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ABSTRACT

Focusing on physical and life scientists, this document is one in a series of forty-one reprints from the Occupational Outlook Handbook providing current information and employment projections for individual occupations and industries through 1985. The specific occupations covered in this document include biochemists, life scientists, soil scientists, astronomers, chemists, food scientists, and physicists. The following information is presented for each occupation or occupational area: a code number referenced to the Dictionary of Occupational Titles; a description of the nature of the work; places of employment; training, other qualifications, and advancement; employment outlook; earnings and working conditions; and sources of additional information. In addition to the forty-one reprints covering individual occupations or occupational areas (CE 017 757-797), a companion document (CE 017 756) presents employment projections for the total labor market and discusses the relationship between job prospects and education. (BM)

Physical and Life Scientists

Reprinted from the Occupational Outlook Handbook, 1978-79 Edition.

U.S. Department of Labor
Bureau of Labor Statistics
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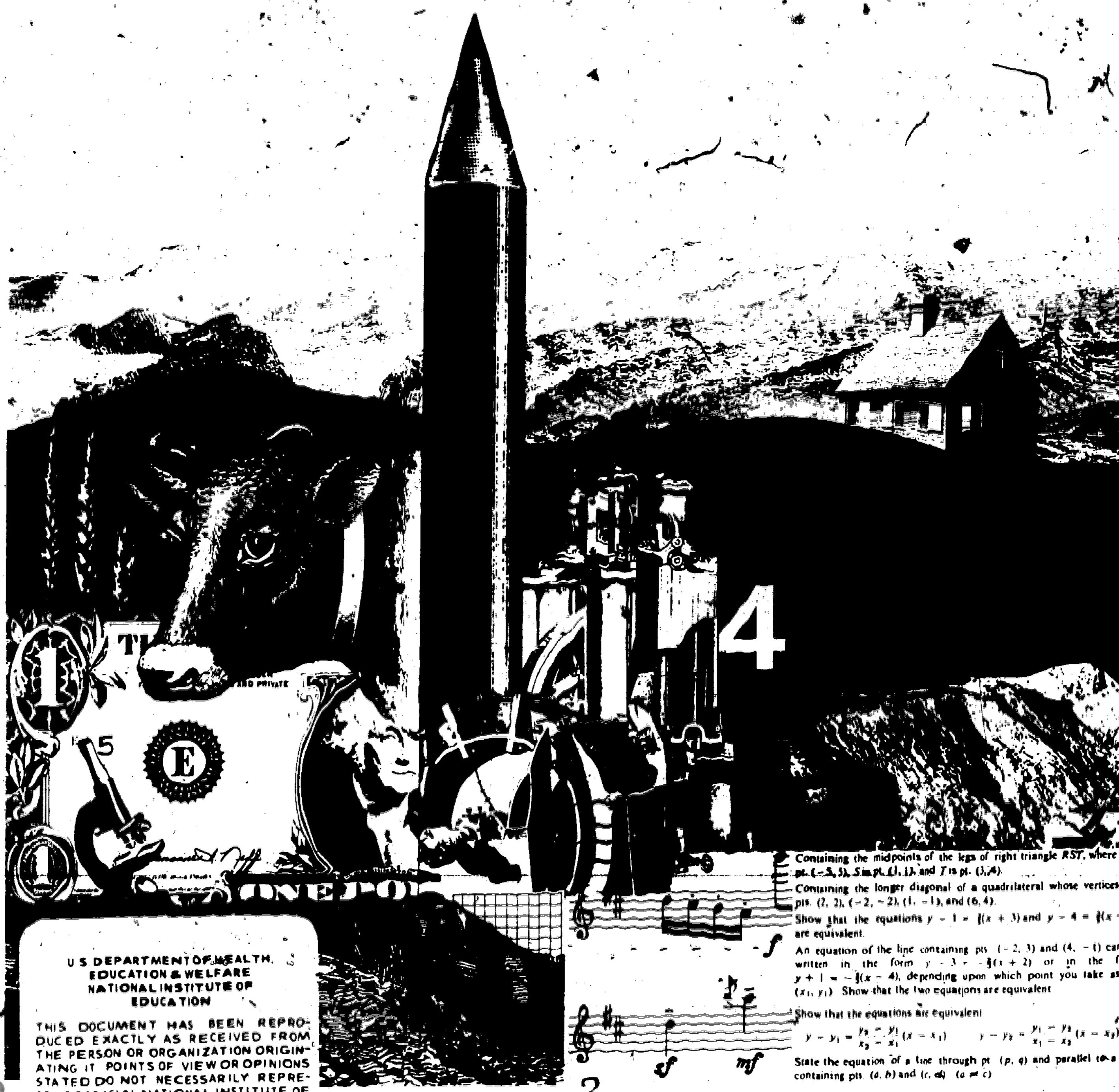


LIFE SCIENCE OCCUPATIONS

Life scientists study living organisms and their life processes. They are concerned with the origin and preservation of life, from the largest animal to the smallest living cell. The number and variety of plants and animals is so large, and their processes so varied and complex, that life scientists usually work in one of the three broad areas—agriculture, biology, or medicine.

Life scientists teach, perform basic research to expand knowledge of living things, and apply knowledge gained from research to the solution of practical problems. New drugs, special varieties of plants, and a cleaner environment result from the work of life scientists.

This chapter discusses life scientists as a group. It also contains separate statements on biochemists and soil scientists.

BIOCHEMISTS

(D.O.T. 041.081)

Nature of the Work

Biochemists study the chemical composition and behavior of living things. Since life is based on complex chemical combinations and reactions, the work of biochemists is vital for an understanding of reproduction, growth, and heredity. Biochemists also may study the effects of food, hormones, or drugs on various organisms.

The methods and techniques of biochemistry are applied in areas such as medicine, nutrition, and agriculture. For instance, biochemists may investigate causes and cures for diseases, identify the nutrients necessary to maintain good health, or develop chemical compounds for pest control.

More than 3 out of 4 biochemists work in basic and applied research activities. The distinction between basic and applied research is often one of degree and biochemists may do both types. Most, however, are in basic research. The few doing strictly applied research use the results of basic research to solve practical problems. For example, knowledge of how an organism forms a hormone is used to synthesize and produce hormones on a mass scale.

Laboratory research involves weighing, filtering, distilling, drying, and culturing (growing microorganisms). Some experiments also require the designing and constructing of laboratory apparatus or the use of radioactive tracers. Biochemists use a variety of instruments, including electron microscopes and centrifuges, and they may devise new instruments and techniques as needed. They usually report the results of their research in scientific journals or before scientific groups.

Some biochemists combine research with teaching in colleges and universities. A few work in industrial production and testing activities.

Places of Employment

About 12,700 biochemists were employed in the United States in 1976. About one-half are employed in colleges and universities; over one-fourth work in private industry, primarily in companies manufacturing drugs, insecticides, and cosmetics; some work for nonprofit research institutes and foundations; and others for Federal, State, and local government agencies. Most government biochemists do health and agricultural research for Federal agencies. A few self-employed biochemists are consultants to industry and government.

Many biochemists work in basic and applied research activities.

Training, Other Qualifications, and Advancement

The minimum educational requirement for many beginning jobs as a biochemist, especially in research or teaching, is an advanced degree. A Ph. D. degree is a virtual necessity for persons who hope to contribute significantly to biochemical research and advance to many management and administrative jobs. A bachelor's degree with a major in biochemistry or chemistry, or with a major in biology and a minor in chemistry, may qualify some persons for entry jobs as research assistants or technicians.

More than 100 schools award the bachelor's degree in biochemistry, and nearly all colleges and universities offer a major in biology or chemistry. Persons planning careers as biochemists should take undergraduate courses in chemistry, biology, biochemistry, mathematics, and physics.

