

What can I do with a chemistry degree?

Chemistry and biochemistry are tremendously versatile majors, preparing you for a wide variety of career options and providing a strong foundation for applied and health sciences. The table below enumerates just *some* of the broad employment categories available, along with the number of current jobs in that field and the projected increase in new jobs in the next few years.

Job	Median Wage, 2012*	Number Employed in U.S., 2012	Projected Growth (2022)
Chemist	\$71,770	87,900	6%
Biochemist	\$81,480	29,200	19%
Medical Scientist	\$76,980	103,100	13%
Chemical Technician	\$42,920	63,600	9%
Pharmacist	\$116,670	286,400	14%
Physician / Surgeon	> \$220,942	691,400	18%
Dentist	\$149,310	146,800	16%
Optometrist	\$97,820	33,100	24%
Physician Assistant	\$90,930	86,700	38%
High School Chemistry Teacher	\$55,050	35,000	6%
College Chemistry Professor	\$71,140	25,300	14%
Forensic Science Technician	\$52,840	12,900	6%
Technical / Scientific Sales	\$74,970	382,300	10%

*Median wages are national averages. They do not necessarily represent the local area, specialty within categories, or starting salaries. For more information go to http://www.bls.gov/oes/current/map_changer.htm.

Research and Development and Industry-Related Professions

Chemists study substances at atomic and molecular levels and the ways in which substances react. They use their knowledge to develop new and improved products and to test the quality of manufactured goods.

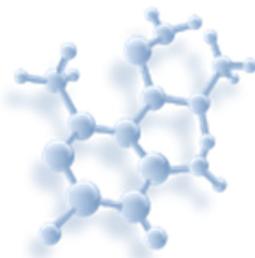
WHAT THEY DO: Many chemists work in basic and applied research and development and quality control job environments. Most also work as part of a team. Chemists:

- Plan and carry out complex research projects like development of new products and testing methods.
- Direct technicians and other workers in proper chemical processing and testing procedures and in analyzing components and the physical properties of materials.
- Prepare solutions, compounds, and reagents used in laboratory procedures; analyze substances to determine their composition and concentration of elements; conduct tests on materials and other substances to ensure that safety and quality standards are met
- Write technical reports detailing methods and findings and present results to scientists, engineers, and other colleagues

DIVISIONS WITHIN CHEMISTRY:

Analytical chemists investigate the composition, structure, and nature of a substance. Some specialize in developing new methods. Research has a wide range of applications, including food safety, pharmaceuticals, and pollution control.

Inorganic chemists study properties and reactions of molecules that do not contain carbon, such as



metals. Inorganic chemists figure out how they can be modified, separated, or used in products like ceramics and superconductors.

Medicinal chemists (see below) research, develop, and test compounds that can be used as pharmaceuticals. They also help develop processes to produce drugs on large scales.

Organic chemists study the structure, properties, and reactions of molecules that contain carbon. They design and make new substances with unique properties and applications. These have been used to develop many commercial products such as pharmaceutical drugs and plastics.

Physical chemists study fundamental characteristics of how matter behaves on a molecular level and how chemical

reactions occur. They often work on teams that develop uses for new materials.

Many chemists work in interdisciplinary fields like **biochemistry** (see below) or geochemistry. Additional coursework in related fields is often helpful to pursue (and sometimes required) for jobs that use the fundamental understanding of chemistry in applied ways.

SPECIALIZED APPLICATIONS:

- If you are interested in how humans interact with our environment, you might be a food and flavor chemist, an agricultural chemist, a consumer product chemist, an environmental chemist, or a water chemist.
- If you are interested in the improved manufacture of new and useful products, you might be a polymer chemist, an oil and petroleum chemist, a pulp and paper chemist, a textile chemist, a quality control chemist, a materials scientist, a hazardous waste manager, an inorganic or catalysis chemist, or an organic chemist.

EDUCATION NEEDED: At least a bachelor's degree in chemistry, however, a master's degree or Ph.D. is needed for many research jobs.

EMPLOYMENT SECTORS. About 20% of chemists are employed in research and development in physical, engineering, and life sciences industries and 20% in pharmaceutical and medicine manufacturing. Another 10% work in testing laboratories. Federal, state, and local government agencies, colleges, universities, and professional schools, computer and electronic product manufacturing, basic chemical manufacturing, and other industries make up the remainder.

