ACADEMIC PROGRAM GUIDELINES

Program in

Plant and Microbial Biosciences

(Revised July, 2015)
Introduction to the Plant and Microbial Biosciences Program

The Plant and Microbial Biosciences (PMB) Program trains Ph.D. students to have a strong background in modern biology, as well as research training specific to vascular plants, mosses, algae, photosynthetic prokaryotes, and other microbes as experimental organisms to address both fundamental and applied biological questions. Formal coursework requirements, teaching assistantship, and qualifying exam are usually satisfied in the first two years. Research training is accomplished by a combination of required research rotations in the first year followed by a significant thesis research project. Seminars and journal clubs help members of the program stay current with the latest scientific advances.

Advising

The PMB Steering Committee advises each new student. The committee provides guidance concerning course work and lab rotations and is responsible for overseeing program requirements. Once the student has chosen a laboratory in which to do thesis research (by the end of the first academic year) and passed their Qualifying Examination, a thesis advisory committee is formed and assumes primary responsibility for monitoring the student's progress towards graduation. The Steering Committee monitors the written reports of the thesis advisory committees and makes sure that students schedule meetings with their advisory committees at appropriate intervals, not to exceed one year. See appendix A for information about the composition of the Steering Committee.

Timetable

The general time line for graduate work in the PMB program is as follows:

Year 1:  Begin required coursework, complete at least three research rotations and choose thesis lab.
Year 2:  Complete course requirements; satisfy teaching requirement; pass Qualifying Examination; assemble thesis advisory committee and successfully defend Thesis Proposal.
Years 3-5 (longer, if necessary):  Conduct thesis research. Publish work. Graduate!

Exceptions to the expected timetable require the approval of the PMB Steering Committee.
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Course Requirements:
The objective of our curriculum is to help students develop the skills they will need to pursue a variety of successful careers in science, including academic research, teaching, industry, and intellectual property. These skills include: critical reading of scientific literature, experimental design and data interpretation, oral and written communication, and proposal writing. Students will obtain additional knowledge in specific areas of plant and microbial biology by enrolling in elective and special topics courses and by participating in journal clubs.

Core courses:
1. Experimental Design and Analysis in Biological Research; Bio 5703 (2 credits, taken in Fall of year 1). Critical reading course; will be offered for first year students. Meets 2 hours every week.
2. Nucleic Acids and Protein Biosynthesis; Bio 548 or Fundamentals of Molecular Cell Biology Bio; 5068 (3 credits, taken in Fall of year 1).
3. Modern Approaches in Plant and Microbial Research; Bio 4025 (3 credits, taken in Spring of year 1).
4. Seminar in Plant and Microbial Biology; Bio 5723 (2 credits, taken in fall of year 2).
5. One Additional Journal Club- Students in their third year should take one journal club from a different DBBS program- Cell Bio or Genetics being good options
6. Ethics and Research Science; Bio 5011 (1 credit, Spring, taken in year 2)

Year One:
Integrated Communication Component
The ability to communicate concisely both in writing and in oral presentations is critical for a successful career in science. To this end, BIO 5703 Experimental Approaches and BIO 4025 Modern Methods include an integrated oral and written component. In addition, first year students are expected to participate in the DBBS Fellowship Writing Workshop.

- During the fall semester (BIO 5703) students will:
  - Write and revise 6 sets of specific aims on different topics under the guidance of the course instructors
  - Select one set of specific aims for a 30-minute oral Power Point presentation.
    - PowerPoint slides are prepared in advance and given to course instructor for feedback and revision prior to class presentation
    - Presentation should include background and significance and outline experimental approaches. Students are expected to be able to defend all aspects of their proposal.

- During the spring semester (BIO 4025)
  - Students will work to turn the project they selected for the oral presentation in BIO 5703 into a full length NIH NRSA style proposal under the guidance of the course instructor
  - Submit their final proposals for evaluation in faculty led by student run study sections modeled on the NIH. Each proposal will be evaluated by 2 students serving as Reviewers 1 and 2 and by the faculty leader serving as Reviewer 3
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- DBBS Fellowship Writing Workshops (Fall Year 1). To obtain further practice writing, students who have not received outside funding prior to graduate school are encouraged to participate in DBBS predoctoral fellowship workshops during the fall of their first year.

