

INFORMATION BROCHURE
THE TRAINING PROGRAM FOR GRADUATE STUDENTS
IN BIOCHEMISTRY

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1. Prerequisites for Admission

Prerequisites for admission are one year each of organic chemistry, calculus, biology and physics. Applicants must also have received a BA, BS or equivalent undergraduate degree. As part of the application process, students are required to take the Graduate Record Examination (verbal, quantitative and an advanced area test, usually biology, biochemistry or chemistry). Some students with otherwise excellent qualifications, but lacking some of the prerequisites may be conditionally admitted with the understanding that specified deficiencies will be made up within a stipulated time span. Students with advanced training (coursework, laboratory research, M. S. degree, etc.) may be given advanced standing; each case will be evaluated on its own merits.

2. The Pre-Thesis Committee

By May 1 of the graduate student's second year, in consultation with the student's advisor, a Pre-Thesis Committee of at least four members is formed. It should include at least two members of the Biochemistry Program Faculty, one of whom is the thesis advisor. Associate Faculty or Faculty from other departments should be included so that the student may benefit from their expertise in a relevant area. The chairman of the Committee will be one of the Biochemistry faculty, but not the advisor. The function of this committee is to review regularly the scholastic and research activities of the student and to provide advice and guidance. The committee will meet as often as necessary to fulfill its function but at least one meeting must be held each academic year. It is the obligation of the student to schedule the meeting. The chairman of the committee will prepare a written report summarizing the results of the meeting. The report must be signed by the members of the Pre-Thesis Committee and given to the student. The written report is mandatory in order to avoid misunderstanding between the student and the Committee of any recommendations the Committee may make. The Pre-Thesis Committee also forms the nucleus of a final defense Committee which will evaluate the thesis and make recommendations whether or not the degree should be granted.

In the Spring of the 2nd year, the Ph.D. student in consultation with his/her advisor will submit in writing to the Pre-Thesis Committee a description of the thesis project in the form of a research proposal which is detailed in Appendix I. This description of the thesis project is to be submitted to the members of the pre-thesis

committee at least one week in advance of the scheduled pre-thesis meeting, which should take place before May 1st. At this meeting the thesis project and other issues important to the student's project will be discussed. Every year thereafter the student will submit a detailed report (6-10 pages) of his/her research project to the Pre-Thesis Committee which describes the progress made and outlines what the future course of the research will be. These meetings are to occur prior to May 1 as well. The student is responsible for setting up all meetings with the Committee.

Ph.D. REGULATIONS

The graduate program is intended to educate students to be mature, contributing research bioscientists. With this goal in mind, three types of training are provided. First, coursework and attendance at seminars provide a framework of current knowledge. Second, communication skills are developed through presentations in journal clubs, laboratory group meetings, seminars, and at the pre-thesis and proposition committee meetings. Finally, both mental and manual aspects of good research approaches are developed in propositions and the thesis research.

COURSEWORK

Although the main component of the Ph.D. degree is research and the dissertation, some coursework is necessary to establish the student's fund of knowledge in basic biomedical sciences. The program is designed so that in the first year about 50% of the student's time is devoted to coursework and 50% to laboratory time, the second year is only 25% coursework, and in subsequent years the students spend greater than 90% of their time working on their research. The first year course, CBIO 453, and 455, is taken by students from all Medical School basic science departments.

Biochemistry 611-612 -- Biochemistry Seminar. There is a one hour departmental seminar each week. These seminars cover on-going research projects, topics of interest to the speaker and the research of invited guest speakers. Each student is required to register for 2 semesters (usually in the second year), and to present 1 literature seminar that must be unrelated to both the thesis work and the research activities of the student's advisor. The Graduate Education Committee shall serve as the student's seminar evaluation committee. If the seminar is viewed as unacceptable, the Committee will recommend that it be repeated. In addition, all Ph.D. or Ph.D.-M.D.

students must give a departmental seminar on their completed thesis work. All students are expected to attend seminar even when they are not registered for BIOC 611/612.

COURSE WORK FOR THE Ph.D. IN BIOCHEMISTRY

The course requirements are designed for students in the Biochemistry Ph.D. Program. The first semester is occupied by the standard courses CBIO 453 and 455 and the execution of laboratory rotations (as IMBS 400 or BIOC 601) to identify a thesis advisor. After completion of this first semester, a student is required to take six additional classes (18 hours minimum). Three classes in Biochemistry (one of which must be BIOC 412 or BIOC 434) and three classes outside the area of Biochemistry are required. For students in the M.D./Ph.D. program, the first two pre-clinical years are considered equivalent to the four CBIO classes (other requirements for the Ph.D. degree are as defined above for Ph.D. students). Coursework completed at the undergraduate level (i.e. calculus, physical chemistry, biology) is devalued by 50% (i.e. 2 undergraduate courses = 1 graduate course).

For students with advanced standing (some graduate course work completed, M.D. degree obtained, etc.), course requirements will be determined on a case-by-case basis by the Graduate Education Committee and/or by the student's prethesis committee. The general principle will be to obtain the equivalent of 8 three credit hour graduate courses that provide training in the general area of biochemistry, molecular biology, cell biology and structural biology.

