**What is Nanoscience and Nanotechnology?**

Nanoscience and nanotechnology are the study and application of extremely small things which is about 1 to 100 nanometers and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering.

Nanoscience and nanotechnology involve the ability to see and to control individual atoms and molecules. Everything on Earth is made up of atoms—the food we eat, the clothes we wear, the buildings and houses we live in, and our own bodies.

But something as small as an atom is impossible to see with the naked eye. In fact, it’s impossible to see with the microscopes typically used in a high school science class. The microscopes needed to see things at the nanoscale were invented relatively recently—about 30 years ago. Once scientists had the right tools, such as the scanning tunneling microscope (STM) and the atomic force microscope (AFM), the age of nanotechnology was born.

Today's scientists and engineers are finding a wide variety of ways to deliberately make materials at the nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger-scale counterparts. Nanotechnology is helping to considerably improve, even revolutionize, many technology and industry sectors: information technology, homeland security, medicine, transportation, energy, food safety, and environmental science, and among many others.

Using nanotechnology, materials can effectively be made stronger, lighter, more durable, more reactive, more sieve-like, or better electrical conductors, among many other traits. Many everyday commercial products are currently on the market and in daily use that rely on nanoscale materials and processes.

**What is Biochemistry?**

Biochemistry is the application of chemistry to the study of biological processes at the cellular and molecular level. It emerged as a distinct discipline around the beginning of the 20th century when scientists combined chemistry, physiology and biology to investigate the chemistry of living systems.

Biochemistry is both a life science and a chemical science - it explores the chemistry of living organisms and the molecular basis for the changes occurring in living cells. It uses the methods of chemistry, physics, molecular biology and immunology to study the structure and behaviour of the complex molecules found in biological material and the ways these molecules interact to form cells, tissues and whole organisms.

Biochemists are interested, for example, in mechanisms of brain function, cellular multiplication and differentiation, communication within and between cells and organs, and the chemical bases of inheritance and disease. The biochemist seeks to determine how specific molecules such as proteins, nucleic acids, lipids, vitamins and hormones function in such processes.

Biochemistry has become the foundation for understanding all biological processes. It has provided explanations for the causes of many diseases in humans, animals and plants. It can frequently suggest ways by which such diseases may be treated or cured.

The knowledge and methods developed by biochemists are applied to in all fields of medicine, in agriculture and in many chemical and health related industries. Biochemistry is also unique in providing teaching and research in both protein structure/function and genetic engineering, the two basic components of the rapidly expanding field of biotechnology.

**What is Biotechnology?**

Biotechnology is technology that utilizes biological systems, living organisms or parts of this to develop or create different products.

Brewing and baking bread are examples of processes that fall within the concept of biotechnology [use of yeast (=living organism) to produce the desired product]. Such traditional processes usually utilize the living organisms in their natural form (or further developed by breeding), while the more modern form of biotechnology will generally involve a more advanced modification of the biological system or organism.

With the development of genetic engineering in the 1970s, research in biotechnology (and other related areas such as medicine, biology etc.) developed rapidly because of the new possibility to make changes in the organisms' genetic material (DNA).

Today, biotechnology covers many different disciplines (e.g. genetics, biochemistry, molecular biology, etc.). New technologies and products are developed every year within the areas of e.g. medicine (development of new medicines and therapies), agriculture (development of genetically modified plants, biofuels, biological treatment) or industrial biotechnology (production of chemicals, paper, textiles and food).

**What is genetic engineering?**

Genetic engineering refers to the direct manipulation of DNA to alter an organism’s characteristics (phenotype) in a particular way.

Genetic engineering, sometimes called genetic modification, is the process of altering the [DNA](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)) in an organism’s [genome](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)). This may mean changing one [base pair](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)) (A-T or C-G), deleting a whole region of DNA, or introducing an additional copy of a [gene](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)). Genetic engineering is used by scientists to enhance or modify the characteristics of an individual organism. Genetic engineering can be applied to any organism, from a [virus](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)) to a sheep. For example, genetic engineering can be used to produce plants that have a higher nutritional value or can tolerate exposure to herbicides.

To help explain the process of genetic engineering we have taken the example of insulin, a [protein](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)) that helps regulate the sugar levels in our blood. Normally [insulin?](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)) is produced in the [pancreas?](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)), but in people with type 1 [diabetes](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)) there is a problem with insulin production. People with diabetes therefore have to inject insulin to control their blood sugar levels. Genetic engineering has been used to produce a type of insulin, very similar to our own, from yeast and [bacteria](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)) like [E. coli](javascript:void(%22Click%20to%20expand%20this%20glossary%20term%22)).

