



Sackler School of
Graduate Biomedical Sciences

Graduate Program in Molecular Microbiology

Program Guide
2016 - 2017

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The requirements described in these guidelines may be amended or altered by the Graduate Program. Note that Sackler-wide policies supersede program specific policies.

Welcome and Key Program Contacts

Welcome to the Graduate Program in Molecular Microbiology. This Program Guide provides key information and guidelines on the requirements of the program. It supplements information contained in the Sackler School Catalog (<http://sackler.tufts.edu/Student-Life/Sackler-Catalogs>), which has the official degree requirements and course listings, and the Sackler School Handbook (<http://sackler.tufts.edu/Student-Life/Sackler-Student-Handbook>), which contains important information about topics such as the Sackler academic and registration policies, professional conduct guidelines, financial matters, and information about student benefits, services, and resources.

This Guide includes a listing of other graduate students in the program and contact information for faculty, staff, and students. You can find information about the research interests and publications of the faculty, as well as up-to-date schedules of seminars, journal clubs and research reports on our website (<http://sackler.tufts.edu/Academics/Molecular-Microbiology-Welcome>). We would greatly appreciate any feedback from you to help us make this Guide more useful.

There are several people who can serve as valuable resources during your PhD training and are always willing to discuss any issues or concerns about the program or direct you to the appropriate office. They are listed below, along with information on how to contact them.

Name & Position	Location	Phone	Email
Michael Malamy, Program Director	Stearns 504	6756	michael.malamy@tufts.edu
Katya Heldwein, 1 st Year Student Advisor	Arnold 611C	0858	katya.heldwein@tufts.edu
Andrew Camilli Director of Admissions & Molecular Genetics Director	S Cove 503	2144	andrew.camilli@tufts.edu
Ralph Isberg, Qualifying Exam Advisor & MERGE-ID Director	Jaharis 424A	3993	ralph.isberg@tufts.edu
Rima Mycynek, Program Coordinator	S Cove 501	6750	rima.mycynek@tufts.edu
Molly Kyle Administrative Assistant	S Cove 501	3451	molly.kyle@tufts.edu
Verna Manni, Department Manager	M&V 401	6663	verna.manni@tufts.edu
Ila Anand & Stacie Clark GSC Representative	Jaharis 424A	4092	ila.anand@tufts.edu stacie.clark@tufts.edu
Student Advisory & Health Administration Office	Posner 4	2700	http://medicine.tufts.edu/Student-Services-and-Campus-Life/Student-Advisory-and-Health-Office/Contact-Us

The Program Director is elected by the graduate program faculty to administer the educational mission of the graduate program. The Program Director represents the interests of the program on the Sackler School's Executive Council where policy matters concerning the School's programs are discussed and enacted.

The Admissions Director is responsible for recruiting high quality program candidates, identifying candidates for interview from the applicant pool, arranging for interviews of these candidates with program faculty, and selecting the best candidates (with input from the faculty) to be given placement offers.

The Student Advisor serves as a mentor to the first year students, including providing specific advice on selecting appropriate sites for laboratory rotations, choosing elective courses, and identifying laboratories for thesis work.

The Advisor also serves as an advisor to upper level students including, but not limited to, membership of thesis advisory committees, electives, individual development plans, issues arising with mentors, faculty members, staff and even other students. In general, the Advisor acts as a student advocate within the faculty.

The Qualifying Exam Advisor guides the student through the Qualifying Exam examination process providing advice on topic selection and approaches to constructing the written proposal and oral presentation.

The Program Coordinator and Administrative Assistant assist the Program Director in the functioning of the program as needed, as well as help students schedule rooms, complete forms, plan events, and manage program requirements.

Graduate Student Council Representatives. Two representatives are elected by the students to serve as the program's representatives to the Sackler Graduate Student Council (GSC). The GSC organizes activities, including the Annual Sackler Relays, and the GSC Officers are ad hoc members of the Sackler School Executive Council.

Supplemental Employment

Because Sackler students receive stipends, usually from federal grants, their ability to work in additional on-campus jobs is limited. You will find the Sackler School Supplemental Employment Policy in the Student Handbook (<http://sackler.tufts.edu/Student-Life/Sackler-Student-Handbook>). Examples of student jobs include pouring plates in the media kitchen, transporting lab dishware, and tutoring.

In addition, the following restrictions apply to Molecular Microbiology students:

1. Any student seeking such employment must have successfully passed the qualifying exam, and must be in good standing.
2. Any student who has been granted an extension of time to complete the MS or PhD degree may not hold such employment.
3. Any student who has registered for "Degree Only" may not hold such employment.

Sackler School Student Vacation and Sick Policies

Students receive vacation and sick benefits each year (vacation dates to be approved by advisor in advance). For complete information about these and other benefits as well as Attendance Policy, please refer to the Sackler Student Handbook (<http://sackler.tufts.edu/Student-Life/Sackler-Student-Handbook>).

