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## Pre-graduate School Preparation

*One fish, two fish, red fish, blue fish.*

– Dr. Seuss, American writer and cartoonist

### 1.1 Introduction

You may be asking yourself, “What does a Dr. Seuss quote have to do with graduate school application?” When you are an undergraduate you can often feel like you are one insignificant fish in a giant school of fish; especially if you were an undergraduate at a large university. Because of this, and other distractions, it can be hard to get specific instructions on how best to prepare for the next step in your education, that ominous specter known as graduate school. In this chapter, we provide a comprehensive brief of what you should be doing in preparation for graduate school, including the aspects that may seem obvious to some. We also have sections which focus on underrepresented groups, nontraditional students, and international students.

Initial contemplation about applying to graduate school can elicit a wide range of emotions as you ponder the quality of your GPA, prepare for the GRE, and debate whether or not schools will think you are as desirable a candidate as you hope you are! In a traditional sense, graduate education is the final hurdle

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in committing yourself to a target discipline, and the number of years required to begin fostering expertise in a defined subject can be daunting. That aside, the intricacy of the graduate application process has to be traversed before those concerns can be recognized. Applying to graduate school is a process that can be both difficult and awkward because it involves more than just simple grades; although the application process may deter many potential students, the final acceptance will be rewarding. You can assuage these concerns by positioning yourself with the appropriate amount of preparation before you even begin applying. Although much of this preparation can be conducted while you are still an undergraduate, it can also be continued as a postgraduate, particularly for nontraditional students who may spend some years in employment before returning to school.

### 1.2 Undergraduate Course Selection

Your undergraduate years can be some of the most defining years in your life. You have just branched out from under the supervision of your parents, and you are free to develop and mature into the person you want to be. Undergraduate education is also a time for you to plan and choose how you want to intellectually stimulate yourself. If you are one of the fortunate undergraduates who recognized early that you want to pursue graduate education in the natural sciences, the courses you choose should reflect that. Few people like Orgo (organic chemistry) but it is a rite of passage for science students that you should wear proudly. More importantly, the courses that you select and take as an undergraduate should lay the foundation for your graduate studies.

When contemplating course selections think about where you want to end up in terms of what field of study you would like to pursue. Determine what traits or educational skills you will need if you were in a graduate program in that field (we provide suggestions for how to determine this later in the chapter), and select your courses based on that mentality. If you are unsure of what educational background or traits you would need for a particular

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program you are interested in, you can talk with your undergraduate academic advisor, reach out to graduate students at your school, or attempt to contact graduate students at a graduate program you would like to enroll in. We suggest reaching out to a graduate student instead of the PI because graduate students will be aware of what educational background would be useful in the program they are currently in, and may be more likely to respond to such an inquiry than the PI. However, do not let the possibility that a PI might not respond discourage you from trying if you so desire.

To provide an example, let's say you are interested in studying deep sea organisms at a Marine Lab; if you emailed one of the students in a lab doing that work, they might suggest that you get some background in genetics as a lot of genetic work is conducted on deep sea vent communities at present, and a background in biostatistical analysis (this is probably useful if you are going to be in any field of the natural sciences). Similarly, if you were interested in studying immunology, a graduate student might suggest you ensure you understand the fundamentals of cellular and molecular biology, and try not to be intimidated by cytokine pathways, antibodies, and cellular signal pathways. Further, make sure you are able to study with an animal model, as this is a necessity in the field of immunology.

These examples were provided to us from former graduate students in each respective program, and they give you a sense of what you could expect to hear back from students you email, but more importantly they show that the descriptive title of the field does not encapsulate the required skills (e.g. needing genetics for deep sea ecology). We also strongly suggest you email more than one student, and be persistent if you do not hear back from the people you contact. The easiest way to locate students in the lab of a PI is to go to the PI's website. Often they have listed on their website which students are in their lab. Sometimes they may have hyperlinks to those students' graduate student websites. If they do not, you can usually note the names of the students in that particular lab, and then locate them on the university's website in the directory. If this proves too difficult, a simple internet search of the student(s) names with the

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university/institution will generally bring up a graduate web page providing their email contact information.

