns an academic or personal matter. The faculty and staff of the Department are here to help in any way that they can. On the one hand, a student's first contact in seeking help might be his or her thesis advisor or the graduate student advisor. On the other hand, a student might wish instead to contact the Chair of the Department, the Chair of the Thesis Committee, or any other faculty member. If the matter is sensitive, students should say so and should request confidentiality in related discussions. At the same time, students should not hesitate to ask for assistance (be it advice or intervention) whenever they need it.

20. ***Grievances*** **-** Students desiring to express a formal grievance or to seek redress in academic matters should send a written statement to the Chair of the Department who will assume the responsibility of ensuring that the student's grievance is heard by a standing or ad hoc departmental committee and that appropriate action is taken. Every effort will be made to ensure confidentiality in all related proceedings. Formal university grievance procedures may be followed if agreement cannot be reached among all concerned in a timely fashion.

PLEASE ASK FOR HELP, GUIDANCE OR, CLARIFICATION WHENEVER YOU HAVE A QUESTION OR A PROBLEM!

Requirements for students registered in the five units will be as follows:

BMB: Protein Fundamentals, Structure and Function of Membrane Proteins and one course each in Cell Biology and Molecular Biology. Additional recommended courses: Nucleic Acid Structure and Function and Molecular Biophysics: Theory and Applications.

Developmental Biology: One course in Cell Biology, one course in Genetics, one course in Molecular Biology, and three courses in the field of Developmental Biology

Genetics: Genetic Analysis, Genetic Mechanisms, Molecular Biology I, and one of three courses: Population Genetics, Molecular Evolution or Human Variation and Disease

Human Genetics: Genetic Analysis, Human Genetics I, Human Variation and Disease, and one of the following: Developmental Genetics of Model Systems, Genetic Mechanisms, Molecular Biology I, Population Genetics, and Introduction to Statistical Genetics

MGCB: One course in Cell Biology, one course in Genetics, one course in Molecular Biology, plus one additional course in one of these areas

To complete the divisional requirement of nine graded courses, students will

- do a minimum of two laboratory rotations, which will count as one graded course
- take a combination of elective and/or reading courses

Each student designs an individual program of coursework in consultation with their academic advisor.

Students who are undecided about which of the five units they would like to join are advised to take the following courses during their first two quarters to facilitate their transition from one unit to another:

FALL QUARTER
Cell Biology
Genetic Analysis
Protein Fundamentals
Developmental Genetics of Model Systems
Human Genetics I

WINTER QUARTER
Molecular Biology I

AUTUMN QUARTER COURSES

BCMB 30100 - Basic Biochemistry and Molecular Biology: The course is intended as an introduction to biochemistry and molecular biology for first year graduate students, first year medical students, and advanced undergraduates. It has three sections. The first is the structure and function of macromolecules (proteins, including enzymes, and nucleic acids) and supramolecular aggregates such as biological membranes. The second section is on cellular metabolism, emphasizing enzymatic mechanisms, cellular compartmentalization, and integration of metabolic systems. The third is the beginning of molecular biology of the gene, emphasizing DNA replication, transcription, and translation. Prereq: Two quarters of organic chemistry. *Meredith, Philipson*

BCMB 30400 – Protein Fundamentals: The course covers the physico-chemical phenomena that define protein structure and function. Topics include: 1) the interactions/forces that define polypeptide conformation; 2) the principles of protein folding, structure and design; and 3) the concepts of molecular motion, molecular recognition, and enzyme catalysis. Prereq: BCMB 30100, which may be taken concurrently, or equivalent. *Koide, Keenan*

BCMB 30600 - Nucleic Acid Structure and Function: This course focused on the biochemistry of nucleic acids. Topics include nucleic acid structure, folding, and chemistry, protein-nucleic acid interactions, non-coding RNAs, and the enzymology of key processes such as DNA repair and recombination. A special emphasis is placed on primary literature. Prereq: Courses in Biochemistry, molecular biology and organic chemistry. *Rice, Pan, Sosnick*

BCMB 31400 – Genetic Analysis of Model Organisms (=MGCB 31400): Fundamental principles of genetics discussed in the context of current approaches to mapping and functional characterization of genes. The relative strengths and weaknesses of leading model organisms are emphasized via problem-solving and critical reading of original literature. *Bishop, Ferguson, Glotzer, Palmer, Malamy.*

BCMB 31600 – Cell Biology (=MGCB 31600): Eukaryotic protein traffic and related topics, including molecular motors and cytoskeletal dynamics, organelle architecture and biogenesis, protein translocationand sorting, compartmentalization in the secretory pathway, endocytosis and exocytosis,and mechanisms and regulation of membrane fusion. *Turkewitz, Glick*

BCMB 31800 - Current Seminar Topics in Biochemistry and Molecular Biology: This course will expose students to current research topics in biochemistry and molecular biology by highlighting a selection of speakers from the weekly seminar series. Prior to each highlighted seminar, we will discuss relevant papers and subsequently, we will review the seminar. **This is a required ½ credit course for all BMB first year students and will be graded as Pass/Fail.** *Fiebig*