Year Two:
Bio 5723- Seminar in Plant and Microbial Biosciences:
- 2 credit course. Will count towards PMB’s journal club course requirement
- Students will divvy up assigned papers and present them such that each student gets a fair share of the burden
- Presenting student writes a 1 page primer on each paper to hand out to the class prior to their presentation. (Primers are essentially short reviews of the field that hit only the highest highlights—see Current Biology Quick Guides and Primers for examples)

Elective courses
In addition to the core requirements, students must take at least 6 credits of advanced electives (400 level or higher) that facilitate specialization in their area of interest. Students are strongly recommended to complete their elective requirement by the end of year two. Relevant, popular courses include:

- How Plants Work: Plant Physiology, Growth and Metabolism (Fall, odd years); Bio 4023; 3 credits
- Advanced Genetics (Spring); Bio 5491; 3 credits. This course is recommended strongly for all students. In addition to the material covered, students write a research proposal on a topic that can be developed further for the qualifying exam (see below).
- Fundamentals of Molecular Cell Biology (Fall); Bio 5068; 4 credits
- Developmental Biology (Spring); Bio 5352; 3 credits
- Molecular Microbiology & Pathogenesis (Spring); Bio 5392; 3 credits
- Protein Analysis, Proteomics and Protein Structure Laboratory (Spring); Bio 4522; 3 credits
- Bioenergy (Spring); Biol 4830; 2 credits
- Algae: Cell Biology and Molecular Evolution (Spring) Bio4331; 2 credits
- Computational Molecular Biology (Fall) Bio 5495; 3 credits
- Genomics (Spring) Bio 5488; 3 or 4 credits
- Electron Microscopy of Cellular Structures and Processes (Spring) Bio 4330; 4 credits
- Statistics for Medical and Public Health Researchers (Spring) Math 507M; 3 credits.
- Metabolic Engineering and Synthetic Biology (Fall) EECE 596A.
- Mass Spectrometry (Spring); Chem 550; 3 credits
- Biotech Industry Innovators (Spring); Bio 5014; 3 credits

Important notes concerning course requirements:
1. Students must earn a grade of B- or better in core courses. Students earning grades lower than B- will need to take the course again so that they can master the material.
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2. **Students must earn a grade of C or better in advanced elective courses.**

3. Students who meet only the minimum course requirements take only 15 credits of lecture courses. It has come to the attention of the Division of Biology and Biomedical Sciences that some universities in the southeastern United States have a requirement that their professors must have taken at least 18 credits of lecture courses during their Ph.D. studies in order for them to be eligible to teach. Journal clubs and our ethics course do not count toward this requirement. The Plant Program has opted not to require 18 credits of lecture courses for the Ph.D. degree but students may wish to voluntarily take another course beyond the minimum requirements.

**Other scholarly activities**

All PMB graduate students are expected to regularly attend and participate in:

- Plant and Microbial Biosciences Lunch, held every Wednesday at noon
- The annual PMB Retreat held in the Fall
- Relevant biology seminars sponsored by the Biology Department, the Donald Danforth Plant Science Center, and the Division of Biology and Biomedical Sciences.

**Laboratory Research Rotations**

- During the first 9 months after entering the program, each student arranges research rotations in at least three laboratories to help identify a laboratory in which to carry out their Ph.D. thesis research.

- The purpose of the rotations is to broaden the intellectual and technical experience of the student and to expose the student to available opportunities before a thesis mentor and research area are selected. It should be recognized by both student and rotation mentor that the *objective of the research rotation is to find a research home, and NOT to complete a significant amount of work*. With this in mind, students should plan on spending ~10-15 hours at the bench during a fall or spring semester rotation.

- Each lab rotation should last 6 weeks, to facilitate completion of at least three rotations by the end of the Spring semester. The rotation should not be prolonged beyond the normal *6 week period* to meet particular research objectives. Students should begin their first rotation by September 1 of their first year, and move on to their second and third rotations by Oct 15 and Jan 3, respectively. This will allow time for a fourth rotation in the second half of the spring semester, if necessary. Students may choose to end a rotation after 3 weeks, should they find it desirable to move on to the next rotation. At least one rotation must be conducted on the Washington University campus with a mentor whose primary affiliation is with the PMB Program. Students are expected to affiliate with a laboratory by May 1 of their first academic year.

- Incoming students have the option of carrying out their first research rotation during the summer before the beginning of their first academic year. Summer rotations, during which the student can dedicate full time to their lab work, need only be 4 weeks long, and should be completed by August 15.
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- Prior to arranging rotations, students are encouraged to meet with either or both of the program directors to discuss their plans. It is strongly recommended that students do not plan more than one rotation “in advance” and that they take advantage of the opportunity to sample different disciplines and techniques outside of their comfort zone.

