

Graduate Student Handbook

**Department of Biological Sciences
Academic Year 2021-2022**

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Introduction to Department and Program

Welcome to the Department of Biological Sciences! This handbook is intended to provide you with the details of our graduate programs. Most of this information can also be found on the Departmental website under “graduate programs.” If you find details missing that you would like to be included here, please let the graduate committee know – we will revise the content of the handbook as needed. In the meanwhile, if you have questions or concerns at any time during your education, feel free to send an email/make an appointment with the Graduate Director. The composition of the graduate committee and the graduate director changes periodically; current members are listed below.

For the Academic Year 2021-2022:

Department Chair: Linda Lowe-Krentz

Acting Graduate Director: Amber Rice (co-Director Gregory Lang on leave Fall 2021)

Graduate Committee: Julie Haas, Kathy Iovine, Greg Lang (on leave Fall 2021), Michael Layden (on leave AY 21-22), Amber Rice, and Vassie Ware

Department Staff:

Academic Coordinator: Erin Curtolo

Administrative Secretary: Judy Vasquez-Tatis

Business Manager: Maria Brace

Laboratory Manager: Lee Graham

Communication:

Throughout your time here, you will receive program-related information via email from the office staff, from the graduate committee, and from other faculty. Sometimes these emails will invite you to lunch with an outside speaker, or to remind you to do something important (i.e. register for classes). **Please take the time to read the email carefully and to respond!** More often than not these emails contain or request relevant information. Please make the jobs of the people helping you easier by responding to emails in a timely manner. For information about grievance resolution procedures, please see the Supplemental Information section of this handbook (page 15).

Other places you can find information relevant to attaining your degree:

- Biology Department website: <https://www.lehigh.edu/~inbios/>
- Lehigh's College of Arts and Science PhD Graduate Manager: <https://cas.lehigh.edu/node/339>
- The College of Arts and Sciences graduate student handbook: <http://cas.cas2.lehigh.edu/content/cas-graduate-student-handbook>

Departmental Support

General timeline for completion of the PhD:

Year 1 – Coursework, find a research lab (ideally by the beginning of the Summer)

Year 2 – Coursework, take qualifying exam, continue research

Year 3 – Coursework if necessary, complete proposal defense, continue research

Year 4 – Research towards PhD

Year 5 – Research towards PhD and complete thesis defense

The Department of Biological Sciences is committed to five years of support for all graduate students in good standing and with demonstrated timely completion of the requirements of their program. This includes satisfactory performance in required coursework, admission to candidacy, passing of qualifier examinations, defense of a doctoral thesis proposal and regular progress meetings. Determination of satisfactory progress is accomplished through the student meetings with the Graduate Committee and includes grades, progress in supervised research, and input from the research adviser.

Funding after five years is not guaranteed, but instead is contingent upon the availability of funds either from the student's mentor or from the Department of Biological Sciences. Students and their mentors may request support beyond the student's fifth year in writing to the Graduate Committee. At the beginning of the fifth year, students will receive a letter from the graduate committee with instructions for requesting Departmental support beyond the Spring semester of their fifth year in the program. Students requesting support should expect to provide feedback from the dissertation committee to the graduate committee and a timeline for completion of their degree.

Current university policy mandates that our offer to pay you a stipend is contingent upon you residing in the United States. We are unable to pay the stipend of students who remain in their home country or travel internationally for personal reasons. However, program-related international travel, such as for meetings or research, will not affect your stipend.

Existing mechanisms of support:

Teaching Assistantship (TA): A TA is when a graduate student helps a faculty member to teach an undergraduate course. Responsibilities may include grading, leading a lab section, leading a recitation section, proctoring exams, and meeting with students. You are expected to give about 20 hours/week towards this position. Assignments are made by a combination of student expertise, student preferences, faculty preferences, and course demand. Please remember that the faculty member

(and perhaps other TAs for that course) are counting on you to fulfill your responsibilities for the course. Therefore, it is best to avoid making arrangements for travel during the semester when you are a TA.

Research Assistantship (RA): A RA is when a faculty member supports the student stipend/tuition using external funding, as from a federal grant from the NIH or NSF. You are expected to give an average of 20 hours of service per week towards this position. Please refrain from scheduling personal travel while receiving this support until you have spoken with your faculty adviser.

Internal fellowship: The Department has two endowed accounts that are used to support existing students. More information can be found on page 13 of this handbook and on the Departmental website. Department fellowships are competitive and based on student progress in research. Students that have completed their proposal defense are given preference for these awards. A sample rating form for the review of fellowship applications can be found on page 23 of this handbook.

External fellowship: Students are strongly encouraged to prepare and submit research proposals to support themselves. Possible agencies that will support pre-doctoral research include the NIH, the NSF, and the American Heart Association. Please discuss these and other options with your faculty adviser.

During the Summer, students may be supported by a TA (if available), as an RA, from a University Fellowship (nominations are submitted via the Graduate Committee), from the BDSI program, or by Departmental funds. When provided, Summer support is intended for students that will continue into the Fall semester, unless the student defends their thesis during the Summer.

Please understand that you are being supported to give *full-time* effort towards your education, unless you are being supported as a TA. In the latter case, your *full-time* effort will go towards both your research and your teaching assignment. In any case, your support carries with it the stipulation that you are NOT employed outside of the graduate program. External employment will result in the termination of financial support (stipend and tuition).

Best practices regarding graduate student travel and personal time

The Department of Biological Sciences supports students for all 12 months of the year. We recognize that graduate students do take vacation and personal time. Unfortunately, Lehigh does not have a clear policy on doctoral student vacation time. Personal time away from campus (distinct from professional or conference travel), should be worked out in advance whenever possible between the student and their advisor and TA supervisor, if applicable. Travel without advance approval from the student's relevant supervisors (e.g., advisor, TA supervisor, and/or research supervisor) risks

consequences, which may include forfeiture of pay if duties cannot be performed. For international students traveling home to renew their visa, please allow adequate time, as visa renewal often takes longer than expected.

COVID-19-specific restrictions on graduate student travel in the Fall 2021 semester

Due to the COVID-19 pandemic, Lehigh's travel policies may change at short notice, as the Pennsylvania Department of Health (PA DOH) and the Centers for Disease Control (CDC) update their guidelines and recommendations. For students who must travel, consult with the University Health and Wellness Center about any related quarantine requirements that may be necessary upon return to campus. Graduate students are also advised to consult Lehigh's COVID Dashboard for the latest information on any travel restrictions (<https://coronavirus.lehigh.edu/transportation-travel>). Advance communication between the student and the PI and/or Teaching Assistant instructor is strongly recommended before any travel is planned, especially for the two major holidays in November and December.

