Preparing for Graduate School in Biology and Related Fields

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From time to time, God causes men to be born - and thou art one of them - who have a lust to go abroad at the risk of their lives and discover news - today it may be of far-off things, tomorrow of some hidden mountain, and the next day of some near-by men who have done a foolishness …. These souls are very few…
- Lurgan Sahib, in Kipling's *Kim*

Introduction

Graduate school training leading to a PhD can be rewarding in its own right and open a number of fulfilling career options, including, but not limited to, BioMedical research. People who love learning about biology and also like figuring things out are particularly likely to benefit from biology grad school. In considering graduate school, some introspection can help you to make the right choice. Many people love learning about biology or science in general. They love their classes, reading about new discoveries, and talking to others about science. Only a subset of these people enjoy the practice of figuring new things out for themselves. These people have the mindset that makes the good candidates for research training.

If you are one of the people who "lust" to "discover news," good preparation at Brown will help you find and get into the right program while also testing your true interest prior to committing. This will involve class choices at Brown, research experience, appropriate choices of schools to apply to, plus the ins and outs of applications, recommendation letters, GREs, and interviews.

Class Choices

In discussing class choices and options, I will use examples related to my department and graduate program. If your interests are in Neuroscience, Biomedical Engineering, Immunology, there will be courses among those I mention that are relevant as well as others you can figure out from looking at the lists of courses featured in these concentrations and talking with your advisor.

Brown's open curriculum makes it possible to dig into your intellectual interests, including science, with a vengeance. Your first and second years let you indulge your scientific interests while setting the foundation for the really cutting edge stuff in your third and fourth years. As part of this, do not ignore the freshman seminar options. Try to get your Chemistry and Math requirements done in the first two years, as well as the key bio prerequisites for your interest (e.g, Genetics, Biochemistry). This sets you up to take more advanced courses (1000 level) in your field as well as in Chemistry or Math. These courses, or ones like them, open up courses dealing with the newest research results in biology such as Analysis of Development, Molecular Genetics, Biology of the Eukaryotic Cell, Cancer Biology and Virology. These have fewer students than the lower division classes, involve reading primary research papers, and involve more direct interaction with the faculty. Taking upper division courses in your fifth, sixth, and seventh semesters allows you to start taking

graduate-level seminars as early as your sixth semester. Seminars let you really challenge yourself while dissecting the latest research papers in an extremely interactive environment. In my experience, well-prepared undergrads can be among the strongest contributors to these courses, so don't shy away.

If you are now more senior and have not pushed this hard so far, there are still options. In particular, make sure to take as many of the literature-based 1000 level courses as you have the time for. This is not just to sweeten your resume. These courses help make sure you are ready to thrive when you get to graduate school.

Faculty Interactions

Most of the faculty love science and like talking about it. Take advantage of this. First year seminars are a good way to get to know a professor, especially if it turns out that the faculty member's interests overlap yours. Taking upper division courses makes it easier to know faculty members and for them to know you. Not only are the classes smaller, you almost certainly have papers to discuss. This does not mean that you cannot get to know your lower division instructors, especially in courses with homework help sessions, or available office hours, but it is easier in the smaller upper division classes. Once you have a concentration advisor, be sure to keep in touch with him or her, not just for immediate advice, but also to talk more generally about what you are doing or are interested in. When talking to professors, do try to have honest questions about things that truly interest you, since professors do have 'Brown Noser' sensors.

Research

For most graduate programs it is highly advantageous to have relevant research experience. **An extended, productive period in one lab is worth far more than a series of one semester stays in many labs**. Getting an entree into a lab may be difficult, but many faculty members take one or more research undergrads. An important aspect of finding a favored lab is your grades in relevant courses, and the depth of your course work. For example, an 'A' in Genetics gets my attention, and an additional 'A' in Molecular Genetics pretty much seals the deal.

The search for a lab is a place where knowing your instructors helps. It may be that one of your professors has research of interest to you. If you have established a rapport with an instructor, with a good grade in class, you have a significant opportunity. Even if you are not directly interested in your professors' projects, you can discuss your interests with them and get pointers to other faculty members. This gives you a faculty-to-faculty connection, and a recommender, to validate your sterling qualities.

Once you join a lab it is critical that you become a full fledged member of the lab. Attend every group meeting and journal club. Go to department seminars and relevant special seminars. If you don't understand something, ask a graduate student or postdoc to clarify things for you. In the lab you will probably be working with a graduate student or postdoctoral fellow. Labs are organized like outlines. The general field is overarching. The professor's interest is broad but focused in a sub-area of the field. Each postdoc or grad student has a project dealing with a subset of the professor's interest. You will be working,

at least initially, on a sub-portion of your grad student's or post doc's project. You should learn all you can about each of these levels well enough to be an active participant in group meetings, and to discuss with others what the lab does.

Initially, you will be learning methods and pretty much doing what your supervisor tells you to do. This is good training, but you are not in the lab to be an unpaid technician. Use your brain, make contributions to the planning of new experiments. If you have good hands and good ideas, there is a high probability that you will gain significant autonomy in your work. A key point to remember: Actual lab work does not follow a schedule that you can write on a card like a class schedule. Things need to be done at odd times, and certainly at the right time. Often a short trip or two to the lab one day saves one of two additional days on the way to a result. Sure, it's Sunday morning at 8:00, but go in there and pick those colonies. Come back at 10 PM and set up the cultures for tomorrow.

