



# Sloan Career Cornerstone Center

## Chemical Engineering Overview

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### The Field

It would take too long to list all the products that are impacted by chemical engineers, but knowing what industries employ them may help you comprehend the scope of their work. Chemical engineers work in manufacturing, pharmaceuticals, healthcare, design and construction, pulp and paper, petrochemicals, food processing, specialty chemicals, polymers, biotechnology, and environmental health and safety industries, among others. Within these industries, chemical engineers rely on their knowledge of mathematics and science, particularly chemistry, to overcome technical problems safely and economically. And, of course, they draw upon and apply their engineering knowledge to solve any technical challenges they encounter. Don't make the mistake of thinking that chemical engineers only make things, though. Their expertise is also applied in the area of law, education, publishing, finance, and medicine, as well as many other fields that require technical training.



Specifically, chemical engineers improve food processing techniques, and methods of producing fertilizers, to increase the quantity and quality of available food. They also construct the synthetic fibers that make our clothes more comfortable and water resistant; they develop methods to mass-produce drugs, making them more affordable; and they create safer, more efficient methods of refining petroleum products, making energy and chemical sources more productive and cost effective. They also develop solutions to environmental problems, such as pollution control and remediation. And yes, they process chemicals, which are used to make or improve just about everything you see around you.

Chemical engineers face many of the same challenges that other professionals face, and they meet these challenges by applying their technical knowledge, communication and teamwork skills, the most up-to-date practices available, and hard work. Benefits include financial reward, recognition within industry and society, and the gratification that comes from working with the processes of nature to meet the needs of society.

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## Preparation

A bachelor's degree in engineering is required for almost all entry-level chemical engineering jobs. Preparation for a career in chemical engineering begins as an undergraduate, but is not limited to course work. Employers value a range of capabilities which you can develop as you acquire technical competence in the classroom. You may also want to explore the possibility of a transfer program or a graduate degree.



## Admission Requirements

Admissions requirements for undergraduate engineering schools include a solid background in mathematics (algebra, geometry, trigonometry, and calculus) and science (biology, chemistry, and physics), and courses in history, humanities, and computer and information technology. Bachelor's degree programs in engineering typically are designed to last 4 years, but many students find that it takes between 4 and 5 years to complete their studies. In a typical 4-year university curriculum, the first 2 years are spent studying mathematics, basic sciences, introductory engineering, humanities, and social sciences. In the last 2 years, most courses are in engineering, usually with a concentration in one branch. For example, the last 2 years of an aerospace program might include courses in fluid mechanics, heat transfer, applied aerodynamics, analytical mechanics, flight vehicle design, trajectory dynamics, and aerospace propulsion systems.

## Co-ops / Internships

Many employers expect candidates to have some type of experience and are more likely to give second interviews and job offers to students with an internship or co-op on their resumes.

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## Accreditation

Those interested in a career in engineering should consider reviewing engineering programs that are accredited by the official accrediting agency for their country. More details are at [www.accreditation.org](http://www.accreditation.org), but in general, accreditation helps ensure that a program offers a consistently high standard of education in a specific field. The process of accreditation also serves to foster self-examination by universities; to develop a dialog between constituents of educational programs on content, methods, and outcomes; and to encourage continuous improvement of academic programs.



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## Day In The Life

Although the specific responsibilities of chemical engineers vary among industries -- and even within companies -- it's possible to categorize them in general terms. Titles such as "Process Engineer" and "Design Engineer" describe positions in most industries, whatever type of work, process, equipment, or product is involved. Typical functions include:

### **Attorney**

Specializes in intellectual property law, patent law, technology transfer, environmental compliance, and safety issues. Patent attorneys obtain patents for clients and monitor the marketplace for possible patent infringements.

### **Biomedical Specialist**

Works alongside physicians to develop systems that track critical chemical processes in the body. Biomedical specialists may be involved in the design of artificial organs, such as hearts and lungs.

### **Computer Applications and Technology Engineer**

Designs instrumentation and programs systems to control certain processes. Automation engineers may develop ways to monitor a series of interactive steps in chemical, petroleum, or biotechnology facilities.