BCMB 31900 - Introduction to Faculty Research: Lectures on current research by departmental faculty and other invited speakers. A required course for all first-year graduate students. *Staff*

BCMB 39800 - Selected Reading Topics in Biochemistry and Molecular Biology: Subject matter for individual tutorial-based study is selected through prior consultation and is given under the guidance of a faculty member. The student and faculty member must indicate at time of registration whether the course will be taken on a letter grade or pass/fail basis. Prereq: Consent of Department and Instructor. *Staff*

BCMB 39900 - Introduction to Research: The student participates in one of the research programs of the Department. Prereq: Consent of Department Chairman and individual faculty member. *Staff*

BCMB 40100 - Research in Biochemistry and Molecular Biology: The student conducts original investigation under the direction of a faculty member. The research is presented and defended as a dissertation in candidacy for the degree of Doctor of Philosophy. Prereq: Completion of course requirements and qualifying examination at the Ph.D. level and approval of Chairman of the Department. *Staff*

WINTER QUARTER COURSES

BCMB 30500 – Fundamentals of Structural Biology: This course emphasizes the basic principles of protein structure determination by X-ray crystallography and NMR spectroscopy. The underlying physical concepts of these methods will be introduced and the capabilities of each will be discussed and compared in context of their uses in de novo structure determination and protein engineering studies. *Kossiakoff, Koide*

BCMB 31000 – Fundamentals in Molecular Biology (=MGCB 31000): The course covers nucleic acid structure and DNAtopology, recombinant DNA technology, DNA replication, DNA damage, mutagenesis and repair, Transposons and site-specific recombination, prokaryotic and eukaryotic transcription and its regulation, RNA structure, splicing and catalytic RNAs, protein synthesis, and chromatin. *Storb, Staley*

BCMB 31200 – Molecular Biology I (=MGCB 31200): Nucleic acid structure; methodology; nucleic-acid protein interactions; mechanisms of transcription and replication. Regulation of transcription in prokaryotes, and of DNA replication in prokaryotes and eukaryotes. *Rothman-Denes*

BCMB 31500 – Genetic Mechanisms (=MGCB 31500): Advanced coverage of genetic mechanisms involved in genome stability and rearrangement in lower and higher organisms. Topics include the genetics of mutagenesis, DNA repair, homologous and site specific recombination, transposition and chromosome segregation. *Bishop, Ellis, Shapiro*

BCMB 31900 – Introduction to Research: Lectures on current research by departmental faculty and other invited speakers. A required course for all first-year graduate students. *Staff*

BCMB 32300 – Structure and Function of Membrane Proteins: This course will be an in depth assessment of the structure and function of biological membranes. In addition to lectures, directed discussions of papers from the literature will be used. The main topics of the courses are: (1) Energetic and thermodynamic principles associated with membrane formation, stability and solute transport (2) membrane protein structure, (3) lipid-protein interactions, (4) bioenergetics and transmembrane transportmechanisms, and (5) specific examples of membrane protein systems and their function (channels, transporters, pumps, receptors). Emphasis will be placed on biophysical approaches in these areas. The primary literature will be the main source of reading. *Perozo*

BCMB 39800 - Selected Reading Topics in Biochemistry and Molecular Biology: Subject matter for individual tutorial-based study is selected through prior consultation and is given under the guidance of a faculty member. The student and faculty member must indicate at time of registration whether the course will be taken on a letter grade or pass/fail basis. Prereq: Consent of Department and Instructor. *Staff*

BCMB 39900 - Introduction to Research: The student participates in one of the research programs of the Department. Prereq: Consent of Department Chairman and individual faculty member. *Staff*

BCMB 40100 - Research in Biochemistry and Molecular Biology: The student conducts original investigation under the direction of a faculty member. The research is presented and defended as a dissertation in candidacy for the degree of Doctor of Philosophy. Prereq: Completion of course requirements and qualifying examination at the Ph.D. level and approval of Chairman of the Department. *Staff*

SPRING QUARTER COURSES

BCMB 30800 – Introduction to Single Molecule Methods: This course presents a series of advanced case studies designed to familiarize students with current single molecule research. Topics include: motor proteins and the cytoskeleton, nucleic acid processing enzymes, ion channels, and force spectroscopy and macromolecule folding. *Rock*

BCMB 31300 – Molecular Biology II (=MGCB 31300): Eukaryotic Gene Expression. Transcriptiona and Posttranscriptional Regulation. Analysis of regulatory pathways and mechanisms involved in the control of eukaryotic gene activity. *Singh, Staley*

BCMB 31800 - Current Seminar Topics in Biochemistry and Molecular Biology: This course will expose students to current research topics in biochemistry and molecular biology by highlighting a selection of speakers from the weekly seminar series. Prior to each highlighted seminar, we will discuss relevant papers and subsequently, we will review the seminar. **This is a required ½ credit course for all BMB first year students and will be graded as Pass/Fail.** *Fiebig*

