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Department of Biology
Graduate Handbook
(2012/2013)

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Welcome to the Department of Biology at The Pennsylvania State University! We are pleased that you have chosen our department from among the many fine programs of graduate study available nationwide. You are joining the Department of Biology at a very exciting time. The life sciences are experiencing increasing popularity among students, and biology is assuming a pre-eminence worldwide, similar to that enjoyed by physics at the turn of the century. Our department has added ten new and energetic faculty in the past three years, with research programs spanning: molecular evolutionary genetics; plant, cell, and molecular biology; neurobiology; genomics; proteomics; molecular, community, and theoretical ecology; and infectious disease dynamics. Biology has expanded and modernized its research and teaching laboratories, including a new greenhouse, complete with an approved transgenic facility. In addition, the Millennium Science Building, a state-of-the-art collaborative research facility, opened last year.

Keeping abreast of recent developments in biology is facilitated by a weekly departmental seminar series featuring speakers of national and international renown. Similar series are provided by the Department of Biochemistry and Molecular Biology, the Huck Institutes for the Life Sciences, the Ecology program and the numerous other departments and programs at Penn State. Each year special lecture series are held, including the John M. Chemerda Lectures in Science and The Russell Marker Lectures in Evolutionary Biology, which provide a distinguished scientist in residence for a week of stimulating presentations and interactions. Finally, we have many long-standing journal clubs organized around specific aspects of biology that meet weekly throughout the year.

This handbook is meant to provide you with basic information concerning our department and graduate programs. It does not attempt to review all the regulations and requirements of the Graduate School; consequently, you should access the *Graduate Degree Programs Bulletin* and *Thesis Guide* for further details. Perhaps your best source of inside information concerning the academic and social life of a graduate student is your fellow graduate students. Get to know them! A variety of functions are scheduled by the graduate student organizations at the beginning of each semester which provide a perfect opportunity to become acquainted with your peers. Each Friday, the graduate students host the Biology Coffee/Donut Hour where faculty, staff, and graduate students share ideas and conversation in an informal setting.

Once again, welcome to the Department of Biology. You have made an excellent choice—one that we are confident you won't regret. We urge you to take advantage of all the opportunities we offer—from seminars by outstanding scientists to classes by faculty who are expanding our knowledge and writing the textbooks of tomorrow! Take advantage of our collegiality and become personally acquainted with all members of our faculty. Take time to interact with your fellow graduate students at department and university activities. All of these folks, faculty and students, will be your peers and colleagues forever!

We look forward to getting to know each of you personally in the years you will spend here. If there is anything we can do to assist you in the coming years, do not hesitate to ask.

Sincerely,

Douglas Cavener
Department Head
Professor of Biology

Chuck Fisher
Asst Department Head for Graduate Affairs
Professor of Biology

INTRODUCTION

The purpose of this handbook is the orientation of incoming biology graduate students, and it is not intended to replace or supersede any official published University regulations, guidelines, or policies. In addition to the *Graduate Degree Programs Bulletin* and *Thesis Guide*, which cover the details necessary for completion of your degree, a variety of Penn State regulations and policies are presented in the *Policy Manual* and *General Forms Usage Guide*, which you can review on Penn State's General University Reference Utility (GURU) at: www.guru.psu.edu.

All graduate students in biology should obtain a Penn State photo ID card and email address as soon as they arrive. The University will provide you with an Access Account. Computer accounts for University-supported research and email are provided free of charge to graduate students. To activate your email account, please take your Penn State photo ID card to one of the Signature Stations on campus (<http://aset.its.psu.edu/accounts/sigstations.html>).

Biology laboratories and offices are located in a number of buildings throughout campus and may be accessed by key (or card swipe in some cases). Please contact the graduate program secretary in 208 Mueller about acquiring access to the appropriate building(s). Please be aware that you may be asked to pay a refundable deposit and may also be responsible for the cost of re-coring the locks if a key is lost so guard your keys.

If you have a teaching assistantship, you will be given your teaching assignment in early July and be directed to the lab coordinator for further information on your assignment. If you have not already done so, see our graduate secretary in 208 Mueller and complete the necessary payroll forms. It is University policy that your check be deposited directly into the bank account of your choice. If you don't have a bank account at the present time, you should establish one immediately so there will be no delay in receiving your paycheck each month.

Information Technology Services (ITS) maintains two walk-in help desks, one in W130 Pattee Library and one in 204 Wagner Building. A variety of "hard copy" information is available at the help desks, as well as warm-blooded sources of information and assistance. Details are also available at: <http://www.psu.edu/dept/itscss/internet/pdf/index.html>. ITS conducts a variety of mainframe and PC (both IBM and Mac) related seminars every semester and maintains over 20 laboratories on campus with an assortment of terminals for the mainframes. A list of these facilities is available from the ITS help desks and is also on their home page (<http://its servicedesk.psu.edu/>). You may also email the help desks at: helpdesk@psu.edu.

For most students, the first few semesters are the ideal time to get the majority of required course work out of the way. Your plan of study should be developed in close consultation with your advisor. Some Ph.D. students do rotations during their first year. Consult your first rotation advisor for advice on classes during your first semester. Any remaining undergraduate course deficiencies should have a high priority at this time. Also, many graduate courses are only offered in alternate semesters and so require advanced planning. When putting together your course schedule, remember that both research and teaching assistantships require significant time and effort, and allowance should be made for these obligations. You have now made the transition to graduate study and will be expected to work hard.

GRADUATE PROGRAMS IN THE DEPARTMENT OF BIOLOGY

Students entering the graduate program in biology are encouraged to work directly towards the Ph.D. degree if that is their ultimate goal. However, it is realized that careers exist for personnel with more limited graduate training in the biological sciences, and the department offers a thesis M.S. degree for students interested in those types of positions. A program without a specific research component meets the professional goals of other students, and the Department of Biology also offers the option of a non-thesis M.S. degree in biology. Students earning graduate degrees in biology may elect to focus on an option, if desired, such as Molecular Evolutionary Biology (see Appendix A), Plant Biology (see Appendix B).

A. Doctor of Philosophy in Biology

The Ph.D. program in the Department of Biology is first and foremost a research-oriented program. The single most important facet of the Ph.D. program is the successful completion and defense of an original research project – your thesis. Additionally, the Department of Biology and the Graduate School require that students meet certain residency requirements, maintain satisfactory scholastic performance, demonstrate mastery of the English language, and successfully pass candidacy, comprehensive, and final oral examinations. The following information is provided to assist you during your tenure in the department, but you should consult the *Graduate Degree Programs Bulletin* (the “White Book”) for details. You can access the “White Book” at: <http://bulletins.psu.edu/bulletins/whitebook/>.

