This document provides a detailed description of the academic requirements and course of study for graduate students in the Program in Molecular Biology and Microbiology.
# Molecular Biology & Microbiology Graduate Student Handbook

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**Fall 2004**
OVERVIEW

The Program in Molecular Biology & Microbiology offers comprehensive graduate training leading to the Ph.D. or combined M.D./Ph.D. degrees. Because professional scientists today require many tools to succeed in a competitive environment, the faculty have designed a challenging course of study that provides training in 1) problem-solving, critical analysis of data and modern technical approaches leading to scientific excellence; 2) communication skills, both oral and written; and 3) ethical issues and scientific integrity.

The centerpiece of the training program in Molecular Biology & Microbiology is the completion and publication of a substantial body of original research. Additional components of the program include didactic coursework, seminars and journal clubs to keep students abreast of the latest developments in their field, and opportunities to present research findings at national or international meetings.

TRAINING PHILOSOPHY

The overall objective of the graduate training program in Molecular Biology & Microbiology is to provide predoctoral students with the necessary conceptual and technical foundations to address important problems in modern biology as independent investigators. The trainers affiliated with this program believe that both faculty and students prosper when students are treated as promising junior colleagues, deserving of dedicated guidance from their mentors in the scientific community. We subscribe to the view endorsed by the Council of Graduate Studies:

"The Doctor of Philosophy degree is the highest academic degree granted by North American universities. It is a research degree and is to be distinguished from other doctorates such as the M.D., J.D. or Ed.D. degrees, which are designed for professional training or which focus on applied rather than basic research. The Doctor of Philosophy degree is designed to prepare a student to become a scholar, that is, to discover, integrate and apply knowledge, as well as communicate and disseminate it...The program emphasizes the development of the student's capacity to make significant original contributions to knowledge in a context of freedom of inquiry and expression."

PRACTICAL MATTERS: GRADUATE STIPEND AND OTHER BENEFITS

Tuition and Stipend Support
Students registered full-time in the Molecular Biology & Microbiology Program are eligible for tuition and stipend support. Tuition is generally paid by the department in which the student’s faculty advisor holds a primary appointment. Stipend support begins upon matriculation and is guaranteed as long as the student remains in good standing. The stipend level for 2003-2004 is $21,000 for twelve months. Stipends may derive from a variety of sources: investigator-initiated NIH Research grants, NIH-supported training grants, other federal and private research grants, and university resources.

Individual Predoctoral Grant Support
It is extremely advantageous for students to successfully compete for individual grant support, for example from the National Science Foundation (http://www.fastlane.nsf.gov/fastlane.jsp). Note that funding agencies often require that applications be submitted early in graduate training.

Tax Liability
The stipend portion of compensation (stipend plus tuition) is taxable. Note that students may also be required to pay local taxes if they live outside the city of Cleveland. Information can be obtained from each municipality.
Health Insurance
Upon matriculation, coverage begins through student health services. A copy of the CWRU Medical Plan for Students can be obtained at the University Health Services, 2145 Adelbert Road.

University Health Service 216-368-2450
Appointments:
   General Clinic 216-368-4539
   Women’s Clinic 216-368-2453
   Mental Health 216-368-2510
University Counseling Service 216-368-2510

Molecular Biology & Microbiology Computer
Once students commit to a specific laboratory, they will become eligible for a limited number of grants providing matching funds to purchase a laptop computer. We will reimburse students up to $500 or 50%, whichever is lower, of the actual expense for a newly purchased computer. The computer must be ordered through the Departmental office to be eligible for university discounts, and must be paid for when the computer is delivered. All students, including MSTP students, are eligible for these funds once during their graduate studies. Many students prefer to purchase a computer near the time when they are writing their thesis, while others prefer to get one early in their studies.

Student Effort
Upon entering the graduate program, students are expected to pursue the Ph.D. degree with drive and dedication. As full-time graduate students receiving a stipend from the University, students are held to a high standard of accountability. From the first year onward, they should plan to work in the laboratory and attend seminars even when classes are not in session. If it is necessary for a student to be away from the laboratory for an extended period of time, her/his absence must be approved by his or her current academic advisor. Unless permission has been granted by the advisor, vacation time is limited to 2 weeks in addition to the official holidays for university staff.

It is the responsibility of each student to become familiar not only with the specific rules that apply to the program of study in Molecular Biology & Microbiology (this document) but also with the general rules and regulations of the University. Any requirements not specifically addressed below, such as those pertaining to residency and fees, conform to the regulations for the Ph.D. degree specified in the School of Graduate Studies Section of the General Bulletin of Case Western Reserve University (also available on-line at http://www.cwru.edu/provost/gradstudies/). This web site also contains downloadable forms that will need to be filed with the Graduate Studies Office as the student advances through her/his graduate career. Hard copies of forms that must be deposited by each graduate student in her/his file in the Molecular Biology and Microbiology Office are provided as an appendix to this document. For more complicated issues, students may want to contact the Graduate Studies Office directly (Baker Building, Room 121). This office is especially helpful when it comes time to prepare and defend the dissertation. It is expected that students will be proactive in seeking information regarding university regulations.

GETTING STARTED

The Graduate Program in Molecular Biology and Microbiology is administered by the Department of Molecular Biology and Microbiology. Its affiliated faculty includes approximately two dozen individuals who hold either primary or secondary appointments in this department. Generally, students seeking a Ph.D. in Molecular Biology and Microbiology will enter the program at the end of their first semester of graduate study after being admitted through the Biomedical Sciences Training Program (BSTP). This interdepartmental umbrella program, which includes twelve other departments or programs in addition to Molecular Biology and Microbiology, oversees not only admissions but also first semester coursework and advising.

Incoming graduate students are strongly encouraged to arrive in early July, which gives them an opportunity to become familiar with CWRU and complete a research rotation before classes begin in the fall. All students must be on campus for the beginning of the fall semester in late August. Upon arrival, students should check in with the BSTP Office, where they
will receive information about such practical matters as obtaining an ID card, activating their e-mail account (see http://www.cwru.edu/med/BSTP/index.html), and initiating health insurance coverage, tuition and stipend support, etc. The BSTP office will also provide instructions about how to sign up for safety training through the Department of Occupational and Environmental Safety (a prerequisite to working in research labs).

Molecular Biology & Microbiology Department Office SOM W235
Phone 216-368-3420; FAX 216-368-3055
Web site http://www.cwru.edu/med/microbio/mbio.htm

As soon as possible after arriving on campus, each student should meet with the Graduate Student Advisor to whom s/he has been assigned based on research interests indicated on the application. These first year graduate student advisors, who represent each program within the BSTP, oversee the first semester of graduate study, including providing advice about coursework, research rotations, and selection of a thesis advisor. The GPEAC advisor also signs registration and other relevant forms, periodically discusses with each student his or her progress in the program, and can serve as a student advocate should difficulties arise.