GRADES

Graduate students should maintain at least a B average to graduate. The University has set this and other guidelines for good academic standing (see the CWRU catalogue). A cumulative GPA of 3.0 is required for graduation. Passing grades for BIOC 434,412 and other "Biochemistry" courses are A or B. A grade of C is not acceptable and the student must repeat the Biochemistry course until a satisfactory grade is obtained. Passing grades for all other courses are A, B, C, or S. Research and seminar courses are satisfactory/unsatisfactory (S/U). In the event that the course in which a grade of C was obtained is not offered the following year, an alternate course can be taken at the discretion of the Pre-thesis Committee.

**COURSEWORK FOR THE M. S. DEGREE IN BIOCHEMISTRY - SEE
APPENDIX IV**

COURSEWORK FOR THE Ph. D. DEGREE IN BIOCHEMISTRY

Example of a Ph. D. schedule

First year				Credit hours
Fall	C3MB Core	Cell Biology	CBIO 453	4
		Molec. Biol.	CBIO 455	4
		Lab rotation	IBMS 400	1
Spring	professional ethics		BIOC XXX	3
			CHEM XXX	3
			BIOC 601	3
			IBMS 500	0
Summer		research	RSCH 750	0
Second year				
Fall		seminar	BIOC 434	3
			BIOC 611	1
			BIOC 601	2
			BIOC 701	3
Spring		seminar	BIOC 420	3
			BIOC 612	1
			BIOC 701	5
Summer		research	RSCH 750	0
Third year				
Fall			GENE 500	3
			BIOC 701	3
Spring		proposition	BIOC 641	2
			MBIO 445	3
			BIOC 701	3
Summer		research	RSCH 750	0

Forth year

Fall	BIOC 701	1
Spring	BIOC 701	1
Summer	RSCH 750	0

Fifth year

Fall	BIOC 701	1
Spring	BIOC 701	1

Requirements to satisfy the Department and the School of Graduate Studies

CBIO 453, 455	C3MB	8
BIOC 412 or BIOC 434		3
BIOC 601		6
BIOC 611/612	seminar	2
BIOC 641	proposition	2
BIOC 701	thesis research	18
total credit hours in advanced Biochemistry classes		9
total credit hours in advanced science classes (not Biochemistry)		9

3. Annual Review of Student Performance

It takes a considerable level of commitment to successfully meet the requirements for obtaining the Ph.D. degree. Except for the first year of study, when coursework puts heavy demands on the student's time, the Department expects students to consider laboratory research as a full time endeavor and to be mentally and physically engaged in its practice. At the end of each year, each student's progress shall be reviewed by the Graduate Education Committee and the general conclusions communicated to the student by the advisor. If after careful consideration of the student's academic record, and other relevant factors, it is the opinion of a majority of the Graduate Education Committee that further graduate training in the department is not justified, the student, after being notified of the reason will be placed on probation. Should a second semester of unsatisfactory progress be reported, the student may be separated from the Program. In case of doubt, the decision shall be in the student's favor, and he/she shall be permitted to enroll in the next year's work with the explicit understanding, in writing, that continuance shall be contingent upon satisfactory improvement over the previous year's performance. If it becomes apparent, by the end of the first semester of the next year that the student is not making satisfactory progress, the student, at the discretion of the Graduate Education Committee, may be offered the alternative of completing the requirements of the M.S. degree (see Appendix IV).

4. Propositions for Qualifying Examinations

The student is asked to submit a Research Proposition that states a problem meriting investigation, and then presents the experimental design by which the problem might be studied. This problem should be unrelated to the students' thesis research, the advisor's research and the student's literature seminar. After the preliminary proposition is approved, the student is asked to write a full-length document and to defend it in an oral examination by a committee. The examination committee will be assembled based upon faculty expertise relative to the research topic chosen by the student. The committee of three faculty will be constituted with either one or two faculty members of the Biochemistry Department. The proposition is to be defended no later than the Spring of the third year (For Ph.D.-M.D. students, no later than Spring of the fourth year). For full details (and for Ph.D.-M.D. students) see Appendix II.

5. Candidacy for the Ph.D. Degree

The graduate school requires formal admission to candidacy for the Ph.D. degree. Students will be admitted to candidacy following satisfactory performance on the qualifying exam (research proposition).

6. Language Requirement

The University and the Program in Biochemistry do not require a reading knowledge of a foreign language.

7. University Requirements for the Doctorate

a. Full-time students must be registered for fall, winter and summer semesters. This requirement is met by registration for 9 credit hours (including dissertation research) each regular semester (Fall and Spring) or at least one credit hour of either BIOC 601, BIOC 651 or BIOC 701 and 0 credit hours of RSCH 750 during the summer session. In sum, the student is effectively registered as a full-time student year round through the period of his/her position as a Ph.D. candidate in the Biochemistry Program.

b. The qualifying examination must be passed no later than the semester before the student expects to receive his/her degree. The Chairman of the Graduate Education Committee will notify the Graduate School as soon as the student has completed his/her proposition.

c. The dissertation must present a significant contribution to existing knowledge in the student's field and at least a portion of the content must be suitable for publication in a reputable professional journal or as a book chapter or monograph.

d. All the requirements for the Ph.D. must be completed within a total of five consecutive calendar years after a student first registers for dissertation research (BIOC 701), including leaves of absence. Students whose leaves of absence are for duty in the Armed Services or maternal/paternal leave will automatically have the time limitation extended by an equivalent time period. A student who fails to complete the requirements within five years in order to continue his/her studies for the degree may request and be granted an extension of a maximum of one year.

e. Once a student registers for Dissertation Research (BIOC 701), she/he must continue her/his registration for BIOC 701 each succeeding regular semester (Winter and Spring) until the dissertation is complete.