1. Selection of Advisor

The faculty advisor/graduate student relationship plays a central role in the education and growth of the graduate student. All students in the graduate program in biology should have an advisor by the end of their first academic year. The faculty advisor will participate in the design and planning of the thesis project and advise you as necessary during all phases of your graduate program. Under some circumstances, a change in advisor may be warranted. In this case, it is your responsibility to find another suitable faculty advisor.

2. Selection of Courses

The Graduate School does not require a specified number of graduate courses or credits as a prerequisite to the Ph.D. However, this is an opportunity for you to complement your education with respect to areas of weakness and to benefit from the considerable and varied expertise represented by the Penn State faculty. Biology faculty offer a wide variety of graduate classes, many of which may be especially useful in your chosen field of specialization. Your initial program of study should be designed in close consultation with your faculty advisor. As a result of your performance on the candidacy and comprehensive examinations, the examining committee may also suggest specific course work. Since both your faculty advisor and your doctoral committee must sign your thesis, all of their recommendations should be taken seriously.

All doctoral students must maintain a satisfactory scholastic record. A failing grade in any class or a grade point average below 3.0 for any semester may be considered evidence of failure to maintain a satisfactory scholastic record and could be grounds for termination by the graduate program. You must have a grade point average above 3.0 when you take each of your

examinations and to graduate. The Graduate Council has established an upper limit of 12 credits of quality (letter) grades for credit in the 600 series. Additional research credits must be assigned an R grade.

Four biology courses are curricular requirements for all incoming biology doctoral students: BIOL 590, BIOL 592, BIOL 598A/B and BIOL 602, as is the successful completion of ethics training, defined below.

BIOL 590: All biology graduate students must complete a minimum of four semesters of BIOL 590 (Colloquium, Section 001) for one credit per semester. This course provides a vehicle for introduction/integration into the departmental seminar series. You are encouraged to enroll in BIOL 590 each semester you are in residence. This course requires attendance at all biology seminars and at least six of the after-seminar gatherings. The sign-up sheets for the after-seminar talks are available on ANGEL (<https://cms.psu.edu>).

BIOL 592 (Critical Evaluation of Biological Literature) is a one-credit seminar course specifically designed to provide you with professional training in the ethical conduct of research, experience in critical evaluation of science methods and publications, and to assist in preparation for the candidacy examination. All incoming students are required to register for this class during their first fall semester in residence.

BIOL 598A/B (Experiential Teaching in Biology) is a pedagogical training course to prepare teaching assistants for the classroom.

BIOL 602 (Supervised Experience in College Teaching) is a one-credit, required course for teaching assistants. The Biology program considers teaching an important aspect of graduate education and, therefore, includes a teaching requirement in the curriculum. Teaching assistantships provide an opportunity for students to receive pedagogical training, as well as to develop their verbal communication skills, and are considered invaluable tools in preparing students to present science in clear terms. Two credits of BIOL 602, corresponding to two semesters as a teaching assistant, are required for all Ph.D. candidates in biology.

The Graduate School requires all post-baccalaureate, degree-seeking students to complete an ethics course as part of the SARI (Scholastic and Research Integrity) program. This training consists of two components. The instructional component for biology students is part of BIOL 592 (Critical Evaluation of Biological Literature), while the web-based component is administered by the Collaborative Institutional Training Initiative (CITI) and is completed online.

Students register for the CITI course at: <https://www.citiprogram.org>. Select "Pennsylvania State University" as the participating institution, and complete the rest of the enrollment information. Choose the RCR (Responsible Conduct of Research) course and the Biomedical option. The course takes about 10 hours to complete and can be taken in advance of or simultaneously with BIOL 592. Students should provide the graduate secretary with their completion report when they have finished the online CITI course. For students entering the graduate program in fall, the CITI course is required to be completed by September 15.

3. Candidacy Examination

The Graduate School requires that all Ph.D. students take a candidacy examination after

completion of at least 18 graduate credits beyond the baccalaureate and within three semesters (summer sessions do not count) of admittance to the doctoral program. You must be a registered student (full- or part-time) in the semester you take the examination. In the Department of Biology, the candidacy examination currently consists of both a written and an oral component. The candidacy committee, which consists of at least four faculty from the Department of Biology, administers the examination once each semester. This examination is designed to test your ability to read and understand primary biological literature; to critique the research based on your knowledge of the scientific method, as well as specific techniques and statistical treatments; to evaluate the interpretation and presentation of the research; and to express yourself clearly and concisely in grammatically correct, written English. For this examination, each student is asked to read and provide a written critique of one short article from appropriate recent literature, based on guidelines available to the student well in advance of the examination. The committee provides a number of articles from which to choose, covering a range of topics that reflect the general fields of study of the students taking the examination. The articles are made available to the students at 8:00 a.m. on a Saturday, and the typed critiques are due at 6:00 p.m. the next evening. Each examination is graded by all members of the committee with three possible outcomes: (1) unconditional pass, (2) conditional pass, with a requirement of satisfactory completion of specific course work, or (3) fail.

Two options are available for a student who fails the initial candidacy examination: the student may retake the written examination the following semester, or elect to take an oral examination. In the event of failing the written examination twice, the student may, at the committee's discretion, be given the opportunity to take an oral examination. The oral examination will cover fundamental knowledge in the biological sciences (such as covered in our freshman and sophomore curriculum), ability to formulate hypotheses, and understanding of experimental design and interpretation. This examination will be scheduled at the mutual convenience of the student and the committee within three months of the written examination. Failure on the oral candidacy examination will result in notification to the student of failure to be accepted as a Ph.D. candidate by the department and termination of any departmental support at the end of the current academic semester.

Successful completion of the candidacy examination marks the formal and official acceptance by the department and the Graduate School of your candidacy for a doctoral degree.

4. Selection of Doctoral Committee

The general guidance of a doctoral candidate is the responsibility of a doctoral committee consisting of at least four members of the Penn State graduate faculty, two of whom must represent your major field of study and one who must be from outside that field. Your research (thesis) advisor will be one of the major field members of your committee, but another tenured faculty member in the Department of Biology must be designated as the chair. Your goal in selecting your doctoral committee should be to assemble a group of faculty with diverse, complementary, and relevant expertise who can assist you in planning and conducting your doctoral research. The committee should be selected immediately after successful completion of the candidacy examination in close consultation with your faculty advisor. In addition to guidance throughout your doctoral research program, this committee will administer both your comprehensive and final oral examinations.

