

GRADUATE PROGRAM IN MOLECULAR MICROBIOLOGY

Program Guide
2020-2021

NOTE: Due to COVID-19 restrictions, some timelines, deadlines and requirements may be modified.



Graduate School of
Biomedical Sciences

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

WELCOME AND KEY PROGRAM INFORMATION

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 GSBS Catalog (<https://gsbs.tufts.edu/studentLife/schoolCatalogs>), which has the official degree requirements and course listings, and the GSBS Student Handbook (<https://gsbs.tufts.edu/studentLife/StudentHandbook>), which contains important information about topics such as the GSBS academic and registration policies, professional conduct guidelines, financial matters, and information about student benefits, services, and resources.

This Guide includes a listing of all 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 (<https://GSBS.tufts.edu/academics/molecularMicrobiology>). 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.

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 GSBS's Executive Council where policy matters concerning the School's programs are discussed and enacted.

The Student Advisor serves as a mentor to the 1st year students, including providing specific advice on selecting appropriate sites for laboratory rotations, choosing elective courses, keeping track of academic performance, and identifying laboratories for thesis work.

The Qualifying Exam Co-advisors guide the student through the Qualifying Exam process providing advice on topic selection and approaches to constructing the written proposal and oral presentation.

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 Project Administrator and Administrative Coordinator 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.

KEY PROGRAM CONTACTS

Katya Heldwein, Program Director

M&V 404E	617-636-0858	katya.heldwein@tufts.edu
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Ralph Isberg, 1st Year Student Advisor & MERGE-ID Track Director

Jaharis 424A	617-636-3993	ralph.isberg@tufts.edu
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Andrew Camilli, Director of Admissions & Molecular Genetics Track Director

S Cove 510	617-636-2144	andrew.camilli@tufts.edu
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Aimee Shen, Qualifying Exam Co-Advisor

M&V 409	617-636-3792	aimee.shen@tufts.edu
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Wai-Leung Ng, Qualifying Exam Co-Advisor

Arnold 511C	617-636-6996	wai-leung.ng@tufts.edu
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TBD, Program Coordinator

TBD	TBD	TBD
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Juan Hernandez-Bird, GSC Representative

Jaharis 423	617-636-3993	juan.hernandez-bird@tufts.edu
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Richard Lavin, GSC Representative

M&V 404D	617-636-3586	richard.lavin@tufts.edu
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Graduate Student Council Representatives. Two representatives are elected by the students to serve as the program's representatives to the GSBS Graduate Student Council (GSC). The GSC organizes activities, including the Annual Relays, and the GSC Officers are ad hoc members of the GSBS Executive Council.

Supplemental Employment

Because GSBS PhD students receive stipends, usually from federal grants, their ability to work in additional on-campus jobs is limited. You will find the GSBS Supplemental Employment Policy in the Student Handbook (<https://gsbs.tufts.edu/studentLife/StudentHandbook>). 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 received Permission to Defend may not hold such employment.

WELCOME AND KEY PROGRAM INFORMATION

GSBS 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 GSBS Student Handbook (<https://gsbs.tufts.edu/studentLife/StudentHandbook>).

Key events for students

Year	Date	Event	Faculty Contact
1	Spring & Summer	Complete coursework. Requirements are listed in the GSBS Catalog (https://gsbs.tufts.edu/studentLife/schoolCatalogs)	1st year advisor
1	June	Select thesis advisor	1st year advisor
1	Summer	Form thesis committee	Thesis advisor
1	Summer/Fall; by Nov. 1 at the latest	Complete qualifying exam	Qualifying exam committee chair
2	Fall; by Dec 1 at latest	First thesis committee meeting convened	Thesis advisor, TAC members
2	Spring; by mid-May at latest	Research Report presentation Journal Club presentation Thesis project defense at the TAC	Thesis advisor, TAC members
3 and above		Thesis committee meetings once per semester, for fall and spring semesters, until permission to defend has been obtained Research Report presentation Journal Club presentation (year 3 only) Satisfy teaching requirement (generally Fall of years 2-4) Continued coursework as needed during year 3	Thesis advisor, TAC members
4 and above		Thesis preparation and defense	Thesis advisor, TAC members, outside examiner

ACADEMIC INTEGRITY

Scientific Misconduct

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

The official GSBS Student Code of Ethics can be found in the GSBS Student Handbook, which is accessible at the following website: <https://gsbs.tufts.edu/studentLife/StudentHandbook>.