Of course, as an undergraduate you will have an academic advisor to guide you through course selection, though this advisor may not specialize in your specific interests for graduate education. Typically, the purpose of the academic advisor in undergraduate education is to ensure that you are meeting your requirements for graduation. These advisors can provide sound advice on course selection within your major; however, discussions with students or scientists at programs that you want to enroll in will be more valuable as the individuals will have intimate knowledge of that field and program, as well as the application process.

### 1.3 Maintaining a Strong GPA

Your grade point average (GPA) is an important parameter of consideration during application to graduate school; it is a value that represents your cumulative academic performance as an undergraduate. The GPA is calculated by taking the number of grade points a student earned in a given period of time and averaging them based on the class workload (indicated by the credits a class is worth). It goes without saying that if you want to pursue graduate education, it is vital to maintain a strong GPA; the GPA is the best representation of your body of academic work as an undergraduate, and graduate schools look at it closely. With all the distractions in college it can be easy to lose focus. We do not have suggestions about how to maintain your focus, which is something you will have to solve on your own. However, when you are selecting courses, it would be prudent to space out your most challenging courses and not take multiple challenging courses in a single semester (if possible). As we suggested above, you should be taking courses that will prepare you for graduate school, but try to avoid arranging too many of your most difficult courses in the same semester. Inevitably there will be courses you inherently perform better in than others. If you can have one or two difficult courses a semester, you will be able to better allocate your time to focus on these classes. In addition to

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your final GPA, graduate admission offices look at the courses that make up your GPA, and how well you performed in the courses that most closely represent the field of graduate study you are applying for. Graduate programs in the USA rated performance in “in-major” courses as extremely important (rated 4.0 out of 5.0), and the majority of programs noted that performing well in your in-major classes can make up for average performance in non-major courses. This brings us to our next point.

While it is important to maintain a good overall GPA, it is equally, if not even more important, to ensure that you are performing well in your in-major courses. Your performance in courses in your major (generally science and math courses) provides a view of your capacity for science comprehension and application at the graduate level. For example, if you are applying to a physical science program, but you have struggled in calculus, this could be an indication to a graduate school that you might struggle in their program as well. You need to perform to the best of your ability in your in-major courses, especially those with direct applicability for graduate programs in your area of interest. When given the choice between selecting a student with A) a high overall GPA but lower in-major GPA, or B) a lower overall GPA, but exceptionally high in-major GPA, 96% of graduate programs selected student B. This highlights the importance of the in-major GPA for graduate school acceptance. If you have not performed well in a course that you know will be important for graduate programs you intend to apply to, consider retaking the course, or be prepared to explain your performance in the course. A particularly poor performance in a course would necessitate that you include an explanation for the grade in your personal statement (discussed below) or address it during your visit (see Chapter 7: *Visiting and Interviews*). In any course you take, but especially those courses in your major, if you recognize that you might struggle in the course take advantage of any tutoring available at your college. Tutors are often students who excel in that specific discipline and are able to better explain confusing concepts or processes as they have a student’s perspective.

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If you do not have a good GPA, there are a number of things that you can do to make up for your less-than-stellar performance in coursework. What a low GPA generally represents (to a graduate admissions office), is someone who did not really comprehend the information they were being taught, or someone who lacked a work ethic to do well in the class. If you are a person with a low GPA, you need to dispel both notions in your personal statement and have letters of reference that support you in that pursuit as well; do not hide from your GPA, tackle it head-on. In your personal statement be forthright about your grades not being of the standard or quality that best represents your intellectual aptitude or work ethic. You should then provide reasoning as to why there were extenuating circumstances that contributed to you losing focus as an undergraduate and not performing to the level of which you are capable. Once you have done this you then need to draw upon other strengths in your application, and this is where you need to have properly prepared and positioned yourself to have experiences and qualities to draw on. When US graduate programs were asked what an applicant can do to help compensate for a low GPA, letters of recommendation had the strongest support, followed by establishing a personal relationship with the potential advisor and research experience from an internship.

