

# **Graduate Student Handbook**

**Department of Biological Sciences  
Academic Year 2025-2026**

## **Table of Contents**

Introduction to Department and Program	3
Departmental Support	4
University Requirements	7
Grading Policy and Coursework	8
Grading Policy	8
Coursework	8
Finding a research lab	11
Qualifying exam	11
Post-Candidacy	11
Progress Meetings	12
Dissertation Defense	13
Fellowships	13
Seminar Series, Job Talks, and Internal Talks	15
Seminar series: Fridays at 11:00 am during the academic year	15
Job talks: Seminar topics and times posted weekly	15
“Training” Seminars: Mondays at 11:00 am during the academic year (not scheduled during a faculty search)	15
Supplemental Information	16
Grievance Procedures	16
Appealing Grades	16
Further Appeals	17
Reporting Harassment or Discrimination	17
Guidelines and Dates for Qualifying Exam	19
Biology Organization of Graduate Students (BOGS)	24
BIOS Departmental Fellowships Sample Rating Form	
Tax Treaty Information	24
University Graduate Health Insurance Policy	29
Graduate Student Health Subsidy	29
Notes on the PhD Degree	32
Mastering A Subject	32
Extending Knowledge	33

Relationship To Products	33
Research Activities	33
A Few Questions To Ask	34

## Introduction to Department and Program

Welcome to the Department of Biological Sciences! This handbook is intended to provide you with the details of our Ph. D. graduate program. 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 2024-2025:

Department Chair: Kathy Iovine

Ph.D. Graduate Director: Gregory Lang

Ph.D. Graduate Committee: Gregory Lang (chair), Julie Haas, Ju Lu, Dylan Shropshire

Ph.D. Recruitment Committee: Johanna Kowalko (chair), Wynn Meyer, Chenshu Liu

Ph.D. Qualifying Committee: David Zappulla (chair), Santiago Herrera, Wonpil Im

MS MBio via Distance Education Committee: Vassie Ware (Program Director), Mike Behe and Mike Layden

### Department Staff:

Academic Coordinator: Erin Curtolo

Business Manager: Lisa Szydlow

Laboratory Manager: Lee Graham

Faculty Coordinator: *Vacant*

### 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!** Often 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 Graduation Checklist:  
[https://docs.google.com/document/d/12qCwlhzqeGn\\_OsZIDtYIJgw42YxHPilx1XuuYB6\\_Lq/edit?tab=t.0](https://docs.google.com/document/d/12qCwlhzqeGn_OsZIDtYIJgw42YxHPilx1XuuYB6_Lq/edit?tab=t.0)
- The College of Arts and Sciences graduate student handbook:  
[https://docs.google.com/document/d/17X2AJnBk0TPniwfCifsw6q1GBVtC1A7UWrLZgl\\_AKhA/edit?tab=t.0](https://docs.google.com/document/d/17X2AJnBk0TPniwfCifsw6q1GBVtC1A7UWrLZgl_AKhA/edit?tab=t.0)

## **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. 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 planning 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), 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. 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. The following are the guidelines provided by the Office of the Provost and Senior Vice President for Academic Affairs. Please note that more direct guidance on how time off will be accounted for will be forthcoming.

### University Graduate Vacation/Personal Time Policy

Students receiving a stipend may request up to 10 business days in an academic year without suspension of the stipend. Students may take more time away unpaid with permission from the adviser or P.I.

- Unused days do not carry over.
- The academic year includes the semester breaks and the summer.
- Students funded for only the fall and spring semesters have paid time away
- prorated to four days per semester or eight days per year.
- Students can take their time away all at once or in other combinations.
- All GA/TA/RAs with full appointment may request up to 10 paid vacation days/personal days in a calendar year in addition to university holidays (with the exception of Labor Day, on which the university holds classes and labs), without suspension of the stipend.
- International students must consult with the Office of International Students and Scholars to ensure they remain in compliance with visa requirements.
- Unauthorized absences may result in stipend suspension.
- Professional travel does not count toward time away.
- Students should email their request directly to their supervisor and the supervisor should respond to the request in a timely manner.
- In the event of a conflict, the student or supervisor should consult with their graduate associate dean or the associate deputy provost for graduate education.  
<https://provost.lehigh.edu/resources/policies/policies-graduate-research-and-teaching-assistants/graduate-vacationpersonal-time>

### 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 refrigerator and microwave are located in the Biology Common room across from the main office and a second Common Room located on the third floor of Iacocca Hall in the B-wing. There is also a microwave located in the café area of Iacocca Hall.