BCMB 32200 - Molecular Biophysics: Theory and Applications: The course will expose students to modern biophysical methods and to provide background for use of existing facilities at The University of Chicago. Topics will include the measurement of physical properties of biological molecules including structure, thermodynamics, and kinetics. The primary focus will be on practical aspects but will cover a sufficient amount of theoretical background for the proper understanding of the technique. Prereq. BCMB 30500 or consent of instructor. *Sosnick*

BCMB 39800 - Selected Topics in Biochemistry and Molecular Biology: Subject matter for individual tutorial-based study is selected through prior consultation and is given under the guidance of a faculty member. The student and faculty member must indicate at time of registration whether the course will be taken on a letter grade or pass/fail basis. Prereq: Consent of Department and Instructor. *Staff*

BCMB 39900 - Introduction to Research: The student participates in one of the research programs of the Department. Prereq: Consent of Department Chairman and individual faculty member. *Staff*

BCMB 40100 - Research in Biochemistry and Molecular Biology: The student conducts original investigation under the direction of a faculty member. The research is presented and defended as a dissertation in candidacy for the degree of Doctor of Philosophy. Prereq: Completion of course requirements and qualifying examination at the Ph.D. level and approval of Chairman of the Department. *Staff*

SUMMER QUARTER COURSES

BCMB 30700 - Computational Geonomics & Bioinformatics Workshop: This course will focus on introducing graduate students to the application of computational and database tools that are used to mine and visualize genomic data. Array data collected by students early in the course will be used as a working set to apply tools and algorithms that make metabolic and signaling pathway predictions, protein domain structure and COG predictions, and sequence and pathway homology alignments. *Crosson*

BCMB 39800 - Selected Topics in Biochemistry and Molecular Biology: Subject matter for individual tutorial-based study is selected through prior consultation and is given under the guidance of a faculty member. The student and faculty member must indicate at time of registration whether the course will be taken on a letter grade or pass/fail basis. Prereq: Consent of Department and Instructor. *Staff*

BCMB 39900 - Introduction to Research: The student participates in one of the research programs of the Department. Prereq: Consent of Department Chairman and individual faculty member. *Staff*

BCMB 40100 - Research in Biochemistry and Molecular Biology: The student conducts original

investigation under the direction of a faculty member. The research is presented and defended as a dissertation in candidacy for the degree of Doctor of Philosophy. Prereq: Completion of course requirements and qualifying examination at the Ph.D. level and approval of Chairman of the Department. *Staff*

QUALIFYING EXAMINATION-STUDENT GUIDLINES

DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY

The qualifying exam provides an opportunity to evaluate a student's potential for conducting independent research by preparing and defending a research proposal. In addition, the exam provides an opportunity for the students to develop proposal/grant writing skills and receive feedback from faculty.

The exam consists of a concise written research proposal and an oral defense of the proposal. Students are expected to demonstrate their ability to 1) identify a scientific problem, 2) propose experiments to address the problem, 3) interpret potential outcomes from the experiments and 4) frame the question and results in a broader scientific context. In addition, students are evaluated on their ability to clearly convey their ideas in the written proposal and to orally defend the proposal.

Students in good academic standing are eligible to take the qualifying examination after they have completed their required coursework, and have met all other requirements of the department. For most students, the qualifying examination is scheduled during the summer quarter corresponding to the fourth quarter of full time residence in our graduate program. The Curriculum Committee and its chairperson are responsible for determining eligibility and for scheduling the examination.

Timeline for the exam process

1. Choose a topic **Early summer**

The topic of the proposal should be from an area of contemporary biochemistry, biophysics or molecular biology that interests the student. It should be within the focus of the department and should integrate information from coursework, seminars and reading. The question addressed in the proposal should be distinct from the student's projected thesis research, from other research the student has conducted as an undergraduate or during a rotation, and other proposals the student has generated for courses (at Chicago or elsewhere). Any questions about the appropriateness of a topic should be addressed to the Curriculum Committee chairperson.

2. Submit a preliminary title and abstract **Mid-summer**

A preliminary title and abstract will be due in mid-July. The Curriculum Committee chairperson will approve all topics and assign an examination committee based on the submitted research subject. The Graduate Program Administrator will schedule the exam to take place in early September.

The preliminary abstract/summary (no more than 350 words paragraph style) should address (a) the general area of investigation, (b) important gaps in knowledge, (c) long-term goals, (d) specific aims, (e) experimental approach and system, (f) what is expected to be accomplished, and (g) how the proposed research might bring understanding to the area. This represents a lot of information in a few words and requires clear and concise writing.

While the detailed content of the preliminary abstract is likely to change as the research proposal is developed, the general topic should remain the same. Students who wish to change the topic of their research proposal after submission of the preliminary abstract/summary should contact the chairperson of the Curriculum Committee.

