

DOCTOR OF PHILOSOPHY WITH A MAJOR IN QUANTITATIVE BIOSCIENCES

Participating Schools

School of Biological Sciences
School of Chemistry and Biochemistry
School of Earth and Atmospheric Sciences
School of Mathematics
School of Physics
School of Psychology

Objective of the Program

The mission of the Georgia Tech Ph.D. program in Quantitative Biosciences (QBioS) is to enable the discovery of scientific principles underlying the dynamics, structure, and function of living systems. The QBioS program is designed to provide Ph.D. graduates with the skills and expert knowledge necessary to move directly into academia, industry and/or government, where they can apply their specific domain expertise and broadly relevant modeling tools.

The Ph.D. program in Quantitative Biosciences is offered by the College of Sciences. Students select a home school within the College of Sciences and can select a thesis advisor from the entire list of program faculty, irrespective of home school. QBioS Ph.D. students will pursue thesis research across a broad range of research themes spanning molecular and cellular systems, chemical biology, behavior and applied physiology, ecology, evolution and earth systems. The diverse faculty will ensure that students are prepared for quantitative challenges in the biosciences, whether in the analysis of big data, analysis of complex models, and iterative design of theory and experiments.

We welcome applications from high-quality undergraduate students, who are:

1. trained in the physical sciences (e.g., physics, earth systems and chemistry), mathematics, computer science, and engineering, who would like to transition to a career focusing on interface research in the biosciences;
2. trained in the biosciences (e.g., integrative biology, physiology, ecology, evolution, neuroscience, biochemistry, molecular & cellular biology) with particular strengths and interests in quantitative analysis and modeling.

In addition, students with Masters degrees in those thematic areas are strongly encouraged to apply.

For more information visit qbios.gatech.edu

All PhD programs must incorporate a standard set of Requirements for the Doctoral Degree.

The Ph.D. in Quantitative Biosciences is designed to give graduates training in the quantitative analysis of problems in the biosciences – spanning foundational advances and application to challenges in human health, energy and the environment. The requirements include:

- a program of study in core QBioS biosciences and quantitative modeling courses;

- a coherent interface Minor course of study;
- a minimum of two group rotations in the first year;
- an English writing class (if recommended by committee);
- a Thesis Proposal;
- acceptance of at least one scientific publication;
- a written Ph.D. thesis and a public defense of that thesis.

The QBioS student's written thesis proposal satisfies Georgia Tech's requirement for a written qualifying exam. The QBioS student's oral defense of their thesis proposal satisfies Georgia Tech's requirement for an oral qualifying exam. Georgia Tech requires that all doctoral students maintain a 3.0 grade point average. With the permission of the research supervisor and the QBioS Director, Ph.D. students may seek a concurrent MS degree. If so, the courses taken for the MS may be counted to satisfy the Minor requirement. During the semester preceding the semester when the Ph.D. degree is expected, students must submit an Online Application for Graduation to the Registrar. The complete set of requirements involving credit hours are listed below. The majority of coursework should be completed in years 1-2, with thesis research representing the bulk of credit hours in years 3-5.

Code	Title	Credit Hours
Core Courses		
BIOL/PHYS 6750	Foundations of Quantitative Biosciences	4
BIOL 8801	Special Topics (Seminar in Biology - Quantitative Biosciences)	1
BIOL 8801	Special Topics (Seminar in Biology - Quantitative Biosciences)	1
BIOL 8801	Special Topics (Professional Development in Quantitative Biosciences)	1
Quantitative Modeling core ¹		9
Bioscience disciplinary electives ²		6
Quantitative Models in the Biosciences		3
Scientific interface minor ³		9
Rotations		6
Thesis Research		15

¹ Including a computational-focused class

² Two courses; including one involving the application of quantitative methods to the biosciences

³ Three courses; equivalent to Institute approved minor, of which 3 hours must be distinct from courses listed above

Detailed Program Requirements

Core courses (4 courses): These four courses taken in the first year are taken by all QBioS Ph.D. students. The Foundations class is organized around the understanding of key advances in the biosciences, one organizing unit at a time, in which the advances depended critically on quantitative methods and reasoning. The overall objective of the course is to teach graduate students how to reason quantitatively in the biosciences given uncertainty in mechanisms, rates and reliability of measurements. The Seminar classes will enable students to meet, learn and discuss rotating topics representing ongoing advances in QBioS with Program Faculty.

