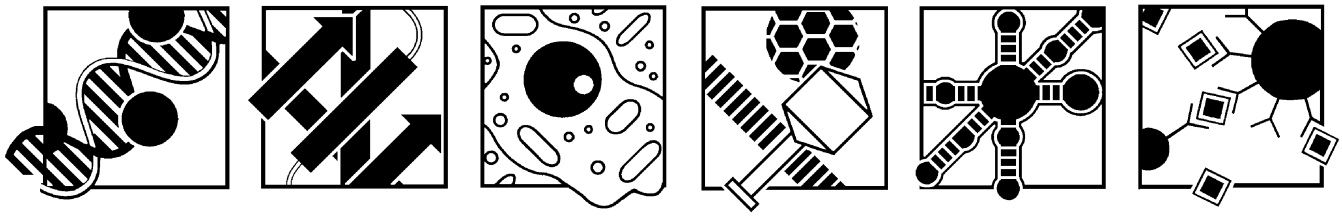
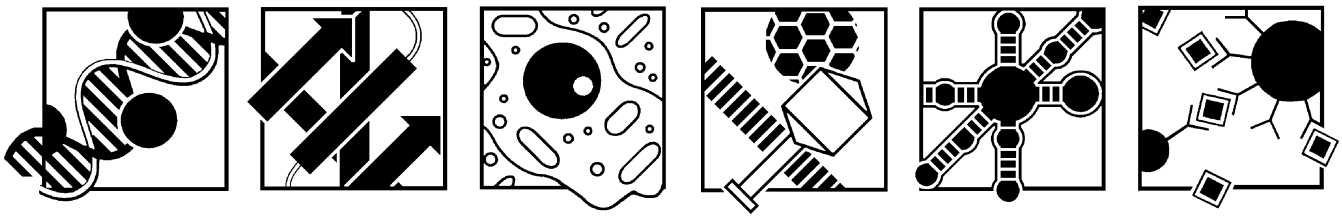


CELLULAR & MOLECULAR BIOLOGY PROGRAM
UNIVERSITY OF MICHIGAN
http://www.med.umich.edu/cmb/

STUDENT
and
FACULTY HANDBOOK

2007 Edition



GRADUATE PROGRAM IN CELLULAR AND MOLECULAR BIOLOGY

GRADUATE STUDENT AND FACULTY HANDBOOK

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CELLULAR & MOLECULAR BIOLOGY PROGRAM

STUDENT AND FACULTY HANDBOOK

GENERAL INFORMATION AND TIMETABLE

The Graduate Program in Cellular and Molecular Biology (CMB) at the University of Michigan is a University-wide, interdisciplinary Ph.D.-granting Program. It provides broad-based training in research involving cellular and molecular biology. CMB trains students to address biological problems from multiple perspectives through individualized, flexible programs of coursework and research.

This guide outlines the steps necessary to complete the requirements for the Ph.D. degree in the CMB Program. A provisional timetable for completion of the program is provided, although each student is guided through the program individually. Students can select CMB at the outset of their graduate training or after the first year in the Program in Biomedical Sciences (PIBS). The timetable is organized according to candidacy status for the Ph.D. degree

Milestone	To be Completed By
Pre-Candidate:	
First Year:	
Lab Rotations (at least 2; additional possible)	6/01 of first year (within PIBS)
Course work	End of second year (MSTP end of first year)
Responsibility in Research	End of first year (within PIBS)
Selection of thesis advisor	6/01 of first year
Second Year:	
Course work (15 credits)	End of second year (MSTP end of first year)
Student Seminar (CMB 850)	Throughout
Short Courses (CMB 630)	Attend at least 4 semesters
Preliminary exam	4/30 of second year (MSTP first year)
Advance to Candidacy	End of second year (MSTP first year)
Form Thesis Committee	End of second year
Attendance at 4 Dissertation Seminars	By end of second year
Candidate	
Third Year and Beyond:	
Student Seminar (CMB 850)	Throughout
Short Courses (CMB 630)	Attend at least 4 semesters
Teaching (one term)	End of the fourth year
Thesis Committee Meetings	Every 6 months
Completion of Degree Requirements	Usually 4-6 years (5 yr avg)
Attendance at 4 Dissertation Seminars	Every Year

Please feel free to discuss any aspect of this guide with members of the Program Committee at any time. A major asset of the CMB program is its flexibility. The Program Committee considers petitions to alter requirements of the training program outlined here to meet the needs of individual students.

ACADEMIC ADVISING

PIBS students meet with the CMB Faculty Advisor or CMB Director as needed for information about CMB and coursework during the first year. A senior CMB student volunteer is also available as a Precandidate Advisor, to discuss course selection and scheduling from a student perspective.

Each pre-candidate CMB student meets individually with the CMB Director twice a year, before Fall and Winter terms, to discuss course work, lab rotations, student seminars, prelim preparations and performance. These meetings facilitate smooth and efficient transitions from the first PIBS year into the CMB Program. The flexibility and individualized nature of CMB training allows optimal overlap with typical course selections during the first year.

CMB students who have achieved candidacy meet individually with the CMB Director at least once each year. At the end of each term, the CMB Director reviews each student's transcript, lab progress and thesis research report, and thesis committee meeting reports.

COURSE SELECTION

Courses are selected and scheduled individually for each student in consultation with the Faculty Advisor or Director and the student Pre-Candidate Advisor. To provide each CMB trainee with common background, CMB **requires coursework in the areas of biochemistry, cell biology and genetics**. Appropriate coursework in each of these three areas can be selected from courses offered throughout the University to complement each student's prior background. Most of these courses are completed during the first (PIBS) year. **Elective courses** provide further intensive preparation in various areas according to each student's research specialization, to fulfill a total requirement of 15 didactic course credits. In addition, CMB students complete at least two research rotations, participate in the weekly CMB student seminar course, take Fall and Winter Short Courses and a course in Research Responsibility.

