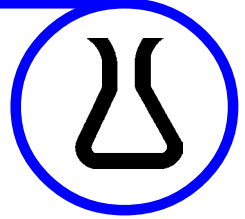


Entomologists



Occupational Brief Title Codes:

- D.O.T.: 041.061-046
- G.O.E.: 02.02.01
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Occupational Subtitles:

- Apiculturists

Work Classification Based Related

D.O.T. Occupations:

- Biologists
- Microbiologists
- Parasitologists
- Zoologists

Interests Based Related

G.O.E. Occupations:

- Anatomists
- Animal Scientists
- Apiculturists
- Staff Toxicologists

Skills Based Related

O*NET Occupations:

- Agricultural Inspectors
- Farmers and Ranchers
- Purchasing Agents and Buyers, Farm Products
- Soil Scientists

Noteworthy Quote:

“Insects are the most diverse and numerous class of organisms on the planet. It is estimated that insects represent fifty percent of all living species and they may represent sixty percent of all living organisms. The ability to adapt to environmental conditions and food availability has contributed to their successful evolution and diversification. This diversity and ability to adapt allows entomologists the freedom to tailor their career path based on their own interests and expertise.”

– Susan T. Ratcliffe, Assistant Professor, Crop Sciences, University of Illinois Urbana-Champaign

Entomologists (en-to-`mol-o-gists) classify insects and study their biology (behavior, physiology, life cycle, and distribution) to understand and manage the impact they have on the world around us.

There are more insects—and more kinds of insects—on this planet than all other animals combined. Although entomologists are aware of about one million species, they estimate that as many as thirty million may exist. It is important that entomologists learn as much as possible about insects because some species may have commercial applications, or may be helpful in medical research or environmental studies.

Although only a small number of insect species are harmful, these few species have a large impact on food production and human health. Insects are capable of destroying crops, forests, and buildings. Governments, ranchers, and farmers spend hundreds of millions of dollars each year to control insect damage to crops and to control insects that attack livestock and poultry. Malaria, yellow fever, West Nile virus, typhus, sleeping sickness, Lyme disease, and other mosquito and tick-borne illnesses afflict people and animals worldwide.

Beneficial insects, on the other hand, have an important impact on our ecosystem and contribute to our quality of life. They help in plant pollination, decomposition of dead plants and animals, and the production of consumer products, such as honey and silk. Insects are a source of food for many birds, plants, animals, and, in some cultures, people. Some insects prey on other insects that damage crops and cause illnesses. Scientists also use some insects in medical research and in the control of aggressive plant species.

In addition to the one million known species of insects, hundreds of new insects are discovered each year. Existing species are also introduced to new habitats either unintentionally through the movement of people and products, or intentionally as biological control agents—beneficial insects used to control harmful insects and weeds. Entomologists are responsible for studying, gathering data, and managing the effects of all these insects.

Work Performed

By studying insects, entomologists increase the body of knowledge on insect and animal social orders, habitat, and behavior. This knowledge can improve ecosystems for insect, animal, plant, and human communities. By studying the physiological and biochemical processes of insects, researchers also discover compounds and gain knowledge that are useful in other fields, such as human biology and medicine.

Career opportunities in the field of entomology are limitless. Entomologists may focus their work in agricultural entomology; applied entomology; economic entomology; forensic entomology; medial entomology; taxonomic entomology (systematics); urban entomology; veterinary entomology; insect behavior, ecology, genetics, morphology, pathology, or physiology; biological control; or integrated pest management.

Some entomologists, for instance, focus on the control of destructive insect populations. These scientists study the basic biology, life cycle, feeding, and mating habits of insect species considered pests to learn how to control them. They work to reduce insect damage to crops, forests, and food in storage. In the past, non-selective poisonous chemicals—broad spectrum insecticides that killed both harmful and beneficial insects—were used to control insects. Some of these chemicals spread

through the food chain and lingered in soil and water, creating long-term ecological problems.

Today, scientists are spending more time studying the effectiveness of integrated pest management (IPM) systems. IPM uses a combination of insect-specific pesticides, biological pest control methods, insect resistance, cultural practices, and sanitary controls to manage insect populations. The emphasis of IPM is on controlling the insect population—not eliminating it—by making informed decisions on the need to reduce insect populations and identifying proper, non-destructive control methods.

Entomologists in IPM and biological control may study substances that disrupt insect development and pest-specific toxins that do not harm the ecosystem. They study the use of pheromones—chemicals produced by different types of insects to communicate by scent with members of their own or other species—to alter insect behavior and disrupt mating. Entomology experts in biological control also develop systems that rely on predator insects and parasites, such as certain species of mites, green lacewings, stinkbugs, ladybug beetles, parasitic wasps, and praying mantises, in the control of other insect populations.

Entomologists in insect pathology study insect control methods that introduce insect-specific bacteria and viruses into an insect population. This approach has been effective in controlling some kinds of grubs by infecting them with milky spore disease. Entomologists have also had good results controlling some kinds of tree-eating caterpillars and chewing insects by infecting them with *Bacillus thuringiensis* (*Bt*)—a type of soil bacteria. These measures allow growers to use fewer pesticides and reduce the risk of groundwater pollution.