8. Thesis (See Also Appendix III)

General -- It is the responsibility of the student's Thesis Committee (Official University Committee; see section 9) to evaluate the thesis. In general, the acceptance for publication of a substantial portion of the thesis by a recognized journal will constitute one type of independent evidence of the acceptability of the thesis. If publication prior to graduation is not possible, it shall be the Official University Committee's duty to evaluate the thesis carefully with regard to future publication and if the thesis in their opinion does not seem likely to yield at least one major paper, the entire thesis should be re-examined carefully with the view that additional work may be desirable.

Thesis Review Process -- A complete rough draft of the thesis must be in the hands of the advisor not later than 2 months preceding the thesis defense date. This time limit leaves only one month for reading, editing, and typing of the thesis and therefore submission of the rough draft by this deadline is essential. When the rough draft of the thesis has been approved by the advisor and at least one other member of the Pre-Thesis Committee (the reader), the student should go to the Graduate School Office for information on thesis specifications and format. For current regulations see Appendix II. It is the student's responsibility to make sufficient hard copies of the final version for distribution to the University Committee. This document must be in final form such that it could be directly sent to the library for binding. Thus, the thesis should be in grammatically correct English and all figures in final form. The copies are then distributed to the members of the Official University Committee. The Committee members may request certain corrections to the version the student handed to them. The Department will pay for the cost of binding 3 copies of the thesis (one for the student, one for the advisor, one for the Department).

University Editor – With the advent of electronic media, the University now usually accepts a CD of the student's thesis and instructions for uploading the thesis to a standard repository are available from the School of Graduate Studies.

9. Appointment of the Official University Committee

The Committee is composed of five members consisting of the advisor, the chair of the pre-thesis committee, possibly another member of the Biochemistry graduate teaching staff (preferably also a member of the pre-thesis committee), and at least two members from other departments. Ordinarily these members are chosen by the student and his/her advisor because: (a) they represent fields in which the candidate has had considerable training, or (b) because they have a special interest and competence in the field of the thesis problem. The prospective members are then contacted by the student's advisor and if they signify their willingness to serve, a formal recommendation is made by the Departmental Chairman to the Dean of the Graduate School asking that such a committee be appointed. The Committee must be appointed no later than three weeks before the date of the examination.

10. Final Examination (Defense of Thesis)

After allowing sufficient time (at least 10 working days) for the thesis to be read by the members of the Official University Committee, the candidate meets with the Committee for a final oral examination. The student makes arrangements for the time and place of the examination and then formally requests of the Dean of the Graduate School that the examination be set on the specified date and that the Committee be notified. As the Department currently requires the student to present his/her thesis work in a Departmental seminar prior to the formal defense, the most common practice will be to have the seminar at noon and the defense following immediately thereafter.

Report to Graduate Office -- Following the oral examination, a report of the examination must be submitted to the Graduate School Office. The proper form is entitled "Final Report on The Candidate for the Ph.D. Degree" and one copy signed by the members of the Official Committee is sufficient. In addition, the Official Committee members must sign five copies of the Thesis Approval Forms.

11. Financial Assistance to Graduate Students

In view of the length of time necessary to attain an advanced degree, and in order that graduate training may be open to students on the basis of merit, and not financial resources, the Program provides financial assistance for all of its graduate students. The present scale for M.S., Ph.D. and Ph.D.-M.D. candidates is a stipend of \$23,500 per year

(effective as of September 1, 2007) with four weeks of free time and with tuition exemption if eligible under graduate school regulations. It should be noted that holiday periods such as the Christmas and Spring breaks do count as part of the allowable four weeks. Legal holidays are not considered additional free time.

12. Attendance at Scientific Meetings

Ph.D. and M.D.-Ph.D. students are encouraged to attend one major scientific meeting each year. Toward this end, an equitable share of the departmental funds available for travel shall be allocated to those graduate students directly connected with the department, should the advisor have inadequate travel funds.

13. Program Responsibilities of Graduate Students

The departmental responsibilities of the graduate students fall into the following general categories.

- a. Teaching duties.
- b. Maintaining equipment or carrying out other duties such as care of cold rooms, conference rooms, library, etc. that are specifically assigned to the student.
- c. Cooperating in the general maintenance of all departmental equipment, conference rooms, store rooms, cold rooms, etc., even though not assigned specifically to the student.
- d. Participating in seminars and journal clubs.
- e. Maintaining the laboratory bench and the laboratory in which the student works in a tidy condition.
- f. Making suggestions and plans for the general improvement of the Program.

Most of the above responsibilities require no specific comment. The principal teaching duties of the graduate students are grading homework and exams for undergraduate Biochemistry courses and holding conferences/review sessions for undergraduate and graduate students. These duties constitute an important part of the graduate student's training and every full-time biochemistry student is required to assist, unless excused by the staff. An attempt will be made to lighten the load of fifth year

Ph.D. students and fifth year Ph.D.-M.D. students (third year in the laboratory); otherwise, the duties shall be divided as equitably as possible.