Graduate student offices:

The Department provides all graduate students with a desk in an office that is separate from your research lab unless computational-only lab space is available. This space is meant to give students a quiet place to read, think, write, etc. There is an attempt to mix students with different levels of experience (to facilitate mentoring between new and mature students) and between concentrations (to facilitate interactions across disciplines). As a result, you may be asked to change desks/offices during your time here. Due to the large number of students in the Department, it may not be possible to put students in offices within a particular location or to group students by lab.

You are not permitted to have live pets, fish tanks greater than 2 gallons, refrigerators, microwaves, or an excess of personal items. A fridge and microwave are located in the Biology Common room across from the main office.

University Requirements

Course credits:

All graduate students are required to take 24 course credits, where at least 12 credits are at the 400 level.

Total credits:

Students that enter with a B.S. degree are required to take at least 72 credits (24 course credits and 48 research credits).

Students that enter with an M.S. degree are required to take at least 48 credits (24 course credits and 24 research credits).

Once you complete the appropriate number of credits (i.e. as noted above) and complete your proposal defense (see page 10), you will continue to take 1 credit per semester as “maintenance of candidacy.” You must be registered for at least 1 credit in each semester until you defend your thesis. If you defend over the Summer, you must have been registered for 1 credit in the preceding Spring semester.

University Time limits:

Students that enter with a B.S. have 10 years to complete the PhD degree.

Students that enter with an M.S. have 7 years to complete the PhD degree.

In both cases, it is possible to petition for additional time. See the Academic Coordinator for help in completing the petition forms.

The University time limit should not be confused with the amount of time that you will receive Departmental support (see page 4). In the event that Departmental support is terminated, you may still utilize additional time to complete your degree (however, you will no longer receive a stipend and may have to pay for your tuition).

Terminal Master’s degree:

You have entered a PhD program. We do not offer an on-campus M.S. degree.

However, should you decide to leave the program before completing the PhD, you may receive a terminal master’s degree if you meet the requirements (30 credits total, 24 course credits and 6 research credits).

Grading Policy and Coursework

Grading Policy

A regular status graduate student pursuing a doctoral degree who receives a grade lower than a B- in more than one program-related course numbered 300 or above will be dropped from the program.

Coursework

All graduate students are required to take 24 course credits towards the PhD. Each concentration has specific requirements as well as acceptable elective courses. *Of the 24 total credits, at least 12 must be at the 400 level.*

As part of the 24 credits all students will enroll and attend:

- BIOS 408 (0 credits) Responsible Conduct of Science within their first year of graduate study.
- BIOS 406 (1 credit) Biological Sciences Seminar at least twice in the first four semesters.
- All Departmental Seminars including seminars from job candidates.

In order to meet the University requirement for 24 course credits, students may take 1-3 credits of a Special Topics course (e.g., BIOS 405, 410, or 483) with their research advisor.

Specific course requirements and electives follow for each of the four concentrations in *Biochemistry*, *Cell and Molecular Biology*, *Neuroscience*, and *Evolution and Behavior*. Any deviations from the requirements for each concentration (e.g., when a student can demonstrate mastery of material due to an overlap with undergraduate-level or master's-level coursework) must be approved by the Graduate Committee.

Biochemistry Concentration:

Required Core Courses (17 credits in core)

- BIOS 473 and 372 – Principles of Biochemistry I and Elements of Biochemistry II
- One literature-critique based course (BIOS 471 - Eukaryotic Signal Transduction, BIOS 421 – Molecular Cell Bio I/cell bio, BIOS 422 – Molecular Cell Bio II/mol gen)
- CHM 423 - Bio-organic Chemistry OR a 400-level bioinformatics course (through CSE or BIOS)
- BIOS 345 - Molecular Genetics OR BIOS 411 Advanced cell biology
- Seminar Course in Biological Sciences (BIOS 406 – 2 credits) Elective Courses
- Additional courses to reach 24 course credits (12 at the 400-level) may be chosen from the upper-level courses in Biochemistry, Molecular Biology, and Bio-Organic Chemistry.

Elective examples: any of the alternative courses listed above, CHM 472 (Lipids and membranes, offered periodically), CHM 468 (protein structure/function combined lab/lecture course).

Cell and Molecular Biology Concentration:

Recommended Core Courses

- BIOS 345 - Molecular Genetics (or equivalent)
- BIOS 473 – Principles of Biochemistry I
- BIOS 372 - Elements of Biochemistry II (or equivalent)

- BIOS 411 - Advanced Cell Biology
- BIOS 421 - Molecular Cell Biology I (prerequisite = BIOS 411 or equivalent)
- BIOS 422 - Molecular Cell Biology II (prerequisite = BIOS 345 or equivalent)

Elective Courses

- Additional courses to reach 24 course credits may be chosen from the upper-level courses in Biochemistry, Molecular Biology, and Cell Biology.

Neuroscience Concentration:

Core Courses (take one course from each of the four categories below; 12 credits in core)*

- Behavioral Neuroscience (BIOS 453: General Neuroanatomy OR BIOS 457: Advanced Behavioral Neuroendocrinology)
- Neurophysiology (BIOS 415: Synapses, Plasticity & Learning OR BIOS 424: Advanced Neurobiology of Sensory Systems)
- Neuroscience Elective (BIOS 471: Eukaryotic Signal Transduction, BIOS 486: Genes and the Brain, OR any 400-level course in Behavioral Neuroscience or Neurophysiology)
- Non-neuroscience Elective (any of the 400-level Cell and Molecular offerings OR any of the 400-level Evolution and Behavior offerings)

Additional Required Course

- BIOS 401: Professional Skills for Biological Sciences Graduate Students
(*strongly recommended to be taken in first two years*)

Elective Courses

- Additional 300- and 400-level courses to reach 24 course credits may be chosen from offerings in Neuroscience or other relevant fields (as determined in discussions with your faculty adviser).

**Please note that course offerings in Neuroscience may change based on faculty availability.*

Evolution and Behavior Concentration:

Core Courses (take three 400-level courses from the Evolution and Behavior category below, and one 400-level non-Evolution/Behavior elective; 12 credits in core)*

- Evolution and Behavior (BIOS 423: Evolution of Development, BIOS 426: Coevolution, BIOS 428: Molecular Evolution, BIOS 434: Speciation, BIOS 435: Epigenetics, BIOS 448: Marine Biology)
- Non-Evolution/Behavior Elective (any of the 400-level Cell and Molecular offerings OR any of the 400-level Neuroscience offerings)

Additional Required Course

- BIOS 401: Professional Skills for Biological Sciences Graduate Students (*strongly recommended to be taken in first two years*)

Elective Courses

- Additional 300- and 400-level courses to reach 24 course credits may be chosen from offerings in Evolution or other relevant fields (as determined in discussions with your faculty adviser).