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 promoter 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 promoter 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 promoter 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 promoter 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 promoter 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 GSBS Student Handbook (<https://gsbs.tufts.edu/studentLife/StudentHandbook>) for the complete policy.

CURRICULUM OVERVIEW

MERGE-ID and Molecular Genetics Training

The MERGE-ID (Medically-oriented Research in Graduate Education) Track 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. They complete a summer course that incorporates infectious diseases, problem based learning, and clinical rounds. After choosing a research advisor, MERGE-ID students have the option of performing a clinical practicum connected to their thesis research. Students performing the practicum will have a practicing clinician as a member of the Thesis Advisory Committee. Four times per year, students in the MERGE-ID program will be expected to attend the Weekly Intercity Infectious Disease Rounds to hear case presentations on the latest cases in infectious diseases encountered by attending physicians from Tufts-associated hospitals. Participation in clinical shadowing experiences during graduate years 2 and above may be available, but this is dependent on physician availability.

The Molecular Genetics Track 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 GSBS Catalog for the year in which students were admitted lists these required courses (<https://gsbs.tufts.edu/studentLife/schoolCatalogs>). In addition, the Catalog contains course descriptions and progression plans for the first and second years.

Elective Courses

Elective courses must be approved by the thesis advisor and should be used to explore students' interests and further their understanding of their thesis research fields. Courses may be chosen from any GSBS program or from other schools that allow cross-registration.

Remediation

Remediation mechanisms are at the discretion of program Faculty and course directors and should be clearly stated in the course syllabus. Remediation is offered only to failing students and only to achieve the minimum passing grade of B- or S as applicable.

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 and 3 must present one 30-minute 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 2 and higher must present an annual 30-minute presentation 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 GSBS 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.

Teaching Requirement

As part of their academic training during years 2 and 3, students are required to participate twice as a lab instructor in Medical Microbiology wet labs and/or as a teaching assistant in a 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. Additional opportunities may be available for teaching, perhaps including a small stipend.

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 the GSBS Dean's Office.

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

CURRICULUM OVERVIEW

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 GSBS. 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.

Master's Degree Requirements can be found in the GSBS Student Handbook (<https://gsbs.tufts.edu/studentLife/StudentHandbook>).

LABORATORY ROTATIONS

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.

Students choose rotations based on their interests and the willingness of the rotation mentor to accept a student. Students are encouraged to use the rotations to explore the full range of molecular microbiology research areas before focusing on a thesis topic. To facilitate exploration of different research areas, students must complete at least one rotation in a laboratory that is focused on prokaryotic biology, and at least one rotation in a laboratory focused on another research area.

In addition, students have the option of performing their final two rotations in GSBS laboratories outside of the Molecular Microbiology program and may choose to do their thesis work in one of the latter laboratories with the consent of the proposed mentor and that mentor's program. Students may choose a GSBS faculty member who is not in the program as a thesis adviser and remain in the Molecular Microbiology program, subject to the suitability of the proposed thesis project, as determined by the Molecular Microbiology faculty.

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

The GSBS Laboratory Rotation Policy is published in the Student Handbook (<https://gsbs.tufts.edu/studentLife/StudentHandbook>) and the dates for laboratory rotations are posted on the GSBS website in the Academic Calendar (<https://GSBS.tufts.edu/studentLife>).

Several weeks before rotations begin the GSBS 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 GSBS website (<https://GSBS.tufts.edu/facultyResearch/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

LABORATORY ROTATIONS

rotation, the nature of such report is left to the discretion of the principal investigator in the rotation lab.

QUALIFYING EXAMINATION

1. All graduate students in the Molecular Microbiology Program must take the Qualifying Exam (QE) as a requirement for the Ph.D. degree. The QE is designed to measure originality and independence and requires that the student suggest a feasible research project on a biologically significant problem, critically analyze the literature, outline a potential experimental approach to its solution, and discuss the likely data that could be obtained. This exam must be completed within 12 months after course work begins for all first-year students. Failure to complete this requirement in a timely fashion is grounds for dismissal from the Graduate Program. It is the responsibility of the student to initiate the qualifying procedure, but the qualifying exam committee (QEC) must make sure that the student is fulfilling this responsibility. Because scheduling meetings is difficult during the summer, students are encouraged to begin this process as early as possible.