Currently, the Molecular Biology & Microbiology Graduate Student Advisor is Dr. Lloyd Culp Location: W248 SOM; Phone: x3407; E-mail: lac7

Just before classes begin in August, the BSTP sponsors a series of program orientations featuring presentations by Program Directors affiliated with 3-4 of its component Ph.D.-granting programs. Students interested in the possibility of pursuing a Ph.D. in Molecular Biology and Microbiology are encouraged to attend the session in which this program presents. Also available at this session from the Molecular Biology & Microbiology Graduate Advisor will be a brief description of the program (the “Quick Start Guide”) aimed at first year students. The orientation will provide students with an opportunity to ask questions about procedural matters and any other issues that may bear on their decision to join the program.

Incoming students are expected to take a preliminary exam based on chapters 1-3 of *Molecular Biology of the Cell* by Alberts *et al.* (4th ed.) or 1-6 of *Molecular Cell Biology* by Lodish *et al.* The purpose of this exam is to make sure that each student has mastered the background required for the Cell and Molecular Biology Core Course in which they will enroll during fall semester.

After the first semester, students should discuss course selection and other academic issues with their thesis advisors. With their advisor's approval, students can obtain PIN numbers for online registration from Dr. Ecklund in the departmental office. Hard-copies of registration forms must be signed by the student's research advisor. For M.D.-Ph.D. students, registration forms must be signed by the MSTP office and a copy of the form must be supplied to the MBio GPEAC advisor.

**YEAR ONE, FALL SEMESTER**

The first semester academic program consists of research rotations and coursework, which are described separately in Sections 1 and 2 below. Section 3 describes the process by which thesis advisors are selected.

**RESEARCH ROTATIONS**

One of the most important decisions a student must make during the first year of graduate study is to choose a faculty advisor to supervise his or her dissertation research. In addition to serving as the primary basis for making this decision, rotations provide exposure to a variety of research problems and laboratory techniques. Students enrolled in the BSTP must complete a minimum of three rotations of 4-6 weeks duration by December 15 of their first year. **Students are strongly encouraged to arrange their first rotation prior to arriving at CWRU.** By arriving on July 1, a student may have sufficient time to do more than three rotations. A longer rotation is preferred if the student is interested in joining a lab, while a shorter period of time should be spent if the level of interest on the part of either the student or faculty member is considered low.
During the summer and when classes are not in session, students are expected to work in the lab at least 40 hours per week. Once classes begin, the time spent in activities associated with the rotation may be reduced to 20-25 hours per week. In addition to laboratory work, students should participate in other research-related activities such as lab meetings, journal clubs, and departmental seminars to get a better idea of what it would be like to be a member of the rotation lab.

A tentative schedule for the rotations should be determined during the first meeting between a new student and the GPEAC advisor, but this may be revised as the student’s interests evolve. Students interested in the Molecular Biology and Microbiology Program may elect to rotate with any affiliated faculty member (for a complete list, see http://www.cwru.edu/med/microbio/facultyr.htm). However, because the main purpose of rotations is to allow students to sample potential thesis laboratories, they are encouraged to focus primarily on training faculty who have an opening for a Ph.D. student. A list of faculty members with open slots is available from the GPEAC advisor.

Students are encouraged to look over all available material describing the research interests of training faculty when planning rotations. In addition to the brief summaries available on the departmental web site (http://www.cwru.edu/med/microbio/mbio.htm), files containing grant applications, reprints and preprints of papers, and other pertinent information are maintained in the BSTP office in room WG 46. Alternatively, students may obtain comparable material directly from individual faculty members. The student is responsible for contacting faculty members of interest to determine whether they will be available to serve as a rotation supervisor during the period of the planned rotation. In general, a student should try to meet with the faculty member in person before scheduling the rotation, but telephone or e-mail contact can also be useful, particularly for the first rotation.

Because rotating students place a considerable demand on faculty time, trainers are discouraged from supervising more than one rotation student at a time. It may be helpful for the student and rotation mentor to discuss the student’s time commitment prior to beginning the rotation to assist the supervisor in designing a project of suitable scope. It is expected that rotating students will work on a substantive project and should aspire to generate publishable data. Note, however, that a student should not be pressured by a rotation supervisor to prolong a rotation in order to obtain more complete results. In this event, the student may want to consult the GPEAC advisor to intervene on his or her behalf.

**Finishing a rotation:** At the conclusion of each rotation, students must complete the following four steps (described in detail below):

1. Prepare a rotation report and submit it to the rotation advisor for review.
2. Ask the rotation supervisor to fill out a Rotation Evaluation Form.
3. Meet with the rotation supervisor for an "exit interview."
4. Submit copies of the Rotation Evaluation Form and the rotation report to the BSTP office.

**Guidelines for Rotation Reports**

Typically, the report should be 2-3 pages double spaced (not including literature citations), but it may be longer if the student has data figures to present. It should include:

1. **Rationale.** Outline the problem under investigation, describe what new information is being sought by the research performed during the rotation, and indicate how this information will be useful.
2. **Description.** Indicate the experimental approach, outline the procedures, present data and figures (if any were acquired during the rotation), and describe clearly how the data were analyzed.
3. **Discussion.** Relate the results to the rationale for the research, existing literature and other pertinent information. Outline any further experiments that may be required to complete the rotation project. Indicate what knowledge was gained from the rotation beyond simply the techniques that were mastered.
4. **Literature citations.** Provide documentation of literature pertinent to the project. Typically five to ten papers are cited.
Students are responsible for providing the faculty member with the Rotation Evaluation Form (available from the BSTP Office, WG46). It should be given to the rotation mentor along with the report within one week after completion of laboratory work. Within one week of turning in the report, the student should schedule an “exit interview” with the rotation supervisor to discuss the rotation as a whole and go over the evaluation and report. This interview is intended to be constructive and to give useful feedback to the student. It is expected that the research advisor will be honest and indicate the degree to which s/he is interested in having the student pursue dissertation research in her/his lab. The student may also want to indicate degree of interest to the PI during the exit interview. After both the student and the mentor have signed the form, it should be returned, together with a copy of the rotation report, to the BSTP Office for inclusion in the student’s file.

**Important!!** In order to receive credit for the research rotations and register for spring semester classes, students must complete at least three rotations and hand in the reports and evaluation forms by the end of the fall semester. Students who fail to do so will not receive credit for the course and will not be allowed to register for the spring semester and begin research in the thesis lab.

**COURSEWORK**

During the fall semester, MBio students must complete the Core Curriculum in Cell and Molecular Biology (C3MB), an integrated course which provides formal instruction in modern cell and molecular biology. This course covers the biology of eukaryotic organisms including basic genetics, macromolecular biosynthesis, regulation of gene expression, cell structure/function, growth and signaling. The course content is designed to provide a foundation upon which students’ graduate research will build.

Students with strong backgrounds may, with permission from the MBio GPEAC Advisor, be exempted from part of the Core Curriculum. These are typically students with Master’s degrees, who will instead enroll in one or more advanced courses during the fall semester. For these students, it may be appropriate to apply for the transfer of credit from their previous institution (see the General Bulletin or go to [http://www.cwru.edu/provost/gradstudies/](http://www.cwru.edu/provost/gradstudies/). Transfer credit must be requested prior to beginning coursework at CWRU.