Scientific Misconduct

Tufts University takes very seriously issues pertaining to ethical practices, scientific misconduct, and academic violations.

The official Sackler School Student Code of Ethics can be found in the Student Handbook, which is accessible at the following website: <http://sackler.tufts.edu/Student-Life/Sackler-Student-Handbook>.

The official policy of Tufts University with respect to scientific misconduct can be found at the following website: <http://viceprovost.tufts.edu/policies/scientific-integrity/policy/>.

The National Academy of Sciences has published a very useful pamphlet, called "On Being a Scientist," that addresses these issues in a clear and thought-provoking manner. See http://books.nap.edu/openbook.php?record_id=12192&page=R1.

Plagiarism: Definition and Guidelines:

Plagiarism is defined as the intentional representation of someone else's words or ideas as your own. This definition, however, is interpreted differently in different academic disciplines and in different cultures. Nonetheless, plagiarism by a student can be grounds for dismissal from graduate school. Plagiarism by an investigator at any level can be grounds for loss of employment and sanctions with respect to publishing and competitive funding. Therefore, it is critically important to understand fully the practical definition of plagiarism that is currently accepted by scientists in the United States.

The following discussion is meant to provide some guidelines for practice. Whenever you are unsure about how to handle a specific case, it is a good idea to seek advice from a more experienced scientist. In addition, NSF and NIH have written documents that explain plagiarism and how to avoid it.

1. Both ideas and the specific ways that ideas are expressed are covered by plagiarism rules.
2. Never copy phrases, sentences, or paragraphs from the writings of others, unless those phrases are set apart by quotation marks and properly attributed.
3. When restating ideas written or spoken by others, recast those ideas in your own words, but give credit to the originators of the ideas.
4. Be explicit and generous when citing the prior work or ideas of others.

Example 1: Original authors—Smith and Jones (1999):

TopA protein was purified using the procedure of Johnson and Johnson (1995) with the following modifications: Ion exchange chromatography was on DEAE-Sephacel instead of DEAE-cellulose and the pH of the elution buffer was 7.5 instead of 8.0.

Acceptable forms of subsequent citation:

1. The method of Smith and Jones (1999) was used for purification of TopA
2. We purified TopA using the method of Johnson and Johnson (1995), as modified by Smith and Jones (1999).

Unacceptable forms of subsequent citation:

1. TopA protein was purified using the procedure of Johnson and Johnson (1995) with the following modifications: Ion exchange chromatography was on DEAE-Sephacel instead of DEAE-cellulose and the pH of the elution buffer was 7.5 instead of 8.0. (no rewording, no citation of Smith and Jones)
2. We purified TopA using the procedure of Johnson and Johnson (1995) with the following modifications: Ion exchange chromatography was on DEAE-Sephacel instead of DEAE-cellulose and the pH of the elution buffer was 7.5 instead of 8.0. (insignificant rewording, no citation of Smith and Jones)

Example 2: Original authors—Smith and Jones (1999):

Our results lead us to speculate that TopA is a regulator of topB transcription that binds directly to the topB promotor region and represses transcription.

Acceptable forms of subsequent citations:

1. The results of our binding and in vitro transcription experiments demonstrate that TopA binds to the topB promotor region, thereby repressing transcription, as predicted by Smith and Jones (1999).
2. Smith and Jones (1999) suggested that TopA is a direct repressor of topB. Our in vitro results provide strong confirmation of this prediction.
3. (rarely used) Smith and Jones (1999) speculated that "TopA is a regulator of topB transcription that binds directly to the topB promotor region and represses transcription." Our results provide strong confirmation of this prediction.

Unacceptable forms of subsequent citations:

1. Our results lead us to conclude that TopA is a regulator of topB transcription that binds directly to the topB promotor region and represses transcription. (re-use of same language; no citation of Smith and Jones)
2. The results of our binding and in vitro transcription experiments demonstrate that TopA binds to the topB promotor region, thereby repressing transcription. (no citation of Smith and Jones)

Laboratory Data and Notebook Policy

As researchers depend more and more on direct recording of primary data into spreadsheets and other computer formats, it has become essential to define the rules for substituting computer files for traditional laboratory notebooks. It is also important to reinforce the general standards for acquisition and retention of primary data. These standards apply to all methods of data recording. Please refer to the Laboratory Data and Notebook Policy in the Sackler Student Handbook (<http://sackler.tufts.edu/Student-Life/Sackler-Student-Handbook>) for the complete policy.

