



GRADUATE PROGRAM IN BIOTECHNOLOGY

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GRADUATE PROGRAM IN BIOTECHNOLOGY

The Graduate Program in Biotechnology offers advanced training appropriate for careers in academia, government or industry in the field of Biotechnology. Admission is open to both Master's-level students and Ph.D. - level students.

I. Governance

To fulfill Ph.D. requirements students must complete a prescribed course of study, pass a Qualifying Examination, complete and publicly defend a doctoral dissertation, and participate in the undergraduate and graduate teaching programs of the Division of Biology and Medicine. Attainment of the Ph.D. degree normally requires four to five years for Ph.D. candidates and three to four years of graduate work for M.D./PhD. candidates. A Master's Degree will require one to two full years depending upon the student's undergraduate preparation.

The Graduate Program in Biotechnology is administered by the Program Director and a series of standing and *ad hoc* committees, as a component of the Graduate Program of the Division of Biology and Medicine. Standing committees are the Steering Committee and the Graduate Program Committee, described below. *Ad hoc* committees include a Preliminary Advisory Committee, Qualifying Examination Committee, Thesis Advisory Committee and Thesis Committee for each graduate student. These committees, chosen at appropriate stages in the student's career, are described below.

The Steering Committee is composed of the current Graduate Program Director and two senior faculty members. The Program Director is a senior faculty member appointed by the Dean of Biology and Medicine or designate upon recommendation by the Steering Committee for a term of three years, renewable. The Steering Committee is responsible for establishing policy, curricular matters, allocating resources and designating faculty as trainers or members within the Graduate Program, as outlined below.

The Graduate Program Committee is composed of the Program Director and at least four other faculty members. The faculty members are appointed by the Program Director in consultation with the Steering Committee. The term for faculty members of the Graduate Program Committee is three years, renewable. The responsibilities of the Graduate Program Committee include admissions and dismissal recommendations to the Graduate School and curriculum recommendations to the Steering Committee.

The faculty of the Graduate Program will be divided, with respect to graduate training, into two categories, members and trainers. Members will have an active research interest in the areas encompassed by the Program. They will participate in the activities of the Program by involvement in an upper level course, or by attending program seminars or journal clubs, or by serving on *ad hoc* committees. They may serve as thesis advisors for Sc.M. students. Trainers are those faculty who may serve as thesis advisors for Ph.D. students. Trainers must conduct an active research program and must be prepared to commit the time and effort required to supervise the student's research. They are also expected to have the financial resources to support a graduate student and to support the graduate student's research project. When accepting a graduate student into the lab, trainers must make a commitment to provide funding for stipend, tuition, health insurance, and fees until the student's thesis is completed. Trainers also commit to provide timely feedback to the student as well as the Program Director about the student's progress in research. In cases where progress is not satisfactory, this feedback must be documented and shared with student and Program

Director. Ph.D. training is most appropriate in an environment where the student can interact with other active investigators and graduate students. Trainers are expected to offer at least one upper level course every other year, either alone or as a leading instructor in a group.

Potential members and trainers are proposed to the Steering Committee by one of its members, who will provide the committee with documentation of the candidate's credentials. Designation of faculty status, as a member or trainer, is made on the basis of the credentials, subject to review every three years. New trainers must provide a summary of the academic and research guidance they provided to their student following the first year annual review for assessment of the training environment by the Steering Committee.

II. Admission

Entering students are expected to have strong undergraduate qualifications in biological sciences, mathematics, physics, or chemistry. However, engineers who are interested in enriching their education in biology and material science are also encouraged to apply. The Steering Committee will make recommendations to the full faculty for interviews and acceptance after the applications have been made available for review by the faculty. Any requests for transfer into the Program will be evaluated by the Graduate Program Director in consultation with the Graduate Program Committee. All students admitted to the Biotechnology Graduate Program (Ph.D. and Sc.M./A.M.) must submit their official final transcript demonstrating the conferral of all degrees listed on their application before matriculating in the Program. Failure to provide the official transcript according to the Graduate School's deadline will result in a student being withdrawn from the Program.

III. Counseling

Until the Thesis Advisory Committee is selected, counseling on academic matters and review of student progress will be carried out by the Graduate Program Committee. This committee will also put students in touch with other faculty members with related interests who may also provide useful advice. In subsequent years, counseling will be provided by the adviser and the student's qualification exam/thesis committees.

