

Agricultural and Food Scientists

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Significant Points

- Almost 4 in 10 salaried agricultural and food scientists work for Federal, State, or local governments.
- A bachelor's degree in agricultural science is sufficient for some jobs in applied research; a master's or doctoral degree is required for basic research.
- Slower-than-average job growth is projected because of limited growth in the Federal Government and modest growth in State and local governments, the largest employers of these scientists.

Nature of the Work

The work of agricultural and food scientists plays an important part in maintaining the Nation's food supply by ensuring agricultural productivity and the safety of the food supply. Agricultural scientists study farm crops and animals, and develop ways of improving their quantity and quality. They look for ways to improve crop yield with less labor, control pests and weeds more safely and effectively, and conserve soil and water. They research methods of converting raw agricultural commodities into attractive and healthy food products for consumers.

Agricultural science is closely related to biological science, and agricultural scientists use the principles of biology, chemistry, physics, mathematics, and other sciences to solve problems in agriculture. They often work with biological scientists on basic biological research and on applying to agriculture the advances in knowledge brought about by biotechnology.

In the past two decades, rapid advances in basic biological knowledge related to genetics spurred growth in the field of biotechnology. Some agricultural and food scientists use this technology to manipulate the genetic material of plants and crops, attempting to make organisms more productive or resistant to disease. These advances in biotechnology have opened up research opportunities in many areas of agricultural and food science, including commercial applications in agriculture, environmental remediation, and the food industry.

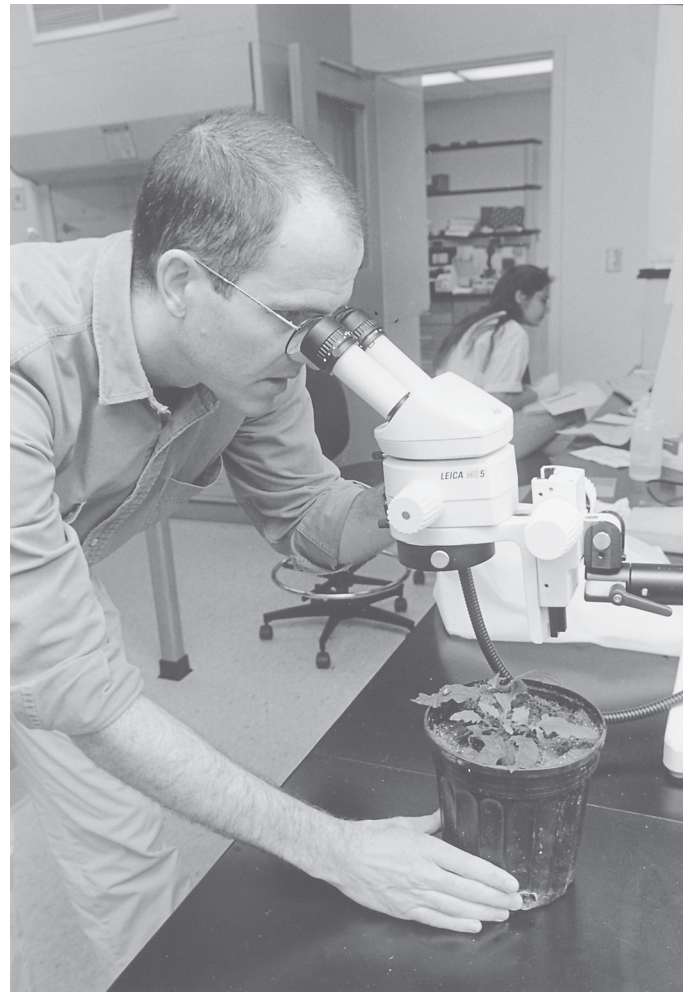
Many agricultural scientists work in basic or applied research and development. Others manage or administer research and development programs, or manage marketing or production operations in companies that produce food products or agricultural chemicals, supplies, and machinery. Some agricultural scientists are consultants to business firms, private clients, or government.