2. Qualifying Exam Topic and Specific Aims Approval

- a. The QEC will be assigned to the student by the Program once the student has been placed into the thesis lab. The QEC will consist of 2 members of the Tufts Program in Molecular Microbiology and will not include the thesis advisor. One of the members will be designated as the QEC Chair. A third member will be brought on by the QEC depending on the subject area of the proposal.
- b. All students are advised to choose a **thesis-adjacent topic**, in other words, a topic that is related to, but different from, their own thesis research. QE topics directly related to any research projects being performed by other lab members or any work performed by the student prior to starting graduate school are not allowed. However, a research topic on the same organism or biological process, for which the student's thesis topic is focused on, is allowed. QE topics should not be based on papers covered in journal club or classes. The final topic will be approved by the members of the QEC after informal consultation with the student. If a retake of the QE is necessary, the QEC will be formed by faculty members outside of the student's QEC.
- c. MD/PhD students in the Microbiology Program can initiate their QE process in the Spring term of their first year. It is recommended that they start as soon as they have completed or almost completed all the required coursework. The QEC will be assigned by the Program after the thesis advisory committee (TAC) has formed. The QEC is composed of one faculty member from the student's TAC and another member outside of the TAC. A third member will be recruited based on the topic of the proposal.
- d. Within the first week, students will submit two to three topics to the QEC, singly or as a group, using the "three questions" form, which will outline for each potential topic (1) important unanswered questions raised by contemporary research, (2) why

QUALIFYING EXAMINATION

addressing this topic is important, and (3) general ideas about approach. Appropriate references should also be provided (i.e. main paper, review papers). The QEC will provide feedback as to whether the proposed area would be good for a qualifying proposal. **Students are expected to finalize a topic within two weeks after the QEC has been formed.**

- e. Once a topic has been decided, the student should develop a working Specific Aims page to be distributed to QEC members. Depending on the familiarity of the QEC with that topic, the student may be asked to provide some background in the form of a written summary of the topic. In many cases, the student may be requested to present the Specific Aims to a meeting of the QEC.
- f. Final approval of the Specific Aims by the QEC starts the clock for the next stage (see #3), although if this process takes too long, it will reduce the time to write the QE proposal. The QEC Chair will help ensure that the student holds to the deadlines set by these guidelines and completes the examination in a timely fashion.

3. Qualifying Exam Written Proposal

- a. The QE written proposal must consist of a set of experiments that answer a defined question or test a specific hypothesis. It should seek to make a significant advance in our knowledge about an important topic. 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 (i.e., expected outcomes) and provide alternative strategies.
- b. Once the Specific Aims page has been approved by the QEC, students have **5 weeks** to write their QE proposal (see #4). Students should schedule their oral defense once the Specific Aims have been approved (see 6a); they also have the option of scheduling their exams in advance of the examination deadline. Scheduling the exam can be difficult in August, so setting a date as soon as possible is strongly encouraged.
- c. This five-week period will be used for reading research papers on the topic and the actual writing of the QE. During this 5-week period only, the student is not necessarily required to carry out experimental work on his or her thesis project. They should still fulfill other obligations to the laboratory, such as attending weekly lab meetings, if such attendance is normally expected.
- d. The final proposal must propose experiments that are the student's own ideas. During preparation for the examination, the student may ask members of the QEC for feedback on these ideas, but in no way should these consultations be used to get others to

formulate experiments for the student.