About 150 colleges and universities offer graduate degrees in biochemistry. Graduate students generally are required to have a bachelor's degree in biochemistry, biology, or chemistry. Many graduate programs emphasize one specialty in biochemistry because of the facilities or the research being done at that particular school. Graduate training requires actual research in addition to advanced science courses so students should select their schools carefully. For the doctoral degree, the student does intensive research and a thesis in one field of biochemistry.

Persons planning careers as biochemists should be able to work independently or as part of a team.

Precision, keen powers of observation, and mechanical aptitude also are important. Biochemists should have analytical abilities and curious minds, as well as patience and perseverance to complete hundreds of experiments necessary to solve a single problem. They should also express themselves clearly when writing and speaking to communicate the findings of their research effectively.

Graduates with advanced degrees may begin their careers as teachers or researchers in colleges or universities. In private industry, most begin in research jobs and with experience may advance to positions in which they plan and supervise research.

New graduates with a bachelor's degree usually start work as research assistants or technicians. These jobs in private industry often involve testing and analysis. In the drug industry, for example, research assistants analyze the ingredients of a product to verify and maintain its purity or quality.

Employment Outlook

Job opportunities for biochemists with advanced degrees should be favorable through the mid-1980's. The employment of biochemists is expected to grow about as fast as the average for all occupations during this period. Some additional job openings will result each year as biochemists retire, die, or transfer to other occupations. The outlook for biochemists is based on the assumption that research and development expenditures in biochemistry and related sciences, primarily by the Federal Government, will increase through the mid-1980's, although at a slower rate than during the 1960's. If actual expenditures differ significantly from those assumed, the outlook for biochemists would be altered.

The anticipated growth in this field should result from the effort to find cures for cancer, heart disease, and other diseases, and from public concern with environmental protection. Biochemists will also be needed in the drug and other industries and in hospitals and health centers. Colleges and universities may need additional teachers as biochemistry enrollments continue to increase.

Earnings and Working Conditions

Average earnings of biochemists were about twice the average for all nonsupervisory workers in private industry, except farming. According to a 1976 survey by the American Chemical Society, salaries for experienced biochemists averaged $18,000 for those with a bachelor's degree; $19,000 for those with a master's degree; and $26,000 for those with a Ph. D.

Starting salaries of biochemists employed in colleges and universities are comparable to those for other faculty members. (See statement on college and university teachers elsewhere in the *Handbook*.)

Biochemists in research and development do most of their work in a laboratory, but they also may write, lecture, and do library research.

Sources of Additional Information

For general information on careers in biochemistry, contact:

American Society of Biological Chemists, 9650 Rockville Pike, Bethesda, Md. 20014.

LIFE SCIENTISTS

(D.O.T. 040.081, 041.081, 041.168, 041.181, 041.281)

Nature of the Work

Life scientists, who study all aspects of living organisms, emphasize the relationship of animals and plants to their environment.

About one-third of all life scientists are primarily involved in research and development. Many conduct basic research to increase our knowledge of living organisms which can be applied in medicine, in increasing crop yields, and in improving the natural environment. When working in laboratories, life scientists must be familiar with research techniques and complex laboratory equipment such as electron microscopes. Knowledge of computers also is useful in conducting experiments. Not all research, however, is performed in laboratories. For example, a botanist who explores the volcanic Alaskan valleys to see what plants grow there also is doing research.

About one-third of all life scientists teach in colleges or universities; many also do independent research. Almost one-fifth work in management or administration ranging from planning and administering programs for testing foods and drugs to directing activities at zoos or botanical gardens. Some life scientists work as consultants to business firms or to government in their areas of specialization. Others write for technical publications or test and inspect foods, drugs, and other products. Some work in technical sales and services jobs for industrial companies where, for example, they demonstrate the proper use of new chemicals or technical products.

Scientists in many life science areas often call themselves *biologists*. However, the majority are classified by the type of organism they study or by the specific activity they perform.

Botanists deal primarily with plants and their environment. Some study all aspects of plant life, while others work in specific areas such as identifying and classifying plants or studying the structure of plants and plant cells. Other botanists concentrate on causes and cures of plant diseases.

Agronomists, who are concerned with the mass development of plants, improve the quality and yield of crops, such as corn, wheat, and cotton, by developing new growth methods or by controlling diseases, pests, and weeds. They also analyze soils to determine ways of increasing acreage yields and decreasing soil erosion. *Horticulturists* work with orchard and garden plants such as fruit and nut trees, vegetables, and flowers. They seek to improve plant culture methods for the beautification of communities, homes, parks, and other areas as well as for increasing crop quality and yields.

Zoologists study various aspects of animal life—its origin, behavior, and life processes. Some conduct experimental studies with live animals in controlled or natural surroundings while others dissect animals to study the structure of their parts. Zoologists are usually identified by the animal group studied—ornithologists (birds), entomologists (insects), and mammalogists (mammals).

Animal husbandry specialists do research on the breeding, feeding, and diseases of domestic farm animals. *Veterinarians* study diseases and abnormal functioning in animals. (See statement on veterinarians elsewhere in the *Handbook*.)

Anatomists study the structure of organisms, from cell structure to the formation of tissues and organs. Many specialize in human anatomy. Research methods may entail dissections or the use of electron microscopes.

Some life scientists apply their specialized knowledge across a number of areas, and may be classified by the functions performed. *Ecologists*, for example, study the relationship between organisms and their environments, particularly the effects of environmental influences such as rainfall, temperature, and altitude on organisms. For example, ecologists extract samples of plankton (microscopic plants and animals) from bodies of water to determine the effects of pollution, and measure the radioactive content of fish.

Embryologists study the development of an animal from a fertilized egg through the hatching process or gestation period. They investigate the causes of healthy and abnormal development in animals.

Microbiologists are life scientists who investigate the growth and characteristics of microscopic organisms such as bacteria, viruses, and molds. They isolate and grow organisms for close examination under a microscope. *Medical microbiologists* are concerned with the relationship between bacteria and disease or the effect of antibiotics on bacteria. Other microbiologists may specialize in soil bacteriology (effect of microorganisms on soil fertility), virology (viruses), or immunology (mechanisms that fight infections).

Nutritionists examine the bodily processes through which food is utilized and transformed into energy. They learn how vitamins, minerals, proteins, and other nutrients build and repair tissues.

Pharmacologists conduct tests on animals such as rats, guinea pigs, and monkeys to determine the effects of drugs, gases, poisons, dusts, and other substances on the functioning of tissues and organs. They may develop new or improved drugs and medicines.

Pathologists specialize in the effects of diseases, parasites, and insects on human cells, tissues, and organs. Others may investigate genetic variations caused by drugs.

Biochemists and biological oceanographers, who are also life scientists, are included in separate statements elsewhere in the *Handbook*.