**Please note that course offerings in Evolution and Behavior may change based on faculty availability.*

Pre-Candidacy

Finding a research lab

All graduate students are encouraged to rotate among different labs during the Pre-Candidacy Phase. Rotations provide 1) first-hand laboratory experience, 2) training in lab-specific techniques and 3) one-on-one interactions with faculty. After a maximum of three lab rotations, the graduate student and Faculty Advisor together will decide upon a lab for completion of the dissertation research. While there are no set time frames for rotations, it is in the student's best interest to decide upon a research lab by the end of the first Spring semester so that research towards the PhD can begin over the Summer.

Qualifying exam

All students must pass a qualifying exam in order to continue in the program. The exam consists of two parts—a written proposal and an oral examination—and is completed during the fourth semester in the program. The goal of the exam is to test the student's depth and breadth of knowledge in their chosen field. Please see detailed guidelines and a detailed timeline for the qualifying exam on pages 18-21 of this handbook.

If a student fails his/her first attempt at the written proposal or the oral examination, s/he will be provided one opportunity to re-do each component of the qualifying exam. Both the written and the oral components of the qualifying exam should be passed within one calendar year.

Post-Candidacy

Candidacy is the second stage of the graduate experience. In this phase, the Doctoral Candidate engages primarily in research activities with the goal of publishing new and novel results. Throughout this phase, the student meets regularly with a Dissertation Committee chosen by the student in consultation with the student's Major Advisor. Candidacy is typified by research publications, and attendance and participation in both research conferences and departmental colloquia. This phase culminates in the generation and defense of a PhD Dissertation.

Within one year of successfully completing the qualifying exam, the student should prepare a written document representing their proposal thesis research. This should be written in conjunction with their advisor. The proposal should be submitted to the Dissertation Committee (determined by the student and the Faculty Advisor) two weeks in advance of the proposal defense. The minimum four-member Dissertation Committee includes three departmental Faculty (including the Faculty Advisor) and one doctoral level scientist from outside of the department (either within Lehigh or outside of Lehigh). At the proposal defense, the student will orally present the contents of the thesis and will address questions and concerns of the committee.

The Proposal defense includes a General Examination in which the student's adequate understanding of the science related to his or her field of study will be assessed. Upon successful defense of the Dissertation Proposal and satisfactory performance in the General Examination, the following two forms must be signed by all members of the Dissertation Committee and submitted to the Graduate Programs Office of the College of Arts and Sciences:

1. Proposal Title Page (this is part of your proposal document)
2. "Report on the General Doctoral Examination" –found here:
<https://cas.cas2.lehigh.edu/content/general-exam-form>

Upon successful completion of your proposal defense, you will meet with the Associate Dean for Research and Graduate Studies. This meeting is intended for you to briefly explain your dissertation research and to review the process and timeline for completion of your degree.

Please note that if the composition of your dissertation committee changes, you must inform the University Graduate Office as soon as possible (and *before* completing your dissertation defense). This is accomplished by filing a petition. The Graduate Coordinator can help you to fill out the appropriate forms.

In summary, the successful completion of coursework, the qualifying exam, and the defense of a Dissertation Proposal/General Examination are requirements for

Admission to Candidacy. By University regulations, Admission to Candidacy requires 72 credits beyond the Bachelor's degree or 48 credits beyond the Master's degree. At least 24 of the credits must be in course work. Students that have progressed to Candidacy will continue to take 1 credit per semester.

Progress Meetings

Progress is assessed of all students throughout their time in the graduate program. Prior to the proposal defense, students meet twice per year with the graduate committee. After the proposal defense, students meet at least once annually with their dissertation committee.

Pre-candidacy

The Academic Coordinator will set up meetings with students in December and May of each year in order to evaluate student progress, address concerns related to progress, and/or to address concerns/questions of the student. Prior to the meeting, students are required to supply a self-assessment and an updated CV to the Academic Coordinator, for distribution to the Graduate Committee. Students must bring an updated Checklist of Professional Development to their progress meeting.

Post-candidacy

Following the proposal defense, the student should schedule annual meetings with their Dissertation Committee to report on progress. If things are going well, this provides you with an opportunity to update your committee. If you are experiencing difficulties, it gives your committee an opportunity to help you through the challenge before you have an extended delay. Regular meetings also signal that you are meeting requirements for adequate progress towards your degree. This may contribute to documentation used by the graduate committee to make funding decisions beyond your 5th year in the program. At the completion of a Progress Report meeting, please complete the Progress Report Form as documentation of your meeting (see the Academic Coordinator in the BIOS main office for the appropriate forms).

The graduate committee will send out reminders if it becomes apparent that you are not meeting regularly with your committee. However, the progress you make towards your degree is your responsibility and it is up to you to schedule meetings.

Dissertation Defense

The graduate student, together with their dissertation committee, will determine when the student is prepared for their final examination as a student: the thesis defense. The student will prepare a written document representing the novel research completed during the thesis, including relevant background and discussion that provides context for the completed research. The thesis should be distributed to the committee two weeks ahead of the defense date. Guidelines for preparation of the dissertation itself, as well as all requirements for completion of the PhD can be found here:

<http://cas.cas2.lehigh.edu/content/graduate-management-assistant>.

Fellowships

At the discretion of the Graduate Committee and Department Chair, the Department of Biological Sciences awards fellowship funds provided by both Gordon C. Thorne and Marjorie Nemes to support graduate research. The fellowships are awarded on a competitive basis to recognize exceptional students who have demonstrated excellence in research and have made significant progress toward their Ph.D.

Eligibility: All full time Ph.D. students are eligible to apply, but preference will be given to students who have advanced to candidacy. Nominations are accepted from faculty, fellow students, or from the candidate.

The award: Fellowships provide tuition and stipend support for one semester. Students may receive a fellowship for no more than 2 semesters. The goal of the award is to support full-time research and data collection. Fellows are required to present their research to the department as part of either the Tuesday or Friday seminar series during the semester following their support.

