**Thinking of Applying to Graduate School in Biology?**

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In many biology fields obtaining a graduate degree will increase your range of employment options or improve your earnings; graduate school can also help prepare you to enter a health-related professional program. However, graduate school is a big commitment and is not right for everyone. Reading this document will help you decide whether graduate school is the right thing for you. If you have more questions, the best thing to do is to talk to your professors or contact the biology graduate program director at the university to which you are applying.

**1. What is graduate school?** Students wishing to pursue graduate studies will typically work towards earning a Master of Arts (MA) or a Master of Science (MS), a Master of Science in Teaching (MST), or a Doctorate (Doctor of Philosophy - PhD). The requirements for these degrees vary somewhat among universities, but most Master's programs and all PhD programs will require an original research project (a thesis for the Master's, or a dissertation for the PhD). The Department of Biology at Portland State University offers the MA, MS, MST, and PhD degrees. The requirements for the MA and the MS are nearly the same with respect to course work and the thesis, with the exception that MA requires course work in a second language. The MST is designed primarily for students who are interested in biological education careers in environmental education programs, museums, or in secondary level schools. The PhD is a terminal degree in the field of biology, and is for individuals wishing to pursue research or teaching careers at private and public agencies, with industry, or at private and public colleges and universities.

**2. Is graduate school right for me?** For many students in biology, the Bachelor's degree is not adequate for them to achieve their career goals. Students obtaining Master's degrees typically have a broader range of options available to them, with more opportunities for working in positions of greater responsibility or earning higher salaries. When deciding whether you should apply to graduate school, consider what your career goals are and which type of degree will be best to advance you towards those goals. If you ultimately plan to obtain a PhD, it is not necessary for you to get a Master's degree first, but it is generally advantageous in the long run. Students who obtain a Master's first generally have more success in PhD graduate programs and can benefit from more diverse training experiences if they obtain their degrees from different universities. Also, getting a Master's degree first allows you to switch projects, advisors, and schools without losing important time spent on a project.

**3. What does it take to get into graduate school?** If you are thinking of pursuing a graduate degree, there are some basic requirements that you will need to meet. Outstanding grades as an undergraduate, previous research experience, and excellent scores on the Graduate Record Exams (GREs) will all help. However, it is important to recognize that admission to graduate programs depends largely on the availability of assistantships (teaching or research) and on the availability of positions (and funding) in a particular research lab. Even if you are the best applicant, you may not be admitted if the professor you are applying to work with does not have

any room in his/her lab. For that reason it is important to establish a correspondence with professors at different universities and to apply to more than one graduate program.

**4. Are there minimal requirements?** Most graduate programs have minimal requirements and will not accept students with undergraduate GPAs that are less than a B average, or General GRE scores that sum to less than 1000. However, graduate admissions committees will take a number of factors into account when deciding which students to admit. The type of things they are likely to consider include: 1) if your GPA was higher in your last year of undergraduate school, 2) if your GPA for classes in your major was higher than your overall GPA, 3) whether you have done well in graduate-level courses as a post-bac student, 4) whether you have completed an undergraduate independent research project, 5) whether you have strong letters of recommendation from your undergraduate professors, 6) if your first language is not English there may be more leniency for exam score requirements, and 7) if you have high scores on one or more of the GREs or subareas (either the General exam, or the subject exam in Biology or in Biochemistry, Cell and Molecular Biology). What most graduate programs are looking for are motivated students who want to do research and to engage in scholastic activities- your biggest assets are your enthusiasm, willingness to do hard work, and persistence.

**5. Will I be taking a lot of courses in graduate school?** Not really. A full load for graduate students at most universities is 9 instead of 12 credits per term. Graduate students typically take more courses in their first year (perhaps two or three per term), but many fewer after that. Most of the course load each term is made up of research, reading, and thesis or dissertation credits. These programs are designed to reflect the fact that most of your scholastic effort is your engagement in a research project. The courses you take will also typically have a different format, with much less lecturing by the professor, and more discussion-based learning. Your courses will help you understand the process of science, collection and analysis of data, and will help you become familiar with the primary scientific literature.

**6. What will I learn in graduate school?** The primary focus of MA and MS programs is to learn how to design and execute a research project. These programs focus on: 1) The development of a research proposal that includes a review of the relevant primary literature, the identification of specific hypotheses, and an experimental plan for testing the proposed hypotheses; 2) the implementation of the experimental plan for the purpose of data collection and data analysis; 3) application of the results to tests of hypotheses; and, 4) interpretation of the results within the context of the existing literature. The primary product of the Master's degree is a thesis that describes the research activities in standard scientific format (introduction, methods, results, discussion and literature). The student will usually present his or her results in a public seminar and will be required to pass an exam administered by a committee of faculty.

