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The Biologists' Forum

What can you do with a biology degree?

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One does not need a Ph.D. to become a scientist or to pursue a career in science. Many people who have received training in science do not end up working in a lab. Having a bachelors or graduate degree in biology can lead to a variety of career paths, many of which do not require you to hold a pipettor or run a gel.

Biotechnology and biomedical science has the potential to greatly impact the quality of life in the 21st century the same way advances in engineering, physics and computer technology have changed our lives during the 20th century. More is understood about the functioning of biomolecules in living systems and in organisms than ever before, and this information will create opportunities for individuals with a scientific background. Be it academic research, industry R&D, information technology, business, public policy, or intellectual property, chances are that one's scientific training will be applicable and desired.

Let's start with academic research. As far as permanent jobs are concerned, there are really two main categories, technician and principal investigator (PI). Of course academic labs are staffed with undergraduates, graduate students (M.Sc. and Ph.D.-level) and postdoctoral fellows (Ph.D. graduates who are receiving additional training in the form of an apprenticeship), however for the purpose of this article, these will not be viewed as careers, but training.

A PI is an individual who has earned a Ph.D., completed a postdoc, and now heads his/her own lab at an academic institution. This career path is often referred to as tenure-track. This means that after a period of about five years a PI is granted tenure by their institution and is now a permanent faculty member possessing all of the benefits associated with tenure.

Tenure-track researchers oversee projects designed to answer questions within a field of study. Usually their research interests lie in the fields with which they have been involved during graduate school and their postdoctoral period. Other responsibilities include teaching classes, mentoring graduate students and postdocs, peer-review of scientific publications by other researchers in their field, and grant writing. In fact, most PIs do not spend much time in the lab. In short, a PI wears many hats—acting as a manager, fundraiser, mentor, and lecturer.

It must be noted that less than one-third of all Ph.D. graduates in the life sciences occupy these positions. This statistic is not meant to discourage you. A position in academia is in many ways a lifestyle, which is not suited for everyone. If you feel that this career track is what you really want to do, then you will most likely excel and meet your career goals. Most biology PhDs deliberately and consciously choose alternate career paths.

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Many academic labs are also staffed with technicians. The responsibilities of lab technicians vary from lab to lab; some labs encourage their technicians to work on independent research projects, while others delegate to their technicians the responsibility of preparing stock reagents for the lab, managing supplies, and assisting graduate students and postdocs with their experiments. A Bachelors degree is sufficient for this position, however a Masters degree can provide some advantages such as higher pay and seniority. An academic lab tech position does not offer much in the way of career advancement or a high salary, but it does provide a flexible and casual work environment. If you like working at the bench without the responsibility of writing grants or the stress of producing results for publications, then this career path may be an excellent option.

Industry is another venue for research. This category can be subdivided further into pharmaceutical companies and biotech companies. While both utilize science to produce commercial products, they are not the same. Pharmaceutical companies are much larger, better established (many have been around for a full century!), and tend to have a highly structured corporate culture (i.e. there is always a right way and a wrong way to do things). Biotech companies are younger, smaller, and are often breaking into uncharted territory such as genomic-based research. Their culture has a very entrepreneurial spirit, and having fewer employees than their big pharma counterparts, these companies tend to have more of a collegiate atmosphere. However, unlike pharmaceutical companies, there is less security and the overall direction and focus of the company can change quickly.

Opportunities exist for all levels of training in both pharmaceutical and biotech companies. Those who hold a B.Sc. or M.Sc. degrees are employed in research as associate scientists (sometimes also referred to as research associates). These positions entail a significant amount of responsibility. Associate-level scientists conduct their own independent experiments and projects under the guidance of a supervisor. The B.Sc./M.Sc. career path can offer advancement opportunities, but there are limits. Some companies do not have a formal degree requirement for promotion within the research track, but Ph.D.-level scientists fill most senior research positions. Quality control, sales, marketing, and regulatory (making sure that the company is in compliance with government regulations) positions all offer opportunities for advancement without the need for a Ph.D. Many Bachelors and Masters degree holders move into these positions after spending time at the bench.

For Ph.D. scientists, a career in industry can be very rewarding. Unlike an academic career, there are more rungs on the scientific ladder. For most Ph.D.-level positions, a 2–5 year postdoc is required, although this varies depending on your specific field of expertise. Those who find themselves in entry-level positions are expected to conduct independent research, as well as supervise associate-level scientists. Most companies are not willing to train a Ph.D.-level scientist, so it is important to posses the desired skills required for a given position. A Ph.D. scientist can advance up the scientific ladder heading a lab or groups of labs staffed with entry-level PhDs, and associate scientists. A Ph.D. scientist with many years of industrial lab experience can also move from research to management.