For assistance in preparing your application, please see the sample rating form on page 23. A similar form will be used by faculty reviewers to rate each application. Note the criteria descriptions at the bottom. A rating form summarizing the faculty panel's discussion will be used to provide feedback to applicants after the awards are announced.

Application: Successful applications should document the student's achievements in research. In order to receive full consideration for the award, the application should include (please submit to the Academic Coordinator electronically):

- 1) A nomination letter from the nominator (or candidate if self-nominated) carefully explaining why the candidate is deserving of special recognition by the department.
- 2) A 1-2 page research proposal from the candidate, explaining the specific research plan for the duration of the award. Please also include a brief explanation of how the specific research goals fit into the dissertation as a whole. If applicable, the candidate may also include any specific reasons for why this award would enhance

progress toward the degree. If the candidate is self-nominated, the proposal may be incorporated into the justification for nomination (above).

- 3) A letter from the candidate's advisor addressing the candidate's qualifications and demonstrated commitment to their studies. The advisor is welcome to address any factors related to how the award will impact their research laboratory.
- 4) A CV including all research, teaching, and service accomplishments.
- 5) Copies of manuscripts: published, in press, or in preparation.

Applications should be submitted electronically and are due to the department's academic coordinator by:

*Spring Semester Fellowships: **November 15th***

*Fall Semester Fellowships: **April 15th***

Seminar Series, Job Talks, and Internal Talks

Seminar series: Fridays at 3:00 pm during the academic year

The Department hosts weekly seminars from outside speakers, Lehigh faculty, and from Fellowship recipients. These speakers are hosted by Department faculty or BOGS, and they represent leaders in their fields of research. What you can learn from these seminars is not limited to the current research on a particular research topic. You can also observe different speaking styles and learn how to give an effective research presentation (note that you can learn the latter whether a particular seminar was effective or not). These are important skills. Barring a program-related conflict such as TA-responsibilities, **all graduate students are expected to attend weekly seminars.**

Job talks: Seminar topics and times posted weekly

When searching for a new faculty position, the Department invites up to six candidates for 2.5 day visits. Each candidate gives both a formal seminar and a less formal "chalktalk" on future research plans. This can mean up to four seminars in a week during a job search. **All graduate students are expected to attend** unless they have a program related conflict. This will take a lot of everyone's time. For those of you who will be looking for jobs some day (i.e. *all* of you), consider our job candidates equivalent to your future competition. What does a good job talk look like/sound like? What kind of evidence do you need to convince a group of critical scientists that your hypothesis is worth pursuing? What do *you* have to do now to compete at this level?

As part of this process, the Search Committee will ask for feedback from all members of the Department. Please take these opportunities to provide informed feedback to the Search Committee on each candidate.

Internal talks: Tuesdays at 4:30 pm during the academic year (not scheduled during a faculty search)

As a part of their training, graduate students are required to give research seminars several times during their time in the program, following a regular rotation. These seminars occur during the academic year on Tuesdays. Post-docs may also be invited to give an internal seminar. These talks are a good opportunity to learn first-hand how to give a good seminar and also to learn more about what your fellow graduate students are doing in the lab. Faculty attend these seminars and stay after to provide feedback on the presentation and content.

Supplemental Information

Grievance Procedures

While many disagreements and concerns can be resolved by informal discussion among the parties, on occasion it may be necessary to initiate a more formal grievance resolution process. Generally speaking, for issues regarding grades, courses or other aspects of a graduate program, students should first seek resolution directly with the faculty member(s) involved. If resolution cannot be reached with the faculty member(s), the student should next bring the issue to the attention of the program's graduate director and department chair. If resolution cannot be reached within the department, the student should bring the issue to the attention of the Associate Dean for Research and Graduate Programs in the College of Arts and Sciences.

We encourage all relevant parties to try to resolve issues first by meeting to discuss the situation. If this is unsuccessful, however, students should submit formal grievances in writing, with a description of their concerns and a requested course of action. The faculty member(s) and (if subsequently involved) the graduate director and department chair will evaluate the student's request and provide written responses. If resolution is not reached within the department/program, these written records should be submitted in full to the Associate Dean for Research and Graduate Programs. The Associate Dean, in consultation with the Dean of the College, will gather information and provide a decision.

If at any point in this process you are unsure how to proceed or have concerns about raising issues within your department/program, we encourage you to reach out to the Associate Dean's Office for advice (MaryAnn Haller, Manager of Graduate Programs: 610-758-4280, mh0h@lehigh.edu; R. Michael Burger, Associate Dean: 610-758-4282, rmb206@lehigh.edu). You may also skip a step in the hierarchical grievance process (e.g., go straight to the department chair or associate dean) if you have serious concerns about approaching a particular individual. For advice outside of the College, you can also contact the Associate Deputy Provost for Graduate Education (Kathleen Hutnik; 610-758-3648, kaha@lehigh.edu) or the University Ombuds Office (<http://www.lehigh.edu/~inombuds/index.html>).

Appealing Grades

Appeals regarding course grades are governed by the Rules and Procedures of the Faculty. These state:

A student has the right to have all written materials submitted to meet the requirements of a course returned or made available for inspection. To be "made available" does not guarantee the right to a photocopy, but

the materials may be examined in the faculty office or academic department office. All written materials not returned to the student must be retained by the faculty member or the department office for at least one long-session term following the completion of the course.

A student questioning the validity of a grade must file the appeal to the faculty member of the academic department before the last class day of the long semester term following the completion of the course. This does not limit the ability to correct a grade based on miscalculation or data entry error.

Further Appeals

Students who are not satisfied by the resolution provided by the procedures above may appeal by petition to the Committee on Standing of Graduate Students (SOGS). (Petition forms are available [here](#).) Please note, however, that this committee deals only with academic issues. The SOGS committee includes the graduate associate deans of the colleges, the director of graduate student life, and a representative from the Graduate and Research Committee. The committee meets regularly with the Registrar and considers all graduate petitions. The Registrar's Office notifies the petitioner of the committee's decision.

If a student is not satisfied with the decision of the SOGS committee, he or she may appeal the decision to the Graduate and Research Committee (GRC), an elected committee of the University Faculty. Appeals to the GRC are, however, rare and the petitioner must make clear in writing why the decision of the SOGS committee was inappropriate and why the resolution proposed by the petitioner is more appropriate.