At least one regular member of the doctoral committee must represent a field outside the candidate's major field of study in order to provide a broader range of disciplinary perspectives

and expertise. This committee member is referred to as the “Outside Field Member.” In cases where the candidate is also pursuing a dual-title field of study, the dual-title representative to the committee may serve as the Outside Field Member.

Additionally, at least one regular member of the doctoral committee must have a primary appointment in an administrative unit outside the primary appointment administrative home of the student’s dissertation advisor (e.g., for tenure-line faculty, the tenure home) in order to avoid the potential for conflicts of interest. This committee member is referred to as the “Outside Unit Member.” A qualified individual may serve as both the Outside Field Member and the Outside Unit Member.

If the candidate is also pursuing a dual-title field of study, a co-chair representing the dual-title field must be appointed. If the candidate has a minor, that field must be represented on the committee by a “Minor Field Member.”

Additional persons of particular expertise from outside the University may serve on your committee either as full *special members* (participating in all obligations of the committee) or as *special signatories* who are required only to read and approve the thesis. Persons from outside the University must be officially recommended by the assistant department head for graduate affairs and approved by the director of Graduate Enrollment Services. *Paperwork to appoint the committee is available from the graduate secretary in 208 Mueller. Graduate School notification of changes to the committee must occur at least three weeks in advance of scheduling the comprehensive or final oral examination.*

You are required to meet with your committee at least once a year, beginning in the second year of study. The purpose of these meetings is to keep your committee informed of your plans and progress, as well as to obtain the maximum benefit from their expertise and input. Failure to meet this requirement will make a student ineligible for any departmental support, fellowships/scholarships, or travel grants.

5. Language Requirements

All doctoral candidates are required by the Graduate School to demonstrate a high level of competence in the use of the English language – including reading, writing, and speaking – prior to taking the comprehensive examination. Additionally, reasonable competency in reading, writing, and speaking English is required of all teaching assistants. International students from a non-English speaking country must demonstrate this ability to the satisfaction of the Graduate School and the Biology program before being permitted to teach. This includes satisfactory performance on the Test of English as a Foreign Language (TOEFL) prior to admittance, as well as passing the American English Oral Communicative Proficiency Test (AEOCPT) upon arrival at the University. The Biology program must also assess and work to improve the English competence of both domestic and international students, and the candidacy examination serves as a major component in that process. If a deficiency is noted, the student will be required to take and pass English 418 (Advanced Technical Writing and Editing), with a grade of B or better. There is no foreign language requirement for a Ph.D. in biology.

6. Comprehensive Examination

The comprehensive examination is designed primarily to evaluate your research proposal and your ability to conduct the research. Therefore you will be expected to be familiar with methods

and literature pertinent to the subject matter of your research topic, as well as to demonstrate an ability to integrate material from related fields. Your doctoral committee will administer this oral examination, and all members of the committee are required to be present. It is recommended that you discuss the examination format and content with all members of your committee before the examination.

This examination should be taken after you have completed all course work and your thesis research is well under way. You must have already demonstrated a high level of competence in the English language and passed your candidacy examination by this time. You must have a grade point average of 3.0 or better with no deferred or missing grades to take the comprehensive examination and must also be in registered status (full or part-time) in the semester that you take the examination. The paperwork will be completed and forwarded to the Graduate School by the department's graduate secretary and must be submitted at least two weeks prior to the scheduled date of the examination.

Because this examination focuses on the evaluation of your research program, you must prepare a written prospectus of your thesis research and provide copies to all members of your committee at least two weeks prior to your examination. At the minimum, this prospectus should describe your thesis research, its significance, the research design and techniques to be used, the results of preliminary studies, and a time schedule for its completion. The prospectus should also include an up-to-date student activity summary.

The dissertation advisor, as well as the chair of the doctoral committee, along with additional members of the committee to total a minimum of three (3), must be physically present at the comprehensive examination. The graduate student must also be physically present at the exam. (Thus for a five-person committee, two could participate via distance.) No more than one member may participate via telephone; a second member could participate by teleconference. A request for remote participation of committee members must be submitted by the program secretary to the director of Graduate Enrollment Services for approval at least four weeks prior to the date of the exam.

A favorable vote of at least two-thirds of the committee is required to pass the examination. A report on the examination will be submitted to the assistant department head for graduate affairs by the chair of the doctoral committee. Should a student fail the comprehensive examination, a second examination may be given, at the discretion of the doctoral committee, no later than the following semester. A second failure will result in the student being terminated from the Ph.D. program.

By proffering a favorable report on the comprehensive examination, the doctoral committee acknowledges its approval of your thesis plans and confidence in your potential to complete the requirements for the Ph.D. At this point, your academic efforts should be centered on the completion of your thesis research and preparation of the results for publication. After completing the comprehensive examination, you should meet with your doctoral committee at least once each academic year to review your progress and facilitate completion of your degree. Prior to these meetings you should present each member of your committee with a written progress report and a student activity summary.

A graduate student must be registered continuously for each semester (excluding summers) from the time the comprehensive examination is passed until the thesis is accepted by the doctoral committee.

7. Thesis Requirements

The central requirement for a Ph.D. in biology is the completion and acceptance of a written thesis. The Ph.D. thesis should represent a substantial and original contribution to the body of knowledge in your chosen field. The research should be rigorous and of such extent and significance to garner the respect of scholars in the field. The quality of the thesis must meet the publication standards of high-quality, refereed journals; in fact, it is strongly recommended that portions of the thesis be submitted for publication in refereed journals as soon as they are completed.

The thesis must be prepared according to an established format found in the *Thesis Guide*, which can be downloaded from the web at: <http://forms.gradsch.psu.edu/thesis/thesisguide2012.pdf>. A variety of other bulletins, directories, time tables, and workshops pertinent to thesis preparation are also available through the Thesis Office located in 115 Kern Graduate Building (865-5448). You are responsible for knowledge of all details and deadlines and are urged to make use of these resources well in advance of your final semester. A summary of applicable deadlines is available from the graduate secretary in 208 Mueller.

The thesis should be in final draft form before the final oral examination (thesis defense) is scheduled. This final draft should include all major revisions, tables, figures, and bibliography, and be in the proper format for acceptance by the Graduate School. A copy of this final draft must be supplied to all members of the doctoral committee well in advance of the final oral examination.

Acceptance of your thesis by the Graduate School and its inclusion in the University Libraries is the final step for obtaining your Ph.D. The final version must meet the style guidelines detailed in the *Thesis Guide* (mentioned above) and be signed by all members of your doctoral committee and the department head. The Graduate School now required electronic submission of the doctoral thesis/dissertation, and details for this option may be found at: <http://www.etsd.psu.edu>. Be sure to allow sufficient time to make all changes required by the signatories and the Graduate School prior to the final thesis submission deadline.