- e. The proposal must be written entirely by the student. However, it is permissible for students to ask fellow graduate students (**postdocs are not included**) to read a **completed** draft of the QE. Students are encouraged to exercise this option, since the peer review process has the potential to benefit both the proposal writer and reviewers in improving the writing and critical thinking of the writer and the reviewers' critical thinking skills in critiquing the proposal.
- f. The overall goal of obtaining peer review feedback is to improve the readability, clarity, and presentation of the QE proposal. If proposal writers exercise this option, they need to complete a draft sufficiently in advance to respectfully solicit feedback from their peers. The proposal is due on the dates indicated above regardless of whether the student has received feedback from their peers.
- g. Peer reviewers should keep in mind that a driving force behind the QE is for faculty to assess a student's ability to develop a specific hypothesis and design a set of cohesive experiments that will test this hypothesis. Therefore, in requesting feedback, the proposal writer must provide the following information to the peer reviewers (This information will also be distributed to all graduate students):
 - Peer reviewers can highlight areas that need improvement, whether it is indicating sections that are confusing, pointing out experimental weaknesses, or suggesting a better way to visually present some of the proposed work.
 - Peer reviewers can point out that the proposed experiments will not actually test the stated hypothesis, or they can suggest that a table of expected outcomes would improve the proposal's readability.
 - Peer reviewers can point out critical flaws in the project such as assumptions or expectations that, if incorrect, could nullify the purpose of the proposed work.
 - Peer reviewers cannot re-write sections of the proposal aside from correcting grammatical errors and spelling. They may not design experiments for the student taking the QE, or suggest alternative approaches. While reviewers can explain why alternative approaches are needed, they cannot suggest solutions to this problem.

4. Format of Qualifying Proposal

The QE will follow the format of an F31 proposal ("Innovation" section is not required): **1 page for the Specific Aims section and 6 pages for the Research strategy section.** Note, the 6-page research strategy includes figures directly embedded in the proposal. **The proposal should be single-spaced with 0.5"**

QUALIFYING EXAM

margins using at least 11-point font (Arial).

Examples of proposals from previous years will be made available. There are also example F31 proposals available from the NIAID website.

<https://www.niaid.nih.gov/grants-contracts/sample-applications#f31>

More detailed instructions are available in the “Grant Application Writer’s Workbook” distributed to the students.

5. Written Proposal Assessment

- a. Upon submission of the proposal, the QEC 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 QEC before an oral exam is permitted.
- b. If rewriting is necessary at this stage, the revised proposal must be submitted within two weeks after such notification by the QEC.
- c. If the rewritten proposal is still not satisfactory, the student will receive a grade of unsatisfactory and a joint meeting of the QEC and the TAC 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 will either be placed on probation or be dismissed from the graduate program.
- d. In some cases, the QEC will allow the student to proceed with the oral examination even though the written proposal still requires revision.

6. Oral Examination

- a. The oral defense of the QE proposal should be scheduled for a date **~6 weeks after Specific Aims approval**. Students are strongly encouraged to schedule a tentative date for the oral examination as soon as possible. Failure by the student to adhere to the deadlines set by the QEC will lead to a more stringent assessment of the QE proposal and defense.
- b. A practice oral defense with fellow students is allowed after the proposal is submitted (No postdoctoral fellows or faculty are allowed).
- c. The GSBS Qualifying Examination Report Form (found on the GSBS Website at <https://GSBS.tufts.edu/studentLife/currentStudents/forms>, also see Appendix) 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 QEC and the student may attend the oral examination. The thesis advisor may not attend this meeting.

- d. The length of the oral exam should be no more than 2 hours. The student should outline the rationale for the proposed research and the specific aims of the proposal, followed by a presentation of the Research Plan. During this time, the student will answer any questions of the QEC. The questions can be either specific to the proposal or cover general disciplines related to the proposed research.
- e. 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”).
- f. 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 QEC.
- g. If the revised written proposal or the second oral defense is still not satisfactory, the student will receive a grade of Unsatisfactory and a joint meeting should be called immediately, in which the QEC discusses with the TAC the problems regarding the examination. The Program Faculty will then be informed of the student’s status. Based on the progress of the student to that date, a committee comprised of the TAC, QEC, and the program director will decide if the student will either be placed on probation or be dismissed from the graduate program.”

Upon completion of the exam, the QEC will decide if the student has written a reasonable proposal and defended it competently in the oral examination. Successful completion of the oral and written parts of the examination, as determined by the QEC, constitutes completion of all qualifying examination requirements. The completed Qualifying Examination Form (found on the GSBS website at <https://GSBS.tufts.edu/studentLife/currentStudents/forms>) must be submitted to the GSBS Registrar and the Molecular Microbiology Program staff.

RESEARCH AND CAREER PLANNING

Selection of a Thesis Advisor

Students are matched with thesis mentors in June 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.

Each student will be asked for 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 upon entering the program after having completed two summer rotations during medical school .