Key Events for Students

Year	Date	Event	Faculty contact
1	Fall & Spring	Complete coursework requirements are listed in the Sackler School Catalog (http://sackler.tufts.edu/Student-Life/Sackler-Catalogs)	First year advisor
1	May	Select thesis advisor	First year advisor
1	Summer	Form thesis committee	Thesis advisor
1	Summer; must be completed by Sept 1	Complete qualifying exam	Qualifying exam committee chairperson
2	Fall	First thesis committee meeting convened by December 1	Thesis advisor, thesis committee members
2	Spring	Second thesis committee meeting convened by June 1	Thesis advisor; thesis committee members
2	March	Candidacy in PhD program determined by Molecular Microbiology faculty	Thesis advisor
2-5, etc.		<ul style="list-style-type: none"> • Thesis committee meetings once per semester, for fall and spring semesters, until permission to defend has been obtained • Satisfy teaching requirement (generally Fall of years 2-4) • Project evaluation meeting at or before end of year 3 	Thesis advisor, thesis committee members
3	Summer	<ul style="list-style-type: none"> • Continue coursework as needed • Formal written thesis proposal due at the first thesis committee meeting of year 3 	Thesis advisor, thesis committee members
		Thesis preparation and defense	Thesis advisor, thesis committee members, outside examiner

Curriculum Overview

MERGE-ID and Molecular Genetics Training

The MERGE-ID (MEdically-oriented Research in Graduate Education) Program provides students with the knowledge they need to conduct hypothesis-driven research that attacks critical issues related to the treatment, prevention, diagnosis, and management of infectious diseases. MERGE-ID students begin their training in the first week of July. They complete a summer course that incorporates didactic courses, problem based learning, and a clinical practicum

The Molecular Genetics Program provides rigorous training in fundamental aspects of molecular genetics. The curriculum emphasizes strong grounding in fundamentals such as biochemistry and molecular biology as well as fundamental aspects of genetics. Trainees complete courses focusing on prokaryotic and eukaryotic microbial genetics that cover topics such as chromosome replication and segregation, recombination, mutant screens and selections, regulation of gene expression, cell-to-cell communication, differentiation, stress responses, and physiology.

Required Courses

Students complete a series of required didactic courses designed to provide a strong knowledge base for their research. The Sackler School Catalog for the year in which students were admitted lists these required courses (<http://sackler.tufts.edu/Student-Life/Sackler-Catalogs>). In addition, the Catalog contains course descriptions and progression plans for the first and second years.

Elective Courses

Students are required to complete elective courses in addition to the required courses. Elective courses must be approved by the thesis advisor and the Program Director and should be used to explore students' interests and further their understanding of their thesis research fields. Students choose these courses from the list of electives in the Sackler School Catalog. Courses may be chosen from any Sackler program or from other schools that allow cross-registration. In addition, students are expected to acquire expertise in prokaryotic molecular genetics, eukaryotic molecular genetics, pathogenic microbiology, and microbial physiology.

Journal Club

The overall goal of the Journal Club (JC) is to advance the student's skills in critically evaluating scientific literature and improve the student's presentation skills. Students may choose to present JC topics that they are familiar with, or they may wish to gain important experience by choosing topics that are new to them. Students should consult with their mentors when choosing a topic for presentation.

Attendance in JC is required and students who do not attend regularly will receive a warning; continued absence will result in a failing grade. PhD students must register each semester for journal club except for those students who have registered for PhD Degree Only. Students in years 2, 3, and 4 must present one journal club presentation per year. Presentations will be monitored and evaluated by members of the Faculty.

Graduate Seminar

The goal of attending the Graduate Seminars is to improve the student's appreciation for how research progress is obtained and to raise awareness of recent advances in the field. All students must register each semester for graduate seminar except for those students who have registered for PhD Degree Only.

Research Presentations

Students in years 3 and higher must present an annual report of their research, except those students who have received permission to defend their theses. The Student Research Presentation schedule is provided to students at the beginning of each academic year and will also be posted on the Sackler calendar. Research Presentations are attended by students, faculty, and other interested members of the Program. All

students are required to attend these meetings. MERGE-ID track students will attend bi-weekly, alternating with the ID Journal Club.

Candidacy

On the basis of a student's performance in coursework, qualifying exam, laboratory rotations, and research in the thesis laboratory during the first 18 months of the graduate program, the faculty evaluates the student's potential to do original research and determines whether the student is qualified to become a candidate for the PhD degree.

1. Students must have passed their qualifying exam and had at least one thesis committee meeting before candidacy can be considered.
2. Students are notified in writing as to the status of their candidacy and of any problems that may need to be corrected.

Teaching Requirement

As part of their academic training during years 2-4, students are required to participate twice as a lab instructor in Medical and Dental Microbiology wet labs and/or as a teaching assistant in either a Dental or Medical School course directed by the program faculty. As teaching assistants, students are required to attend all lectures, participate in small group sessions, and tutor students. Compensation will be determined.