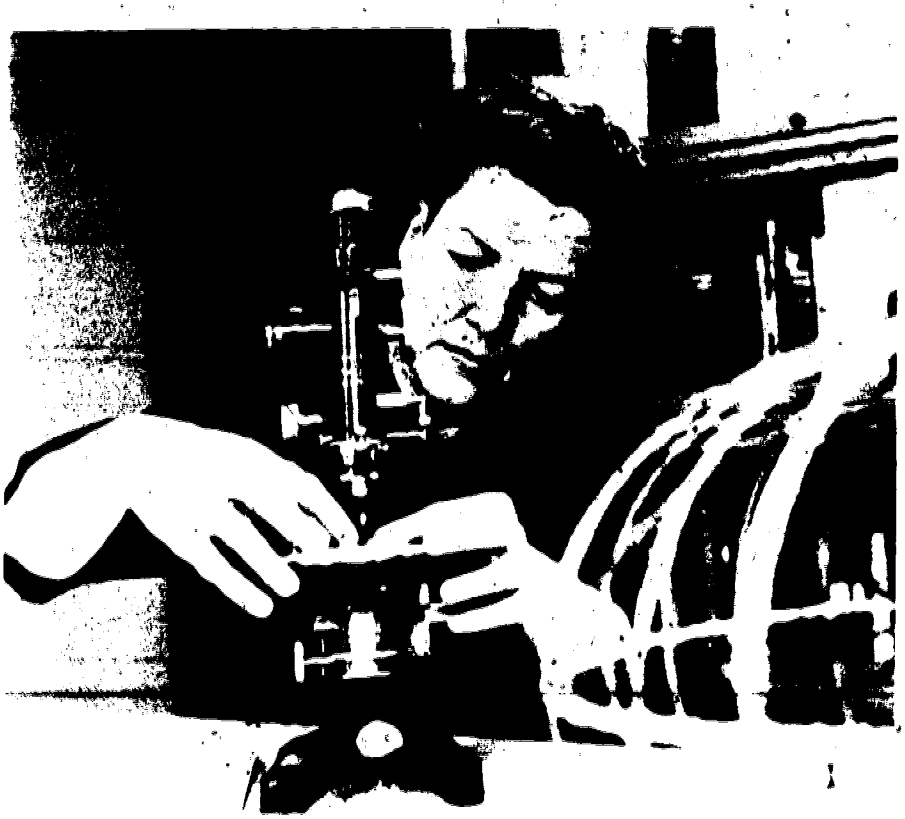
Places of Employment

An estimated 205,000 persons worked as life scientists in 1976. Almost 40,000 were agricultural scientists, about 100,000 were biological scientists, and about 65,000 were medical scientists.

Colleges and universities employ nearly three-fifths of all life scientists, in both teaching and research jobs. Medical schools and hospitals also employ large numbers of medical investigators. Sizable numbers of specialists in agronomy, horticulture, animal husbandry, entomology, and related areas work for State agricultural colleges and agricultural experiment stations.

About 18,000 life scientists worked for the Federal Government in 1976. Of these, over half worked for the Department of Agriculture, with large numbers also in the Department of the Interior, and in the National Institutes of Health. State and local governments combined employed about 22,000 life scientists.

Approximately 40,000 life scientists worked in private industry,



Life scientists study living organisms and their life processes.

mostly in the pharmaceutical, industrial chemical, and food processing industries in 1976. About 6,000 worked for nonprofit research organizations and foundations; a few were self-employed.

Life scientists are distributed fairly evenly throughout the United States, but employment is concentrated in some metropolitan areas—for example, nearly 6 percent of all agricultural and biological scientists work in the Washington, D.C., metropolitan area. Life science teachers are concentrated in communities with large universities.

Training, Other Qualifications, and Advancement

Persons seeking a career in the life sciences should plan to obtain an advanced degree. The Ph. D. degree generally is required for college teaching, for independent research, and for many administrative jobs. A master's degree is sufficient for some jobs in applied research and college teaching. A health science degree is necessary for some jobs in medical research (See section on health occupations elsewhere in the *Handbook.*)

The bachelor's degree is adequate preparation for some beginning jobs, but promotions often are limited for those who hold no higher degree. New graduates with a bachelor's degree can start their careers in testing and inspecting jobs, or become technical sales and service representatives. They also may become advanced technicians, particularly in medical research or, with courses in education, a high school biology teacher. (See statement on secondary school teachers elsewhere in the *Handbook.*)

Most colleges and universities offer life science curriculums. However, different schools may emphasize only certain areas of life science. For example, liberal arts colleges may emphasize the biological sciences, while many State universities and land-grant colleges offer programs in agricultural science.

Students seeking careers in the life sciences should obtain the broadest possible undergraduate background in biology and other sciences. Courses taken should include biology, chemistry, physics, and mathematics.

Many colleges and universities confer advanced degrees in the life sciences. Requirements for advanced degrees usually include field work and laboratory research as well as classroom studies and preparation of a thesis.

Prospective life scientists should be able to work independently or as part of a team and must be able to communicate their findings in clear and concise language, both orally and in writing. Some life scientists, such as those conducting field research in remote areas, must have good physical stamina.

Life scientists who have advanced degrees usually begin in research or teaching jobs. With experience, they may advance to jobs such as supervisors of research programs.

Employment Outlook

Employment opportunities for life scientists are expected to be good for those with advanced degrees through the mid-1980's, but those with lesser degrees may experience competition for available jobs. However, a life science degree also is useful for entry to occupations related to life science such as laboratory technology and the health care occupations. Employment in the life sciences is expected to increase faster than the average for all occupations over this period. In addition, some openings will occur as life scientists retire, die, or transfer to other occupations.

Employment in the life sciences will grow as a result of increased interest in preserving the natural environment and a continuing interest in medical research. Employment opportunities in industry and government should grow as environmental research and development increases and new laws and standards protecting the environment are enacted. Additional life science teachers will be needed if college and university enrollments increase as expected.

Earnings and Working Conditions

Life scientists receive relatively high salaries; their average earnings are more than twice those of nonsupervisory workers in private industry, except farming.

Beginning salary offers in private industry in 1976 averaged $10,900 a year for bachelor's degree recipients in agricultural science and $10,200 a year for bachelor's degree recipients in biological science.

In the Federal Government in 1977, life scientists having a bachelor's degree could begin at $9,303 or $11,523 a year, depending on their college records. Life scientists having the master's degree could start at $11,523 or $14,097, depending on their academic records or work experience. Those having the Ph. D. degree could begin at $17,056 or $20,442 a year. Agricultural and biological scientists in the Federal Government averaged $21,600 a year.

Earnings of all life scientists averaged about $20,300 a year in 1976, according to the limited data available. Life scientists who have the M.D. degree generally earn more than other life scientists but less than physicians in private practice.

Most life scientists work in well-lighted, well-ventilated, and clean laboratories. Some jobs, however, require working outdoors under extreme weather conditions, doing strenuous physical labor.

Sources of Additional Information

General information on careers in the life sciences is available from:

American Institute of Biological Sciences, 1401 Wilson Boulevard, Arlington, Va. 22209.

American Society for Horticultural Science, National Center for American Horticulture, Mt. Vernon, Va. 22121.

American Physiological Society, Education Office, 9650 Rockville Pike, Bethesda, Md. 20014.

Special information on Federal Government careers is available from:

U.S. Civil Service Commission, Washington Area Office, 1900 E St. NW., Washington, D.C. 20415.

SOIL SCIENTISTS

(D.O.T. 040.081)

Nature of the Work

Because soil is one of our most valuable resources, it must be used wisely. Soil scientists help to accomplish this by studying the physical, chemical, biological, and behavioral characteristics of soils. A large part of their job is categorizing soils according to a national classification system. To do this, a soil scientist investigates the soils at various places within an area, often taking samples to analyze in the laboratory. Once the soils in an area have been classified, the soil scientist prepares a map, usually based on aerial photographs, which shows soil types throughout the area as well as landscape features, such as streams or hills, and physical features, such as roads or property boundaries.

Because different types of soil are better suited for some uses than others, soil type maps are invaluable tools for urban and regional planners concerned with land use. A planner who may wish to locate large buildings, such as factories or apartment buildings, on a secure base would look for firm soils containing clay. In contrast, sandy soils drain much better than clays, and thus are better suited for uses that require good drainage, such as farming. In addition, a small but increasing number of States require certified soil scientists to examine soils and determine their drainage capacities before issuing building permits for lots on which residences using septic systems are to be built.