Depending on the agricultural or food scientist's area of specialization, the nature of the work performed varies.

Food science. Food scientists and technologists usually work in the food processing industry, universities, or the Federal Government, and help to meet consumer demand for food products that are healthful, safe, palatable, and convenient. To do this, they use their knowledge of chemistry, physics, engineering, microbiology, biotechnology, and other sciences to develop new or better ways of preserving, processing, packaging, storing, and delivering foods. Some food scientists engage in basic research, discovering new food sources; analyzing food content to determine levels of vitamins, fat, sugar, or protein; or searching for substitutes for harmful or undesirable additives, such as nitrites. They also develop ways to process, preserve, package,

or store food according to industry and government regulations. Traditional food processing research into functions involving baking, blanching, canning, drying, evaporation, and pasteurization will continue to be conducted and will find new applications. Other food scientists enforce government regulations, inspecting food processing areas and ensuring that sanitation, safety, quality, and waste management standards are met. Food technologists generally work in product development, applying the findings from food science research to the selection, preservation, processing, packaging, distribution, and use of safe, nutritious, and wholesome food.

Plant science. Agronomy, crop science, entomology, and plant breeding are included in plant science. Scientists in these disciplines study plants and their growth in soils, helping producers of food, feed, and fiber crops to continue to feed a growing population while conserving natural resources and maintaining the environment. Agronomists and crop scientists not only help increase productivity, but also study ways to improve the nutritional value of crops and the quality of seed, often through biotechnology. Some crop scientists study the breeding, physiology, and management of crops and use genetic engineering to develop crops resistant to pests and drought. Entomologists conduct research to develop new technologies to control or eliminate pests in infested areas and to prevent the spread of harmful pests to new areas, as well as technologies that are compatible with the environment. They also conduct re-



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search or engage in oversight activities aimed at halting the spread of insect-borne disease.

Soil science. Soil scientists study the chemical, physical, biological, and mineralogical composition of soils as they relate to plant or crop growth. They also study the responses of various soil types to fertilizers, tillage practices, and crop rotation. Many soil scientists who work for the Federal Government conduct soil surveys, classifying and mapping soils. They provide information and recommendations to farmers and other landowners regarding the best use of land, plant growth, and methods to avoid or correct problems such as erosion. They may also consult with engineers and other technical personnel working on construction projects about the effects of, and solutions to, soil problems. Because soil science is closely related to environmental science, persons trained in soil science also apply their knowledge to ensure environmental quality and effective land use.

Animal science. Animal scientists work to develop better, more efficient ways of producing and processing meat, poultry, eggs, and milk. Dairy scientists, poultry scientists, animal breeders, and other scientists in related fields study the genetics, nutrition, reproduction, growth, and development of domestic farm animals. Some animal scientists inspect and grade livestock food products, purchase livestock, or work in technical sales or marketing. As extension agents or consultants, animal scientists advise agricultural producers on how to upgrade animal housing facilities properly, lower mortality rates, handle waste matter, or increase production of animal products, such as milk or eggs.

Working Conditions

Agricultural scientists involved in management or basic research tend to work regular hours in offices and laboratories. The work environment for those engaged in applied research or product development varies, depending on the discipline of agricultural science and on the type of employer. For example, food scientists in private industry may work in test kitchens while investigating new processing techniques. Animal scientists working for Federal, State, or university research stations may spend part of their time at dairies, farrowing houses, feedlots, or farm animal facilities or outdoors conducting research associated with livestock. Soil and crop scientists also spend time outdoors conducting research on farms and agricultural research stations. Entomologists work in laboratories, insectories, or agricultural research stations, and also may spend time outdoors studying or collecting insects in their natural habitat.

Employment

Agricultural and food scientists held about 18,000 jobs in 2002. In addition, several thousand persons held agricultural science faculty positions in colleges and universities. (See the statement on postsecondary teachers elsewhere in the *Handbook*.)

