The Biology Department offers research opportunities in many different areas within molecular biology, developmental biology, physiology, behavior, ecology and conservation biology. Although graduate education involves specialization, we want all our students to be familiar with the broad, general concepts of our science, to be able to appreciate and respect work in several areas of biology, and to understand how they are interrelated.

Common Experience
The Biology Department requires that all graduate students attend and participate in all departmental seminars. When an outside speaker in your concentration area comes, students are expected to read recent papers by that scientist before the seminar and sign up to meet with them if times are available; journal club discussions of papers by the speaker are encouraged.

Expectations and requirements for graduate students are set forth so that our graduate students, both incoming and experienced, will have a clear idea of what is expected of them and the time schedule for meeting these obligations.

Course Requirements

Doctor of Philosophy - Students will take courses as required by their committees (see Graduate Committees below). Normally a student registers for full-time status (502FT) and 1-2 courses each term during the first and second year of the PhD program. One of these courses may be for research credit. Either Bio243 (Topics in Molecular and Cell Biology), Bio244 (Topics in Evolutionary Ecology) or Bio246 (Topics in Animal Physiology) is required of all Ph.D. students. While doing fall or spring semester rotations during the first year, students will enroll in Rotation Research courses (Bio253 fall or Bio254 spring; one credit for each rotation completed, usually for a letter grade). This serves to provide both laboratory research experience (see below) as well as an in depth knowledge of the subject matter. Students who already have a MS degree in a related area may petition to complete the second rotation in the same lab upon approval of their research advisor or entrance committee. In their second year, PhD students should enroll and receive credit for Bio293 (fall) and Bio294 (spring) (Special Topics; choose the section led by your research mentor). This course provides credit for learning experimental design, research presentation, and reading papers in the field of the chosen research mentor. Ph.D. candidates should register each semester (including both summer semesters) as a continuing doctoral student (Bio502FT). PhD candidates should also register each fall and spring semester as either a TA or RA, in consultation with their advisor. See the Graduate Student Course List posted on the website for a summary of the course sequence.

PhD students normally must have taken several biology courses (especially Introductory Biology and Genetics), as well as one semester of calculus, physics and organic chemistry as undergraduates. If critical courses have not been taken before admission, they must be made up, generally within the first year. Because we offer a broad-based biology grad program, we require that all graduate students take or have taken at least one course from each of the three subdisciplines - Groups A, B, and C (See catalogue for definitions of A, B, and C).

The Graduate Entrance Committee (see Graduate Committees below) will tell accepted students how and when it expects certain courses to be made up. Any 100-level biology courses approved by the student's committee can be used toward the graduate degree. A student's PhD Dissertation Committee may also require other courses to be taken, depending on the student's area of study. A list of course suggestions is listed for each concentration on the Biology Graduate Program website.
**Masters of Science (Thesis track; Th-MS)** - Ten graduate level course credits are required and the grades must be B- or higher (starting fall 2017; 8 for students who entered prior to that). Students will take courses as recommended by the graduate school, the biology program and by their committees (see Graduate Committees below). Normally 5 of the credits will be for laboratory research. Typically this will include one rotation project (Bio253 fall or Bio254 spring; one credit for each rotation completed, for a letter grade) two semesters of a Special Topics course with your advisor (Bio 293 fall, 294 spring, one credit each, for a letter grade), and two semesters of Master’s thesis research (Bio256 summer session 1 or Bio257 summer session 2, and Bio295 fall or Bio296 spring; one credit each, generally graded as satisfactory or unsatisfactory). The other 5 must be regular graduate level courses (100 level or above). All courses must be completed with grades of B- or better to count towards the degree. Two of the ten should be an approved seminar course – typically a 100 level or above seminar and either Biology 243 (Topics in Molecular and Cell Biology), Biology 244 (Topics in Evolutionary Ecology) or 246 (Topics in Physiology of Animal Behavior). Biology 260 (Teaching Biology: Pedagogy and Practice) is a required course for students supported on a TA; it does not count as one of the seminar courses but does count as one of the 5 graduate courses. Th-MS students must register for Bio402FT (Masters candidate full-time); this is critical for international and other students needing to demonstrate full-time status as a student.

**Master of Science (Open Choice track; OC-MS)** – The Biology Masters Open Choice track is designed for students wishing to focus on conceptual and analytical work and strengthen their knowledge of current biological concepts. Masters students in this track are not required to do research nor to write a thesis. OC-MS students who wish to explore optional research can do so by taking up to two courses in Independent Research (Bio 193 or 194), with permission of the faculty mentor. Upon entering, a student will be assigned an advisor, generally the OC-MS program director. Students may also add a second advisor in their area of study. It is suggested that OC-MS students meet with their advisor once each semester, to review the student's progress with the ten-course program of study outlined below.