Entomologists may specialize not only in a particular branch of entomology, but a particular species. **Apiculturists**, for instance, experiment with pollination and bees. They investigate the causes of bee diseases and look for cures. They breed bees to improve bee strains, and study the elements that affect the nectar and pollen of plants that bees use. They do research on bee venom and royal jelly—the substance bees feed to bee and queen larvae. More information on apiculturists can be found in our brief on *Beekeepers*.

Entomologists often work with other scientists and professionals in other fields on joint projects. Entomologists and crop scientists, for instance, are trying to develop crops resistant to insect damage. Entomologists have also worked with plant geneticists to insert *Bt* into the genome of plants. Other entomologists work with government officials setting up and administering quarantine stations to prevent the transport and entry of harmful insects into the United States. These teams have intercepted bark beetles that spread Dutch elm disease, woodborers in packing crates, and the larvae of fruit flies that can threaten the entire citrus fruit industry.

Entomologists also work with microbiologists, virologists, and medical and veterinary professionals to control insects that carry the causal agents of diseases. These insects cause epidemics by transmitting infectious organisms to plants, animals, and humans. A hundred years ago malaria, for instance, was common in the United States. Entomologists

helped to stop the spread of the disease by discovering that malaria is caused by an organism transmitted by mosquitoes and finding ways to control the vector (disease carrying insect) species.

Many entomologists work in basic or applied research and development. Some manage or administer research and development programs, or manage marketing or production operations in companies that produce agricultural chemicals, supplies, and machinery. Others work with computer programmers to develop software that tracks insect populations, and predicts pest outbreaks and the likelihood of insecticide resistance in a particular insect population.

Some entomologists work primarily as educators. Some work in forensics with law enforcement personnel to help them solve homicides and other crimes. They can provide scientific information on the time and location of the crime based on entomological evidence. Some are consultants to business firms, private clients, or government. Many entomologists also write articles for professional journals and popular magazines.

Working Conditions

Working conditions for entomologists vary. Entomologists work in agricultural research stations, research farms, offices, laboratories, and insectories. They may work with farmers, students, other scientists, government officials, business people, and homeowners. They may work by themselves, or they may work as part of a team. Entomologists may study insects under microscopes or use other special equipment to evaluate life processes. At times they may handle venomous insects or toxic chemicals.

Some entomologists spend much of their time in research laboratories conducting controlled experiments. Some teach or may supervise research studies. Other entomologists work outdoors. They collect insects and study their behavior in their natural habitats. They may work in urban or rural settings both here and abroad. They may travel to nearby farms, parks, or community centers in their home state, or travel to remote foreign deserts or jungles. Fieldwork is exciting, but can be strenuous.

Hours and Earnings

Entomologists may have a standard forty-hour work week, but they often work many more hours when they are doing research or when they are in the field. To keep up with developments in entomology, these scientists must read professional journals, research reports, and new books on their specialty. For many, the only time to do this reading is outside working hours.

Entomologists generally enjoy fairly good earnings. However, exact earnings vary with education, experience, job duties, employer, and geographic location. Those in private industry, for instance, often make more money than government workers or those who work in higher education. The Bureau of Labor Statistics classifies entomologists with plant and soil scientists. In 2004, plant and soil scientists earned an average of \$56,900 a year. Overall, earnings

ranged from a low of around \$30,000 a year to well over \$90,000 a year. Roughly half earned between \$39,000 and \$70,000 a year.

In 2005, the average salary for entomologists working for the federal government was around \$73,573 a year. Entomologists entering the work force with a bachelor's or a master's degree generally start at a GS-5 or a GS-7 grade respectively. In 2005, salaries for these grades ranged from a low of \$24,677 a year to a maximum of \$39,738 a year. With experience and further education, entomologists in managerial and administrative positions can earn up to a GS-13 grade. Salaries in this grade ranged from \$64,478 to \$83,819 a year.

Most employers offer fringe benefits such as paid holidays and vacation time, sick leave, health and life insurance, and pension plans. Some also pay for all or part of the cost of continuing or advanced education in the field.

Education and Training

Workers in the field of entomology need at least a bachelor's degree in agricultural or crop science. Graduates with a four-year degree in agricultural or crop science can become food products inspectors or crop scouts. They may also find jobs as laboratory technicians or may work in sales and service. Most entomologists, however, go on to get a master's degree or a doctorate. Graduates with a master's degree can qualify for some applied research jobs. Entomologists interested in independent research, administrative work, or college teaching should plan to earn a doctorate.

High school students interested in this branch of life sciences should take college preparatory courses including biology, chemistry, mathematics, physics, and English. In college, students should take courses in microbiology and biochemistry, ecology, genetics, computer science, and statistics. Many colleges and universities offer undergraduate agricultural or crop science degree programs, which incorporate many of the courses useful to becoming an entomologist. In fact, some entomologists major in biology, agricultural or food science, botany, or zoology, and then study entomology in graduate school.