Prior to achieving candidacy, each student enrolls for a minimum of 9 units (formal coursework plus research credits) in each of the Fall and Winter terms. Students should consult the Faculty Advisor to determine the maximum number of units for which they should enroll in each term.

Required coursework:

CMB Courses

1. CMB 850 - Student Seminar (1 credit) – Mandatory weekly attendance throughout Ph.D. training, starting in the second year.

Precandidates present a critical review of a report in the scientific literature; senior students present their own research. Students and faculty participate in discussion. Training in presentation skills is built into preparation and presentation of seminars. See "The CMB Student Seminar" below.

2. CMB/HG 630 – Advanced Topics in Molecular Biology (1 credit). Offered Fall and Winter terms. Students attend at least four different terms.

Each of these "Short Courses" is a mini-symposium consisting of a series of seminars and discussions on a special topic of current interest to students, presented by leaders in the field invited over several weeks each semester. The courses are designed to facilitate student

interactions with visiting speakers. (Sponsored cooperatively by the CMB Program and the Genetics Pre-doctoral Training Program).

Basic Coursework.

Students in CMB take basic coursework in Biochemistry, Cell Biology, and Genetics (3 credits each). Appropriate courses available throughout the University are determined individually based on student's background, upon discussion with the CMB Faculty Advisor.

1. **Biochemistry (3 credits)** can be fulfilled by:
   Biol Chem 550 - Macromolecular Structure and Function (3 cr)
   -- or other appropriate courses including:
   Biol Chem/Physiol/Pharmacol 576 - Signal Transduction (1 cr)
   Biol Chem 640 – Post-transcriptional mechanisms (2 cr)
2. **Cell Biology (3 credits)** can be fulfilled by:
   CDB 530 - Cell Biology (3 cr)
   -- or other appropriate courses including:
   Physiol/ Biol Chem/Pharmacol 576 – Cell Physiol: Signal Transduction (1 cr)
   Physiol 577 – Cell Physiol: Transport and Membranes (1 cr)
   Physiol 578 - Cell Physiol: Nerve Muscle and Synapse (1 cr)
3. **Genetics (3 credits)** can be fulfilled by:
   HG 541 - Molecular Genetics (3 cr)
   --or other appropriate courses including:
   Biol Chem 650 – Mechanisms of Eukaryotic Gene Expression (3 cr)
   Micro 681 - Prokaryotic Gene Expression (1 cr)

4. **Responsibility in Research** (1 credit)- PIBS 501/503 is offered in the Fall term each year. Training in Research Responsibility is required of every CMB student. See below for details (Training in Ethics and Research Responsibility).

Course substitutions - Written requests for substitutions of "equivalent" courses should be addressed to the CMB Director or Faculty Advisor; these will subsequently be forwarded to the Program Committee if approved.

Elective Courses.

CMB requires six credits of elective courses in addition to the basic coursework to fulfill the required 15 didactic course credits. Students can take any classes to fulfill those requirements to complement their research training.

Possible Electives (not inclusive – see PIBS Curriculum Guide and UM Course Lists)**:**
The appendix shows sample curricula which reflect the flexibility and range of classes the CMB Program offers. These examples show possible course selections for a CMB student interested in Cancer Biology, Developmental Biology, Immunology, Signal Transduction.

Biological Chemistry
BCHM 525: Survey in Bioinformatics
BCHM/Pharm/Phys 576: Signal Transduction
BCHM 578: Biochemical Techniques
BCHM/Physiol/Pharm 591: Special Topics in Signal Transduction
BCHM 640: Post-transcriptional mechanisms
BCHM 645: Signal Transduction and Regulation of Gene Expression During Development

BCHM 650: Mechanisms of Eukaryotic Gene Transcription
BCHM 673: Kinetics & Ligand Binding
BCHM/CDB/M&I 675: Advanced Topics in Protein Trafficking and Localization

Biophysics
Biol Phys 520/521: Biophysical Chemistry I, II
Biol Phys 503: Macromolecular NMR spectroscopy
Biol Phys 608: Biophysical Principles of Microscopy

Cellular and Developmental Biology
CDB 580: Development
CDB 680-83: Organogenesis of Complex Tissues
CDB 710/715: Stem Cells/Development

Ecology and Evolutionary Biology
EEB 514: Topics in Molecular Evolution

Human Genetics
HG/ Physiol 555: Integrative Genomics

Molecular and Cellular Developmental Biology
MCDB 501: Professional Writing in Biology

Molecular and Integrative Physiology
Phys 510: Integrative Physiology
Phys/HG 555: Integrative Genomics
Phys/Pharm/BCHM 576: Cell Physiol: Signal Transduction
Phys 577: Cell Physiol: Transport and Membranes
Phys 578: Cell Physiol: Nerve, Muscle, Synapse
Phys/Pharm/BCHM 591: Special Topics in Signal Transduction

Microbiology and Immunology
Micro 501-503: Introduction to Microbiology, Immunology, Virology
Micro 505: Introduction to Infectious Disease
Micro 525: Cellular and Molecular Networks
Micro 553: Cancer Biology
Micro 607-609: Microbial Pathogenesis (Modules 1-3)
Micro 615-617: Virology (Modules 1-3)
Micro 640-642: Molecular and Cellular Immunology (Modules 1-3)

Neuroscience
Neuro 601/602: Principles of Neuroscience I/II

Pathology
Path 581: Molecular Basis of Disease
Path 643: Immunopathological Mechanisms of Disease

Pharmacology
Pharm 502: Scientific Communication
Pharm 610: Seminars in Receptor Pharmacology
Pharm 612: Seminars in Antimicrobial and Cancer Pharmacology

Note: The Rackham Graduate School requires students to complete 36 Rackham fee credits to achieve candidacy, and at least 68 Rackham Fee Credits to obtain the Ph.D. Students register for at least 9 credits each semester as precandidates, and as candidates for 8 credits/term (generally research) thereafter. Students must be registered for 8 credits during the term in which they defend the thesis.