Ten graduate level course credits (numbered 100 or higher) are required for the OC-MS degree and the grades must be B- or higher (8 for students who entered prior to fall 2017). No more than one of the required courses may be a guided individual study (e.g. Bio293, 294) and no more than two may be a research course (e.g. Bio193, Bio194). One of the ten should be an approved seminar course at the 100 or 200 level.

**Graduate Student Registration**: All full time students must register for either Bio402FT (Masters candidates) or Bio502FT (PhD candidates). These courses automatically confer full-time status, regardless of what appears on the transcript. Authorities seeking to verify the student’s status (for the purposes of immigration, student loans, health insurance, etc.) will receive an “enrollment verification form” indicating full-time student status. STUDENTS MUST REGISTER EACH SEMESTER – INCLUDING SUMMER SEMESTERS DURING THEIR TENURE AT TUFTS (summer semester applies to full time students only).

**Below Guidelines Apply to PhD and Th-MS students Only**

**Student Research Rotations** - A research rotation is an opportunity to explore a new area of Biology, to learn new techniques, and to become acquainted with some of the research ongoing in our department.

All Ph.D. students are expected to do at least two rotations in the department. Thesis M.S. students are required to perform one research rotation, which may be in the lab in which they plan to do their thesis research. If a PhD student on entering is already interested in a particular lab for dissertation research, one of the required rotations can be in that lab. PhD students entering with a MS may petition to stay in their chosen lab for the second rotation upon permission of their advisor and entrance committee. Students need not have both rotations in the same general area of biology. Students must choose and be accepted by a lab for dissertation research by the end of the summer of the first year. Research credit is given to students successfully completing the requirements of their rotations via enrolling in either (fall) Bio253 or (spring) Bio254 Rotation Research courses (1 credit each for a letter grade).
Under special circumstances, with committee consent, students can work as a research assistant with a principal investigator outside our department for one of the rotations.

Students should start and end rotations in synchrony on a semester basis so that a critical mass of students can report on rotations at the same time: Fall rotation—early September to mid-January, spring rotation—mid-January to end of May, and summer rotation—beginning of June to end of August. Students will normally present their findings on or near the following dates: one of the first Fridays of spring semester (fall semester rotations), and one of the first Fridays of the fall semester (spring or summer rotations). Oral reports will be given to a group consisting of other students who have just finished a rotation, the sponsoring research mentors, members of the students' committees, graduate students, and other interested persons. Thesis M.S. students doing a rotation or engaged in research in year 1 will give oral reports on their work as well. Following the oral presentations, the students will schedule a meeting with their entrance committee.

Graduate Committees

Entrance Committee - Upon entering the Graduate program students will be assigned a committee of two or three faculty members, whose functions are: (1) to review undergraduate courses to determine if coursework deficiencies exist, (2) to provide advice on coursework and rotations until a thesis committee is established, and (3) to file semi-annual reports of progress made toward completion of the requirements.

Ph.D. Qualifying Exam Committee - This committee will consist of the student's dissertation advisor and at least two additional members, usually to represent breadth as well as depth. These members will be chosen in consultation with the advisor and this committee will be approved by the student's entrance committee.

Thesis M.S. Committees - Once a research advisor is identified, the student in consultation with the advisor, will select at least two additional committee members, for a minimum of three committee members.

Ph.D. Dissertation Committees - Once a research advisor is identified, the student in consultation with the advisor will select at least two additional committee members. At least 3 members, including the advisor, should be from within the department; usually the qualifying exam committee members will continue to serve on the dissertation committee, but changes or additions can also be made. A fourth member from outside the University is required for the defense of the Ph.D. dissertation. The Ph.D. Dissertation Committee will approve the outside member before he or she is invited.

Defense of Thesis M.S. - To complete the Thesis M.S., the candidate is required to prepare and defend a thesis based on original research done under supervision of a departmental faculty member. Prior to completion, the student will give a public presentation of his/her results to the department, and then immediately meet with the thesis committee to defend the thesis.

Ph.D. Qualifying Exam - Research Proposal

General comments about the PhD QUALIFYING EXAM – RESEARCH PROPOSAL
The purpose of the proposal is to make students thoroughly familiar with the theory behind the techniques that they will use; to give them a complete grounding in the literature, both current and historical, of their research field; and, most importantly, to get them to think about their research. The proposal is called a research proposal, not a dissertation proposal. The proposal will cover the expected dissertation area, but is it not inconceivable that the dissertation will eventually be on another topic.