8. The Final Oral Examination

Your entire doctoral committee administers the final oral examination (also known as the thesis defense). As indicated above, it should not be scheduled until your thesis is in final draft form, approved by your thesis advisor, and ready for distribution to the committee. You must notify Graduate Enrollment Services (through the department's graduate secretary) at least three weeks prior to scheduling your examination, which must be at least three months after passing the comprehensive examination and at least ten weeks before commencement. You must be in registered status during the semester you schedule this examination.

The oral examination consists of a presentation of the thesis by the candidate, followed by a period of questions and responses. The first portion of the examination, in which the thesis is presented, is open to the public. Questions from the committee will relate in large part to the thesis. However, since this examination is intended to assess the general scholarly attainment of the candidate, questions relating to any aspect of the candidate's program of study are appropriate.

The dissertation advisor, as well as the chair of the doctoral committee, along with additional

members of the committee to total a minimum of three (3), must be physically present at the final oral examination. The graduate student must also be physically present at the exam. (Thus for a five-person committee, two could participate via distance.) No more than one member may participate via telephone; a second member could participate by teleconference. A request for remote participation of committee members must be submitted by the graduate secretary to the Graduate School at least four weeks prior to the date of the exam.

A favorable vote of at least two-thirds of the doctoral committee is required for passing. The committee can make several specific recommendations at this time:

1. Both thesis and examination be approved.
2. The candidate be approved and the thesis be approved after minor changes or additions.
3. The candidate be approved but the thesis be substantially revised and resubmitted.
4. Both thesis and candidate be re-examined at a later date.
5. The candidate be disapproved unconditionally for the degree.

The doctoral committee will provide a written report to the assistant department head for graduate affairs and the Graduate School detailing its recommendations.

9. Details

A variety of other details and deadlines, not specifically covered in this summary, are fully explained in the *Graduate Degree Programs Bulletin* (the “White Book”) and in publications available from the Thesis Office and on the web. Most of these will not affect the majority of graduate students. However, if you are delayed significantly, spend a significant portion of your time off campus, or are not registered continuously as a student, you should consult the *Graduate Degree Programs Bulletin* carefully to make sure you meet the specific time limits and residency requirements. The most generally applicable details are the following:

- 1) You must be registered continuously each fall and spring semester between the passing of your comprehensive examination and your final oral examination.
- 2) You must file your Intent to Graduate through eLion (<http://elion.psu.edu>) before the Graduate School deadline, which is early in the semester of graduation.
- 3) Over some 12-month period between passing your candidacy examination and completion of the Ph.D., you must spend two semesters as a registered full-time student at the University Park Campus, Hershey Medical Center, or Penn State Harrisburg.
- 4) The final oral examination must be held within six years of completion of the comprehensive examination, or the comprehensive must be retaken.
- 5) A maximum of eight years is allowed from the time of admission to candidacy for completion of the Ph.D.

B. Master of Science in Biology (Thesis)

The general requirements for the M.S. degree include 30 graduate credits, a written thesis, and successful defense of the thesis before a faculty committee. The following guidelines and information are provided to assist you during your tenure here, but you should consult the *Graduate Degree Programs Bulletin* (the “White Book”) for additional information and details. You can access the “White Book” at: www.psu.edu/bulletins/whitebook/

1. Selection of Advisor

The faculty advisor/graduate student relationship plays a central role in the education and growth of the graduate student. Students entering the M.S. program in biology must select an advisor by the time they arrive. The primary role of the faculty advisor is to participate in the design and planning of the thesis research and to advise students during all phases of their graduate program. Although it leads to a loss in time and effort, a change in advisor may be warranted under some circumstances. In this case, it is the responsibility of the student to find another suitable faculty advisor.

2. Requirements for Course Work

A minimum of 30 graduate credits is required for a M.S. degree, 20 of which must be completed at the University Park campus. This must include at least 18 credits from courses in the 500 and 600 series with a minimum of 12 credits of course work (not including research credits) in the 400 and 500 series, 6 of which should be at the 500 level. All incoming biology graduate students are required to enroll in BIOL 590, Section 1, for four semesters. This is a one-credit course, and provides a vehicle for introduction/integration into the departmental seminar series. This course requires attendance at the seminars and six after-seminar meetings each semester. The post-seminar meetings are generally held in 317 Mueller Lab. Sign-up sheets are available on ANGEL (<https://cms.psu.edu>).

The Graduate School requires all post-baccalaureate, degree-seeking students to complete an ethics course as part of the SARI (Scholastic and Research Integrity) program. This training consists of two components. The instructional component for biology students is part of BIOL 592 (Critical Evaluation of Biological Literature), while the web-based component is administered by the Collaborative Institutional Training Initiative (CITI) and is completed online.

Students register for the CITI course at: www.citiprogram.org. Select "Pennsylvania State University" as the participating institution, and complete the rest of the enrollment information. Choose the RCR (Responsible Conduct of Research) course and the Biomedical option. The course takes about 10 hours to complete and can be taken in advance of or simultaneously with BIOL 592. Students should provide the Graduate Program Secretary with the completion report when they have finished the online CITI course. For students entering the graduate program in fall, the CITI course is required to be completed by September 15.

All graduate students must maintain satisfactory scholastic performance. A failing grade in any class or a grade point average below 3.0 for any semester may be considered evidence of failure to maintain a satisfactory scholastic performance and grounds for termination from the graduate program. The Graduate Council has established an upper limit of six credits of quality (letter) grades for M.S. thesis research. Additional research credits must be assigned an R grade.

3. Selection of Committee

You, in conjunction with your thesis advisor, must select a faculty committee, which will be responsible for administering your thesis defense and approving your thesis. This committee should consist of at least two members of the graduate faculty in addition to your thesis advisor. Although the first requirement for interaction with your graduate committee is at your thesis defense, you are strongly urged to select the committee as soon as you develop your plan of study. If the committee is carefully chosen, the members will contribute intellectually during your thesis research. Thus, including the committee members at an early stage of your research will enrich your thesis and may avoid unpleasant surprises during the latter stages of completion of your thesis.