Students must register for 9 credit hours during the fall semester, which is the minimum number of credit hours required for full-time student status. Typically, this will consist of the Core Curriculum (CBIO 453 and 455; 6 hours) and 3 hours of research rotation (BSTP 400). Students may not register for more than 9 hours except under extraordinary circumstances. Once registered, students cannot add or drop courses without the permission of the GPEAC advisor, since it will impact both tuition and stipend support.

**Satisfactory Progress:** The MBio Program considers only grades of B or better to be satisfactory. To remain in good standing, a student must maintain a Grade Point Average (GPA) of 2.50 or higher at the end of the first 12 semester hours that receive quality point grades (A = 4.0; B = 3.0; C = 2.0). This is a higher standard than the University minimum for the initial period of study, but is consistent with the University's standard of a 3.0 GPA overall for award of the Ph.D. If, at the end of the first year, a student has received two grades of C, s/he is considered to be making unsatisfactory progress and is separated from the program. Research rotations are graded Pass/No Pass. If a student receives a rating of “Poor” from the supervisors of all three research rotations, this will result in a grade of NP and may also lead to separation from the program.

Students normally choose their thesis advisors in December. If there are circumstances that prevent placement by this date, a student may be allowed to do additional rotations with the approval of the Graduate Program Educational Advisory Committee (GPEAC).
SELECTING A MENTOR FOR THESIS RESEARCH

Criteria. The mentor's laboratory provides the setting for a student's most crucial learning experiences, which occur in the later years of graduate study. Thus, it is important to weigh this decision carefully. Although choosing a thesis advisor whose research interests match one's own is an important consideration, it is by no means the only factor that should be taken into account. In addition to evaluating the environment in various labs, students should consider the type and quality of available research projects, the influence of postdocs and other students in the lab, the level of the advisor's involvement in the day-to-day life of the laboratory, and the character of the advisor's relationship with students. All of these factors, combined with the student's own intelligence, determination, creativity, and initiative, will determine the success of the student's graduate education. Finally, it is important to emphasize that there is no absolute scale for rating such intangible qualities of the research lab; rather, they must be considered in light of the distinctive features of an individual student's personality and approach to experimentation and learning.

The decision-making process. It is important for students and faculty to understand that matching students with thesis advisors is based largely on information provided by the principals. Thus, it is important not only to have a forthright and frank discussion about the prospects for a match at the end of the rotation, but also to keep in touch afterwards. The initial discussions must be tentative in character because (except for the last rotation), the student will be rotating in other laboratories and the faculty member may supervise additional rotating students. As students continue with their rotations, the views expressed at the exit interview may evolve. As a student's interests become more focused on a particular faculty member, the faculty member should be kept informed, so that s/he can respond appropriately both to that student and to any other students interested in that lab. If a faculty member is not willing to have a student join his or her lab, this must be communicated explicitly to the student and to the student's GPEAC advisor.

Faculty availability to serve as a thesis advisor may also change during the course of the first semester. At the beginning of the year, faculty members are asked by the GPEAC advisor to list openings as Definite or Probable. The latter category means that space and funding for a student are likely, but not certain. To facilitate the selection process, a revised Slot List is compiled in October that shows only Definite slots.

Mechanics of the selection process. The responsibility for assigning students to laboratories falls to the Director of the BSTP, currently Dr. Martin Snider, in consultation with the GPEAC advisors. This process will begin on or around December 15. At this time, each student should meet with his or her GPEAC advisor and turn in the selection form, on which all placements acceptable to the student are ranked in order of preference. This meeting should include a detailed discussion to make certain that the GPEAC advisor understands the reasoning behind the preferences and the strength of each preference.

Once all of the student preferences have been assembled and the appropriate faculty members have been consulted, the GPEAC advisor will make final assignments. The process, which will be completed by early January, will in most cases result in a student being assigned to his or her preferred advisor. A lower-ranked choice may be assigned if two or more students list the same advisor as first preference. Program policy regarding multiple placements is the following:

1. One student per lab per year is preferred.
2. Two students can be placed in one lab in one year, if the faculty member has sufficient resources, is willing to take both students, and agrees not to take a student the following year.

In resolving conflicts over thesis advisor selection, all pertinent information is taken into account, including the strength of the preferences expressed by the students, the preference of the faculty member, and the alternative assignments available to each student. All assignments are made with the consent of the student and no student will be assigned to a lab against her/his wishes.
In rare cases, a student may exhaust his or her options without being assigned to a lab. Such cases are handled on an *ad hoc* basis. If necessary, the student may be allowed more time to consider additional laboratories. However, the student must be accepted into a laboratory by March 15. Any faculty member who agrees to accept a rotation student after January 1st of the first year must do so only with confirmed financial support should the student decide to work in that laboratory.

Once a student has selected a thesis laboratory, the research advisor replaces the GPEAC advisor as the primary source of advice not only on matters pertaining to research, but also should be consulted about course selection and any other academic decisions that the student must make.

**YEAR ONE, SPRING SEMESTER**

**Thesis Research:** This should be the primary focus of students once they have chosen a laboratory in which to pursue their dissertation. The spring semester should be used to formulate a thesis project and obtain preliminary data. Although the actual writing of the dissertation may be some years off, students should bear in mind the following guidelines during the formative stages of their project.

**GUIDELINES FOR THESIS RESEARCH**

**A. Goals for graduate students:**

- Students must develop with their advisor a research project that yields a coherent and original body of work.
- The thesis must be written in a scholarly manner with a detailed historical introduction and a critical discussion.
- The first draft of the thesis must be the original and individual effort of the student. The draft submitted to the Thesis Committee should be a polished document developed in consultation with the mentor.
- In general, the thesis research should utilize more than one technical approach.
- In the written thesis, thesis seminar, and thesis defense, students should demonstrate that they have become an expert in their field of research.
- By the time of the thesis examination, it is expected that the student will have submitted for publication in a *peer-reviewed* journal at least one experimentally based manuscript on which s/he is the first author. The first drafts of all manuscripts should be written by the student.
- Students should seek opportunities to present data generated in the course of their graduate research at one or more national or international meetings.

**B. Goals for Training Faculty:**

- The thesis advisor will provide the student with intensive training in the scientific method, including the ability to formulate clear research questions, develop feasible experimental approaches to answering them, critically evaluate data from his or her own research and that of others, and discuss the significance of the work in the context of the field as a whole.
- The thesis advisor, in conjunction with the thesis advisory committee, is responsible for developing and implementing a training plan with the student, including the elaboration of an independent research project.
- The thesis advisor is responsible for providing the physical, financial, and intellectual resources necessary for completing the research plan.
- The thesis advisor should work regularly with the student to develop strong communication skills, both oral and written.
- The thesis advisor should encourage the student to think broadly about the research project and not necessarily be limited to approaches/techniques currently used in the advisor’s laboratory.
RESEARCH INTEGRITY

The importance of this topic cannot be over-emphasized. Throughout the course of their scientific careers, scientists must be very careful to properly allocate credit for data or written material generated by others. “As a general working definition, the Office of Research Integrity (ORI) (a regulatory arm of the NIH) considers plagiarism to include both the theft or misappropriation of intellectual property and the substantial unattributed textual copying of another’s work. It does not include authorship or credit disputes. Substantial unattributed textual copying of another’s work means the unattributed verbatim or nearly verbatim copying of sentences and paragraphs which materially mislead the ordinary reader regarding the contributions of the author. ORI generally does not pursue the limited use of identical or nearly identical phrases which describe a commonly used methodology or previous research because ORI does not consider such use as substantially misleading to the reader or of great significance.” For more information on this issue, see http://ori.dhhs.gov/html/policies/plagiarism.asp.