3. Prepare written proposal **Summer quarter**

This research proposal is analogous to a graduate or postdoctoral fellowship application or a thesis proposal. In other words, it should clearly and concisely detail experiments that you could complete yourself in 3-4 years. The proposal should include the following sections: (a) Title Page, (b) Abstract (1/2), (c) Specific Aims (1/2), (d) Background and Significance (1-2), (e) Experimental Design/Methods (2-3), (f) Figures, and (g) References. The heart of the proposal (sections b-f) should be no longer than 6 pages in length (single-spaced). Suggested page lengths for each section are indicated in parentheses. It is an important skill to be able to stay within page limits. Do not go beyond a total of 6 pages for sections

b-f.

(a) The **Title** is important as it keys the reader to the goal of the project. In the title page, please include your title, your name, the statement "Preliminary examination – Department of Biochemistry" and the date of submission.

(b) The **Abstract** should summarize the proposal as described above. It is expected that the final abstract will have changed from the preliminary abstract as the proposal is developed.

(c) The **Specific Aims** are the cornerstone of the proposal. Set the stage with 2-3 sentences of background and state the long-term question or goal. Then state each of the specific aims and the experiments that will address the aims with enough detail that the reader will understand what will be done. Most proposals have 2-4 specific aims.

Keep in mind: The long-term goal is one that will not be accomplished by the experiments in this proposal. The specific aims are the short-term goals that will be addressed by the proposed experiments and should be problem/hypothesis/question oriented. There should be a logical flow to the aims; however they should not be so dependent on each other that if aim 1 fails to work the others cannot be carried out.

(d) The goal of the **Background and Significance** is not to review an entire field, but give the reader what is necessary to understand the context of proposed experiments. You want to convey that you understand the literature in the field, the outstanding questions or controversies, and how your project fits into ongoing research. You will not be able to review the entire field or cite every paper. Be selective and review and cite what is most relevant to your project. Make sure you communicate the significance of the proposed research—why your question is interesting; why it is important to answer it; what will we learn from the answers; how does this relate to a fundamental biological question or an important health concern etc.

(e) The **Experimental Design and Methods** should elaborate each of the specific aims and detail the experiments and analysis that will be done to accomplish them. Use the specific aims as section headings and present the experiments in each section as they are outlined in the aims.

For each aim you should consider (a) experimental design—how data will be collected, analyzed, and interpreted; (b) important controls, both positive and negative and (c) expected results, how they will be interpreted, and how they might lead to further experimentation. Choose your methods carefully remembering that every method has its caveats. What method is best suited to answer the question at hand? Point out potential difficulties, limitations or drawbacks to the proposed approach. Give alternative approaches that could confirm results or be used if the first approach fails and explain the benefit of the alternate approach. Make clear what you expect to get from each experiment, and how each experiment fits into your overall goal of finding out how things really work.

It may be helpful to start with a "Rationale" section for each aim where you justify the approach you have chosen. Then present an "Experimental Detail" section where you provide the meat of the experimental design. While there is not enough space to include every experimental detail, you should consider and describe the details are critical to the success of the project. Provide enough detail so that it is clear you understand the experiments you propose.

(f) **Figures** and diagrams can often be an effective way to convey a complicated model, experimental scheme, or expected/hypothetical results. Use them wherever they will help you make your point. Figures should be accompanied by a title and legend that describes the major features of the illustration. Imbed the figures in the text where appropriate, not at the end of the document. Be sure to give citations for figures or tables that are taken or adapted from the work of others.

(g) The **References** section contains all of the literature references cited throughout the proposal. The style used for citing references in the text and listing references in this section should be similar to *Biophysical Journal*, *Cell* or *EMBO Journal* which use author(s) and year to identify references in the text, an alphabetically ordered reference list, and include the full title of the citation in the reference list. The use of a citation manager such as EndNote is highly recommended. While there is no limit, most proposals generally include 25-40 citations.

By the time you turn in your preliminary abstract, you should have a rough outline of your proposal. Develop the ideas in your outline throughout the summer. Often students find as they get into the details, that what they initially proposed is not feasible, or that another approach is superior. Give yourself enough time that you can develop your ideas, identify the problem areas in your experimental plan, and revise the direction of your proposal if necessary. The written proposal is due one week before the oral exam.

4. The oral exam **Scheduled in September**

During the first portion of the meeting, the student will be asked to wait outside the room while the faculty briefly reviews the student's academic record. In the second portion of the exam, the student will present a brief (~20 minute) overview of the proposal. Throughout the presentation, the exam committee will ask questions to gauge the student's depth of knowledge and to clarify or extend points that were made in the written proposal. While many questions will be focused on the area of biochemistry and molecular biology represented by the proposal, others may be directed towards connecting areas with which the student should be familiar. The oral examination should last no longer than two hours.

5. Outcomes

After all students have defended their proposals, members of the exam committees and the Curriculum Committee will meet to discuss each student's proposal and exam and to discuss the outcomes of all the exams. The chairperson of each exam committee will then contact the student regarding the outcome of their exam. Two outcomes of the examination are possible. In the first outcome, a student can receive a pass that applies to both the written proposal and the oral examination. In the second outcome, a student will not receive a pass. Any student who does not pass the exam will have the opportunity to respond to the committee's concerns and either revise portions of the exam or re-write the proposal as indicated by the committee. In these cases, students will need to write a cover letter addressing the concerns of the committee and the changes that have been made. In addition, students will have to orally re-defend the revisions with part or all of the exam committee. If a student is asked to re-write and re-defend the entire proposal, an additional faculty member will be added to the exam committee. For continuation in the program, students must successfully complete the qualifying exam by the end of the fifth quarter of full-time residence as a graduate student in Biochemistry and Molecular Biology.

