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A Personal View

Career counseling: 101+ things you can do with a degree in biology

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Eyster KM. Career counseling: 101+ things you can do with a degree in biology. *Adv Physiol Educ* 31: 323–328, 2007; doi:10.1152/advan.00042.2007.—Biology is the science of life and of how living things work. Our students choose to major in biology in college because of a fascination with understanding how living things function, but often they have difficulty in identifying a career that uses their foundation in biology despite the variety of biology-based careers available. The purpose of this discussion is to assist biology students and the career counselors who work with them in identifying satisfying careers that build upon their interest and foundation in biology. The categories of career options include research, healthcare, teaching, science writing, administration/management, government, industry, and miscellaneous careers that do not fit into the other categories.

research; healthcare; education; industry; science writing

BIOLOGY is the science of life and of how living things work. Most of us who choose to study biology do so because of an inherent fascination with the function of living things. However, too often we and our students are unaware of the wide variety of careers available to us when we have a foundation of knowledge in biology. Frequently, we are only aware of a career option if we know someone who works in that occupation. The purpose of this discussion is to enumerate the career options available to biologists for use by career counselors, biology faculty, and biology students. Many of the careers listed require additional education beyond the bachelor's degree, but a foundation in biology is important to all of them. Many of the careers listed here are equally available to students with training in biochemistry or chemistry. The career options are divided into categories and include careers in research, healthcare, teaching, science writing, administration and management, government, industry, and miscellaneous careers that do not fit into other categories as well as careers that build on a foundation in biology but require a different major from biology. Recommendations on advising students in making career choices are also discussed.

Careers in Biological Sciences

Research. The first career option that a biologist should consider is a career in research. Research is discovery, learning how things work, learning something new that no one else in the world knows, and then telling everyone else what you've discovered. Being involved in research is an exciting way to spend your life. A career in research will hone your skills in critical thinking, creative problem solving, and persistence. Participation in research takes place at a variety of levels (Table 1), and a variety of fields of biology-based research are available (Table 2).

An undergraduate, or a high school student, can become involved in research. Many researchers welcome students into their research laboratories, especially during the summer, and there are many programs to support research internships. A summer research internship is an excellent opportunity to experience the excitement, as well as the process, of research. It is also a good opportunity to determine whether a career in research is a good fit for your personality. Summer undergraduate research opportunities vary from year to year; an internet search on "biology undergraduate summer research" will identify current opportunities. Graduate students in MS or PhD programs are involved in research as part of their graduate programs. A career in research is available as a research technician or research associate after earning a BS or MS degree. A PhD degree in a biological discipline opens additional doors into research careers. University professors maintain their own research laboratories in an academic setting. Doctoral-level scientists also maintain research laboratories in the pharmaceutical industry, biotechnology industry, agricultural industry, in private research institutes, and in government research laboratories such as those at the National Institutes of Health, National Institutes of Environmental Health Sciences, United States Department of Agriculture, or military health research laboratories. Research technician and research associate positions for individuals with BS or MS degrees are available in each of these settings (university research laboratories, industry, private research institutes, and government laboratories).

Biology-based researchers can choose a focus from a variety of disciplines. In the biomedical sciences, a scientist can focus on a variety of disciplines (Table 2). One can further specialize within each of these fields. For example, in physiology, individuals specialize in endocrinology, the cardiovascular system, the renal system, the respiratory

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Table 1. *Ways to be involved in research*

As an undergraduate or high school student
As a research technician with a BS or MS degree
As a graduate student through a MS or PhD program
In a university setting
Within the pharmaceutical industry
Within the biotechnology industry
Within the agricultureal industry
In a government research laboratory
In a private research institution

system, the gastrointestinal system, neurophysiology, and cellular physiology, with further subdivisions in each specialty. The range of disciplines in biological sciences is also extensive and diverse (Table 2). The disciplines of biomedical and biological sciences overlap, and as in the biomedical sciences, one can further specialize in each of the broad fields of biology.