4. The Thesis

A M.S. thesis in biology includes the presentation of original research. The thesis research will be conducted under the guidance of a thesis advisor who holds a faculty appointment in the Department of Biology and is a member of the Graduate Faculty. Since the M.S. generally takes less than half the time to complete as a Ph.D., the master's thesis is not expected to be as extensive as the doctoral thesis. However, the M.S. thesis must be an original contribution and should be of sufficient quality for publication in a refereed journal. Your thesis advisor must approve the thesis, and all necessary changes must be made before submission to your graduate committee.

The thesis must be prepared according to an established format which is described in detail in the *Thesis Guide* found at: <http://forms.gradsch.psu.edu/thesis/thesisguide2012.pdf>. A variety of other bulletins, directories, timetables and workshops pertinent to thesis preparation are also available through the Thesis Office (115 Kern Building, 865-5448). You are responsible for knowledge of all details and deadlines, and are urged to make use of these resources well in advance of your final semester. A summary of applicable deadlines is available from the graduate secretary in 208 Mueller.

5. The Thesis Defense

Your thesis defense should be scheduled with your committee after they have been supplied with a final draft of your thesis (previously approved by your thesis advisor). An e-mail needs to be sent to the graduate secretary to confirm the date of your defense. The Graduate School does not need to be notified of a M.S. thesis defense.

During your thesis defense you will be expected to answer questions that pertain directly to your research, as well as related topics at the discretion of the committee. You should be prepared to defend your choice of topic, methods, and interpretation. The committee may suggest corrections, additions, additional experiments, re-examination at a later date, or in extreme cases may recommend that the candidate be dropped from the program at this time. The final thesis, signed by all members of the committee, must be submitted to the head of the Department of Biology for signature prior to submission to the Thesis Office for final approval. The Thesis Office may require additional editorial or formatting corrections if their guidelines have not been followed. When planning to graduate in a particular semester or session, make sure to allow sufficient time to complete all of the revisions before the announced deadline for that semester or session. It is imperative that you activate your Intent to Graduate through eLion

(<http://elion.psu.edu>) before the deadline in the semester you plan to graduate. Strict adherence to Graduate School deadlines is required, and little flexibility is allowed. Failure to comply may result in your inability to graduate.

C. Master of Science in Biology (Non-Thesis)

The professional goals of some students may best be met with a non-thesis M.S. degree. A non-thesis M.S. student must have a biology faculty member serve as his/her advisor and choose a faculty committee consisting of at least two members of the graduate faculty in addition to your advisor. A non-thesis M.S. must include a minimum of 30 graduate credits at the 400 and 500 level, with at least 18 credits at the 500 level. At least 24 credits should be course credits, with at least 15 credits from Department of Biology courses. Also, BIOL 590 should be scheduled for each semester in residence (see section B2 above). A "professional paper" of acceptable scientific quality is required, and up to six credits of BIOL 596 (Independent Studies) can be earned for this work. The paper might review a topic in biology based on current research, put forth a mechanistic concept, or report on original research at a level somewhat lower than that required for a M.S. thesis. The paper is not submitted to the Graduate School, but a copy is retained by the Department of Biology. The academic program, the performance of the student, and acceptability of the paper must be approved by the student's advisor, his/her committee, and the assistant department head for graduate affairs.

FINANCIAL ASSISTANCE

A. General Information

Financial support for graduate students can come from many sources. Teaching and research assistantships are among the most common means of support for graduate students in the Biology program and are described below. However, a wide variety of scholarships, fellowships, and grants-in-aid are available to graduate students through the University, governmental funding agencies, and even private sources. These resources are too numerous to list and only a few are outlined in this section. With the variety and diversity of support available, the best fellowships often go to those students who most vigorously seek support. Your faculty advisor can be an excellent guide to sources of financial support in your discipline; additional information can also be obtained from the following sources:

- 1) **University Fellowship Office**, 212 Boucke Building (863-8199), is a primary resource for information on outside sources of funding. A variety of publications is available through this office, along with computer searches for opportunities in your discipline.
- 2) **Office of Graduate Fellowships and Awards Administration**, 314 Kern Building (865-2514). This office administers the Graduate School Fellowships (based on scholarship) as well as Grants-in-Aid (based on financial need).
- 3) *The Graduate Degree Programs Bulletin*.
- 4) *The Annual Register of Grant Support* which is located in Pattee Library in the Reference Library section (call number Q180.A1A6).
- 5) A variety of additional programs are available for students with disabilities, students from under-represented groups, and veterans. Information on these programs is available from: the **Office for Disability Services**, 116 Boucke Building (863-1807, V/TTY); the **Office of Graduate Educational Equity Programs**, 111J Kern Building (863-1663); and the **Office of Veterans Programs**, 325 Boucke Building (863-0465), respectively.
- 6) **The Office of Student Aid**, 314 Shields Building (865-6301). Special loans for graduate students and a graduate student work-study program are administered through this office. However, our goal in the Biology program is to provide support at a level that eliminates the need to resort to this program.

B. Graduate Assistantships

Graduate assistantships are of two types: those funded through research grants directed by individual faculty and those funded by the Eberly College of Science and administered by the Department of Biology for teaching. The Department of Biology has no control in awarding research assistantships; the faculty member administering a grant makes the decisions pertaining to that grant.

The department will award financial support in the form of teaching assistantships, up to one per year, to Ph.D. students for a maximum of five years (this time period is not extended if other sources of support are used during the first five years). Students taking longer to finish will have

the lowest priority when teaching assistantships are awarded. To renew your eligibility for teaching assistantships each year, you must demonstrate satisfactory progress toward your degree, as evidenced in your annual student activity summary, as well as demonstrate competence as a teaching assistant.

Graduate assistantships serve two interrelated functions. The first is to give students training and experience in diverse academic pursuits. As such, these assistantships represent an apprenticeship in your discipline. Second, graduate assistantships assist you and your mentor in meeting your educational and professional objectives. Graduate assistantships are not honorary fellowships, and you are expected to meet your work obligations with a sense of responsibility and to view them as an integral part of your graduate education.

Teaching assistantships provide an opportunity for students to develop their verbal communication skills and receive pedagogical training. The Department of Biology requires that all Ph.D. students complete two semesters as teaching assistants as part of their degree. The Department of Biology administers approximately 50 teaching assistantships each semester. A teaching assistant (TA) receives a monthly stipend, and tuition is waived for the semester of the assistantship. A full semester teaching assistantship in the Department of Biology is paid over five months. The monthly stipend for a Biology TA currently ranges from \$1908 to \$2115 (2012/13 academic year), depending primarily on your progress towards your degree. Research assistantships are also paid at comparable rates.