Almost 4 in 10 salaried agricultural and food scientists work for Federal, State, or local governments. One out of 6 worked for the Federal Government in 2002, mostly in the U.S. Department of Agriculture. Another 1 in 6 worked for State governments at State agricultural colleges or agricultural research stations. Some worked for agricultural service companies; others worked for commercial research and development laboratories, seed companies, pharmaceutical companies, wholesale distributors, and food products companies. Over 1,600 agricultural scientists were self-employed in 2002, mainly as consultants.

Training, Other Qualifications, and Advancement

Training requirements for agricultural scientists depend on their specialty and on the type of work they perform. A bachelor's degree in agricultural science is sufficient for some jobs in applied research or for assisting in basic research, but a master's or doctoral degree is required for basic research. A Ph.D. in agricultural science usually is needed for college teaching and for advancement to administrative research positions. Degrees in related sciences such as biology, chemistry, or physics or in related engineering specialties also may qualify persons for some agricultural science jobs.

All States have a land-grant college that offers agricultural science degrees. Many other colleges and universities also offer agricultural science degrees or some agricultural science courses. However, not every school offers all specialties. A typical undergraduate agricultural science curriculum includes communications, mathematics, economics, business, and physical and life sciences courses, in addition to a wide variety of technical agricultural science courses. For prospective animal scientists, these technical agricultural science courses might include animal breeding, reproductive physiology, nutrition, and meats and muscle biology. Graduate students typically specialize in a subfield of agricultural science, such as animal breeding and genetics, crop science, or horticulture science, depending on their interest and the kind of work they wish to do. For example, those interested in doing genetic and biotechnological research in the food industry need to develop a strong background in life and physical sciences, such as cell and molecular biology, microbiology, and inorganic and organic chemistry. However, students normally need not specialize at the undergraduate level. In fact, undergraduates who are broadly trained have greater flexibility when changing jobs than if they had narrowly defined their interests.

Students preparing as food scientists take courses such as food chemistry, food analysis, food microbiology, food engineering, and food processing operations. Those preparing as crop or soil scientists take courses in plant pathology, soil chemistry, entomology, plant physiology, and biochemistry, among others. Advanced degree programs include classroom and fieldwork, laboratory research, and a thesis or dissertation based on independent research.

Agricultural and food scientists should be able to work independently or as part of a team and be able to communicate clearly and concisely, both orally and in writing. Most of these scientists also need an understanding of basic business principles, and the ability to apply basic statistical techniques. Employers increasingly prefer job applicants who are able to apply computer skills to determine solutions to problems, to collect and analyze data, and to control various processes.

The American Society of Agronomy offers certification programs in crop science, agronomy, crop advising, soil science, plant pathology, and weed science. To become certified, applicants must pass designated examinations and have at least 2 years of experience with at least a bachelor's degree in agriculture or 4 years of experience with no degree. To become a certified crop advisor, however, candidates do not need a degree.

Agricultural scientists who have advanced degrees usually begin in research or teaching. With experience, they may advance to jobs such as supervisors of research programs or managers of other agriculture-related activities.

Job Outlook

Employment of agricultural and food scientists is expected to grow more slowly than the average for all occupations through 2012. This projection reflects limited growth in the Federal Government and modest growth in State and local governments. The need to replace agricultural and food scientists who retire or otherwise leave the occupation permanently will account for many more job openings than will projected growth.

Past agricultural research has resulted in the development of higher yielding crops, crops with better resistance to pests and plant pathogens, and chemically based fertilizers and pesticides. Research is still necessary, particularly as insects and diseases continue to adapt to pesticides and as soil fertility and water quality continue to need improvement, resulting in job opportunities in biotechnology. Agricultural scientists are using new avenues of research in biotechnology to develop plants and food crops that require less fertilizer, fewer pesticides and herbicides, and even less water for growth.

Biotechnological research, including studies and approaches relying on the tools of genomics, will continue to offer possibilities for the development of new food products. This research will allow agricultural and food scientists to develop techniques to detect and control food pathogens, and should lead to better understanding of other physiological responses of pathogens in food environments.