Besides the many soil scientists who are employed mapping soils, some conduct research into the chemical and biological properties of soils to determine their agricultural uses. With the assistance of agricultural technicians, they set up experiments in which they grow crops in different types of soils to determine which are most productive for certain crops. They also may test the effects of fertilizers on various types of soils to develop fertilizers adapted to particular soils and to find ways to improve less productive soils. Other soil scientists, who have backgrounds in the biological sciences, may investigate the presence of organic materials in soils and study the effects of these organisms on plant growth.

In recent years, mounting concern over the quality of water has led to research into the causes of pollution and it has been found that sediment, or soil runoff, is responsible for much of the problem. Many States, in an effort to comply with Federal antipollution laws, now employ soil scientists to inspect large highway and building sites where vegetation has been stripped away, and agricultural lands where fertilizers have been applied, to make sure proper erosion control methods have been followed.

Places of Employment

An estimated 2,500 soil scientists were employed in 1976. Soil scien-

Most soil scientists work for the Federal Government, State experimental stations, and colleges of agriculture.

tists work all over the country, in every State and nearly every county. More than half were employed by the Soil Conservation Service of the U.S. Department of Agriculture. Some worked for other agencies of the Federal Government, State agricultural experiment stations, and colleges of agriculture. Others were employed in a wide range of other public and private institutions, including fertilizer companies, private research laboratories, insurance companies, banks and other lending agencies, real estate firms, land appraisal boards, State conservation departments, and farm management agencies. A few are independent consultants, and others work for consulting firms. In addition, some soil scientists worked in foreign countries as research leaders, consultants, and agricultural managers.

Training, Other Qualifications, and Advancement

Training in a college or university is important in obtaining employment as a soil scientist. For Federal employment, the minimum qualification for entrance is a bachelor's degree with a major in soil science or in a closely related field of study, with 30 semester hours of course work in the biological, physical, and earth sciences, including a minimum of 12 semester hours in soils. For students interested in working in the Soil Conservation Service, one of the best courses of study is agronomy, the study of how plants and soils interact. Also, a major in agriculture may enable an applicant to find employment with the Soil Conservation Service. In addition, courses in chemistry and cartography, or mapmaking, are helpful to people interested in this career, and are required by some employers. Soil scientists often must write reports decribing their work and thus need some writing skills.

Soil scientists who have been trained in both field work and laboratory research may have the edge in obtaining the best jobs, and an advanced degree—especially a doctorate degree—may be needed to advance to the more responsible and better paying research jobs. Also, a strong background in chemistry may be necessary for obtaining research positions.

Many colleges and universities offer fellowships and assistantships for graduate training, or employ graduate students for part-time teaching or research.

A few States now require certification of soil scientists who inspect soil conditions prior to construction activities. One such certification program requires candidates for certification to have a bachelor's degree and 3 years of experience as a soil scientist, or a master's degree and 2 years of experience. In addition, candidates must complete a written examination, demonstrating their knowledge of soil science.

Soil scientists often can transfer to related occupations such as land appraiser or farm management advisor.

Employment Outlook

One of the major objectives of the Soil Conservation Service is to complete the soil classification survey of all rural lands in the United States. This program includes soil classification and soil interpretation for use by agriculturists, engineers, and land-use planners. Although the number of soil scientists working on this project has not changed over the past decade, about 100 openings arise each year to replace those scientists who retire, die, or leave the Soil Conservation Service for other reasons.

In addition, some employment growth may be expected in State and local government agencies as concern for pollution and destruction of our soil resources increases. Employment growth also is expected in the private sector of the economy, in businesses such as fertilizer manufacturers, and with lending institutions that make loans for farm lands, such as banks, mortagage companies, and life insurance companies. However, openings for soil scientists may not keep pace with the number of jobseekers in this field.

Earnings and Working Conditions

The incomes of soil scientists depend upon their education, professional experience, and individual abilities. The entrance salary in the Federal service for graduates having a B.S. degree was $9,303 in 1977. They may expect advancement to $11,523 after 1 year of satisfactory performance. Those who had outstanding records in college, or a master's degree, started at $11,523, and could advance to $14,097 after 1 year. Further promotion depends upon the individual's ability to do high quality work and to accept responsibility. Earnings of well-qualified Federal soil scientists with several years of experience ranged from $17,046 to $28,725 a year.

Soil scientists generally spend much of their time doing field work, which requires them to travel within their area—usually within a county. During inclement weather they generally work in an office, preparing maps and writing reports. Researchers spend much of their time doing experiments in fields and greenhouses.

Sources of Additional Information

Additional information may be obtained from the U.S. Civil Service Commission, Washington, D.C. 20415; U.S. Department of Agriculture, Office of Personnel, Washington, D.C. 20250; any office of the Department's Soil Conservation Service; any college of agriculture; the American Society of Agronomy, 677 S. Segoe Rd., Madison, Wis. 53711; or the Soil Society of America, 677 S. Segoe Rd., Madison, Wis. 53711.

See also statements on chemists and life scientists elsewhere in the *Handbook*.

PHYSICAL SCIENTISTS

Physical scientists investigate the structure and composition of the earth and the universe. Four physical science occupations are described in this section: astronomers, chemists, food scientists, and physicists. Astronomers study the nature of the universe and the celestial bodies, while chemists examine the composition and interaction of substances in the world around us. Food scientists search for better ways to commercially process and preserve food. Physicists study the nuclear structure of matter and its relationship to energy. A knowledge of the physical sciences is also required by engineers, environmental scientists, and life scientists; these occupations are described in separate sections elsewhere in the *Handbook*.

Many physical scientists perform research directed toward increasing our knowledge of the universe. Physical scientists also employ the results of research in the development of new products and production processes. Some physical scientists teach in colleges and universities. Others, particularly chemists and food scientists, work in production and sales-related activities in industry.

Many high level jobs in the physical sciences require graduate education and often a Ph. D. degree.

ASTRONOMERS

(D.O.T.021.088)

Nature of the Work

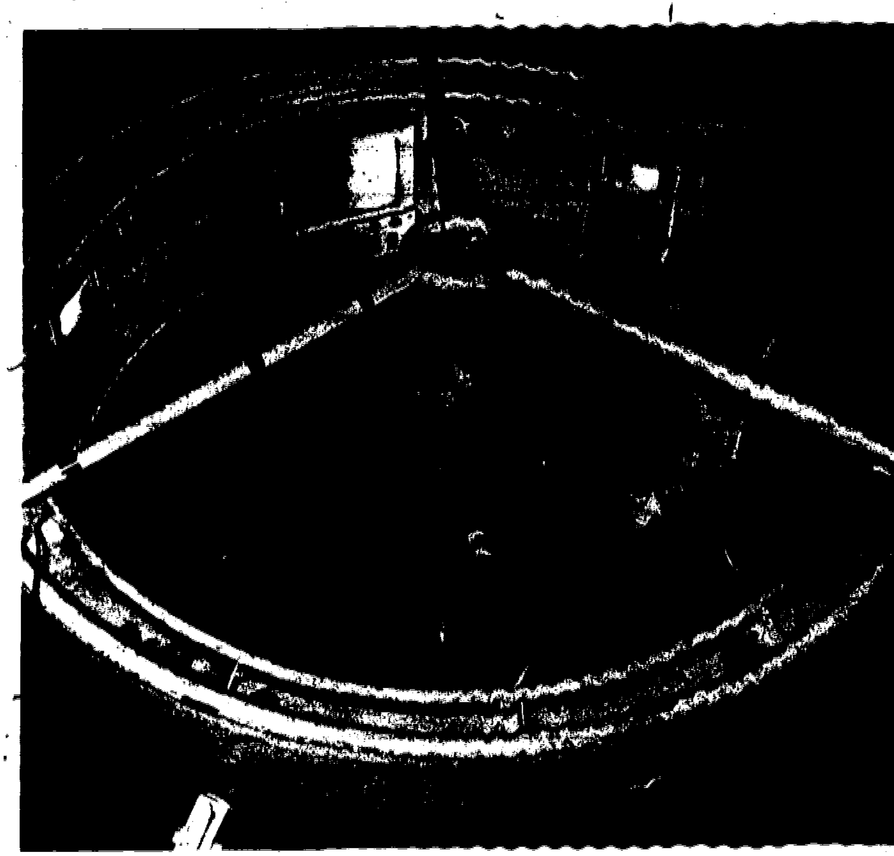
Astronomers seek answers to questions about the fundamental nature of the universe, such as its origin and history and the evolution of our solar system. Astronomers—sometimes called *astrophysicists*—use the principles of physics and mathematics to study and determine the behavior of matter and energy in distant galaxies. One application of the information they gain is to prove or disprove theories of the nature of matter and energy such as Einstein's theory of relativity.