Proposal Content
Your research proposal should consist of:

1. **Title**
2. **“Abstract”** (Summary or Project Overview) (What are you planning to do and why? – Big picture)
3. **Hypothesis statement** – (What are the important questions being asked? What don’t we currently know?)
4. **Specific Aims** (Overview and rationale of how are you planning to ask your questions)
5. **Background & Significance** (What is already known or **not** known? (the ‘gap’ in literature) Why should we care?)
6. **Preliminary Data** (What have you already done to address this gap and answer your questions?)
7. **Research Design and Methods** (How are you doing to ask your questions – the proposed methods/data analysis/interpretation/plan B)
8. **Conclusion /Summary** (What will we know after the proposed experiments/project are completed, that we didn’t know before the project was completed)
9. **Literature cited**

Specific writing instructions are located in a document entitled “Ph.D. Qualifying Exam Research Proposal Instructions”

A self-evaluation rubric is provided to help you assess whether your written proposal meets the department expectations, entitled “Research Proposal Self Evaluation”.

Both documents are posted on the website http://ase.tufts.edu/biology/graduate/resources.htm

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**Proposal Time Line**

The qualifying exam will be completed by the end of May in the second year. Under extenuating circumstance, with permission of the committee and graduate program chair, an extension can be granted. The deadlines below are final deadlines; it is suggested that students adopt an earlier timeline to assure sufficient time to make revisions suggested by their advisor or committee.

- The student must turn in a copy to the advisor on or before the **last day of March**. The advisor has 10 days to give approval or suggest revisions.
- The committee members should receive their final advisor-approved copy no later than the **last day of April**. The committee members will communicate to the student whether the proposal is defensible or needs significant revisions within 10 days.
- The proposal defense date is scheduled to take place before the end of the spring semester of the second year (defined as the **end of May** for this purpose).

**Proposal Expectations**

More detailed writing instructions and a guideline for self-assessment of the written research proposal can be found at on our department website (entitled, “Research Proposal Self-evaluation”).

In the oral defense, we expect students to cogently discuss their written research proposal. Additional expectations include, but are not limited to, an ability to:

- Explain the significance of their research within their field
- Demonstrate understanding of relevant concepts & literature
- Explain and defend their chosen approach
Discuss alternative approaches

Outside Feedback Guidelines
1. The ability to design specific aims and approaches is one of the skills being tested in this examination. Therefore, the student is responsible for making the choice of how to answer the questions they pose. Although students can discuss and get advice from others (e.g., on specific techniques), developing the aims & approaches is the student’s responsibility.

2. The proposal should be written by the student, and text from the advisor’s grant proposal (e.g., aims) should not be used.

3. Advisors should avoid specific edits (e.g., line by line editing), but general feedback on the structure of the proposal may be given. Examples: the aims don’t follow well from the hypothesis, the hypothesis or rationale (or section) isn’t clear, the methods or proposed experiments do not address an aim, additional experimental approaches should be added to an aim.

4. On a separate page, students must acknowledge all outside sources of significant input or feedback by name, such as advisors, committee members, or colleagues. The contribution(s) of each outside source must be described. Examples: Committee member X provided feedback on the two main methods of testing Y. Graduate student X provided advice on using analytical tool Y under new conditions.

Qualifying Exam outcomes
At the defense, the student presents the proposal orally and is then questioned about it. Students will receive either, (1) a full pass (no other action is required on the part of the student) or (2) a conditional pass (additional action is required on the part of the student), or (3) a fail.

Conditional passes are given if the committee finds there is an area that still needs to be addressed by the student. For example, if a student is deficient in a specific area that the committee feels will be important for the student’s success in the Ph.D. program, they might require the student review and be re-tested on that area. Re-writing a section of the grant proposal to clarify/correct a point that wasn’t clear in the original version is another common condition that can be assigned to students receiving a “conditional pass”.

In the case of a fail, the committee has the option of allowing a re-examination. If this course of action is taken, the student must be re-examined within four months on those aspects of the defense indicated by the committee as not satisfactory. Re-examination can only occur once.

In the case of a fail and re-examination does not occur, the committee will decide whether the student must leave the program. Alternatively, the committee may recommend that the student transfer to one of our MS programs.

