Exploring Careers in Biochemistry and Molecular Biology

ASBMB
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The molecular life sciences are at the forefront of scientific discovery. Over the past decade, an ever growing arsenal of techniques has helped researchers dissect the innermost secrets of the cell and develop new ways to detect and attack disease. These techniques also have been used to produce vast amounts of once rare drugs and vaccines, trace the path of evolution, create instant tests for a host of illnesses, warn people when their children might inherit a deadly disease, and identify criminals and victims of disasters.

*The leaders in this scientific revolution have been biochemists and molecular biologists.*

If cancer is to be cured, if solutions to the world’s energy crisis are to be found, or if the planet’s pollution is to be cleaned up, it will probably be the biochemists and molecular biologists with the knowledge and skills to power these breakthroughs.

Challenge yourself, feed your curiosity for the natural world and explore a microscopic universe that is as strange and breathtaking as any imaginable. Make biochemistry and molecular biology your future career!

*Few fields are so interesting, so challenging and potentially so rewarding.*

Take the Biochemistry and Molecular Biology Challenge
What is Biochemistry and Molecular Biology?

Biochemistry is the study of chemical processes in living organisms. It deals with the structures and functions of cellular components such as proteins, carbohydrates, lipids, nucleic acids and other biomolecules.

Molecular biology is the study of biology at a molecular level. It deals with interactions between the various systems of the cell, including the interactions between DNA, RNA and protein synthesis, as well as learning how these interactions are regulated.

Biochemists and molecular biologists study the chemical realm inside cells in order to understand the genetic and molecular bases of cellular processes.

Biochemistry and molecular biology together have grown to encompass virtually the entire spectrum of science, from physics and chemistry to biology and medicine. Women and men in these fields are studying life on every level, from individual molecules to the interrelated web of Earth's organisms and all the bacteria, yeast, plants, amphibians, and mammals in between.

What Do Biochemists and Molecular Biologists Do?

Biochemists and molecular biologists work in a variety of fields such as:

**Medicine and Health**
Work as physicians, dentists or veterinarians.

**Drug Manufacture and Design**
Develop and produce vaccines and drugs, and design new or improve existing tools for diagnosis and detection of disease.

**Agriculture and Related Industries**
Create genetically engineered crops that are more resistant to frost, drought, spoilage, diseases and pests.

Develop diagnostic agents and tools for bioremediation (removal of contaminated material from the environment).

**Forensic Science (Crime Lab Science)**
Work on criminal investigations through the examination of biological samples.

**Education**
Engage in science education as biology or chemistry teachers, professors, or museum curators.

**Other Industries**
Some biochemists and molecular biologists find fulfilling careers in sectors such as science policy, science writing, science reporting, and biological and medical illustration.
Preparing for a Career in Biochemistry and Molecular Biology

High School Foundation
High school students interested in biochemistry and molecular biology should take at least one year each of the following courses:

- Science Courses: Biology, Chemistry, Physics
- Mathematics Courses: Algebra, Geometry, Trigonometry, Introductory Calculus
- English courses that emphasize writing skills are strongly recommended because scientists must communicate results clearly and accurately through articles published in scientific journals
- Humanities and social science courses enhance critical thinking skills

In preparation for college, remember that individual schools sometimes have their own special requirements for admission. So plan ahead, visit the college’s website or talk to someone from the admissions office and make sure you’ve taken all the courses necessary for admission.

Research
If possible, high school students should get involved in summer research at their high school or at local colleges and universities. Having high school experience with hands on research can be a great asset in the college admissions process.

SAT and ACT
It is important that students prepare for the Scholastic Aptitude Test (SAT) or American College Testing (ACT) by taking the Preliminary Scholarship Aptitude Test (PSAT) and/or the National Merit Scholarship Qualifying Test (NMSQT) in their sophomore or junior years.

The PSAT and NMSQT automatically make Hispanic students eligible for the College Board’s National Hispanic Scholar Awards Program and black students eligible for the National Achievement Scholarship Program for Outstanding Negro Students.
Two-Year Laboratory Technician Training at Community Colleges
For a high school graduate who wants to work in a laboratory and enter the job market with a minimal amount of preparation, community colleges offer special two-year programs that lead to an associate of arts (A.A.) or associate of applied science (A.A.S.) degree in the field.

College Education
The best way to prepare for a career in biochemistry and molecular biology is to attend a four-year college or university and earn a bachelor’s degree, in one of these areas:

- Chemistry with coursework in biology, molecular genetics, and biochemistry.
- Biology (or related field) with coursework in chemistry, mathematics, physics, and biochemistry.

**Tip:** In your first year, consult with a faculty advisor or career counselor who is familiar with careers in biochemistry and molecular biology.