Healthcare. The field of healthcare offers a very wide variety of career choices (Table 3). Many specialties are available to a physician with either a Doctor of Medicine (MD) or Doctor of Osteopathy (DO) degree or with the combined MD/PhD degree. Osteopathic physicians are trained in the same medical and surgical therapies as allopathic physicians (MDs), with the addition of manipulative techniques for the treatment of structural problems. Physicians who hold the combined MD/PhD degree obtain training in research as well as medicine, so they are better prepared for careers in medical research. Specializations available to physicians include family medicine, obstetrics and gynecology, internal medicine, psychiatry, pathology, surgery, allergy and immunology, anesthesiology, dermatology, emergency medicine, pediatrics, medical genetics, neurology, nuclear medicine, ophthalmology, orthopedics, otolaryngology, plastic surgery, radiology, and urology, among many others. In addition to the many areas of medical specialties, there are many career options for physicians. The most common choice, and the greatest demand for physicians, is in clinical practice. However, there are many other choices for physicians. For example, a physician can develop a career in medical investigation at the Centers for Disease Control or in research at the National Institutes of Health. Alternative career paths for physicians include broadcast journalism, i.e., explaining medical advances and other clinical issues to the public on television or on the internet, the teaching of clinical medicine to medical students, and clinical research. A physician may also carry out early clinical trials in the pharmaceutical industry or more advanced clinical trials in clinical practice.

There are many other career options in healthcare. Opticians and orthopticians are both involved in eye care. Optometry is a doctoral-level program, whereas orthoptics, the treatment of crossed eyes/lazy eye, is a 2-yr program after a BS degree. Podiatry is a doctoral-level program in foot care for which there is a strong demand (1). Pharmacy is now a doctoral-level program. The student typically takes 2–3 yr of undergraduate work and then enters the 4-yr pharmacy doctoral program. Dentistry is also a doctoral program that one enters after completing a BS degree; there are additional specialties within dentistry, such as orthodontics. The positions of dental hygienist and dental assistant are positions in dental clinics that require less education than that of the dentist. Physical therapists and occupational therapists work with people with a variety of rehabilitative needs. Programs in physical therapy and occupational therapy are available at both MS and PhD levels. Epidemiology and public health are related careers; epidemiologists study the factors that affect the health of populations, and public health is concerned with challenges to the health of populations. Physician's assistant programs are 2-yr programs after a BS degree and are typically MS-level programs. The physician's assistant is involved in hands-on patient care and can specialize in the same broad areas of patient care as a physician. Medical technologists work in hospital or clinic laboratories and perform tests on patient samples as part of the process of disease diagnosis. Training in medical technology involves 3–4 yr of college followed by 1 yr of clinical training in a hospital training program. Within the field of medical technology are a number of specialties including microbiology, hematology, chemistry, serology, virology, blood banking, immunohematology, and forensic serology. A specialist in quality control/quality assurance is needed in all clinical laboratories and is another career option. Additional clinical laboratory/technical specialties include positions as a cytotechnician, respiratory technician, in vitro fertilization technician, sperm bank technician, radiation therapy technician, magnetic resonance technician, surgical technologist, orthotics and prosthetics patient care technician, medical appliance technician, diagnostic medical sonography technician, perfusionist, audiologist, emergency medical science technician, anesthesiology assistant, environmental science and protection technician, and X-ray technician. A genetics counselor helps families understand genetic disorders and assists those who are at high risk for genetic disorders in making decisions about expanding their families. Phlebotomists draw blood in hospitals and in clinics. In sports, physicians who specialize in sports medicine are needed, as are athletic trainers and personnel involved in sports testing. There are also careers as an acupuncturist, naturopathy practioner, or chiropractor. An internet search on any of these career choices will identify the most up to date information on requirements and training programs.

Healthcare is important for the care of animals as well as people. Veterinarians specialize in large domestic animals,

Table 2. *Disciplines of biology-related research*

Fields in Biomedical Research		
Physiology	Pharmacology	Biochemistry
Molecular Biology	Bacteriology	Virology
Anatomy	Neuroscience	Cell biology
Oncology	Genetics	Immunology
Space Physiology	Embryology	Kinesiology
Fields in Biological Research		
Botany	Horticulture	Plant Taxonomy
Paleobotany	Palynology	Evolutionary Biology
Phycology	Ecology	Environmental Science
Ichthyology	Forensic Biology	Forensic Anthropology
Parasitology	Entomology	Ornithology
	Marine Biology	Vertebrate Zoology
Herpetology	Wildlife Biology	Invertebrate Zoology
Biophysics	Developmental Biology	Bioethics
Conservation Science		