Reporting Harassment or Discrimination

As per Lehigh University's Policy on Harassment and Non-Discrimination:

Lehigh University upholds [The Principles of Our Equitable Community](#) and is committed to providing an educational, working, co-curricular, social, and living environment for all students, staff, faculty, trustees, contract workers, and visitors that is free from harassment and discrimination on the basis of age, color, disability, gender identity or expression, genetic information, marital or familial status, national or ethnic origin, race, religion, sex, sexual orientation, or veteran status. Such harassment or discrimination is unacceptable behavior and will not be tolerated. The University strongly encourages (and, depending upon the circumstances, may require) students, faculty, staff or visitors who experience or witness harassment or discrimination, or have information about harassment or discrimination in University programs or activities, to immediately report such conduct. (Full policy [here](#).)

Reports should be made to:

Karen Salvemini, Equal Opportunity Compliance Coordinator
Alumni Memorial Building, Room 302
(610) 758-3535, eocc@lehigh.edu

In the event that the conduct involves the Equal Opportunity Compliance Coordinator, reports should be made to:
Linda Lefever, HR Associate: Employee Relations, Staff Development, Career Management
306 South New Street – Suite 437
610-758-5195, lip3@lehigh.edu

Reports of harassment or discrimination can also be made:

- To the Lehigh University Police Department (610-758-4200)
- To any member of the faculty (e.g., your advisor or graduate director) or university administration (e.g., the Associate Dean's Office).
- Online at go.lehigh.edu/harassment

Before a disclosure is made, an individual who wishes to talk about these issues confidentially and without initiating a report or investigation can contact:

Lehigh University Counselling & Psychological Services
Johnson Hall, 4th floor
610-758-3880 / <https://studentaffairs.lehigh.edu/content/counseling-psychological-services-ucps>

Lehigh University Chaplain's Office
661 Taylor Street
610-758-3877 / <https://chaplain.lehigh.edu/>

Guidelines and Dates for Qualifying Exam

Overview of exam:

The proposal-based qualifying exam will require students to generate a specific hypothesis that extends from current findings within the literature, and to design an appropriate experimental approach to test their hypothesis. The exam will consist of two parts: a written proposal and an oral examination. The goal of this exam is to test the student's ***depth and breadth of knowledge in their chosen field***. The written format will follow the NIH NRSA pre-doctoral award format (see below for details), and require students to generate a grant proposal to address a novel question in biology. The oral examination will be a presentation where students defend and expand upon the information provided within the written proposal. During the oral presentation committee members are also able to ask students any questions deemed necessary to determine *depth and breadth* of knowledge. The topic cannot be directly related to a student's likely thesis research. Additionally, the three aims must encompass a wide range of experimental approaches that demonstrate the student's breadth of knowledge regarding methods in their field.

The student and the graduate committee will choose the members of the student's examining committee. The student and exam committee will then work together to choose a suitable topic. Once a topic is chosen, the student will be given 4-6 weeks to prepare a Specific Aims page (following NIH format) that briefly outlines the evidence that led to the hypothesis and the need to address the hypothesis, followed by a brief explanation of each aim. The committee will provide written feedback on the Aims page to the student. The remainder of the semester will be spent writing the rest of the proposal. Students will submit written proposals, which will be read by their committee prior to the oral examination. The oral exams will be scheduled throughout the month of May based on availability of faculty serving on committees, but each student will be given at least one week between handing in the written proposal and the scheduled date of the oral examination.

Outline of the exam process: (Specific dates will vary each year)

Committee selection – Students can request up to two faculty for their committee, and those faculty should confirm in writing to the graduate committee that they agree to participate in the student's exam. The graduate committee will take the student's choices into account and select the final committee based on faculty availability and the expertise necessary to evaluate the student's performance based on their chosen field. The committee should be selected by the end of the fall semester.

Choice of topic – Prior to the start of spring semester each student will provide the examining committee with at least three potential topics and hypotheses for their

proposal. The examining committee will decide if any or all of the topics are sufficiently different than the student's thesis topic. The student will then choose from the vetted list.

Specific Aims – The specifics aims page will be due the 1st of March or the first Monday thereafter.

Faculty feedback – Faculty on the exam committee will read the student's specific aims page and provide written feedback including potential concerns the student may need to address for the final proposal. Feedback will be provided by the Monday after Spring Break.

The final proposal – The final proposal will be due by the last day of classes for the spring semester, and may include an updated/edited specific aims depending on exam committee feedback.

The oral exam – The orals will be scheduled prior to completion of the written proposal, based on teaching schedules and exam committee availability. Each student will have at least one week to prepare for their oral exam.

Written proposal format:

The proposal-based qualifying exam will use the same format as the NIH NRSA predoctoral awards.

The Grant proposal must include the following sections:

Specific Aims – 1 Page
Research Strategy – 6 Pages
References – No limit

Generally speaking, the specific aims and proposal together should provide the reader with enough background to understand what evidence supports the hypothesis, and how the experimental approaches will address the hypothesis.

Helpful Resources:

<https://grants.nih.gov/grants/funding/phs398/phs398.pdf>

<https://grants.nih.gov/grants/funding/phs398/phs398.html>

On Course Site, we will also provide PDFs with guidance on how to construct an effective proposal. Outside of the main writing period (mid-March through May), students may also ask faculty about formats and what should be included in a proposal.

The following requirements must be adhered to.

Paper size – Standard 8.5 X 11-inch page size

Margins – 0.5 inch or larger margins on all sides

Font size – 11pt font or larger

Oral examination format:

The oral examination will begin with a brief presentation prepared by the student that expands on the background and experimental approaches in the written proposal. Ideal presentations will have slides that have schematic depictions of workflow and experimental designs, as well as schematics of predicted results and their interpretations. If students expect specific questions from the committee, they may consider preparing extra slides to help in answering these questions. The exam faculty will interrupt students during their presentations to ask questions. The oral exam offers faculty an opportunity to challenge a student's ***breadth and depth*** of knowledge regarding not only the biology in question, but how the work relates to other fields, how theoretical results may alter the student's interpretation, and the limitations and strengths of proposed experiments and alternative approaches.

Possible outcomes of exams:

Faculty will score exams based on a predetermined rubric that roughly outlines expectations to the best possible degree given the range of potential topics. Students may potentially:

Pass – The student has completed all components of the exam at or above the standards necessary to embark on dissertation-quality research.

Conditionally Pass – The overall progress of the student was sufficient, but issues that could negatively impact the student's potential to perform doctoral-level research were identified. The exam committee will determine the effective remediation and student will have passed the exam once all exam committee members are satisfied that the student has fulfilled the remediation expectations.

Fail – The exam components (written, oral or both) do not meet necessary standards. The student will retake the exam following guidelines put forth in the student handbook. It should be noted that the exam retake does not require a student start from scratch; exam committee members can determine if the student needs to retake the written, oral, or both and if the proposal topic can be the same or must be modified.