**Tip:** Acquire research experience by taking advantage of internship programs offered on campus, at research institutions (also a great way to sample graduate schools) or at state and federal research facilities. The National Science Foundation and the National Institutes of Health sponsor many research opportunities for undergraduates. Plan ahead and apply early, especially if you want a paid internship.

Visit [www.asbmb.org/summerresearch](http://www.asbmb.org/summerresearch) for an up-to-date listing of summer internships and research opportunities.
Specialized Laboratory Training
There are many career opportunities for a person with a bachelor’s degree in biochemistry and molecular biology. One way to enhance your job prospects is to spend another year at a college/university that offers training programs for specialized laboratory techniques such as cell culture, genetic engineering or DNA sequencing and synthesis. This is often known as a “certificate program.”
Preparing for a Career, continued

Graduate School
Careers that involve teaching, directing scientific research at a university, a government laboratory or a biotech company require at least a master of science (M.S.) degree and preferably, a doctorate (Ph.D.) degree. Many students bypass the M.S. degree and proceed directly to a Ph.D. program. It is not uncommon for students to enter graduate school after working for a few years.

Master of Science (M.S.)
For a master’s degree, schools typically require one year of coursework and the completion of an independent research project.

Doctor of Philosophy (Ph.D.)
Ph.D. programs typically involve the following:

- Full-time coursework for up to two years
- Special examination at the end of the initial phase
- Formal thesis that involves extensive original research leading to significant new scientific findings
- Most students complete a Ph.D. in four or five years

Earning a Ph.D. means that you know how to conduct important research in biochemistry and molecular biology with little or no guidance from others.

Post-Doctoral Training
After obtaining a Ph.D., many scientists obtain further research experience by doing post-doctoral research (postdoc) before they take permanent jobs. A postdoctoral position:

- Requires no formal coursework and earns no degree
- Is two to three years in duration
- Is a full-time paid research position (salary or fellowship)
- Is generally expected of a person who wishes to become a professor or conduct independent research

For a list of post-doctoral research opportunities, visit www.asbmb.org/education.
Preparing for a Career, continued

Other Advanced Degrees

- **M.D.**—Because biochemistry and molecular biology are tied closely to medicine, some Ph.D. scientists also earn a medical degree.
- **J.D.**—Scientists interested in science and technology patent law or cooperate law sometimes earn a juris doctor (law degree).

Applying to Graduate Schools

The most frequent requirement for acceptance to graduate school is a bachelor degree in biochemistry or molecular biology (or in chemistry or biology with supplemental courses in biochemistry and molecular biology). Many students also enter graduate programs from diverse fields such as physics, psychology, nutrition, microbiology, or engineering.

Students need to have graduated college with at least a B average, especially in his/her science courses. Applicants should take the Graduate Record Examination (GRE), including the advanced test in biology, chemistry, biochemistry, or cell and molecular biology. Scores from these tests must be submitted to graduate schools for admission consideration.

Choosing a Graduate School

Many factors enter into a student’s choice of graduate schools:

- The presence of outstanding faculty in the subspecialty that you find interesting
- The breadth of course and research experience available
- The reputation of the program
- Personal considerations such as location

**Tip:** The faculty at your college/university should be able to give you information and advice.
Other resources for information about graduate programs are:

- The ASBMB website, www.asbmb.org
- Peterson’s Annual Guides to Graduate Study Programs in Biological, Agricultural, and Health Sciences
- The American Chemical Society (ACS) Directory of Graduate Research

Financial Aid

Most students in Ph.D. programs have all their education expenses covered by the school, including tuition and fees, and receive a stipend for living expenses.

Many Ph.D. students obtain teaching assistantships where they assist the instructors of a course, help students, and correct homework and exams. A smaller number of students with outstanding academic records are supported by fellowships and research traineeships.

Tip: Ask the schools to which you are applying about their financial aid programs.

A graduate education program is intensive but many students thrive on the concept that they are being paid to think.
Careers in Biochemistry and Molecular Biology

Career Prospects
Career prospects are bright for someone trained in the molecular life sciences. Job market projections indicate that there will be high demand for science and engineering jobs in the future. A large fraction of these will be filled by biochemists and molecular biologists.

According to the U.S. Bureau of Labor and Statistics, employment of biological scientists is projected to grow 21 percent over the 2008-18 decade, much faster than the average for all occupations, as biotechnological research and development continues to drive job growth. (Occupational Outlook Handbook, 2010–2011).

The median annual wage of a biochemist in May 2008 was $82,840. (Occupational Outlook Handbook, 2010–2011)

Work Environment
Most biochemists and molecular biologists spend time doing research in laboratories and in offices writing up the results of their research findings. Many, especially those employed as professors, also spend time writing grant proposals to support their research and teaching.