6. Tips for preparation for the qualifying exam

It is critical that you talk to your exam committee as you are preparing your proposal. You must meet with your committee chairperson at least once (more is preferred) and it is recommended that you meet with your other committee members as well. It is recommended that you meet with your chairperson early in the process and discuss the scope of your proposal. Often students prepare overambitious proposals and your committee can help you focus your aims. As you develop the proposal, bring an outline to your committee to make sure they feel your approach is reasonable. Be prepared to answer questions that are meant to guide you in the process and improve your proposal. Discuss the level of detail and which kinds of details they feel are appropriate for the experiments you are proposing. Your committee members are not intended to generate the ideas or serve as editors. Instead, they may ask questions to help you identify areas that have problems, or point out literature you should be familiar with. Your committee is meant to guide you in the process.

In addition, help may be sought from other parties under the same guidelines that you ask for feedback on your ideas, but not for the ideas themselves. Leverage the resources you have around you. Discuss your proposal ideas with other students and postdocs. Ask for their feedback; what are the weaknesses in your plan, what are the strengths? Scientists do not work in a vacuum and good ideas are made better by dialog.

Start early enough that you have time to develop your ideas and to address unexpected problems that are guaranteed to come up.

Effective communication, written and oral, is critical to your success as a scientist. The proposal **MUST** be clear and well written. Many proposals are rejected for funding because they are poorly written, sloppy or do not clearly convey the ideas. Clear writing demonstrates that your ideas are well thought out.

- Follow the "General tips on writing well" document available from the Graduate Student Administrator. "The Science of Scientific Writing" is another very helpful document and is available at http://www.amstat.org/publications/jcgs/sci.pdf.
- Have others read your proposal to identify mistakes (errors with grammar and spelling), to point out places that are difficult to understand and need clarification, and to make sure the ideas come across and are reasonable.
- Practice your oral presentation with other students. Senior students have been through this and have the experience to help identify weak areas before the exam.

THE FACULTY AND THEIR RESEARCH INTERESTS

Erin Adams - Structure and biochemistry of proteins involved in immunological recognition. Characterization of gamma delta T cell receptors and their ligands and activating and inhibitory receptors involved in the innate immune response.

Francisco Benzanilla - The main interest in my lab is the search for the dynamics of the molecular correlates of the function in membrane transport proteins. This is being approached with physical techniques such as temperature effects and complex capacitance measurements in the frequency domain combined with mutations of the molecule and assessed by gating currents, macroscopic currents and single molecule recordings. The correlation with structural changes are being monitored with optical techniques using real time fluorescence spectroscopy including lifetimes, changes in intensity and fluorescence resonance energy transfer from probes attached to strategic sites in the molecule of interest while being functional in the membrane.

Sean Crosson - Cells have the extraordinary ability to rapidly modulate their physiology in response to changes in their environment. This plasticity is particularly evident in microbial species, many of which adapt to grow across an extremely diverse range of conditions. Our interests center on how chemical and physical signals are received, processed, and integrated by a bacterial cell to generate an adaptive response. To address these questions, we are using an interdisciplinary set of tools including NMR and crystallography to explore the structural basis of signal detection and transduction by sensor histidine kinases, genetics and array-based transcriptional profiling to decipher the function and topology of microbial signaling networks, and mathematical modeling to test our experimentally-derived network topologies.

Glyn Dawson - Biochemistry of cell membrane lipids and their role in programmed cell death (apoptosis). We are especially interested in the mechanisms of neural cell injury, (including inherited lysosomal storage diseases and multiple sclerosis) and the malignant transformation of glial cells. Research involves better understanding of cell signalling through cell surface, lipid-rich microdomains called Rafts. We use primary cultures of neural cells, cell lines in which we can knock in genes to express tagged proteins, and mouse models of human disease.

Herbert C. Friedmann - My laboratory studies the enzymology and control of bacterial formation of delta-aminolevulinic acid (ALA) from glutamate in a tRNA-dependent three-step pathway. This pathway is found also in plants, but not in mammals or aerobic bacteria. Since ALA is the first committed compound in tetrapyrrole formation, its synthesis is controlled. The control mechanisms for its formation, related to the participation of a tRNA-containing substrate, are at present very poorly understood.

Godfrey S. Getz - Research in my laboratory is focused on the role of three apolipoproteins in lipoprotein metabolism, lipoprotein structure (some of which is done in collaboration with S. Meredith) and in the regulation of the process of atherosclerosis. In particular we are studying the comparative structure of human and murine apo protein A-1 in each of these regards, as well as canonical synthetic amphipathic peptides based on its structure in the prevention of atherosclerosis The other two apoproteins we are studying are apo E and the acute phase protein Serum Amyloid A both of which associate with HDL and remodel it and are implicated also in atherosclerosis.