1. Provisions of the Assistantship Agreement

Graduate assistantships are available only to full-time degree students. They are normally considered “half-time,” although quarter-time assistantships may be available. Half-time assistantships pay a stipend plus full tuition. An average of 20 hours work per week for the semester is required. Fall assistantships extend from August 16 through December 31, while spring assistantships begin on January 1 and end on May 15.

A student holding a half-time assistantship must schedule 9-12 credits of academic work each semester.

2. Training Requirements for Teaching Assistants

Legislation passed by the University Faculty Senate in 1981 and 1989 recommended that all newly appointed teaching assistants participate in a TA training program unless they can provide evidence of successful prior teaching experience. Also, all new international TAs must take and pass the American English Oral Communicative Proficiency Test. In addition, the Department of Biology provides training for all new teaching assistants. Further details of the procedures for meeting the training requirements for TAs may be obtained from the graduate secretary and by contacting the Schreyer Institute for Teaching Excellence, (www.schreyerinstitute.psu.edu, 863-2599).

3. Summer Tuition Assistance Program

Students, who have been supported by assistantships/fellowships in both the fall and spring, may apply for the Summer Tuition Assistance Program so they can continue to take classes during the summer. Summer tuition assistance is also provided to graduate students appointed as graduate lecturers during the summer. These awards may be used for a maximum of 6 credits during the

summer session. Applications are completed online: <https://secure.gradsch.psu.edu/cosign/stap>.

C. Select Fellowships and Grants

One of the best fellowships available is the *National Science Foundation Pre-Doctoral Fellowship*. Both first and second-year graduate students are eligible for this fellowship, which is generally awarded to students with outstanding test scores and grades. If you think you may qualify, consult your advisor and apply immediately. This fellowship pays tuition and a 12-month salary for three years, as well as a travel allowance for work at another institution. Similar fellowships are available from the *National Institutes of Health*, the *Howard Hughes Medical Institute*, and the *Office of Naval Research*.

The Department of Biology administers a limited number of special awards to graduate students. The *J. Ben and Helen D. Hill Awards* offer up to \$2,000 per award to support graduate student research in Plant Biology or Genetics. The *H. W. Popp Fellowship* is given to senior graduate students with botanically oriented research projects. The exact amount of this award varies from year to year, but is approximately \$7,000 and can be used in conjunction with other support to provide students with additional open time to complete their thesis. All outstanding graduate students majoring in Biology are eligible for the *Jeanette Ritter Mohnkern Scholarship in Biology*, although first preference is given to female graduate students. This is also a variable award with the scholarship currently about \$6,500 per year.

Some graduate students receive a University Graduate Fellowship or Braddock Award for their first year. The Graduate School and the Eberly College of Science give these awards to scholastically outstanding incoming students. The Braddock Awards may range from \$1,000 to \$8,000 and are supplemental to your assistantship. Nominations for these awards are made by the department.

The department also regularly provides partial travel support for graduate students to present the results of their research at professional meetings. These monies are awarded competitively, and the amount awarded per year is limited to \$250 per student. Applications for travel awards must be made to the graduate secretary well in advance of the meeting.

D. Payroll

Incoming students must complete the following forms and return them to the graduate secretary no later than mid-July in order to receive payment on the first payroll date at the end of August:

1. Terms of Offer (assistantship contract)
2. I-9 (Employment Eligibility Verification form)
3. W-4 (Employee's Withholding Allowance Certificate)
4. Salary Deposit Request form
5. Affirmative Action Data form
6. Intellectual Property Agreement
7. Workman's Compensation Employment Notification form
8. Drug-Free Workplace form
9. Alien Information Request Form (only for international students)

For returning students, the only form that must be completed every appointment period is the Terms of Offer (assistantship contract) unless the I-9 form is expiring and needs to be renewed.

A new W-4 form should be completed when a student moves, changes his/her name or marital status, or wishes to change the number of dependents claimed.

E. Health Insurance

For graduate assistants and fellows, the University provides the Penn State student health insurance plan, which includes medical, dental, and vision insurance. The University pays 80% of premiums, while the remaining 20% is deducted from student paychecks on a monthly basis from September through May. The premium deductions in Spring (January through May) are slightly higher than in Fall (September through December) because they include the premium expense for the summer months as well.

Graduate assistants and graduate fellows are automatically enrolled in the Penn State student insurance plan (unless a declination form is submitted by the deadline in early September). You may decline any or all coverage, but must provide proof of alternative basic medical insurance. Dependent family members must be enrolled every year by the deadline in early September.

To decline health insurance or to enroll dependent family members, please visit:
<http://studentaffairs.psu.edu/health/services/insurance/graduate.shtml>

For more detailed information about the health insurance plans offered by Penn State, please contact:

**Student Health Insurance
302 Student Health Center
University Park, PA 16802
(814) 865-7467
studentinsurance@sa.psu.edu
<http://www.sa.psu.edu/uhs/basics/insurance.cfm>**

GRADUATE STUDENT ORGANIZATIONS

A. Penn State Graduate Student Association (GSA)

The Graduate Student Association serves and represents the graduate student community at Penn State and maintains an office in 312 HUB Building (865-4211). All graduate students are automatically members. As well as acting as a liaison with the administration, the GSA provides activities and entertainment for graduate students, child-care information, garden plots, a tax guide, and a bargain rate on thesis paper. They publish a monthly newsletter, which can be accessed at: <http://gsa.psu.edu>. A wide variety of information of potential interest to all graduate students can be found in *The Guide to Graduate Life* (<http://www.pennstategsa.com/guide-to-graduate-life.html>)

B. Biology Department Graduate Student Association (BDGSA)

As a graduate student in biology, you are also automatically a member of the BDGSA. As noted earlier, your best information is often gained from other graduate students; the BDGSA is a good way to establish professional and personal bonds with your colleagues.

Regular meetings are held approximately once a month. These meetings serve three main purposes: to consider matters relevant to graduate students, to discuss current research, and to organize social events.

Perhaps the most important role of the BDGSA is as a collective voice for the Biology Department's graduate students. The group has been able to influence decisions made by the department, including the assessment of teaching assistant loads and input into newly developed courses. The BDGSA provides graduate student representatives who attend departmental faculty meetings, serve on faculty search committees, and other appropriate committees.

Through the BDGSA, graduate students may invite and host a Department of Biology seminar speaker each year, and assist in the organization of certain departmental functions.

The BDGSA web site is: <http://www.personal.psu.edu/jep295/blogs/bdgsa/>

C. International Student Associations

The Office of Global Programs, located in 410 Boucke Building (865-6348), is a primary resource for information of specific interest to international students (citizenship, taxes, English tutoring, etc.) and American students wanting to study abroad. This is the office to contact for information concerning the numerous associations for students of different nationalities at the University Park campus. This office also organizes various cultural events and trips for international students to places of interest in America.