The teaching duties of the student should be considered a serious responsibility and should not be neglected in favor of research or course work during the period of such assignments as in aggregate, the teaching duties are light. Research achievement and scholastic record are obviously of prime importance, but the extent to which the student assumes departmental responsibilities is also considered in evaluating a graduate student's performance.

14. Publications -- Authorship and Credit for Work

Credit for participation in scientific work by a graduate student shall be acknowledged appropriately in all publications. The nature of the acknowledgment shall be in accord with the student's actual contribution to the problem, and shall not be prejudiced by the lack of academic rank. Specifically, in a collaborative effort in which a student makes the major scientific contribution, the student's name shall appear on the publication in the position of first author. It shall be the responsibility of those supervising the work of graduate students to guard against injustices in this connection. If the graduate student believes that proper assignment of credit has not been made, the questions should first be discussed among the collaborators, where the problem should be settled. If agreement is not reached, the dispute should be submitted to the Graduate Education Committee for arbitration.

15. Procedures to be Completed Before Leaving the Department

- a . The laboratory bench and desk shall be left clean.
- b . Stocked items are to be cleaned and returned to the stock room, and borrowed equipment returned to the appropriate laboratory.
- c. All stock chemicals should be returned to the shelves.
- d. Check items stored in refrigerators, freezers, and cold rooms and dispose of those unneeded.
- f. All keys should be returned.
- g. All books belonging to libraries and individuals should be returned.
- h. The Post Office and Departmental Office should be notified, and provided with a forwarding address.

- i. Arrangements should be made for the distribution of thesis.

16. Health Service Facilities

- a. Student Medical Plan -- All Biochemistry Program graduate students registered as full time students will receive this coverage for outpatient service. This service is also available during the summer months by special arrangements between the Department and Student Health Service even though the student may not be registered for credit at that time. The University Health Service (phone number 368-2450) is located at 2145 Adelbert Road and has the following hours of service:

Spring and Fall Semesters: MTWF 8:30 A.M. to 4:30 P.M.

Th 9:30 A.M. to 4:30 P.M.

Summer semester and other times: MTWF 8:30 A.M. to Noon, 1:00 P.M. to 4:30 P.M.

Th 9:30 A.M. to 4:30 P.M.

Appointments with the Health Service can be made by calling 368-4539. In case of an emergency, a nurse or physician of the counseling staff is available 24 hours a day, 7 days a week at 368-2450. Most emergencies will be referred to the Emergency Room of University Hospitals. Further descriptions of services offered are available in the CWRU catalog or in information booklets from the University Health Service. In case of a serious emergency, go directly to the Emergency Room located at the end of Emergency Drive off of Cornell. As medical coverage varies a bit from year to year, students are encouraged to seek the Graduate Student Coordinator if they have questions about their coverage.

APPENDIX I

Pre-Thesis Committee

Biochemistry Program policies require that all students have an advisory committee, the principal function of which is to provide advice and counsel to the student during the training period. The committee must meet at least once during each of the academic years that the student spends in the program. Initially, the committee will provide advice and oversight regarding the student's coursework, which should be discussed at each meeting. As appropriate, the committee will review plans for the student's research program, and provide guidance relating to the research or any problems that may arise. A Pre-Thesis Committee Report Form must be submitted by the Committee chair to document each meeting. The same committee will serve as the examining committee for review and approval of the student's research report at the conclusion of the studies.

The committee should consist of at least three faculty members for M.S. students and four faculty members for Ph.D. students, including the research adviser. At least two of these should be members of the Biochemistry Program faculty, one of whom will serve as the chair, but not the advisor. Additional members may be any faculty member with appropriate research expertise. For those students (and advisers) who are new to the Program, it is strongly recommended that two of the committee members be Biochemistry Department faculty who are familiar with the operation of the committee.

Please discuss suggestions for your committee with your adviser and with the appropriate representative of the Graduate Education Committee (currently Dr. Paul Carey), if necessary, and select other appropriate faculty members, as noted above. After obtaining the prior agreement of faculty members to serve on the committee, please submit their names to the Graduate Education Committee as soon as possible, so meetings can be scheduled for the spring term.

GUIDELINES FOR THE FIRST PRE-THESIS MEETING OF Ph.D. STUDENTS IN BIOCHEMISTRY

INTRODUCTION: Ph.D. students in the second year of the graduate program in Biochemistry must prepare a reasonably complete description of their intended thesis research for the first Pre-Thesis meeting. The student will be expected to formulate and

explain the specific research project which, at the time of the meeting, appears to be the most likely subject for continued research leading to a completed thesis. Prior to the meeting, the student will provide a written description of the project, which will be modeled after a NIH grant application, as described below. The student must write the proposal independently, but is encouraged to seek help from his/her adviser, students, postdocs and other faculty members. The student is expected to be familiar with the scientific literature in the field, manuscripts, grants, etc. from his/her laboratory and with related work from the chosen field of study. Students are encouraged to schedule this first meeting as soon as their familiarity with the research project allows, but certainly no later than the end of the second academic year.