Requirements for the Master of Science Degree

A student in good standing in the doctoral program who is unable to complete the requirements for the PhD degree may be allowed to write and defend a Master's thesis. Permission to submit a Master's thesis must be obtained in advance from the Program faculty and will only be granted if compelling reasons for leaving the PhD program are provided and if specific guidelines are followed and specific criteria are met. Master's Degree Requirements can be found in the Sackler School Student Handbook (<http://sackler.tufts.edu/Student-Life/Sackler-Student-Handbook>).

A Master's candidate may only begin writing the thesis after obtaining explicit permission to do so from the thesis advisory committee. The student's thesis must describe original laboratory research carried out by the candidate under the supervision of a faculty member, and must form a coherent body of work of publishable quality, even though the scope of the work may not permit publication. The Master's thesis should be presented in the same format as a PhD thesis, as required by the Sackler School. The suitability of the Master's thesis will be determined by the thesis advisory committee after an oral defense of the thesis by the candidate and is subject to ratification by the program faculty.

Laboratory Rotations

Purpose

Laboratory rotations are designed to acquaint students with some of the research projects of current interest in the program, to allow students to assess the suitability of a particular lab for their thesis research, and to allow faculty members to assess the suitability of individual students for work in their labs. A minimum of four lab rotations must be completed during the first academic year, and students are expected to rotate in four different laboratories.

Rotation Matching Process

Students choose rotations based on their interests and the willingness of the rotation mentor to accept a student. Students are strongly encouraged to choose rotations that expose them to areas of research with which they are not already familiar.

The Sackler School Laboratory Rotation Policy is published in the Student Handbook (<http://sackler.tufts.edu/Student-Life/Sackler-Student-Handbook>) and the dates for the laboratory rotations are posted on the Sackler website in the Academic Calendar (<http://sackler.tufts.edu/Student-Life>).

Several weeks before rotations begin the Sackler School Dean's Office emails students a list of available faculty laboratories. This email contains a link to a survey in which students are to enter their first, second, and third choices for rotations. The Program Student Advisors meet with students to discuss their possible matches. Information regarding the research areas of program faculty members can be found at the Sackler School website (<http://sackler.tufts.edu/Faculty-and-Research/Sackler-Program-Faculty>). In addition, students should meet with potential mentors during the last three weeks of the immediately prior rotation, but no commitment should be made about whether or not the student may rotate in a lab before all rotation matches are announced. Students should share their interests and mentors discuss the possible projects available in the lab. All students will be notified of their matches simultaneously by their Student Advisors.

Each rotation is evaluated by the rotation mentor. Grades are given for each rotation. When multiple rotations are completed in one semester, the grades are averaged to obtain the grade for the Laboratory Rotations course.

Students are required to provide a report at the end of each rotation, the nature of such report is left to the discretion of the principal investigator in the rotation lab.

All students in the Molecular Microbiology Program are required to fulfill distribution requirements with respect to their rotations. The aggregate rotations must provide significant experience in prokaryotic biology, eukaryotic biology, biochemical analysis, and genetic analysis. These requirements must be fulfilled even when students choose to do rotations with faculty members outside the Program. One of the roles of the first year advisor is to judge the suitability of the student's rotation program in terms of completing these requirements.

When choosing rotation laboratories, MERGE-ID track students should keep in mind that they are expected to complete a medically relevant thesis.

Qualifying Examination

Purpose

A Qualifying Examination is given to all graduate students in the Molecular Microbiology Program. The purpose of the examination is to determine whether a student has adequate general knowledge in research and whether s/he is able to formulate experiments, to test biological hypotheses, and to critically analyze experimental results and literature.

Timing of the Qualifying Exam

The Qualifying Examination must be completed by the end of summer term of the first year for PhD students. MD/PhD may take the exam earlier.

All students must take the qualifying exam as a requirement for candidacy. Students who fail to complete this requirement in a timely fashion will receive a failing grade and be dismissed from the Sackler School. It is the responsibility of the student to initiate the qualifying procedure, but the Molecular Microbiology program director must make sure that the student is fulfilling this responsibility. Because scheduling meetings is more difficult during the summer, students are encouraged to begin this process as early as possible.

No more than four weeks after gaining approval for the chosen topic from the Qualifying Exam Committee, the student must submit a written document to each committee member that follows the prescribed format described below.

Selection of the Qualifying Exam Committee

A Qualifying Examination Committee will be assigned to the student by the Program. The committee will consist of three (3) members of the Tufts Program in Molecular Microbiology and will not include the thesis advisor. Two of these members will be assigned by the program. The first two members will choose the third member after the student has determined the general subject area of the proposal. If the proposal topic is changed after the Committee has been chosen, the third member may not be changed. One of the three members will be designated by the Program as Committee Chair.

It is the responsibility of the Committee Chair to make sure that the student holds to the deadlines set by these guidelines and completes the examination in a timely fashion. To this end, the Chair must set up a timetable for completion of the examination. The Molecular Microbiology Program Qualifying Examination Progress Report form is used to document the scheduling.