The MST program focuses primarily on the interpretation of science process and results for education purposes. MST students typically choose a particular sub-area of biology as a model for the development of lesson plans and curricula. The MST program includes course work in science education where different pedagogical techniques are presented and discussed. The primary product of the MST degree is a curriculum that describes the lesson plans developed by the student. The student will usually present his or her results in a public seminar and will be required to pass an exam administered by a committee of faculty and experts in the field.

The PhD has many of the same goals as the Master's degree, but the research conducted by the student encompasses a research program that includes a series of interrelated experiments.

Students in a PhD program are expected to work much more independently. Each student is responsible for the development and implementation of a research program and the preparation and publication of papers in the primary literature. Students completing the PhD are expected to have engaged in a course of research that will result in a series of publications, and to have become fluent in the primary literature relevant to their field of research. The primary product of the PhD is a dissertation of separate chapters- each of which describes the design and results of an individual set of experiments in scientific format. The student will present his or her results in a public seminar and will be required to pass an exam administered by a committee of faculty and experts in the field.

**7. Is graduate school in biology just about research?** No, it is also about teaching. Research and teaching go hand-in-hand, so it is natural that most graduate programs will emphasize both. Graduate students in most programs are required to participate in teaching activities at some stage of their career. These teaching experiences are primarily through the delivery of laboratory sessions. These will provide students with opportunities to deliver short lectures and to engage in one-to-one teaching experiences with undergraduates. Depending on the needs of the program, your primary activity may be teaching, or in others, you may have a series of research assistantships that alternate with teaching assistantships. Laboratory teaching activities by graduate students will be supervised by a professor, and most programs will provide you with the necessary guidance and training for this to be a fruitful and rewarding experience. Virtually any job you obtain in the future will involve presentation, teaching, and training responsibilities. The opportunities that you are given in graduate school to hone your presentation and teaching skills will be valuable for your future success.

**8. How hard will I have to work?** Graduate degree programs are more intellectually demanding than undergraduate programs. In addition to class work, you will have responsibilities for your research and teaching activities. Graduate students should expect to spend at least 40 hours per week on their course work and research activities, and an additional 15 to 20 hours per week on their assistantship duties. To be successful in your graduate program you will need to spend many hours on weekends and weekday evenings in addition to your regular work day. So, the caricature of hard-working graduate students obsessed with their thesis work is not far from the truth. But if this is the right path for you, you will find that much of the work is a joy and not a burden. Your motivation and rewards will come from the thrill of being engaged in original research, from the intellectual challenges that you will face, and from the camaraderie that you will develop with your fellow graduate students.

**9. How should I prepare for graduate studies in biology?** The best way is to first complete a Bachelor's degree in biology or a related field. Depending on your degree and the graduate program you enter, you may be required to take additional courses that fulfill the general education requirements of the department. It is also an excellent idea to become involved in a research project as an undergraduate. Look for opportunities for engaging in independent research or a senior honor's thesis at your institution. ***You should start looking for research opportunities during your sophomore or junior year.*** This will often require that you make the effort to get involved- talk to your professors about opportunities in their labs. The particular project that you become involved with is not as important as the opportunity for independent research. There are often opportunities to earn credits from your independent study activities, or maybe even earn some money if the lab you are working in is well-funded. Whatever project

you choose, it will give you valuable experience in the practice of scientific research and hypothesis testing, and this experience will be the best way to help you decide if you want to proceed with a research-focused post-graduate education.

**10. How do I decide on where to apply?** The first thing to remember is that it is best to apply to the professor rather than the program. This may mean that you need to look far and wide for university professors across the country, or maybe even across the world. The best way to search for the opportunities is by reading the primary literature (scientific journals), searching the web, talking to your professors, and by subscribing to list servers that advertise positions in your areas of interest (e.g., EvolDir [http://evol.mcmaster.ca/brian/evoldir.html] or EcoLog [https://listserv.umd.edu/]). Here are some pointers:

A. If you are looking for a Master's program, you may decide to work with a professor you already know. This is fine, but remember that the range of courses that may be available to you will be more limited if you choose to continue your graduate studies at your undergraduate institution.

B. While it is generally fine to pursue a Master's or MST degree at the same institution where you obtained your Bachelor's, it is usually not the best idea to obtain a PhD from the same institution. However, this really depends on the type of research you plan to do- remember, the first thing is the professor (lab), rather than the institution or location. Your goal is to find the best lab in the country (world) that can accommodate your needs. Aim to get the best education that you can, even if that means having to live in a place that you don't like for a few years.