Table 3. *Careers in healthcare*

Doctor of Medicine	Doctor of Osteopathy	Combined MD/PhD
Optometrist	Orthoptician	Podiatrist
Dentist	Dental Hygienist	Dental Assistant
Orthodontist	Epidemiologist	Public Health Professional
Pharmacologist	Physician's Assistant	Physical Therapist
Occupational Therapist	Medical Technologist	Cytotechnician
Genetics Counselor	Respiratory Technician	X-Ray Technician
Quality Control Specialist	Sperm Bank Technician	Phlebotomist
Athletic Trainer	Sports Tester	In Vitro Fertilization Technician
Aquarist	Perfusionist	Radiation Therapy Technician
Zookeeper	Veterinarian	Veternary Assistant
Surgical Technologist	Exercise Physiologist	Anesthesiology Assistant
Orthotics and Prosthetics Specialist	Audiologist	Medical Appliance Technician
Acupuncturist	Diagnostic Medical Sonography Specialist	Emergency Medical Science Specialist
Magnetic Resonance Technician	Environmental Science and Protection Technician	Clinical Trials Coordinator
Naturopath	Chiropractor	

small domestic animals, exotic pets, zoo animals, or laboratory animals. Careers are also available as veterinary technicians or veterinary assistants. Careers as zookeepers, zoo assistants, and aquarists also build on a foundation in biology.

Education. Another large area of careers for those with an interest in biology is education (Table 4). Instructors in biology are needed at all levels of education, including elementary school, middle school, junior high school, high school, and college. Teachers for graduate students and medical students are also necessary as well as teachers with a biology-based education for technical training schools and community colleges. Schools at all levels may be either public or private. The requirements for teaching vary. A teaching certificate with a BS degree is needed for teaching at the elementary school through high school levels. Teaching at the college, graduate school, and medical school levels typically requires a PhD degree, although some colleges and community colleges hire teachers with MS-level degrees. Another significant requirement for teaching is to enjoy and appreciate students of the age group that you've chosen to teach; for example, if you don't like teenagers, don't become a high school teacher. Moreover, teaching requires focus and concentration and forces you to keep up with advances in science to ensure that you convey the latest and most exciting information to your students. A teacher must be dedicated and creative to maintain the attention and motivation of students.

Science writing. Students who have an interest in writing as well as biology may find a rewarding career in science writing (Table 4). Areas of focus include the writing of feature articles for science journals such as Science and Nature, the writing of science articles for news magazines such as Time or Newsweek, and writing for local or regional newspapers. Textbooks in biological sciences must be written for students at all levels (i.e., elementary school, middle school, junior high school, high school, college, graduate school, medical school, and continuing education). Editors of those textbooks are also necessary. Technical manuals must be written for every piece of medical or research equipment used in hospitals, hospital laboratories, clinics, or research laboratories, and the writers of these manuals need to understand the biological basis of the use of the equipment. People who have an aptitude for both art and science may find a satisfying career as a scientific or medical illustrator. Other careers in this broad field include broadcast journalism, such as writing or consulting for medical dramas or serving as the host of television shows about nature, science, or animals, and creative writing, such as writing stories with a biology or medical background.

Administration and management. Another field that employs people with a biology background is administration and management (Table 5). One example of a career in this field is a grants administrator at an agency that funds research. Grant funding agencies include national governmental agencies such as the National Institutes of Health and the National Science

Table 4. *Career opportunities in education, science writing, and related fields*

	Careers in Education	
Elementary School Teacher	Middle/Junior High School Teacher	High School Teacher
College Professor	Junior College Professor	Technical Training School Teacher
Graduate School Professor	Medical School Professor	
	Careers in Science Writing	
Writer of Feature Articles in Scientific Journals	Writer of Science Articles for Newsmagazines	Textbook Writer
Textbook Editor	Writer for Local or Regional Newspaper	Writer of Technical Manuals
	Related Fields	
Scientific/Medical Illustrator	Broadcast Journalist (i.e., dramas)	Television Show Host (for shows about nature, animals, or science)
Creative Writer (material with a biological/medical theme)	Copy Editor (for scientific journals)	

Table 5. *Administrative/management careers in biology-related fields*

Executive Director of a professional society
Grants Administrator at a national government agency or nonprofit agency
Administrator at a university office of research or compliance office
Administrator/Manager of a biotechnology firm
Administrator/Manager of a pharmaceutical firm

Foundation as well as nonprofit agencies such as the American Heart Association, American Diabetes Association, American Cancer Society, and March of Dimes. Administrators are needed in university Offices of Research as well as Safety and Compliance Offices. Administrators and managers who understand biology are also needed at biotechnology and pharmaceutical firms. Another example is executive director of a professional society such as the American Physiological Society.