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 select their Thesis Advisory Committee early in the fall semester of their second graduate year, and MD/PhD students do so during fall of their first graduate year.

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 three GSBS faculty members, but preferably four, 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 thesis advisory committee members also decide whether the outside examiner proposed by the student for the thesis defense is suitable. This decision should be made unanimously, and the committee needs to consider potential conflicts of interest.

The student should ask each member if they are willing to serve on the committee. Faculty members may decline if they feel they do not have adequate expertise or 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 <https://GSBS.tufts.edu/studentLife/currentStudents/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 the Associate Dean about career planning, in addition to their Thesis Advisory Committees.

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 (G1) 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 GSBS website (<https://GSBS.tufts.edu/studentLife/current-Students/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 GSBS Registrar who records the grade on the student's transcript.

The first TAC meeting

Prior to the first TAC meeting in the Fall of their 2nd year, students will prepare a written proposal describing the relevant background and a preliminary version of their project's goals and specific aims, as well as any preliminary results that have been obtained. The guidelines for the TAC proposal should be obtained from the Program Coordinator. The proposal should be distributed to the committee members at least five days before the meeting. This is an opportunity for the student and their mentor to receive initial feedback from the committee on 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.

Subsequent TAC meetings

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. The guidelines for the TAC proposal should be obtained from the Program Coordinator. This report should be distributed to the committee members at least five 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

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progress has been unsatisfactory, this evaluation will be included in the report.

Research Report Presentations

In Spring of their 2nd year, each student will give a 30-minute Research Report presentation within the Microbiology-wide Research Report series. This presentation will serve as the basis for the discussion at the oral Thesis Proposal Defense (see below). During the presentation, students will cover the goals and the significance of their proposed project, what they are proposing to do, and how they plan to do it. They will also include any relevant data they have obtained during the first few months in the lab. The presentation will be taped to allow all TAC members to review it prior to the defense.

Subsequent Research Report presentations will occur annually and will be ~30 minutes long.

Thesis Project Defense

In the Spring of Year 2, after their first Research Report presentation, the students are expected to defend their thesis project in front of their TAC at the Spring TAC meeting. The oral defense of the thesis project is a new requirement. The goal is to stimulate the students to read and analyze the literature relevant to their thesis project and to start thinking independently about their thesis project earlier, which will help them to take control of their research as soon as possible.

During this oral defense, the TAC will evaluate the student's understanding of their proposed thesis project, including:

- What is the goal of the thesis project?
- What question(s) does the proposed thesis project intend to answer?
- Why is the proposed work significant and how is it positioned in the context of current knowledge?
- What is novel about the proposed work?
- What approaches will be used to achieve, why they are appropriate, and what alternative approaches will be used should the chosen approach fail?

Students are expected to understand their project and prepare to answer questions at the defense at the level comparable to that of the qualifying exam.

The defense **MUST** occur before the end of the Spring term (no later than mid-May).

Specific guidelines:

Year 2 FALL TAC meeting: At the Fall TAC meeting, students should present a preliminary version of their project's goals and specific aims as part of their written report and oral presentation. This is an opportunity for the student and their mentor to receive initial feedback from the committee on their proposed thesis project.

Year 2 SPRING Research Report presentation: This 30-minute Research Report presentation will serve as the basis for the discussion at the oral defense. During the

presentation, students should cover the goals and the significance of their proposed project, what they are proposing to do, and how they plan to do it. They should also include any relevant data they have obtained during the first few months in the lab. The presentation will be taped to allow all TAC members to review it prior to the defense.

Year 2 SPRING TAC meeting:

1. *Written report:*

Unlike during the qualifier exam, there is no requirement for a formal written proposal. However, students are required to submit the standard written report for the TAC meeting. This report should include: a specific aims page (1 page), the background/significance of the thesis project (similar to the background/significance section of a proposal) (1.5 pages total), and a report of the experimental progress made since the previous meeting (with data).

2. *Discussion and defense:*

This meeting should be scheduled after the 2nd year research report. As at regular TAC meetings, there will be two short discussions with the committee at the beginning of the meeting, one in the absence of the student and the other in the absence of the PI.