There are also more than fifty multicultural and international student organizations on campus, including the African Student Association, Chinese Friendship Association, Canadian Club, Indian Graduate Student Association, Latino Caucus, and Muslim Student Association. The Student Organization Directory is available at:

<http://studentaffairs.psu.edu/hub/studentorgs/orgdirectory/search.aspx>

SEMINARS

Seminars and colloquia are important parts of your education and provide opportunities to interact with a diverse group of scientists on topics both in your area of research and others. These seminars include series sponsored by almost every department on campus, numerous student groups, as well as weekly seminars sponsored by the Huck Institutes of the Life Sciences and intercollege graduate degree programs such as ecology, genetics, neuroscience and plant biology. The Center for Infectious Disease Dynamics (CIDD) also has a regular seminar series. “Science Seminars,” summarizing the seminars being offered by departments in the Eberly College of Science, is available at: <http://science.psu.edu/science-seminars>. In addition, the Institute for Molecular Evolutionary Genetics sponsors a weekly journal club lunch, and the ecology program hosts a weekly “brown-bag” lunch series designed especially for graduate student presentations (lunch is not provided at these functions, so you should bring your own).

The Department of Biology sponsors weekly seminars during the fall and spring semesters that feature speakers from both inside and outside the Penn State scientific community. Following most of these seminars, the speaker meets for 45 minutes with interested graduate students to discuss the seminar or other topics of interest to the students. **All graduate students should plan to attend all departmental seminars and register for Biology 590 (Section 001).** Students registered for BIOL 590 are required to meet with at least six of the speakers after their seminars over the course of the semester. Sign-up sheets are posted on ANGEL: <http://cms.psu.edu>.

There are six lecture series in the Eberly College of Science generously endowed by Russell Marker, professor emeritus of organic chemistry at Penn State, whose pioneering work led to the development of the birth control pill and the founding of Syntex. In addition to the Marker Lectures in Evolutionary Biology, the college presents annual Marker Lectures in astronomy and astrophysics, the chemical sciences, genetic engineering, the mathematical sciences, and the physical sciences.

The Eberly College of Science also hosts the annual Chemerda Lectures in Science. Named in honor of Dr. John M. Chemerda, a chemistry major and a member of the Penn State Class of 1935, the lectures are supported by a grant from Merck & Co., Inc., made in connection with an award conferred to Dr. Chemerda by Merck’s Board of Directors.

RESEARCH EXHIBITIONS

The Penn State Graduate School organizes a Graduate Research Exhibition each March, and biology graduate students are encouraged to participate. This university-wide exhibition provides an opportunity to present a poster about your research to a wide audience, with cash awards for the best posters totaling \$10,000.

Once a year, the Departments of Biology and of Biochemistry and Molecular Biology host a one-day joint research forum consisting of faculty and graduate student talks and a well-attended poster session. This one day retreat provides an added opportunity for interdepartmental exchange of information and ideas, as well as a forum for new students to see the whole span of research conducted within the two departments.

STUDENT ACTIVITY SUMMARY

Every year you will be asked to complete a Student Activity Summary (SAS) form and submit it to the graduate program secretary by June 15. We will use the information in this form to follow your progress towards your degree and to evaluate your progress as applicable for teaching assistantships, special awards, travel support for professional meetings, summer support, etc. This exercise is also intended to give you an opportunity to evaluate your own professional progress and make you aware of the many ways we as scientists interact professionally. The SAS is completed online with a hard copy reviewed and signed by your advisor.

PROBLEMS AND THE “CHAIN OF COMMAND”

Occasionally problems may arise during your graduate career associated with serious personal conflicts, your research, or your teaching responsibilities. Your advisor should be your first choice as an advocate to help you in resolving most problems. However, if for any reason, it is inappropriate or you are not comfortable discussing a specific problem with your advisor, several options are available to you within the department.

If you already have your thesis committee in place, the chair is the logical point of contact after your advisor. In some cases you may feel most comfortable talking with another faculty member who knows you well, and you can expect that any of these conversations will be treated in confidence. Additionally, the doors to the offices of the department head and the assistant department head for graduate affairs are always open to you, and either will be willing to advise you in options for the resolution of your problems.

Finally, if you are unable to get resolution within the department, you may file a grievance with the dean of the college. The dean will convene a hearing committee, consisting of three graduate students from within the student's college, three faculty members, and an administrator (from outside the department, program, or intercollege program in which the disagreement originated), who will serve as the chairperson. The dean of the college refrains from additional contact in the resolution of the problem from this point. All details are listed in the *Graduate Degree Programs Bulletin* (the “White Book”) under “Procedure for Resolution of Problems.”

CAMPUS SAFETY AND SECURITY

Police Services (located on the ground floor of Eisenhower Parking Garage) is the law-enforcement unit at Penn State-University Park.

To contact Police Services, dial:

9-1-1 for emergencies

or 814-863-1111

Emergency/Pole Phones, directly linked to Police Services, are located throughout campus. Pole phones are the newest style of emergency phones and can be easily identified by the blue lights above them. These phones have no receiver, but instead contain a built-in speaker. A map with the locations for emergency phones is available at:
<http://www.police.psu.edu/documents/campusnightmap.pdf>

Security Escort Service, sponsored by Auxiliary Police, provides walking accompaniment for Penn State students, employees, and visitors who may feel unsafe walking alone on campus at night. To request an escort, call **814-865-WALK (9255)**. This service is available from dusk to dawn, 365 days a year.

Other services/programs related to safety are listed on the Police Services and Public Safety website at: <http://www.police.psu.edu/>

For crime statistics at University Park, visit the **Clery Act** website:
<http://www.police.psu.edu/cleryact/>

BACKGROUND CHECKS AND SELF-REPORTING

Background checks are required of all new hires and current employees in sensitive/critical positions.

