

# Expectations of M.S. and Ph.D. Students

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## Introduction

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This document is intended to give my current and potential graduate students (i.e., you) a description of my general expectations during your studies here at Lehigh University. I do this to eliminate any misunderstandings as you work with me and my laboratory.

As a graduate student, you will be spending the next few years immersed in research and study. During this time you will learn how to formulate research questions, you will develop the technical and analytical skills to solve those questions, and you will learn how to communicate your results to a wide range of audiences. A substantial portion of your graduate studies will be spent performing advanced research and you will operate with considerably greater independence than you did as an undergraduate student. This can be a significant paradigm shift for students who just earned their undergraduate degree and are unfamiliar with performing independent research.

You will need to do in-depth literature reviews on your research topic, enhancing your understanding of both the broad field of study and the specific technical and analytical aspects of your research project. You will develop experimental procedures and protocols to investigate your topic in the laboratory and you will develop mathematical models to both understand the system you are investigating and to interpret your experimental results. Inherent in this independence are the requirements that you must have the ability to learn and adapt; show initiative, be dependable and be self-motivated; and conduct your research to the highest standards.

It is important to realize that it takes a lot of work to earn a graduate degree. Your life will revolve around your research and coursework, and most students spend a minimum of 50-60 hours a week on their graduate studies (both research and coursework). To give you an idea of what characteristics are important to succeed in a graduate research program, the table on the following page compares mediocre students to outstanding students. I only invite students to join my research group if I think they have the ability to be outstanding students. If you fall under the mediocre student category, you need to spend some time thinking why you want to perform graduate-level research.

Most importantly, don't think graduate school is all hard work and toil. It can and should be one of the best experiences of your life. You will have opportunities available to you that are not available in any other setting; you will make new friends from across the globe; and you will learn, if you have not already, that you can succeed at anything if you put your mind to it.

## Characteristics of Mediocre and Outstanding Students<sup>1</sup>

Characteristic	Mediocre Student	Outstanding Student
Work habits	Has a rigid view of research as a “9 to 5” job. Is unwilling to come in on evenings or weekends when required to complete laboratory experiments and leaves early Friday afternoons. Takes shortcuts on laboratory experiments because the experiment is “taking too much time.” Only performs experiments at advisor’s prodding.	Uses time efficiently and is willing to work non-standard hours to complete laboratory experiments and to ensure they are performed to the highest standards. Proactively initiates experiments.
Keeping up with current literature	Reads only journal articles provided by advisor or other students.	Actively and continuously performs literature searches to independently locate journal articles.
Research hypothesis	Content to work on research hypotheses developed by research advisor or others.	Independently and continuously assesses research data, both from the student’s project and that from other researchers, and formulates hypotheses describing observed phenomena.
Lab notebooks	Takes general notes, where the notebook acts more as a research diary.	Provides detailed descriptions of work done in the lab. Step-by-step descriptions and observations are recorded so that anyone using the notebook can completely replicate the experiment.
Writing	Only writes at the request of their advisor and does the minimal writing required.	Continually writes, including maintaining updated literature review of pertinent topics, writing journal publications and reports, and developing research protocols.
Publication	Looks at publication as an afterthought to the experiments. Minor effort put forth in developing manuscripts and assumes advisor will rework mediocre manuscripts.	Realizes that publication of research results is paramount, and focuses considerable effort in developing and writing manuscripts. Continuously develops new publication ideas and proactively approaches advisor with potential manuscripts.
Problem solving	Comes to advisor seeking solutions to research problems.	Looks at research problems as an opportunity to grow and learn. Develops potential solutions to problems and discusses them with advisor.
Teamwork	Focuses solely on own research.	Understands that the collective output of the laboratory is a key component of the student’s own success, and therefore willingly assists others in the lab with projects and lab chores.

<sup>1</sup> Adapted from a memo by Dr. R. Hughes, UMI, to his graduate students, dated 16 December 2003.

