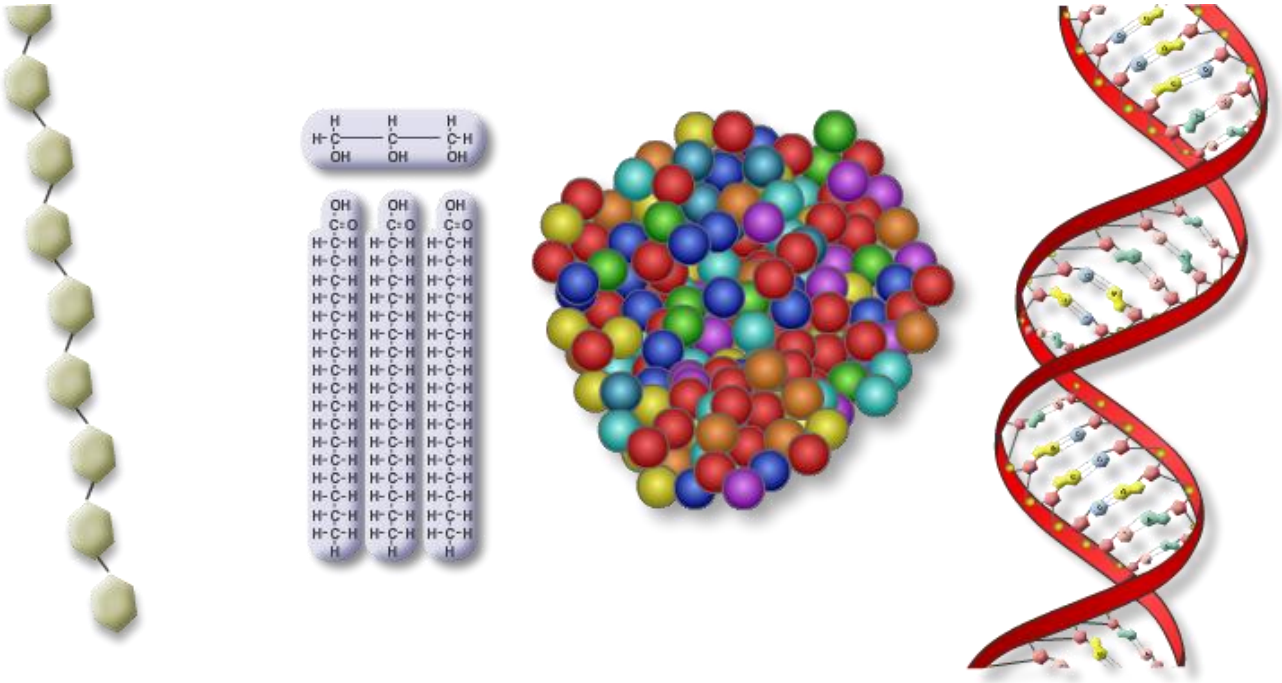
Bio-molecules



Bio-molecules

The living matter is composed of mainly six elements — **carbon**, **hydrogen**, **oxygen**, **nitrogen**, **phosphorus** and **sulfur**. These elements together constitute about 90% of the dry weight of the human body. Several other functionally important elements are also found in the cells. These include Ca, K, Na, Cl, Mg, Fe, Cu, Co, I, Zn, F, Mo and Se.