### 1.4 Research Experience

Research experience is one of the most important components of undergraduate preparation for graduate school and provides you with a range of positive benefits, including hands-on involvement in actual scientific studies. The best way to learn about research is through experience. Getting this experience as early as possible will familiarize you with the research process and common terminology in your respective discipline, and help you begin to hone skills and learn techniques that will be of use to you later in your graduate career. It also exposes you to the process of developing research ideas and conducting projects to answer scientific questions. Essentially, a history of research indicates that it is likely that you

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will be able to “hit the ground running” in graduate school, and will require less initial training than a born-again English major who decides upon graduation that they want to investigate the origins of our universe (though, if this is your predilection, go for it!). While gaining this invaluable experience you also have the opportunity to learn about yourself. Through different experiences, you determine what your research interests are and are not. Are you more of a lab warrior, sporting your not-so-white lab coat with pride? Or would you prefer to be outside, with the wind in your hair, and bugs at your ears? Often students surprise themselves about what truly piques their interests after garnering experience with varied research opportunities. Using this experience to narrow down your interests, even slightly, will aid your search for a potential advisor or graduate research program (see Chapter 4: *Choosing a Graduate Program*).

Another benefit of research experience is that it looks great on your *curriculum vitae* (CV). When you apply to graduate school, one of the facets of the application that represents who you are is your CV. It is best to gain as much research-based experience as possible to include on your CV to show that you are familiar with developing scientific questions, and the process of research and data analysis that goes into answering such questions. Also, with respect to your graduate application, having strong research experience can serve as a buffer or counterweight for less stellar aspects of your application (e.g. below-average GPA or GRE scores). The benefits of research experience for your CV and how to set up your CV are discussed in more detail in Chapter 3: *Your Curriculum Vitae (CV)*.

Research experience is also a great avenue for networking within your potential field; both with peers and senior scientists. Your academic peers will be working directly in your lab, office, or building, and this is a great time to begin setting up your scientific network. Establishing social professional relationships with other students is great because your interactions with them can broaden your horizon about other research experiences and opportunities. Also, later in your career you may cross paths with those same peers at scientific

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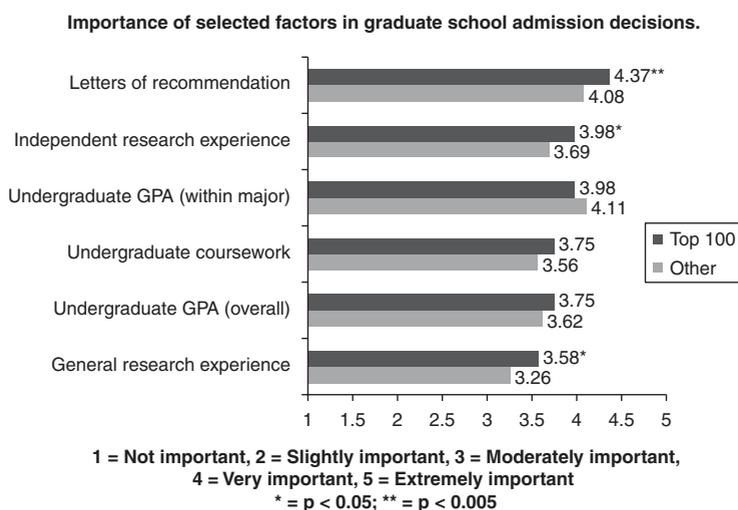
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conferences, immediately providing you with a social connection. This is especially important for those new to science. Science meetings can be intimidating places, and we discuss this in more detail later in this chapter. Who knows? You may even end up collaborating with some of these people in the not-too-distant future!