Quantitative Modeling Core (3 courses): Students select courses *a la carte* that involve rigorous quantitative methods and models. Any MATH

6xxx, 7xxx or 8xxx course is eligible for this requirement, as are many courses in the Colleges of Science, Computing, and Engineering. Please contact the QBioS Director for approval of courses not listed on the list of approved courses [HERE](#).

Bioscience Disciplinary Electives (2 courses): Students select courses *a la carte* that deepen their understanding of the biosciences in one of the following areas:

- Chemistry of Biological Systems
- Molecular and Cellular Systems
- Physiology & Behavior
- Ecology
- Evolution
- Earth Systems

Quantitative Models in the Biosciences (1 course): Students select one course *a la carte* that satisfies the requirement that students take a course involving the direct application of quantitative methods to the biosciences. All courses satisfying this requirement are 3 credit hours, including problem sets, involving mathematical and computational methods. Please note that any courses approved to fulfill Quantitative Models in the Biosciences may instead be used to fulfill Quantitative Modeling Core requirements. A list of approved courses may be found [HERE](#).

Graduate Coursework from Other Universities and Programs: Graduate level course work taken for a Master's degree (even at another university) may be included in the Ph.D. Program of Study provided that a grade of B or better was earned for these courses. The submitted program of study and course justification should also include a copy of the student's transcript and a detailed course description and syllabus for each course for which the student wishes to receive credit. The QBioS Graduate Committee typically approves up to two courses (6 credit hours). Students may appeal to count more in extenuating circumstances.

Interface Minor

Students select three courses that will enhance the thesis and enable the development of breadth and flexible thinking in the student. This requirement will also serve, in part, to satisfy the Institute required minor. One of these courses must be in addition to those taken as part of the core course requirements.

Rotations

Special Problems (BIOL/PHYS/home school 8901) is two, 3-hour courses arranged with two QBioS program faculty members in the spring semester of the first year. Registration requires the permission of two professors. The Special Problems should be viewed as a serious opportunity to begin Ph.D. research. Students should also register for a Special Problem in the summer of their first year for 12 credit hours. In most cases this course will have a single professor using the special problem designation appropriate to the School of the advisor and the special problem advisor will represent the eventual thesis advisor of the student. However, students are permitted to arrange for up to 2 additional rotations using Special Problems mechanism in the summer of their first year. Selection of a thesis advisor is expected for all students by the end of their first year in the program.

Academic Writing Requirement

All students must demonstrate competency in academic and technical writing to complete the academic writing requirement. The student's Thesis Proposal Committee (TPC) is responsible for evaluating this requirement, through evaluation of first-authored publications and/or the

thesis proposal. In the event that students require additional training, the TPC may recommend that students take and pass a semester-long graduate course in English-language academic writing. For non-native English speakers, the relevant course is CETL 8723. Non-native speakers may also take ESL-OL01L thorough the GT Language Institute. This online course is aimed at international graduate students and helps them develop a fundamental understanding of the basic principles of academic research writing. For native English speakers, the relevant course is CETL 8721. At this time, the Center for Teaching and Learning plans to offer the 8721 course during summer semesters only. For all students, the writing requirement should be discussed as part of the initial TPC meeting and the initial evaluation of the writing requirement should be completed no later than the end of the 2nd year, consistent with the scheduling of the thesis proposal.

Thesis Proposal and Qualifying Exam Written Thesis Proposal

By the end of the second year at Georgia Tech (no later than September 30 of year 3), every QBioS Ph.D. student must seek admission to candidacy by presenting a 10-page thesis Proposal, including 2 additional pages of references to a Thesis Proposal Committee (TPC). The written Thesis Proposal should contain (1) a review of the literature of their field; (2) a discussion of how the proposed research fits into that field; (3) a summary of preliminary results; (4) a description of the planned work and primary aims of the thesis.

Oral Defense of Proposal

Every student is required to defend their Written Thesis Proposal to their TPC in the form of a

45 minute oral presentation followed by brief questions from the public, followed by an additional 30-60 minutes of questions from the committee. Each TPC member (except for the supervisor) is expected to ask questions designed to probe the students' understanding of their proposed research. It is the responsibility of the TPC to decide if the student "passes" or "fails" the Thesis Proposal – judged comprehensively based on the quality of the written and oral components. A student who passes is formally admitted to Ph.D. candidacy. Criterion for evaluating the quality of the proposal will be distributed by the TPC to the student in advance of the proposal development and submission.