Managers in the chemical industry supervise the work of other scientists. They direct activities related to research and development, and coordinate activities such as testing, quality control, and production.

EDUCATION NEEDED: Natural sciences managers usually advance to management positions after years of employment as scientists. Natural sciences managers typically have a bachelor's degree, master's degree, or Ph.D. in a scientific discipline or a related field, such as engineering. Some managers may find it advantageous to have an advanced management degree—for example, a Master of Business Administration (MBA) or a Master of Public Administration (MPA).

Chemical Technicians use special instruments and techniques to help chemists and chemical engineers research, develop, and produce chemical products and processes.

WHAT THEY DO:

- Monitor chemical processes and test product quality to make sure standards and specifications are met
- Set up and maintain laboratory instruments and equipment, prepare chemical solutions
- Conduct chemical and physical experiments and tests for a variety of purposes
- Compile and interpret results of tests; prepare technical reports, graphs, and charts, and give presentations that summarize their results.



EDUCATION NEEDED: For most jobs, chemical technicians need at least 2 years of college work.

EMPLOYMENT SECTORS. Chemical technicians typically work in laboratories or in industrial facilities such as chemical and pharmaceutical manufacturing plants. The largest employment sectors are in testing laboratories (22%), research and development in the physical, engineering, and life sciences (13%), basic chemical manufacturing (8%), pharmaceutical and medicine manufacturing (7%), and at colleges, universities, and professional schools (4%).

Life Science-Related Professions

Biochemists and biophysicists study the chemical and physical principles of living things and of biological processes such as cell development, growth, and heredity. They may also be described as molecular biologists or cell biologists.

WHAT THEY DO: Basic research is conducted without any immediately known application; the goal is to expand human knowledge. Applied research is directed toward solving a particular problem.

- Plan and conduct complex projects in basic and applied research on the effects of substances such as food, drugs, and hormones on tissues and biological processes
- Isolate, analyze, and synthesize proteins, enzymes, DNA, and other molecules
- Manage laboratory teams and monitor the quality of their work
- Prepare technical reports, research papers, and recommendations based on their research and present findings to scientists, engineers, and other colleagues. Prepare grant proposals for funding of basic research.



Biochemists and biophysicists use advanced technologies like electron microscopes and lasers to conduct experiments; they also use computer modeling to determine 3-D structures of proteins and other molecules. In biotechnology research, they may use chemical enzymes to synthesize recombinant DNA. Basic research could study genetic mutations that lead to cancer and other diseases, how nerve cells communicate or how proteins work. Applied research may attempt to develop products and processes that detect diseases or genetic disorders or to develop new drugs and medications. Outside of medicine, biochemists and biophysicists research ways to genetically engineer drought or disease-resistant crops, investigate biofuels, or use bio-organisms to protect the environment and clean up pollution.

EDUCATION NEEDED: Biochemists and biophysicists need a Ph.D. to work in independent research and development positions. Bachelor's and master's degree holders are qualified for some entry-level positions. Most Ph.D. holders begin their careers in temporary postdoctoral research positions.

EMPLOYMENT SECTORS. Nearly half of all biochemists and biophysicists work in research and development in the physical, engineering, and life sciences industries. 17% are employed at colleges and universities, and 14% in the pharmaceutical industry.

Medical Scientists' work is aimed at improving overall human health. Medical scientists are also known as cancer researchers, clinical and medical informaticians, neuroscientists, pharmacologists, immunochemists, industrial pharmacists, or toxicologists. They use both clinical and basic research to reach their findings.

WHAT THEY DO: Medical scientists study the causes of diseases and other health problems and investigate methods of preventive care and treatment of diseases.

- Analyze medical samples and data to study causes and treatment of toxicity or disease
- Standardize potency, doses, and methods to allow for mass manufacturing of medicinal compounds
- Work with health departments, industry, and physicians to develop programs that improve health outcomes
- Develop instruments for medical applications
- Apply for funding from government agencies and private funding sources by writing research grant proposals



Many medical scientists, especially in university settings, form their own hypotheses and develop experiments. They often lead teams of technicians and sometimes students who perform support tasks. Medical scientists in private industry usually have to research topics that benefit the company. They do not have the pressure of writing grant proposals to get money for research, but they often must explain research plans to nonscientist managers or executives.