- Faculty and students are requested to refrain from discussing thesis laboratory selections until after the student has completed at least three rotations and not prior to January 1st of the first year for those students who have completed a summer rotation.

Laboratories outside the Division of Biology and Biomedical Sciences
Students can arrange to perform their third rotation at a St. Louis area biotechnology company, or with a laboratory whose principal investigator is not a member of the Division of Biology and Biomedical Sciences (e.g. some of the labs at Danforth Plant Science Center) if they can identify a thesis lab in their first two rotations. Ideally, such rotations should be arranged with the help and advice of the future thesis mentor.

Please note that a student wishing to carry out a research rotation at a company must make arrangements to do so several months in advance with the program director and program coordinator. This is necessary to allow sufficient time for all approvals to be granted and any required paperwork to be completed. Even if a probable thesis lab is identified in the first two rotations, each student must complete three rotations to broaden their exposure to different techniques and experimental perspectives.

Teaching Requirement
Students are required to assist in the teaching of one or two courses depending upon the workload of the course(s). Teaching usually is completed during the second year of graduate study, and Teaching Assistant (TA) assignments to a particular course are made with the student’s background and interests in mind. If a student desires to TA a particular course, the student is encouraged to contact the course instructor before requesting TA assignments. Note that this does not guarantee a TA assignment. TA assignments assist the Biology Department's teaching mission and provide a valuable opportunity for students to develop or improve their teaching skills. Students wishing to gain additional teaching experience can arrange a second TA experience. Students can also work towards earning a Teaching Citation. More details are available at http://teachingcenter.wustl.edu/teaching-citation

Qualifying Examination
Literature-based “general” exam testing the ability to read primary research articles, synthesize information, and apply critical thinking and analysis to important biological questions across disciplines. Examinations will take place in the last two weeks in January of year 2.
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Objectives:
- Gain facility with critical analysis of the primary literature
- Master the wide range of approaches, techniques, and model systems applicable to research in PMB

Paper Selection:
- PMB faculty will be asked to submit a primary research article they feel best represents “the best in their field” for the previous twelve months.
- Submissions will be due August 7, to ensure that the 30 selected papers can be given to 2nd year students by August 15, prior to the start of classes.
- Steering committee or program advisors will select the 30 articles that best represent the range of research in PMB and a wide spectrum of approaches and fields
- Students read and analyze the group of 30 papers as part of a fall student run journal club- Bio 572- Seminar in Plant and Microbial Biosciences*

Preparation:
Students are expected to enroll in Bio 572: Seminar Plant and Microbial Biosciences in the fall of their second year as part of their preparation for the QE.

Committee Selection:
- 4 faculty members will be assigned to committees based on availability and balanced composition. Exam chairs will be selected from the PMB steering committee
- Once the examination committee is selected, faculty will send their paper selections to the committee chair to avoid overlap.
- Students will not be told beforehand which faculty are on their exam

Exam Format:
- During the 90-minute exam, each of 4 faculty examiners select 2 papers (8 total) to question students on round robin style. Once the first question has been asked, the floor is open to questions from all 4 faculty examiners. A soft 10 minute limit per paper will be enforced by the chair to ensure the exam proceeds in a timely manner.
- The exam chair will have pdfs of all the papers available to put up on screen to help the student (and the examiners) get their bearings.
- Faculty are encouraged to test critical thinking and AVOID questions focusing on memorization!
- Students will not be told their status until after the steering committee has met.

Evaluation:
- At the end of the exam, faculty score performance on a 1 to 5 scale with 5 being high. Students will need an average of 2.5 or higher to pass
- To ensure as much continuity as possible across committees, the ultimate decision on pass/fail is left up to the steering committee which meets after all exams are complete.
Outcomes:

- Pass.
- Fail. If a student fails the QE, they will have three weeks to schedule a retake. The reading list will not change, but papers that were utilized in the first round will be eliminated from the pool. The chair of the first exam committee will serve on (but not chair) the retake exam committee.
- Note that a failing outcome upon retaking the exam will result in automatic dismissal from the program.
- If the student does not wish to retake the exam, it is possible to graduate with a terminal Master’s degree pending submission and defense of a Master’s Thesis.