To make observations of the universe, astronomers use large telescopes, radiotelescopes, and other instruments that can detect electromagnetic radiation from distant sources. Astronomers of today spend little time visually observing stars through telescopes because photographic and electronic light-detecting equipment is more effective with dim or distant stars, and galaxies. By using spectroscopes to analyze light from stars astronomers can determine their chemical composition. Astronomers also use radiotelescopes and other electronic means to observe radio waves, X-rays, and cosmic rays. Electronic computers are used to analyze data and to solve complex mathematical equations that astronomers develop to represent various theories. Computers also are useful for processing astronomical data to calculate orbits of asteroids or comets, guide spacecraft, and work out tables for navigational handbooks.

Astronomers usually specialize in one of the many branches of the science such as instruments and techniques, the sun, the solar system, and the evolution and interiors of stars.

Astronomers who work on observational programs begin their studies by deciding what stars or other objects to observe and the methods and instruments to use. They may need to design optical measuring devices to attach to the telescope to make the required measurements. After completing their observations, they analyze the results, present them in precise numerical form, and explain them on the basis of some theory. Astronomers usually spend relatively little time in actual observation and relatively more time in analyzing the large quantities of data that observatory facilities collect.

Some astronomers concentrate on theoretical problems and seldom visit observatories. They formulate theories or mathematical models to explain observations made earlier by other astronomers. These astrono-



Almost all astronomers do research or teach.

mers develop mathematical equations using the laws of physics to compute, for example, theoretical models of how stars change as their nuclear energy sources become exhausted.

Almost all astronomers do research or teach; those in colleges and universities often do both. In schools that do not have separate departments of astronomy or only small enrollments in the subject, they often teach courses in mathematics or physics as well as astronomy. Some astronomers administer research programs, develop and design astronomical instruments, and do consulting work.

Places of Employment

Astronomy is the smallest physical science; only 2,000 persons worked as astronomers in 1976. Most astronomers work in colleges and universities. Some work in observatories operated by universities, nonprofit organizations, and the Federal Government.

The Federal Government employed almost 600 astronomers and space scientists in 1976. Most worked for the National Aeronautics and Space Administration. Others worked for the Department of Defense, mainly at the U.S. Naval Observatory and the U.S. Naval Research Laboratory. A few astronomers worked for firms in the aerospace field, or in museums and planetariums.

Training, Other Qualifications, and Advancement

The usual requirement for a job in astronomy is a Ph. D. degree. Persons with less education may qualify for some jobs; however, high-level positions in teaching and research and advancement in most areas are open only to those with the doctorate.

Many students who undertake graduate study in astronomy have a bachelor's degree in astronomy. In 1976, about 50 colleges and universities had programs leading to the bachelor's degree in astronomy. However, students with a bachelor's degree in physics, or in mathematics with a physics minor, usually can qualify for graduate programs in astronomy.

About 55 universities offer the Ph. D. degree in astronomy. These programs include advanced courses in astronomy, physics, and mathematics. Some schools require that graduate students spend several months working at an observatory. In most institutions, the work program leading to the doctorate is flexible and allows students to take courses in their own particular area of interest.

Persons planning careers in astronomy should have imagination and an inquisitive mind. Perseverance and the ability to concentrate on detail and to work independently also are important.

New graduates with a bachelor's or master's degree in astronomy usually begin as assistants in observatories, planetariums, large departments of astronomy in colleges and universities, Government agencies, or industry. Some work as research assistants while studying toward advanced degrees. New graduates with the doctorate can qualify for teaching and research jobs in colleges and universities and for research jobs in Government and industry.

Employment Outlook

Persons seeking positions as astronomers will face keen competition for the few available openings expected through the mid-1980's. Employment of astronomers is expected to grow slowly, if at all, because the funds available for basic research in astronomy, which come mainly from the Federal Government, are not expected to increase enough to create many new positions. Most openings will occur as replacements for those who die or retire. Since astronomy is such a small profession, there will be few openings needed for replacements. There will be keen competition for these openings because the number of degrees granted in astronomy probably will continue to exceed available openings.

Earnings and Working Conditions

Astronomers have relatively high salaries, with average earnings more than twice the average earnings for nonsupervisory workers in private industry, except farming.

In the Federal Government, in 1977, astronomers holding the Ph. D. degree could begin at $17,056 or $20,442 depending on their college record. Those having the bachelor's degree could start at $9,303 or $11,523; with the master's degree at $11,523 or $14,097. The average annual salary for astronomers and space scientists in the Federal Government was about $25,100 in 1977. Astronomers teaching in colleges and universities received salaries equivalent to those of other faculty members. (See statement on college and university teachers elsewhere in the *Handbook*.)

Most astronomers spend most of their time working in offices or classrooms, although astronomers who make observations may need to travel to the observing facility and frequently work at night.

Sources of Additional Information

For information on careers in astronomy and on schools offering training in the field, contact:

American Astronomical Society, 211 FitzRandolph Rd., Princeton, N.J. 08540.

CHEMISTS

(D.O.T. 022.081, .168, .181, and.281)

Nature of the Work

The clothes we wear, the foods we eat, the houses in which we live—in fact most things that help make our lives better, from medical care to a cleaner environment—result, in part, from the work done by chemists.

Chemists search for and put into practical use new knowledge about substances. They develop new compounds, such as rocket fuel; improve foods; and create clothing that is chemically treated against flammability, soil, and wrinkles.

Over one-half of all chemists work in research and development. In basic research, chemists investigate the

Many modern products, including plastics and other synthetics, have resulted from research in chemistry.

properties and composition of matter and the laws that govern the combination of elements. Basic research often has practical uses. For example, synthetic rubber and plastics have resulted from research on small molecules uniting to form larger ones (polymerization). In research and development, new products are created or improved. The process of developing a product begins with descriptions of the characteristics it should have. If similar products exist, chemists test samples to determine their ingredients. If no such product exists, experimentation with various substances yields a product with the required specifications.

Nearly one-fifth of all chemists work in production and inspection. In production, chemists prepare instructions (batch sheets) for plant workers that specify the kind and amount of ingredients to use and the exact mixing time for each stage in the process. At each step, samples are tested for quality control to meet industry and government standards. Records and reports show results of tests.

Others work as marketing or sales representatives to obtain technical knowledge of products sold. A number of chemists teach in colleges and universities. Some chemists are consultants to private industry and to government agencies.

Chemists often specialize in one of the subfields of chemistry. *Analytical chemists* determine the structure, composition, and nature of substances, and develop new techniques. An outstanding example was the analysis of moon rocks by an international team of analytical chemists. *Organic chemists* at one time studied the chemistry of only living things, but this area has been broadened to include all carbon compounds. When combined with other elements, carbon forms a vast number of substances. Many modern commercial products, including plastics and other synthetics, have resulted from the work of organic chemists. *Inorganic chemists* study compounds other than carbon. They may, for example, develop materials to use in solid state electronic components. *Physical chemists* study energy transformations to find new and better energy sources. Increasingly, however, chemists consider themselves members of new specialties that include two of the preceding fields or more. *Biochemists*, often considered as either chemists or life scientists, are discussed elsewhere in the *Handbook*. Some chemists specialize in the chemistry of foods. (See statement on food scientists elsewhere in the *Handbook*.)