Overview of the Qualifying Exam Process

1. The student will choose a general topic to be covered in the qualifying examination in order to initiate the procedure. If in a thesis lab, the student may consult with the thesis advisor on the topic.
2. The chosen topic will be presented to the Qualifying Examination Committee, as individuals or as a group, in an informal fashion, and the student can initiate work on the topic after gaining approval from the committee. There is no need for the committee to meet as a group at this time, although such a meeting may take place at the request of the student or committee members if it should be deemed necessary.
3. Students will have 4 weeks to read research papers on the topic and write the examination document. During this period, the student should identify, in consultation with the examination committee, important unanswered questions raised by contemporary research on the chosen topic. During this 4-week period only, the student is not required to carry out experimental work on his or her thesis project, but should still fulfill other obligations to the laboratory such as attending weekly lab meetings, if such attendance is normally expected.

4. The final paper must propose experiments that are the student's own ideas. During preparation for the examination, the student may ask members of the committee for feedback on these ideas, but in no way should these consultations be used to get others to formulate experiments for the student.
5. The examination paper must be written entirely by the student, and the paper may not be shown to anyone other than a committee member prior to completion of the examination. Review of the paper by others, for any reason, prior to submission is not allowed without the consent of the members of the Examination Committee.
6. The submitted examination paper must be a research proposal on a subject that is unrelated to the thesis topic, as determined by members of the Qualifying Examination Committee after informal consultation with the student.
7. Upon submission of the document, a date for an oral examination will be set. This date will normally be about one week after submission. The Qualifying Examination Committee will read the proposal and decide no later than 48 hours in advance whether an oral exam can take place at the previously designated time or whether the proposal should be rewritten according to the recommendations of the Committee before an oral exam is permitted. If rewriting is necessary, the revised proposal must be submitted within two weeks after such notification by the Committee.
8. If the rewritten proposal is still not satisfactory, a joint meeting of the Qualifying Committee and the Thesis Committee should address all aspects of the performance and status of the student and make recommendations to the faculty of the Program with regard to that status. Based on the progress of the student to that date, the student may or may not receive a passing grade for the Qualifying Examination.
9. The student must obtain the Sackler School Qualifying Examination Report Form (found on the Sackler Website at <http://sackler.tufts.edu/Student-Life/Information-for-Current-Students/Student-Forms>) and present it to the Chair prior to the start of the oral examination. During the oral examination, the Chair will be responsible for making sure the meeting goes smoothly and for completing the Qualifying Examination Report Form to document the results of the exam. Only members of the Qualifying Examination Committee and the student may attend the oral examination. Specifically, the thesis advisor may not attend this meeting. The format of the examination will be as follows:
 - a. The student should spend 15 minutes or less outlining the proposed research and then answer any questions of the Committee.
 - b. Following the presentation, there will be a question period of no more than two hours. The questions can be either specific to the proposal or cover general disciplines related to the proposed research.

Format of the Written Qualifying Exam

The written Qualifying Examination document can be no more than 20 double-spaced pages in length and should conform to the same standards as are found in a typical post-doctoral fellowship application. An example of a typical application will be on file in the Molecular Biology & Microbiology Department office.

1. The proposal must consist of a set of experiments that answer a defined question or test a specific hypothesis. They should seek to make a significant advance in our knowledge about an important topic.
2. The proposal should include a list of specific aims and a section that covers the background and significance of the proposed research (the background should be limited to 5 pages).
3. The rest of the proposal should describe the experimental approaches and methods that will be used to fulfill the specific aims and should indicate how specific experimental results will be interpreted.

Evaluation of the Qualifying Exam

Upon completion of the exam, the Committee will decide if the student has written a reasonable proposal and defended it competently in the oral examination.

1. If the written portion of the examination is in any way unsatisfactory, but the oral examination is acceptable, the student may be asked to rewrite portions, or all, of the proposal. The student has two weeks to complete the rewriting (called "revised written proposal").
2. If the oral portion of the examination is unsatisfactory, this portion must be repeated (called "second oral defense") within two weeks of the original oral examination or within one week of submission of a revised written proposal. A new version of the written examination may not be necessary, at the option of the Committee.
3. If the revised written proposal or the second oral defense is still not satisfactory, a joint meeting should be called immediately, in which the Qualifying Examination Committee discusses with the Thesis Committee the problems regarding the examination. A recommendation regarding the status of the student will be forwarded as soon as possible to the Program Faculty. Based on the progress of the student to that date, the student may or may not receive a failing grade for the Qualifying Examination.
4. Successful completion of the oral and written parts of the examination, as determined by the Examination Committee, constitutes completion of all qualifying examination requirements. The completed Qualifying Examination Form (found on the Sackler website at <http://sackler.tufts.edu/Student-Life/Information-for-Current-Students/Student-Forms>) must be submitted to the Sackler School shared drive for use by the Registrar and the Molecular Microbiology Program staff.

