



Agricultural Chemists

... Study life processes for obtaining food

Agricultural chemistry focuses on chemical compositions and changes involved in the production, protection, and use of crops and livestock. It seeks to control and understand the processes by which humans obtain food and fiber for themselves and feed for their animals. Agricultural chemists work with food producers to increase yields, improve quality, and reduce costs. They also study the causes and effects of biochemical reactions related to plant and animal growth, seek ways to control these reactions, and develop chemical products that provide help in controlling these reactions. Chemical products developed to assist in the production of food, feed, and fiber include herbicides, fungicides, insecticides, plant growth regulators, fertilizers, and animal feed supplements.

... Regulate the safe use of chemicals

Through research and experimentation, agricultural chemists increase our understanding of the impact of chemicals in the food stream and advise farmers, the government, and the agricultural industry on the effective and safe use of chemicals to improve and expand production. Every year in the United States, millions of pounds of chemicals are used in herbicides, fungicides, and insecticides that are applied to crops. Some industrial scientists in this field use their expertise in agriculture and chemical processes to make sure these products are safe for humans and for the environment. These chemicals are applied in huge quantities to commercial crops. In test fields, the air, plants, soil, and water are tested for the presence of these chemicals or their metabolites—compounds which result from the breakdown of the chemicals. A significant presence may be dangerous to animals and humans.

Other agricultural chemists do similar work for government agencies such as the U.S. Department of Agriculture (USDA). These agricultural scientists focus on the environmental fate of pesticides, finding out where they go, which can sometimes be unexpected. Chemists test for these chemicals in the atmosphere, surface water, and groundwater. Agricultural chemists also work at the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA), the U.S. government regulatory agencies for the industry. In some cases, the work that both industry and government do results in changes in the way that some chemicals are used.

... Have a variety of opportunities

Some chemists develop molecules used in herbicides or other pesticides, and others develop molecules and new compounds that effectively reduce damage to crops from pests and dis-

ease but are less toxic to animals and humans who eat the food. Still others help to improve the cost-effectiveness of food production or are focused on other business-related aspects of the field.

Agricultural biotechnology is the fastest growing sub-discipline within agricultural chemistry and is currently focused in three major areas: genetic engineering of crops to be more herbicide-tolerant or less apt to be killed along with the weeds during herbicide treatment; genetic engineering of produce, to improve taste and color and promote longer shelf life; and the improvement of plants' natural tolerance to certain pests. An example of the latter is the Calgene Corporation's work on introducing the *Bacillus thuringiensis* (Bt) protein into its proprietary cotton varieties. This causes the plants to produce a Bt toxin that kills *Heliothis*, a principal cotton insect pest. Crops engineered to be herbicide tolerant are thought to be safer and more environmentally friendly than other crops.

... Are business-oriented

Process development scientists at agricultural firms seek ways to make their products efficiently. They work with the research and development departments to identify market needs and find ways to meet them. These scientists concern themselves most with how to produce needed chemicals at a reasonable cost to their buyers and with minimal environmental impact.

... Work with other scientists

Agricultural chemists work a lot with scientists in other fields, including agronomists, biologists, toxicologists, and biochemists. There is a wide spectrum of research projects in this field. Thus, it is important to be able to work, or at least to be conversant, in other fields. An agricultural chemist should be as well-rounded as possible. Although the work is very team-based, there's still autonomy in research as long as the research ultimately has an application that will benefit agriculture.

Agricultural chemistry is not a distinct discipline. It ties together genetics, physiology, microbiology, entomology, and other sciences that contribute chemical techniques to agriculture. For example, agricultural chemists help develop more productive plant and animal strains, determine the kinds and amounts of nutrients needed for optimum growth of plants and animals, and determine a soil's ability to provide essential nutrients for the support of crops or livestock. Every scientific discipline that contributes to agricultural progress depends in some way on chemistry.