RECORD-KEEPING

Student records are maintained in the Department of Molecular Biology and Microbiology Office. In general, the student has the right to view his or her record, except for certain confidential items (i.e., letters of recommendation to which the student has specifically waived right of access). The purpose of record-keeping is to provide documentation of the student’s progress in graduate studies, including fulfillment of requirements; to assist the thesis committee in advising the student; to assist the student in preparing a CV; and to assist faculty who may be asked to write letters of recommendation for the student.

In addition to the student’s original application (which includes his or her academic record prior to enrollment in graduate school at CWRU), items routinely included in the file include:

1. Transcripts of CWRU graduate coursework
2. Research rotation reports and evaluation forms
3. Copies of the student’s annual progress reports and Research Qualifying Exam Proposal
4. The forms and accompanying chair’s reports documenting annual thesis committee meetings (which list the names of the advisor and committee members present)
5. The Qualifying Exam Report form and accompanying narrative
6. The Advancement to Candidacy and Planned Program of Study forms filed concurrently with the Office of Graduate Studies
7. If applicable, the form to register for MBIO 703 (dissertation fellowship)
8. Flyers for seminars given by the student including dates and titles
9. Miscellaneous items including records of attendance at scientific meetings or other off-campus scientific activities, participation in teaching, and authoriship on publications
10. The Notification for Scheduling the Oral Exam
11. The Application to Graduate

It is the joint responsibility of the student and the advisory committee chair to make sure that the record is up to date by submitting pertinent information and documents, and by reviewing the record at the time of each committee meeting and amending or supplementing it if necessary.

COURSEWORK

While the program’s major emphasis is to provide a stimulating atmosphere conducive to carrying out high quality, independent research, it is recognized that a certain amount of formal instruction is necessary and desirable for Ph.D. students. To address this need, a flexible program of coursework is outlined below. It is expected that the student, in consultation with her/his thesis mentor and advisory committee, will design a program compatible with her/his research goals. In general, students should enroll in two advanced courses during the spring semester of their first year.
Ph.D. students are required by the University to take 36 semester hours of graduate coursework; this total includes required courses, advanced electives and MBIO 601 (pre-thesis research). **At least 24 hours must be graded coursework (not research).** For the typical student in the Molecular Biology and Microbiology Program, the University course requirement, as well as the program requirement, will be satisfied by 8 hours of Core Curriculum (C3MB) in the first semester, 16 hours of advanced coursework in subsequent years, and 12 hours of MBIO 601. Grading in MBIO 601 is on a P/NP basis (University rule, see General Bulletin), and because no more than 12 hours graded P may count towards the University course requirement (another University rule), it follows that **18 hours of advanced coursework must receive traditional letter grades.** Students who elect to take an advanced course graded P/NP can report these hours in place of comparable MBIO 601 hours for satisfying the University requirement, if they so desire, but will still need to accumulate 18 credit hours of traditionally-graded advanced coursework prior to graduation.

For Ph.D. students, credit can be counted towards the degree only for advanced courses at the 400 level or higher. Any combination of courses from within or outside the department can be used to fulfill the requirement as long as the planned program of study has the approval of the student’s advisor and committee. Although no specific advanced courses are absolutely required, the following table lists some that students might particularly want to consider taking. Many of these are cross-listed in several departments.

**Molecular Biology and Microbiology**
- Yeast Genetics and Cell Biology
- Macromolecular Structure and Function
- Structure and Function of RNA
- Prokaryotic Genetics and Pathogenesis
- Principles of Microbiology
- Signaling via Cell Adhesion

**Molecular Virology**
- Mol. Biol./Pathogen. of RNA & DNA Viruses
- Host-Virus Interactions
- Molecular Genetics of Cancer
- Mechanisms of Drug Resistance
- Immunology of Infectious Disease

**Biochemistry**
- Macromolecular Structure and Function
- Mechanism and Regulation of Protein Biosynthesis
- RNA and DNA Biosynthesis
- Advanced Methods in Structural Biologicals
- Protein Structure, Folding and Design
- Transcriptional Mechanisms

**Genetics**
- Advanced Eukaryotic Genetics
- Developmental Genetics
- Chromosome Structure & Function
- Advanced Human Genetics

**Neurosciences**
- Principles of Neural Development
- Cellular & Molecular Neurobiology
- Developmental Neurobiology

**Pathology**
- Cell Biology of the Nucleus
- Cellular and Molecular Biology of Cancer
- Advanced Molecular Immunology
- Structure and Function of Cytokines
- Mechanisms of Mammalian Cell Growth Control

**Pharmacology**
- Molecular Pharmacology
- Developmental Pharmacology
- Membrane Transport Processes
- Mechanisms of Drug Action

**Physiology and Biophysics**
- Cell Signaling
- Molecular Endocrinology
- Fluorescence Microscopic Imaging
- Epithelial Cell Biology

**Grades:** As noted above, the School of Graduate Studies requires that students have at least a B (3.0) overall grade point average to meet the standard for award of the Ph.D. Thus, a student who receives a C in a course must eventually balance this with equal credit hours of A. A student who receives two grades lower than B will be evaluated by the GAAC to determine whether s/he should continue in the program. Courses in which a student earns a C do count towards the fulfillment of degree requirements.
Bioethics Course: Although they will not receive academic credit for this course, all MBio students are required to take the one week bioethics course “On Being a Professional Scientist” (IBMS 500) at the end of the spring semester of their first year.

Molecular Biology Graduate Seminar: Three of the credit hours allocated to advanced coursework may come from participation in this newly developed course (MBIO 435), at the rate of 1 credit hour per semester. Registration for credit may begin in the second semester of the first year. The course will be graded based on attendance in both the graduate student research seminar series (Tuesdays at 1:00 PM) and outside speaker series (Thursdays at 1:00 PM) and on participation in the graduate student seminar series. The goal of the seminar course is to develop students’ skills in listening comprehension and speaking extemporaneously. Even after students take three semesters of seminar for credit, they are still expected to attend the departmental seminar series although they will not receive course credit for their participation.

Currently, the faculty member who oversees the Molecular Biology & Microbiology Graduate Seminar Course is Dr. Piet deBoer, Location: W239, E-mail: pad5, Phone: x1697

YEAR TWO, SUMMER

Thesis Research: The summer following the first year of graduate study will provide students with their first opportunity to devote their full energies to research in the Ph.D. thesis lab. This time should be spent continuing to develop the thesis project not only through bench work but also critical reading of the literature and discussions with their mentor and other members of the research group.

YEAR TWO, FALL SEMESTER

COURSEWORK

Advanced Electives: Students will continue to accumulate credit towards the Ph.D. degree during the third semester of graduate study. It is suggested that students enroll in at least one 3 credit graduate-level course during the fall semester of year 2.