More importantly, research experience allows you to begin establishing relationships with senior scientists who are established in your field. This is important because as you continue your scientific career you will find that it is important to have people who are able to speak about your scientific abilities on your behalf. This usually takes place through the writing of reference letters, but can also occur less formally. It is vitally important to have an established scientist who knows you and your research acumen, and is willing to say, “Yes, this person has what it takes to succeed.” How important are letters of recommendation writers? Graduate institutions listed them as extremely important in our survey, and this aspect of applying to graduate school received the highest rating (4.2 out of 5.0). Your references also play an important role in securing additional research opportunities where you can establish more scientific relationships. If you continue on this positive feedback route, when you decide to apply to graduate school, you will have a healthy network of established scientists to call on for letters of support. We suggest that you keep in touch with each of the senior scientists you connect with as you continue your progression. They are more likely to agree to write you a letter of reference, and write one that is accurate and meaningful, if they are updated about where you are in your fledgling career. You may even find that the relationship you have with the scientist you worked with evolves into the potential for graduate work!

Generally, research experience can be garnered in one of three ways: through a research-related job, as a research assistant in a lab, or by having an internship. We distinguish research jobs, where an individual works full-time (forty hours plus per week) from a research assistantship, where an individual works in a part-time capacity; these qualitative titles (internship, research assistantship, technician) are meant to provide some order to the hierarchy of

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**FIGURE 1.1** A comparison of the most important selected factors in admission decisions between IHEs in the top 100 (dark gray) and IHEs not in the top 100 represented as “Other” (light gray). Asterisks represent significant differences between groups (i.e. Top 100 and Other).

scientific research experience. The research-related job is the most straightforward and can occur during your undergraduate years, or immediately following them. Most research-related jobs occur in a research lab, usually as a technician though sometimes as a lab manager. As a technician you will not have much independent authority (except maybe over undergraduates), but you will get a lot of exposure and “hands-on” experience learning a variety of techniques and methods. Research technician jobs do not generally pay well, but offer a great opportunity to build your scientific skill set, learn new techniques, build your CV, and establish a relationship with a well-known scientist to get a letter of reference (usual this is the scientist leading the lab). Research assistants, another research-related job, tend to have the same style of job as a research technician, though the time they put in is often limited to much less than forty hours a week and is more of a temporary/part-time position.

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All research experience is not created equal, and of these three types, often the most valuable research experience you can get is through an internship because it allows you to conduct an independent research project. You can think of independent research internships as mini-modules of what it is like to be an academic scientist. Under the supervision of a PI, from start to finish, these opportunities require you to develop an independent research project, conduct the research, analyze the data, synthesize the results, and present your findings in a presentation and/or paper. When surveyed, graduate institutions stated that research internships where a student conducted an independent research project were very desirable (rated 3.9 out of 5.0), in comparison with general research experience (e.g. technician and research assistantships), which were rated at 3.4 out of 5.0. General research experience is still important, as indicated by the 3.4 value, but it is not as valuable as an internship which provides independent research experience. When research programs look at an applicant, only one of these three research experiences indicates an aptitude to conduct research independently, and this is the internship. We should point out the caveat that often while participating in a research assistantship you may have the opportunity to conduct your own research project. If you do, the quality of that experience is more in line with an internship and should be represented as such in your CV. If you are unable to acquire an internship, but have a research assistantship opportunity, take it! Graduate programs still look favorably upon these experiences, and they hold far greater weight than work experience that is not research related. Graduate programs in our survey rated non-research related work experience as unimportant with a score of 1.7 out of 5.0 (see Figure 1.2).

Research programs are looking for indications that you will be able to operate independently as a graduate student and still maintain a level of success academically and scientifically. When you are in graduate school there will be varying levels of supervision by your major advisor, but there is an expectation of independence for graduate students. When you as an undergraduate are contemplating opportunities to participate in, you need to choose the ones