A defining characteristic of both biotech and pharmaceutical companies is that they merge science and business. Thus, executives often know a great deal about research, while scientists learn a fair amount about business. Ph.D.-level personnel have the opportunity to climb the corporate ladder in a pharmaceutical company. In biotech companies, it is often a necessity for scientists to fill additional roles such as those involving sales and marketing. This is especially true in start-up biotech companies, which can begin with few employees.

The federal government is another employer of scientists from many backgrounds. Most biologists employed by the government work for the National Institutes of Health (NIH), Food and Drug Administration (FDA), or Centers for Disease Control (CDC). Working in a government lab is not the same as working in an academic lab or an industrial lab. Very simply stated, it can be

said that working in a government lab is kind of a mixture of both. Government-run research tends to be very collaborative in nature, which is very similar to how research is conducted in industry. The atmosphere is more academic; the bottom line is not profit or sales, but medicine (NIH), public health (CDC) and public safety (FDA).

Individuals possessing a Bachelors or Masters degree can find themselves working in a lab running experiments and participating in larger research projects. These positions usually bear the title research associate, and will require you to report to someone who holds a Ph.D. or an MD, and in many cases an MD/Ph.D. You are a government employee so you receive all the government benefits associated with your rank. Your salary is better than that paid by a comparable academic position, but less than you would receive in the private sector. Similar to industry, an individual with a B.Sc. or M.Sc. can move into administrative positions involving safety, regulatory, technology transfer to the private sector (many technologies developed in government are transferred to the private sector for commercialization) and grants (the NIH is one institution that issues the grant funding for research received by Universities). These administrative positions offer more advancement opportunities for B.Sc. and M.Sc.-level scientists than research positions.

PhDs, MDs and DVMs (veterinary degree) are all employed as scientists. Many MDs and DVMs perform clinical research or laboratory research and see patients. Veterinarians play a very important role in lab animal medicine, and are an integral part of the research plan involving the use of transgenic mice or primates. Ph.D. scientists are employed as staff scientists and follow a path of advancement similar to that in industry. It is possible for one to be promoted to lab chief (very much like a PI) and receive tenure. Doctorate-level people also find themselves moving from research into administration and even politics. For example, at the NIH, it is common for high-level scientists to be in their lab in the morning, and testifying before congress in the afternoon. A government lab can be a wonderful environment for a biology Ph.D. Unlike an academic PI, you never have to write a grant, and unlike industry, you do not have to worry about corporate buy-outs and downsizing. However, government labs must justify their budgets to the administartion, and are required to maintain productive and competitive research programs.

Thus far, careers in scientific research have been discussed. In all of them, varying degrees of opportunity exist for personnel of all levels in a research track as well as the ability to transit from the lab bench to other types of positions. What about opportunities for individuals with a life science background that do not involve scientific research at all? There are an abundance of these so-called alternative careers.

Management or strategic consulting firms are one such group seeking scientists. Management consulting firms such as McKinsey and Co. and the Boston Consulting Group are very large, and have offices in major cities all over the world. These firms serve clients such as Chrysler or GE and answer questions involving everything from corporate restructuring, product line development and public relations. In short consulting firms solve problems too large for the clients to solve themselves. Traditionally it has been people with a background in business—undergraduates with a degree in business, finance, or communications for example, and MBAs—who occupy the positions in consulting firms. Recently, these firms have begun to hire people with scientific and technical backgrounds. Who better to research problems and gather information than a scientist?

During one's scientific training an individual learns how to organize and communicate ideas, as well as analyze complex problems. A scientific background provides you with advantages over other backgrounds that do not necessarily include your specific technical knowledge. These skills are exactly what consulting firms look for in their employees. Most scientists who are hired by consulting firms have a graduate degree. A masters degree holder can eventually qualify for consultant, but scientists usually need a Ph.D. to occupy this position. The thought process is very similar to what goes into scientific

research, and in some cases the firm may assign you to a client involved in science. In other cases you may be researching something completely unrelated to biology. Consulting is a difficult job, with long hours and lots of traveling. But you are compensated extremely well, and after a few years of consulting many other companies will likely be recruiting you for the unique and valuable background you have created with your science degree and consulting experience. If you enjoy a fast-paced environment and constant learning, then consulting may be an ideal environment.

