

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 Sc.M. students and Ph.D. 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. An Sc.M. 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 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 (stipend, etc) and to support the graduate student's research project. 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.

II. Admission

Entering students are expected to have strong undergraduate qualifications in mathematics, physics, and chemistry as well as in biological sciences. 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.

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.

IV. Course of Study

The University requires at least 24 course credits 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. 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 basis. Failure to achieve a grade of B or better will result in the student being placed on probation. Students in the M.D./Ph.D. program can receive 8 credits for satisfactory completion of the first two years of the Program in Medicine.

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. Students must complete the Ethics Training Course in their first year.

V. Student Seminars

Graduate students are expected to attend and participate in departmental weekly seminars. Each student will give at least one departmental seminar within one year of passing the Qualifying Exam. This may be based on the student's original research or may consist of a critical analysis of the literature.

VI. Teaching

Graduate students in the Ph.D. Program are expected 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. Prior teaching experience, comparable to that which would be obtained at Brown, is applicable toward fulfillment of the teaching requirement. 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. The students will submit a one page report describing their academic and research progress for the first year.

VIII. Qualifying Examination

Before 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, three other members of the Brown Faculty, and, where possible, an authority in the area of the thesis research from another institution. 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 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 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. 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 will be no more than 15-25 pages (single-spaced) in length excluding references. This document will be written in the style of a research grant proposal with the following sections; specific aims, background/significance, preliminary studies/progress report, research design and methods,

literature cited. A final draft of the thesis proposal must be provided to all Qualifying Examination Committee members at least two weeks prior to the date of the oral examination. This document will be the primary focus of the oral examination. 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 allowed to retake the Qualifying Examination, 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 full faculty that the student be dismissed. The chairperson will communicate the final decision and summarize the 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. Thesis Advisory Committee

Each PhD candidate will have a Thesis Advisory Committee, consisting of the thesis advisor, three other members of the Brown Faculty, and, where possible, an authority in the area of the thesis research from another institution. 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 must 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 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 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).

X. Ph.D. Thesis

The Thesis Committee consists of the thesis advisor, three other members of the Brown faculty, and a reader external to Brown. The doctoral thesis should represent a comprehensive summation of the student's total research effort. It is expected to contribute significantly to the field of study and to be of sufficient quality to merit publication in a refereed journal. 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 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.

XI. Financial Support

Graduate students who are candidates for 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.

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. Students may also request the Program Director to have the Program budget pay their final dissertation fee (approximately \$50).

XII. Dismissal

Failure to fulfill any requirements in a timely fashion will result in a student being placed on probation. A student on probation 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 or termination of support.

XIII. Sc.M. Degree

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 or a non-thesis degree. Students who elect to fulfill the requirements of a non-thesis degree receive the A.M. degree. Students in these programs 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.

To satisfy the requirements of the 5th Year Masters Program, students must complete an approved program of study consisting of a minimum of eight semester long-courses (eight tuition units). For students doing research and a thesis, no more than three of the eight courses are to be for thesis research. These students must complete at least five structured, advanced-level courses in biology or the sciences.

For students doing research and a thesis, they must submit and defend an acceptable thesis. Student and faculty mentor select Thesis Committee. For students not doing research (non-thesis), they must complete an approved program of study consisting of at least eight structured, advanced-level courses in biology or the sciences. Students who elect to fulfill the requirements of a non-thesis degree receive the A.M. degree.

All students must attain a grade designation of B or better on their courses, which may not be taken on a S/NC basis. 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. Approval of the courses by the Director of Biotechnology Graduate Studies is required.

For the Sc.M. Program for non-Brown students, a student must apply by completing the standard Graduate School application and indicate their interest in the Biotechnology Sc.M. degree program. To satisfy the requirements of the Sc.M. Program, students must complete an approved program of study consisting of a minimum of eight semester-long courses (eight tuition units). For students doing research and a thesis, no more than three of the eight courses are to be for thesis research. These students must complete at least five structured, advanced-level courses in biology or the sciences. For students doing research and a thesis, they must submit and defend an acceptable thesis. Student and faculty mentor select Thesis Committee. For students not doing research (non-thesis), they must complete an approved program of study consisting of at least eight structured advanced-level courses in biology and the sciences. Students who elect to fulfill the requirements of a non-thesis degree receive the A.M. degree.

All students must attain a grade designation of B or better in all courses, which may not be taken on a S/NC basis. Transfer of credit towards the Sc.M. Program is not accepted. There is no teaching requirement for the Sc.M. degree.

XIV. M.D./Ph.D. Degree

M.D./Ph.D. students must complete all of the Program requirements specified for the Ph.D. degree.