EDUCATION NEEDED: Medical scientists typically need a Ph.D. Dual-degree programs are available that pair a Ph.D. with M.D., D.D.S., D.M.D., and D.O. clinical degrees. Ph.D. studies focus on research methods, project design, laboratory work, and original research. Students in dual degree programs learn both the clinical skills needed to be a physician and the research skills needed to be a scientist. Students planning careers as medical scientists typically pursue a bachelor's degree in biology, chemistry, or related fields.

EMPLOYMENT SECTORS. One-third of medical scientists work in research and development within industry. 20% are employed at university settings, 14% in hospitals or physician practices, and 8% in pharmaceutical and medicine manufacturing jobs.

Healthcare Professions

Physicians and surgeons diagnose and treat injuries or illnesses.



WHAT THEY DO: There are two types of degrees: M.D. (Medical Doctor) and D.O. (Doctor of Osteopathic Medicine). Although both use the same methods of treatment, including drugs and surgery, D.O.s place additional emphasis on the musculoskeletal system, preventive medicine, and holistic (whole-person) patient care. D.O.s are most likely to be primary care physicians, although they can be found in all specialties.

- Take a patient's medical history
- Update patient information to show current findings and treatments
- Order tests for nurses or other staff to perform and review test results to identify abnormal findings
- Recommend and design a plan of treatment
- Help patients by discussing topics such as proper nutrition and hygiene and preventative healthcare
- Surgeons operate on patients to treat injuries

EDUCATION NEEDED: Most applicants to medical school have at least a bachelor's degree, and many have advanced degrees. Undergraduate coursework in biology, chemistry, physics, mathematics, and English are admission requirements. Students also take courses in the humanities and social sciences and are required to take the Medical College Admission Test. Physicians complete 4 years of medical school and depending on their specialty, 3-8 years in internship and residency programs.

EMPLOYMENT SECTORS. Many physicians work in private offices or clinics. Increasingly, physicians work in group practices, healthcare organizations, or hospitals, where they share many patients with other doctors.

Pharmacists dispense prescription medications to patients and offer expertise in the safe use of prescriptions. They also may provide advice on how to lead a healthy lifestyle, conduct health and wellness screenings, provide immunizations, and oversee the medications given to patients.

WHAT THEY DO:

- Fill prescriptions, verifying instructions from physicians on the proper amounts of medication
- Check whether the prescription will interact negatively with other drugs or any other medical conditions and instruct patients on how and when to take medicine
- Advise patients about general health topics, such as diet, exercise, and managing stress, and on other issues like what equipment or supplies are best to treat a health problem
- Give flu shots and, in most states, other vaccinations
- Work with insurance companies to ensure that patients get the medicines they need
- Oversee the work of pharmacy technicians and pharmacists in training (interns)

EDUCATION NEEDED: Pharmacists must have a Doctor of Pharmacy (Pharm.D.) degree as well as pass licensure and law exams. All Doctor of Pharmacy programs require applicants to have taken courses such as chemistry, biology, and anatomy. Most programs require at least 2 years of undergraduate study, although some require a bachelor's degree. Applicants must also take the Pharmacy College Admissions Test (PCAT).

EMPLOYMENT SECTORS. About half of all pharmacists work in drug stores, one-quarter are employed at hospitals, and about 20% work in grocery and other general merchandise stores.

Dentists diagnose and treat problems with a patient's teeth, gums, and related parts of the mouth. They provide advice and instruction on taking care of teeth and gums and on diet choices that affect oral health.

EDUCATION NEEDED: Most dental schools require an undergraduate degree to have been completed, and all dental schools require applicants to have completed certain required science courses, such as chemistry and biology. Dental schools also require applicants to take the Dental Acceptance Test (DAT) during their junior year of college.

EMPLOYMENT SECTORS. Some dentists own their own businesses and work alone or with a small staff. Other dentists have partners in their practice.



Optometrists examine, diagnose, treat, and manage disorders of the visual system, eye diseases, and injuries. They prescribe eyeglasses or contact lenses as needed.

WHAT THEY DO: (optometrists should not be confused with ophthalmologists, physicians who treat disease and perform surgery)



EDUCATION NEEDED: Optometrists must complete a four year Doctor of Optometry (O.D.) degree program. Applicants must have completed at least 3 years of college coursework in biology, chemistry, physics, English, and math and must take the Optometry Admission Test.

