UNIVERSIDAD CENTRAL DEL CARIBE
Office of the Associate Dean for Research and Graduate Studies
PPOHA Program

Degrees and Careers in Biomedical Science

Biomedical scientists study the function of molecules, cells and organism and apply these discoveries to the treatment and prevention of human diseases. Although it is possible to work as a biomedical scientist with a bachelor's degree in a relevant field (e.g., Biology, Molecular Biology, Biochemistry, Physiology, Microbiology or Chemistry) many job opportunities require the experience and the expertise usually acquired during graduate or professional training. This handout discusses various graduate degrees in Biomedical Science and provides examples of occupations pursued by professionals with these degrees. It is meant to be used a starting point for students evaluating career choices in Biomedical Science and should not be considered a comprehensive list of all the employment opportunities for the specialists in this field.

I. Graduate programs in Biomedical Science

A. Master programs

- The Master of Science (M.S.) is a research-based degree that prepares students for a variety of careers in Biomedical Science through a combination of coursework and hands-on investigations. Master students invest a significant amount of time on a thesis project that enables them to gain experience in the scientific methods and the experimental designs used in the research area of their interest. An adviser, in collaboration with the thesis committee members, supervises the work to ensure that the student produces publishable results that satisfy the current scientific standards of their field. M.S. programs entail at least 2 years of study after the bachelor's degree and may also serve as an intermediate point for those interested in enrolling in a Ph.D. program.

- The Master of Art (M.A.) degree is a non-thesis program for those seeking employment in a field where scientific investigation is not the primary focus. The coursework load is similar for both M.A. and M.S. students. Nevertheless, while M.A. students may work in a laboratory to gain experience, a literature-based review paper is usually the culminating product of the program. Some institutions provide the M.A. option to those students interested in teaching Science at the secondary level.

B. Doctoral programs

- The Doctor of Philosophy (Ph.D.) is the highest academic degree offered by universities. In order to earn a Ph.D., a person must demonstrate the mastery of the specific subject of interest and must actively extend the current body of knowledge about that topic. In order to master the subject, students take specialized courses, read the scholarly journals used by scientists to report the results of their scientific investigations and take a battery of exams. Ph.D. students spend most of their time conducting a lengthy research project whose primary purpose is to provide a deep understanding of a particular research question. Research results are published in scholarly journals and constitute proof of the student's contributions to extending the body of knowledge of a particular field of study. To complete a Ph.D., each student must summarize the research in a formal document called a dissertation. The Ph.D. committee members scrutinize the dissertation and the student must defend his or her research in an oral examination that is usually open to the public. The amount of time to complete a Ph.D. varies greatly among institutions but a student can foresee to be enrolled in a Ph.D. program for a period of 4 to 7 years.

- The Doctor of Medicine (M.D.) and the Doctor of Osteopathy (D.O.) are the 2 degrees awarded in the United States to individuals that complete medical training. Osteopathic physicians are trained in the same medical and surgical therapies as allopathic physicians (M.D.s), with the addition of manipulative techniques for the treatment of structural problems. After completing 4 years of medical school and obtaining a medical degree, many physicians participate in specialized training that can take between 3 and 8 years to complete. In order to practice medicine in the U.S.A., physicians must pass a battery of exams designed to assess the candidate's mastery of the skills necessary to practice medicine without supervision. In addition, each state has a medical board with differing requirements for certification.

- M.D./Ph.D. dual programs provide training in both medicine and research. They are specifically designed for those who want to combine biomedical research with a clinical practice to become research physicians, also known as physician-investigators or physician-scientists. Besides the obvious advantage of having solid trainings in scientific research and medicine, many M.D./Ph.D. students have a reduced residual post-training debt because their education was partially financed by special grants set aside by institutions to attract the best students to their dual programs. Many students complete the M.D./Ph.D. requirements within 7 to 8 years, compared to an average of 10 years if the degrees were pursued independently. Upon graduation, many M.D./Ph.D.s become faculty members on academic medical centers where they conduct research approximately 70 to 80% of the time. The rest of the time is divided between clinical service, teaching and administrative duties.

