



# Biochemists

## **... Have a broad range of scientific knowledge**

Biochemistry is the study of the structure, composition, and chemical reactions of substances in living systems. Biochemistry emerged as a separate discipline when scientists combined biology with organic, inorganic, or physical chemistry and began to study such topics as how living things obtain energy from food, the chemical basis of heredity, and fundamental biological changes that occur in disease. Biochemistry includes the sciences of molecular biology; immunochemistry; neurochemistry; and bioinorganic, bioorganic; and biophysical chemistry.

## **... Engage in viral research**

Biochemistry is applied to medicine, dentistry, and veterinary medicine. In food science, biochemists research ways to develop abundant and inexpensive sources of nutritious foods, determine the chemical composition of foods, develop methods to extract nutrients from waste products, or invent ways to prolong the shelf life of food products. In agriculture, biochemists study the interaction of herbicides with plants. They examine the structure–activity relationships of compounds, determine their ability to inhibit growth, and evaluate the toxicological effects on surrounding life.

Biochemistry spills over into pharmacology, physiology, microbiology, and clinical chemistry. In these areas, a biochemist may investigate the mechanism of a drug action; engage in viral research; conduct research pertaining to organ function; or use chemical concepts, procedures, and techniques to study the diagnosis and therapy of disease and the assessment of health.

Work in the field of biochemistry is often related to toxicology. Scientists in the area do research to understand ways in which organic compounds in the body are changed by enzymes into toxic metabolites. They focus on determining the health effects of inhaled pollutants, develop chemical analytical techniques to detect pollutants and their metabolites in body tissues and fluids, use mathematics to describe the relationships between the air and body concentrations of these chemicals or their metabolites, and determine how these concentrations change with time.

## **... Interact with scientists from many disciplines**

Real-world problems seldom come neatly packaged for one discipline to study. For example, engineers, aerosol scientists, veterinarians, analytical chemists, pathologists, and mathematicians, as well as biochemists worked as a team to investigate the health effects of an increased number of diesel-powered cars on the road. Biochemists also interact often with people outside of their organizations, for example, those who sponsor their work.

Interaction with others is integral to the job. A biochemist who specializes in enzymology identifies and characterizes enzymes as drug discovery targets. In this specialty, a biochemist often works with people from different disciplines such as physiology or medicinal chemistry, for example, to find a compound that can be used in clinical trials.

The underlying principle of biochemistry is understanding the structure of living systems. By understanding the structure of something, a scientist has a vital start toward understanding its function. For instance, a biochemist might study the structures of virus-producing proteins. Then he or she might share the results with other researchers and work together with them to develop drugs that control the proteins' actions, and through them, the virus.

Biochemists find exchanging information in this way very gratifying. Their ability to share their information and insight makes them highly valued members of research teams. The desire to discover things about how nature works and then use that knowledge to develop products to improve people's quality of life often motivates them.

Studying the cell and the chemistry of life results in valuable contributions being made to medicine, industry, and society. This knowledge helps fight illness and improve the quality of life, making the field interesting, challenging, rewarding, and full of opportunity. Biochemistry is a vast field. Although biochemists already understand much about how cells work, they really have only just scratched the surface. The field is wide open.



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## **FACT FILE: Biochemists**

**WORK DESCRIPTION** ► Biochemists study the chemical components and processes of living systems—plants, insects, viruses, microorganisms, and mammals—to explain how and why chemical reactions occur. Their work contributes to many fields of science.

**WORKING CONDITIONS** ► Biochemists work in modern research laboratories that stimulate creative work. Often they interact with scientists and specialists from other fields because their research is tied to another discipline. Biochemistry's application to other fields and its focus on improving the quality of our lives means that laboratory research must conform to strict guidelines. The results often are presented to others who have an outside interest in the work.

**PLACES OF EMPLOYMENT** ► Colleges and universities employ the majority of biochemists as teachers or researchers in schools of arts and sciences, medicine, engineering, pharmacy, dentistry, veterinary medicine, and agriculture. The Department of Agriculture, the National Institutes of Health, and the Environmental Protection Agency are just a few of the government agencies that employ biochemists who specialize in basic research analyzing food, drugs, air, water, waste, or animal tissue. Industries that produce pharmaceuticals, agricultural chemicals, foods, feeds, and consumer products also employ biochemists in research as well as in areas outside the lab such as marketing, management, science information, technical writing, and editing. Drug companies employ biochemists to research the causes of disease and to develop drugs to combat these diseases. Biotechnology companies employ biochemists in research quality control, clinical research, manufacturing, and information systems with applications to the environment, energy, human health care, agriculture, and animal health. Biochemists are also involved in chemical research and in some cases, the delivery of medical care.

**PERSONAL CHARACTERISTICS** ► Biochemists are curious about the chemical origins of life, the cell, the effects of organisms on the cell, and how altering conditions can improve life on earth. They are creative, imaginative, hardworking individuals who enjoy interacting with other scientists to discover applications for their research. Perseverance is a key to success. Because they often work in teams, biochemists must be cooperative and able to work well with others. Oral and written communication skills are essential. Biochemists usually establish an area of expertise, but diversity and flexibility are essential when working with other disciplines.

**EDUCATION AND TRAINING** ► Preparing for a career in biochemistry requires earning a bachelor's degree in biochemistry or chemistry with specialties in cell biology, genetics, molecular biology, biophysics, and biochemical methods. A bachelor's degree in biology with additional coursework in chemistry and physics, coupled with a biochemistry course and lab work, will also provide a foundation for entering the field. Some universities offer a one-year program after undergraduate school for training in specialized laboratory techniques. Researchers and companies consider this program extremely valuable. At some universities, students can work simultaneously toward a bachelor's degree and a certificate for completing work in cell culture, genetic engineering, recombinant DNA technology, in vitro cell culture, or DNA sequencing and synthesis. Positions that involve teaching in a college or directing research require at least a master's degree, and preferably a doctorate.

**JOB OUTLOOK** ► Job opportunities are good for skilled professionals trained in this field. It is expanding and growth is expected in industry, especially in genetic research.

**SALARY RANGE** ► According to the 2003 ACS Salary Survey, biochemists with a bachelor's degree can earn \$32,000–\$60,000 per year, while Ph.D. biochemists in industry earn from \$70,000 to \$125,000. Ph.D. biochemistry professors at four-year colleges earn \$58,000–80,000 with 6–10 years experience. Starting academic salaries range in the mid \$40,000s.

### **FOR MORE INFORMATION**

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**WHAT YOU CAN DO NOW** ► Consult with a faculty adviser and choose your courses carefully. Seek opportunities that provide on-the-job experience in a biochemistry laboratory through co-ops, internships, or research programs sponsored for undergraduates. Consider whether employment opportunities in undergraduate school that call for skilled workers in basic research or teaching precollege science are what you prefer, or whether going on to graduate school and pursuing opportunities for directing research, working on state-of-the-art projects, or teaching at the college level is more to your liking.