- Perform vision tests, diagnosing problems like nearsightedness or glaucoma
- Prescribe eyeglasses and medications and refer patients to other healthcare providers as needed
- Promote eye health by counseling patients on topics such as how to clean and wear contacts

EMPLOYMENT SECTORS. 53% of optometrists are employed in stand-alone offices of optometry. Optometrists may also work in doctors' offices, retail stores, and outpatient clinics.

Physician Assistants practice medicine on a team under the supervision of physicians and surgeons. They are formally educated to examine patients, diagnose injuries and illnesses, and provide treatment.

WHAT THEY DO: Physician assistants (PAs) are not medical assistants (who perform routine clinical and clerical tasks but do not practice medicine). A physician assistant might

- Conduct physical exams and give treatments like setting broken bones or immunizing patients
- Order and interpret x-rays or blood tests
- Educate and counsel patients and their families and conduct outreach programs, talking to groups about managing diseases and promoting wellness
- Prescribe medicine when needed
- Record a patient's progress and research the latest treatments to ensure the quality of patient care



Physician assistants work under the supervision of physician or surgeon, but the extent of supervision differs from state to state. PAs confer with other healthcare workers as needed and required by law. They work in all areas of medicine, specific duties depending in large part on their specialty – a PA working in surgery may close incisions and provide care before and after the operation – a PA in pediatrics may give routine vaccinations. In medically-underserved areas, PAs may be the primary care providers at clinics where physicians are present only 2 days per week.

EDUCATION NEEDED: Physician assistants need a master's degree from an accredited educational program. While admissions requirements vary from program to program, most programs require two to four years of undergraduate coursework with a focus in science, and most applicants have a bachelor's degree and some healthcare-related work experience. All states require physician assistants to be licensed.

Other health-related professions that require backgrounds with a detailed understanding of chemistry (but may have other heavy emphasis areas as well):

- **MEDICAL LABORATORY TECHNOLOGISTS AND TECHNICIANS** collect samples and perform tests to analyze body fluids and tissues. A bachelor's degree in life sciences is usually required. Technologists perform more complex medical laboratory tests than technicians. There are around 164,300 positions, three-fourths in hospitals, physician offices, and diagnostic testing labs. The median wage earned was \$47,820, and it is expected that over the next ten years, employment will grow 22%.
- **VETERINARIANS** diagnose, treat, and research medical conditions of pets, livestock, and animals. Veterinarians must complete a Doctor of Veterinary Medicine (D.V.M.) degree, which generally takes 4 years to complete. Vet schools typically require applicants to have taken many science classes, including biology, chemistry, anatomy, physiology, zoology, microbiology, and animal science. The median annual wage for veterinarians was \$84,460 in May 2012. There are 70,000 veterinarians, and the field is projected to grow 12% in the next ten years.
- **DIETICIANS AND NUTRITIONISTS** advise people on what to eat in order to lead a healthy lifestyle or achieve a specific health-related goal. They hold 67,400 jobs in hospitals, nursing homes, cafeterias, and schools, projected to increase by 21% over the next ten years. A bachelor's degree in dietetics, foods and nutrition, or related areas is required, including courses in nutrition, psychology, chemistry, and biology. The median annual earnings are \$55,240.
- **OCCUPATIONAL HEALTH AND SAFETY SPECIALISTS** analyze procedures and work environments and inspect them for adherence to health and environmental regulations. Specialists need at least a bachelor's degree in safety, occupational health, or a related scientific field like engineering, biology, or chemistry. One-third of 62,900 workers in this field are employed by governmental agencies. The occupation is expected to grow by 7% by 2022, with a median annual wage of \$66,790.

Knowledge-Related Professions

High School Chemistry Teachers help prepare students for life after graduation. They teach academic and other skills that students will need to attend college and to enter the job market.

WHAT THEY DO:

- Plan lessons in chemistry and related sciences for students with varying levels of abilities
- Evaluate students' abilities, strengths, and weaknesses and grade assignments to monitor progress
- Teach students as a class or in small groups; work with individuals to challenge them or improve their abilities
- Communicate with parents about students' progress



EDUCATION NEEDED: All states require public high school teachers to have at least a bachelor's degree. Most states require public high school teachers to have majored in a subject area, although this is not the case in Tennessee. Public school teachers must also pass a licensure exam in order to attain a job. Teachers in private schools do not need to meet state requirements, but private schools typically seek high school teachers who have a bachelor's degree and a major in a subject area. Within the state of Tennessee, additional education and teacher preparation coursework is also required.