Geoffrey L. Greene - I am interested in the mechanisms by which specific intracellular receptor proteins mediate steroid hormone action in eukaryotic cells. We are studying the composition, structure, dynamics and cellular function of nuclear receptors, especially the estrogen receptor, as transcriptional modulators of gene expression in hormone-responsive tissues and cancers.

Robert Haselkorn - We study the genes encoding the enzyme acetyl-CoA carboxylase, which catalyzes the first step in fatty acid biosynthesis. Recombinant yeast strains have been constructed that express the ACC of wheat, malaria and man. These strains are being used to identify new herbicides, new anti-malarial drugs, and drugs to treat obesity in man.

Robert Keenan - We study the relationship between protein structure and function in order to understand the way proteins work, both in isolation, and as multi-component systems within the cell. We leverage this knowledge to generate proteins with new or optimized activities. Our experimental strategy combines two fundamental and complementary approaches: directed evolution and structural analysis.

Stephen Kent - Ultimately, we want to be able to design and build protein molecules with pre-determined, controlled properties. Our laboratory has pioneered general methods for the total chemical synthesis of proteins. This enables the use of powerful physical methods such as mass spectrometry, NMR, and FTIR to elucidate the molecular basis of biological function in the protein molecule. Synthetic organic and peptidomimetic chemistry can also be used to systematically vary the chemical structure of a protein: we can then correlate these controlled changes in structure with effects on protein function. Currently, we are investigating the molecular basis of protein folding and stability in the model protein crambin; we have designed and built diastereomeric ubiquitin protein molecules to study their stability; we are investigating the electronic nature of chemical catalysis in the aspartyl proteinase enzyme HIV-1 Protease; we have undertaken the design and synthesis of adenyl-RNase A, as a 'transition state analogue' of the enzyme molecular itself; and, we are using synthetic chemistry to investigate the molecular basis of photocycle behavior in the Photoactive Yellow Protein. A major focus of our research program is to extend chemical protein synthesis methods to integral membrane proteins that function within the lipid bilayers of the cell.

Shohei Koide - We are interested in understanding the molecular basis of protein folding and target recognition by proteins. We design, construct and characterize proteins with novel function and/or structure. Current projects include (i) structure and energetics of "single-layer" beta-sheets, (ii) engineering of novel binding proteins and their applications in structural biology, (iii) structure-function relationships of estrogen receptor and RKIP. We utilize a variety of techniques in protein engineering, biophysics, in particular NMR spectroscopy, and combinatorial library screening.

Anthony Kossiakoff – Our research centers on defining the structural and functional properties that determine the role of molecular recognition in the initiation and regulation of biological processes. Our experimental approach is to couple protein structure determination by X-ray diffraction with protein engineering and peptide synthesis techniques. We are also doing mass spectrometry based proteomics to identify and structurally characterize novel proteins from organisms that thrive in extreme environments.

Shutsung Liao - Molecular mechanisms involved in the control of androgen action, prostate cancer progression and growth; green tea catechin control of endocrine systems, obesity, sebum production, and prostate cancer growth; new receptor pathway for cholesterol metabolism and regulation; pathogenic factors involved in cholesterol accumulation, novel LXR agonists for control of cardiovascular and cerebrovascular abnormalities; and roles of cholesterol in cancer cell progression and suppression.

Marvin W. Makinen - Our research is directed towards the structural basis of enzyme action. Stereochemical relationships of enzyme-substrate interactions are determined through magnetic resonance spectroscopy of true enzyme reaction intermediates and analyzed through computer based molecular modeling. Further, the mobility of protein residues in enzyme-substrate complexes is analyzed by computer simulation of dynamical motion to determine how time dependent structural fluctuations influence these stereochemical relationships. The results of these studies identify the structural relationships in catalytically active states that are responsible for the chemical transformation of substrates to products.

Stephen Meredith - I am interested in protein and peptide structure and function, focusing mainly on

Alzheimer's β-amyloid , prions, amylin, huntingtin,α-synuclein and other fibril forming peptides. The main tools we use include solid-state NMR, solution state NMR, CD and fluorescence. Through the introduction of mutations, side chain and backbone modifications, we are trying to elucidate the steps in fibril formation. We have also developed potent fibrillogenesis inhibitors that are backbone modified peptides, e.g., peptides containing N-methyl amino acids at alternate positions, esters, and non-natural amino acids. We are also interested in assessing therpeutic potential of these peptides, for example assessing the effect of inhibitors on the progression of neurogdegeneration in a transgenic mouse model of Alzheimer's Disease. Other projects examine the interaction of aggregating peptides, such as β-amyloid, with lipid surfaces that can modulate the rate of fibril formation. A recently initiated project will look for the existence of "strains" in -amyloid, i.e., similar to those that are found in prions.