MSTP students in CMB

MSTP students receive 18 credit hours for medical school coursework. This includes training in biochemistry and cell biology that satisfies CMB requirements in these areas. In addition, MSTP students are given credit for electives such that hey are only required to take three elective credits in graduate coursework to fulfill CMB requirements. Like other CMB students, MSTP students are required to take coursework in genetics (e.g. Human Genetics 541), ethics (503), and the CMB student seminar course (CMB 850). Additional requirements are the same as other CMB students (participation in at least 4 CMB/Genetics short courses and attendance at a minimum of 4 dissertation seminars per year). Like all CMB students, MSTP students are expected to meet with their thesis committees every six months.

THE CMB STUDENT SEMINAR (CMB 850)

Overview

The Special Topics Seminars (CMB 850) in Fall, Winter and Spring terms consist of student seminars at noon on Mondays. These seminars bring the Program together each week. All CMB students, including candidates, and CMB faculty, participate in and contribute to the student seminars. Precandidates in the CMB Program are required to register for the course. All candidate students are also required to attend (whether or not they enroll for credit). First year students in PIBS can attend CMB 850 seminars and may request an opportunity to present a seminar. The seminar date for each student is indicated on a schedule prepared by the Student Seminar Coordinator at the beginning of each academic year. To accommodate attendance by all CMB faculty while maintaining the personal nature of student-faculty interactions, each CMB faculty member is assigned at least three attendance dates during the academic year.

Precandidate students generally present a critical review of one or two related reports in the current scientific literature dealing with a significant advance in molecular/cellular biology. The presentation should be a critical evaluation of the work, not simply a summary of it. Coordination of paper choices with the topic of each term's Short Course is scheduled just prior to the Short Course each term. Third year students generally serve as evaluators and chair the discussion session that follows the seminar. More senior candidate students present seminars on their own research. Precandidate students occasionally choose this option.

Students work with a faculty advisor, generally the research mentor, to prepare the talk and practice it formally before the actual presentation. A practice session is scheduled during the week prior to the scheduled seminar and is attended by the mentor, a faculty evaluator, a student evaluator and others invited by the student. At the seminar, discussion and criticism of the research by the audience is encouraged. Student discussants lead off and moderate the discussion, which includes students and faculty. At least one faculty member and a student evaluator discuss the presentation with each student at the end of each session.

Specifics of Seminar Preparation

1. At the beginning of each fall term, a schedule is set up for student presentations for the academic year. Each student is expected to arrange for a faculty mentor to help prepare for the seminar in the faculty member's field of interest.

2. At least four weeks prior to the presentation, each student should begin preparations with the faculty mentor. They should discuss the topic, identify interesting papers, and the student should begin preparing the presentation with advice from the faculty member. In keeping with

the broad approaches in CMB training, it is recommended that students select papers from the highest quality journals of broad interest rather than from specialty journals.

3. Two weeks prior to the seminar, the student should provide the CMB Administrator with the principal references (including pdf or url), relevant secondary references and a paragraph summarizing the topic (as a hard copy and electronically). This is distributed to faculty and students by e-mail a week prior to the presentation.

4. During the week prior to the seminar, students should schedule a formal practice with the faculty advisor. One of the faculty evaluators for the course, and the student evaluator also attend this practice and provide comments. In this way, the student has an opportunity to implement suggestions for the formal seminar presentation. For convenience, the seminar room is generally reserved on Fridays for rehearsals.

5. The student presents the seminar to assembled CMB students, faculty and other interested individuals, and answers questions from the floor. Audiovisual equipment is available or requested via the CMB office. An assigned student discussant/evaluator provides a professional introduction to the speaker, prepares questions to lead off discussion during the seminar and serves as moderator during the discussions. The discussant also provides a final evaluation to the presenting student following the seminar.

6. A faculty member from the Student Seminar Committee and one of the student discussants meet with each student immediately after the presentation to discuss strengths and weaknesses of the seminar. Written critiques from the evaluators are made available to the student and reviewed by the Student Seminar Committee.

TRAINING IN ETHICAL ISSUES IN SCIENCE

On entering the graduate program through PIBS, students are issued copies of the Rackham Graduate School "Student Handbook" and the University of Michigan Medical School "Guidelines for Responsible Conduct of Research". The former addresses the standards of student behavior expected of all members of the graduate community. The latter discusses in depth the responsibilities of a Ph.D. mentor, appropriate methods of data collection and analysis, guidelines for manuscript authorship and issues pertaining to relationships between industry and academic institutions.

During the first year, graduate students attend a 6-session discussion series on "Ethics in Research" prepared and presented through PIBS (PIBS 501/503), which includes CMB faculty members. In preparation, the students read "On Being a Scientist: Responsible Conduct in Research", published by the National Academy of Science. This course, specifically designed for graduate students in biomedical sciences, includes lecture material and discussion of sample cases covering each of the broad major areas: data handling, protection of creative rights (authorship, attribution, confidentiality), sharing of results and materials, and conflicts of interest.

Problem cases are discussed in small groups. Students may be asked to provide answers to many of the problems both before and after they are discussed.

Topics covered in the PIBS course "Responsible Conduct of Research" recently include:

- Data Collection, Storage & Ownership
- Animal and Human Subjects/ Animal Care/NIH guidelines
- Credit & Publications

- Minority and women scientists
- Cultural issues in science
- Mentorship & Peer Review
- Scientific Misconduct
- Conflict of Interest
- Panel discussion with U of M Faculty and Research Administration representatives including Conflict of Interest Board Manager.
- Gene Patents/ Drug Patents
  And the Band Played On-Discussion of the Gallo case

LABORATORY ROTATIONS

During the first year, under the auspices of PIBS, each student participates in research immediately upon entering the University by completing at least two laboratory rotations. Students interested in CMB must complete at least one rotation under the supervision of a CMB Program faculty member. The duration of one laboratory rotation is generally one full term, although summer rotations are often desired, including the summer prior to the first year. Half-term rotations may be arranged with permission of the mentors. The student receives academic credit for each rotation by enrolling in PIBS 600 or in CMB 599 (Non-Dissertation Research) for a number of hours arranged in consultation with the sponsoring faculty member. The two laboratory rotations should be completed during the first 10 months of enrollment and must be completed prior to the selection of a dissertation mentor. Students may choose to do additional rotations before selecting a mentor. The appropriateness of rotations with faculty outside of CMB will be reviewed by the CMB Program Committee.