Government. Careers for people with a foundation in biology are also available at all levels of government, including local, state, national, and international levels of government (Table 6). Positions are available in natural resource management/environmental regulation and management, including field research, in the areas of rivers and streams, fish, wildlife management (i.e., wildlife biologist), and forest management, and as county extension agents. A foundation in biology is useful for park rangers and park interpreters as well as personnel involved in water quality control and waste management. Science policy analysts, researchers, and administrators as well as lobbyists for science, technology, and education issues will benefit from a background in biology. International health organizations need biologists in administrative or research positions, and there are careers in administration and research for nonprofit public interest organizations that support a cause or issue related to life sciences or the environment at regional, national, and international levels. The federal Food and Drug Administration employs biologists for the drug approval process as well as investigators of food safety and questions of contamination of the food supply. Governments employ inspectors of meat and other food processing plants, restaurants, and imported goods of a biological nature. Governments regulate safety in the workplace through Occupational Health and Safety regulations and inspections. There are nongovernment positions in some of these fields as well; for example, there are private fisheries and wildlife biologists.

Table 6. *Government careers in biology-related fields*

Enviromental Regulator (rivers, streams and fish, wildlife, and forest management)
Park Ranger or Park Interpretor
Lobbyist (science, technology, and science education)
Water Quality Control Specialist
Waste Management Technician
County Extension Agent
Science Policy Analyst
Sciene Policy Researcher
Administrator/Researcher for an international health group
Administrator/Researcher for a nonprofit public interest group
Food and Drug Administration Researcher (drug approval or food safety)
Manager of a Wildlife Refuge
Occupational Health and Safety Specialist

Industry. Many industries, including pharmaceutical, biotechnology, food, and agriculture industries, hire personnel at many levels with foundations in biology (Table 7). Positions include market research (i.e., in the food industry), product development and testing, and sales and marketing. People with strong communication/linguistic skills may find employment in public relations in industry. The pharmaceutical industry hires drug representatives, and positions are also available for sales representatives in the agricultural industry and for companies that sell scientific reagents and equipment for research and clinical laboratories. The agricultural industry offers positions in plants and crops, animals, and biofuels industries. There are also positions in regulatory affairs and quality control in industry. Industry also employs scientific consultants. Biological entrepreneurs often found companies that develop into biotechnology or other industries.

Miscellaneous biology-based careers. There are many careers for biologists that do not fit into the above categories (Table 7). For example, biology is not a requirement to become an astronaut, but some astronauts do need to be biologists. A good brewmaster or baker needs to understand the life cycle and nutrient requirements of yeast. An interest in law and biology together may lead to a career in patent law, environmental law, or medical legal law. An interest in finance and biology may lead to a career as a financial analyst in science- or technology-based areas. Biostatisticians analyze the statistics of biological fields. Bioinformatics requires a foundation in computer analytical techniques as well as biology. This field developed from the need for analysis of the large quantities of data that emerged from the sequencing of the human and other genomes and the subsequent global biological applications of genomics and proteomics, and it has undergone significant expansion in recent years. Biofouling examines biological contamination and its prevention, from the bacterial contamination of hospital catheters to the contamination of ship's ballasts with unwanted biologicals such as zebra mussels.