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FACT FILE: Agricultural Chemists

WORK DESCRIPTION ► Research projects for agricultural chemists cover many fields of inquiry, including the development of a molecule or chemical compound that controls a weed or other pest; the development of that molecule for full-scale manufacturing; modifications to the molecule, so that it works for longer periods of time or at lower dosages; and testing for the impact and fate of the chemical in food and the environment.

WORKING CONDITIONS ► Agricultural chemists generally work in a lab or a simulated environment such as a test field or test waterway. In determining the presence and fate of agricultural chemicals, analytical chemistry methods are used. In development work, agricultural chemists rely heavily on their training in process chemistry and basic organic chemistry.

PLACES OF EMPLOYMENT ► Agricultural chemists are employed in government agencies, such as the USDA, the FDA, and the EPA, in industry, and in academia, because agricultural chemistry is a very active area of research, classroom teaching, and outreach. Career opportunities are also available in food companies that are involved in genetically modified foods. Some of the large chemical companies count their agricultural divisions as their most lucrative businesses. The increase in environmental regulations has created opportunities in environmental chemistry work within the agricultural chemicals industry. However, the primary focus for most of these companies is still developing and selling agricultural chemicals at the most competitive price.

PERSONAL CHARACTERISTICS ► Because agricultural chemicals potentially come in contact with everything—crops, weeds, plankton, soil, air, animals, and humans—an agricultural chemist must be able to think in an interdisciplinary manner, considering many ideas simultaneously and across different scientific disciplines. Those students with an interest in the environment will likely be attracted to the high degree of involvement with environmental issues in this field. In addition, good communication skills are a must, as team efforts are the characteristic work model in most labs.

EDUCATION AND TRAINING ► Many Ph.D. chemists work in the agricultural chemicals field, although an advanced degree is not a prerequisite for nonresearch support positions. A Ph.D., however, generally gets an individual more complex and challenging research assignments earlier in his or her career. Agricultural chemists recommend that students take courses in biology, biochemistry, human toxicology, water and soil chemistry, and geology. Knowledge of computers and a course in research ethics are also strongly suggested. Scientists already in the field point out that there are now many more degree programs in environmental sciences now than existed in the past. These, they say, are another route into this field.

JOB OUTLOOK ► The agricultural chemicals business is experiencing a transition, which makes the job outlook less clear than it has been in the past. More than twenty years ago, a boom in agricultural chemicals opened up the job market, but those within the industry say departments are now getting smaller and jobs are more competitive. Agricultural companies are consolidating, and agricultural chemists expect that a few firms will soon dominate the business. Once this reorganization has happened, clearer hiring patterns will begin to emerge. Most of the growth in agricultural chemistry is in biotechnology and bioengineering.

SALARY RANGE ► The starting annual salary for a Ph.D. chemist is in the mid-\$70,000s. B.S. and M.A. degree holders going into industry can expect to start anywhere from the mid-\$30,000s to the mid-\$40,000s, depending on the size of the company for which they work. Jobs in government laboratories traditionally pay less. Chemists in government starting at a GS-9 level can expect to earn \$44,000 annually. At a GS-11 level, salaries are closer to \$47,100 per year.

FOR MORE INFORMATION

For information on industries and companies that produce agricultural chemicals:

American Crop Protection Association
1156 15th St. NW, Ste. 400
Washington, DC 20005-1716
202-296-1585
www.acpa.org

For information on opportunities for agricultural chemists in biotechnology:

Biotechnology Industry Organization
1625 K St., NW, Ste. 1100
Washington, DC 20006-1621
202-857-0244
www.bio.org

You may also want to investigate the Environmental Protection Agency's Web site at www.epa.gov and the Food and Drug Administration's Web site at www.fda.gov.

WHAT YOU CAN DO NOW ► Chemists in the agriculture business say that any advantage a student can gain through internships or summer jobs at a company will be extremely helpful because the job market is so competitive. Personal contacts are important in this field and will give you an opportunity to discover whether this field is right for you.