Goals

The mission of the Plant Biological Sciences (PBS) Graduate Program is to develop graduate students as creative leaders of the plant biological sciences and to provide outstanding interdisciplinary education for careers in academia, industry, government and public service. The program draws strength from an emphasis on basic research and the integration of conceptual and technical approaches across all levels of biology, from molecules to ecosystems. The PBS program is primarily focused on the Ph.D., although options for a M.S. degree with (Plan A) or without a thesis (Plan B) are also available.

The graduate program was established to provide students with:
- excellent interdisciplinary educational and research experiences,
- possibilities to work with scientists on a broad range of cutting-edge research topics in plant and fungal biology,
- skills and opportunities to conduct independent research and develop as innovative educators, and
- opportunities to participate in the international plant science research community through seminars, colloquia, and conferences.

The PBS program expects students to develop an integrated framework and cognitive structure for understanding plant biology; skills for the synthesis of information and the recognition of significant, approachable research problems; and the capability for independent scholarship for professional success, positioning them to make effective use of their degrees.

Assessment of Goals

How does the program know that it is meeting its goals?

Evidence that the program collects and uses to evaluate success of the program include
- products of student work, such as publications, presentations, fellowships, and grants,
- student time to degree, and
- alumni employment histories.

Assessments of student satisfaction with the educational and research experiences provided by the program and suggestions for program improvement have been obtained through surveys, meetings between the Director of Graduate Studies and the graduate students, and with exit interviews of graduating students. High faculty and student engagement in the program, as shown by participation on committees, Colloquium and Spring Retreat attendance, and willingness to contribute to teaching efforts, is another measure of success of the program.

How well is the program currently meeting its goals?

- Provide students with excellent interdisciplinary educational and research experiences.
The interdisciplinary education of students starts with the Itasca Orientation for all incoming PBS students. This orientation fosters interactions among students and faculty, introduces research design concepts and techniques to students, and provides advice on first semester coursework. The experience differentiates the PBS program from other graduate programs, builds community among the cohort, and provides a support network for the students as they progress through their degree programs.

All new students also complete up to two laboratory rotations, providing them opportunities to identify potential thesis research projects, advisors, or committee members as well as to gain exposure to a variety of research topics and techniques. First year students are required to attend Colloquium talks throughout the year, thus providing further exposure to the breadth of plant biology and to national and international plant researchers. Students are required to take PBS 8081 Integrative Plant Biology; Connecting Molecules to Ecosystems, which introduces them to critical reading of primary literature across a range of plant biology research.

A requirement of 30 total course credits with 12 in a supporting field ensures that students develop expertise in plant biology and their chosen area of specialization. Course requirements for all PBS students other than those listed above include PBS 8900 Seminar, in which first and fifth semester students present and critique each other’s seminars on their thesis proposals or areas of interest; PBS 8123 Research Ethics; PBS 8901, a proposal writing class to help students prepare for their Written Preliminary Examinations; and Grad 8101 Teaching in Higher Education, which provides pedagogical instruction. Periodic review of the curriculum occurs at the annual Fall Graduate Faculty meeting.

The PBS students maintain a student organization, the Phytograds, which sponsors activities supporting academic goals and promoting community, thus allowing students to develop leadership skills and demonstrate engagement in intellectual pursuits. The Phytograds annually organize the Spring Retreat highlighting student research and a soup lunch to raise charitable donations. Phytograds serve on administrative PBS committees, and take responsibility for inviting and hosting one or more Colloquium speakers.

The PBS program has implemented procedures to ensure that all students complete their degrees in a timely manner. Annual evaluations with their advisory committees are required of all first-to third-year students to provide students with advice regarding their research and education, address any issues as early as possible, and ensure future funding. Students starting in their fourth year and beyond are required to hold an advisory committee meeting each semester to ensure that timely progress is being made. A review of curricular and research progress is performed, and a list of expected accomplishments for the upcoming year is provided by the advisory committee. Each year students are required to provide a list of achievements produced during the year, including peer-reviewed and other publications, presentations, fellowships, honors, etc. These accomplishments demonstrate student progress towards becoming independent researchers.