Procedures for Re-examination of the Proposal

A student who fails must rewrite his/her Thesis Proposal and/or repeat the oral presentation as directed by their TPC. The re-examination must occur no later than the semester subsequent to the initial exam. A student who fails his/her examination twice will be removed from the program.

Publication Requirement

Some portion of the Ph.D. candidate's research must have been submitted as a "first-author" publication in a refereed scientific journal or suitable public archive before the thesis defense. Given differences in fields and author order conventions, here we use the term "first-author" to denote the person primarily (or equally) responsible for conducting the research that led to publication. The term first-author applies to "joint" designations of first-authorships. In fields in which last name ordering is used, the "first-author" requirement is satisfied so long as the student was primarily – whether solely or jointly – responsible for conducting the research that led to publication. Note that if your work was supported in part by the QBioS program thorough a program GRA, then you should include an Acknowledgement as such: "This work was supported in part by the Interdisciplinary Graduate Program in Quantitative Biosciences at the Georgia Institute of Technology."

All publications arising during your PhD include two addresses:

1. Interdisciplinary Graduate Program in Quantitative Biosciences;
2. Your home school (School of Biological Sciences, School of Physics, etc.).

The physical address can be the same (i.e., Georgia Institute of Technology, Atlanta, GA 30332).

PhD Thesis Defense Procedures Prior to the Defense

Institute-Required Forms: To complete its records for each Ph.D. student, the Registrar's Office requires an Online Application for Graduation, which must be submitted to the Registrar's Office prior to the student's final semester. The exact date is listed in the official school calendar by semester.

Enrollment Status: The student must be registered during the semester in which the final presentation occurs. A student must also be registered the semester he/she plans to graduate unless an enrollment waiver is requested and approved. An enrollment waiver will not be approved if the Thesis has not been accepted by the Graduate Studies Office by the published deadline.

Thesis Documents: The Ph.D. thesis presentation consists of (1) a written thesis document and (2) an oral presentation and examination evaluated by the Ph.D. Thesis Reading Committee. The thesis document must be received by the members of the thesis committee at least two full weeks prior to the oral presentation and examination. The student should contact each committee member to arrange the delivery of the written thesis in either hard-copy or electronic format.

Scheduling: The student must poll the committee and establish a date and time for the presentation, reserve a room and prepare an announcement of the presentation. The student is responsible for reserving the room and obtaining the necessary audio-visual equipment prior to the oral presentation. Some faculty have extremely busy schedules, and this step should be done at least 6 weeks in advance to ensure faculty availability.

Procedures During the Defense

The thesis defense includes an oral presentation of the findings of the thesis, questions from the audience and the committee, and a closed Q&A with the student and the thesis reading committee (TRC). After successful public defense of the Thesis, the candidate prepares a final manuscript incorporating the modifications required by the Thesis Committee. After obtaining approval signatures from the Thesis Committee and the Director of QBioS, the candidate should follow the electronic submission, printing and distribution specified online.

Doctoral Advisor and Thesis Committee Selecting an Advisor

Students will rotate with two different QBioS faculty members in the spring of their first year, with additional opportunities for up to two more rotations in the summer of their first year. QBioS students should identify a thesis advisor no later than the end of the summer of their first year. Upon mutual agreement, the student and advisor will inform the QBioS graduate committee which will then review and confirm all requests

Committee Formation

Students should identify a Thesis Proposal Committee (TPC) composed of their primary research supervisor and three other faculty members. Of these three, at least one must be from the QBioS program faculty. The TPC is responsible for evaluating the proposal and should be constituted in the fall semester of the second year in the program –

and hold an initial, advisory meeting with the student. In most cases the TPC members continue to serve as members of the Thesis Reading Committee (TRC) after the student passes their qualifying exam.

Georgia Tech requires that all doctoral students have five members for their final thesis committee (Thesis Reading Committee), three of whom must be academic faculty. Georgia Tech requires that one committee member must be outside the student's home school. QBioS requires that the Thesis Reading Committee includes five faculty members*, composed of your primary research advisor and four other members. Of these four members, at least two must be members of the academic faculty of QBioS program and at least one must be external to the QBioS program.

*GT allows external committee members that are not faculty (e.g., staff scientist or museum curator), so long as they hold a PhD.

Yearly Thesis Review

The student should meet with his/her Thesis Reading Committee on at least a yearly basis to review research progress. Students are required to complete an annual progress update that is due at the start of each subsequent fall semester or upon graduating and will be distributed electronically.