Plant Biology

The Graduate Program in Plant Biology is designed to train students in modern research areas of plant biology. Students' courses of study are designed individually, in light of their interests and career goals. The graduate program features an introductory seminar (Faculty Research Review), six five-week core course modules, and additional special topic courses and seminars in areas of faculty specialties. The department has research expertise in the following areas: molecular, cellular, genetic, biochemical, physiological, developmental, and structural biology, and plant-microbe interactions. The core courses cover plant developmental genetics, genomics and computational biology, plant diversity and evolution, plant cell biology, plant biochemistry, and plant systems biology.

Admission to the University

Uniform minimum requirements for admission

The following minimum requirements apply to all programs and will be verified by the Graduate Division:

1. A bachelor's degree or recognized equivalent from an accredited institution;
2. A minimum grade-point average of B or better (3.0);
3. If the applicant comes from a country or political entity (e.g. Quebec) where English is not the official language, adequate proficiency in English to do graduate work, as evidenced by a TOEFL score of at least 570 on the paper-and-pencil test, 230 on the computer-based test, 90 on the iBT test, or an IELTS Band score of at least 7 (note that individual programs may set higher levels for any of these); and
4. Enough undergraduate training to do graduate work in the given field.

Applicants who already hold a graduate degree

The Graduate Council views academic degrees as evidence of broad research training, not as vocational training certificates; therefore, applicants who already have academic graduate degrees should be able to take up new subject matter on a serious level without undertaking a graduate program, unless the fields are completely dissimilar.

Programs may consider students for an additional academic master's or professional master's degree if the additional degree is in a distinctly different field.

Applicants admitted to a doctoral program that requires a master's degree to be earned at Berkeley as a prerequisite (even though the applicant already has a master's degree from another institution in the same or a closely allied field of study) will be permitted to undertake the second master's degree, despite the overlap in field.

The Graduate Division will admit students for a second doctoral degree only if they meet the following guidelines:

1. Applicants with doctoral degrees may be admitted for an additional doctoral degree only if that degree program is in a general area of knowledge distinctly different from the field in which they earned their original degree. For example, a physics PhD could be admitted to a doctoral degree program in music or history; however, a student with a doctoral degree in mathematics would not be permitted to add a PhD in statistics.
2. Applicants who hold the PhD degree may be admitted to a professional doctorate or professional master's degree program if there is no duplication of training involved.

Applicants may only apply to one single degree program or one concurrent degree program per admission cycle.

Any applicant who was previously registered at Berkeley as a graduate student, no matter how briefly, must apply for readmission, not admission, even if the new application is to a different program.

Required documents for admissions applications

1. **Transcripts:** Upload unofficial transcripts with the application for the departmental initial review. Official transcripts of all college-level work will be required **if admitted**. Official transcripts must be in sealed envelopes as issued by the school(s) you have attended. Request a current transcript from every post-secondary school that you have attended, including community colleges, summer sessions, and extension programs.
   If you have attended Berkeley, upload unofficial transcript with the application for the departmental initial review. Official transcript with evidence of degree conferral ***will not*** be required if admitted.
2. **Letters of recommendation:** Applicants can request online letters of recommendation through the online application system. Hard copies of recommendation letters must be sent directly to the program, not the Graduate Division.
3. **Evidence of English language proficiency:** All applicants from countries in which the official language is not English are required to submit official evidence of English language proficiency. This requirement applies to applicants from Bangladesh, Burma, Nepal, India, Pakistan, Latin America, the Middle East, the People's Republic of China, Taiwan, Japan, Korea, Southeast Asia, and most European countries. However, applicants who, at the time of application, have already completed at least one year of full-time academic course work with grades of B or better at a U.S. university may submit an official transcript from the U.S. university to fulfill this requirement. The following courses will not fulfill this requirement: 1) courses in English as a Second Language, 2) courses conducted in a language other than English, 3) courses that will be completed after the application is submitted, and 4) courses of a non-academic nature. If applicants have previously been denied admission to Berkeley on the basis of their English language proficiency, they must submit new test scores that meet the current minimum from one of the standardized tests.