## **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).

### 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 of an MS in Molecular Biology or Biology if you meet the requirements (30 credits total, 24 course credits and 6 research credits). In addition to a terminal master's degree, you can choose to apply to receive a MS in Biology. Please reach out to the Academic Coordinator for more information on receiving this degree "along the way" to your PhD.

## **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 401: Professional Skills for BIOS Students (3 credits)
- BIOS 402: Ethics and Rigor in Research (1 credit) *Note: must be taken within their first year of graduate study.*
- BIOS 406: Biological Sciences Seminar (1 credit) *Note: must be taken at least twice in the first four semesters.*
- BIOS 408: Responsible Conduct of Science (0 credits) *Note: must be taken within their first year of graduate study.*
- 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:**

Core Competency Courses: Required if background is insufficient. Need will be determined by the Graduate Committee based on the student's academic history.

- BIOS 473: Principles of Biochemistry I
- BIOS 372: Elements of Biochemistry II

Concentration Electives: Concentration electives, choose 3-4 courses, (3-12 credits).

Note: If both BIOS 473 and BIOS 372 were taken, choose only 2 courses.

- One literature-critique based course (BIOS 471 - Eukaryotic Signal Transduction, BIOS 421 – Molecular Cell Bio I/cell bio, BIOS 422 – Molecular Cell Bio II)
- CHM 423 - Bio-organic Chemistry OR a 400-level bioinformatics course (through CSE or BIOS ie: BIOS 474: Computational Molecular Modeling and Simulation
- BIOS 345 - Molecular Genetics OR BIOS 411 Advanced cell biology

### Free Electives

- 400 or 300-level courses outside of concentration or department. Choose 1-3 courses together with the Graduate Committee or Research Advisor. (3-9 credits)

## **Cell and Molecular Biology Concentration:**

Core Competency Course: Required if background is insufficient. Need will be determined by the Graduate Committee based on the student's academic history.

- BIOS 345 - Molecular Genetics (or equivalent)

Concentration Electives: Choose 3-4 courses (9-12 credits)

- 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)

Free Electives: 400 or 300-level courses outside of concentration or department.

Choose 1-3 courses together with the Graduate Committee or Research Advisor. (3-9 credits)

## **Evolution and Behavior Concentration:**

Core Competency Course: Required if background is insufficient. Need will be determined by the Graduate Committee based on the student's academic history.

- BIOS 317 - Evolution

Concentration Electives: Choose 3-4 courses (9-12 credits)

- BIOS 423: Evolution of Development
- BIOS 426: Coevolution
- BIOS 428: Molecular Evolution
- BIOS 434: Speciation
- BIOS 435: Epigenetics
- BIOS 448: Marine Biology

Free Electives: 400 or 300-level courses outside of concentration or department. Choose 1-3 courses together with the Graduate Committee or Research Advisor. (3-9 credits)

- Non-Evolution/Behavior Elective (any of the 400-level Cell and Molecular offerings OR any of the 400-level Neuroscience offerings)

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

### **Neuroscience Concentration:**

Core Competency Course: Required if background is insufficient. Need will be determined by the Graduate Committee based on the student's academic history.

- BIOS 404 - Behavioral Neuroscience

Concentration Electives: Choose 3-4 courses (9-12 credits)

- BIOS 415: Synapses, Plasticity and Learning
- BIOS 424: Advanced Neurobiology of Sensory Systems
- BIOS 438: Neurodegenerative Diseases in Model Organisms
- BIOS 453: General Neuroanatomy
- BIOS 457: Advanced Behavioral Neuroendocrinology
- BIOS 486: Genes and the Brain

Free Electives: 400 or 300-level courses outside of concentration or department. Choose 1-3 courses together with the Graduate Committee or Research Advisor. (3-9 credits)

- 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)

## **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. [General Exam Form](#)
2. [CAS PhD Candidacy Application](#)

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. You must submit a completed\* application and complete your interview by the [posted deadlines](#).

\*a completed application must be signed by each committee member before the deadline to be considered complete

### **Progress Meetings**

Progress is assessed on 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: [CAS Graduation Checklist](#)

### **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 (pronounced “Knee Miss”) 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. 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 should receive 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 1st***

*Fall Semester Fellowships: **April 1st***

## **Seminar Series, Job Talks, and Internal Talks**

### **Seminar series: Fridays at 11 am 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 “chalk talk” 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.