Seminar: Students will continue to participate in all departmental seminars, for which they will receive 1 credit hour by registering for MBIO 435.

Research: Students will spend the remainder of their time on thesis research and register for the appropriate number of hours of MBIO 601 to make up 9 credit hours total.

SELECTION OF THE THESIS ADVISORY COMMITTEE

Another key decision must be made by students at this point in their graduate career. In consultation with the mentor, each student must select a thesis advisory committee by the end of the fall semester of the second year. This committee will consist of a total of four members. In addition to the thesis advisor, at least one member of the committee must hold a primary or secondary appointment in the Department of Molecular Biology and Microbiology. University rules stipulate that at least one committee member must hold a primary appointment in a different department. The fourth member may be selected from within the department or from another department; for the purposes of constituting this
committee, faculty with secondary appointments in Molecular Biology and Microbiology may count as either “inside” or “outside” members. The thesis advisory committee functions as an oversight body to help guide the student’s graduate education by providing advice on coursework, periodically reviewing the student’s research progress and offering constructive criticism on either completed or planned experiments, and conducting the qualifying and thesis examinations. From a more philosophical perspective, the role of the thesis advisory committee is to further the central goal of graduate training, i.e. the extension of knowledge and development of scholarship. The input that these faculty members provide to the student and faculty advisor aids in determining the scope of the research. Thesis committee members should have expertise in areas related to the proposed work and an acknowledged interest in contributing actively to the student’s progress towards becoming an independent research scientist. Ideally, the committee will consist of both junior and senior faculty members and will include at least one member who has served previously on thesis advisory committees in the Molecular Biology and Microbiology Program. All thesis advisory committees must be approved by the Graduate Academic Advisory Committee, which is responsible for student oversight beyond the first year. Each graduate student should submit the names of proposed committee members to the chair of this body in early December of their second year.

Currently, the Molecular Biology & Microbiology Graduate Academic Advisory Committee (GAAC) consists of Drs. Jo Ann Wise (Chair), Lloyd Culp and Jonatha Gott. Dr. Wise’s office is located in W259; Phone: x1876; E-mail: jaw17. Dr. Wise also acts as the Department's Director of Graduate Studies, with overall administrative responsibility for graduate programs and the Cell and Molecular Biology Training Grant. Students will periodically get information about changes to the student program from Dr. Wise.

YEAR TWO, SPRING SEMESTER

Coursework and Research: During this semester, students will continue to enroll in graded courses as necessary and make up the remainder of their credits with registration in MBIO 435 and MBIO 601. They will spend most of their time conducting thesis research, with a brief hiatus to carry out the activities described in the next section.

SUBMISSION OF THE PRE-PROPOSAL, FIRST DEPARTMENTAL SEMINAR AND FIRST THESIS ADVISORY COMMITTEE MEETING

During the spring semester of their second year, students will pass these three interconnected landmarks in their graduate career, which are described sequentially in the following sections.

PREPARATION OF THE PRE-THESIS PROPOSAL

The format for the written pre-thesis proposal, which lays out the student’s planned graduate research, is described below. This document must be delivered to all members of the thesis advisory committee at least one week in advance of the student’s first scheduled departmental seminar. The student’s first thesis advisory committee meeting must be held within two weeks of the seminar, but preferably immediately afterwards.

A specific report format is required at this stage to provide the student with experience in the type of writing required for the research qualifying exam, which will take place within the next six months. The pre-thesis proposal should be patterned after a grant application in NIH format and should describe the student’s thesis project in sufficient detail to allow the advisory committee to critically evaluate the proposed research. The document should be approximately 10 double-spaced type-written pages and should follow the organization described below for the qualifying exam proposal except that the balance of the various sections may be adjusted appropriately; for example, students may have only limited preliminary data at this early stage of their graduate career.
When writing the pre-proposal, students should seek input from their thesis advisor and other senior members of their own or other laboratories. By incorporating suggested changes prior to handing out the pre-proposal to the advisory committee, the student will maximize the benefits derived from the thesis committee meeting. In evaluating this document, the committee will provide the student with feedback on his or her writing and organizational skills as well as scientific content. These comments should be borne in mind when preparing the written portion of the research qualifying exam, which must be the student’s own work, independent of faculty input.

FIRST SEMINAR

The Department sponsors a trainee seminar series held on Tuesdays at 1:00 p.m. Speakers will include Molecular Biology and Molecular Virology students, postdoctoral fellows and Cell and Molecular Biology Trainees. Beginning in the spring semester of the second year in graduate school, students will be required to make an annual formal presentation that is open to the University community. For second-year students, it is expected that the seminar will last approximately 30 minutes. In general, the student should begin the talk by stating the goal of their proposed thesis project or the question to be addressed, followed by a discussion of relevant background literature and significance of the proposed research. Although most students will not have accumulated a great deal of preliminary data at this point, they should describe the approaches employed and results of the experiments they have conducted to date. The final section of the seminar should be devoted to setting forth future goals, including a description of the experimental approaches to be taken and the rationale for why they were chosen. In preparing for this seminar, it is critical that students not only devote considerable energy to the preparation of clear and informative slides, but also practice the talk in advance in order to benefit from constructive criticism provided by their advisor and/or other members of the research group.

FIRST COMMITTEE MEETING

As noted above, a meeting between the student and his or her thesis advisory committee will generally be held immediately following the seminar presentation. This first committee meeting will begin with a brief discussion, in the student’s absence, of his or her performance to date in the program. To provide a basis for this discussion, the faculty mentor must bring to the meeting the student’s file, which should include at this point the original application, transcripts of graduate coursework, and rotation reports/evaluations. After reviewing this material and discussing any concerns about the pre-proposal and/or the student’s seminar presentation, the committee will elect a chair. This person must be a member other than the mentor who holds either a primary or secondary appointment in the Department of Molecular Biology and Microbiology. The student will then be asked to return to the room and the chair will convey any concerns the committee might have to him or her. The bulk of the first committee meeting will be devoted to discussing the research completed to date by the student and the experiments planned for the next year and beyond. As this meeting sets the tone for student/committee relations, a frank conversation about the strengths and weaknesses of the proposed work should be encouraged. Following this discussion, the student and committee should discuss the timing of her/his research qualifying exam. By the end of the meeting, a consensus plan for the next year should be developed.

Following the pre-thesis committee meeting, the student and chair must complete the Pre-Thesis Committee Meeting Report (the form can be found in the appendix). This form must be accompanied by the committee chair’s report, which gives a brief synopsis of the meeting, summarizing the sentiment of the committee members regarding the student’s progress and noting any recommendations made to the student. This report is distributed (either as a hard copy or via email) to the student and the committee members and is also placed on file in the student’s permanent folder in the Departmental Office. The written committee report is important, as it provides a reference point for future committee meetings. To ensure accuracy, the chair’s report should be written and distributed within one week of the committee meeting.
YEAR THREE, SUMMER AND FALL SEMESTER

RESEARCH AND COURSEWORK

During the summer preceding their third year in the program, students will be intensively engaged in research and related activities such as critical reading of the literature in preparation for taking the research qualifying examination. Many students will have completed their graded coursework by this point, but some may need to register for one last class in the fall of their third year; e.g., they may have waited for a course that is offered only every other year. Again, the remainder of a student’s 9 credit hours should be allocated to MBIO 601.