IV. Ph.D. Course of Study

The University requires at least three years of full time study (i.e. 24 tuition units) for graduation at the Ph.D. level, of which a maximum of 8 can be transferred from post-baccalaureate upon review and approval by the Graduate Program Director. Likewise, students in the M.D./Ph.D. program can receive the maximum of 8 credits for satisfactory completion of the first two years of the Program in Medicine.

Students must receive a grade of B or better on courses used in fulfillment of the Ph.D. and these courses must be taken for a grade rather than on a credit/no credit (S/NC) basis. Failure to achieve a grade of B or better will result in the student being placed on academic warning.

Programs of study and research are developed individually in consultation with the student's thesis advisor and advisory committees and are designed to ensure expertise in the student's principal research

field. Interdisciplinary work is encouraged and may be undertaken with other graduate programs of the Division of Biology and Medicine.

Students must complete an approved sequence of six structured upper level courses, two of which must be 2000-level courses. All students are required to enroll in independent study with their research mentor. In addition to the structured course requirements, all students must fulfill training in Responsible Conduct of Research (RCR) and statistics. Students with demonstrated experience in statistical design and analysis may be excused from the latter training requirement at the discretion of the Program Director.

V. Student Seminars

Graduate students are expected to attend and participate in departmental weekly seminars. Each student will give at least one departmental seminar each year in the BME/Biotechnology Seminar Course (BIOL 2230/2240). This may be based on the student's original research or may consist of a critical analysis of the literature. Students are encouraged to also attend seminar series of individual interest hosted by other programs/departments.

VI. Teaching

Graduate students in the Ph.D. Program are encouraged to gain experience in teaching. Students may serve as a teaching assistant, preferably in a course in which graduate students conduct a discussion or laboratory section or present a small number of lectures. Participation in seminars and certificate programs offered through the Sheridan Center is another way to enhance teaching skills.

VII. Research

The choice of a Ph.D. thesis advisor and research area will be made no later than by the end of the first semester unless an exception has been made by the Program Director. Entering students who have not identified a thesis advisor before coming to Brown are encouraged to attend seminars, talk with faculty and participate in available opportunities for rotation through different research areas. Progress of entering students will be reviewed by the Graduate Program Committee at the end of the first year. These students will compile a one page report describing their academic and research progress and have it reviewed by their adviser, who will send it to the Graduate Program Committee along with a full evaluation of the student's performance in the first year. Failure to select a research mentor by the end of the first semester can result in a student being put on academic warning. Failure to produce satisfactory research progress can result in a student being put on academic warning. Not maintaining continuous research progress can result in a student being put on academic warning.

VIII. Qualifying Examination

Before the start of semester 5, each student is required to take a Qualifying Examination. The examining committee, designated the Qualifying Examination Committee, shall consist of the thesis advisor and at least three other members of the Brown faculty. At least one member of the committee must also be a member of the Graduate Program Committee (who will give continuity from exam to exam). Members of the committee will be asked to serve by the thesis advisor after being selected jointly by the advisor and the student. The student or the thesis advisor will send a memo to the Graduate Program Director listing the membership of the committee for inclusion in the student's file. The thesis advisor or student will also schedule the meeting time of this committee, but should not chair the committee. The Program Director will designate the chair of the committee, which typically will be the Graduate Program Committee representative. Requests for delays in achieving the stated deadline will be reviewed by the Steering Committee of the Graduate Program before approval of the request by that committee.