**What is Molecular Biology?**

Molecular biology is a branch of science concerning biological activity at the molecular level. The field of molecular biology overlaps with biology and chemistry and in particular, genetics and biochemistry. A key area of molecular biology concerns understanding how various cellular systems interact in terms of the way DNA, RNA and protein synthesis function. The role, function and structure of biomolecules are key areas of focus among biochemists, as is the chemistry behind biological functions and the production of biomolecules.

Molecular biology looks at the molecular mechanisms behind processes such as replication, transcription, translation and cell function. One way to describe the basis of molecular biology is to say it concerns understanding how genes are transcribed into RNA and how RNA is then translated into protein.

**What is Polymer Chemistry?**

Polymer chemistry is the study of the synthesis, characterization and properties of polymer molecules or macromolecules or polymers, which are large molecules composed of repeating chemical subunits known as monomers. The simple reactive molecule from which the repeating structural units of a polymer are derived is called a monomer.

Polymer chemistry can also be included in the broader fields of [polymer science](https://en.wikipedia.org/wiki/Polymer_science) or even [nanotechnology](https://en.wikipedia.org/wiki/Nanotechnology), both of which can be described as encompassing [polymer physics](https://en.wikipedia.org/wiki/Polymer_physics) and [polymer engineering](https://en.wikipedia.org/wiki/Polymer_engineering).

[Polymers](https://en.wikipedia.org/wiki/Polymer) can be subdivided into [biopolymers](https://en.wikipedia.org/wiki/Biopolymers) and [synthetic polymers](https://en.wikipedia.org/wiki/Synthetic_polymers) according to their origin. Each one of these classes of compounds can be subdivided into more specific categories in relationship to their use and properties.

[**Biopolymers**](https://en.wikipedia.org/wiki/Biopolymer) are the structural and functional materials that comprise most of the organic matter in organisms. One major class of biopolymers are [proteins](https://en.wikipedia.org/wiki/Protein), which are derived from [amino acids](https://en.wikipedia.org/wiki/Amino_acid). [Polysaccharides](https://en.wikipedia.org/wiki/Polysaccharide), such as [cellulose](https://en.wikipedia.org/wiki/Cellulose), [chitin](https://en.wikipedia.org/wiki/Chitin), and [starch](https://en.wikipedia.org/wiki/Starch), are biopolymers derived from sugars. The poly[nucleic acids](https://en.wikipedia.org/wiki/Nucleic_acid) [DNA](https://en.wikipedia.org/wiki/DNA) and [RNA](https://en.wikipedia.org/wiki/RNA) are derived from phosphorylated sugars with pendant nucleotides that carry genetic information.

[**Synthetic polymers**](https://en.wikipedia.org/wiki/Synthetic_polymer) are the structural materials manifested in [plastics](https://en.wikipedia.org/wiki/Plastic), [synthetic fibers](https://en.wikipedia.org/wiki/Synthetic_fiber), [paints](https://en.wikipedia.org/wiki/Paint), [building materials](https://en.wikipedia.org/wiki/Building_material), [furniture](https://en.wikipedia.org/wiki/Furniture), mechanical parts, and [adhesives](https://en.wikipedia.org/wiki/Adhesive). Synthetic polymers may be divided into [thermoplastic polymers](https://en.wikipedia.org/wiki/Thermoplastic_polymer) and [thermoset plastics](https://en.wikipedia.org/wiki/Thermoset_plastic). Thermoplastic polymers include polyethylene, [teflon](https://en.wikipedia.org/wiki/Teflon), [polystyrene](https://en.wikipedia.org/wiki/Polystyrene), polypropylene, [polyester](https://en.wikipedia.org/wiki/Polyester), [polyurethane](https://en.wikipedia.org/wiki/Polyurethane), [Poly(methyl methacrylate)](https://en.wikipedia.org/wiki/Poly(methyl_methacrylate)), [polyvinyl chloride](https://en.wikipedia.org/wiki/Polyvinyl_chloride), [nylons](https://en.wikipedia.org/wiki/Nylon), and [rayon](https://en.wikipedia.org/wiki/Rayon). [Thermoset plastics](https://en.wikipedia.org/wiki/Thermoset_plastic) include [vulcanized](https://en.wikipedia.org/wiki/Vulcanization) [rubber](https://en.wikipedia.org/wiki/Rubber), [bakelite](https://en.wikipedia.org/wiki/Bakelite" \o "Bakelite), [Kevlar](https://en.wikipedia.org/wiki/Kevlar) and [polyepoxide](https://en.wikipedia.org/wiki/Epoxide" \o "Epoxide). Almost all synthetic polymers are derived from [petrochemicals](https://en.wikipedia.org/wiki/Petrochemical).