RESEARCH QUALIFYING EXAMINATION

This examination is designed to assess students’ preparation to advance to candidacy for the Ph.D. degree. The examination has both a written and an oral component, as described below. In keeping with the Program’s commitment to producing independent scientists, the exam focuses on the student’s own research project and will be evaluated based on his or her ability to demonstrate a firm grasp of the problem under investigation and formulate a coherent experimental strategy to address it.

1. Structure of the Exam

   **Written Component:** The written proposal is a concise original description of the student’s research project. It should be scholarly, rigorous, and contain sufficient detail to be judged as a stand-alone document. The quality of the written proposal is a major factor in determining the outcome of the exam, and the student is expected to organize and write the proposal without editorial input from the advisor or other faculty members. The format is modeled after a grant application to the NIH with the following structure and overall 20-page limitation for sections A-D (double-spaced typed written pages with 1” margins; all pages should be numbered). When preparing the proposal, a student may want to consult successful examples submitted by previous students in the program (available in the Departmental Library).

   A. **Specific Aims:** List the broad, long-term objectives and provide a concise, realistic statement of what the proposed research is intended to accomplish, e.g., to test a stated hypothesis, solve a specific problem or answer a fundamental question. This section should include a brief description of the approaches to be employed but should not be simply a list of experiments. Suggested limit, 2 pages.

   B. **Background and Significance:** Briefly sketch the background relevant to the proposed project, critically evaluating existing knowledge and specifically identifying gaps that the research is intended to fill. State concisely the importance of the proposed research in relation to previously published data and discuss how it may contribute to answering larger biological questions. Suggested limit, 6 pages.

   C. **Preliminary Studies:** Summarize results obtained to date and discuss how they relate to experiments proposed for the future. This section should describe all pertinent experiments carried out, not necessarily only those that gave the expected/desired outcome. Figures depicting experimental data (positive or negative), including graphs, autoradiograms, etc., with appropriate legends, should be included either within the text or as an appendix. Suggested limit for text, 4 pages.

   D. **Experimental Design and Methods:** Describe the experimental strategies and the procedures to be used to accomplish the specific aims of the project; cite published work in which similar strategies were employed or include other information that bears on the feasibility of the proposed research. A key component of this section is a discussion of how the data will be analyzed and interpreted and of any new methodology and its advantage(s) over existing methodologies; it should also point out
potential difficulties and limitations of the proposed procedures and discuss alternative approaches to achieve the aims. Finally, a tentative sequence or timetable for the investigation should be provided. Suggested limit, 8 pages.

E. **Literature Cited.** Provide complete citations, including titles, for all relevant published research papers and reviews. Typically 25-30 references will be necessary to document the background and feasibility of the proposed research.

The completed written proposal must be delivered to committee members two weeks prior to the date set for the oral exam. Upon receiving this document, committee members will evaluate whether it is of sufficient clarity to serve as the basis for the oral examination. Within one week of receiving the written proposal, committee members will convey to the committee chair via email their decision about whether to proceed with the oral exam as scheduled. If the written proposal is deemed inadequate, the defense will be postponed and the student will be provided by the committee chair with a detailed description of the deficiencies to be addressed in a revised proposal. Once a satisfactory written document has been received, the next phase can proceed.

**Oral component:** In the oral examination, the student is expected to defend the proposed research in terms of feasibility of experimental design and/or possible problems that may be encountered in interpreting results. It should be stressed that this applies to results of experiments already performed as well as potential results of proposed experiments. It is also expected that the student will be conversant with the literature in all areas that impinge on her/his specific project and will know, in detail, the scientific content of any literature cited in the written proposal. To begin the exam, the student is given the opportunity to present a short (10-15 minute) overview of the project; which may include visual aids but need not. This is followed by a question and answer session aimed at evaluating the student’s intellectual preparation to carry out and rigorously interpret the proposed research. Questioning is conducted by the student’s committee with the exception of the student’s advisor. The advisor is present primarily as an observer, but s/he may be invited to clarify either misconception or matters of fact relating to the student’s project.

2. **Evaluation of the Exam**

The oral defense is considered complete once all committee members have agreed that they have no further questions for the student. At this point, the student will be asked to leave the room to await the committee’s judgment. Based upon both the written and oral presentations and the oral defense, and following a detailed discussion, the committee will recommend one of three outcomes: 1) Pass; 2) Provisional Pass; or 3) Fail. If the student passes unconditionally, s/he will be advanced to Ph.D. candidacy (see below). The determination of the committee will be communicated orally to the student immediately following post-exam deliberations and in writing through a mechanism similar to that employed after the first committee meeting. A special form is required which will include numerical evaluations from all committee members, accompanied by a memo written by the chair. Again, the report will be distributed to the student and all committee members, and a copy placed in the student’s file in the Departmental Office. The content of the committee chair’s report is particularly critical if the student receives a “Provisional Pass” or “Fail.” The narrative must clearly identify any and all specific weaknesses in the student’s performance which necessitate repetition of either or both parts of the qualifying exam or other remedial action. For example, even if the written document was deemed adequate to proceed with the oral defense, the committee may still ask the student to re-write part or all of the document. Other deficiencies may warrant a suggestion from the committee to take a course in a particular area. Finally, weaknesses in the oral defense may necessitate repeating this part of the exam. If a student fails the exam, he or she will ordinarily be given a second opportunity to remedy whatever deficiencies were found. A student whose performance on the exam is deemed to be below acceptable standards will be given a grade of “Fail” and will not be allowed to continue in the Ph.D. program.

3. **Timing of the Exam**

To continue in the program, a student must successfully complete the qualifying exam by the end of the fall semester of her/his third year. Because advancement to candidacy is based on intellectual preparation, not preliminary results, there is no penalty for scheduling the research qualifying examination early. By arranging to take the exam during the summer after the second year or early in the fall semester of the third year, the student ensures that, if deficiencies are revealed, sufficient time is available to overcome them. This deadline applies to all Ph.D. students.
whether they entered the program with a Master’s or Bachelor’s degree. The timing of the exam is more flexible for M.D./Ph.D. students, but the general expectation is that the qualifying exam will be passed by September of their fourth year in the combined degree program.

ADVANCEMENT TO CANDIDACY

Students will formally advance to Ph.D. candidacy upon successful completion of the research qualifying examination. After advancement to candidacy, students will register for MBIO 701 (dissertation research) rather than 601. Students must complete 18 hr of MBIO 701 in order to obtain a Ph.D. Copies of the required forms that must be filed with the Office of Graduate Studies in order for the student to advance to candidacy and to register for MBIO 701 are included in the appendix. This course is graded on a Satisfactory/Unsatisfactory basis, and students should be aware that two grades of U in dissertation research will result in automatic separation from the program (University rule; see the General Bulletin). Thus, should problems arise with their advisor, students are urged to seek intervention (see below) well before the point of receiving a second “Unsatisfactory” grade. After completing 18 hours of 701, it is necessary for students to register for only one credit hour of MBIO 701, which significantly reduces tuition costs. However, if for some reason it is necessary for a student to have full-time status (for example, to maintain visa eligibility or to postpone repayment of a student loan), s/he may also sign up for 8 credit hours of MBIO 703 (dissertation fellowship), which incurs no additional tuition charges. A copy of the form to register for MBIO 703 is included in the Appendix.