The Qualifying Examination will consist of written and oral parts. The student will submit a detailed, written document describing both his/her research progress and a proposal for thesis research. The thesis proposal document will be written in the style of an NIH R01 research grant proposal with the following sections; specific aims (1 page), background/motivation and significance, innovation, preliminary results, research strategy, and literature cited. The research strategy should include relevant subsections such as validation/evaluation and potential problems/alternative strategies, as well as a realistic timeline. A final draft of the thesis proposal must be provided to all. The exam will consist of a 45 minute oral presentation of research progress and the proposal by the student, followed by a question and answer session with the committee covering the research progress and thesis proposal. The Qualifying Examination Committee will assess the student's written and oral communications skills, progress in research, ability to devise a research plan and their depth and breadth of knowledge of the chosen topic and the discipline of Biotechnology. Based on the student's overall performance, the committee will make one of three recommendations; "pass, pass with stipulations, or fail". If a recommendation of "pass with stipulations" is made, the committee will devise a plan and a time-line for the student to correct all deficiencies and a means to assess that the deficiencies have been corrected. If a recommendation of "fail" is made, the student will be immediately placed on warning and allowed to retake the Qualifying Examination once, but it must occur before the end of the 5th semester. If a student fails for a second time, the committee chairperson will recommend to the Program Director and the Graduate Program Committee that the student be dismissed from the Program. The chairperson will communicate the final decision and summarize the Qualifying Exam Committee's response to the candidate. Written notification of the outcome of the examination and a copy of the student's written proposal will be sent by the chair of the Qualifying Examination Committee to the Program Director for inclusion in the student's record. Qualifying Examination results will be reported to the Registrar. Each student who passes and satisfies the requirements of the Qualifying Examination will become a candidate for a Ph.D. in Biotechnology.

IX. Ph.D. Thesis Advisory Committee

Each PhD candidate will have a Thesis Advisory Committee, consisting of the thesis advisor, and at least three other members of the Brown faculty. An authority in the area of the thesis research from another institution is an optional member of the Thesis Advisory Committee. Members of the committee will be asked to serve by the thesis advisor after being selected jointly by the advisor and the student. Members of the Qualifying Examination Committee are encouraged to serve as members of the Thesis Advisory

Committee. Any changes must be approved by the Graduate Program Director. The thesis advisor will send a memo to the Graduate Program Director and Program Coordinator listing the membership of the Thesis Advisory Committee, for inclusion in the student's file. The thesis advisor will also schedule the meeting times of this committee and will chair the committee. The student and the thesis advisor should arrange a meeting of the Brown affiliated members of the Thesis Advisory Committee with the student at least once a year after completion of the Qualifying Examination. The purpose of this committee is to follow the progress of the student, to help the student with difficulties encountered in the dissertation research, and to aid with the evolution of the project. These meetings could be scheduled for the intersession between semesters in the academic year, a time when both faculty and students are likely to be available and free of teaching responsibilities. The student will prepare a written report of progress and proposed work to be distributed to committee members prior to each annual meeting. Examples of an acceptable annual report include a manuscript published, submitted, or in preparation along with a detailed description of planned experiments. Following the annual meeting, the thesis advisor will prepare, and the committee will review, a written evaluation of the student's progress. A copy of the student's and advisor's annual progress report should be sent to the Program Director for inclusion in the student's file.

The Thesis Advisory Committee must approve that the research is sufficiently near completion between 1-3 months prior to the defense date. A written memo will be sent by the Committee to the Program Director confirming the status of the research, in order to schedule the thesis defense (see below). Prior to scheduling a thesis defense, the student must convene a meeting with their Thesis Advisory Committee (pre-defense meeting). The student will prepare an oral presentation summarizing the work they have completed and a list of manuscripts that have been accepted for publication, submitted, under preparation and their proposed plan to finish. Students cannot schedule a thesis defense without approval from their Thesis Advisory Committee.

X. Ph.D. Thesis

The Thesis Committee consists of the thesis advisor, and at least three other members of the Brown faculty. An authority in the area of the thesis research from another institution is an optional member of the Thesis Committee. The Program Director will designate the chair of the committee, typically the ranking Biotechnology faculty member other than the thesis advisor. The chair will preside over the thesis examination proceedings. The doctoral thesis should represent a comprehensive summation of the student's total research effort. It must contribute significantly to the field of study and be of sufficient quality to merit publication in a refereed journal. All candidates must publish or show proof of acceptance of at least one first-author, original research paper by the date of thesis defense. The thesis can be presented in either of two formats. The first format, which may be used by any degree candidate, should contain the following elements:

- a) Abstract - less than 350 words summarizing the thesis problem, methods used to solve the problem, the results and conclusions.
- b) Introduction - a comprehensive review of the field and reasons for performing the research.
- c) Methods and Results - a description of the research performed.

d) Discussion - an evaluation of the contribution of the thesis research to the field of study and consideration of future directions

The second format may only be used by candidates whose thesis work forms the basis for two or more papers accepted for publication in refereed journals. In this case the published papers (or relevant portions of the manuscripts) may be substituted for the Methods and Results section of the thesis. Otherwise the format should be the same as that given above; i.e., it should contain a complete Abstract, Introduction, and Discussion.