Admission to the Program

Prospective students for the graduate program in plant biology are expected to demonstrate academic excellence and potential for independent scientific research. Students are expected to have a basic background in chemistry, physics, mathematics, and biology equivalent to those in the undergraduate program. An admissions committee composed of nine to ten members of the department will review applications and make recommendations to the full department on admissions matters. Recommendations for admission will be based on a demonstration of academic excellence and potential for independent scientific research as shown by grades in university-level undergraduate and graduate courses, letters of recommendation, written statements of academic and professional goals, and other evidence of academic accomplishment. Scores on standardized tests, such as the

Graduate Record Examination (GRE), will be required of all applicants. Students seeking detailed information about matters such as admission, curriculum, and courses of financial support should contact the student affairs adviser or the graduate adviser.

Normative Time Requirements

Normative Time to Advancement

Normative time to advancement to PhD candidacy is 2 years

Year 1
Students perform three laboratory rotations in order to explore areas of research interest and identify a faculty mentor, dissertation project and laboratory. Students undertake required core classes and attend seminars of interest.

Year 2
Students attend seminars, perform their first teaching assignment, and prepare for the PhD qualifying exam which consists of two research proposals and an oral examination. With the successful passing of the qualifying exam, students select a dissertation committee and advance to candidacy for the PhD degree prior to the start of the 5th semester.

Normative Time in Candidacy

Years 3 – 5/5.5
Students attend seminars of interest and perform their second teaching assignment. Students conduct original laboratory research for the PhD dissertation with the guidance of their faculty mentor and a self-selected 3 to 4 person dissertation committee. Students are required to meet annually with the dissertation committee. Students write the dissertation based on the results of their research. Upon approval of the dissertation by the dissertation committee and Graduate Division, students are awarded the doctorate. There is no formal defense of the completed dissertation; however, students are expected to publicly present a talk about their research in the final year.

Total Normative Time

Total Normative Time to Degree is 5 – 5.5 years.

Time to Advancement

Curriculum

Courses Required

PLANTBI 200A	Plant Developmental Genetics	1.5
PLANTBI 200B	Genomics and Computational Biology	1.5
PLANTBI 200C	Plant Diversity and Evolution	1.5
PLANTBI 200D	Plant Cell Biology	1.5
PLANTBI 200E	Plant Biochemistry	1.5
PLANTBI 200F	Plant Systems Biology	1.5
PLANTBI 201	Faculty Research Review	2
PLANTBI 210	Scientific Reasoning and Logic	1
PLANTBI 290	Seminar (or equivalent)	2
PLANTBI 299	Graduate Research (multiple)	1-12
PLANTBI 300	Course Not Available	
PLANTBI 298	Plant Biology Group Studies	1-6

Professional Development

Research Presentations

All plant biology graduate students attend the Plant & Microbial Biology (PMB) department retreat at least once during their graduate studies. Students are encouraged to attend both the Plant & Microbial Biology department retreat and the Graduate Group in Microbiology retreat and present their research. Students are highly encouraged to present during the PMB department student/post-doc seminar series. They are also encouraged to attend national and international conferences to present research.

Teaching

Plant biology graduate students are required to teach two semesters. Students are required to teach in two distinctly different classroom settings; specifically, teaching in a “large” enrollment course (100+) and a “small” upper division, lab, or low enrollment (< 100) course.

Grant Writing

Students are encouraged to take PLANTBI 297 Grant Writing and Research Presentations.

Plant Biology

PLANTBI 200A Plant Developmental Genetics 1.5 Unit
The students will be provided with both the basic framework and current topics of plant developmental genetics.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Hake

PLANTBI 200B Genomics and Computational Biology 1.5 Unit
Principles of computational and genomic biology. Covers evolutionary, algorithmic, and statistical foundations of sequence analysis, allowing students to understand concepts underlying modern computational methods. Practical applications wil be pursued in student-coordinated sessions. Combined lecture with 220B.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Brenner

PLANTBI 200C Plant Diversity and Evolution 1.5 Unit
This course will introduce the students to the diversity of plant form and function and provide them with a basic understanding of the tools and techniques used to study plant diversification and evolution. Molecular and morphological data will be discussed and plant diversity will be introduced at molecular, population, organismal, and ecological levels.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Specht

PLANTBI 200D Plant Cell Biology 1.5 Unit
The course will describe the conceptual framework of plant cell biology followed by in-depth discussion of several active areas of research including cell wall biology, membrane transport, cellular trafficking, and cell signaling.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Luan