The format of the rest of the TAC meeting will be analogous to the oral portion of the qualifying exam at the end of year 1. The students will prepare a 10-15-minute recap of their proposed project, which can be interrupted by the committee, and then will answer questions from the committee and discuss the plans for a thesis project. According to the TAC rules of the Graduate School of Biomedical Sciences, the PI has to be present at the meeting. However, they are not allowed to answer any questions or intervene in any way during the defense. Any PI who is unable to stay silent during the defense shall be asked to leave the TAC meeting. At the end of the discussion, the student will leave the room and the committee will agree on feedback to the student.

After the student comes back, the student and the committee may have an additional short discussion pertaining the data included in the report, and any suggestions and feedback the committee has on the more technical aspect of the project.

3. *Preparation for research report and defense:*

The student should work together with their PhD mentor in crafting the aims of the project and are encouraged to get feedback for both the report presentation and the defense preparation from others. The goal of the defense is not to evaluate whether the student can design the experiments on their own, but rather to ensure that the student understands the goals of their thesis project, why their proposed work is important, and why the chosen approaches are appropriate and preferable to others. A defense practice with people outside of the thesis lab is encouraged because their

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familiarity with the student's project will more closely resemble that of the committee.

4. Scheduling and evaluation:

The TAC meeting must occur within the Spring term, which ends usually mid-May. If the committee is unsatisfied with the preparation, the students will be asked to re-defend, which has to happen by the end of August to avoid a failing grade.

While the Spring TAC meeting in Year 2 will focus on the defense, the TAC will also make sure that the student is making sufficient progress in their project.

Preparation for Research Report Presentation and Thesis Proposal Defense

The student should work together with their PhD mentor in crafting the aims of the project and are encouraged to get feedback for both the report presentation and the defense preparation from others. The goal of the defense is not to evaluate whether the student can design the experiments on their own, but rather to ensure that the student understands the goals of their thesis project, why their proposed work is important, and why the chosen approaches are appropriate and preferable to others. A defense practice with people outside of the thesis lab is encouraged because their familiarity with the student's project will more closely resemble that of the committee.

Thesis Proposal Defense

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, thesis formatting guidelines and information about Commencement Ceremonies at Tufts University.

To complete their graduate studies, PhD students must write a thesis and defend their research in an oral examination. Students distribute their thesis to their Thesis Defense Committee members approximately two weeks before their scheduled defense. The chair of the TAC 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 thesis defense is the culmination of the thesis process and consists of both a public presentation of approximately 45-60 minutes, followed by a closed discussion period with the committee and outside examiner. The public presentation is the opportunity for the student's lab and the GSBS community at large to hear the research. Consequently, all public presentations will take place as follows:

- In Boston for students in Boston or Medford labs
- In Portland for students in Maine Medical Center Research Institute Labs
- In Bar Harbor for students at The Jackson Laboratory

Public presentations should also be available remotely for faculty and students on different campuses. For those students who may be working at affiliated (non-Tufts/MMCRI/

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JAX) labs, the defense should take place at the location the student was originally placed.

It is expected that all members of the Thesis Advisory Committee (TAC) plus the approved outside examiner will be present onsite at both the public presentation and closed discussion. However, if necessary and unavoidable, up to one committee member may participate in the presentation and the discussion remotely. During social distancing and limited on-campus presence, thesis presentations and discussions may be held remotely.

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 GSBS Time-from-Thesis-Defense-to-Completion Policy, governing thesis revisions and continued receipt of a stipend, is in the Student Handbook (<https://gsbs.tufts.edu/studentLife/StudentHandbook>).

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 section 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 PROGRAM FACULTY

Bree Aldridge, Ph.D., Associate Professor. Quantitative analysis of mycobacterial stress tolerance and virulence strategies.

Andrew Camilli, Ph.D., Professor, Admissions Director, and Howard Hughes Medical Institute Investigator. Analysis of host-pathogen interactions; virulence factors of the human diarrheal pathogen *Vibrio cholerae* and respiratory pathogen *Streptococcus pneumoniae*; regulation of virulence gene expression during infection.

Athar Chishti, Ph.D., Professor. Cytoskeletal regulation in cancer and malaria.

John M. Coffin, Ph.D., American Cancer Society Research Professor. Mechanisms of replication, expression, and integration of retroviruses; mechanism of acquisition of retroviral oncogenes; molecular biology of carcinogenesis; structure, genetics and evolution of endogenous viruses; genetic variation and evolution of retroviruses.