Representative employment opportunities in Biomedical Science

A. Research – Advancing science and applying this knowledge to improve the lives of humans worldwide is the primary goal of Biomedical Science. Biomedical scientists with a B.S. or a M.S. degree can become research technicians or research associates after earning their degrees. A doctoral degree opens additional doors to research careers. University professors usually hold at least 1 doctoral degree and seek external grants to fund their laboratories to conduct research in collaboration with the graduate students and the technicians working under their supervision. Doctoral-level scientists also mange research laboratories in the pharmaceutical and the biotechnology industry, in private research institutes and in government research laboratories like the National Institutes of Health or the military health research laboratories.

B. Education – Science teachers are needed at all levels of education, from elementary school to universities. A B.S. degree and a teaching certificate are usually needed for teaching at the elementary school to high school levels. Teaching at colleges and universities usually requires a doctoral degree, although some institutions hire instructors with master degrees to teach introductory and service courses.

C. Industry – The pharmaceutical and the biotechnology industries hire personnel with a strong background in Biomedical Science to work at different stages of their business operations including: product development and testing, clinical trial coordination, quality control, regulatory affairs, sales and marketing and scientific consultation, among others. Most of the positions are open to professionals with bachelor or master degrees but a doctoral degree may be needed to fulfill the duties of key leadership and highly technical positions. For example, clinical trial divisions are usually directed by M.D.s and Ph.D.s are highly qualified to lead the units where a thorough scientific understanding is pivotal for the business's success (e.g., vaccine development programs).

D. Healthcare – There are many career options in healthcare for a professional with a B.S. in Biomedical Science and a comprehensive list of the alternatives in this field is beyond the scope of this handout. The level of additional training varies depending on the profession of choice. For example, medical technologists that perform tests on patient samples complete 1 to 2 years of post-graduate training in clinical laboratory practices. Genetic counselors that help families understand and manage the risk of conceiving children with genetic disorders hold M.S. degrees. Pharmacy in now a doctoral program that requires 3 years of undergraduate work followed by 4 years of professional training.

E. Science administration – Professionals with a strong scientific background are needed to manage research programs and to ensure that the research performed by active scientists complies with all the ethical and the safety regulations governing research. Grant funding agencies like the National Institutes of Health and the National Science Foundation fund most of the biomedical and basic research conducted at universities across the United States. Non-profit foundations like the American Cancer Society and the non-profit branches of the multinational pharmaceutical companies (e.g., the Merck Foundation) provide significant funds to investigators working on projects targeting the organizations' scientific goals. Scientists with Ph.D.s direct the research divisions of these institutions and support personnel with bachelor and master degrees assist with the daily operations of managing the research portfolio. Likewise, universities and other recipients of research funds have research administration and compliance offices that overlook the financial aspects of research and safeguard the wellbeing of people used as

research subjects, the welfare of experimental animals, as well as the overall laboratory and environmental safety.

F. Other positions – Biomedical training can serve as the foundation to pursue a variety of careers. Some examples include:

- FDA scientist - The Food and Drug Administration (FDA) employs scientists to evaluate the safety and the efficacy of the new products developed by companies in the pharmaceutical, biotechnology or medical device sectors. FDA scientists also conduct routine inspections on the facilities used for the production of drugs and devices.
- Intellectual property - Professionals with a thorough Biomedical Science training work with the technology transfer offices of universities and the legal divisions of companies to file patents to protect the intellectual property emerging from scientific research and new product development. Scientist can also work for the U.S. Patent and Trademark Office to evaluate the validity of the patent claims. Many patent agents and patent lawyers specializing on pharmaceutical and biotechnology products combine Biomedical Science and law to achieve their career goals.
- Scientific writing - Many scientific writers draft articles for scientific journal and popular magazines while others work as editors for the publishing companies that sell the textbooks used at all educational levels. Scientific writers can also prepare the contents used on the manuals that accompany the equipment used in hospitals and in laboratories or the literature used to market pharmaceutical products.
- Politics - Even though politics is not the primary career of choice for biomedical scientists, people with this expertise are needed to work as Science policy analysts, researchers or administrators and as lobbyists for Science, technology and education issues.

References:

Eyster, K.M. 2007. Career counseling: 101+ things you can do with a degree in biology. *Adv Physiol Educ* 31: 323-328.

Useful Career Guides for Biomedical Science Mayors:
(http://www.marquette.edu/csc/documents/JobSearchforBIOMEDICALSCIENCEMajors.pdf)
(http://www.careers.umbc.edu/students/majorsheets/BIOL.pdf)

Careers in Medical Research Resources from the Association of American Medical Colleges
(https://www.aamc.org/students/considering/exploring_medical/research/)

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