Agricultural and Food Scientists

Significant Points

- Faster than average growth is expected as agricultural and food scientists develop new products using biotechnology and work to limit the negative environmental impact of agriculture.
- A bachelor's degree in agricultural science is sufficient for most jobs in product development; a master's or Ph.D. degree is generally required for research positions.
- Opportunities are expected to be good.

Nature of the Work

The work of agricultural and food scientists plays an important role in maintaining the Nation's food supply by ensuring agricultural productivity and food safety. *Agricultural scientists* study farm crops and animals and develop ways of improving their quantity and quality. They look for ways to improve crop yield, 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. Some agricultural scientists look for ways to use agricultural products for fuels.

In recent years, advances in the study of genetics have spurred the growth of biotechnology. Some agricultural and food scientists use biotechnology to manipulate the genetic material of plants and crops, attempting to make these organisms more productive or resistant to disease. 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. Interest in the production of biofuels, or fuels manufactured from agricultural derivatives, has also increased. Some agricultural scientists work with biologists and chemists to develop more efficient processes for turning crops into energy sources, such as ethanol produced from corn.

Another emerging technology expected to affect agriculture is nanotechnology—a molecular manufacturing technology which promises to revolutionize methods of testing agricultural and food products for contamination or spoilage. Some food scientists are using nanotechnology to develop sensors that can quickly and accurately detect contaminant molecules in food.

Many agricultural scientists work in basic or applied research and development. Basic research seeks to understand the biological and chemical processes by which crops and livestock grow, such as determining the role of a particular gene in plant growth. Applied research uses this knowledge to discover mechanisms to improve the quality, quantity, and safety of agricultural products. Other agricultural scientists 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 scientists and technologists usually work in the food processing industry, universities, or the Federal Government to create and improve food products. 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. Others engage in applied research, finding ways to improve the content of food or to remove harmful additives. They also develop ways to process, preserve, package, or store food according to industry and government regulations. Some continue to research improvements in traditional food processing techniques, such as baking, blanching, canning, drying, evaporation, and pasteurization. Other food scientists enforce government regulations, inspecting food processing areas and ensuring that sanitation, safety, quality, and waste management standards are met.

Some agricultural and food scientists conduct experiments on new varieties of crops.

Projections data from the National Employment Matrix

Occupational Title	SOC Code	Employment, 2008	Projected Employment, 2018	Change, 2008-2018	
				Number	Percent
Agricultural and food scientists	19-1010	31,000	35,900	4,800	16
Animal scientists	19-1011	3,700	4,200	500	13
Food scientists and technologists	19-1012	13,400	15,600	2,200	16
Soil and plant Scientists	19-1013	13,900	16,100	2,200	15

(NOTE) Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook.*

Food technologists generally work in product development, applying the findings from food science research to improve the selection, preservation, processing, packaging, and distribution of food.

Plant scientists study plants, helping producers of food, feed, and fiber crops to feed a growing population and to conserve natural resources. *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. Some plant scientists develop new technologies to control or eliminate pests and to prevent their spread in ways appropriate to the specific environment. They also conduct research or oversee activities to halt the spread of insect-borne disease.

Soil scientists study the chemical, physical, biological, and mineralogical composition of soils as it relates to plant 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 and plants 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 work to ensure environmental quality and effective land use.

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, and growth 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 animal mortality rates, handle waste matter, or increase production of animal products, such as milk or eggs.

Work environment. 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 specialty and 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, farm animal facilities, or outdoors conducting research. Soil and crop scientists also spend time outdoors conducting research on farms and agricultural research stations.

Training, Other Qualifications, and Advancement

A bachelor's degree in agricultural science is sufficient for private industry jobs in product development or applied research, but a master's or doctoral degree is generally required for research jobs at universities.