The standard background check includes:

- Criminal History Check
- Sex and Violent Offender Registry Check

Additional background check items as required for specific positions based on job-related need may include:

- Education Verification (required for all academic positions)
- Motor Vehicle Record (required for positions where it can be anticipated that an individual will be regularly required to drive a University-owned vehicle or other vehicle on University business, i.e. government relations positions requiring in-person visitation to state or federal government offices, van drivers, mail couriers)
- Credit History Check (conducted only for sensitive/critical positions with extensive authority to commit financial resources of the University or with extensive fiduciary responsibility for financial resources of the University including but not limited to

Administrator, Academic Administrator, and Executive positions; or as required by law; or due to a reasonable belief that an employee has engaged in a specific activity that constitutes a violation of the law)

- Employment Verifications
- License Verification
- Other verifications, as needed, based on job requirements

Records gathered as a result of a background screening check are part of an employee's personnel file. However, Human Resources will keep such records in files separately from the individual's general personnel file. For complete details regarding background checks, see HR-99: <http://guru.psu.edu/policies/OHR/hr99.html>

Penn State employees (including graduate students) are also required to submit a self-disclosure form within 72 hours of arrest or conviction for reportable offenses. For the form and the list of offenses, please visit: <https://guru.psu.edu/policies/arrestandconvictionselfdisclosureform.pdf>

APPENDIX A

Molecular Evolutionary Biology: Option in Biology Graduate Degree Program

Molecular evolutionary biology is concerned with the study of evolution at the molecular level to understand the mechanism of evolutionary change and to clarify the evolutionary history of organisms. It is a multidisciplinary science that integrates molecular biology, developmental biology and population biology.

Resolving future issues of evolutionary biology requires the proper training of students in these areas. The importance of molecular evolutionary biology is acknowledged by several major societies and numerous journals including: (1) *Evolution*, (2) *Molecular Biology & Evolution*, (3) *Genetics*, (4) *Journal of Molecular Evolution*, (5) *Journal of Evolutionary Biology*, and (6) *Molecular Phylogenetics and Evolution*, as well as several taxonomically focused journals which cover evolutionary topics regularly.

Penn State has a strong research program in the field of evolutionary genetics through both the Institute of Molecular Evolutionary Genetics (IMEG) and the Intercollege Graduate Program in Genetics, many members of which belong to the Department of Biology. The Option for the M.S. and Ph.D. in Molecular Evolutionary Biology centralizes and formalizes a student's training in Molecular Evolutionary Biology. Graduation with this option will document the student's preparation and competence to contribute to this increasingly important area of science.

Requirements for the Graduate Degree in Biology with a Molecular Evolutionary Biology Option:

1. The student shall meet the criteria for the M.S. or Ph.D. in Biology.
2. The student's research advisor shall be a member of the Department of Biology and/or a full member of the Institute of Molecular Evolutionary Genetics. Other committee members may be chosen as needed, providing that a majority of the committee is associated with the IMEG.
3. In addition to the normal Biology program requirements, the student shall take:
 - a. For both a M.S. and Ph.D. in Biology, 3 credits of course work in Biology 591 (Molecular Evolutionary Biology Colloquium).
 - b. For both a M.S. and Ph.D., a minimum of 9 credits from among the following list of approved courses (to be selected in consultation with the student's committee):

BIOL 405	Molecular Evolution (3)
BIOL 422	Advanced Genetics (3)
BIOL 427	Evolution (3)
BIOL 428	Population Genetics (3)
BIOL 505	Statistical Methods in Evolutionary Genetics (3)
BIOL 510	Molecular Basis of Plant Development (2)
BIOL 514	Systematics and Evolution (2)
BIOL 524	Seminar in Genetics (1)
BIOL/ENV/WILDL 542	Systematics (3)
BMB/Bioch 514	Molecular Biology and Cellular Regulation (3)
 - c. Any other course work or training deemed appropriate by the student's committee, such as BIOCH 401 (General Biochemistry), BMB 450 (Microbial/Molecular Genetics), BMB 514 (Molecular Biology & Cell Regulation), ANTH 401 (Human Evolution: The Material Evidence), ANTH 471, (Human Evolutionary Biology), ANTH 571 (Human Population Biology I), and ENT 541 (Insect Taxonomy).

APPENDIX B

Plant Biology: Option in Biology Graduate Degree Program

The graduate program option in Plant Biology reflects the rapidly advancing research in the plant sciences. The course of study is multidisciplinary in that it draws upon the strengths of biochemistry, molecular biology, molecular genetics, evolutionary biology, ecology, physiology and cell biology, statistics, as well as the various research programs within the Department of Biology. Our faculty address current issues in areas such as plant development, signal transduction, genetic and biochemical aspects of cell and organ structure, physiology and cell biology, plant reproductive biology, plant ecology and molecular evolution.

The option for the M.S. and Ph.D. in Plant Biology is a means toward focusing a student's graduate training in the plant sciences. Graduation with this option will underscore the student's background and competence to contribute to this critical and challenging area of research.

Requirements for the Graduate Degree in Biology with a Plant Biology Option:

1. The student shall meet the criteria for the M.S. and Ph.D. in Biology.
2. The student's research advisor shall be a member of the Department of Biology. Other committee members may be selected as needed to assure that a well-rounded graduate advisory committee is established.
3. In addition to the requirements of the normal Biology program, the student shall take:
 - a. Required colloquia in the field of specialization.
 - b. For either a M.S. or Ph.D., a minimum of 6 credits from among the following list of approved courses. These courses, as well as any additional course work, are to be selected in consultation with the student's committee.

BIOL 414	Taxonomy of Seed Plants (3)
BIOL 427	Evolution (3)
BIOL 441	Plant Physiology (3)
BIOL 448	Ecology of Plant Reproduction (3)
BIOL 510	(PLPHY) Molecular Basis of Plant Development (2)
BIOL 513	Plant Cellular Signaling (3)
BIOL 514	Topics in Systematics and Evolution (2)
BIOL 515	(PLPHY) Modern Techniques and Concepts in Plant Cell Biology (2)
BIOL 516	(PLPHY) Modern Techniques and Concepts in Plant Molecular Biology (2)
BIOL 544	Advanced Physiological Ecology (4)
BIOL 597	Special Topics (1-9)
BMB 514	Molecular Biology and Cellular Regulation (3)
HORT 444	Plant Water Relations (3)

Note that other courses may be substituted with the approval of the student's committee.

- c. Any other course work deemed appropriate by the student's committee.

This publication is available in alternative media on request.

The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. It is the policy of the University to maintain an academic and work environment free of discrimination, including harassment. The Pennsylvania State University prohibits discrimination and harassment against any person because of age, ancestry, color, disability or handicap, genetic information, national origin, race, religious creed, sex, sexual orientation, gender identity, or veteran status and retaliation due to the reporting of discrimination or harassment. Discrimination, harassment, or retaliation against faculty, staff, or students will not be tolerated at The Pennsylvania State University. Direct all inquiries regarding this Nondiscrimination Policy to the Affirmative Action Director, The Pennsylvania State University, 328 Boucke Building, University Park, PA 16802-2801: tel. 814-863-0471/TTY. U.Ed. SCI 13-17.