### **Training Seminars: Mondays at 11:00 am 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 Mondays. Postdocs 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 (Mandy Fraley, Manager of Graduate Programs: 610-758-4280, [amf518@lehigh.edu](mailto:amf518@lehigh.edu); R. Michael Burger, Associate Dean: 610-758-4282, [rmb206@lehigh.edu](mailto: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](mailto:kaha@lehigh.edu)) or the University Ombuds Office (<https://www2.lehigh.edu/ombuds>).

## **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: <https://cas.lehigh.edu/graduate/current-students/graduate-forms-resources>.) 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:**

Kayleigh Baker, J.D., Interim Title IX Coordinator / Interim Equal Opportunity Compliance Coordinator  
Alumni Memorial Building, Room 302  
(610) 758-3535, [eocc@lehigh.edu](mailto: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, [ljp3@lehigh.edu](mailto:ljp3@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](http://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 Counseling & Psychological Services  
Johnson Hall, 4<sup>th</sup> 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/>

# Qualifying Exam for Biology PhD

## Definitions

- **Qualifying Exam Oversight Committee (Qual Oversight Committee).** Oversees approval of topics, Qual Committee assignments, and overall qualifying exam policies. Currently: David Zappulla, Wonpil Im, Santiago Herrera
- **Qualifying Exam Committee (Qual Committee).** Responsible for evaluating student proposals and conducting the oral examination. Two department faculty members plus a member of the Qual Oversight Committee.
- **Graduate Committee.** The BIOS department-level PhD Program committee responsible for graduate program oversight, including exam retakes and appeals.

## Exam Overview

The PhD qualifying exam assesses a student's ability to formulate a significant, hypothesis-driven research proposal, demonstrate rigorous experimental planning, effectively communicate their scientific reasoning, and demonstrate depth and breadth of knowledge in the field of their proposed topic. The exam will consist of two parts: a **written proposal** and an **oral examination**.

The **written format** follows the NIH NRSA (National Research Service Award) predoctoral award format (see below for details) and requires the student to generate a grant proposal to define and address a question in biology. The **oral examination** will include a presentation where the student defends the proposed research, expands upon the information provided within the written proposal, and demonstrates strong fundamental knowledge in the relevant research field. **Qual Committee** members will ask the student any necessary questions to determine the exam outcome during the oral examination.

## Exam Process

The qualifying exam takes place during the **spring of the second year**, as follows:

### *1. Topic*

- The student may **choose any topic in Biology** for their proposal, including those within their laboratory or field.
- The student may discuss topic options with their advisor.
- The student must submit their topic choice to the Qual Oversight Committee by **January 15** (or the first Monday thereafter).
- The Qual Oversight Committee will review the topic and provide formal approval or revision requests via email by **January 31**.

### *2. Qualifying Exam Committee member composition*

- The student may **suggest up to two faculty members** for their Qual Committee to the Qual Oversight Committee via email **by January 15** (or the first Monday thereafter).
- Student suggestions are considered strongly, but the final decision rests with the **Qual Oversight Committee** based on faculty availability and expertise.
- Committee composition will be communicated directly to the student via email **by January 31**.
- The student's advisor is not permitted to serve on the Qual Committee.

### 3. *Specific Aims page*

- The student must submit a Specific Aims page to their Qual Committee **by March 1st** (or the first Monday thereafter).
- The Specific Aims page must follow the **NIH NRSA format**, clearly stating the central hypothesis and briefly summarizing supporting rationale and specific aims.
- The Specific Aims page **must contain at least 2 aims**.
- **At least one aim must be original to the student and approved by their advisor**. The advisor must verify the originality of this student-directed aim in writing to both the Qual Committee and the Qual Oversight Committee prior to submission.

### 4. *Faculty feedback*

- Faculty on each **Qual Committee** will review the student's Specific Aims page and provide **written feedback by the Monday after Spring Break**.
- The student is encouraged to solicit feedback from their **Qual Committee** and advisor throughout the exam process.

### 5. *Final proposal submission*

- The final written proposal (1 Specific Aims page + 6 Research Strategy pages, as per NIH NRSA format) will be **due by the last day of classes of the spring semester**.
- Submission must be completed electronically via the designated Course Site.
- The student is expected to have revised their Specific Aims page based on the **Qual Committee's** feedback.
- Page limits must be strictly followed. Content beyond the specified lengths may not be considered during evaluation

### 6. *Oral examination*

- The **oral exam is critical** for overall success on the qualifying exam. The oral examination typically lasts 2-3 hours, including student presentation and questioning.
- The Qual Committee will score the exam using a **standardized rubric**, which students can access in advance through CourseSite.
- The oral exam will begin with a student presentation (no more than 30 minutes) outlining the research premise, background, aims, and experimental plan.