## **Philosophy of Advising Graduate Students**

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My main goal in supervising graduate students is to prepare you to be an independent thinker who is capable of formulating research questions; to be technically capable, so you can develop and implement plans to address those questions; and to be an effective communicator in disseminating your ideas and results to both the scientific community and general public. As your research advisor, I will help you learn how to do research, including how to design and conduct appropriate experiments; analyze and interpret your data; develop numerical models to accurately and efficiently describe your system; and publish and present your results. I will act as your mentor, collaborator, counsel and advocate. In return, I expect you to work hard and be self-motivated; be diligent, conscientious, and strive for excellence; and proactively initiate and conduct your research.

My views on M.S. and Ph.D. degrees differ only in the amount of work required to achieve the degree and in my involvement in laying out the research problem. They are:

**M.S. Thesis** is based on advanced research focusing on solving an engineering or scientific problem, with the problem and solution approach typically defined by me. It often involves writing and submitting a one journal article in a peer-reviewed journal.

**Ph.D. Thesis** represents the student's original and independent research that advances the field being studied, and involves the publication of a minimum of three peer-reviewed research articles. While the research topic is often dictated by an existing research grant, the research is developed, performed, and reported by the student under my supervision.

Finally, I truly believe that one other aspect of advising graduate students is for your faculty advisor to help you obtain the skills appropriate to your intended vocation after finishing your graduate degree. For example, if your goal is to pursue a faculty position after obtaining your Ph.D., then I will help you gain experience developing research ideas, writing proposals and papers, teaching courses, and advising students on research projects. To this end, we will have discussions on your career goals, where we will identify the requisite skills and will design a plan for your graduate program to help develop these skills.

## **Expectations of Graduate Students**

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I expect hard work, self-motivation, creativity and honesty from my students. I firmly believe that you can learn more from your failures than you do from your successes, so I also expect a willingness to pursue new ideas without fear of failure. A requirement to join my research group is that my students must be fluent in English (both orally and written), as a significant portion of research involves presenting and publishing the research and results.

You are responsible for managing and conducting your research to the highest standards. This requires a responsible, independent and professional outlook on your part. I expect (and demand) that you be ethical in your approach to your research, your studies, and your interactions with fellow students and faculty. I am unwavering in my demand for the highest ethical standards. Examples of unethical behavior include plagiarism, cheating on coursework,

and fabricating experimental data. Unethical behavior will result in immediate dismissal from my research group. If you have any questions related to ethics, you should talk them over with me.

I also have an expectation of continual progress and excellence in your research. When you set-out on an experimental series, I expect that you will see it completely and thoroughly through to completion, including analyzing the data and writing up the experimental results. Publication is paramount in research – you can do the best work, but if it is not published, it is meaningless. Given this, continual progress in your research includes publication of results. After your first year at Lehigh, you should plan to develop and submit at least one journal publication per year on your research. This results in at least one publication for M.S. students and a minimum of three publications for Ph.D. students.

I have weekly research group meetings, and all students are expected to take turns presenting their research during these group meetings. This is an excellent forum to gain experience in presenting your research and to obtain feedback from your lab mates. I also meet at least once weekly one-on-one with each of my students to discuss their research and progress (we typically meet multiple times per week, both in the lab and in my office).

Finally, for students working in my laboratory, I have a separate document on laboratory protocol and etiquette available to my research group members that you must read prior to beginning your experiments. For documenting experiments, I assign laboratory notebooks to my students and these notebooks remain the property of the laboratory. You are to maintain the notebook such that anyone could read it and be able to completely replicate your experiments. This involves writing down step-by-step protocols for conducting your experiments, notes and observations during your experiments, and summarizing the results of each experiment. These notebooks remain with the laboratory at the completion of your research.

## **Final Thoughts**

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My goal with this document is to give you an idea of what you may expect during your graduate studies. I hope you find it useful in preparing for and conducting your graduate research and I highly recommend that you frequently refer to this document and use it for self-assessment and guidance. And remember, graduate study can be one of the best experiences of your life. I wish you well on your studies and hope that you enjoy advanced research as much as I do!