FIRST PRE-THESIS MEETING: The first pre-thesis meeting is neither an examination nor an adversarial forum, but is intended to be the basis for exchange and discussion of scientific information and ideas, and for development of a mentoring process. The meeting is intended to serve several functions. Initially, it presents the students with an opportunity to focus on and begin to formulate their own research project, with the help and advice of their advisers. The intent is to encourage students, as early as possible, to do the necessary background reading needed to understand and formulate a focused research program. Second, it gives the students practice in preparing a research proposal, both for their proposition defense in the next year and for writing proposals in the future. Third, it provides a format for students to obtain the advice and guidance of their advisers and other faculty in preparing research proposals, before the proposition examination. Finally, it enables the students to become acquainted with the faculty members, who will be their most immediate mentors and advisers during their graduate work in Biochemistry. For the faculty member of the committees, the first meeting is important to acquaint the faculty with the details of the planned project, as well as to provide the opportunity to begin the mentoring process they will continue during the student's education.

The first meeting is to include a written description of the research project, following the guidelines outlined below, an oral presentation of the project by the student, and discussion with the committee members. It is the responsibility of the

student to arrange a meeting time and location acceptable to the entire pre-thesis committee, and within the deadlines set by the committee coordinator.

WRITTEN COMPONENT: The written component will be a concise description of the thesis research project in the student's own words. The basic format of the document will be that of an NIH grant, as outlined below. Other persons, including the adviser, may provide detailed criticisms of the project description, but the final organization and writing must be the student's. The completed written component (doubled spaced with normal margins and type) must be give to the committee members at least one week prior to the meeting.

A copy of the written description must be attached to the Pre-Thesis Committee Report Form and submitted to the Graduate Studies Coordinator for inclusion in the student's file.

ORGANIZATION OF THE WRITTEN PROJECT DESCRIPTION

A. SPECIFIC AIM: Consists of a clear statement of the central hypothesis or the research problem, the general approach to be taken and the significance of the proposed studies. Limit two pages.

B. BACKGROUND: Consists of a concise summary of pertinent literature and its bearing on the proposed research. This section should place the proposed experiments in a broad biological context so that the significance of the research is clear. Limit six pages.

C. PROGRESS REPORT: Consists of a summary of any research done to date and how it relates to the proposed experiments. Limit, four pages. Preliminary results are not necessary for the first pre-thesis meeting. The emphasis of the meeting is on appropriate background information for and feasibility of the project. It is not intended to evaluate laboratory skills, accomplishments, or other achievements of experienced investigators.

D. EXPERIMENTAL DESIGN AND METHODS: Consists of a presentation of the detailed plan and sequence of experiments which will answer the initial hypothesis presented in specific aims. Procedures should be presented in a logical format so that it is clear how experiments are related to one another and to the overall objectives of the study. Protocols should be described in sufficient detail so that it is clear the student

understands a procedure, yet not so detailed that a reader becomes overwhelmed. The analysis and interpretation of the data generated from each procedure should be part of the description of any proposed experiment. The advantage and/or limitation of new methodologies over existing methodologies should be presented as well as alternative approaches to achieve an aim in the event that an initial attempt is unsuccessful. Structure the problem so that any result, positive or negative is interesting. Limit, eight pages.

LITERATURE CITED: An appropriate bibliography must be provided with all citations in a complete and acceptable scientific format (author, article title, journal, etc.).

ORAL COMPONENT: The student must orally describe the research to the committee. The student should be familiar with the areas of Biochemistry which are related to his/her research topic and the contents, in some detail, of any literature cited. The discussion will center on the feasibility, experimental design and interpretation of results, as presented in the written document.

Committee members are expected to provide feedback to the students, which will aid him/her in preparation of the proposition defense for the next year, in preparation of future grant applications, and in carrying out future research.

SUBSEQUENT PRE-THESIS MEETINGS - For all pre-thesis meetings held after the first one, the student should provide each member with a write-up of progress to date with sufficient background/introductory material to allow the committee to evaluate the appropriateness of the project, the progress made to date and where problems might exist. The student must have at least one pre-thesis meeting every year. At the request of either the student or one of the members of the pre-thesis committee, additional meetings can be held depending on need. For each subsequent meeting, the student should also provide an update on progress made with respect to coursework, literature seminar, and qualifying exam. The chair of the committee should write a one page description of the content of the meeting and a copy of all the written material plus this description should be placed in the student's file.

APPENDIX II

GUIDELINES FOR THE RESEARCH PROPOSAL (Proposition)

INTRODUCTION: Students in their third year of the graduate program in Biochemistry must complete a proposition. Propositions are part of the qualifying procedure for the Ph.D. degree and consist of both written and oral components. The format of the written component of the exam will be modeled after a NIH grant application as described below. The student must write the proposal independently but is encouraged to seek help from his/her advisor, students, postdocs and other faculty members.

PRELIMINARIES: Students during the summer following their second year in the graduate program should begin to formulate the major hypothesis on which his/her research proposal will focus. The subject of the research proposal may not be related to the student's (or the advisor's) research nor the student's literature seminar. During the fall of the third year of graduate school, each student will submit an abstract to the proposition coordinator clearly stating the central hypothesis and a general outline of the plan of attack. The abstract will be limited to one page. The abstract will be used for initial "approval" of the topic and committee selection. In the spring of that academic year, the student will register for BIOC 641 (proposition 1) and defend the proposition.

WRITTEN COMPONENT: The written component will be a concise description of the student's original research proposal. Others, including the advisor, may provide criticisms of the proposal but the final organization and writing of the document must be the student's alone. The completed written component (double spaced with normal margins and type) must be given to the committee members two weeks prior to the oral exam.

ORGANIZATION OF THE DOCUMENT

A. SPECIFIC AIM: Consists of a clear statement of the hypothesis, the general approach to be taken and the significance of the proposed studies. Limit two pages.

