The Biology Department offers research opportunities in many different areas within molecular biology, developmental biology, physiology, behavior, ecology, evolution, 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**
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. Policies that apply to all AS&E graduate students at Tufts are found in the “Graduate Student Handbook” posted on the GSAS website. You should read this handbook and refer to it for general policies. In addition to those general policies, the following specific policies apply to Biology Graduate Students.

**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. While doing fall or spring semester rotations during the first year, students will enroll in Rotation Research courses (Bio253 fall or Bio254 spring; three credits for each rotation completed, 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. Students are also required to register for the Biology department seminar (1 credit, S/U) and the lab meeting of the lab they are rotating in (1 credit, S/U). Students TAing for the first time are required to enroll in Bio 260-01, Teaching Biology: Pedagogy and Practice (3 credits, graded). 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, which can be taken in the first or second year.

In their second year, PhD students should enroll and receive credit for Bio257 (fall) and Bio258 (spring) (2nd year graduate research; 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, and for the Biology department seminar (Bio 201) and lab meeting (Bio 200; choose the section led by your research mentor). In the spring of the second year, PhD students should register for Bio 259, Capstone: Research Proposal and Review, which is the course associated with preparing for and taking their qualifying exam by the end of May (3 credits, S/U). 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 or biostatistics, 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 (Molecular Biology, Physiology, and Ecology/Evolution).

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 courses (30 credits) are required and the grades must be B- or higher. Students will take courses as recommended by the graduate school, the biology program and by their committees (see Graduate Committees below). Normally about 2/3rds of the credits will be for laboratory research. Typically this will include one rotation project (Bio253 fall; 3 credits for a letter grade), one semester of 1st year MS thesis research (Bio 256, spring, 3 credits, letter grade), two semesters of 2nd year graduate research (Bio 257 (fall) and Bio 258 (spring) -choose the section led by your research mentor- 5 credits each, for a letter grade), and credit for writing your MS thesis (Bio295 if in the fall or Bio296 if in the spring; 3 credits).

**The degree requires 4 graded non-research graduate level courses (100 level or above) for at least 12 credits.** All courses must be completed with grades of B- or better to count towards the degree. Two of the four non-research courses 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 4 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), after passing two courses with a B- or better and 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. Ten graduate level courses (numbered 100 or higher) counting for at least 30 credits are required for the OC-MS degree and the grades must be B- or higher. 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.

**Master of Science (transfer from PhD program)**- It is possible for PhD students in good academic standing to transfer to a Biology MS degree if goals or plans change. PhD students may transfer to one of the MS degrees listed above or may earn a Biology MS degree with the following requirements: 30 SHUs of graduate course credit, the required concentration courses (including 243, 244 or 246), and the BIO 259 “Capstone: Research Proposal and Review” course. For the MS degree only, there are two alternatives to fulfilling the BIO 259 course requirement: (1) A “pass” on the qualifying exam proposal, or (2) A written capstone paper describing the research results obtained to date (Introduction, Results, Discussion, Methods, and Supplementary data). The capstone paper needs to be approved by the student’s advisor and committee as fulfilling the requirement of the course.

**Graduate Student Registration:** All full time ThMS and PhD 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. ThMS and PhD STUDENTS MUST REGISTER EACH FALL AND SPRING SEMESTER DURING THEIR TENURE AT TUFTS. Summer registration is not required. Students who fail to register by the end of the second week of classes will be administratively withdrawn and subject to a $350 reinstatement fee. This is a university policy. See the graduate student handbook pg. 11 for details.

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 should 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 mid-May, and summer rotation—mid-May 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. Students are encouraged to schedule a committee meeting just after their oral presentation to ensure timely feedback from their committee on ways to improve their presentation.

**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 a 1st year Graduate Student Progress Report Form after the spring semester meeting. An optional meeting can take place in the summer after the second rotation, if needed. Faculty membership in the entrance committee lasts one year and then dissolves. This is replaced by a thesis committee (see below).

**Thesis M.S. Committees** - Once a research advisor is identified, the student in consultation with the advisor, will identify at least two faculty to serve as thesis committee members, for a minimum of three committee members. It is the student’s responsibility to ask each committee member to serve on their committee.

**Ph.D. Dissertation Committees** - Once a research advisor is identified, the student in consultation with the advisor will identify at least at least two faculty to serve as thesis committee members from the Biology
department. Additional members can come from within or outside the department. It is the student’s responsibility to ask each potential member to serve on their committee.

This initial dissertation committee will also serve as the qualifying exam committee. After passing the qualifying exam, members will continue to serve on the dissertation committee, but changes or additions can also be made with approval of the research advisor. Three members (including the advisor) must be from the Biology department, a fourth (optional) member from inside or outside of the department may be added if desired. In addition, an external faculty evaluator, from outside the University, is required for the defense of the Ph.D. dissertation. This individual cannot have advised the student’s work previously. 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**

These are general guidelines based on a 15-page proposal, but keep in mind that different scientific fields require different grant styles (how many aims, location of hypothesis statement, level of detail of the methods description...). Your research proposal may consist of the following:

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**
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 in 20-30 minutes with no interruptions (time limit strictly enforced) and is then questioned about the proposal, the presentation, and related material, including background information or techniques related to the proposal. 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. 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 attach a CV with additions since the last committee meeting highlighted. Students should bring their lab notebooks containing the original data to the scheduled meetings. Students should also bring a paper or electronic copy of the “Graduate Student Progress Form”, which is posted on the departmental website, with the first page filled out. First year students should use the specific “First Year Graduate Student Progress Form”.

The chair of each student's committee will be responsible for filling out the second page (Progress Evaluation) of the “Graduate Student Progress Report” form. 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 filled out form is put into the student's folder, it should be circulated to all committee members for additions and/or corrections and signatures. 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. Two semesters of unsatisfactory progress noted on the Graduate Student Progress Form is grounds for dismissal from the program.

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. 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 3.0.

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.

**Readiness to Defend a Doctoral Dissertation**
A student ready to defend their doctoral dissertation and earn a PhD should demonstrate deep knowledge of their field, and make a significant contribution to that field. Expectations for a significant contribution differ by field, and should be discussed by the student and advisor at an early stage of the PhD work.

A **minimum** requirement for a PhD in the Biology department is an accepted publication in a peer-reviewed journal. Exceptions must be approved by the committee.

**Submission of Master’s Thesis or 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.
# Time Line of Important Dates for Ph.D. Candidates

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<tr>
<th>TIME</th>
<th>ACTION</th>
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<tbody>
<tr>
<td>Year 1</td>
<td>Complete Rotations (at least 2; fall &amp; spring)</td>
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<tr>
<td></td>
<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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<tr>
<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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<tr>
<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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<tr>
<td>Year 6</td>
<td>T.A. Support completed (end of year 6)</td>
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