Education and training. Training requirements for agricultural scientists depend on the type of work they perform. Most jobs in the farming and food processing industry require a bachelor's degree, but a master's or doctoral degree is usually required for research positions at universities. A Ph.D. in agricultural science is also needed for college teaching and for advancement to senior research positions. Degrees in related sciences such as biology, chemistry, or physics or in related engineering specialties also may qualify people for many 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 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 example, degrees in animal sciences may include courses on animal breeding, reproductive physiology, nutrition, and meat and muscle biology. Graduate students usually specialize in a subfield of agricultural science, such as animal breeding and genetics, crop science, or horticulture science, depending on their interests. For example, those interested in doing genetic and biotechnological research in the food industry need a strong background in life and physical sciences, such as cell and molecular biology, microbiology, and inorganic and organic chemistry. Undergraduate students, however, need not specialize. In fact, undergraduates who are broadly trained often have greater career flexibility.

Students preparing to be food scientists take courses such as food chemistry, food analysis, food microbiology, food engineering, and food processing operations. Those preparing to be soil and plant 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.

Licensure. Some States require soil scientists to be licensed to practice. Licensing requirements vary by State, but generally include holding a bachelor's degree with a certain number of credit hours in soil science, a certain number of years working under a licensed scientist, and passage of an examination.

Other qualifications. 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, the ability to apply statistical techniques, and the ability to use computers to analyze data and to control biological and chemical processing.

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

The American Society of Agronomy certifies agronomists and crop advisors, and the Soil Science Society of America certifies soil scientists and soil classifiers. Certification is not necessary to work in these occupations, but it may improve opportunities by providing proof of a worker's qualifications. Certification in agronomy requires a bachelor's degree in agronomy or a related field and 5 years of experience, a master's degree and 3 years, or a doctoral degree and 1 year. Crop advising certification requires either 4 years of experience or a bachelor's degree in agriculture and 2 years of experience. To become certified in soil science or soil classification, applicants must have a bachelor's degree in soil science and 5 years of experience or a graduate degree and 3 years of experience. To receive any of these certifications, applicants must also pass designated examinations and agree to adhere to a code of ethics. Each certification is maintained through continuing education.

Employment

Agricultural and food scientists held about 31,000 jobs in 2008. Soil and plant scientists accounted for 13,900, food scientists and technologist for 13,400, while the remaining 3,700 were animal scientists. In addition, many people trained in these sciences held faculty positions in colleges and universities. (See the statement on teachers—postsecondary elsewhere in the *Handbook*.)

About 20 percent worked for manufacturing companies, mainly in food and pharmaceutical manufacturing, and another 15 percent worked in educational institutions. The Federal Government employed about 7 percent, mostly in the U.S. Department of Agriculture. Other agricultural and food scientists worked for research and development laboratories and wholesale distributors. About 12 percent of agricultural scientists were self-employed in 2008, mainly as consultants.

Job Outlook

Job growth among agricultural and food scientists should be faster than the average for all occupations. Opportunities are expected to be good over the next decade, particularly in food science and technology and in agronomy.

Employment change. Employment of agricultural and food scientists is expected to grow by 16 percent between 2008 and 2018, faster than the average for all occupations. Job growth will stem primarily from efforts to increase the quantity and quality of food produced for a growing population. Additionally, an increasing awareness about the health effects of certain types of foods and the effects of food production on the environment, will give rise to research into the best methods of food production.

Emerging biotechnologies will continue to play a large role in agricultural research, and applying these advances will provide many employment opportunities for scientists. For example, they may use findings from genomics to create agricultural products with higher yields and resistance to pests and pathogens. New developments will also be used to improve the quality and safety of prepared food products bought by consumers.

Agricultural scientists will also be needed to balance increased agricultural output with protection and preservation of soil, water, and ecosystems. They increasingly will help develop sustainable agricultural practices by creating and implementing plans to manage pests, crops, soil fertility and erosion, and animal waste in ways that reduce the use of harmful chemicals and minimize damage to the natural environment. In addition, demand for biofuels—renewable energy sources derived from plants—is expected to increase. Agricultural scientists will be needed both to find new techniques for converting organic material into usable energy sources and to find ways to increase the output of crops used in these products.