C. You may be in a position that requires you to take into account the needs of a partner or family as well as your own. In that case, you will need to work out a compromise to settle on a solution that will work best for all of you.

D. And, most importantly- the "best" person to work with in your field is not necessarily the most famous- in fact, it is usually not! Look for a professor who is doing exciting research, who will be an outstanding advisor, who will invest time and resources (equipment, money, energy) to your work, and who is located in a place that works for you.

**11. How do I decide on what type of degree to pursue?** If you are interested in a research degree, it is generally best to obtain a Master's degree first, even if you plan to ultimately get a PhD The MST is better if you are most interested in teaching and education activities- whether it is at a school, environmental institute, outdoors program, or a museum. The MST will provide you with the best background for delivering a diverse and engaging education program in biology. If you do decide to pursue a position at a secondary school you will need to obtain the appropriate teaching certificate in addition to your Master's.

**12. I know I want to get a PhD, so why not skip the Master's?** The best way to prepare for a PhD is to get a Master's degree first. Unless you have an excessive amount of undergraduate research experience or specialized work experience and are very focused in your research interests, then get a Master's first. Students who have completed a Master's will have a much broader appreciation of the research opportunities and areas of expertise that are available to them. Getting a Master's first may also help you decide that getting a PhD is really not the thing for you, but will take you a long way towards helping you to decide what on the next best step.

**13. I'm already stretched financially, so I don't think I can afford to continue school.** Well, that's the best part about a graduate program in biology- if it is a good one, they will pay you a

stipend (salary) and give you a full tuition waiver. Graduate student packages (stipend plus tuition waiver) vary from around $8,000 to more than $40,000 per year. Even though the money might be tempting, it should not be your primary motivation for choosing a graduate program. Remember, professor (lab) first, institution and stipend level second. Nearly all graduate programs in biology will provide their students with enough stipend to subsist without having to take out loans. You won't be able to afford many luxuries during grad school, but you won't have time to enjoy them anyway. If this path is right for you, the work itself is rewarding enough. And remember, with a tuition waiver you won't be a drag on your family's finances anymore, so you will have a sense of financial independence that you can build on as your career develops. If you are a single parent, or if you have other financial obligations, then you may be eligible for financial assistance beyond the normal stipend offered to most students.

**14. Ok, I'm pretty sure I want to start applying, so what do I do next?** Here are some steps to take:

**A. Start at least a year in advance of when you want to enter a graduate program.** Most programs will admit students in the fall, but admission at other times of year might also be possible. Do your research and identify three to six professors with whom you might want to work. If there is a professor in your undergraduate program who does research or teaching in the field that you are interested in, then this person may be your best resource. One way to approach a professor would be to first find the name of a person from the web or maybe a paper you read. Ask them if they have heard of so-and-so, or if they have met them. Here are some other things you can do:

1. If you do find a paper that you think is exciting or very much the type of research that you would like to do, then pay close attention to the institution notes for each author (there are often several authors). Papers will often be authored by students and post-docs in the lab as well as the *principle investigator* (the PI - the professor who is the head of the lab). The hard part may be to figure out who is who, and the PI will not usually be the first author, but more often the last one on the list. One thing you can do is to look for one name that is designated as the "corresponding author" - that person is probably the PI. The other thing you can do is to search a literature data base by each author's name to figure out what other type of research that they have done. You may find that the PI on your paper is close to retirement, or maybe they have a very large lab and you are not sure you want to work in an environment like that. In that case look to see if any of the other authors have recently moved to a new university- maybe where they are starting a new faculty position and are looking to recruit students.

2. Another great resource is the web. Usually, if a PI is interested in recruiting grad students they will put some effort into developing an attractive web page. This will also give you a better idea of what they are up to now (rather than a few years ago when they were doing research on a paper you read) and how big their lab is. This last factor is an important thing to consider- it might be exciting to be in a big lab where a lot is going on, or you might prefer to work in a smaller lab where you are more likely to get more personal attention from the PI. Talking to grad students who are already working in the lab and making a visit might help you get a better idea of what the lab atmosphere is like.

3. Join a listserve and look for ads for the type of research that you want to do. PIs who have funding for graduate research assistants will often advertise on these lists. You will also find ads for graduate programs and groups of faculty who specialize in a particular research area. Scanning these ads will give you a start on learning what opportunities are out there.

4. Go to a scientific meeting (conference). Particularly if you are engaged in a research project, you may find out that the professor you are working with is going to a national or regional meeting. Meetings are often the best place to meet faculty from different institutions and to find out what research they are engaged in. It is also a great place to meet graduate students who work with them so you can insights into how it is to work in their lab.