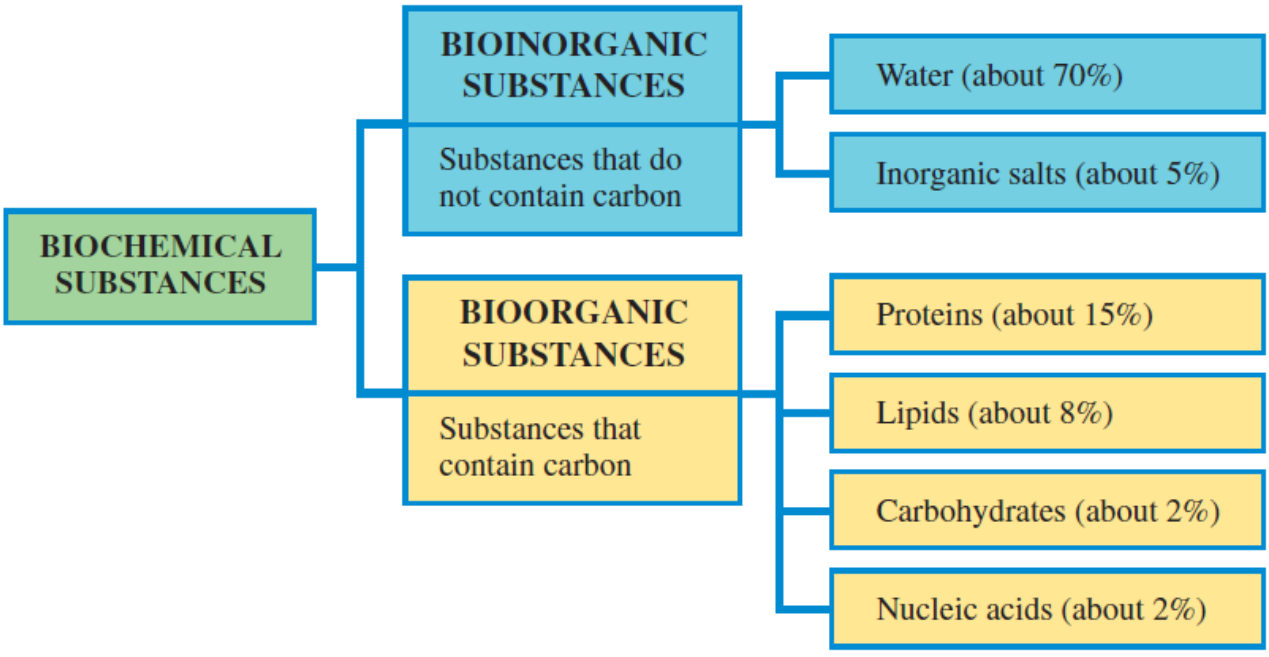
A **biochemical substance** is a chemical substance found within a living organism.

Biochemical substances are divided into two groups:

Bioinorganic substances: include water and inorganic salts.

Bioorganic substances: include carbohydrates, lipids, proteins, and nucleic acids.

The figure below gives an approximate mass composition for the human body in terms of types of biochemical substances present.



Although the human body is usually thought of as containing mainly organic (biochemical) substances, such substances make up only about one-fourth of total

body mass. The bioinorganic substance water constitutes more than two-thirds of the mass of the human body, and another 4%–5% of body mass comes from inorganic salts.

Carbon—a unique element of life

Carbon is the most predominant and versatile element of life. It possesses a unique property to form infinite number of compounds. This is attributed to the ability of carbon to form stable covalent bonds and C-C chains of unlimited length. It is estimated that about **90% of compounds** found in living system invariably **contain carbon**.

Chemical molecules of life

Life is composed of lifeless chemical molecules. A single cell of the bacterium, Escherichia coli contains about 6,000 different organic compounds. It is believed that man may contain about 100,000 different types of molecules although only a few of them have been characterized.

Complex biomolecules with their functions

The organic compounds such as amino acids, nucleotides and monosaccharides serve as the **monomeric units** or building blocks of complex biomolecules—proteins, nucleic acids (DNA and RNA) and polysaccharides, respectively.