A timeline for taking milestone exams has been instituted. Second year students take a thesis writing proposal course to help them prepare proposals that comprise their Preliminary Written Examination. The exam consists of an original research proposal written by the student that is to be completed by April of the fourth semester. The student is then requested to complete their Preliminary Oral Examination by the end of their second summer in the program. For the
remainder of their graduate education, the students focus on completing research and writing the thesis. Adherence to the timeline has helped maintain the median time to degree at 5.7 years, even for thesis projects that require fieldwork that can be subject to vagaries of weather.

To help students navigate program and Graduate School requirements, the PBS student handbook was revised so that all policies, forms, and procedures are clearly organized in a single document. A workbook has also been provided to all students that lists annual milestones and helps them determine tasks for each year. The final milestone, the thesis defense and final oral exam, includes a public seminar presentation of thesis research and a separate meeting between the examining committee and the student to critically evaluate the dissertation; a discussion of final revisions to the thesis, if necessary; and general discussion of the student’s future plans. The process of adhering to milestones verifies that the student has successfully identified and solved a significant and approachable research problem, developed an integrated framework for understanding plant biology, and synthesized relevant information.

- Provide students with possibilities to work with scientists on a broad range of cutting-edge research topics in plant and fungal biology.

Students choose advisors from program faculty who work on plant and fungal biology topics including molecular genetics and development, physiological and functional studies at the cellular level, systematic and evolutionary biology, as well as proteomic and metabolomic approaches. Program faculty are members of departments in the College of Food, Agricultural, Natural Resource Sciences, and the College of Biological Sciences, both on the Twin Cities campus, as well as the Swenson College of Science and Engineering on the Duluth campus. Students in the program have the opportunity to study plants and fungi at all levels of biological organization. Diverse options for field, laboratory, and computational research provide PBS students with a broad range of interdisciplinary and collaborative opportunities.

Students are also able to have advisory and exam committee members who are not affiliated with the University of Minnesota, dependent on approval from the College of Biological Sciences. External committee members can be faculty from other national and international universities or research institutions, as long as the student and advisor can justify the need for such expertise. These external committee members provide research advice, technological expertise, and access to resources and networks useful to the students’ projects and future employment.

Students have been granted travel funds to work in laboratories outside Minnesota to learn new techniques or skills. As College funding has constricted, the program needs to continually seek means to provide students these opportunities.

- Provide students with skills and opportunities to conduct independent research and develop as innovative educators.

Students develop skills necessary to work as independent researchers through classwork, workshops, rotations or visits to different laboratories, and as they complete their dissertation research under the guidance of their advisor and advisory committee. They also develop as independent thinkers through the development of their thesis proposals, which are the bases for their Written Preliminary Examinations. Preparation for the Oral Preliminary Examination and
seminar presentations further hone their conceptual and critical thinking skills.

The Grad 8101 course, Preparing Future Faculty, helps students develop as innovative educators. Students are all required to work as teaching assistants for at least one semester during their program. Assisting in teaching classes provides opportunities to test educational concepts and abilities.

Professional development skills are first introduced to students at the Itasca Orientation, where students are provided with some advice on transitioning from college to graduate school. PBS 8900, the seminar class, helps students practice presentation skills and prepare “elevator talks”. Faculty guests in PBS 8081, the integrative plant biology course for all first-year students, discuss topics such as networking, developing and managing collaborations, choosing viable research projects and grant proposal topics, managing laboratories and employment opportunities. Students also practice writing lay abstracts of scientific papers with the goal of learning to explain science to the public. Students have participated in professional development opportunities such as the workshops provided through the College of Biological Sciences that teach skills related to networking, preparing “elevator talks”, and redirecting scientific skills to employment opportunities beyond academia. Upon their own initiative, students have initiated and participated in activities that educate the public about plant biology at venues such as the Midtown Farmers’ Market, the Bell Museum, and youth gardens.

• Provide students with opportunities to participate in the international plant science research community through seminars, colloquia, and conferences.

The program supports a weekly Colloquium series, inviting several speakers from outside the University of Minnesota. Students have the opportunity to interact with invited speakers at lunches, at one-on-one meetings, and at the seminars. Students also serve on the Colloquium Committee, and host speakers. The program also contributes funding for the majority of students presenting posters and talks at national and international conferences.

Review of Goals and Assessments

Periodic review of program goals and progress towards those goals occurs at biannual PBS Steering Committee meetings and at the annual Fall Graduate Faculty meeting. Graduate student representatives attend both meetings. Surveys and exit interviews with graduate students further contribute information on program progress.