Thesis Proposal and the Thesis Advisory Committee

After passing the Qualifying Examination students organize a thesis advisory committee in consultation with the thesis mentor. This committee should be composed of the thesis advisor and at least three additional members; one of whom should have their primary affiliation with another program. Also, note that the final Thesis Examination Committee requires at least five members, so a thesis advisory committee with only four members must be augmented by the time of the thesis defense. The faculty of the advisory committee should be chosen for their expertise and their willingness to help guide the student’s thesis research. The chair of the thesis advisory committee must be different than the thesis advisor, but need not be a member of the PMB Program. Students must see the Program Coordinator to obtain approval of the advisory committee composition; the necessary Thesis Advisory Committee Approval form is available on the DBBS web site.

The student will prepare a written thesis proposal and present this document, as well as an oral presentation of the proposal, to the advisory committee for their approval. The thesis proposal is expected to be equivalent in quality and impact to a full-length NRSA/USDA predoctoral grant proposal, (~12-15 pages). Sections of the proposal should include the Background and Significance of the topic, Specific Aims to be accomplished, the Research Methods to be employed, Anticipated Results and their interpretation, Potential Pitfalls that might be encountered (and alternative ways to achieve the aims), and a Timetable for completion of the aims. The written proposal must be provided to the committee at least two weeks in advance of the oral presentation. During the oral presentation, the student will discuss his/her research progress to date, describe the experiments to be done and the anticipated outcomes, and respond constructively to concerns or alternative ideas raised by committee members. If the committee is not satisfied with the quality of the proposal, the student will be given 3 weeks to revise accordingly. The faculty advisor is responsible for ensuring the thesis proposal is written to a standard sufficient for application for outside funding.

The thesis proposal, and all subsequent meetings of the thesis advisory committee, will be chaired by a committee member other than the thesis advisor. This chairperson will be responsible for completing a written report of the thesis proposal examination and for completing reports at subsequent thesis committee meetings. These reports are sent to the Graduate student Coordinator, who, in turn, sends copies to thesis advisory committee members and the chair of
the program Steering Committee. It is strongly recommended the student bring this form to the attention of the committee chair, either by bringing a paper copy of the form to the meeting, or by sending an e-mail with a copy of a blank form to the chair prior to the meeting.

**Thesis Committee Meeting Forms are Available at:**
http://www.dbbs.wustl.edu/curstudents/StudentForms/Pages/StudentForms.aspx.

*The thesis proposal must be prepared and defended by June 1 of the student’s second academic year.* Failure to meet this deadline will result in immediate suspension of stipend support.

After gaining approval of the thesis project, the student should provide written and/or oral progress reports to the thesis advisory committee and must convene a meeting of this committee *at least once per year*. It is customary for the student to send their committee a brief (1-2 page) update summarizing their progress ~1 week prior to the advisory committee meeting. *Note that committee meetings should be scheduled during the regular academic year and not between June 1 and September 1.* This is due to the fact that many faculty have 9 month appointments at the University and have no academic duties for 3 months during the summer. Instead, most research-active faculty members receive summer salary from their research grants and owe 100% of their time to those grants. Note that a *quorum of four committee members* is required to hold a thesis update meeting.

Students must receive approval from the thesis committee prior to writing their thesis. After receiving approval, the student is required to schedule the thesis defense within a reasonable timeframe (<6 months). The student will also file the 'Intent to Graduate' form at this time.

**Doctoral Thesis**

The thesis is expected to be of high quality, acceptable for publication in reputable, refereed journals. Typically, students have one or more first-authored papers published prior to the thesis defense. The preparation and defense of the thesis will follow guidelines set by the University Graduate School of Arts and Sciences (available in the Graduate Studies Office or at http://graduateschool.wustl.edu/files/graduate/Doctoral_Dissertation_Guide.pdf). Details for how to prepare to graduate are available at:

http://www.dbbs.wustl.edu/curstudents/StudentForms/Pages/GettingReadytoGraduate.aspx

Per the Graduate School of Arts and Sciences: The thesis examining committee must include five members with at least one member whose affiliations are with programs other than the PMB Program. Four of the five must be tenured or tenure-track Washington University faculty; one of these four may be a member of the Emeritus faculty. The fifth member must have a doctoral degree and an active research program, whether at Washington University, at another university, in government, or in industry. All committees must be approved by the Dean of the Graduate School of Arts & Sciences. Generally, the members of the thesis advisory committee also serve on the final Examining committee. Copies of the final written thesis must be in the hands of all members of the thesis committee at least 14 days prior to the scheduled defense. The format for
the defense is a public seminar followed by a closed question and answer session with the Examining committee.