### **Consultant**

Works for many different customers and brings specialized knowledge to individual projects. Consultants in a construction company may work with teams of engineers to design and construct an expansion for a pharmaceutical company. Most consultants have several years of professional experience.

### **Process Design Engineer**

Designs manufacturing facilities and the equipment and materials used inside. Process design engineers work with teams of engineers to develop new or improved processes to meet a company's production needs.

### **Environmental Engineer**

Develops techniques to recover usable materials, and reduce waste created during manufacture of a product. Environmental engineers design air pollution control and wastewater treatment systems, waste storage and treatment facilities, and soil and groundwater clean-up systems. They also may be responsible for monitoring all systems in a facility for compliance with environmental regulations.

### **Technical Manager**

Responsible for the engineering staff and programs at a facility. Manages people, research programs, and daily operations of the engineering functions. Technical managers may oversee R&D. With plant managers, they may plan and implement the funding and expansion programs necessary to develop a new product.

### **Business Coordinator**

Develops budgets and capital projections for a facility or process. Business coordinators work closely with production and design team members to determine the exact needs of a new process, then plan the capital needs necessary to implement the program.

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### **Plant Process Engineer**

Provides technical support to staff and troubleshoots processes in a production facility to keep a plant running efficiently. Plant process engineers work closely with equipment operators to get feedback on the operations of each process and determine how to avoid shut-downs. They may also be involved with design work for improving methods of production.

### **Process Safety Engineer**

Designs and maintains plants and processes that are safer for workers and communities. Process safety engineers may conduct safety analyses of new and existing equipment, and train employees on how to operate a new piece of equipment safely.

### **Product Engineer**

Follows the production cycle of a particular product to ensure it is meeting specification. Product engineers may work with marketing and R&D to ensure that a product will meet the needs of customers, then see the product through production. They may work on new products or variations of existing products.

### **Manufacturing Production Engineer**

Responsible for the day-to-day operation of a specific manufacturing process. Manufacturing production engineers work directly with operators to ensure that a particular product is made according to specifications.

### **Professor**

Instructs students and conducts research. Professors may teach several classes in chemical engineering, be members of university committees, and conduct research using government, corporate, or private funding.

### **Project Engineer**

Oversees the design and construction of specific processes in a facility. After construction, they may assist in equipment testing, operator training, and plant start-up.

### **Project Manager**

Oversees the overall design and construction of a facility, then manages ongoing operations. Project managers may manage a group of project engineers during the design and construction of a new facility.

### **Quality Control Engineer**

Monitors the manufacture of product to ensure that quality standards are maintained. Quality control engineers may bring samples of a product in from a field test, or from a normal application, and test them to determine how specific properties -- such as strength, color, and weatherability -- change over time.

### **Regulatory Affairs Engineer**

Researches, develops, and monitors policies and procedures to ensure the proper handling of chemicals and chemical components. Chemical engineers in regulatory affairs may be government employees who study the environmental impact of a new chemical, then recommend appropriate guidelines for the chemical's use.

### **Research and Development Engineer**

Seeks out new and more efficient ways of using and producing existing products. Explores and develops new processes and products and determines their usefulness and applicability. Chemical engineers working in R&D may work with chemists and other engineers to develop a new process or new product that will better meet customer needs.

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### **Sales and Marketing Engineer**

Assists customers in solving production and process problems by providing products and services to meet their specific needs. Chemical engineers in sales use their technical knowledge to sell chemicals, equipment, and other products, and provide follow-up services and training, where needed.

### **Technical Services Engineer**

Works with customers, usually on-site, to solve production problems caused by a process or machine. Chemical engineers working in technical services may represent the manufacturer of a machine to determine why it is not performing as designed. They often must understand the other steps in the production process to determine if there is a breakdown in another area.

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## **Professional Societies**

Professional organizations and associations provide a wide range of resources for planning and navigating a career in engineering. These groups can play a key role in your development and keep you abreast of what is happening in your industry. Many offer opportunities for university students to become members and provide programs and resources to pre-university students considering a career path.

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## **Earnings**

Earnings for engineers vary significantly by specialty, industry, location, and education. Even so, as a group, engineers earn some of the highest average starting salaries among those holding bachelor's degrees. Many professional societies keep track of earnings in their area of focus and geographic base.

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