Research, Career Planning, and Thesis

Selection of a Thesis Advisor

Students are matched with thesis mentors in May of their first year after completing their laboratory rotations. The centralized matching system is designed to maximize the chances that students are matched with one of their top choices. Starting in mid-April, students should begin to discuss with potential thesis advisors the range of research projects that may be open to a student. No such discussions should occur at any earlier time. At no time should a student expect, or faculty members provide, any guidance or commitment as to the likelihood that the student would be accepted into the lab. At this

stage, all students are afforded an equal opportunity to discuss potential projects with all faculty members who have indicated a willingness to accept one or more students.

During a predetermined period in May, each student will post a list of his/her first, second and third choices of thesis labs. The student advisor will make known to relevant faculty members the names of students who have listed the faculty member as a first choice. Each faculty member will then have the option to accept the student(s) or to decline. When more than one student asks to be accepted into the same lab and only one space is available, the faculty member has the option of choosing which student to accept. If a student is not accepted into his/her first lab choice, every effort will be made to assure that that student's second choice is successful. In summary, faculty members do not recruit students into their labs and students should not make commitments to faculty members or ask for commitments from faculty members except through the process described above.

MD/PhD students usually select a thesis advisor after completing two summer rotations during medical school and upon entering the program.

A student who chooses a faculty thesis mentor in a research lab that is not part of the Molecular Microbiology Program must decide whether to switch graduate programs or stay within the Program. In the latter case, the student would be required to meet all the requirements of the Program, the thesis advisor would have to be approved by the Molecular Microbiology Program Faculty, and the student's thesis project would have to be judged appropriate for a degree in Molecular Microbiology. MERGE-ID track students must seek the approval of the Director if they wish to remain in the track but want to choose a thesis advisor who is not a member of the Molecular Microbiology Program.

Selection of the Thesis Advisory Committee

PhD students will select a Thesis Advisory Committee early in the fall semester of their second graduate year, and MD/PhD students will do so during fall of their first graduate year. Students are responsible for holding their first TAC meeting before the end of this semester.

The responsibility of the thesis committee is to monitor and guide the student toward successful completion of the PhD program. The thesis committee must have a minimum of four Sackler faculty members, including the thesis advisor. Three of the members must be Molecular Microbiology faculty. The student and the advisor should work together to form the committee. The expertise needed for the thesis project and the probability of forming good working relationships should be considered as the members of the committee are selected.

The student should ask each member if he/she is willing to serve on the committee. Faculty members may decline if they feel they do not have adequate expertise, or if they have too many committee responsibilities.

A member of the committee other than the thesis advisor will serve as the committee chairperson. The chair is responsible for conducting the committee meeting, for preparing the committee report and for confirming that all degree requirements are being met on schedule.

Career Planning

All PhD research trainees must have an Individual Development Plan (IDP) to help develop their career paths. Tufts has created two forms to assist students in identifying their career goals and current activities they participate in to achieve them. These forms are available at <http://sackler.tufts.edu/Student-Life/Information-for-Current-Students/Student-Forms>.

- The IDP form is intended to help students consider their career aspirations as well as the types of skills and attributes that may affect these aspirations and students' ability to attain their goals. It is not intended to predict or identify careers that match their skills. The document is for students' personal use only. Students are not required to share this document with anyone or provide anyone at Tufts with a copy of the completed document. Students may, however, choose to share the document with mentors who may suggest ways to improve skills that are appropriate to the career path(s) being considered. This document should be a living document and one that is updated as students advance in their training.
- The Training and Career Goals Progress Report form is designed to help students think about what they are learning and how to develop professionally. Students are asked to complete this form with a reflective assessment of their current progress and their plans for reaching both short- and long-term career goals. Note that some questions on the form may not apply depending on the student's stage of training. This annual progress report is designed to provide ongoing documentation of progress made towards career goals. Once a year, students complete this form and submit it to their thesis committees along with their research reports for discussion at a TAC meeting. It is the responsibility of thesis committees to provide advice on the resources that will help students achieve their goals at Tufts and beyond.

IDPs have proven so valuable that NIH has mandated that every trainee they support have one. Students can learn about IDPs at this very useful site, <http://myidp.sciencecareers.org/>. They may also talk with their mentors, Student Advisors, the Program Director, or Kathryn Lange about career planning, in addition to their Thesis Advisory Committees.

Thesis Advisory Committee Meetings and Assessment of Research Progress

Molecular Microbiology students are responsible for holding their first Thesis Advisory Committee (TAC) meeting before the end of the fall semester of their second graduate year. MD/PhD students must hold their first TAC meeting in the fall semester of their first graduate year.