Choosing Your Schools

Unfortunately, applying to grad school costs money. Unless you have lots of free time and lots of money, you will need to limit the number of applications you submit. You should consider the academics, research atmosphere and opportunities, as well as the general environment of the school and community, after all, you will be there about five years, you want to be comfortable in program, the lab and the community.

Try to define your own scientific interests early on, and decide whether you want a narrowly focused program, say Virology or Cancer Biology, or one with multiple options across a broad range of biological research. Then start asking the graduate students and postdocs you know about schools they visited or trained at before coming to Brown. Talk to your professors about programs that might fit your style and interests. There are also various websites that you can use to get some idea of the nature of programs. Once you have a list of possible places, take a look at the program websites and other material about the schools and programs. Check faculty research interests. Look them up in PubMed to see what they are doing now.

The Application Process

Your complete application will consist of some basic information about yourself, an official copy of your transcript, your GRE scores, usually including a subject test, a personal statement, and letters of recommendation. The parts that you produce yourself (your basic info and personal statement) can be submitted on line. Your GREs will be sent to all the schools you request, as will your transcript. You will need to ask your referees to send letters to all the schools to which you are applying. Many schools now allow submission of reference letters electronically.

The deadline for applications depends on the school, but deadlines can be as early as mid-November and as late as early January. Be sure to find out the deadline for each school. The institution of electronic applications makes it significantly harder to submit a late application, so plan ahead and meet your deadlines.

Take the GRE early, even in the spring before your application. If you score well, you can relax, otherwise, you can prepare a bit more and take it over again. The subject test can be taken in the spring or fall, but do look at what will be covered ahead of time.

This leaves the letters of recommendation and your personal statement. Lets start with the letters. These can make a significant difference in the process. Strongly favorable letters have a major effect on reviewers, as do notably negative letters. The best letters are from faculty members who know the student well over an extended period, and who know the nature of the discipline. In other words, no matter how well a literature professor knows you, the impact will be much smaller than that of a letter from a biology professor. Obviously, the most important letter will be from the professor who heads your lab. He, and the student/postdoc you work with have the best insight into how you will function as a research scientist, both in terms of your mind and in terms of your skill at the bench. The other professors should know you well and, usually, have taught you in a course in which you did well.

The personal statement can both help you and hurt you. It matters. This is your opportunity to discuss your academic training as well as your research and ongoing scientific interests. Some people like to include touching anecdotes about how they became interested in science. These may or may not be effective. In discussing your academics, you can use the essay to note the classes you have taken that make you particularly prepared for advanced study. As many of our 1000 level courses also offer graduate credit, there is a good chance that at least some of your courses have had grad students as well as undergrads. Go ahead and mention that, as well as noting any graduate level seminars you have taken. In each case make the relevance of these clear by noting important content and the experience you have gained in reading and discussing the primary literature. If you had an anomalously bad semester, it would not hurt to explain why. This is especially true of you have a good explanation such as 'I had mono,' or it was your first semester and you took a while to adjust to college. It is probably not advised to say that a relationship ended and you were in the dumps for a semester.

A key portion of the essay is the description of your research. Remember the outline-like nature of the lab organization and use that. Note what questions and goals are associated with each level from the top all the way down to your portion of your postdoc/grad student's project. Particularly explain the big picture and the question you and your immediate mentor want to answer. Show how your work fits into the big picture, even if all you are doing is making plasmids for the postdoc to use in cell culture assays. Explain the results from the parts of the project you have done, referencing if they fit or contradict any of the hypotheses you may have had, and how you now interpret your results.

Recruitment / Interviews

If your application is viewed favorably, you will almost certainly be invited for a recruitment visit. At some schools this is an interview visit as well, while at others you are already accepted before you visit. In any case, you want to make a good impression. As part of the visit, you and probably others will meet individually with multiple faculty members in the program. These meetings generally last 30-45 minutes.

Part of this will involve you discussing your work. Again, take advantage of the outline nature of your lab's organization and then discuss your work in that context. Remember to list possibilities or hypothesis and how your results fit in. Also, be prepared for background questions about the system you are working with. Just knowing your tiny part of the system is not enough. If you are on top of what the lab does, this can be quite pleasant. During another part of these meetings the faculty member will tell you about his or her work. Look interested. Feel free to ask questions, especially questions that connect to his research, either directly or by connection to something you know from classes or seminars you have attended. Do not push things to the point of excess. If you start using fancy terms incorrectly and pontificating foolishly, you will substantially hurt your chances for admission or your reputation if you are already admitted.

You will also have multiple opportunities to interact with the resident graduate students and your fellow candidates. These are your future colleagues and friends. Be polite and sociable. Drink moderately.

Finally, you will also interact with the program staff, including the various administrative assistants and program coordinators that make the day-to-day activity of the department and program go smoothly. Treat these people with a friendly, polite manner. They work hard and deserve your polite treatment. Remember, you may be interacting with these people for the next 5-6 years. There are times when you will really need their help. Help them want to help you.

Summary

Plan your schedule so you can take upper division and graduate courses in your third and fourth years. Take advantage of opportunities to talk science with the faculty. When you join a lab, throw yourself into it as if you were a graduate student: group meetings, seminars, journal clubs, lab work. When applying, note your positive qualities, and discuss your research experience in a clear, scientific manner. When interviewing, be prepared to discuss your lab work and background topics and feel free to ask questions of the faculty and students. Be polite and pleasant and do your best to have a good time. Good luck.

Professor McKeown is Director of the Molecular Biology, Cell Biology and Biochemistry Graduate Program. He has served on graduate admissions committees for both the Biology Department at the University of California, San Diego and at Brown, as well as participating in at least 15-20 interview weekends.