New students are urged to become acquainted with research interests of the CMB Program Faculty. These are detailed in the CMB Program brochure and on the CMB website (www.med.umich.edu/cmb/). Faculty new to CMB present their research at “New Faculty” luncheons coordinated by PIBS. A valuable source of information is the Program-wide CMB Poster Session held during the Annual CMB Symposium early each academic year. Students also learn about CMB faculty research in private discussions with faculty members, public seminars and research presentations, and in literature surveys.

SELECTION OF A DISSERTATION MENTOR AND THESIS RESEARCH

Each student selects a dissertation mentor from the CMB Faculty to guide his or her dissertation research. This selection must be approved by the Program Committee. As soon as possible after completion of laboratory rotations, the student should submit his/her choice of mentor to PIBS and to the CMB Director. The selection of the dissertation mentor should generally occur by the end of the first academic year of study.

Once a student selects a lab, CMB research credits are elected each term. The research is conducted in the context of CMB 990 for precandidates, and CMB 995 for Candidates.

The dissertation mentor submits a report of thesis research progress to the CMB office each term throughout the student’s training. This report should first be discussed and signed by both mentor and student. It is then reviewed by the Program Director. The mentor and student are responsible for coordinating thesis committee meetings every six months, and submitting reports within two weeks of each meeting.

PRELIMINARY EXAMINATION. The preliminary examination must be passed before a student achieves Candidacy for the Ph.D. degree.

1. Purpose

The oral preliminary exam (prelim) tests the student's ability to reason analytically and to develop ideas and experimental approaches. The exam gives the student an opportunity to demonstrate creativity, imagination and knowledge of one area of current research interest. Committee members appreciate creative proposals that use challenging techniques and approaches. The oral exam is to be completed no later than April 30 of the student's second year (first year for MSTP students). Requests for extensions must be submitted in writing to the coordinator. The entire process should take approximately 8 weeks.

2. Eligibility

Each student's academic record and laboratory progress are reviewed by the Director and the CMB Program Committee at the beginning of the semester in which a student expects to take the preliminary exam. The student's dissertation mentor is asked to write a detailed evaluation of the student's performance in conjunction with the review of eligibility. Factors considered in determining a student's eligibility to proceed with the preliminary exam include: (a) academic record meets Rackham requirements (average of B or better), (b) required CMB coursework (biochem, cell biology, genetics) has been accomplished with grades of B or better, (c) laboratory progress is satisfactory based on completion of rotations and up-to-date reports from the dissertation mentor. If deficiencies are identified, the Program Committee will recommend procedures for correcting the deficiencies to bring the student to eligible status before that student is allowed to proceed with the preliminary exam.

3. Choosing a Topic (checkpoint)

The topic should not be the same as that to be developed by the student for a thesis, during a laboratory rotation or previous laboratory experience. Students consult with the Prelim Coordinator as to whether a topic is appropriate before investing significant effort in researching and writing an abstract. The scope of the project should be appropriate for a thesis topic (i.e. one person, 3-4 years full-time, 2-3 papers).

4. Abstract (checkpoint)

The student submits to the Prelim Coordinator a one-page abstract describing the proposed topic. This page should include how the project evolves from the previous studies, the hypothesis to be tested, the specific aims to address the hypothesis, the general experimental approach used to test the hypothesis and the significance of the project. This page will serve as the first page of the proposal ("Specific Aims" page).

5. Preliminary Examination Committee

A. Members

The student submits the names of two CMB faculty members who have agreed to serve on the examining committee at the time that the abstract is submitted. The Prelim Coordinator appoints two additional members and appoints one prelim committee member to serve as committee chair. The student's thesis advisor may not serve as a member of this committee.

B. Arranging the Meeting (checkpoint)

Once the committee is chosen, the coordinator will notify the student, who will then be responsible for arranging a day and time that all of the committee can attend the oral exam. The CMB Administrator helps the student reserve a room and obtain appropriate audiovisual aids for that day and time. The student is responsible for seeing that each committee member

receives a copy of the abstract describing the research problem. The committee members will review the abstract and provide feedback to the student within one week, directly or via the Prelim Committee chair.

6. Written Proposal

A. Format

The written proposal should contain background information and a brief summary of an original experimental approach to a scientific problem of current interest in cellular and molecular biology. It is suggested that the student use a format similar to that of an NIH grant: i.e. 1 page hypothesis and specific aims (see "Abstract" description above), 3-4 pages significance and rationale, including pertinent background, and 5-6 pages experimental design and methods, including justification of the approach taken, controls, interpretation of possible results, priority of experiments, limitations and alternative approaches. Since the student will not have worked on the project, no preliminary data section is necessary.

The student is responsible for independently deciding on the problem and devising logical and convincing experimental approaches. When writing the proposal and preparing an oral presentation, students can ask peers and faculty for advice on execution of specific techniques or specific interpretation of published work. Faculty are encouraged to suggest reading materials when possible, but should avoid taking active part in experimental design. Others can help proofread the proposal. When in doubt about appropriate boundaries of advice from others, the student should consult members of the examining committee. Students preparing for the exam can look over copies of previous student proposals that were considered excellent, which are kept on file by the CMB Administrator.