Exam re-take guidelines:

The qualifying exam is completed each year in May. If a student fails their first attempt at the qualifying exam, they should re-take the exam in August (or within three months, if the first attempt did not follow the standard timeline). A full re-take will use the same time intervals between steps as described above, and will use the same exam committee. The schedule of a partial retake will be determined by the exam committee.

If the student fails the qualifying exam a second time, funding support will terminate and the student will no longer be included in the program. Termination will occur at the end of the semester that follows the first oral exam. For instance, with the standard schedule of a May oral exam and a summer re-take with failures in both attempts, the fall semester will be the last funded semester in the program.

Once the student is notified of a failing score, the student will meet with their research advisor and the graduate committee to plan for the final semester. During this meeting, the student will be advised about how to satisfy the requirements to obtain a master's degree by the end of their time in the program.

Biology Organization of Graduate Students (BOGS)

Within the Department of Biological Sciences, the graduate students together form BOGS.

We are an organization with seven goals:

- (1) To promote effective communication between the department faculty and the graduate students;
- (2) To provide professional enrichment to graduate students through career-related seminars and activities;
- (3) To promote scientific outreach through community service;
- (4) To encourage social interaction among all graduate students via nonacademic activities;
- (5) To provide academic consultation to graduate students to assist in preparation for their qualifying exams;
- (6) To help BOGS members procure travel grant funding through the Graduate Student Senate (GSS); and
- (7) To represent BOGS members' interests to the GSS and the graduate student body.

Highlights include a Graduate Student Research Symposium during candidates' day, and invitation of an external seminar speaker. Recreational activities BOGS has participated in include: weekly dinners following departmental seminars, bowling and movie events, June Day, an outdoor picnic, hikes, and a summer softball league. BOGS strives to be involved in community outreach through events such as a Bio Fair hosted at a local middle school, park clean-ups and tree planting, clothes and book drives, and the judging of several local science competitions.

As a member of BOGS, you may be offered the opportunity of holding an officer position. Such positions include the president, vice president, secretary, treasurer, and the qualifying exam liaison. The positions are voted on annually by BOGS members.

It is encouraged for you to reach out to other graduate students in our Department. We are diverse group of people with a broad range of experiences and interests, and we are always thrilled to meet new colleagues.

2021-2022 BOGS Officers

President: Luke McCartin (ljm419@lehigh.edu)

Vice President: Kayli Silimperi (kas618@lehigh.edu)

Secretary: Austin Russell (aar420@lehigh.edu)

Treasurer: Nicole Pittoors (ncp220@lehigh.edu)

Community Relations and GSS Representative: Joan Spinelli (jcs518@lehigh.edu)

BIOS Departmental Fellowships Sample Rating Form

Please rank the following categories between 1 and 5 for this application (1 being the lowest, 5 being the highest). If a 3 or lower is given in any category, please provide specific explanation for the ranking in the additional comments section.

Rating category	1	2	3	4	5
Research productivity/Progress					
Big picture					
Hypothesis/Research question					
Methodology					
Letter from advisor					

Additional comments:

Key to Criteria

Research productivity/Progress: How well did the applicant demonstrate research productivity and progress toward their degree? Examples of demonstrated productivity and progress include: publications based on thesis research; presentations at international, national, or regional conferences; successful grant applications.

Big picture: How well did the applicant convey the big picture/importance of the proposed research to the field in their proposal?

Hypothesis/Research question: How well was the hypothesis or research question explained within the applicant's proposal?

Methodology: How well was the methodology described? Proposal should include sufficient detail so that someone broadly trained in the Biological Sciences could understand what is proposed.

Letter from advisor: How strong was the letter from the applicant's advisor? (Note: Review panel will keep this information confidential).

University Graduate Health Insurance Policy

All international graduate students and any domestic graduate student who enrolls in 9 or more credits per semester are required by the University to have health insurance. Students with certified full-time status are not required, but are strongly encouraged, to have health insurance. Official policy guidelines on who is required to have health insurance can be found here: <https://financeadmin.lehigh.edu/HealthInsurance>

Students required to have insurance under this Graduate Health Insurance Policy will be automatically enrolled in the Lehigh University Student Health Insurance Plan at the start of the Fall semester. **This enrollment must be either confirmed or waived** (if you can provide evidence of coverage under another policy). Graduate students with certified full-time status are eligible to voluntarily enroll in the Lehigh University Student Health Insurance Plan. Deadlines for confirming or waiving enrollment in the Lehigh University Student Health Insurance Plan, and other details about this plan, are found here: <https://financeadmin.lehigh.edu/content/health-insurance-graduate-details>

Complete details about the Lehigh University Student Health Insurance Plan, including eligibility requirements, effective dates and costs, enrollment periods, and the schedule of benefits, are available here:

https://www.universityhealthplans.com/letters/letter.cgi?group_id=4

A subsidy is available to eligible students for partial reimbursement of health insurance costs. See below for the 2021-2022 details of this subsidy program from the Provost's Office.

Graduate Student Health Subsidy

Access to good insurance is essential for the health of our students. To this end, the University established a subsidy program to help eligible graduate students pay for health insurance and a payroll deduction option to help students who wish to avoid one large payment (see below for deadlines and forms). Since the establishment of the subsidy program in spring 2003, more and more graduate students have received the subsidy and enrolled in the insurance program.

For 2021-2022, the annual premium for *students only* coverage will be \$2,057. To help eligible students, see criteria below, to afford individual coverage, the University will provide a subsidy of \$1,023.50 on Lehigh's student health plan for the 2021-2022 academic year. The out-of-pocket premium cost for the individual coverage will be \$1,033.50. Eligible students will receive a subsidy payment of \$511.75; minus the appropriate taxes for each semester during which they qualify. The subsidy will be paid at the end of each semester (with December 15th and May 13th paychecks.) NOTE: If your paychecks stop before these dates, you will not be eligible to receive the subsidy.

The subsidy program is an integral part of the University's commitment to providing our graduate students with a quality insurance program. This insurance covers the graduate student only and not his/her dependents. In order to help those students that require dependent coverage explore the dependent coverage available, University Health Plans, the university's insurance broker, will maintain a website that will list the insurance companies that provide coverage for dependents.

Criteria for Student Health Insurance Subsidy Program

The subsidy program is offered to graduate students who meet ALL the criteria listed below on the payment subsidy date. PLEASE READ CAREFULLY.