B. BACKGROUND: Consists of a concise summary of pertinent literature and its bearing on the proposed research. This section should place the proposed experiments in a broad biological context so that the significance of the research is clear. Limit six pages.

C. PROGRESS REPORT: Consists of a summary of any research done to date and how it relates to the proposed experiments. Limit, four pages. This would likely be data from papers or seminars which formed the starting point for the proposed research whereas Background (above) sets the historical context for the proposed studies.

D. EXPERIMENTAL DESIGN AND METHODS: Consists of a presentation of the detailed plan and sequence of experiments which will answer the initial hypothesis presented in specific aims. Procedures should be presented in a logical format so that it is clear how experiments are related to one another and to the overall objectives of the study. Protocols should be described in sufficient detail so that it is clear the student understands a procedure, yet not so detailed that a reader becomes overwhelmed. The analysis and interpretation of the data generated from each procedure should be part of the description of any proposed experiment. The advantage and/or limitation of new methodologies over existing methodologies should be presented as well as alternative approaches to achieve an aim in the event that an initial attempt is unsuccessful. Structure the problem so that any result, positive or negative is interesting. Limit, eight pages.

E. LITERATURE CITED:

References should be cited as is appropriate for a journal representative of the research area. The references should include all authors, inclusive page numbers and the title of the article.

ORAL COMPONENT: The student must orally defend the written research proposal before an examining committee. The student should be familiar with the areas of Biochemistry which are related to his/her research proposal topic and the contents, in some detail, of any literature cited. The bulk of the defense will center on the feasibility, experimental design and interpretation as presented or omitted in the written document.

EXAMINING COMMITTEE: The examining committee will consist of Biochemistry members as felt necessary by the proposition coordinator (often one non-

Biochemistry faculty member is also a member). Usually there will be three members on the examining committee.

EVALUATION: The committee will grade both the written and oral components of the proposition for feasibility, knowledge, and presentation. An overall grade of "Pass", "Conditional Pass" or "Fail" will be determined by the committee. If a grade of "conditional pass" is given, specific weakness(es) in the student's performance will be identified and only that portion of the initial component of the proposition need be repeated. The committee will schedule a new completion date (usually no more than two weeks) for the additional material. In the event of a "Fail" grade, the entire proposition, both written and oral must be retaken including the choice of a new topic. The committee will recommend types of improvements which need to be made in the second research proposal which were not present in the first. Failure to pass the second proposition/qualifying exam will result in the termination of the student's participation in the Ph. D. program. At this point, the student may obtain a Master's degree if all of the requirements for this degree are met.

DETAILS: The initial one page summary abstract is due in the fall semester when requested by the proposition coordinator. The abstract will be provided to each member of the examining committee so that preliminary feedback can be provided to the student. Defense dates will be decided by lottery so that the times will spread throughout the spring of the third year in the Biochemistry Program (for Ph. D. students, their third year, for M. D./Ph. D. students, their fifth year). The proposition must be completed by the end of the spring semester of the third year. The final written document must be distributed to the committee members no later than two weeks prior to the defense date. Arranging a defense time and location acceptable to the entire examining committee is the responsibility of the student. Copies of the abstract, written report, committee report, and any materials related to a conditional pass must be submitted to the Graduate Coordinator for placement in the program files.

APPENDIX III
INSTRUCTIONS FOR THE PREPARATION
OF THESES AND DISSERTATIONS

(See also section 4 of the Graduate Student Information Brochure)

The style manual adopted by the Graduate Council for theses and dissertations at Case Western Reserve University is A Manual for Writers of Dissertations by Kate L. Turabian, published by the University of Chicago. This guide may be purchased at the University Bookstore in Thwing Hall. Other style manuals may be followed only by special permission of the Office of Graduate Studies, in any case, the following regulations apply.

NUMBER OF COPIES REQUIRED

1. Deposit Copies for the Library

See current School of Graduate Studies requirements.

2. Additional Copies for the Examiners

A sufficient number of Master's and Doctor's theses are required for each member of the examining committee, normally: Master's Theses -- 3; Doctor's Theses -- 5. It is the student's responsibility to deliver to each examiner a copy of his thesis at least ten working days prior to the examination.

3. Department

A bound copy of the thesis will be given to the advisor and a bound copy will be kept in the Merton F. Utter Reading Room (library - W443) of the Biochemistry Department.

FORMAT OF THESES AND DISSERTATIONS

4. Paper

Deposit copies for the Library must be on 20-pound bond with at least 25% rag-content paper. Additional copies may be on lighter weight paper.

5. Margins

The margins on the left side of all pages must be at least 1 1/2". Top, bottom and right-hand margins must be at least 1 1/4".

6. Spacing

The text should be double spaced (not space-and-a-half). Quotations of three lines or more, itemized or tabulated material, footnotes, and bibliography should be single spaced and indented. Footnotes, when used, should be separated from the text by an underline across the page. The first line of a footnote should be indented as for paragraphs. Double space between footnotes.

7. Title Page

The title page of the thesis or dissertation should follow the format of the Graduate School. An extra copy of the title page of the doctoral dissertation is required for University Microfilms. An extra copy of the title page is not required for Master's theses.