Two weeks prior to the oral exam, the student submits to the members of the Prelim Committee a written proposal of not more than ten typewritten pages (single spaced), not counting figures and references. This written proposal is primarily to place at the disposal of the committee the raw materials for the upcoming exam. When the proposal is completed it is recommended that the written proposal be hand-delivered to each member of the examining committee, at least two weeks before the exam. A copy should also be submitted to the CMB office. Students should solicit feedback from committee members during the proposal writing process, and within a week prior to the exam. Committee members should provide feedback to the student (to the extent they are comfortable) upon receipt of abstract and at least one week prior to the exam.

B. Timeline and Checkpoints

To facilitate preparation of a focused proposal, students should consult with the Prelim Committee for feedback at the following stages according to the estimated timeline shown:

Checkpoint	**Reviewed By**	**Time for Submission**	**Time for Review**
Topic Selection	Prelim Coordinator	Jan./Feb.	----------
Abstract Submitted	Prelim Coordinator	Feb./Mar.	----------
Abstract Approval	Prelim Committee	----------	1 Week
Submit Proposal	Prelim Committee	2 Wks before exam	1 Week
Oral Exam	Prelim Committee	----------	By April 30

Committee members review the proposal and may return comments and/or edited copies or meet with the student to discuss the draft in the time indicated. At each checkpoint, the Prelim Committee chair may transmit comments from the other committee members.

7. Oral Exam

A. Focus

The oral exam tests the student's ability to reason analytically and to develop ideas and defend them in front of other scientists. Thus, the emphasis is on hypothesis testing and experimental design. The student should be familiar, however, with the key past experiments performed that led to the hypothesis and the important basic concepts of the approaches to be used (i.e. if studying a membrane receptor, the student must know aspects of that receptor binding, whether the cell type is appropriate for studying that receptor, whether antibodies or cDNAs have been made to that receptor). The committee members will expect students to be familiar enough with each technique proposed to understand its theoretical basis, as well as its appropriateness and limitations in addressing the hypothesis being tested. However, detailed knowledge of such things as buffer ingredients and incubation times are less important, unless they are vital to the interpretation of the results. For example, if one proposes to use PCR, one should know how PCR works, whether the necessary starting materials are available, whether PCR is the best approach to address the question being asked, and the limitations of using PCR. One does not need to know the exact ions needed for the PCR reaction to take place, nor the incubation time of the step. In contrast, if one were studying ion channels, one would be expected to know the ion concentrations in the buffers to be used to measure ion transport.

B. Format

Each student's file is provided to the Prelim Committee by the CMB Administrator one day prior to the exam. At the start of the examination the student will be asked to leave the room for a few minutes while the examining committee has a chance to discuss the student's record, issues related to the proposal, and how they wish to organize the examination. The student will then be asked to give a 15-20 minute oral presentation. This presentation should start with the hypothesis, specific aims, and a few sentences pertaining to the significance. However, the emphasis should be on the experimental approaches to be taken to address the hypothesis. The members of the committee might wait until the presentation is over, or might ask questions as points are presented. At the end of the presentation committee members will then ask questions for the remainder of the examination (usually lasting approximately 2 hours).

C. Evaluation

When all committee members have had the opportunity to ask all the questions they wish, the student will be asked to leave the room. The committee will then discuss whether the student has displayed sufficient depth and breadth of scientific knowledge, insight into experimental design, and ability to think critically, analytically and quantitatively, to predict a high likelihood of success in pursuit of a Ph.D. thesis.

For the outcome of the prelim, the committee can decide to pass the student unconditionally, to fail the student unconditionally, or something in between. The latter is not unusual, and students are often asked to rewrite part or all of the written proposal, or occasionally to retake the exam with the same problem, or with a different problem. The committee and student should keep in mind that the examination is a learning experience, and that students who retake the exam usually improve immensely the second time. If there is a serious question as to whether the student should pass, it is recommended that the student be asked to retake the examination.

Immediately following the examination, the chair of the Prelim Committee should indicate the outcome and discuss with the student the strengths and weaknesses of the performance on the prelim. Then the chair writes a summary of the examination on the form provided by the CMB office. All of the committee members sign the form, which is returned promptly (within one week) to the CMB office.

8. Advancement to candidacy.

The final approval as to whether the student is advanced to candidacy will be made by the faculty members of the CMB Program Committee, and will incorporate the totality of the student's record. The Prelim Exam summary statement, together with information from the student's file relating to performance in courses, research rotations and dissertation work will be included. If clarification is needed, the student's dissertation mentor or prelim committee chair may be asked to attend the Program Committee meeting when the student's performance is discussed. Once the Program committee decides to advance the student to candidacy, the CMB Office will process the candidacy with Rackham. Students should be reminded that they must register for every semester after advancing to candidacy.

DISSERTATION COMMITTEE AND THESIS RESEARCH

The dissertation committee guides the research project of the student. The committee is **appointed within one month** after the student achieves candidacy, and **meets within six months after the student achieves candidacy, and at least twice per year thereafter**. The committee advises, guides and reviews the thesis progress. The dissertation mentor chairs the Committee, which includes at least 4 additional members, each of whom must be affiliated with a Ph.D. program. At least two members of the committee in addition to the chair must be members of the CMB Program faculty. Students should submit the names of proposed thesis committee members and a full abstract of the proposed project for approval by the CMB Program Committee.

Thesis committee meetings should take place every six months. Students must advise the CMB office when each thesis committee meeting is scheduled. Although not required, students and committee members often find it useful if a student prepares and distributes a brief summary/outline for the meeting, which may include recent data. The chair of the dissertation committee (thesis mentor) submits a report of each thesis committee meeting within two weeks after each meeting. This report is reviewed and signed by both mentor and student before being reviewed by the Program Director.

Upon approval by the thesis committee, the student writes a scholarly thesis formatted according to the Rackham guidelines. Published manuscripts are often included as chapters in the thesis. In addition, a scholarly introduction and discussion must be included to provide an integrated dissertation. The thesis is defended at a public seminar followed by a meeting with the thesis committee. Students must be registered for the semester in which the thesis is defended. CMB students are expected to attend at least four CMB thesis defenses each academic year.