**B. Take the general GREs.** This can be done at a testing center on a computer any time. Study the material and take practice exams. Once you have your scores, you are ready to start contacting potential advisors.

**C. Write an introductory letter.** Get a professor or somebody else in science to read your draft and help you refine it. When you contact potential advisors by email or letters you will want to say four things: 1) I am generally interested in these fields of research (related to what this person does), 2) I am really interested in your research because I think it is very exciting..... I read your paper.....and I was thinking, etc. 3) I'm a really good student. My GPA is X and my first two GRE scores are X and X. Although these scores are not as high as some, I am a very motivated and hard working student, etc. Or, I have not taken the GREs yet, but I plan to soon. 4) Tell them exactly what type of degree you would like to pursue. If you are looking to pursue a Master's degree, then you should ask if Masters students in their department are supported with stipends and tuition waivers. Many departments in very large research universities will typically only support PhD students, and this information is often not readily available on their web sites. If they say no, then you may have to look elsewhere. If they say no but they are the person you really want to work with, then you may want to consider pursuing a PhD Even if you enter a PhD program and you decide you do not like it after a year or two, there is usually the option to leave with a Master's degree (assuming you have completed an adequate amount of research).

**D. Sign up for the subject GRE.** This exam is offered only twice per year and is in a paper format only. You can sign up on line (www.ets.org/gre/). Not all graduate programs require a subject score for admittance, but some do, and your scores may help your cause. You will want to take the exam in late fall (early December) so you will have the score in time for the earliest deadlines (often late December or early January). Exams are also scheduled in April of each year.

**E. Narrow your list.** Some of the professors you contact may say that they are not accepting students right now, some may not have room or funding resources to support you, and some may not respond at all. All of these you can cross off your list (maybe after a reminder email if you do not get a response right away). Focus on the ones that do give you an enthusiastic response. If they write back, respond again and establish a correspondence. ***This is the most critical part of the application process***- individual professors often have the most influence on which students get admitted, so if you can establish a positive correspondence with a professor, that is your best ticket to a successful application.

**F. Contact graduate students who are already in the program.** Don't be shy about contacting students who are already working in the lab you are interested in- that is often the best way to get a feel for what it would be like to work with that person. Ask some direct questions about the atmosphere in the lab and the working environment. The responses you get from students will be your best guide for finding a good lab to work in.

**G. Make a visit to the lab.** This is often difficult financially, but if you can swing it, visiting the lab and talking to people who work there face-to-face is often the best way to decide if the fit is right for you. Sometimes graduate programs will offer travel assistance for their top candidates, so you should enquire about this.

**H. Have a look at the department and the resources at the university.** The types of things you will want to think about and questions you will want to ask are whether there are enough faculty members in the department who are closely related to your area of research to provide you with an advisory committee. This does not mean you will need to have all your committee members working exactly within the specialty you want to focus on- in fact, such a committee would be undesirable. But, you will need to make sure that there are an adequate number of potential mentors in your general area of study, and related areas that are relevant to your focus. Most programs also encourage students to have outside members, so your advisory committee may ultimately include members from other departments or institutions.

You will also want to look at what other resources the department and the university offers. Are research funds for your project available from your potential advisor or through the department or university? Does the department offer opportunities to interact with people at other universities and institutions? Are there adequate resources and the appropriate types of equipment or field sites available for you to pursue your research project? Some of these questions will be difficult for you to assess because you probably do not know exactly what research activities you will engage in. The best approach is to talk to your potential advisor to discuss the types of research their students typically do. If you are corresponding with a couple different PIs you will be able to get a pretty good idea of what opportunities will be available to you in each of the labs you are applying to.

**I. Plan on applying to at least three programs.** Even if a potential advisor says that they really want you to come and they will do everything they can to get you admitted, this will not guarantee that your application will be successful. If you do get accepted by more than one program, then you will want to consider other advantages and disadvantages to of each one. They will usually give you a deadline to respond by, but if you are really interested in another program and have not heard from them yet, then you may be able to request for the admissions committee to give you an extension. However, don't expect an extension of much more than a week or two, so you may need to start asking for a decision from your top choice if you don't want to lose the opportunity to take a less desirable position.

If you decide to pursue a graduate degree, it may be one of the rewarding educational experiences you ever have. However, making decisions on whether you want to go to graduate school, and if you do go, where and when, can be very daunting. The best way to decide may be to speak to a professor you like or know well, discuss it with your fellow students, or talk to graduate students at your current institution or maybe at a university where you would like to apply. The more you understand about the joys and demands of graduate school, and the benefits you may reap from a graduate degree, the more likely you are to be happy with whatever decision you make.