Subsequently, two meetings a year, one in the fall semester and one in the spring semester, will be necessary for satisfactory performance in the graduate research course. Failure to hold meetings in a timely fashion will result in an Incomplete grade for research for the semester which will become a failing grade if not completed by the end of the subsequent term.

Students should summarize their research progress and plans on the most up to date TAC Evaluation form on the Sackler website (<http://sackler.tufts.edu/Student-Life/Information-for-Current-Students/Student-Forms>). After the Committee meeting, the TAC Chair enters the Committee's assessment on the Thesis Advisory Committee Evaluation form and assigns a grade for Graduate Research. The form is signed by all

members and an electronic copy is sent to the Sackler Registrar who records the grade on the student's transcript.

Prior to the first committee meeting, the student should prepare a written proposal describing the relevant background and overall goals of the thesis research, as well as any preliminary results that have been obtained. The proposal should be distributed to the committee members at least five days before the meeting. The committee will evaluate the feasibility and suitability of the work as a thesis project. It is understood that the direction or emphasis of the student's research may change over time.

For each subsequent meeting, the student is expected to prepare a written summary which includes the results from the previous period, a clear outline of the goals stated at the prior meeting, a concise description of how those goals have been reached or modified, and plans for future research. This report should be distributed to the committee members at least seven days before each meeting. During these meetings, the student will give an oral presentation based on this report. Completed and future coursework will also be discussed at the committee meetings. The student should also prepare for the committee meeting by considering issues or concerns that he or she would like to discuss with the committee. It is important to note that the student must take an active and responsible role in directing his/her training.

The report must contain a meaningful evaluation of the student's progress and cite aspects that reflect both advances and possible problems. If the committee feels the student's progress has been unsatisfactory, this evaluation will be included in the report.

The Project Evaluation Meeting

At or before the end of the second laboratory year (usually the third year in the program), the committee will communicate its confidence or lack thereof in the student's project. The committee will rigorously evaluate the overall progress in achieving the goals of the thesis project and the likelihood that remaining goals can be achieved. The student's thesis proposal at this time should contain a clear and concise summary of the work completed so far and of the remaining goals of the project. The experiments that are projected to fulfill these goals should be outlined briefly. The report, as all other committee reports, should be given to the committee at least seven days before the meeting.

In the case of a positive evaluation, the committee will be stating that, barring unforeseen developments, it is confident that the project can lead to successful completion of the thesis research. In the case of a negative evaluation, the committee chair drafts a report detailing the committee's objections to the project.

It is important to note that a positive committee evaluation at the end of the third laboratory year does not guarantee a degree. In addition, it is extremely important to understand that a negative evaluation at this point does not rule out the possibility that the student can successfully complete the thesis with the project in which the committee does not have confidence. The goal of a negative evaluation is to send a clear warning signal to the student and the advisor.

Thesis Proposal

All students will be required to prepare a five page detailed review of the literature of the

thesis subject to be included as part of the Thesis Committee report in the Fall semester of the third year (i.e., within two years after matriculation for PhD students and within one year after choosing a thesis lab for MD-PhD students). Evaluation of the review will be part of the research grade for the Fall semester. In addition, students will be required to include a more extensive introduction to the thesis topic as part of the third year Research Presentation to the department in the second semester of the third year.

This proposal should include a critical evaluation of the relevant literature, the context for the thesis project, the specific aims of the thesis research, and a summary of the experimental approaches that will be used to address these aims. To the extent possible, progress toward meeting those goals should be incorporated as well. But the major emphasis of the proposal should be the theoretical justification for and the context of the project, not the progress report.

Unlike the qualifying exam, the thesis proposal is not a test. The purpose of the thesis proposal is to help students gain a detailed understanding of the background for their research before finalizing their approaches and data collection. The proposal is also expected to serve as a precursor to the Introduction section of the student's thesis. Therefore, students should prepare their proposals after detailed discussions with their thesis advisors. The proposal will be submitted to the thesis advisory committee, which will judge its acceptability and may require modification or amplification.

Failure to submit an acceptable thesis proposal in a timely manner will lead to a grade of Unsatisfactory for thesis research for the term in which it is due. If the failure to complete this requirement extends through a second term, a second grade of Unsatisfactory will be filed with the Registrar.

Permission to Defend

The student must obtain permission from the thesis committee to schedule the thesis defense and work full-time on writing the thesis.

1. The student, after consultation with the advisor, must present the thesis committee with an outline of the Results section of the thesis. The outline should delineate the major findings, highlight their significance, and be accompanied by a list of figures and tables. An abstract of the work should also be included.
2. Usually, the student only seeks permission to defend when all or nearly all experiments considered necessary for the thesis have been completed. It is anticipated that very little bench work will remain once the committee gives permission and that no experiments critical to an acceptable thesis will remain to be completed.
3. Upon evaluation of the outline, the committee will decide whether to grant permission to defend. In granting permission, the committee is not guaranteeing the degree but merely stating that it feels that the body of work presented is sufficient in breadth for the thesis.
4. Once permission to defend has been granted, the student is excused from additional committee meetings and student presentations.
5. The student, after consultation with the advisor, should propose an outside

examiner for the thesis defense at the final committee meeting. If the student is uncertain about the willingness or availability of the first choice, several names may be proposed. The committee can approve all or some of the choices and can offer additional suggestions.