- Faculty on the Qual Committee will then ask the student questions, and the student **should be prepared to answer them in detail**. They should practice for this conversational defense of their knowledge and arguments.
- Oral exams will be **scheduled throughout May** based on faculty availability.
- There will be **at least one week** between the written proposal submission and the oral examination.
- The advisor may attend the oral exam as a silent observer. They may provide input to the Qual Committee before and after the exam, but must leave the room during final Committee deliberations.
- The student will receive written notification of the exam outcome, including rubric-based feedback, within one week of the oral examination.

## Written proposal format

The proposal-based qualifying exam will follow the **NIH NRSA predoctoral award format** and must include the following sections:

- **Specific Aims** – 1 Page
- **Research Strategy** – 6 Pages
- **References** – No Limit
- Half-inch margins, font size 11; see NRSA instructions for further details.

The written proposal must:

- Provide **sufficient background** that clearly establishes the scientific context, key knowledge gaps, and significance of the research questions.
- State focused, **testable hypotheses** that logically emerge from the literature and highlight what will be investigated.
- **Detail the approach**, explaining how it will address the research questions and why it is appropriate.
- Demonstrate **feasibility** with a realistic plan and milestones, emphasizing how the work will advance understanding in the field.
- Highlight **novelty** by clearly showing what is innovative or distinct about the proposed work.
- **Anticipate challenges** by identifying risks, assumptions, and contingency plans for potential experimental pitfalls.
- **Write clearly and professionally**, using precise language that is accessible to specialists outside the proposal's subfield (the Qual Committee is the target audience).

Plagiarism policy:

- All submitted documents must adhere to the University's Code of Conduct on academic integrity. Violations, including plagiarism or use of AI-generated text without proper disclosure, will result in disciplinary actions as outlined in university policies, potentially including dismissal from the program.

Helpful resources:

- NIH Ruth Kirschstein NRSA predoctoral fellowship F31 [website](#) (see links there for F-award “SF424” instructions via downloadable PDF)
- [NIH Grant-Writing Guide](#)
- [NIH Proposal Submission Guidelines](#)
- Additional proposal writing guidance will be provided on the Course Site.

**Possible outcomes of the Exam:**

1. **Pass** – The student meets or exceeds all expectations and is ready to proceed to dissertation research.
2. **Conditional Pass** – The student meets most expectations, but **remediation** is required to address specific weaknesses. The student **must fulfill remediation expectations** to pass.
3. **Fail** – The student’s performance **does not meet the necessary standards** (written, oral, or both).

**Exam Retake Guidelines:**

- If a student fails, the Qual Committee will determine whether a full or partial retake is required, clearly communicating remediation expectations in writing.
- Any **retake** should be done before the Fall semester.
- The retake Qual Committee composition may be unchanged or adjusted by the Qual Oversight Committee.
- If **only one component (written or oral) is inadequate**, a **partial retake** may be scheduled.
- If a retake occurs, this reexamination attempt is the final chance for passing.

If a student fails the retake, they will lose program funding and will be withdrawn from the Ph.D. program at the end of the Fall semester. The student will meet with their advisor and the Graduate Committee to discuss options for completing a Master’s degree.

## Qualifying Exam Timeline Summary

<b>Date</b>	<b>Milestone</b>	<b>Responsible</b>
<b>January 15</b> (or first Monday thereafter)	Submit proposed topic to Qual Oversight Committee	Student
	Submit suggested Qual Committee members	
<b>January 31</b> (or first Monday thereafter)	Receive approval or revision request on topic	Qual Oversight Committee
	Receive final Qual Committee assignments	
<b>March 1</b> (or first Monday thereafter)	Submit Specific Aims page to Qual Committee (and verification of original aim(s) from advisor)	Student (and advisor)
<b>Monday after Spring Break</b>	Receive written feedback on Specific Aims page	Qual Committee
<b>Last day of spring semester classes</b>	Submit final written proposal via Course Site (Specific Aims + Research Strategy)	Student
<b>Throughout May</b>	Oral examination held (scheduled based on faculty availability)	Student + Qual Committee
<b>Within 1 week of oral exam</b>	Receive written outcome and rubric-based feedback	Qual Committee
<b>Before fall semester (if needed)</b>	Complete retake of exam (partial or full, if applicable)	Student + Qual Committee

## **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 non-academic 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.