**Publications**

There is no specific requirement for publication to receive the Ph.D. However, high quality, peer-reviewed publications are an important determinant for a student’s career. Similarly, the process of writing and submitting a manuscript and responding to reviewer critiques is an essential part of a student’s training. Therefore, the publication record is one of several important and appropriate measures to be used by a thesis committee in evaluating a Ph.D. candidate. It is generally expected that students will have submitted and/or published one or more first author manuscripts in peer-reviewed journals at the time of the defense.

**Expanding Your Horizons**

There are many co-curricular opportunities for learning new things and obtaining additional experience outside of the laboratory or classroom during your PhD at WUSTL. If you are interested in gaining more teaching experience, getting involved in scientific outreach programs, or learning about entrepreneurship, science policy or legal issues related to intellectual property, please visit the following websites:

- **Organizations and Student Groups:**
  [http://www.dbbs.wustl.edu/resources/Pages/Organizations-Student-Groups.aspx](http://www.dbbs.wustl.edu/resources/Pages/Organizations-Student-Groups.aspx)

- **Citations and Opportunities for Graduate Students:**
  [http://www.dbbs.wustl.edu/curstudents/Pages/Teaching-Opportunities-for-Graduate-Students.aspx](http://www.dbbs.wustl.edu/curstudents/Pages/Teaching-Opportunities-for-Graduate-Students.aspx).

*Note- these activities are intended to enrich your experience at WUSTL, and should not compromise your course work or research progress.*

**Conflict of Interest**

Research funding from sources that have intellectual property interests in the research, or in which the PI has personal financial interest, may create a real or perceived conflict of interest, given the dual roles of the principal investigator in obtaining funding for the lab and as a mentor for graduate students. Issues of paramount importance are (i) the ability to publish results in a timely fashion; (ii) the ability to communicate research results openly, especially to members of the thesis committee; and (iii) academic rights to publish and speak freely, especially as related to a graduate student’s thesis and defense.

**Statement of policy.**

The following principles should apply to any situation involving a graduate student supported by funding that is associated with a confidentiality agreement:

- The limitations and nature of the confidentiality agreement must be fully disclosed to and approved by the student, the thesis committee, and the DBBS Associate Dean for Graduate Affairs;
- The confidentiality agreement must not place an unreasonable burden or delay in publication or reporting at scientific meetings;
- The confidentiality agreement must not delay the writing or defense of the thesis.
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The complete policy can be viewed at:

http://www.dbbs.wustl.edu/curstudents/DBBSStudentPolicies/Pages/ConflictofInterestPolicy.asp

Academic Standing
The Program, Division, and the Graduate School have multiple requirements for graduate students to remain in good academic standing. Failure to maintain these standards may result in being placed on academic probation. Academic probation serves three purposes:

(1) Explicitly warn the student of his or her status,
(2) Provide the student with clear guidelines of the performance that will be necessary to return to good standing
(3) Offer the student reasonable time to meet these expectations.

We stress that the purpose of academic probation is not punitive. It is a mechanism to help establish firm milestones through each students training, and to ensure follow through by all parties towards those milestones.
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Appendix A

Guidelines for Faculty affiliated with the PMB Program

1. Steering Committee and Program Director
The Steering Committee is responsible for student recruitment, student advising, and establishing Program guidelines. The Steering Committee will be composed of 5-6 full-time Washington University professors (any rank) whose primary or secondary affiliations within DBBS are with the PMB Program. The committee should be made up of a representative combination of faculty members working primarily on microbial or plant systems. The Program will be led by two Co-Directors, who will also serve as the co-chairs of the Steering Committee. The Directors must also be full-time Washington University professors whose primary affiliations are with the PMB Program. The term for Program Director is normally 3-5 years, and the terms of the Co-directors should be staggered to provide continuity in the leadership of the program. Only Program members who are full-time Washington University faculty are eligible to participate in the selection of Steering Committee members and selection of the Program Directors. One adjunct faculty member from a partner institution will also be invited to serve as a representative to the Steering Committee.

The Ph.D. students select 1-2 representatives to the Steering Committee to provide feedback and suggestions from the students’ perspective.

2. Adjunct faculty affiliation with the Program
Principal investigators who obtain an adjunct appointment the Department of the Biology are eligible to request an affiliation with the PMB Program, thus making them eligible to train PMB graduate students in their laboratory. As a condition of Program affiliation, Adjunct Professors are expected to contribute to the Program’s educational mission by contributing to teaching (e.g. core courses, advanced elective courses, and journal clubs) and serving on qualifying examination and thesis advisory committees.