JOURNAL CLUBS AND SEMINARS

In addition to giving seminars on their own research, it is expected that students will participate in one or more journal clubs in which they will present talks on articles from the literature. Examples of such activities include the Molecular Biology and Microbiology Graduate Student Journal Club, Cell Biology Journal Club, Developmental Biology Journal Club and Cell Adhesion Molecule Journal Club.

Another very important component of graduate training is attending talks given by others, including both fellow students and outside visitors. Students are strongly encouraged not only to attend these presentations, but to actively participate by asking questions. It is expected that students will broaden their scientific horizons by attending not only MBio seminars, but also seminar series sponsored by other departments and programs. Examples include Biochemistry, Cell and Molecular Biology Training Program, Developmental Biology, Genetics, Molecular Virology, Neurosciences, Pharmacology and the Center for RNA Molecular Biology.

Meeting outside speakers for lunch. Students are also encouraged to avail themselves of every opportunity to meet with visiting speakers. The MBio office will periodically arrange lunches for students to meet visiting speakers. These meetings provide an extremely valuable forum in which to practice talking about science in a concise, interesting way, as well as to discuss experimental strategies or possible collaborations. Furthermore, they offer a unique opportunity to get to know the speaker and her/his institution, and can therefore lead to identification of a postdoctoral mentor.

Student-sponsored departmental seminar speaker. At least one visitor per year in the Molecular Biology and Microbiology seminar series is selected and sponsored by the graduate students in the Ph.D. program. Visiting faculty are honored by this distinction and are very accessible to students during their visit. Faculty input about candidates is encouraged to ensure that “student-friendly” speakers are selected.

Graduate Student Symposium. The graduate students in the biomedical sciences at CWRU organize a symposium once a year that includes student posters and a keynote speaker selected by students. Students in the MBio program have a strong tradition of not only participating, but winning awards in both the poster and oral presentation categories. The current faculty advisor for the Graduate Student Symposium is Dr. Michael Harris (meh2), who holds a primary appointment in the Center for RNA Molecular Biology and a secondary appointment in the Department of Molecular Biology and Microbiology.
Attending national meetings. Although attending local or regional meetings will certainly benefit students, they are strongly encouraged to seek opportunities to present their work at national or international meetings as well. It is worth pointing out that the number of attendees at a meeting dramatically affects the type of experience the student will have. A very large meeting such as the American Society for Microbiology may be appropriate for some students, while others will find small meetings such as Gordon Conferences more rewarding. Students should also be advised that individual travel grants are often available, usually on a competitive basis, and travel funds may also be available from training grants.

Recruitment of prospective graduate students. Often the most candid assessment of our program comes from current students, and that viewpoint is very valuable to prospective students. In the course of their graduate careers, trainees should expect to host prospective students from other institutions. These opportunities to serve as ambassadors for the institution and program may come during the Spring recruitment weekend or during individual visits by prospective students.

YEAR THREE, SPRING SEMESTER

ANNUAL SEMINARS AND CONTINUING THESIS COMMITTEE MEETINGS

It is expected that by their third year in the graduate program, students will have accumulated sufficient data to present a full (50 minute) seminar on their own research. The talk is generally organized in a manner similar to the first seminar, with the time devoted to background, original data and future plans adjusted appropriately. Each year, the date of the student's seminar will move forward somewhat, as students give their seminars in descending order of the year in which they entered the program. The final seminar, which is part of the thesis defense (see below), will be scheduled when the student has completed her or his written dissertation and had it approved by the advisory committee.

It is the student's responsibility to arrange for regular meetings of her/his thesis advisory committee. These meetings must take place at least once every 12 months, but it is often advantageous to assemble the committee more frequently depending on the individual needs of the student. For example, third year students will generally meet with their committees in the spring following the research qualifying exam, which will have been completed during the preceding summer or fall. Advanced students also frequently schedule an additional committee meeting to present their plans for completing the dissertation to their committee. Thesis advisory committee meetings are most useful when scheduled immediately after the annual departmental seminar. A meeting of the committee can be called by any participating member including the student, and s/he should also feel free to consult individual members at any time on an informal basis. The presence of three members of the committee constitutes a quorum for the purpose of making decisions.

To aid the thesis advisory committee in evaluating progress and providing the most useful advice, it is crucial that the student deliver the annual written report at least one week in advance of the meeting or seminar, whichever comes first. This report should not only summarize progress to date, but also provide a detailed plan for the coming year and a general plan for completing the project. The report should include any data figures to be shown at the seminar, as well as other illustrations that may help the committee to understand the completed and proposed research. Relevant literature should be cited with complete references. It is the responsibility of committee members to read the report prior to the seminar/committee meeting.

Each annual meeting will generally begin with a brief session in which committee members will discuss any issues of concern in the student's absence. These will be conveyed to the student upon his or her return. The student and committee will then hold a frank discussion of the strengths and weaknesses of the research plan or its implementation.

Again, the Thesis Committee Meeting Report Form and accompanying narrative must be distributed to the student and committee members and placed on file in the Departmental Office within one week of the committee meeting. In virtually all cases, the form will indicate that “satisfactory progress” is being made towards the Ph.D. The advisory
YEARS FOUR AND BEYOND

FINISHING UP

Although students will continue to engage in many of the activities described above, the focal point of their energies at this point should be completing the dissertation. At what point a research project is sufficiently complete that the thesis can be written is a matter to be decided between the student, the advisor, and to some extent, the other committee members. The decision must be based on the status of the research rather than on external concerns such as the length of time the student has been enrolled. In his or her own interest, a student should reach an understanding with the advisor on this subject sooner rather than later. It is the responsibility of the thesis advisory committee to approve (or not) the shift in a student’s priorities from conducting experiments to writing the thesis.

While guidance of an individual student’s project is the responsibility of the advisor and thesis committee, there is agreement among Program faculty that, after six years of enrollment, the project should be, if not complete, then very nearly so. Therefore, for a student to continue enrollment and receive a stipend beyond the sixth year, the student and advisor must agree upon a well-defined plan for concluding the thesis and have it approved by the Departmental Graduate Academic Advisory Committee. This plan must be presented in writing by July 1 preceding the fall semester of the seventh year, and should concisely describe progress to date on the project, the specific tasks (experiments, manuscripts, etc.) to be completed, and a realistic estimate of the time that will be required to finish. The GAAC will continue to monitor the student’s progress until graduation and take appropriate action if the dissertation is not completed in a timely fashion. Students should plan to schedule their thesis defense and committee meeting well in advance of the actual day. Thesis defenses should be scheduled in the Tuesday 1:00 p.m. trainee seminar series. Please contact Dorothy Canepari (x3420; djc29) to make arrangements.