Oversight of Graduate Student Progress (PhD and Th-MS)
The appropriate committee, entering, exam, or dissertation, depending on the student's stage of progress, should meet with the student twice a year. If the student is presenting his or her work at the Friday afternoon seminar or at a rotation seminar, all members of the student's committee should attend. Students are expected to give a seminar each year to the department for a total of 4 (PhD) or 2 (Th-MS) seminars. See “Graduate Student Seminar Policy Guidelines” on the department website for details. The graduate student is responsible for scheduling a committee meeting in the fall and in the spring (usually within 2 weeks of the student’s seminar; for more details see “Graduate Student Committee Meetings”).

Ph.D. and Thesis Masters students should submit reports to their committees three to four working days before each semi-annual meeting. The reports should be brief, not exceeding 2 pages, excluding figures and tables. Figures can be simple and hand-drawn, but should be clear and easily interpreted. The report should contain the specific aims of their research (for rotations, the limited aim of that period), approaches used, results obtained,
and a brief discussion. The report should conclude with research plans for the next six months. Students should bring their lab notebooks containing the original data to the scheduled meetings. If the student completed a rotation, the head of the lab in which the rotation was done should send a brief evaluation to the committee. These reports will be kept in the student's folder.

The chair of each student's committee will keep minutes of each meeting on the form “Graduate Progress Report for Committee Meetings” on the department website. Items such as course needs, rotations completed or in progress, courses taken and those to be taken, research progress, exam scheduling, and work as a teaching assistant should be discussed.

Before the minutes of the meeting are put into the student's folder, they should be circulated to all committee members for additions and/or corrections. After committee approval, the chair of the student’s committee will give a copy to the student, all committee members, and to the graduate staff assistant for the student’s file). Students have the right to add comments to their files in response to the minutes of committee meetings.

**Unsatisfactory Progress**
The most important aspect of progress toward a degree is generating a dissertation of publishable quality. Course grades must be B- or higher to count for graduate credit. In the event of a lower grade, the student’s committee will decide if the course must be retaken. Overall grade point average must be at least 2.670. Unsatisfactory progress can also result from unacceptable or inadequate work as teaching assistants or in rotations and research, lack of progress in completing the requirements, or academic dishonesty.

In case of inadequate performance in research or courses, the student will be warned, in writing, by his/her committee and given three to six months to improve. The warning should specifically state the work or actions required of the student. In cases of academic dishonesty or failure upon examination or re-examination in the qualifying procedure, dismissal requires no warning.

**Departmental T.A. Support**
All PhD dissertation graduate students are required to TA for at least two semesters. At the end of the semester, an evaluation of the student's work as a T.A. should be completed by the supervising faculty member using the standard evaluation form located on the department website. The evaluation is placed in the student's file. Before the beginning of the semester, all T.A.'s should be given in writing a clear explanation of their duties and responsibilities by the faculty member in charge of the course.

Students assigned to serve as teaching assistants for Bio13L (Introductory Biology) must also enroll in Bio260 (Teaching Biology: Pedagogy and Practice) during the semester they are teaching. (If assigned to teach Bio13L again, returning graduate students will be required to attend only portions of Bio260 in subsequent years.)

A student can only receive T.A. support from the department through the second semester of their sixth year. A student has a maximum of seven years to complete their Ph.D.; however, students are strongly encouraged to complete their dissertation in six years or less.

**Submission of Master’s Thesis and Doctoral Dissertation**
The Graduate School requires that the Thesis/Dissertation be submitted in PDF format through the following link: http://gradstudy.tufts.edu/ (Thesis/Dissertation Electronic submission). The Thesis/Dissertation will be submitted to ProQuest/UMI from this site.

It is the responsibility of the student to provide a final, bound copy for the advisor. It is suggested that Acme Bookbinding Co., Inc., 100 Cambridge St., Charlestown, MA, (617) 242-1100, be used for the advisor copy. Acme will print in color and will be able to match the format of the binding to that used in dissertations submitted by former students in Biology.
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<tr>
<th>TIME</th>
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<tr>
<td>Year 1</td>
<td>Complete Rotations (at least 2; fall &amp; spring)</td>
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<td>Present Rotation 1 Report (early spring semester)</td>
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<td>Choose a Dissertation Advisor (by end of spring or summer rotation)</td>
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<td>Year 2</td>
<td>Present Second Year talk (fall semester; typically on Rotation 2)</td>
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<td>Ph.D. Written Qualifying Exam (spring; end of May deadline)</td>
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<td>Years 3-5</td>
<td>Complete dissertation research; 2 committee meetings per year are required to report on achievement of research and publication benchmarks</td>
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<td>Year 6</td>
<td>T.A. Support completed (end of year 6)</td>
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