TEACHING

All CMB students are required to participate as a teaching assistant for one term, generally teach shortly after achieving candidacy. The CMB Program Committee provides a list of courses appropriate for CMB students to teach. As a minimum, students are expected to attend lectures, prepare material to present in a formal class context (review session or lecture), and to participate in student evaluation (exams). The teaching requirement must be fulfilled prior to completion of the degree. A CMB faculty member serves as Teaching Coordinator. That faculty member and/or the CMB Program Administrator act as liaisons with the contributing departments and assist students in securing teaching positions. Once a teaching position is arranged, the student submits to the CMB office the name of the course and the course director. Directors of courses in which CMB students teach submit a written description of teaching activities and evaluation of the student's performance at the end of the course.

Special Research and Career Training Activities in CMB

Annual CMB Symposium and Poster Session. A centerpiece of the CMB Program is the Annual Symposium and Poster Session at the start of each academic year. The Symposium opens with a keynote address by a prominent scientist whose work represents landmark contributions in cellular and molecular biology. The keynote address has been named "The Myron Levine Lectureship" in honor of former CMB Director Myron Levine. Immediately following the lecture, CMB students and faculty participate in a dynamic poster session. The Rackham Graduate School provides awards for the top three poster presentations; students present their posters to CMB faculty judges as they would at a national meeting. The well-attended CMB poster session also provides an opportunity for incoming students and others in the University community to find out about research in the laboratories of CMB faculty.

CMB Spring Research Forum. The CMB Spring Research Forum gives students the opportunity to present short formal talks as they would at a national meeting. Student abstracts are selected for presentation as polished formal talks to the entire Program. The Forum also features a poster session for new faculty to present their work to the Program, and a reception at which new students and new faculty in the Program are welcomed and recent recipients of the PhD and of Student Awards are congratulated. This event brings students and faculty of the Program together at the end of the academic year.

Career Development Workshops. During the Fall semester, two workshops on "the basics" are presented: "How to present a research seminar" is demonstrated at the first session of the CMB student seminar (CMB 850) each year by the Course Directors, and "How to write a research grant" is presented just prior to the time when students are preparing prelim proposals and writing fellowship applications. During the winter term, special topics of relevance to graduate students have been presented, such as "Preparing an effective CV," "How to apply for a postdoc," "How to get the most out of a scientific meeting," and "Critical preparation and review of manuscripts." These informal sessions complement Career Workshops organized by PIBS and by Rackham; their smaller size allows more open discussion.

Student to student mentoring. The CMB Program sponsors "Students Mentoring Students," an informal mechanism for senior CMB students to mentor students entering CMB from PIBS or MSTP. In this way, students in different labs and different parts of the campus get to know one another better. The mentoring student and incoming student have opportunities for informal and self-directed interactions such as discussion of academic issues, administrative issues, lab issues or other topics of interest. The mentoring program is inaugurated at an informal reception for all CMB students early in the academic year.

Other informal social events are organized by CMB students and/or the CMB office throughout the academic year.

Travel to scientific meetings. The CMB Program encourages students to present their work at local, regional, and national scientific meetings. The Program provides a contribution to expenses for student travel to scientific meetings upon request to the CMB Administrator and approval by the CMB Director.

Policies on Student Employment and Absences

Student Employment Outside the Program. The CMB Program follows NIH policy that students may not be employed outside their training program. The faculty of CMB believe that Ph.D. training is a full-time endeavor. Outside employment subtracts from the time and mental energy a student devotes to his or her research. No student in the CMB Program may be employed outside the Program without permission of both the mentor and the Program Committee.

Vacation, Absences or Leaves

Participation in the CMB Program, without regard to the source of financial support, is to be full time; that is, 12 months per year. Participation includes regularly scheduled Program events and registration in the graduate school for relevant course work, directed research and dissertation research. Other relevant activity such as detached study, or other off-campus course work may be taken with the Director's approval in consultation with the Program Committee and research mentor. Other activity will be viewed as personal and may be undertaken subject to the following policy covering Vacations, Leaves and Absences.

Vacations: Students are entitled to the standard vacation periods of all students; i.e. University-designated holidays, winter and spring breaks. Additionally, subject to the discretion and explicit approval of the mentor, students may take up to two more weeks in the summer when they are supported by CMB funds. During candidacy and full-time dissertation research, vacation time includes University-designated holidays and up to two weeks of additional time, only at the discretion of the mentor. Total vacation time is expected not to exceed 4 weeks per year, including all University breaks and mentor-approved vacations. Any further vacation time should have the additional approval of the mentor and CMB Director, which may be granted without financial support.

Leaves: All requests for Leaves of Absence must be reviewed by the CMB Program Director and CMB Program Committee. A formal letter indicating the duration of the leave is kept in the CMB office.

SUMMARY: REQUIREMENTS FOR STUDENTS IN THE CMB PROGRAM

1. A minimum of 15 credit hours in didactic graduate-level course work (500 or above), excluding CMB 850 and laboratory research courses, with a minimum grade of B in required courses and an average grade of B overall. Also a minimum of 36 fee credits to achieve candidacy and 68 fee credits to achieve the Ph.D. are required by Rackham.
2. Participation in the CMB Student Seminar (CMB 850) throughout the training period
3. Attendance at four dissertation seminars each year
4. The course requirements outlined above (see Course Selection), including short courses.
5. At least two laboratory research rotations.
6. Successful completion of the preliminary examination.
7. One term as a teaching assistant.
8. Regular thesis committee meetings (every 6 months)
9. Successful completion of a research project and defense of a thesis.