Marta Gaglia, Ph.D., Assistant Professor. Virus-host interactions in KSHV and influenza A virus infection.

Claudette Gardel, Ph.D., Adjunct Lecturer.

Caroline Attardo Genco, Ph.D., Professor and Vice Provost for Research. Mucosal pathogens and their interactions with hosts.

Katya Heldwein, Ph.D., American Cancer Society (MA Division) Professor and Program Director. Mechanisms of host manipulation by herpesviruses; mechanisms of viral entry and egress; protein structure determination using crystallography and other biophysical methods.

Linden Hu, M.D., Professor, Vice Dean for Research. Host-Pathogen interaction in *Borrelia* infections.

Ralph R. Isberg, Ph.D., Professor and First-Year Advisor. Analysis of entry and growth of intracellular bacteria into host cells; molecular analysis of innate immune response to pathogens; growth and survival of bacterial pathogens in macrophages; molecular basis of antibiotic resistance in nosocomial pathogens.

Joshua Kritzer, Ph.D., Associate Professor. Peptides and peptidomimetics targeting infectious agents.

Carol Kumamoto, Ph.D., Professor. Regulation of hyphal morphogenesis in the dimorphic yeast *Candida albicans*.

John M. Leong, M.D., Ph.D., Professor and Chair, Department of Molecular Biology and Microbiology. Disease-promoting interactions of entero-hemorrhagic *Escherichia coli*, *Borrelia burgdorferi* (the Lyme disease spirochete) and *Streptococcus pneumoniae* with host immune and epithelial cells.

Michael H. Malamy, Ph.D., Professor. Transfer factors, transposons and conjugal transposons responsible for DNA rearrangements and dissemination in medically important bacteria; virulence factors in the anaerobic pathogen *Bacteroides fragilis*, using genetics, cloning and sequencing, and in vivo models of infection.

Joan Meccas, Ph.D., Professor. Role of type III secretion

system and the *Yersinia Yops* during infection of mammalian tissues using bacterial genetics, molecular biology and biochemical approaches.

Claire L. Moore, Ph.D., Professor. Molecular mechanism and regulation of mRNA 3' end formation in eukaryotic cells; genetic and biochemical characterization of factors catalyzing polyadenylation and transcription termination.

Karl Munger, Ph.D., Professor and Interim Chair, Department of Developmental, Molecular, and Chemical Biology. Molecular mechanisms of oncogenesis mediated by human papilloma viruses.

Wai-Leung Ng, Ph.D., Associate Professor and Qualifying Exam Co-Advisor. Quorum sensing and signal transduction in *Vibrio cholerae* and other related species.

Alexander Poltorak, Ph.D., Associate Professor and Interim Chair, Department of Immunology. Use of mouse models to dissect the genetics of innate immunity.

Marta Rodriguez-Garcia, Ph.D., Assistant Professor, Department of Immunology. HIV infection of the female genital mucosa and the role of neutrophils in the immune response.

Brian S. Schaffhausen, Ph.D., Professor*, Analysis of polyoma virus transforming proteins and the normal pathways of signal transduction with which they interact; role of protein phosphorylation in the regulation of these processes.

Aimee Shen, Ph.D., Associate Professor and Qualifying Exam Co-Advisor. *Clostridium difficile* spore formation and germination.

Abraham L. Sonenshein, Ph.D., Professor Emeritus*. Transcriptional control of carbon and nitrogen metabolism, bacterial differentiation and pathogenesis in Gram-positive bacteria (*Bacillus*, *Clostridium*, *Listeria*).

Shumin Tan, Ph.D., Assistant Professor. Environmental cues in *Mycobacterium tuberculosis*-host interactions.

Honorine Ward, M.D., Professor. Molecular basis of intestinal parasite-host interactions; glycobiology of *Cryptosporidium*.