If portions of the student's work have been done in collaboration with other investigators, the candidate should explicitly state his/her contribution to the work. Detailed instructions on preparation and format of the Ph.D. dissertation should be obtained from the Graduate School.

Students must submit a copy of their thesis to the Thesis Committee at least two weeks prior to the date of the thesis defense. This defense copy of the thesis must be approved by the thesis advisor prior to submission to the Thesis Committee. After submission of the thesis, the student will present his/her work in a seminar, following which there will be an oral examination attended by members of the Thesis Committee and other faculty members who choose to participate. The student, in consultation with thesis advisor, will schedule the thesis defense and notify the Program Director and all program faculty at least one week before the defense. Faculty members are encouraged to read each thesis submitted, attend the seminar and participate in the examination.

The oral examination must follow the Graduate School's rules, provided to the thesis advisor prior to the defense:

- 1) A brief preliminary consultation is appropriate among the members of the committee on their reactions to the dissertation, as well as agreement on the general plan of the examination, the order in which questioners will be called upon, etc.
- 2) Then comes admission of the candidate to the examination room and introduction of the candidate and any faculty or others attending who do not know each other. Formal proceedings are opened by the thesis advisor, who gives a brief resume of the candidate's career to date.
- 3) At the conclusion of the examination, the candidate is asked to withdraw to a nearby area to await the committee's decision. Under the presiding officer's direction, the committee members discuss the candidate's performance. When this discussion is concluded, the committee votes, and the votes are recorded on the "Report of Final Examination". Member of the department of professorial rank (Assistant Professor and above) are ordinarily asked to vote.
- 4) If the examination is satisfactory, the candidate is called back into the room to receive congratulations. If the examination is not satisfactory, the presiding officer should communicate that conclusion to the candidate privately. In case of serious disagreement among committee members, the question might be held in abeyance for a day or two to allow time for reflection and further discussion, in which event the candidate should be informed that he or she will be notified shortly.
- 5) Satisfactory outcomes can still require minor, textual changes to the physical thesis document. Non-satisfactory outcomes are caused by significant problems with the thesis, such as a clear lack of

understanding of the work or revisions that would require any laboratory research. In the case of a non-satisfactory outcome, the candidate will leave the program with a terminal master's degree. The thesis defense can only be taken once.

6) The forms which must be filled out are sent to the administrative assistant of the department, who sees that the presiding officer has them at the appropriate time. After the examination, these documents should be returned to the Graduate School.

XI. Financial Support

Graduate students pursuing the Ph.D. are generally accepted into the Program of Biotechnology with a commitment of financial support not to exceed 5 years while their research and academic studies progress satisfactorily and they are otherwise in good academic standing.

Any student who has passed the Qualifying Examination may request up to \$400/year from the Program Director who administers the Graduate Program budget for travel funds to attend scientific meetings if the student is presenting an abstract in the meeting. These funds are available to students presenting an abstract at a scientific meeting and can only be requested once per fiscal year (July-June). Students may also request the Program Director to have the Program budget pay their final dissertation fee (approximately \$50).

Financial support for degrees other than the Ph.D. are not provided by the University.

XII. Masters Degrees

Students can be admitted to the Biotechnology Graduate Program as candidates for the Sc.M. degree as the terminal degree. Students may enter through the 5th Year Masters Program or the Sc.M. only degree program (Sc.M. Program) which may require 1-2 years of study depending on the student's background. In both pathways, students may elect to fulfill the requirements of a thesis (Sc.M.) or a non-thesis degree (A.M.). Students who elect to fulfill the requirements of a non-thesis degree receive the A.M. degree. Students in the Masters programs (Sc.M./A.M.) are normally not eligible for financial aid.