Intellectual property law or patent law is another area where a background in biology is beneficial. Advances in genomics and molecular biology have spawned many inventions and commercial products that require patents to protect their profitability. The individual who understands the law and the science is currently in high demand.

In patent law, there are two main career paths for biologists. One can become an attorney specializing in patent law; a biology degree followed by law school is required for this career path. The other option is to become a patent agent. A patent agent is an individual who has been admitted to what is known as the patent bar association. This person is not a lawyer but is licensed to prepare patent applications for submission to the US Patent and Trademark Office (USPTO), the government organization that grants a patent. Most patent agents who specialize in biotechnology patents have a life science Ph.D. Many biologists get their start in intellectual property law by working for the USPTO. Others get their start working for a law firm that handles biotechnology patents. A patent agent can attend law school and become an intellectual property attorney, or with years of experience can start his/her own business and execute patents for individuals who do not require litigation. Like management consulting, many of the same problem solving skills required for science apply to patent law. Patent law provides a dynamic work environment, constant learning as well as one-on-one interaction with others. And, in this field one continues to be connected to biology.

Science writing is one of the most common alternative careers for biologists. Written communication is extremely important in science, and it is a skill one develops during one's training to become a biologist. Furthermore, recent advances in biomedical science grips public interest like never before. People are needed to report this type of information to the public at large. Science writing is a term that can encompass many career paths, and one of them is journalism.

Biologists can become reporters for small newspapers and even national televised news programs. In addition to a biology degree, a degree in journalism is very helpful in making the transition into science journalism. A Ph.D. is not required but may be useful in obtaining high-profile positions. The real asset is your ability to communicate complex technical information clearly and concisely to the general public.

Technical writing or medical writing is another avenue for biologists to become science writers. This type of writing is very similar to the style used in scientific manuscripts published in journals such as *Nature* or *Science*. Thus, formal training in technical writing may not be needed, but may be helpful if one encounters difficulty in gaining technical writing experience. Many pharmaceutical companies and biotech companies hire people with a biology background to help write protocols, manuals and other documents containing information about their products.

You have most likely read articles appearing in journals such as *Science,* or articles appearing in biology textbooks. Considerable effort was put into the editing and publishing these documents. This field represents another career path in science writing for biologists. Publishing houses of well-known journals and textbooks seek scientists to help edit and organize documents submitted by scientific authors. Much like technical writing, one's training in biology prepares one to read and write scientific documents. These skills can be transferred to editing and publishing. While no formal training is required for this career path, it is useful to obtain experience in science writing to enter into an editing or

publishing job. A Ph.D. is not needed, but does offer an advantage in terms of advancement.

No one could become a scientist without the training they received from their teachers. Teaching is a role often associated with training in science but it is being discussed here as a distinct career in an attempt to distinguish science teaching (in secondary schools and college-level) from the role occupied by tenured PIs who must devote time to other functions in addition to time spent teaching classes.

Currently, the US is facing a shortage of qualified math and science teachers in our public schools. Advances in science and technology in such areas as genomics and computers require individuals with training that has included these current developments to effectively teach students. Biologists are needed for current teaching jobs.

For public schools, a Bachelors degree plus teaching certification is sufficient to obtain a teaching job. A Masters degree is not required but will offer an advantage in career advancement. Many PhDs are also becoming schoolteachers. Many school systems have assumed that PhDs would not be interested in these positions, and likewise many PhDs did realize that this was a viable career option. However, this is changing. Generally, people who enjoy science and enjoy helping others to learn about science make excellent schoolteachers.

To teach at the college level, one usually needs a Ph.D. Some community colleges have instructor positions open for individuals with a M.Sc., but even in this context a Ph.D. is advantageous. At liberal arts colleges, a Ph.D. is required. These schools usually offer programs in which students work toward a Bachelors degree. To teach in this environment, it is important to grasp a wide range of topics in biology, not just the topic of one's Ph.D. thesis or undergraduate major. Furthermore, one must demonstrate enthusiasm for teaching. One of the benefits of a liberal arts college over a large research institution is that undergraduate students can obtain more individualized attention; the professor's primary function is to teach classes without being distracted by the demands of running a laboratory. A lecturer should care about the students learning and not simply view teaching as just something they have to do.

Becoming a biologist does not mean you have to work in a lab. Many alternative careers are just starting to emerge, while others have become a more common option for scientists. Training in the life sciences offers many opportunities, and those opportunities will continue to grow. A few sites for exploring careers in biology in greater detail can be found on the internet: http://nextwave.sciencemag.org, http://www.biospace.com, http://mdbio.org, or http://bio.org.

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