Agricultural scientists will be needed to balance increased agricultural output with protection and preservation of soil, water, and ecosystems. They will increasingly encourage the practice of "sustainable agriculture" by developing and implementing plans to manage pests, crops, soil fertility and erosion, and animal waste in ways that reduce the use of harmful chemicals and do little damage to the natural environment.

Further food research will result in more job opportunities for food scientists and technologists. This research will be stimulated by a heightened public focus on diet, health, and food safety, as well as domestic and global issues such as increasing world population, availability and cost of usable water, loss of arable land, deforestation, environmental pollution, and climate change.

Those with doctorates in agricultural and food science may face competition for jobs, due to an increase in the number of graduates and the limited numbers of research and teaching positions. Opportunities may be more numerous for those with a master's degree, particularly for graduates seeking basic research positions in a laboratory. Most of these positions, however, entail working under the guidance and direction of a Ph.D. scientist.

Graduates with a bachelor's degree should have opportunities, although not necessarily as an agricultural or food scientist. A bachelor's degree in agricultural science is useful for managerial jobs in businesses that deal with ranchers and farmers, such as feed, fertilizer, seed, and farm equipment manufacturers; retailers or wholesalers; and farm credit institutions. In some cases, persons with a 4-year degree can provide consulting services, or become a certified crop advisor, providing crop management recommendations to farmers to help them meet their objectives. Bachelor's degree holders also can work in some applied research and product development positions, but usually only in certain subfields, such as food science and technology, and the Federal Government hires bachelor's degree holders to work as soil scientists. Four-year degrees also may help persons enter occupations such as farmer, or farm or ranch manager; cooperative extension service agent; agricultural products inspector; or

purchasing or sales agent for agricultural commodity or farm supply companies.

Employment of agricultural and food scientists is relatively stable during periods of economic recession. Layoffs are less likely among agricultural and food scientists than in some other occupations because food is a staple item and its demand fluctuates very little with economic activity.

Earnings

Median annual earnings of agricultural and food scientists were \$48,670 in 2002. The middle 50 percent earned between \$35,770 and \$65,990. The lowest 10 percent earned less than \$28,750, and the highest 10 percent earned more than \$85,460.

The average Federal salary for employees in nonsupervisory, supervisory, and managerial positions in 2003 was \$82,729 in animal science and \$68,846 in agronomy.

According to the National Association of Colleges and Employers, beginning salary offers in 2003 for graduates with a bachelor's degree in animal sciences averaged \$30,026 a year; plant sciences, \$28,203 a year; and in other agricultural sciences, \$29,971 a year.

Related Occupations

The work of agricultural scientists is closely related to that of other scientists, including biological scientists, chemists, and conservation scientists and foresters. It also is related to the work of managers of agricultural production, such as farmers, ranchers, and agricultural managers. Certain specialties of agricultural science also are related to other occupations. For example, the work of animal scientists is related to that of veterinarians, and horticulturists perform duties similar to those of landscape architects.

Sources of Additional Information

Information on careers in agricultural science is available from:

- ▶ American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, 677 S. Segoe Rd., Madison, WI 53711-1086. Internet: <http://www.agronomy.org>
- ▶ Food and Agricultural Careers for Tomorrow, Purdue University, 1140 Agricultural Administration Bldg., West Lafayette, IN 47907-1140.

For information on careers in food technology, write to:

- ▶ Institute of Food Technologists, Suite 300, 221 N. LaSalle St., Chicago IL 60601-1291. Internet: <http://www.ift.org>

Information on acquiring a job as an agricultural scientist with the Federal Government is available from the Office of Personnel Management through a telephone-based system. Consult your telephone directory under U.S. Government for a local number or call (703) 724-1850; Federal Relay Service: (800) 877-8339. The first number is not tollfree, and charges may result. Information also is available from the Internet site <http://www.usajobs.opm.gov>.