PLANTBI 200E Plant Biochemistry 1.5 Unit
The aim of this course is to augment the student's knowledge of key plant-specific (or particularly relevant) biochemical processes focusing on the underlying experiments used to deduce key cycles coupled with current areas of exploration and debate surrounding a given topic area. In addition, this section will broaden and deepen the student's knowledge of biochemistry in general including basic enzyme kinetics, assessment of enzymatic (biochemical) function, and modes of regulation.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Scheller

PLANTBI 200F Plant Systems Biology 1.5 Unit
The aim of this course is to highlight the specific hallmarks of systems biology. Students will be informed of the many resources for systems biology available to plant biologists and the recent published work that capitalizes on these resources. Each lecture will focus on fundamental principles followed by discussion of papers that are germane to the topic.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Harmon

PLANTBI 201 Faculty Research Review 2 Units
Presentation and discussion of faculty research in the areas of plant and microbial biology. Faculty speakers review recent advances in their area of expertise and present an outlook of current research activities in their laboratories. The format of the class is designed to stimulate a dialogue between instructor and students in the course of each presentation.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PLANTBI 202 Faculty Research Review 2 Units
Presentation and discussion of faculty research in the area of microbial biology. Faculty speakers review recent advances in their area of expertise and present an outlook of current research activities in their laboratories. The format of the class is designed to stimulate a dialogue between instructor and students in the course of each presentation.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PLANTBI 210 Scientific Reasoning and Logic 1 Unit
The objectives of this class are to teach students to critically read and interpret scientific papers. Students will read and discuss strongly and poorly reasoned papers. At the end of the class the student should understand the logic and reasoning which make a paper strong, often classic, contribution.
Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Quail

PLANTBI C216 Microbial Diversity Workshop 1 Unit
This workshop for graduate students will parallel C116, Microbial Diversity, which should be taken concurrently. Emphasis in the workshop will be on review of research literature and formulation of paper pertinent to research in microbial diversity.
Rules & Requirements

Prerequisites: Graduate standing; C112 or consent of instructor and organic chemistry (may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of workshop and 1 hour of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Coates

Also listed as: MCELLBI C216

PLANTBI 220A Microbial Genetics 1.5 Unit
The students will learn fundamental principles and advanced techniques in microbial genetics. The use of genetics in deducing biochemical pathways, protein interactions, and signal transduction pathways will be explores through reading and discussion of current and classic papers from the primary literature. Experimental design and interpretation will be the focus of problem sets solved in student-coordinated sessions.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Taga

PLANTBI 220B Genomics and Computational Biology 1.5 Unit
Principles of computational and genomic biology. Covers evolutionary, algorithmic, and statistical foundations of sequence analysis, allowing students to understand concepts underlying modern computational methods. Practical applications will be pursued in student-coordinated sessions. Combined lecture with 200B.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Brenner

PLANTBI 220C Microbial Diversity and Evolution 1.5 Unit
The students will be provided with both the basic framework and current topics of microbial diversity and evolution.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Taylor

PLANTBI 220D Cell Structure and Function 1.5 Unit
The students will be provided with both the basic framework and current topics of cell structure and function.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Komeili

PLANTBI 220E Microbial Physiology 1.5 Unit
The students will be provided with both the basic framework and current topics of microbial physiology.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Coates

PLANTBI 220F Microbial Ecology 1.5 Unit
The students will be provided with both the basic framework and current topics of microbial ecology.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Lindow

PLANTBI 222 Biochemistry of Biofuels: Concepts and Foundations 1 Unit
This course offers a consideration of genes, enzymes, metabolic pathways and biochemical processes leading to the generation of hydrogen, bio-oils, ethanol, and other biofuels. Discussion of biochemistry is extended to cover product yields and techno-economic analyses of commercial viability of the various biofuel products. Lectures are based on historical and contemporary papers in plant and microbial biochemistry, integrating structure, function and evolution of the molecular, cellular, and organismal levels, and discussing how this knowledge can be applied in the generation of renewable biofuels.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Melis

PLANTBI C224 The Berkeley Lectures on Energy: Energy from Biomass 3 Units
After an introduction to the different aspects of our global energy consumption, the course will focus on the role of biomass. The course will illustrate how the global scale of energy guides the biomass research. Emphasis will be places on the integration of the biological aspects (crop selection, harvesting, storage, and distribution, and chemical composition of biomass) with the chemical aspects to convert biomass to energy. The course aims to engage students in state-of-art research.
Rules & Requirements