Places of Employment

Nearly 150,000 persons worked as chemists in 1976. About three-fifths of all chemists work in private industry, almost one-half of them in the chemical manufacturing industry. Most others work for companies manufacturing food, scientific instruments, petroleum, paper, and electrical equipment.

Colleges and universities employed 25,000 chemists in 1976. An equal number worked for State and local governments, primarily in health and agriculture, and for Federal agencies, chiefly the Departments of Defense; Health, Education, and Welfare; Agriculture; and Interior. Smaller numbers worked for nonprofit research organizations.

Chemists are employed in all parts of the country, but they are concentrated in large industrial areas. Nearly one-fifth of all chemists were located in four metropolitan areas—New York, Chicago, Philadelphia, and Newark. About half worked in six States—New York, New Jersey, California, Pennsylvania, Ohio, and Illinois.

Training, Other Qualifications, and Advancement

A bachelor's degree with a major in chemistry or a related discipline is sufficient for many beginning jobs as a chemist. However, graduate training is required for many research and college teaching positions. Beginning chemists should have a broad background in chemistry, with good laboratory skills.

About 1,175 colleges and universities offer a bachelor's degree in chemistry. In addition to required courses in analytical, inorganic, organic, and physical chemistry, undergraduates usually study mathematics and physics.

More than 350 colleges and universities award advanced degrees in chemistry. In graduate school, students generally specialize in a particular subfield of chemistry. Requirements for the master's and doctor's degree usually include a thesis based on independent research.

Students planning careers as chemists should enjoy studying science and mathematics, and should like working with their hands building scientific apparatus and performing experiments. Perseverance and the ability to concentrate on detail and to work independently are essential. Other desirable assets include an inquisitive mind, and imagination. Chemists also should have good eyesight and eye-hand coordination.

Graduates with the bachelor's degree generally begin their careers in government or industry by analyzing or testing products, working in technical sales or service, or assisting senior chemists in research and development laboratories. Many employers have special training and orientation programs which are concerned with the special knowledge needed for the employer's type of work. Candidates for an advanced degree often teach or do research in colleges and universities while working toward advanced degrees.

Beginning chemists with the master's degree can usually go into applied research in government or private industry. They also may qualify for teaching positions in 2-year colleges and some universities.

The Ph. D. generally is required for basic research, for teaching in colleges and universities, and for advancement to many administrative positions.

Employment Outlook

Employment opportunities in chemistry are expected to be good for graduates at all degree levels through the mid-1980's. The employment of chemists is expected to grow about as fast as the average for all occupations during this period; thousands of new jobs will be created each year. In addition, several thousand openings will result each year as chemists retire, die, or transfer to other occupations.

This outlook for chemists is based on the assumption that research and development expenditures of government and industry will increase through the mid-1980's, although at a slower rate than during the 1960's. If actual expenditures differ significantly from those assumed, the outlook for chemists would be altered.

Approximately three-fourths of total employment is expected to be in private industry, primarily in the development of new products. In addition, industrial companies and government agencies will need chemists to help solve problems related to energy shortages, pollution control, and health care. Some also will work in Federal, State, and local crime laboratories.

Little growth in college and university employment is expected, and competition for teaching positions will be keen. (See statement on college and university teachers elsewhere in the *Handbook*.)

Some graduates will find openings in high school teaching after completing professional education courses and other requirements for a State teaching certificate. They usually are then regarded as teachers rather than chemists. (See statement on secondary school teachers elsewhere in the *Handbook*.)

Earnings and Working Conditions

Earnings of chemists averaged more than twice as much as those of nonsupervisory workers in private industry, except farming. According to the American Chemical Society, salaries of experienced chemists having a bachelor's degree averaged $21,200 a year in 1976; for those with a master's degree, $22,100; and for those with a Ph. D., $25,800.

Private industry paid chemists with the bachelor's degree starting salaries averaging $11,500 a year in 1976; those with the master's degree, $13,600; and those with the Ph. D., $18,700.

In colleges and universities, the average salary of those with the master's degree was $17,000 and of those with the Ph. D., $21,000. In addition, many experienced chemists in educational institutions supplement their regular salaries with income from consulting, lecturing, and writing.

Depending on a person's college record, the annual starting salary in the Federal Government in 1977 for an inexperienced chemist with a bachelor's degree was either $9,303 or $11,523. Those who had 2 years of graduate study could begin at $14,097 a year. Chemists having the Ph. D. degree could start at $17,056 or $20,442. The average salary for all chemists in the Federal Government in 1977 was $19,900 a year.

Chemists usually work in modern, well-equipped, and well-lighted laboratories, offices, or classrooms. Some hazard is involved in handling potentially explosive or highly caustic chemicals. However, when safety regulations are followed, health hazards are negligible.

Sources of Additional Information

General information on career opportunities and earnings for chemists is available from:

American Chemical Society, 1155 16th St. NW., Washington, D.C. 20036.

Manufacturing Chemists Association, 1825 Connecticut Ave. NW., Washington, D.C. 20009.

For specific information on Federal Government careers, contact:

Interagency Board of U.S. Civil Service Examiners for Washington, D.C., 1900 E St. NW., Washington, D.C. 20415.

For additional sources of information, see statements on biochemists, chemical engineers, food scientists, and the industrial chemical industry. Information on chemical technicians may be found in the statement on engineering and science technicians.

FOOD SCIENTISTS

(D.O.T. 022.081, 040.081, and 041.081)

Nature of the Work

In the past, consumers processed most food in the home, but today industry processes almost all foods. A key worker involved in the development and processing of the large variety of foods available today is the *food scientist* or *food technologist*.

Food scientists investigate the chemical, physical, and biological nature of food and apply this knowledge to processing, preserving, packaging, distributing, and storing an adequate, nutritious, wholesome, and economical food supply. About three-fifths of all scientists in food processing work in research and development. Others work in quality assurance laboratories or in production or processing areas of food plants. Some teach or do basic research in colleges and universities.

Food scientists in basic research study the structure and composition of food and the changes it undergoes in storage and processing. For example, they may develop new sources of proteins, study the effects of processing on microorganisms, or search for factors that affect the flavor, texture or appearance of foods. Food scientists who work in applied research and development create new foods and develop new processing methods. They also seek to improve existing foods by making them more nutritious and enhancing their flavor, color, and texture.

Food scientists conduct tests to identify bacterial cultures.

Food scientists insure that each product will retain its characteristics and nutritive value during storage. They also conduct chemical and microbiological tests to see that products meet industry and government standards, and they may determine the nutritive contents of products in order to comply with Federal nutritional labeling requirements.

In quality control laboratories, food scientists check raw ingredients for freshness, maturity, or suitability for processing. They may use machines that test for tenderness by finding the amount of force necessary to puncture the item. Periodically, they inspect processing line operations to insure conformance with government and industry standards. For example, scientists test processed foods for sugar, starch, protein, fat, vitamin, and mineral content. They make sure that, after processing, various enzymes are inactive and microbial levels are adequately low so that the food will not spoil during storage or present a safety hazard. Other food scientists are involved in developing and improving packaging and storage methods.

Food scientists in production prepare production specifications, schedule processing operations, maintain proper temperature and humidity in storage areas, and supervise sanitation operations, including the efficient and economical disposal of wastes. To increase efficiency, they advise management on the purchase of equipment and recommend new sources of materials.