8. Abstract

An abstract of the thesis or dissertation, not to exceed 500 words, must be submitted with each copy of the thesis following the format of the Graduate School. An extra copy of the abstract of the doctoral dissertation is required for University Microfilms. An extra copy of the abstract is not required for Master's theses.

9. Organization of Material

Detailed organization of the thesis material is left to the student and his/her thesis advisor. However, each thesis or dissertation is to contain:

Title Page

Abstract (not to exceed 500 words)

Acknowledgments (where applicable)

Table of Contents

List of Figures (where applicable)

List of Tables (where applicable)

Body of Thesis

Appendices

All preliminary material such as the title page, abstract, etc., should be numbered in lower case Roman numerals (e.g. ii, iii). Beginning with the body of the thesis, Arabic numerals should be used (e.g., 1, 2, 3).

10. Style

The thesis should be written in a style consistent with the publication style of journals representative of the student's research area. All journals have available a copy of "Instructions to Authors" as a separate document or in the journal itself (usually each volume will contain this information or cite the volume in the series which does). Of particular importance is adherence to standard nomenclature and a standardized form of reference citation. Independent of the journal style chosen, the references should include the complete title of the cited article.

APPROVAL OF FORMAT BY THE GRADUATE STUDIES OFFICE

The University copies, completely typed in final form, after approval by the examiners, must be submitted to the Graduate Studies Office (see current rules from the School of Graduate Studies for the electronic deposition of the thesis). It is strongly recommended that the first chapter be checked by the Graduate Studies Office before the typist is permitted to continue. Arrangements for bindings additional personal copies may be made with the University Bookstore or a private bindery. The Department of Biochemistry will pay for the binding of three copies, see Graduate Student Brochure, item 8.

SHORT TITLE OF THESES AND DISSERTATIONS

If the title of the thesis or dissertation and last name of the author exceeds 75 spaces, a shortened title must be submitted. This title is used for various purposes, including its use on the spine of the bound volumes deposited in the Library.

SCHEDULE OF GRADUATION FEES

Consult the Graduate Studies Office for a schedule of fees. In case of doubt or if you have any questions about thesis form, please feel free to consult the Office of Graduate Studies (Baker Building, extension 4390) at any time.

APPENDIX IV

Requirements for the M.S. Degree

The Master's of Science degree programs provide advanced training for persons who wish to continue beyond the B.A. or B.S. degree, without committing themselves to a Ph.D. curriculum. Two lines of study are offered:

- I. The Master's of Science in Biochemical Research, a three year program with heavy emphasis on research.
- II. The Master's of Science in Biochemistry, a two year course work program.

I. Master's of Science in Biochemical Research (MSBR)

1. Duration

The duration of the MSBR program is 33 months. Applicants who have been working as full time laboratory technicians may be granted 1 semester credit for one full year of work, and up to 2 semesters credit for two or more years of work. Credit for acceptable didactic course work may be awarded up to a total of 14 hours. All decisions concerning advanced standing or transfer of credit will be made by the Graduate Education Committee following acceptance into the program and in consultation with the advisor. Courses taken to satisfy other degree requirements (i.e. BA or BS) may not be transferred for credit. The maximum of 6 hours is set by the Graduate School as all that can be transferred toward the course requirements for advanced degrees. The program shall not be extended on the basis of work that needs to be completed in order to achieve a publishable result.

2. Academic Credit

The MSBR program follows the Plan A for the Master's degree (see CWRU catalog in the section School of Graduate Studies). The program requires 38 hours of academic credit (including both research and didactic courses) as well as the writing and defense of a thesis. All courses must be at the 400 level or higher. The credit includes didactic courses, research (BIOC 601) and M.S. thesis research (BIOC 651). BIOC 651 is taken only in the third year for 1 credit per semester and requires an examination by the student's pre-thesis committee and a written thesis. The student's

transcript will be annotated M.S. in Biochemical Research, including the title of the student's independent project.

Within the first 2 weeks of the student's matriculation, she/he chooses an academic advisor. In general the selection process involves discussions with those faculty members who have announced their interest in taking a Master's student. In some cases the student may be invited to spend up to a week in the prospective advisor's laboratory to facilitate the decision making process. In the early spring of the first year, an advisory committee (Pre-thesis committee) of three faculty members (at least two of which must be members of the Biochemistry faculty) is chosen by the student, in consultation with the advisor. In yearly meetings, this committee provides additional scientific expertise, offers support in overcoming research difficulties and evaluates the student's progress in research and course work.

3. Didactic Course and Course Credit

All course work has to be at the 400 level or higher. BIOC 407 is required of all students. It may be waived for those who have had a course with content roughly equivalent to that of 307/407. Four courses (12 hours) are the minimum requirements for didactic courses. Additional courses may be taken at the option of the advisory committee.

4. Registration

Students register for didactic courses and for research, all of which carry academic credit. While a student will sign up for courses of various credit values (e.g., BIOC 407 is 4 hours, special topics courses are 2-3 hours), the student should always sign up for research (either 601 and 605) for a total of 9 hr. An example of a Master's schedule is included for reference. Also note that the student must register for the summer semester.