Keith Moffat - My research follows two main lines - the development of synchrotron-based techniques for time-resolved macromolecular crystallography with nanosecond to 100 picosecond time resolution; and the application of these techniques to determine the molecular mechanisms of light-driven signal transduction. We have a particular interest in blue light photoreceptors such as photoactive yellow protein and the so-called LOV domains in plant photoreceptors such as phototropin; in oxygen-sensitive proteins such as fixL; and in red/far-red photoreceptors such as phytochromes. We collaborate with biochemists and microbiologists who identify and purify some of these systems, and with ultrafast optical spectroscopists whose studies parallel our crystallographic investigations.

Tao Pan - Our research focuses on elucidating the principles of RNA folding and on the functional genomics of tRNA.

Eduardo Perozo - Our research aims to understand the molecular mechanisms underlying the transduction of different forms of energy into protein motion; in particular the different molecular mechanisms of ion channel gating. We are equally interested in protein structure as in protein dynamics, for it is the dynamic behavior of a molecule what links structure to function. We rely on spectroscopic methods, and in particular reporter group techniques (EPR, Fluorescence), to study channels and other membrane proteins embedded in a fluid lipid bilayer. Static structural analyses are pursued by X-ray crystallography.

Joseph Piccirilli - Our group is broadly interested in the chemistry and biochemistry of nucleic acids with particular emphasis on RNA and RNA catalysis. The laboratory integrates of areas of organic chemistry, physical chemistry, enzymology, molecular biology, and structural biology to gain a fundamental understanding of nucleic acid structure and mechanisms of catalysis, including folding processes and dynamics.

Phoebe Rice - My laboratory is interested in macromolecular crystallography, the structural and mechanistic aspects of genetic recombination, and protein-DNA interactions. Current projects include the homologous recombinase Rad51, the site specific recombinase FLP, and the DNA bending proteins IHF and HU.

Ron Rock - We are interested in understanding how certain proteins can act as molecular machines by changing shape in a controlled manner. Our research focuses on myosin, the motor protein responsible for muscle contraction as well as intracellular transport along actin. Our approach combines protein engineering with motility assays that measure the force and displacement generated by a single molecule of myosin.

Bernard Roizman - Research focuses on molecular biology and genetics of herpes simplex viruses. Current work centers on the function of cellular and viral *trans*-acting factors involved in regulation of transcription, genome structure, and viral gene function during viral replication and during the latent state.

Benoit Roux - We use theoretical and computational methods to advance our understanding of the structure, dynamics and function of biological macromolecular systems at the atomic level. We are particularly interested in issues concerning the function of ion channels and other membrane transport proteins such as ion permeation, ion selectivity, and gating. Most of our work on ion channels is computational though we have recently started to add an experimental component to our research with electrophysiological measurements and protein crystallography.

Angelo M. Scanu - Studies are being directed at the elucidation of the genetic basis of lipid disorders with particular attention to the structure and function of lipoprotein (a), a cholesterol ester-rich lipoprotein having, as a specific determinant, a glycoprotein made of kringle structures with a striking homology with plasminogen of the coagulation and fibrinolytic system.

Nancy B. Schwartz - The primary focus of our research program is on how the machinery for sulfation, a common posttranslational modification of proteins, lipids and carbohydrates is organized and controlled in higher organisms. The integrated pathway for sulfate uptake, activation and utilization encompasses multiple components and multiple intracellular compartments. Central to this process is the bifunctional PAPS synthetase which synthesizes phosphoadenosylphosphosulfate (PAPS) from ATP and sulfate in a two-step reaction. Our recent work includes the discovery of the PAPS synthetase gene family, the identification of mutations PAPS synthetase that lead to human and animal chondrodystrophies and the elucidation of unique enzymatic properties, underling the significance of this enzyme in the overall sulfation process. Currently features of the fused bifunctional PAPS synthetase which account for he unique mechanistic properties i.e. the channeling phenomenon and the role of the multiple PAPS synthetase family members are being investigated. These studies are aided by a mutant model system with a defect in sulfation that results in altered proteoglycan production and abnormal skeletal growth and development.

James A. Shapiro - My research concerns two topics: (1) How cells engineer their DNA in experimental situations and during evolution; (2) How bacteria organize themselves into spatially structured differentiated populations during colony development.

Tobin Sosnick - My research program involves synergistic studies of protein and RNA folding. The program is based on the premise that rigorous and innovative studies of basic processes have broad implications in many areas of biological research. The growing appreciation of natively-unfoldedproteins in regulation, recognition and disease underscores the relevance of folding to a large number of biological processes. Likewise, recent discoveries of the diverse role structured RNAs play in gene expression illustrate the importance of understanding their dynamics. In the past 7 years, we have learned to direct folding and dynamics of these biopolymers.

Theodore L. Steck - My current research is concerned with understanding the cell biology of membrane cholesterol: how it is sensed, transported, and distributed in human cells and to what effect.

