Who are engineers?

Engineers are the people who use their background in math and science to solve our world's problems by designing creative, economical solutions for the betterment of our world.

Types of Engineers:

Aerospace/Aeronautical	Civil	Marine/Naval
Agricultural/Food	Computer/Software	Materials
Architectural/Structural	Electrical/Electronic	Mechanical
Biomedical/Genetic	Environmental/Biological	Mining/Geological
Chemical	Industrial/Manufacturing	Nuclear
		Petroleum

Aerospace engineers design, develop, and test aircraft, spacecraft, and missiles and supervise the manufacture of these products. Those who work with aircraft are called *aeronautical engineers*, and those working specifically with spacecraft are *astronautical engineers.* Aerospace engineers develop new technologies for use in aviation, defense systems, and space exploration, often specializing in areas such as structural design, guidance, navigation and control, instrumentation and communication, or production methods. They also may specialize in a particular type of aerospace product, such as commercial aircraft, military fighter jets, helicopters, spacecraft, or missiles and rockets, and may become experts in aerodynamics, thermodynamics, celestial mechanics, propulsion, acoustics, or guidance and control systems.

Agricultural engineers apply knowledge of engineering technology and science to agriculture and the efficient use of biological resources. (See biological scientists and agricultural and food scientists elsewhere in the *Handbook*.) They design agricultural machinery and equipment and agricultural structures. Some specialize in areas such as power systems and machinery design; structures and environment engineering; and food and bioprocess engineering. They develop ways to conserve soil and water and to improve the processing of agricultural products. Agricultural engineers often work in research and development, production, sales, or management.

Biomedical engineers develop devices and procedures that solve medical and health-related problems by combining their knowledge of biology and medicine with engineering principles and practices. Many do research, along with life scientists, chemists, and medical scientists, to develop and evaluate systems and products such as artificial organs, prostheses (artificial devices that replace missing body parts), instrumentation, medical information systems, and health management and care delivery systems. (See biological scientists, medical scientists, and chemists and materials scientists elsewhere in the *Handbook*.) Biomedical engineers may also design devices used in various medical procedures, imaging systems such as magnetic resonance imaging (MRI), and devices for automating insulin injections or controlling body functions. Most engineers in this specialty need a sound background in another engineering specialty, such as mechanical or electronics engineering, in addition to specialized biomedical training. Some specialties within biomedical engineering include biomaterials, biomechanics, medical imaging, rehabilitation engineering, and orthopedic engineering.

Chemical engineers apply the principles of chemistry to solve problems involving the production or use of chemicals and biochemicals. They design equipment and processes for large-scale chemical manufacturing, plan and test methods of manufacturing products and treating byproducts, and supervise production. Chemical engineers also work in a variety of manufacturing industries other than chemical manufacturing, such as those producing energy, electronics, food, clothing, and paper. They also work in healthcare, biotechnology, and business services. Chemical engineers apply principles of chemistry, physics, mathematics, and mechanical and electrical engineering. (See chemists and materials scientists, physicists and astronomers, and mathematicians elsewhere in the *Handbook*.) Some may specialize in a particular chemical process, such as oxidation or polymerization. Others specialize in a particular field, such as materials science, or in the development of specific products. They must be aware of all aspects of chemicals manufacturing and how the manufacturing process affects the environment and the safety of workers and consumers.

Civil engineers design and supervise the construction of roads, buildings, airports, tunnels, dams, bridges, and water supply and sewage systems. They must consider many factors in the design process, from the construction costs and expected lifetime of a project to government regulations and potential environmental hazards such as earthquakes. Civil engineering, considered one of the oldest engineering disciplines, encompasses many specialties. The major specialties are structural, water resources, construction, environmental, transportation, and geotechnical engineering. Many civil engineers hold supervisory or administrative positions, from supervisor of a construction site to city engineer. Others may work in design, construction, research, and teaching.

Computer hardware engineers research, design, develop, test, and oversee the installation of computer hardware and supervise its manufacture and installation. Hardware refers to computer chips, circuit boards, computer systems, and related equipment such as keyboards, modems, and printers. (Computer software engineers—often simply called computer engineers—design and develop the software systems that control computers. These workers are covered elsewhere in the *Handbook*.) The work of computer hardware engineers is very similar to that of electronics engineers, but, unlike electronics engineers, computer hardware engineers work exclusively with computers and computer-related equipment. The rapid advances in computer technology are largely a result of the research, development, and design efforts of computer hardware engineers.

Electrical engineers design, develop, test, and supervise the manufacture of electrical equipment. Some of this equipment includes electric motors; machinery controls, lighting, and wiring in buildings; automobiles; aircraft; radar and navigation systems; and power-generating, -controlling, and transmission devices used by electric utilities. Although the terms "electrical" and "electronics" engineering often are used interchangeably in academia and industry, electrical engineers have traditionally focused on the generation and supply of power, whereas electronics engineers have worked on applications of electricity to control systems or signal processing. Electrical engineers specialize in areas such as power systems engineering or electrical equipment manufacturing.

Electronics engineers, except computer, are responsible for a wide range of technologies, from portable music players to the global positioning system (GPS), which can continuously provide the location of a vehicle. Electronics engineers design, develop, test, and supervise the manufacture of electronic equipment such as broadcast and communications systems. Many electronics engineers also work in areas closely related to computers. However, engineers whose work is related exclusively to computer hardware are considered computer hardware engineers. Electronics engineers specialize in areas such as communications, signal processing, and control systems or have a specialty within one of these areas—industrial robot control systems or aviation electronics, for example.