Some food scientists apply their knowledge in areas such as market research, advertising, and technical sales. Others teach in colleges and universities.

Places of Employment

About [illegible] persons worked as food scientists in 1976. Food scientists work in all sectors of the food industry and in every State. The types of products and processes with which they work may depend on the locality. For example, in Maine and Idaho they work with potato processing; in the Midwest, with cereal products and meatpacking; and in Florida and California, with citrus fruits and vegetables.

Some food scientists do research for Federal agencies such as the Food and Drug Administration and the Departments of Agriculture and Defense; others work in State regulatory agencies. A few work for private consulting firms and international organizations such as the United Nations. Some teach or do research in colleges and universities. (See statement on college and university teachers elsewhere in the *Handbook*.)

Training, Other Qualifications, and Advancement

A bachelor's degree with a major in food science, or in one of the physical or life sciences such as chemistry and biology, is the usual minimum requirement for beginning jobs in food science. An advanced degree is necessary for many jobs, particularly research and college teaching and for some management level jobs in industry.

About 60 colleges and universities offered programs leading to the bachelor's degree in food science in 1976. Undergraduate students majoring in food science usually take courses in physics, chemistry, mathematics, biology, the social sciences and humanities, and business administration, as well as a variety of food science courses. Food science courses cover areas such as preservation, processing, sanitation, and marketing of foods.

Most of the colleges and universities that provide undergraduate food science programs also offer advanced degrees. Graduate students usually specialize in a particular area of food science. Requirements for the master's or doctor's degree vary by institution, but usually include extensive laboratory work and a thesis.

People planning careers as food scientists should have analytical minds and like details and technical work. Food scientists must be able to express their ideas clearly to others.

Food scientists with a bachelor's degree might start work as quality assurance chemists or as assistant production managers. After gaining experience, they can advance to more responsible management jobs.

A food scientist might also begin as a junior food chemist in a research and development laboratory of a food company, and be promoted to section head or another research management position.

People who have master's degrees may begin as senior food chemists in a research and development laboratory. Those who have the Ph. D. degree usually begin their careers doing basic research or teaching.

Employment Outlook

Employment of food scientists is expected to grow about as fast as the average for all occupations through the mid-1980's. Most openings will result from the need to replace those who die, retire, or transfer to other fields, although some openings will arise from employment growth.

Employment is expected to grow as the food industry responds to the challenge of providing wholesome and economical foods that can meet changing consumer preferences and food standards. In addition, both private households and food service institutions that supply customers such as airlines and restaurants will demand a greater quantity of processed convenience foods.

Employment opportunities should generally be favorable through the mid 1980's for food scientists with degrees in food science. Opportunities may not be as good for scientists with degrees in related fields such as chemistry or biology. Food scientists with advanced degrees are expected to have more favorable opportunities than those with only a bachelor's degree.

An increasing number of food scientists are expected to find jobs in research and product development. In recent years, expenditures for research and development in the food industry have increased moderately and probably will continue to rise. Through research, new foods are being produced from modifications of wheat, corn, rice, and soybeans. For example, food scientists are working to improve "meat" products made from vegetable proteins. There will be an increased need for food scientists in quality control and production because of the complexity of products and processes and the application of higher processing standards and new government regulations.

Earnings and Working Conditions

Food scientists had relatively high earnings in 1976, twice as high as the average for all nonsupervisory workers in private industry, except farming. Food scientists with the bachelor's degree had average starting salaries of about $11,300 a year in 1976. Those with a master's degree started at about $13,500, and those with the Ph. D. degree at about $17,400.

In the Federal Government in 1977, food scientists with a bachelor's degree could start at $9,303 or $11,523 a year, depending on their college grades. Those with a master's degree could start at $11,523 or $14,097, and those with the Ph. D. degree could begin at $17,056 or $20,442. The average salary for experienced food scientists in the Federal Government was about $21,500 a year in 1977.

Sources of Additional Information

[illegible] contact:

[illegible] Food [illegible] 221 North LaSalle St., Chicago, Ill. 606[illegible]

[illegible]

[illegible]

[illegible] of the Work

[illegible] the probing of ocean depths, [illegible] the safety of the family car [illegible] on research by physicists. Through systematic observation and experimentation, physicists describe in mathematical terms the structure of the universe and interaction of matter and energy. Physicists develop theories that describe the fundamental forces and laws of nature. Determining such basic laws governing phenomena such as gravity, electromagnetism, and nuclear interaction leads to discoveries and innovations. For instance, the development of irradiation therapy equipment which destroys harmful growths in humans without damaging other tissues resulted from what physicists know about nuclear radiation. Physicists have contributed to scientific progress in recent years in areas such as nuclear energy, electronics, communications, aerospace, and medical instrumentation.

The majority of all physicists work in research and development. Some do basic research to increase scientific knowledge. For example, they investigate the fundamentals of nuclear structure and the forces between nucleons (nuclear dynamics). The equipment that physicists design for their basic research can often be applied to other areas. For example, lasers (devices that amplify light and emit electromagnetic waves in a narrow, intense light beam) are utilized in surgery; microwave devices are used for ovens; and measurement techniques and instruments developed by physicists can detect and measure the kind and number of cells in blood or the amount of mercury or lead in foods.

Some engineering oriented physicists do applied research and help develop new products. For instance, their knowledge of solid state physics led to the development of transistors and microcircuits used in electronic equipment that ranges from hearing aids to missile guidance systems.

Many physicists teach and do research in colleges and universities. A small number work in inspection, quality control, and other production-related jobs in industry. Some do consulting work.

Most physicists specialize in one branch or more of the science—elementary particle physics; nuclear physics; atomic, electron, and molecular physics; physics of condensed matter, optics, acoustics, and plasma physics; and the physics of fluids. Some specialize in a subdivision of one of these branches. For example, within solid-state physics subdivisions include ceramics, crystallography, and semiconductors. However,

Physicist developing a coating for optical fibers

[illegible] the same fundamental principles, a physicist's work usually overlaps several specialties.

Growing numbers of [illegible] are specializing in fields combining physics and a related science, such as astrophysics, biophysics, chemical physics and geophysics. Furthermore, the practical applications of physicists' work have increasingly merged with engineering.

[illegible]

[illegible] in 19[illegible] Pr[illegible] employed in all [illegible] physicists primarily [illegible] manufacturing chemicals [illegible] equipment and aircraft [illegible] Many others worked in hospitals, commercial laboratories, and independent research organizations.

Nearly one-half of all physicists taught or did research in colleges and universities, some did both. About 8,000 physicists were employed by the Federal Government in 1976, mostly in the Departments of Defense and Commerce.

Although physicists [illegible] in all parts of the country, their employment is greatest in areas that have heavy industrial concentrations [illegible] enrollments. Nearly one-fourth of all physicists work in four metropolitan areas: Washington, D.C.; Boston, Mass.; New York, N.Y.; and Los Angeles-Long Beach, Calif., and more than one-third are concentrated in three States: California, New York, and Massachusetts.

Training, Other Qualifications, and Advancement

[illegible] physics [illegible] is the minimum [illegible] for most entry level jobs [illegible] and for advancement in all types [illegible]. The doctorate usually is required for full faculty status at colleges and universities and for industrial or government jobs administering research and development programs.

[illegible] usually [illegible] jobs in private industry and in the Federal Government. Some work in colleges and universities in teaching and assisting in research while studying for their Ph. D.

Those [illegible] usually [illegible] applied research and development jobs in private industry and in the Federal Government. Some are employed as research assistants in colleges and universities while studying for advanced degrees. Many with a bachelor's degree in physics apply their physics training primarily in jobs in engineering and other scientific fields. (See statements on engineers, geophysicists, programmmers, and systems analysts elsewhere in the *Handbook*.)