Ira G. Wool The larger aim is to determine how the structure of ribosomes accounts for their function in protein synthesis. In the near-term the aim is to learn how information is transmitted from one ribosomal domain to another so as to coordinate the partial reactions of elongation during protein synthesis. Another concern is with the chemistry of the interaction of proteins and nucleic acids; how ribosomal proteins associate with rRNAs to define the molecular architecture of functional domains.

HOW TO PREPARE YOUR THESIS FOR A PH.D. DEGREE IN

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Your thesis will receive four levels of review prior to the time that it is accepted by the University to fulfill requirements for the Ph.D. degree. These levels of review include (a) evaluation by your thesis committee (which has primary responsibility for considering the content of your thesis with respect to academic standards), (b) evaluation by your thesis advisor (who must indicate satisfaction with your thesis and must ensure that any changes suggested by your Committee have been incorporated into the thesis), (c) evaluation by the Department (the Chair of which is responsible for certifying that the thesis meets the academic and other standards of the department), and (d) evaluation by the Dissertation Office (which has primary responsibility for considering your thesis with respect to physical standards of format and style).

TIME TABLE

1. Do your research.

2. Write your thesis.

3. Get all of the help you can! Pass as many drafts of your thesis as you feel conscionable past your advisor. Ask your colleagues to read your thesis. Confer with anyone else you can think of (valued faculty mentors, significant others, or whomever). Look at (and read) the thesis of other graduate students who have recently received their Ph.D. degrees.

4. Submit semifinal, high quality copies of your thesis to members of your Thesis Committee a minimum of two weeks prior to the date of your thesis examination. At the same time (or even earlier), take a copy of your thesis of the Dissertation Office for its preliminary review. (This saves time and effort later in case any errors in physical make-up are discovered).

5. Successfully defend your thesis and pass your thesis examination.

6. Make all needed changes in your thesis (including those required by your Thesis Committee and any required by the Dissertation Office).

7. Obtain a Departmental Thesis Approval form from the departmental office. Ask your advisor or the chair of your thesis committee to initial the form indicating that your revised thesis meets with his or her approval and that all changes required by your Thesis Advisory Committee have been incorporated into the final document.

8. Submit the final copy of your thesis and the initialed Departmental Thesis Approval form to the departmental office for approval by the Chair. (This usually requires only a day.)

9. Take all required materials to the Dissertation Office for its final review and acceptance of your thesis. Required materials include: (a) two identical, complete unbound copies of the manuscript, each on one (and only one) of the approved papers, boxed separately and appropriately. **No other paper is acceptable,** (b) two copies of a separate abstract of no more than 350 words, paginated separately from the primary manuscript and accompanied by two copies of the title page, are included. The student's name, the title of the dissertation and the advisor's name and title appear at the top of the first page of the abstract, which is numbered Arabic page 1, (c) The final two copies, two separate abstracts and two additional title pages are accompanied by the completed forms, as required by the University, (d) a short title and binding inscription if your thesis title is more than 60 characters, (e) the completed Departmental Approval form, (f) Library Form, (g) Doctoral Dissertation Agreement Form, and (h) the Survey of Earned Doctorate and University Microfilms Agreement forms that are available in the Dissertation Office or you can download the forms at http://www.lib.uchicago.edu/e/phd/forms.html.

10. Make any last-minute minor changes in the thesis. (At this stage, you can simply -provide corrected pages if any changes are needed.)

11. Submit the final version of your thesis to the Dissertation Office.

12. Note that once the final copies of your thesis are accepted you will never see them again. Accordingly, it is important that you retain a complete copy of your thesis (from which additional copies can be made) at all times.

FINANCIAL SUPPORT

All Ph.D. students are supported on divisional unendowed funds, training grants, or research grants. Currently, students supported on divisional unendowed funds are appointed for twelve months (4 quarters). After the first twelve months, the student is supported either by a research grant or the department (until research funds are available).

Training grant support usually lasts about three years, after which the student is supported by the research sponsor on a research grant. While on the training grant, tuition and health fees are paid directly and the student is provided with a stipend. After a student's support from a training grant ceases and support is provided through a research grant, payment of health fees will become the responsibility of the student. **The student must also be aware that when their mechanism of support changes from a training grant to a research grant, there is a lag in pay. On the training grant students are paid at the beginning of the quarter. On a research grant one is paid at the end of the month.**

Payment of the student activity fee is the responsibility of the student, regardless of support source.

Above and beyond the stipend, a student may work as a Teaching Assistant for extra income. Such added work is subject to approval by the student's research advisor and the departmental chair.

Stipend checks are obtained from Parag Shah in the Dean of Students' office during the first week of each quarter. Research Assistants receive checks monthly in the BMB Office on the last working day of the month.

In keeping with its long-standing traditions and policies, The University of Chicago, in admissions, employment, and access to programs considers students on the basis of individual merit and without regard to race, color, religion, sex, age, national or ethnic origin, handicap, or other factors irrelevant to fruitful participation in the programs of the University. The Affirmative Action Officer is the University official responsible for coordinating its adherence to this policy, and the related federal and state laws and regulations (including Section 505 of the Rehabilitation Act of 1973, as amended).