Environmental engineers develop solutions to environmental problems using the principles of biology and chemistry. They are involved in water and air pollution control, recycling, waste disposal, and public health issues. Environmental engineers conduct hazardous-waste management studies in which they evaluate the significance of the hazard, advise on treatment and containment, and develop regulations to prevent mishaps. They design municipal water supply and industrial wastewater treatment systems. They conduct research on the environmental impact of proposed construction projects, analyze scientific data, and perform quality-control checks. Environmental engineers are concerned with local and worldwide environmental issues. They study and attempt to minimize the effects of acid rain, global warming, automobile emissions, and ozone depletion. They may also be involved in the protection of wildlife. Many environmental engineers work as consultants, helping their clients to comply with regulations and to clean up hazardous sites.

Industrial engineers determine the most effective ways to use the basic factors of production—people, machines, materials, information, and energy—to make a product or to provide a service. They are mostly concerned with increasing productivity through the management of people, methods of business organization, and technology. To solve organizational, production, and related problems efficiently, industrial engineers carefully study the product requirements, use mathematical methods to meet those requirements, and design manufacturing and information systems. They develop management control systems to aid in financial planning and cost analysis, and design production planning and control systems to coordinate activities and ensure product quality. They also design or improve systems for the physical distribution of goods and services, as well as determine the most efficient plant locations. Industrial engineers develop wage and salary administration systems and job evaluation programs. Many industrial engineers move into management positions because the work is closely related to the work of managers.

Marine engineers and naval architects are involved in the design, construction, and maintenance of ships, boats, and related equipment. They design and supervise the construction of everything from aircraft carriers to submarines, and from sailboats to tankers. Naval architects work on the basic design of ships, including hull form and stability. Marine engineers work on the propulsion, steering, and other systems of ships. Marine engineers and naval architects apply knowledge from a range of fields to the entire design and production process of all water vehicles. Workers who operate or supervise the operation of marine machinery on ships and other vessels also may be called marine engineers or, more frequently, ship engineers. (These workers are covered under water transportation occupations elsewhere in the *Handbook*.)

Materials engineers are involved in the development, processing, and testing of the materials used to create a range of products, from computer chips and television screens to golf clubs and snow skis. They work with metals, ceramics, plastics, semiconductors, and composites to create new materials that meet certain mechanical, electrical, and chemical requirements. They also are involved in selecting materials for new applications. Materials engineers have developed the ability to create and then study materials at an atomic level, using advanced processes to replicate the characteristics of materials and their components with computers. Most materials engineers specialize in a particular material. For example, metallurgical engineers specialize in metals such as steel, and ceramic engineers develop ceramic materials and the processes for making ceramic materials into useful products such as glassware or fiber optic communication lines.

Mechanical engineers research, develop, design, manufacture, and test tools, engines, machines, and other mechanical devices. They work on power-producing machines such as electric generators, internal combustion engines, and steam and gas turbines, as well as power-using machines such as refrigeration and air-conditioning equipment, machine tools, material handling systems, elevators and escalators, industrial production equipment, and robots used in manufacturing. Mechanical engineers also design tools that other engineers need for their work. Mechanical engineering is one of the broadest engineering disciplines. Mechanical engineers may work in production operations in manufacturing or agriculture, maintenance, or technical sales; many are administrators or managers.

Mining and geological engineers find, extract, and prepare coal, metals, and minerals for use by manufacturing industries and utilities. They design open-pit and underground mines, supervise the construction of mine shafts and tunnels in underground operations, and devise methods for transporting minerals to processing plants. Mining engineers are responsible for the safe, economical, and environmentally sound operation of mines. Some mining engineers work with geologists and metallurgical engineers to locate and appraise new ore deposits. Others develop new mining equipment or direct mineral-processing operations that separate minerals from the dirt, rock, and other materials with which they are mixed. Mining engineers frequently specialize in the mining of one mineral or metal, such as coal or gold. With increased emphasis on protecting the environment, many mining engineers work to solve problems related to land reclamation and water and air pollution. Mining safety engineers use their knowledge of mine design and practices to ensure the safety of workers and to comply with State and Federal safety regulations. They inspect walls and roof surfaces, monitor air quality, and examine mining equipment for compliance with safety practices.

Nuclear engineers research and develop the processes, instruments, and systems used to derive benefits from nuclear energy and radiation. They design, develop, monitor, and operate nuclear plants to generate power. They may work on the nuclear fuel cycle—the production, handling, and use of nuclear fuel and the safe disposal of waste produced by the generation of nuclear energy—or on the development of fusion energy. Some specialize in the development of nuclear power sources for spacecraft; others find industrial and medical uses for radioactive materials, as in equipment used to diagnose and treat medical problems.

Petroleum engineers search the world for reservoirs containing oil or natural gas. Once these resources are discovered, petroleum engineers work with geologists and other specialists to understand the geologic formation and properties of the rock containing the reservoir, determine the drilling methods to be used, and monitor drilling and production operations. They design equipment and processes to achieve the maximum profitable recovery of oil and gas. Because only a small proportion of oil and gas in a reservoir flows out under natural forces, petroleum engineers develop and use various enhanced recovery methods. These include injecting water, chemicals, gases, or steam into an oil reservoir to force out more of the oil and doing computer-controlled drilling or fracturing to connect a larger area of a reservoir to a single well. Because even the best techniques in use today recover only a portion of the oil and gas in a reservoir, petroleum engineers research and develop technology and methods to increase recovery and lower the cost of drilling and production operations.