1. The student must be a full-time or certified full-time graduate student. (It is the student's responsibility to ensure that he/she is registered as full-time or certified full-time student prior to the payment of the subsidy. Failure to do so without good cause will result in the loss of the subsidy payment. AND
2. Receiving an assistantship or fellowship through the university payroll system AND
3. Has paid their Lehigh student health insurance premium in full by the time the subsidy is paid out or has signed up for the payroll deductions of premiums.

You may begin enrolling in the insurance program on June 21, 2021. To enroll in the insurance program you must confirm your enrollment in the health insurance by going to www.universityhealthplans.com AND submit payment to the Bursar's Office. Students must complete their registration prior to being eligible to confirm their enrollment in the health insurance plan. (NOTE: Certified Full Time students must complete an application with the Bursar's Office.)

PLEASE READ ALL THE INSTRUCTIONS THAT FOLLOW TO ENSURE YOU ENROLL PROPERLY.

- Insurance coverage for annual (2021/2022 coverage) OR fall 2021 only policy begins the later of:
 - August 15, 2021, or
 - Upon your online confirmation of enrollment and premium payment. Deadline to confirm your enrollment is 4:00 PM on September 3, 2021.
- Insurance coverage for the spring 2022 only policy begins the later of:
 - January 1, 2022, or
 - Upon submission of an enrollment form and premium payment to the Bursar's Office.
 - Deadline to enroll is 4:00PM on February 4, 2021.

- To confirm enrollment go to www.universityhealthplans.com and then click on the Lehigh University link.
- Certified Full-Time students and students enrolling in the spring only policy must go to the Bursar's Office to obtain an enrollment form.
- Make online payments at <https://financeadmin.lehigh.edu/content/accessing-ebill-suite>. Payroll deduction forms are on the Lehigh University Controllers Office website <http://financeadmin.lehigh.edu/content/payroll-forms> under the Payroll forms (Graduate Student Health Insurance Payroll Deduction Form.)
- Students who are eligible to enroll for the fall semester and choose not to enroll are eligible to enroll for the spring semester ONLY IF the student had a "qualifying event" as described in the Student Health Insurance Brochure.

Subsidy payments to all eligible students each semester is automatic and require no application forms.

The student health insurance plan constitutes qualified health care coverage for the purpose of the ACA individual mandate. Additional information about the Affordable Care Act as it relates to students can be found at:

https://www.lehigh.edu/~inprv/pdfs/pdfs_2014-2015/ACA%20Q&A%20for%20Students_V1.0_2014.12.18.pdf

The following was written by a group of faculty in a Computer Science PhD program, and can be found on the web at: <http://www.cs.purdue.edu/homes/dec/essay.phd.html>. While some of the comments may be particular to Computer Science, the vast majority of the piece is applicable to PhD programs in general, including ours.

Notes on the PhD Degree

Last week at the department colloquium coffee hour, several students engaged the faculty in a discussion about our Ph.D. program. It became clear that many of the students did not understand the basics; they were surprised at some of the questions and confused by some of the answers.

These notes provide basic information about the purpose of a Ph.D. program in an attempt to help students decide whether to pursue a Ph.D. degree.

The Basics

A Doctor of Philosophy degree, abbreviated Ph.D., is the highest academic degree anyone can earn. Because earning a Ph.D. requires extended study and intense intellectual effort, less than one percent of the population attains the degree. Society shows respect for a person who holds a Ph.D. by addressing them with the title "Doctor".

To earn a Ph.D., one must accomplish two things. First, one must master a specific subject completely. Second, one must extend the body of knowledge about that subject.

Mastering A Subject

To master a subject, a student searches the published literature to find and read everything that has been written about the subject. In scientific disciplines, a student begins by studying general reference works such as text books. Eventually, the student must also search scholarly journals, the publications that scientists use to exchange information and record reports of their scientific investigations.

Each university establishes general guidelines that a student must follow to earn a Ph.D. degree, and each college or department within a university sets specific standards by which it measures mastery of a subject. Usually, in preparing for Ph.D. work in a given field, a student must earn both a Bachelor's and Master's degree (or their equivalent) in that field or in a closely related field. To demonstrate complete mastery of the subject, a student may be required to complete additional graduate-level

courses, maintain a high grade average, or take a battery of special examinations. In many institutions, students must do all three.

Because examinations given as part of a Ph.D. curriculum assess expert knowledge, they are created and evaluated by a committee of experts, each of whom holds a Ph.D. degree.

Extending Knowledge

The essence of a Ph.D., the aspect that distinguishes Ph.D. study from other academic work, can be summarized in a single word: research. To extend knowledge, one must explore, investigate, and contemplate. The scientific community uses the term *research* to capture the idea.

In scientific disciplines, research often implies experimentation, but research is more than mere experiments -- it means interpretation and deep understanding. For Computer Scientists, research means searching to uncover the principles that underlie digital computation and communication. A researcher must discover new techniques that aid in building or using computational mechanisms. Researchers look for new abstractions, new approaches, new algorithms, new principles, or new mechanisms.

To complete a Ph.D., each student must present results from their research to the faculty in a lengthy, formal document called a dissertation (more popularly referred to as a thesis). The student must then submit their dissertation to the faculty and defend their work in an oral examination.

Relationship To Products

In some cases, the results of scientific research can be used to develop new products or improve those that exist. However, scientists do not use commercial success or potential commercial profits as a measure of their work; they conduct investigations to further human understanding and the body of knowledge humans have compiled. Often, the commercial benefits of scientific research are much greater in the long-term than in the short-term.

Research Activities

Computer Science research can include such diverse activities as designing and building new computer systems, proving mathematical theorems, writing computer software, measuring the performance of a computer system, using analytical tools to assess a design, or studying the errors programmers make as they build a large software system. Because a researcher chooses the activities appropriate to answer each question that arises in a research investigation, and because new questions arise

as an investigation proceeds, research activities vary from project to project and over time in a single project. A researcher must be prepared to use a variety of approaches and tools.

A Few Questions To Ask

Many of you are trying to decide whether to pursue a Ph.D. degree. Here are a few questions you might ask yourself.

1. Do you want a research career?

Before enrolling in a Ph.D. program, you should carefully consider your long-term goals. Because earning a Ph.D. is training for research, you should ask yourself whether a research position is your long-term goal. If it is, a Ph.D. degree is the standard path to your chosen career (a few people have managed to obtain a research position without a Ph.D., but they are the exception, not the rule). If, however, you want a non-research career, a Ph.D. is definitely not for you.