It usually takes four years to earn a bachelor's degree, and two or three additional years to earn a master's degree. A doctoral degree takes three to four years beyond the master's degree. Advanced degree programs in entomology include classroom and fieldwork, laboratory research, and a thesis or dissertation based on independent research. Scholarships or assistantships are sometimes available to help entomology students earn their graduate degree. Students interested in agriculture may also want to attend a state land-grant college or a university with experimental stations where they can acquire greater field experience.

Licensing, Certification, and Professional Societies

Entomologists need not be licensed. However, in all states, a license is required for pesticide application. Federal and state laws require that those who work with pesticides know how to handle, mix, and apply the chemicals they use.

A number of organizations promote the interests of entomologists. The largest is the Entomological Society of America (ESA) with well over 5,700 members. This group promotes high professional standards, publishes several scholarly journals, and offers numerous educational and networking opportunities, as well as several scholarships and prizes for entomology students.

ESA also administers two certification programs: the Associate Certified Entomologist (ACE) designation, and the Board Certified Entomologist (BCE) designation. The BCE designation certifies the knowledge and experience of practicing entomologists formally educated in entomology. The ACE designation certifies the knowledge and experience of professionals in the field of structural pest management with hands-on training. Candidates for either designation must meet specified education and experience requirements, and pass an examination.

Another organization is the Young Entomologists' Society (YES), a nonprofit youth education organization for budding entomologists. It promotes traveling educational displays and presentations, and publishes informative materials geared toward youths.

Personal Qualifications

Entomologists must be adaptable and willing to work with many different kinds of people under all kinds of conditions. They should find insects fascinating, and they should not be squeamish about working with them. Like other scientists, they must have the patience and perseverance to undertake and complete complicated research projects. Entomologists should be able to work well alone and as a part of a team, and should be able to communicate well verbally and in writing. Those who spend a lot of time in the field should also be able to withstand rugged outdoor conditions.

Occupations can be adapted for workers with disabilities. Persons should contact their school or employment counselors, their state office of vocational rehabilitation, or their state department of labor to explore fully their individual needs and requirements as well as the requirements of the occupation.

Where Employed

According to the Bureau of Labor Statistics, plant and soil scientists (including entomologists) held roughly 17,000 jobs in 2004. About one third of all entomologists work for the federal government. They conduct field or laboratory research and do biological survey work. Some work for the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture. Public health agencies, cooperative extension agencies, plant inspection agencies, private industry, mosquito control districts, and state and local government agricultural departments and conservation agencies also employ entomologists.

Many entomologists teach and conduct research at colleges and universities. Major chemical companies, especially companies that make insecticides and pest control products, employ entomologists skilled in toxicology, insect control, and insect rearing. Entomologists work for fertilizer firms and seed companies. Food processing industries are

hiring more entomologists. Some museums and zoos also hire entomologists to work on insect displays, develop collections, and study the evolution and distribution of insects. Some work for commercial research and development laboratories, pharmaceutical companies, and wholesale distributors. Others were self-employed, mainly as consultants.

Employment Outlook

Employment of entomologists and other plant and soil scientists is expected to grow by 13.9 percent through the year 2014—an increase of around 2,000 jobs. Another 3,000 positions will open due to replacement needs. Thousands of additional basic research and teaching positions at colleges and universities are also expected to become available during the projected period. In general, opportunities will be best for those with an advanced degree.

In the United States, private industry and government agencies are stepping up their efforts to control or eliminate insect pests that cause crop losses. Research will also be stimulated by a heightened public focus on health and preventing the transmission of infectious agents by insects. Entomologists will be needed to find more environmentally safe alternatives to control insect pests, particularly as insects continue to adapt to pesticides. Because of budgetary cutbacks at the U.S. Department of Agriculture, however, fewer opportunities are expected in the federal government.

Organizations committed to the fight against world hunger will need entomologists to find ways to preserve crops from insect damage in various foreign environments. As more insects are discovered, the need to study and classify them also increases. In fact, the rapid destruction of tropical rain forests is compelling many countries to conduct more field studies to discover as many plant and animal species as possible while they are still there.

Entry Methods

College career services offices can help graduates find jobs. Assistantships, internships, and fellowships in entomology, as well as part-time or volunteer work with groups such as the Peace Corps, the Sierra Club, or the Audubon Society may lead to full-time positions. Personnel recruiters sometimes visit college campuses to recruit new employees.

Professional societies frequently list job openings in journals and other publications, as well as on their Web sites. Job seekers may send applications to private industries, laboratories, consulting services agencies, or colleges and universities that employ entomologists. Information on acquiring a job with the federal government is available from the U.S. Office of Personnel Management.

Advancement

Education and experience are the keys to advancement in this field. Entomologists may become directors of research institutions, or they may advance to supervisory positions in government or industry. Entomologists in research often make

important discoveries and receive public recognition and awards. This also increases their earnings and their professional stature.

For Further Research

Entomological Society of America, 10001 Derekwood Lane, Suite 100, Lanham, MD 20706-4876. Web site: www.entsoc.org

Young Entomologists' Society, Inc., 6907 West Grand River Avenue, Lansing, MI 48906-9131. Web site: members.aol.com/YESbugs/bugclub.html

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