Prerequisites: BIOLOGY 1A; Chemistry 1B or 4B, Mathematics 1B

Repeat rules: Repeatable when topic changes with consent of instructor.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructors: Bell, Blanch, Clark, Smit, C. Somerville

Also listed as: BIO ENG C281/CHEM C238/CHM ENG C295A

PLANTBI 238 Readings in Environmental Microbiology 1 Unit
Special Topics and Advanced Seminars in Plant Pathology. Seminar/ discussion by graduate students of current research in the field of plant pathogenic bacteria.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Lindow

Formerly known as: Environmental Science, Policy, and Management 238A

PLANTBI C244 Introduction to Protein Informatics 4 Units
This course will introduce students to the fundamentals of molecular biology, and to the bioinformatics tools and databases used for the prediction of protein function and structure. It is designed to impart both a theoretical understanding of popular computational methods, as well as some experience with protein sequence analysis methods applied to real data. This class includes no programming, and no programming background required.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Sjolander

Also listed as: BIO ENG C244

PLANTBI C244L Protein Informatics Laboratory 3 Units
This course is intended to introduce students to a variety of bioinformatics techniques that are used to predict protein function and structure. It is designed to be taken concurrently with C244 (which provides the theoretical foundations for the methods used in the laboratory class), although students can petition to take this laboratory course separately. No programming is performed in this class, and no prior programming experience is required.
Rules & Requirements

Prerequisites: Bioengineering C244/Plant and Microbial Biology C244

Hours & Format

Fall and/or spring: 15 weeks - 9 hours of laboratory and 1 hour of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: Sjolander

Also listed as: BIO ENG C244L

PLANTBI 290 Seminar 1 - 2 Units
Advanced study in various fields of plant biology and microbial biology. Topics will be announced in advance of each semester. Enrollment in more than one section permitted.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-2 hours of seminar per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PLANTBI 296 Graduate Supervised Independent Study 1 - 12 Units
Graduate student independent study under the supervision of a faculty member. Sections are operated independently and directed toward different topics.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-12 hours of independent study per week

Summer:
6 weeks - 2.5-30 hours of independent study per week
8 weeks - 1.5-22.5 hours of independent study per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

PLANTBI 297 Grant Writing and Research Presentations 2 Units
Each student will write a grant proposal in three steps: a one page outline, a three-page pre-proposal, and a complete 10-page grant proposal. There will be feedback at each step in the process -- each participant will review the other grant proposals. Some of the scheduled classes will include discussion of the outlines and pre-proposals, and the last class will be organized as a grant panel, with students assigned as primary and secondary reviewers.
Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

Instructor: McCormick

PLANTBI 298 Plant Biology Group Studies 1 - 6 Units
Advanced study of research topics which will vary semester to semester. Enrollment in more than one section permitted.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-6 hours of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: The grading option will be decided by the instructor when the class is offered.

PLANTBI 299 Graduate Research 1 - 12 Units
Graduate student research.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-12 hours of independent study per week
8 weeks - 1-12 hours of independent study per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate

Grading: Letter grade.

PLANTBI 375 Workshop on Teaching 2 Units
Designed for all graduate students. This course has two goals: discussion of questions and problems relating to the GSI's teaching, and learning how to design and execute a whole course. Effective teaching methods will be introduced by experienced GSIs and faculty. Students will participate in reciprocal classroom visits, visitation and critique of faculty lectures, course design, lecture preparation, sample lecture presentation, and discussion of current literature on teaching.
Rules & Requirements

Prerequisites: Graduate student status

Repeat rules: Course may be repeated for a maximum of 4 units.Course may be repeated for a maximum of 4 units.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Formerly known as: Plant and Microbial Biology 300

PLANTBI 602 Individual Study for Graduate Students 1 - 8 Units
Individual study in consultation with the major field adviser, intended to provide an opportunity for qualified students to prepare themselves for the various examinations required of candidates for the Ph.D.
Rules & Requirements

Prerequisites: Graduate standing

Credit Restrictions: Course does not satisfy unit or residence requirements for doctoral degree.

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-8 hours of independent study per week
8 weeks - 1-8 hours of independent study per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.

PLANTBI S602 Individual Study for Graduate Students 1 - 6 Units
Individual study in consultation with the major field adviser, intended to provide an opportunity for qualified students to prepare themselves for the various examinations required of candidates for the Ph.D.
Rules & Requirements

Prerequisites: Graduate standing

Hours & Format

Summer: 8 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Plant and Microbial Biology/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.