Over 800 colleges and universities offer a bachelor's degree in physics. In addition, many engineering schools offer a physics major as part of the general curriculum. The undergraduate program in physics provides a broad background in the science and serves as a base for later specialization either in graduate school or on the job. Some typical physics courses are mechanics, electricity and magnetism, optics, thermodynamics, and atomic and molecular physics. Students also take courses in chemistry and require many courses in mathematics.

About 300 colleges and universities offer advanced degrees in physics. In graduate school, the student with faculty guidance, usually works in a specific field. The graduate student, especially the candidate for the Ph. D. degree, spends a large portion of his or her time in research.

Students planning a career in physics should have an inquisitive mind, mathematical ability, and imagination. They should be able to work on their own, since physicists, particularly in basic research, often receive only limited supervision.

Physicists often begin their careers doing routine laboratory tasks. After some experience, they are assigned more complex tasks and may advance to work as project leaders or research directors. Some work in top management jobs. Physicists who develop new products frequently form their own companies or join new firms to exploit their own ideas.

Employment Outlook

[illegible] are expected to be fav[illegible] through the mid-1980's for persons with graduate degrees in physics. Although employment of physicists is expected to grow more slowly than the average for all occupations over the period, fewer physicists are ex pected to enter the labor force than in the past. The number of graduate degrees awarded annually in physics has been declining since 1970, and this trend is expected to continue through the mid-1980's. Most job openings will arise as physicists retire, die, or transfer to other occupations.

Many physicists work in research and development (R&D). The anticipated rapid increase in R&D expenditures through the mid-1980's should result in increased requirements for physicists. If actual R&D expenditure levels and patterns were to differ significantly from those assumed, however, the outlook for physicists would be altered.

Some physicists with advanced degrees will be needed to teach in colleges and universities, but competition for these jobs is expected to be keen. The number of teaching jobs is expected to decline as the number of physics degrees awarded falls over the 1976 to 1985 period.

Persons with only a bachelor's degree in physics are expected to face keen competition for physicist jobs through the mid-1980's. Some new graduates will find employment as engineers or technicians. Others will find opportunities as high school physics teachers after completing the required educational courses and obtaining a State teaching certificate. However, they are usually regarded as teachers rather than as physicists. (See statement on secondary school teachers elsewhere in the *Handbook*.)

Earnings and Working Conditions

Physicists have relatively high salaries, with average earnings more than twice those of nonsupervisory workers in private industry, except farming. Starting salaries for physicists who had a bachelor's degree averaged about $12,600 a year in manufacturing industries in 1976, a master's degree, $13,600, and a Ph. D., $19,000.

Depending on their college records, physicists with a bachelor's degree could start in the Federal Government in 1977, at either $9,303 or $11,523 a year. Beginning physicists having a master's degree could start at $11,523 or $14,097, and those having the Ph. D. degree could begin at $17,056 or $20,442. Average earnings for all physicists in the Federal Government in 1977 were $23,850 a year.

Starting salaries on college and university faculties for physicists having a master's degree averaged $10,800 in 1976, and for those having the Ph. D., $12,800. (See statement on college and university teachers elsewhere in the *Handbook*.) Many faculty physicists supplement their regular incomes by working as consultants and taking on special research projects.

Sources of Additional Information

General information on career opportunities in physics is available from:

American Institute of Physics, 335 East 45th St., New York, N.Y. 10017.

For information on Federal Government careers, contact:

Interagency Board of U.S. Civil Service Examiners for Washington, D.C., 1900 E St. NW., Washington, D.C. 20415.

What to Look For in this Reprint

To make the *Occupational Outlook Handbook* easier to use, each occupation or industry follows the same outline. Separate sections describe basic elements, such as work on the job, education and training needed, and salaries or wages. Some sections will be more useful if you know how to interpret the information as explained below.

The TRAINING, OTHER QUALIFICATIONS, AND ADVANCEMENT section indicates the preferred way to enter each occupation and alternative ways to obtain training. Read this section carefully because early planning makes many fields easier to enter. Also, the level at which you enter and the speed with which you advance often depend on your training. If you are a student, you may want to consider taking those courses thought useful for the occupations which interest you.

Besides training, you may need a State license or certificate. The training section indicates which occupations generally require these. Check requirements in the State where you plan to work because State regulations vary.

Whether an occupation suits your personality is another important area to explore. For some, you may have to make responsible decisions in a highly competitive atmosphere. For others, you may do only routine tasks under close supervision. To work successfully in a particular job, you may have to do one or more of the following:

- motivate others
- direct and super[illegible]
- work with all types of [illegible]
- work with things [illegible]
  - and manual dexterity
- [illegible]k independently [illegible]
  - self discipline
- work as part of a team
- work with details, [illegible]
  - or laboratory reports
- [illegible] people
- use creativ[illegible]
- work [illegible] confined [illegible]
- do physically hard [illegible]
- work outside [illegible]

[illegible] abilities [illegible] you

The EMPLOYMENT O[illegible] the job market is likely to be favorable [illegible] expected growth is compared to th[illegible] rate for all occupations (20.1 percent between 1976 and 1985). The following phrases are used:

Much faster	[illegible]
Faster	25 [illegible]
About as fast	15.0 to 24.9%
Slower	4.0 to 14.9%
Little change	3.9 to 3.9%
Decline	4.0% or mo[illegible]

Generally, job [illegible] growing at least as fast as the economy as [illegible]

But, you would have to know the number of people competing with you to be sure of your prospects. Unfortunately, this supply information is lacking for most occupations.

There are exceptions, however, especially among professional occupations. Nearly everyone who earns a medical degree, for example, becomes a practicing physician. When the number of people pursuing relevant types of education and training and then entering the field can be compared with the demand, the outlook section indicates the supply/demand relationship as follows:

Excellent	Demand much greater than supply
Very good	Demand greater than supply
Good or favorable	Rough balance between demand and supply
May face competition	Likelihood of more supply than demand
Keen competition	Supply greater than demand

[illegible]petition or few job openings should not stop your pursuing a career that matches your aptitudes and interests. Even small or overcrowded occupations provide some jobs. So do those in which employment is growing very slowly or declining.

Growth in an occupation is not the only source of job openings because the number of openings from turnover can be substantial in large occupations. In fact, replacement needs are expected to create 70 percent of all openings between 1976 and 1985.

[illegible] job prospects in your area may differ from those in [illegible] as a whole. Your State employment service can fur[illegible] local information.

The EARNINGS section tells what workers were earning in [illegible]

Which jobs pay the most is a hard question to answer be[illegible] good information is available for only one type of earnings—wages and salaries—and not even this for all occupations. Although 9 out of 10 workers receive this form of income, [illegible] earn extra money by working overtime, night shifts, or irregular schedules. In some occupations, workers also receive tips or commissions based on sales or service. Some factory workers are paid a piece rate—an extra payment for each item they make.

The re[illegible] percent of all workers—the self employ[illegible] includes people in many occupations—physicians, barbers, writers, and farmers, for example. Earnings for self-employed workers even in the same occupation differ widely because much depends on whether one is just starting out or has an established business.

Most wage and salary workers receive fringe benefits, [illegible] as paid vacations, holidays, and sick leave.

Workers also receive income in goods and services (pay[illegible] in kind). Sales workers in department stores, for example, often receive discounts on merchandise.

Despite difficulties in determining exactly what people earn [illegible] the job, the Earnings section does compare occupational earnings by indicating whether a certain job pays more or less than the average for all nonsupervisors in private industry, excluding farming.

Each occupation has many pay levels. Beginners almost always earn less than workers who have been on the job for some time. Earnings also vary by geographic location but cities that offer the highest earnings often are those where living costs are most expensive.