Post-Secondary Teachers instruct students beyond the high school level. They also conduct research and publish scholarly papers and books.



WHAT THEY DO:

- Teach courses in their subject area
- Develop instructional plans for the course(s) they teach to meet college standards; plan lessons and assignments; assess students' progress by grading work
- Advise students about which classes to take and how to achieve their goals
- Stay informed about changes and innovations and conduct research and experiments to advance knowledge in their field; publish original research and analysis in books and academic journals
- Work with colleagues to develop or modify the curriculum for a degree; serve on academic and administrative committees that recommend policies, make budget decisions, or advise on hiring

EDUCATION NEEDED: Postsecondary teachers who work for 4-year colleges and universities are most often required to have a doctoral degree in their field. However, schools may hire those who have a master's degree for some part-time positions.

EMPLOYMENT SECTORS: In 2012, 75% of postsecondary teachers worked for colleges, universities, and professional schools and 21% worked for junior colleges.

Technical writers prepare instruction manuals, journal articles, and other supporting documents to communicate complex and technical information more easily.

They develop, gather, and disseminate technical information among customers, designers, and manufacturers. Some also help write grant proposals for research scientists and institutions. A college degree is required for a position as a technical writer, and experience within the technical subject is important. However, coursework in writing and/or communications is necessary, as employers usually prefer candidates with a degree in journalism, communications, or English. Technical writers held about 49,500 jobs in 2012 with a median salary of \$65,500. The field is expected to grow 15% over the next ten years.

Other Professions

Forensic Science Technicians help investigate crimes by collecting and analyzing physical evidence. Many technicians specialize in either crime scene investigation or laboratory analysis.

WHAT THEY DO AT CRIME SCENES:

- Analyze scenes to determine what and how evidence should be collected. Take photos and make sketches of the crime scene and evidence
- Record all observations and findings
- Collect physical evidence, including weapons, fingerprints, and bodily fluids and catalog and preserve evidence for transfer to crime labs



WHAT THEY DO IN LABORATORIES:

- Perform chemical, biological, and physical analysis on evidence taken from crime scenes
- Explore possible links between suspects and criminal activity using the results of scientific analyses
- Consult with experts in related or specialized fields, such as toxicology and odontology
- Reconstruct crime scenes

All forensic science technicians prepare reports detailing their findings and investigative methods. They must be able to explain reports to lawyers and law enforcement officials and are often called to testify in court about findings and methods.

EDUCATION NEEDED: Forensic science technicians typically need at least a bachelor's degree in a natural science such as chemistry, but should make an effort to take classes related to forensic science. The strongest applicants for forensic science technician jobs will have an undergraduate degree in the natural sciences and a master's degree in forensic science. Competition for jobs is strong because of the substantial interest in forensic science and crime scene investigation that has been generated by popular media.

EMPLOYMENT SECTORS. Nine in 10 forensic science technicians work in state and local government in police departments and offices, crime laboratories, morgues, and medical examiner offices.

Chemical, equipment, or pharmaceutical sales representatives sell goods for wholesalers or manufacturers to businesses, government agencies, and other organizations.

WHAT THEY DO:

- Identify prospective customers and attend trade shows and conferences
- Contact new and existing customers to explain how specific products and services can meet their needs, product specifications, and regulations
- Emphasize product features based on analyses of customers' needs and on technical knowledge of product capabilities and limitations
- Answer questions about prices, availability, and product uses, and negotiate sales and service agreements
- Work with colleagues to exchange information, such as selling strategies and marketing



EDUCATION NEEDED: Those selling scientific and technical products typically must have a bachelor's degree. Scientific and technical products include pharmaceuticals, medical instruments, and industrial equipment. A degree in a field related to the product sold, such as chemistry, biology, or engineering, is often required.

Chemistry-related professions that require backgrounds with a detailed understanding of chemistry (but have other heavy emphasis areas and/or secondary degrees required):

- Patent Law
- Chemical Engineering
- Environmental Science
- Atmospheric and Geo- Sciences
- Biology and Microbiology

For more information about these or any profession

- **Go to <http://www.bls.gov/ooh/>.** Each profession has links and contacts to professional associations and other resources to learn more about the field.
- **Visit <http://www.utc.edu/career-student-employment/>.** This office maintains valuable information about job search preparation, career exploration, and local job postings, in addition to hosting career fairs, mock interviews, and resume critique sessions.
- **Talk with your academic department advisor** and other professionals in the field.