For the 5th Year Masters Program, a student must apply prior to the end of his/her last semester of undergraduate study at Brown. Admission for Brown students in good standing to the 5th Year Masters Program will ordinarily be a matter of course, however, such admission must be applied for at the proper time and decided on in the regular way. For students fulfilling the requirements of research and a thesis, a letter of recommendation must be obtained from a Brown faculty member willing to host the student in his/her lab. To be eligible for the 5th Year Masters Program, students must have successfully completed and fulfilled all requirements of an undergraduate concentration at Brown. As many as two graduate-level courses taken at Brown as part of the student's undergraduate concentration may be applied towards the requirements of the graduate degree as long as they were not used towards fulfillment of the student's undergraduate concentration and are approved by the Program Director.

Non-Brown students must apply by completing the standard Graduate School application and indicate their interest in the Biotechnology Sc.M. degree program. Transfer of credit towards the Sc.M. and A.M. Program is not accepted.

Masters of Science (Sc.M) Degree

To satisfy the requirements of the Sc.M. degree, students must complete an approved program of study consisting of a minimum of eight semester-long courses (eight tuition units). No more than three of the eight courses are to be for thesis research (Graduate Independent Study). Students must complete at least five structured, advanced-level (1000/2000 level) courses in biology or the sciences. These courses must be approved by the Program Director. All students (5th year and non-Brown) pursuing an Sc.M degree must select a thesis advisor by the end of their first month in the program and will do research for the duration of their time in the program. Students are encouraged to have open conversations with their thesis advisor about the amount of time that should be dedicated to their thesis research and general expectations before joining a lab. It is expected that students are performing thesis research even if they are not signed up for graduate independent study. Thesis research progress will be evaluated each semester by the student's thesis advisor. If a student is not making satisfactory progress on their thesis, their advisor may recommend to the Program Director that the student be put on academic warning.

In their terminal semester, students, in consultation with their thesis advisor, must choose a thesis committee which will consist of two members of the faculty and the thesis advisor. The list of faculty serving on the committee should be communicated to the Program Director. Students must prepare a written thesis according to the Graduate School guidelines. The written thesis is due to the student's committee two weeks before the scheduled thesis defense. The final written thesis must follow all the guidelines specified by the Graduate School and be submitted to the Graduate School by the first business day in May. The thesis defense will be an open presentation with the requirement that the entire thesis committee is present. The thesis defense does not require a closed examination session.

All students must attain a grade designation of B or better on their courses /credits for the course toward their degree requirements. Courses/credits may not be taken on an S/NC basis. If a student does not pass their credits with a grade designation of B or better they may be put on academic warning.

Students must also complete the Responsible Conduct in Research (RCR) seminar. Students who cannot attend the seminar will be required to complete a replacement online RCR course. If the RCR requirement is not fulfilled by the end of their first semester, the student may be placed on academic warning.

Masters of Arts (A.M) Degree

Students who elect to fulfill the requirements of a non-thesis degree receive the A.M. degree. The A.M. degree consists of a minimum of eight semester-long courses (eight tuition units). These courses must be 1000/2000 level structured courses in biology and the sciences. These courses must be approved by the Program Director. All students must attain a grade designation of B or better on their courses /credits for the course toward their degree requirements. Courses/credits may not be taken on an S/NC basis. If a student does not pass their credits with a grade designation of B or better they may be put on academic probation.

The Biotechnology Graduate Program does not accept students into Brown's concurrent baccalaureate and Master's program.

XIII. M.D./Ph.D. Degree

M.D./Ph.D. students must complete all of the Program requirements specified for the Ph.D. degree. Prior to leaving for continued medical training, the student must successfully pass the thesis defense, have the final written thesis signed by committee members, and submit this document to the Graduate School. If these requirements are not completed by the time the M.D./Ph.D. student leaves, then the student will be removed from the Ph.D. graduate program and awarded a terminal master's degree, commensurate with the completed requirements.

XIV. Dismissal

Failure to fulfill any requirements in a timely fashion will result in a student being placed on warning. A student on warning may be dismissed from the Graduate Program. A student may be dismissed from the Graduate Program for academic or non-academic reasons. The Program Director will review each case and place his/her recommendation before the Graduate Program Committee convened by the Program Director. Two thirds of the Graduate Program Committee will constitute a quorum and a decision to accept the Director's recommendation will require a favorable majority vote. Appeal of such decisions is to the Dean of Graduate School. The Graduate School Handbook provides additional information regarding dismissal and termination of support.

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