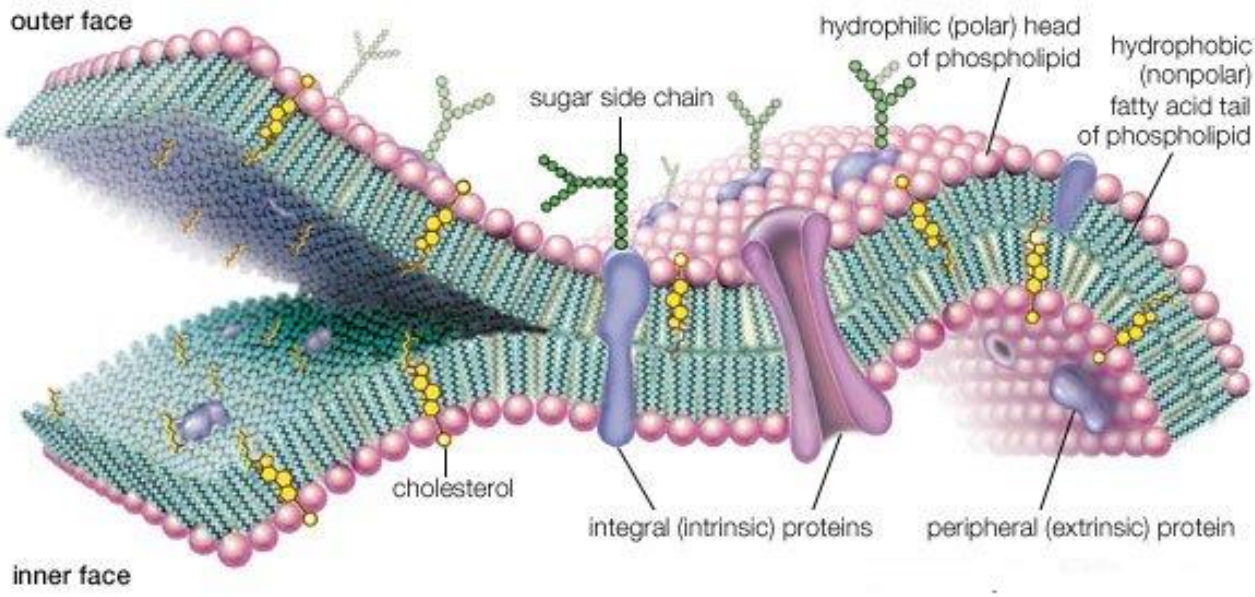
Nucleic acids, namely DNA and RNA, have the unique function of storing an organism's genetic code—the sequence of nucleotides that determines the amino acid sequence of proteins. There are 20 different amino acids that can occur within a protein; the order in which they occur plays a fundamental role in determining protein structure and function .

Proteins themselves are major structural elements of cells. They also serve as transporters, moving nutrients and other molecules in and out of cells, and as enzymes and catalysts for the vast majority of chemical reactions that take place in living organisms. Proteins also form antibodies and hormones, and they influence gene activity.

Likewise, carbohydrates, which are made up primarily of molecules containing atoms of carbon, hydrogen, and oxygen, are essential energy sources and structural components of all life, and they are among the most abundant biomolecules on Earth. They are built from four types of sugar units—monosaccharides, disaccharides, oligosaccharides, and polysaccharides .

Lipids, another key biomolecule of living organisms, fulfill a variety of roles, including serving as a source of stored energy and acting as chemical messengers. They also form membranes, which separate cells from their environments and compartmentalize the cell interior, giving rise to organelles, such as the nucleus and the mitochondrion, in higher (more complex) organisms.

All biomolecules share in common a fundamental relationship between structure and function, which is influenced by factors such as the environment in which a given biomolecule occurs .



The important biomolecules (macromolecules) with their respective building blocks and the summary of their major functions are given in table below.

Biomolecule	Building block (repeating unit)	Major functions
Protein	Amino acids	Fundamental basis of structure and function of cell (static and dynamic functions).
Deoxyribonucleic acid (DNA)	Deoxyribonucleotides	Repository of hereditary information.
Ribonucleic acid (RNA)	Ribonucleotides	Essentially required for protein biosynthesis.
Polysaccharide (glycogen)	Monosaccharides (glucose)	Storage form of energy to meet short term demands.
Lipid	Fatty acids, glycerol	Storage form of energy to meet long term demands; structural components of membranes.

Structural hierarchy of an organism

The macromolecules (proteins, lipids, nucleic acids and polysaccharides) form supramolecular assemblies (e.g. membranes) which in turn organize into organelles, cells, tissues, organs and finally, the whole organism.