**Example of a Schedule for a Candidate
for the M.S. in Biochemical Research**

YEAR I	Fall	BIOC 407	4 hours
		BIOC 601	5 hours
	Spring	BIOC 408	4 hours
		BIOC 601	4 hours
		BIOC 651	3 hours
	Summer	RSCH 650	0 hours

YEAR 2	Fall	CBIO 434	3 hours
		BIOC 601	3 hours
		BIOC 651	3 hours
	Spring	CBIO 412	3 hours
		BIOC 601	3 hours
		BIOC 651	3 hours
	Summer	RSCH 650	0 hours

YEAR 3	Fall	BIOC 601	8 hours
		BIOC 651	1 hour
	Spring	BIOC 601	8 hours
		BIOC 651	1 hour

It should be noted that advisors grade BIOC 601 and BIOC 651 as U/S (unsatisfactory/satisfactory).

5. Thesis

Every student will write a thesis. Co-authorship (achieved or anticipated) on one or more papers does not substitute for the thesis. The Pre-thesis committee will conduct an examination on the basis of the report.

6. Student Progress

A. Adequate Performance

Maintenance of satisfactory academic standing in the M.S. program requires adequate performance both in coursework and in the laboratory. Separation due to inadequate performance in laboratory work may occur for reasons that include lack of acquired skills or lack of effort. In this case, the student will receive a grade of "U" in BIOC 601 after the advisor consults with the Graduate Education Committee. Adequate written documentation of poor performance shall be provided to the student and recorded in his/her file. The receipt of a grade of "U" in a semester may be sufficient grounds for separation from the program.

Because of the special relationship between the advisor and student in the M.S. in Biochemical Research program, it is incumbent upon the student, not only to perform adequately in the laboratory work, but also to establish and maintain an agreeable working relationship with the advisor. The rapport and positive interaction in the laboratory environment is an essential part of the training for leadership in this research degree. Nevertheless, the rare situation may arise in which the student performs adequately in coursework and reasonably in the lab, but desires to transfer from the advisor's laboratory. Such a decision should not be made lightly by the student.

a. Transfer to the Ph.D. program requires the normal application and acceptance by the appropriate admissions committee. Only the exceptional student who is clearly qualified will be allowed this option. Upon admission to the Ph.D. program, the student will have access to all available labs at that time. Transfer of course work will be decided by the Graduate Education Committee.

b. Transfer to another department or to another school will follow standard University procedures and be viewed simply as a voluntary separation from the M.S. program.

c. Transfer to another advisor's laboratory within the Program will only be allowed if an agreeable working relationship with her/his mentor can no longer be maintained, i.e. a "personality conflict" exists, even after sincere effort on the part of both participants. Every effort shall be made by both the student and the advisor to reconcile difficulties in consultation with the Graduate Education Committee.

Master's of Science in Biochemistry (MSB)

The duration of the MSB program is 21 months; it follows the Plan B for the Master's degree (see CWRU catalog in the section School of Graduate Studies). The default advisor for this program is Dr. Merrick, but another advisor may be selected. The student's progress is monitored by a three member Progress Committee selected by the student and by the Graduate Education Committee. The program requires 27 hours of academic credit (including didactic courses and 6 to 12 hours of BIOC 601, Biochemical Research). All courses must be at the 400 level and either from the available list of approved electives, or approved by the advisor. A sample program is as follows.

Semester 1. BIOC 407 (4)
 BIOL 445 (3)
 BIOC 601 (2)

Semester 2. BIOC 408 (4)
 BIOL 443 (3)
 BIOC 601 (2)

Semester 3. BIOC 434 (3)
 PATH 416 (3)
 BIOC 601 (3)

Semester 4. BIOC 412 (3)
 PATH 467 (3)
 BIOC 601 (2)
 EXAM 600 (1)

For the required BIOC 601 course, the student selects a laboratory in which to carry out this research, in consultation with the principal investigator. The final exam (EXAM 600) tests the overall knowledge of the student, as well as his or her specialized understanding of a special topic, which usually will be related to the BIOC 601 research carried out by the student. It will be administered by the student's Progress Committee.

APPENDIX V
FORMS FOR GRADUATE STUDENTS

1. Form 1, Planned Program of Study - This form is to be filled out by Master's, Ph. D. and M.D./Ph. D students as soon as they have chosen an advisor. Note that besides the courses the student proposes to take, there is also a place to list the student's Advisory Committee (which we call the Pre-thesis Committee - see page in the Handbook for further details). This form is used mainly as a check list by the Graduate School to see whether you have completed all the course work necessary for your degree program.

2. Form 2, Revisions to student's planned program of study - In the event you decide to take different courses than originally reported to the Graduate School, you need to report these changes. These forms should be filled out at roughly the time you take the alternate course. Unfortunately, it is likely that each student will fill out one of these as there are a wide variety of excellent courses offered in several departments that are given as "special topics". These courses tend to show up without warning and often are not given on a regular basis.

3. Form 3 - This form is only for Ph. D students. It should be filled out as much as possible within three months of joining the advisor's laboratory. In particular it **ABSOLUTELY** must have the student's name, the advisor's name and the advisor's signature (along with that of the Chairman). Failure to have this form on file with the Graduate School means that the student will not be allowed to register for BIOC 701, Biochemistry thesis research. As additional information becomes available (addition of faculty to the pre-thesis committee, date of passage of the qualifying examination), it will be added to this form and forwarded to the Graduate School.

4. Form 4 - This form should be filled out entirely for each pre-thesis meeting by the student and handed to the chair of the pre-thesis meeting. This form (along with the

chair's letter and a copy of the student's report) should be placed in the student's permanent file.