Thesis Preparation and Defense Procedure

The advisor should read and approve the thesis prior to distribution to the committee. In approving the thesis, the advisor is only judging that it is acceptable for distribution not guaranteeing that further changes will not be recommended/required by the committee at the defense.

1. The advisor must have adequate time to read the draft either in sections or as a complete work. When considering a defense date, the student should allow a reasonable period of time to make any revisions recommended by the advisor.
2. A precise date for the defense should be set only when it is clear to the advisor and the student that the thesis is very close to its final form. Prior to this time, the student may discuss target dates with his/her committee and outside examiner. Indeed, it is often advisable to be aware of travel schedules, etc. far in advance of the actual defense date.

Thesis Format and Defense

When a student receives permission to defend, he/she should make an appointment to meet with the Associate Dean. Students will receive instructions on all aspects of the process used to complete the degree and information about Commencement Ceremonies at Tufts University.

To complete their graduate studies, students have to write a thesis, defend their research in an oral examination. Students distribute their theses to their Thesis Defense Committee members approximately two weeks before their scheduled defense. The chair of the thesis committee will contact all committee members, including the outside examiner, 48-72 hours prior to the defense to determine if the thesis is generally acceptable to the committee.

The oral defense will consist of a public presentation of approximately 45-60 minutes, followed by a closed discussion period with the committee and outside examiner.

During the deliberations of the thesis examination committee, the committee should determine what revisions need to be made to the thesis document and the amount of time needed to complete those particular revisions. The Sackler School Time-from-Thesis-Defense-to-Completion Policy, governing thesis revisions and continued receipt of a stipend, is in the Student Handbook (<http://sackler.tufts.edu/Student-Life/Sackler-Student-Handbook>).

In addition, the Graduate Faculty of the Molecular Microbiology Program has clarified the expectations of thesis committees with respect to the PhD thesis. All PhD theses must have an Introduction that is a detailed, critical review of the relevant literature and places the thesis project in the context of its field. All PhD theses must also include a General Discussion that summarizes the most important conclusions of the thesis research, critically evaluates that research, places the results in the context of the field, indicates

how the results advance the field, and suggests critical experiments that need to be done in the future. Introduction and Discussion sections of research publications rarely fulfill the requirements of breadth and depth appropriate to a doctoral thesis. The reader of a thesis makes the assumption that all data included were generated by the single individual who submits the thesis. When results drawn from collaborative studies or multi-authored papers are included, data generated in whole or in part by others (through collaborative studies) must be explicitly and specifically noted in the text and in figure or table legends, when appropriate.

Every Molecular Microbiology student is required to submit two bound copies of his or her final, approved thesis to the Program Office. One copy will be presented to the student's PI, while the other one will be retained for historical purposes by the Molecular Microbiology Graduate Program. The Program will pay the binding costs for these two copies only.

List of Molecular Microbiology Students

Year in School	Student	University or Advisor
1 st year	Brendan O'Hara	University of Michigan
	Kristen Davis	Cornell University
	Mary Hahm	University of Notre Dame
	Efrat Hamani	University of Maine
	James Phelan	Quinnipiac University
2 nd year	Kelsey Barrasso	Ng Lab
	Allison Matthews	Camilli Lab
	Miriam Ramliden	Ng Lab
	Mengyun Zhang	Isberg Lab
3 rd Year	Robert Blakemore	Munro Lab
	Stacie Clark	Isberg Lab
	Angela Howard	Munro Lab
	Jonah Larkins-Ford	Aldridge Lab
	Lauren Shull	Camilli Lab
	Andrea Wong	Camilli Lab
4 th Year	Ila Anand	Isberg Lab
	Louis Cornacchione	Hu Lab
	Andrea Koenigsberg	Heldwein Lab
	Sanna Herwald (MD/PhD)	Kumamoto Lab
	Michelle Logsdon	Aldridge Lab
	Laura Markey	Kumamoto Lab
	Lamyaa Shaban	Mecsas Lab
5 th Year	Sarah Jung	Ng Lab
	Michael Pereira	Leong Lab
	Antonia Pugliese	Kumamoto Lab
	Sara Roggensack	Leong Lab
6 th Year	Heidi Burke	Heldwein Lab
	Laurice Jackson	Leong Lab
	Kristin Kotewicz	Isberg Lab
	Minmin Yen	Camilli Lab
7 th Year	Anne Weeks	Kumamoto Lab
	Zachary Williams	Coffin Lab

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