Table 7. *Fields in biology-related industries such as the food industry, agricultural industry, pharmaceutical industry, and biotechnology industry and in miscellaneous biology-based careers*

Market Research
Regulatory Affairs
Quality Control
Sales and Marketing
Product Development and Testing
Aerospace
Scientific Consultation
Brewing
Patent, Environment, or Medical Law
Financial Analysis
Bioinformatics
Biostatistics
Biological Entrepreneurship
Biofouling
Baking Industry
Public Relations

Careers for Which Biology Forms the Foundation but That Require a Related Degree

Additional careers that require related degrees but for which biology forms an important foundation (Table 8) include anthropology, biomedical engineering, nursing, and diatetics/nutrition as well as healthcare administration in hospitals, clinics, and nursing homes. Paleontologists need to understand animal biology. For example, they study the origins and insertions of muscles on dinosaur bones and use that information to understand how the animals moved. The study of alcohol and drug abuse forms a foundation for positions in prevention, education, counseling, treatment, and law enforcement. Agricultural sciences also build on the knowledge of living things. Careers in agricultural science include animal science, crop science, soil science, viticulture, apiary, fish farming, dairy production, meat production, poultry science, crop consultation, crop management, and biofuels research. In addition, the United States Department of Agriculture employs researchers in both animal and plant research.

Choosing a Career

How does a student choose a career path, and how do we advise them? The first step is for students to become aware of the many career paths that are available; indeed, raising awareness of potential career opportunities for biologists is the first goal of this discussion. Biology students should then assess their personal interests and aptitudes in the various broad fields of biology (i.e., research, healthcare, teaching, science writing, etc.). What piques their interest? Are they more interested in plants or animals or microorganisms? How many years are they willing to devote to education? Are they willing to devote the necessary study time to achieve the required knowledge level (and accompanying grade point average)? Do they want to work outdoors or indoors? Do they want to work with lots of people? Do they want a job in a specific geographical location? Do they want a job with intellectual stimulation? Do they have other strong interests that could be combined with a foundation in biology to create a unique career? Answers to these questions will provide initial guidance in career choices.

Table 8. *Fields for which biology forms the foundation but that require a related degree*

Anthropology
Paleontology
Nursing
Healthcare Administration
Animal Science
Crop Science
Soil Science
Biofuels Research
Beekeeping
Viticulture
Fish Farming
Crop Consultation
Crop Management
United States Department of Agriculture Research
Alcohol and Drug Abuse Research
Dairy Production
Meat Production
Poultry Science
Biomedical Engineering
Dietetics/Nutrition

To further refine a student's interest in a particular career, an internet search will rapidly identify information about the length of required training, level of difficulty, job demand, projected salaries, and location of training programs for that career. A very useful tool is the *Occupational Outlook Handbook* from the Bureau of Labor Statistics of the United States Department of Labor (1). An internet search using the terms "biology careers" will identify other useful career information. Another method of career exploration is to identify people who are employed in the career of interest and ask questions, such as how did they make their career choices, what was the training pathway, and do they find the career rewarding and worthwhile. Ask whether there is opportunity to shadow the individual, or whether there are internships that would allow hands-on experience in a field to assist the decision-making process. Students should inquire about the academic rigor required for a given career choice and should critically assess their ability to meet that standard.

The demand for personnel in a given career path is an important consideration in choosing a given path. There is strong demand for some positions such as physicians and teachers. On the other hand, there are few job openings in careers such phycology and marine biology (1). Job stability is another issue to consider. For example, research technicians with BS or MS degrees working in university research laboratories are often paid from research grants so the position may only exist for the lifespan of the grant. In contrast, the same research technician position at a pharmaceutical firm may be very stable. The *Occupational Outlook Handbook* (1) provides information about job stability and job demand. Salary is another decisive factor. In general, salaries are proportional to training and level of responsibility. People with a master's degree have greater responsibility and earn a greater salary than those with a bachelor's degree. Similarly, people with a PhD have greater responsibility and earn a larger salary than those with a MS degree. In healthcare, the physician has more years of training and the greatest responsibility and also earns the larger salary.

Many biology programs allow a student to choose a subdisciplinary track during their course of undergraduate study. The available tracks vary among Biology departments but may include a focus on cellular and molecular biology or on ecology or evolution, for example. Larger departments will have a greater diversity of options for the student. However, following an academic track narrows the training that the student receives, thereby narrowing the student's career options. This is not an issue if the student has made a career choice. However, it would be wise of the student not to focus too tightly on a career track until a career choice has been identified.

Summary

It is likely that additional career options for biologists are missing from this list, and certainly many of the specialties within broad fields are not enumerated. However, this roster

should serve as a useful tool for biology students seeking information on career options and for those who assist students in searching for careers that fit their personalities and aspirations as well as their foundation in biology.

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