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

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

### **2025-2026 BOGS Officers**

President: Brooke Dubyna ([bed220@lehigh.edu](mailto:bed220@lehigh.edu))

Vice President: Stefan Choy ([stc221@lehigh.edu](mailto:stc221@lehigh.edu))

Secretary: Dominick Costanzo ([dsc222@lehigh.edu](mailto:dsc222@lehigh.edu))

Treasurer: Julianna Rotondo ([jwr323@lehigh.edu](mailto:jwr323@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.

<b>Rating category</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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).

## TAX TREATIES WITH UNITED STATES FOR FELLOWSHIPS

Country	Dollar Limit *	Treaty Article
Bangladesh	No limit	21(2)
China	No limit	20(b)
Commonwealth of Independent States	9999.99	VI(1)
Cyprus	No limit	21(1)
Czech Republic	No limit	21(1)
Egypt	No limit	23(1)
Estonia	No limit	20(1)
France	No limit	21(1)
Germany	No limit	20(3)
Iceland	No limit	19(1)
Indonesia	No limit	19(1)

Israel	No limit	24(1)
Kazakhstan	No limit	19
Korea, South	No limit	21(1)
Latvia	No limit	20(1)
Lithuania	No limit	20(1)
Morocco	No limit	18
Netherlands	No limit	22(2)
Norway	No limit	16(1)
Philippines	No limit	22(1)
Poland	No limit	18(1)
Portugal	No limit	23(1)
Romania	No limit	20(1)
Russia	No limit	18

Slovak Republic	No limit	21(1)
Slovenia	No limit	20(1)
Spain	No limit	22(1)
Thailand	No limit	22(1)
Trinidad & Tobago	No limit	19(1)
Tunisia	No limit	20
Ukraine	No limit	20
Venezuela	No limit	21(1)

## **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/content/health-insurance-graduate-details>

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://www.universityhealthplans.com/secure/waiver.cgi?group\\_id=4](https://www.universityhealthplans.com/secure/waiver.cgi?group_id=4)

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

### **Insurance Cost & Coverage Periods**

<b>Coverage Period</b>	<b>Annual</b>
<b>Dates of Coverage</b>	8/15/2025-8/14/2026
<b>Student Cost</b>	\$2,745.00
<b>Deadline Date</b>	September 5, 2025

[https://www.universityhealthplans.com/letters/letter.cgi?group\\_id=4](https://www.universityhealthplans.com/letters/letter.cgi?group_id=4)

### **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.

[Health Insurance Subsidy for Funded Graduate Students](#)

## AY 25-26

NOTE: If your paychecks stop before these dates, you will not be eligible to receive the subsidy.

For AY 2025-2026, the annual premium for **\*students only\*** coverage will be \$2,745.00. To help eligible students afford individual coverage, the University will provide a subsidy of \$2,188.00 on Lehigh's student health plan for the 2025-2026 academic year (see criteria below). The out-of-pocket premium for the individual coverage will be \$547.00. Eligible students will receive a subsidy payment of \$833.60 in Fall and \$1,354.40 in Spring, minus the appropriate taxes for each semester during which they qualify. In order to be eligible for the subsidy, the term of employment cannot end before the last day of final exams. The subsidy will be included in the last paycheck of each semester.

This insurance covers the graduate student only and not their dependents. For AY2025-2026, to help afford the dependent coverage, the University will provide a subsidy of \$250 per semester, (\$500 per student/family per academic year) to eligible graduate students with a dependent child and/or spouse; minus the appropriate taxes for each semester during which they qualify. Information regarding eligibility and the application process for the dependent insurance subsidy can be found [here](#).

### **\*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 confirm their enrollment of insurance **AND**
2. 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 a full-time or certified full-time student prior to the payment of the subsidy) **AND**
3. Receiving a graduate assistantship with an appointment of at least 10 hours/week or graduate fellowship paid through the university payroll system **AND**
4. 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.

### **To confirm enrollment in the annual plan, go to:**

<https://www.universityhealthplans.com/lehigh> and then select the Enrollment Form from the menu.

- Students who wish to enroll for Fall-Only or Spring-Only plans or enroll via a Qualifying Event must email the Bursar's Office ([bursar@lehigh.edu](mailto:bursar@lehigh.edu)) to request coverage.
- Make online payments at <https://financeadmin.lehigh.edu/content/accessing-ebill-suite>. Payroll deduction forms are on the Lehigh University Controller's Office website or click here: [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://provost.lehigh.edu/resources/affordable-care-act-aca/aca-qas-lehigh-students>

*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 for 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 textbooks. 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 importantly, 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 workforce

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 Master's 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.