Employment Sectors

College and University Employment
Many doctoral degree holders find rewarding careers as professors at colleges and universities. In addition to classroom and laboratory instruction, many will do basic research in biochemistry and molecular biology.
Government Employment
Many Ph.D. graduates find employment doing basic research and development in industry or as administrators at government agencies where they lead programs that are concerned with the safety of new devices, food, and drugs or influence which projects the National Institutes of Health and the National Science Foundation will support.

Biotechnology Employment
Publically and privately-held corporations belonging to the biotechnology, medical device, and pharmaceutical family of industries are commonly and collectively lumped together into the generic biotechnology industry.

The biotechnology industry has created more than 200 new therapies and vaccines, more than 400 drug products, hundreds of medical diagnostic tests, agricultural biotechnology that benefit farmers, and environmental biotech products that are used to clean up hazardous waste.

According to the Biotechnology Industry Organization, bioscience employment growth greatly outpaced national employment growth from 2001 to 2008. The bioscience industry added 193,748 jobs from 2001 to 2008, a hefty growth rate of 15.8 percent. This rapid rate of job growth was 4.5 times as much as the overall growth rate for the national private sector (3.5 percent). (State of Bioscience Initiatives 2010)

Subsectors of the biotechnology industry include:
- Agricultural feedstock and chemicals
- Drugs and pharmaceuticals
- Medical devices and equipment
- Research, testing, and medical laboratories

The biotechnology industry offers excellent career opportunities for people trained in the molecular life sciences, with opportunities across the spectrum of all company activities.
Non-Traditional Careers
Some biochemists and molecular biologists find fulfilling careers in non-traditional job sectors such as management, science policy, science writing, and medical illustration. To learn more about non-traditional career opportunities, read Career Insights, a monthly column published in ASBMB Today online at http://www.asbmb.org/asbmbtoday/.

Community College Graduates
Someone with a two-year community college degree may work as a technician to conduct routine laboratory work at hospital, commercial, public health, and biomedical research facilities.

College Graduates
Someone with a B.A./B.S. degree can work for a variety of employers:

- Government agencies such as National Institutes of Health, U.S. Food and Drug Administration, Environmental Protection Agency, U.S. Department of Agriculture and individual state laboratories employ skilled personnel in basic research programs and in the analyses of samples of food, drugs, air, water, wastes, or animal tissue.
- Drug companies hire B.A./B.S. degree holders as lab technicians to work on drug development.
- The FBI, state government and private forensics laboratories require increasingly science-oriented individuals in order to take advantage of the powerful tools of DNA fingerprinting and other molecular analyses techniques to solve crime.
- There is high demand for science teachers with molecular life science degrees at junior high and high schools.
- Biotechnology firms hire bachelor degree holders for research, quality control, clinical research, manufacturing/production and information systems jobs.
**Master of Science Graduates**

All the sectors listed under College Graduates apply to Master of Science degree holders. Compared to college graduates, someone with a M.S. has better prospects for advancement and compensation. M.S. graduates will also have more responsibility and independence at their jobs. Some corporations favor M.S graduates who graduated from degree programs that involved substantial research.

**Doctorate Graduates**

In addition to the career opportunities discussed above, a Ph.D. degree is required for work such as:

- Professors at colleges and universities. Many professors combine instruction and basic research in their daily work.
- Program directors at government agencies where they engage in research or as high-level administrators.
- Research directors or senior executives at biotechnology firms.
- Editors of scientific journals.
Online Resources

America’s Job Bank
www.ajb.dni.us

ASBMB
www.asbmb.org/summerresearch

Bio Space
www.biospace.com

Biotechnology Industries Organization
www.bio.org

Cell & Molecular Biology Online
www.cellbio.com/joblists.html

DOE Office of Science
www.science.energy.gov/about/jobs/

Federal Jobs
www.usajobs.opm.gov

NASA
www.nasajobs.nasa.gov

National Institute of Environmental Health Sciences
www.niehs.nih.gov/summers

National Institutes of Health
www.training.nih.gov

National Science Foundation
www.nsf.gov/about/career_opps/

Science Careers
www.sciencecareers.org

Science jobs.com
www.sciencejobs.org
About the American Society for Biochemistry and Molecular Biology

The American Society for Biochemistry and Molecular Biology (ASBMB) is a nonprofit scientific and educational organization with over 12,000 members.

Founded in 1906, the Society is based in Rockville, Maryland. The Society’s purpose is to advance the science of biochemistry and molecular biology through publication of scientific and educational journals: the *Journal of Biological Chemistry*, *Molecular & Cellular Proteomics*, and the *Journal of Lipid Research*, organization of scientific meetings, advocacy for funding of basic research and education, support of science education at all levels, and promoting the diversity of individuals entering the scientific workforce.
Visit www.asbmb.org/summerresearch for an up-to-date listing of summer research opportunities.

For additional information about careers in biochemistry and molecular biology or additional copies of this brochure, write to the national office of the ASBMB at 11200 Rockville Pike, Suite 302, Rockville, MD 20852.

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