Job growth for food scientists and technologists will be driven by the demand for new food products and food safety measures. Food research is expected to increase because of heightened public awareness of diet, health, food safety, and biosecurity—preventing the introduction of infectious agents into herds of animals. Advances in biotechnology and nanotechnology should also spur demand, as food scientists and technologists apply these technologies to testing and monitoring food safety.

Job prospects. Opportunities should be good for agricultural and food scientists in almost all fields. Those with a bachelor's degree should experience very good opportunities in food science and technology and in agronomy. Those with a master's or Ph.D. degree in agricultural and food science will also experience good opportunities, although positions in basic research and teaching at colleges and universities are limited.

Many people with bachelor's degrees in agricultural sciences also find work in positions related to agricultural or food science, rather than in jobs as agricultural or food scientists. A bachelor's degree in agricultural science is useful for managerial jobs in farm-related or ranch-related businesses, such as farm credit institutions or companies that manufacture or sell feed, fertilizer, seed, and farm equipment. In some cases, people with a bachelor's degree can provide consulting services or work in sales and marketing—promoting high-demand products such as organic foods. Bachelor's degrees in agricultural science also may help people become farmers, ranchers, and

agricultural managers; agricultural inspectors; or purchasing agents 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 wages of food scientists and technologists were $59,520 in May 2008. The middle 50 percent earned between $43,600 and $81,340. The lowest 10 percent earned less than $33,790, and the highest 10 percent earned more than $104,520. Median annual wages of soil and plant scientists were $58,390 in May 2008. The middle 50 percent earned between $44,150 and $78,080. The lowest 10 percent earned less than $34,260, and the highest 10 percent earned more than $105,340. In May 2008, median annual wages of animal scientists were $56,030.

The average Federal salary in 2009 was $104,184 in animal science and $79,158 in soil science.

According to the National Association of Colleges and Employers, beginning salary offers in July 2009 for graduates with a bachelor's degree in animal sciences averaged $33,732 a year; plant sciences, $33,456 a year; and in other agricultural sciences, $34,699 a year.

Related Occupations

The work of agricultural scientists is closely related to that of other scientists, including:

Biological scientists
Chemists and materials scientists
Conservation scientists and foresters
Medical scientists

Other occupations that relate to agricultural production include:

Farmers, ranchers, and agricultural managers

Another occupation that works closely with animals:

Veterinarians

Sources of Additional Information

Information on careers in agricultural science is available from Purdue University and the U.S. Department of Agriculture at: **http://www.agriculture.purdue.edu/USDA/careers**

Information on careers in food science and technology is available from:

➤ Institute of Food Technologists, 525 W. Van Buren, Suite 1000, Chicago, IL 60607. Internet: **http://www.ift.org**

Information on careers in plant and soil sciences is available from:

➤ American Society of Agronomy, 677 S. Segoe Rd., Madison, WI 53711-1086. Internet: **http://www.agronomy.org**

➤ Crop Science Society of America, 677 S. Segoe Rd., Madison, WI 53711-1086. Internet: **http://www.crops.org**

➤ Soil Science Society of America, 677 S. Segoe Rd., Madison, WI 53711-1086. Internet: **http://www.soils.org**

Information on getting a job as an agricultural scientist with the Federal Government is available from the Office of Personnel Management through USAJOBS, the Federal Government's official employment information system. This resource for locating and applying for job opportunities can be accessed through the Internet at **http://www.usajobs.opm.gov** or through an interactive voice response telephone system at (703) 724-1850 or TDD (978) 461-8404. These numbers are not toll free, so charges may result.

The Occupational Information Network (O*NET) provides information on a wide range of occupational characteristics. Links to O*NET appear at the end of the Internet version of this occupational statement, accessible at **http://www.bls.gov/ooh/ocos046.htm**