RESPONSIBILITIES OF STUDENTS FOR THEIR PROGRESS

In addition to fulfilling the above requirements of the CMB Program, students are responsible for:

1. Meeting with the Director twice yearly in precandidate year(s), and attending an annual review meeting of candidates thereafter.
2. Ensuring that the preliminary exam is taken in a timely fashion
3. Ensuring that the thesis advisor and dissertation committee are chosen in a timely manner and according to the guidelines of the program.
4. Serving as teaching assistant for one term.
5. Scheduling thesis committee meetings every six months.
6. Making timely progress toward completion of the Ph.D. and giving careful and timely consideration to further career goals (postdocs, jobs, etc.).

CMB students also participate in policy decisions as part of the Program Committee, participate in recruiting new students, and volunteer for various Program-related committees (e.g. Annual Symposium, Short Course).

OPPORTUNITIES FOR STUDENTS IN CMB

- Broad training for students in cellular and molecular biology in the context of a specific biological problem as training proceeds
- Faculty and Program dedicated to training graduate students
- Training in Research Responsibility, presentation skills, professional development
- Opportunities to interact directly with visiting experts (Short courses, Symposium)
- Leadership training (CMB Program Committee, Graduate Student Council, Short Course committee)
- Travel support for professional meetings
- Awards which CMB students have received:
  - H. Weintraub Outstanding Graduate Student Award (national competition)
  - National Fellowship Competitions: NIH, NSF, HHMI, NDSEG, professional societies
  - University of Michigan Distinguished Dissertation Award
  - Michigan Society of Fellows Associate Fellowship for Graduate Students.
  - University of Michigan Susan Lipschitz Award for Outstanding Female Graduate Student
  - Medical School Graduate Student Award for Excellence in Research and Service
  - Medical School Graduate Student Teaching Award
  - Rackham Graduate School Fellowships: Merit, Predoctoral, Dissertation

RESPONSIBILITIES OF CMB FACULTY

Faculty who are already members of the CMB Program are responsible for:

- Mentoring Graduate Student Dissertation Research
- Attending CMB 850 at least 3 times per academic year.
- Serving on committees as asked, particularly on preliminary examination committees and on dissertation committees.
- Monitoring and assuring timely progress through the Program of students in their laboratories.
- Supervising students in preparation of CMB 850 seminars when asked.
- Filing reports at relevant times (rotation evaluations, thesis progress evaluations).
- Ensuring the timely scheduling of thesis committee meetings and dissertation defenses.
- Taking on needed roles in administering the Program.

New Faculty:

- New CMB faculty members will have a one year waiting period before they begin training CMB students in their laboratories as research dissertation mentors. The waiting period does not apply to mentoring research rotations. For newly accepted senior faculty with a history of successful graduate training, this requirement can be waived by the Program Committee.
- New faculty should attend student seminars and can serve as advisors for student presentations.
- New faculty may sit on dissertation committees, serve on oral prelim committees and other committees of the Program prior to accepting students into their own labs.

OPPORTUNITIES FOR CMB FACULTY

- Opportunity to take innovative and productive approaches to training high-caliber students interested in broad training in cellular and molecular biology
- Opportunity to interact with a wide range of students and faculty colleagues sharing interest in cellular and molecular biology
- Updates on current papers and research at Student Seminars
- Dedicated staff to facilitate training of graduate students

CMB FACULTY REVIEW.

The CMB Program has implemented a Faculty Review Process as follows:

The CMB Faculty Review Committee (FRC) reviews a subset of the CMB faculty each year. The FRC is composed of six faculty members appointed by the CMB Director, who serve staggered 3 year terms. The FRC does not have formal student representation. However, students who would like to provide constructive input regarding CMB faculty are encouraged to do so either through the two student representatives on the Program Committee or by contacting the CMB Director.

New CMB faculty members are reviewed 3 years after their appointment. Other faculty are reviewed every 5 years. Approximately one-fifth of the CMB faculty is reviewed each year. Criteria for continued membership in CMB which the FRC will consider to evaluate faculty include: attendance at CMB 850; participation in the various CMB educational activities such as mentoring thesis students, being on CMB thesis committees and CMB prelim committees;

serving on other CMB committees; and presenting a poster at CMB events such as the Fall Symposium.

Faculty participation will be documented by faculty sign-in at CMB 850 each week. In addition, once per year, all CMB faculty will be asked to fill out an annual participation questionnaire which is designed to take each faculty member only about a minute to complete.

In addition, at the time each faculty member is reviewed, she/he provides an updated NIH Biosketch, including publications and grant support. Loss of funding should not lead to dismissal from CMB unless this is for a prolonged period of time. However, a CMB faculty member without long-term funding adequate to support a student and the student's research cannot accept new CMB graduate students into his/her lab.

CMB initiates the faculty review process by asking the faculty member whether she/he wishes to apply for membership renewal. For those who answer in the affirmative, two FRC members will review each faculty by the above criteria. The two FRC reviewers will summarize their evaluations to the entire FRC, which will vote and then make recommendations to the Program Committee. In most cases, the recommendation to the Program Committee will be either: 1) faculty member is renewed for 5 years; or 2) faculty member is not renewed. In difficult cases, the FRC may recommend renewal for less than 5 years. In general, if the FRC recommends renewal for 5 years, the Program Committee will accept this without discussion. However, all other recommendations will be discussed by the Program Committee for a final disposition. This portion of the Program Committee meeting should be attended by at least two FRC members. Faculty members whose membership has been terminated may reapply to CMB if they feel that the circumstances have changed.

The Faculty Review Committee and the Program Committee will evaluate the strengths and weaknesses of the review process on a regular basis, and make adjustments accordingly.