2. Do you want an academic position?

A Ph.D. is the de facto "union card" for an academic position. Although it is possible to obtain an academic position without a Ph.D., the chances are low. Major universities (and most colleges) require each member of their faculty to hold a Ph.D. and to engage in research activities. Why? To insure that the faculty have sufficient expertise to teach advanced courses and to force faculty to remain current in their chosen field. The U.S. State Department diplomatic protocol ranks the title "professor" higher than the title "doctor". It does so in recognition of academic requirements: most professors hold a Ph.D., but not all people who hold a Ph.D. degree are professors.

3. Do you have what it takes?

It is difficult for an individual to assess their own capabilities. The following guidelines and questions may be of help.

Intelligence:

In your college and graduate courses, were you closer to the top of your class or the bottom? How well did you do on the GRE or other standardized tests?

Time:

Are you prepared to tackle a project larger than any you have undertaken before? You must commit to multiple years of hard work. Are you willing to reduce or forego other activities?

Creativity:

Research discoveries often arise when one looks at old facts in a new way. Do you shine when solving problems? Do you like "brain teasers" and similar

puzzles? Are you good at solving them? In school, did you find advanced mathematics enjoyable or difficult?

Intense curiosity:

Have you always been compelled to understand the world around you and to find out how things work? A natural curiosity makes research easier. Did you fulfill minimum requirements or explore further on your own?

Adaptability:

Most students are unprepared for Ph.D. study. They find it unexpectedly different than course work. Suddenly thrust into a world in which no one knows the answers, students sometimes flounder. Can you adapt to new ways of thinking? Can you tolerate searching for answers even when no one knows the precise questions?

Self-motivation:

By the time a student finishes an undergraduate education, they have become accustomed to receiving grades for each course each semester. In a Ph.D. program, work is not divided neatly into separate courses, professors do not partition tasks into little assignments, and the student does not receive a grade for each small step. Are you self-motivated enough to keep working toward a goal without day-to-day encouragement?

Competitiveness:

If you choose to enroll in a Ph.D. program, you will compete with others at the top. More important, once you graduate, your peers will include some of the brightest people in the world. You will be measured and judged in comparison to them. Are you willing to compete at the Ph.D. level?

Maturity:

Compared to coursework, which is carefully planned by a teacher, Ph.D. study has less structure. You will have more freedom to set your own goals, determine your daily schedule, and follow interesting ideas. Are you prepared to accept the responsibility that accompanies the additional freedoms? Your success or failure in Ph.D. research depends on it.

A few warnings:

Students sometimes enroll in a Ph.D. program for the wrong reasons. After a while, such students find that the requirements overwhelm them. Before starting one should realize that a Ph.D. is not:

Prestigious in itself

Almost everyone who has obtained a Ph.D. is proud of their efforts and the result. However, you should understand that once you graduate, you will work among a group of scientists who each hold a Ph.D. degree. (One faculty member used to chide arrogant graduate students by saying, "I don't see why you think it's such a great accomplishment -- all my friends have a Ph.D.!").

A guarantee of respect for all your opinions

Many students believe that once they earn a Ph.D. people will automatically respect all their opinions. You will learn, however, that few people assume a Ph.D. in one subject automatically makes you an authority on others. It is especially true in the science community; respect must be earned.

A goal in itself

A Ph.D. degree prepares you for research. If all you want is a diploma to hang on the wall, there are much easier ways to obtain one. After you graduate, you will have occasion to compare your record of accomplishment to those of other scientists. You will realize that what counts is the research work accumulated after a scientist finishes their formal education.

A job guarantee

When an economy slows, everyone can suffer. In fact, some companies reduce research before they reduce production, making Ph.D.s especially vulnerable. Furthermore, once a person earns a Ph.D., many companies will not hire that person for a non-research position. As in most professions, continued employment depends on continued performance.

A practical way to impress your family or friends

Your mother may be proud and excited when you enroll in a Ph.D. program. After all, she imagines that she will soon be able to brag about her child, "the doctor." However, a desire to impress others is insufficient motivation for the effort required.

Something you can "try" to find out how smart you are

Sorry, but it just doesn't work that way. Unless you make a total commitment, you will fail. You will need to work long hours, face many disappointments, stretch your mental capabilities, and learn to find order among apparently chaotic facts. Unless you have adopted the long-range goal of becoming a researcher, the day-to-day demands will wear you down. Standards will seem unnecessary high; rigor will seem unwarranted. If you only consider it a test, you will eventually walk away.

The only research topic you will ever pursue

Many students make the mistake of viewing their Ph.D. topic as a research area for life. They assume each researcher only works in one area, always pursues the same topic within that area, and always uses the same tools and approaches. Experienced researchers know that new questions arise constantly, and that old questions can become less interesting as time passes or new facts are discovered. The best people change topics and areas. It keeps them fresh and stimulates thinking. Plan to move on; prepare for change.

Easier than entering the work force

You will find that the path to successful completion of a Ph.D. becomes much steeper after you begin. The faculty impose constraints on your study, and do not permit unproductive students to remain in the program.

Better than the alternatives

For many students, a Ph.D. can be a curse. They must choose between being at the top among people who hold a Masters degree or being a mediocre

researcher. The faculty sometimes advise students that they must choose between being ``captain of the B team" or a ``benchwarmer" on the A team. Everyone must decide what they want, and which profession will stimulate them most. But students should be realistic about their capabilities. If you really cannot determine where you stand, ask faculty members.

A way to make more money

While we haven't heard any statistics for the past couple of years, graduate students used to estimate the ``payoff" using the starting salaries of Ph.D. and M.S. positions, the average time required to obtain a Ph.D., the value of stock options, and current return on investments. For a period of at least five years that we know, the payoff was clearly negative. Suffice it to say that one must choose research because one loves it; a Ph.D. is not the optimum road to wealth.

The good news: Despite all our warnings, we are proud that we earned Ph.D. degrees and proud of our research accomplishments. If you have the capability and interest, a research career can bring rewards unequaled in any other profession. You will meet and work with some of the brightest people on the planet. You will reach for ideas beyond your grasp, and in so doing extend your intellectual capabilities. You will solve problems that have not been solved before. You will explore concepts that have not been explored. You will uncover principles that change the way people use computers.

The joy of research: A colleague summed up the way many researchers feel about their profession. When asked why he spent so many hours in the lab, he noted that the alternatives were to go home, where he would do the same things that millions of others were doing, or to work in his lab, where he could discover things that no other human had ever discovered. The smile on his face told the story: for him, working on research was sheer joy.