DISSERTATION AND DEFENSE

At least six months before the student anticipates completion of the Ph.D., a thesis committee meeting should be held to discuss whether the student's research progress is sufficient to bring the project to fruition in the proposed time frame. At this meeting, the student should provide the committee with a detailed proposal for the format (number of chapters, etc.) and content of the thesis. As noted above under Guidelines for Thesis Research, it is expected that, by the time of the dissertation defense, the student will have submitted for publication in a peer-reviewed journal at least one experimentally based manuscripts on which s/he is first author. Often the best theses represent the work contained in two or more papers, and a strong publication record will be extremely advantageous to the student in achieving her/his long-term career goals. It is also in a student's best interest to submit any manuscripts resulting from the thesis research before leaving the University, because once postdoctoral work has begun, it may take precedence. Because many students will have already published manuscripts on their graduate research, the thesis often reflects that work as chapters, placed in context with a general Introduction, and a Discussion that considers the relevance of the studies. The organization of the thesis into chapters is not prescribed by the department, but is arrived at by the student in consultation with her or his thesis committee.

Examples of Molecular Biology & Microbiology graduate theses can be found in the Molecular Biology & Microbiology library. Detailed regulations concerning format, quality, time of submission and oral defense are established by the Dean of Graduate Studies and Research, and instructions are available from the Office of Graduate Studies.
The Program in Molecular Biology and Microbiology adheres to the CWRU dissertation and defense requirements, which state (in part):

“All candidates for the Ph.D. degree must submit a written dissertation as evidence of their ability to conduct independent research at an advanced level. The dissertation must represent 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 or monograph.”

“Each doctoral candidate is required to pass a final oral examination in defense of the dissertation. The examination may also include an inquiry into the candidate's competence in the major and related fields.” (General Bulletin, pg. 94).

In addition, the thesis defense is expected to adhere to the following practices: 1) A draft copy of the dissertation is to be distributed to the members of the thesis advisory committee at least three weeks prior to the defense unless all committee members agree to a shorter time frame. 2) The defense is to be immediately preceded by a public seminar in W234 (the Rottman Seminar Room). 3) Notice of the thesis seminar and defense are to be publicized by a notice in the Campus News as well as flyers posted throughout the university and electronic mail sent to the entire department.

**STUDENT ADVOCACY**

Although the vast majority of students in the program progress smoothly through each stage described above, the training faculty recognizes that this is not guaranteed. In the event that difficulties arise during graduate training, a student is advised to seek help from one or more sources including the thesis advisor, the thesis committee as a whole or individual members, the Graduate Academic Advisory Committee, the Department Chair or, if relevant, the MSTP Director. One problem that may occur in the late stages of a graduate student's career is disagreement with the thesis advisor on the scope of the dissertation, i.e. when the research project is to be considered complete. In these cases, the thesis advisory committee can often play an important role in brokering an acceptable compromise. Since these or other problems are often unanticipated, it is important for the student, the advisor and the committee to develop early on a relationship characterized by mutual respect.

If the student, mentor and committee cannot come to an agreement about the training plan or resolve any other problem that might arise, then the Graduate Academic Advisory Committee should be consulted. A graduate student, thesis advisor, or thesis committee member may bring to the GAAC cases where serious breakdowns in communication have occurred with respect to the students’ graduate studies and ask the Committee to intervene. This committee will do all in its power to grasp what will undoubtedly be a complex situation and mediate a resolution acceptable to all. The Department Chair should be consulted only in extreme situations.

In addition to its role in crisis intervention, the GAAC is charged with monitoring graduate student progress. This will include accepting or rejecting applications for extension of the time allocated for completion of the Ph.D. studies, as noted above, as well as arbitrating any disagreements about whether a given student has met the requirements for graduation. Finally, the Graduate Academic Advisory Committee will meet on an ad hoc basis to discuss policy issues in graduate education. Thus, if students or faculty members have constructive suggestions about any aspect of the program, these should be forwarded, preferably by e-mail, to the chair of this body, currently Dr. Wise (jaw17).

As a very last resort and only if absolutely necessary, students may express a grievance against actions of other students or of faculty and staff through procedures handled by the Office of Graduate Studies (for academic problems) or the University Office of Student Affairs (for non-academic problems). Members of the University community who believe they have been sexually harassed are entitled to an investigation; officials in the Provost's Office, Office of Student Affairs and/or the Office of Affirmative Action/Equal Employment Opportunity will provide options for resolution.

**Foreign students.** The University Attorney’s Office, Office of Foreign Faculty and Scholars (Phone: x4289, FAX: x1881) provides additional resources for foreign students.
MEDICAL SCIENTIST TRAINING PROGRAM (MSTP)

MSTP students in the Molecular Biology & Microbiology Program are expected to complete the requirements for MSTP students as outlined in the MSTP guidelines. The general guidelines and performance expectations for MSTP students in the Molecular Biology & Microbiology Program are identical to those for graduate students. MSTP students are required to take 4 elective courses of 3 credit hours each and are encouraged to take Molecular Biology & Microbiology graduate courses during the first two years of medical school.

The research qualifying exam for MSTP students follows the same format as for other graduate students, and should be completed in the second summer following identification of a laboratory and mentor. The qualifying exam should be scheduled at the conclusion of required coursework, and must be completed by September of the fourth year following admission into the combined program. In keeping with the policies of the MSTP, each student must have a member of the MSTP steering committee and one MD or MD/Ph.D. on her/his thesis committee. MSTP students in the Molecular Biology & Microbiology program are encouraged to complete the Ph.D. portion of the program within 4 years.

MASTER OF SCIENCE DEGREE IN MOLECULAR BIOLOGY & MICROBIOLOGY

The Graduate Program in Molecular Biology & Microbiology is a Doctoral degree-granting program and does not admit students whose sole goal is to earn a Master's degree, nor does it award M.S. degrees as part of the Doctoral curriculum. On rare occasions, a graduate student may decide to leave the Ph.D. program after completing a significant body of coursework and/or independent research. Under these conditions, a Master's Degree in Molecular Biology & Microbiology may be awarded subject to approval by the student's thesis advisory committee. To qualify, a student must maintain continuity of registration and a B average in graded courses, as for the Ph.D. Depending on the point at which the student decides to leave the program, one of the following two options are available:

I. Plan B, no thesis. This program is aimed at students who have completed most or all of the coursework required for the Ph.D. but have not made sufficient research progress to write a Master's thesis. If the student has not yet passed the research qualifying exam, s/he must successfully pass a special M.S. degree examination which also has both a written and an oral component. Upon successfully fulfilling the requirements, these students will earn a Master of Science Degree in Molecular Biology & Microbiology.

II Plan A, with thesis This program is designed for students who have taken most of the courses required for the Ph.D. but in addition have made substantial progress on their research project. In addition to the coursework requirements, candidates for this degree are required to submit an acceptable written thesis based on their original research. The thesis must then be defended in an oral examination administered by the student's thesis advisory committee. Upon successfully fulfilling the requirements, these students will earn a Master of Science Degree in Molecular Biology & Microbiology.

For each of these Master's Degrees, a total of 36 hours of graduate credit is required. A complete list of requirements is available in the Departmental Office or in the General Bulletin of Case Western Reserve University.