APPENDIX

REPRESENTATIVE ACADEMIC PROGRAMS FOR CMB STUDENTS

EXAMPLE 1. FOR A CMB STUDENT INTERESTED IN **CANCER BIOLOGY**

First year (PIBS)

Fall term

PIBS 501/503 – Research skills/Research responsibility and Ethics (1 cr)
PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

BCHM 550 – Protein structure (3 cr)
HumGen 541 – Molecular genetics (3 cr)
Or
BCHM 550 – Macromolecular structure and function (3 cr)
CDB 530 – Cell Biology (3 cr)

Winter term

PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

Path 581 – Tiss, Cell and Molec Basis of Disease (3 cr)
Physio/HG 555 – Integrative Genomics (3 cr)

Second year (CMB)

Fall term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 - Precandidate dissertation research (variable cr)

MI/Path 553 – Cancer Biology (3 cr)
CDB 530 – Cell Biology (3 cr)
Or
MI/Path 553 – Cancer Biology (3 cr)
CDB 683 – Organogenesis: stem cells (2 cr)
Pharm 612 – Antimicrobial & cancer pharmacol (2 cr)

Winter term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 - Precandidate dissertation research (variable cr)

BCHM 640 – Post-transcriptional gene regulation (2 cr)
Physio/BCHM 576 – Signal transduction (1 cr)
BCHM 675 – Advanced Topics in Protein Trafficking and Localization (2 cr)

Shaded areas denote PIBS and CMB courses
CMB 630 – Short Course is formally titled: Advanced topics in Molecular Biology

EXAMPLE 2. FOR A CMB STUDENT INTERESTED IN **DEVELOPMENTAL BIOLOGY**

First year (PIBS)

Fall term

PIBS 501/503 – Research skills / Research responsibility and Ethics (1 cr)
PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

CDB 530 – Cell Biology (3 cr)
BCHM 550 – Macromolecular structure and function (3 cr)

Winter term

PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

CDB 580 – Development (3 cr)
BCHM 650 – Mechanisms of eukaryotic transcription (3 cr)

Second year (CMB)

Fall term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 - Precandidate dissertation research (variable cr)

CDB 683 – Organogenesis: stem cells (2 cr)
CDB 684 – Organogenesis of complex tissues (2 cr)
BCHM 645 – Signal transduction and gene expression during development (3 cr)

Winter term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 - Precandidate dissertation research (variable cr)

Physio/BCHM 576 – Signal transduction (1 cr)
PIBS 505 – Teaching skills (1 cr)
BCHM 675 – Advanced Topics in Protein Trafficking and Localization (2 cr)

Shaded areas denote PIBS and CMB courses
CMB 630 – Short Course is formally titled: Advanced topics in Molecular Biology

EXAMPLE 3. FOR A CMB STUDENT INTERESTED IN **MICROBIOLOGY AND IMMUNOLOGY**

First year (PIBS)

Fall term

PIBS 501/503 – Research skills / Research responsibility and Ethics (1 cr)
PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

CDB 530 – Cell Biology (3 cr)
BCHM 550 – Macromolecular structure and function (3 cr)

Winter term

PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

MI 640-642 – Molec & cell Immunol modules (3)
MI 607-609 - Microbial pathogenesis modules (3 cr)

Second year (CMB)

Fall term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 - Precandidate dissertation research (variable cr)

HumGen 541 – Molecular genetics (3 cr)
MI 615-617 – Virology modules (3 cr)
Path 643 – Immunopathological mechanisms of disease (1)

Winter term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 - Precandidate dissertation research (variable cr)

Path 581 – Tiss, Cell and Molec Basis of Disease (3 cr)
Or
BCHM 675 – Advanced Topics in Protein Trafficking and Localization (2)

Shaded areas denote PIBS and CMB courses
CMB 630 – Short Course is formally titled: Advanced topics in Molecular Biology

EXAMPLE 4. FOR A CMB STUDENT INTERESTED IN **SIGNAL TRANSDUCTION**

First year (PIBS)

Fall term

PIBS 501/503 – Research skills / Research responsibility and Ethics (1 cr)
PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

CDB 530 – Cell Biology (3 cr)
BCHM 550 – Macromolecular structure and function (3 cr)

Winter term

PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

Physio/BCHM 576 – Signal transduction (1 cr)
BCHM 650 – Mechanisms of eukaryotic transcription (3 cr)
Bioinf 525 – Survey of bioinformatics (2)

Second year (CMB)

Fall term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 - Precandidate dissertation research (variable cr)

Physio 510 – Integrative Physiology (4 cr)
Physiol/BCHM 591 – Selected topics in Signal Transduction (2 cr)

Winter term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 - Precandidate dissertation research (variable cr)

Physio/HG 555 – Integrative Genomics (3 cr) or BCHM 675 – Advanced Topics in Protein Trafficking and Localization (2 cr)

Shaded areas denote PIBS and CMB courses
CMB 630 – Short Course is formally titled: Advanced topics in Molecular Biology

EXAMPLE 5. FOR A CMB STUDENT INTERESTED IN **CELL BIOLOGY**

First year (PIBS)

Fall term

PIBS 501/503 – Research skills / Research responsibility and Ethics (1 cr)
PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

CDB 530 – Cell Biology (3 cr)
BCHM 550 – Macromolecular structure and function (3 cr)

Winter term

PIBS 600 – Research Rotation (variable cr)
CMB 630 – CMB Short Course (optional, 1 cr)

BCHM 675 – Advanced Topics in Protein Trafficking and Localization (2 cr)
Physiol/BCHM 576 – Cell Physiology: Signal transduction (1 cr)
Physiol 577 – Cell physiology: Membrane and cell physiology (1 cr)

Second year (CMB)

Fall term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 – Precandidate dissertation research (variable cr)

HumGen 541 – Molecular genetics (3 cr)
Physiol/BCHM 591 – Selected topics in Signal Transduction (2 cr) *or*
Micro 607 – Microbial pathogenesis (2 cr)

Winter term

CMB 850 – Student seminar (1 cr)
CMB 630 – CMB Short Course (1 cr)
CMB 990 – Precandidate dissertation research (variable cr)

optional:
Micro 504 – Cellular Biotechnology (3 cr) *or* CDB 580 – Principles of Development (3 cr) *or* Micro 615 – Viral pathogenesis (2 cr)

Shaded areas denote PIBS and CMB courses
CMB 630 – Short Course is formally titled: Advanced topics in Molecular Biology