** These faculty are active in teaching and educational aspects of the program but no longer accept dissertation students.*

LIST OF PROGRAM FACULTY

*Not accepting new students

Name	Office	Phone	Email
Bree Aldridge	Arnold 511D	6703	bree.aldridge@tufts.edu
Andrew Camilli	South Cove 503	2144	andrew.camilli@tufts.edu
Athar Chishti	Jaharis 714	3457	athar.chishti@tufts.edu
John Coffin	Jaharis 409	6528	john.coffin@tufts.edu
Marta Gaglia	M&V 404D	3586	marta.gaglia@tufts.edu
Claudette Gardel*	Arnold 816	2433	Claudette.gardel@tufts.edu
Caroline Genco	M&V 701	6739	caroline.genco@tufts.edu
Katya Heldwein	M&V 404E	0858	katya.heldwein@tufts.edu
Linden Hu	South Cove 802	8498	Linden.Hu@tufts.edu
Ralph Isberg	Jaharis 423	3993	ralph.isberg@tufts.edu
Joshua Kritzer	Pearson 305B	7-0451	joshua.kritzer@tufts.edu
Carol Kumamoto	Jaharis 429	0404	carol.kumamoto@tufts.edu
John Leong	Arnold 511E	0488	john.leong@tufts.edu
Michael Malamy	Stearns 504	6756	michael.malamy@tufts.edu
Joan Meccas	South Cove 803	2742	joan.meccas@tufts.edu
Claire Moore	Jaharis 408	6935	claire.moore@tufts.edu
Karl Munger	M&V 701G	0306	karl.munger@tufts.edu
Wai-Leung Ng	Arnold 511C	0881	wai-leung.ng@tufts.edu
Alexander Poltorak	Jaharis 529	3596	alexander.poltorak@tufts.edu
Marta Rodriguez-Garcia	Jaharis 529B	2726	Marta.Rodriguez_Garcia@tufts.edu
Brian Schaffhausen	Jaharis 606	6868	brian.schaffhausen@tufts.edu
Aimee Shen	M&V 409	3792	aimee.shen@tufts.edu
Abraham Sonenshein	Jaharis 411	6761	linc.sonenshein@tufts.edu
Shumin Tan	Jaharis 419	3731	shumin.tan@tufts.edu
Honorine Ward	Tupper 503	7022	hward@tuftsmedicalcenter.org

Unless otherwise indicated, all Boston Campus phone numbers begin with 617-636 and all Medford numbers begin with 617-627.

LIST OF PROGRAM STUDENTS

1st Year		University or Advisor
	William Johnson	UMass Amherst
	Pola Kuhn	Bard College
	Isabelle Mueller	Boston College
	Natalie Quirk	University of Notre Dame
	Sylvia Rivera	University of Puerto Rico, Mayaguez
	Natalie Sontag	Dartmouth College
	Yishak Woldetsadik	Towson University
2nd Year		
	Warda Arman	Munger Lab
	Andrew Day	Kumamoto Lab
	Lauren Donnelly (MD/PhD)	Shen Lab
	Nathalie Lavoie	Heldwein Lab
	Pathricia (Angel) Leus	Mecsas Lab
	Yoelkys Morales (MD/PhD)	Mecsas Lab
	Zemplen Pataki (MD/PhD)	Heldwein Lab
	Elizabeth (Liz) Tan	Camilli Lab
3rd Year		
	Nicholas (Nicky) Franks	Genco Lab
	David Giacalone	Tan Lab
	Richard Lavin	Tan Lab
	Rachel Lent	Gaglia Lab
	Martin Ramirez (MD/PhD)	Heldwein Lab
	Shailab Shrestha	Shen Lab
	Sharon Wu (MD/PhD)	Munger Lab
4th Year		
	Jake Bourgeois (MD/PhD)	Camilli Lab
	Emily Forster	Shen Lab
	Lea Gaucherand	Gaglia Lab
	Juan Hernandez-Bird	Isberg Lab
	Yuzo Kevorkian	Tan Lab
	Rachel Levene	Gaglia Lab
	John Ribis	Shen Lab
5th Year		
	Kristen Davis	Isberg Lab
	Efrat Hamani	Isberg Lab
	Brendan O'Hara	Ng Lab
	James Phelan	Hu Lab

LIST OF PROGRAM STUDENTS

6th Year		University or Advisor
	Kelsey Barrasso	Ng Lab
	Allison Matthews	Camilli Lab
	Miriam Ramliden	Ng Lab
	Mengyun Zhang	Isberg Lab
7th Year		
	Robert Blakemore	Munro Lab
	Stacie Clark	Isberg Lab
	Jonah Larkins-Ford	Aldridge Lab
	Lauren Shull	Camilli Lab
	Andrea Wong	Camilli Lab