

Organic molecules in living organisms



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Organic molecules are the chemicals of life that are found in, and produced by, living organisms. Organic compounds are those that have carbon atoms, inorganic molecules don't have these carbon-hydrogen bonds. There are four main classes of organic molecules are: carbohydrates, lipids, proteins, and nucleic acids.

Carbohydrates have a great responsible in our lives. Carbohydrates are used for storing and transporting energy, maintaining the structure of plants and animals, and in helping the functioning of the immune system, blood clotting, and fertilization and much more. Carbohydrates are classified into three groups according to the number of sugar (or saccharide) molecules present. A prefix indicates the size of the molecule (mono-, di-, tri- poly-). The simplest kind of carbohydrate is a monosaccharide. It is a single sugar molecule, such as a fructose or glucose. A disaccharide consists of two linked sugar molecules. A polysaccharide, a polymer, consists of a series of connected monosaccharides. A polymer being a molecule that consists of a single unit (monomer) repeated many times.

Lipids store energy, protect internal organs, provide insulation in frigid temperatures among other things. Lipids are insoluble in water and very hydrophobic, not attracted to water. The four major groups of lipids include fats, phospholipids, and steroids. Triglycerides include fats, oils, and waxes. Phospholipids look just like lipids except that one of the fatty acid chains is replaced by a phosphate. Steroids are characterized by a backbone of four linked carbon rings.

Eggs, muscles, antibodies, silk, fingernails, and many hormones are things that are partially or entirely proteins. Proteins are polymers composed of monomers called amino acids. The bonds between the amino acids are called peptide bonds, and the chain is a polypeptide. There are 20 different amino acids found in nature.

Nucleic acids are universal in all living organisms. The genetic information of a cell is stored in molecules of deoxyribonucleic acid (DNA). DNA is a polymer of nucleotide. A DNA molecule consists of three parts—a nitrogen base, a five-carbon sugar called deoxyribose, and a phosphate group. There are four DNA nucleotides, each with one of the four nitrogen bases (adenine, thymine, cytosine, and guanine).

Cellular Respiration

We all need energy to function and we get this energy from the foods we eat. Cellular respiration is the process by which the chemical energy of “food” molecules is released and partially captured in the form of ATP. We can divide cellular respiration into three processes: glycolysis, the Krebs cycle, and the electron transport chain. Cellular respiration occurs mostly in a cell's mitochondrion. The chemical equation is:

There is an interrelationship between the processes of photosynthesis and cellular respiration. We use the oxygen given off during photosynthesis; plants use the carbon dioxide given off during cellular respiration.

Glycolysis is the first stage in which glucose molecules are broken down to form pyruvic acid molecules. Glucose, a six carbon sugar, is split into two

molecules of a three carbon sugar. In the process, two molecules of ATP (adenosine triphosphate), two molecules of pyruvic acid and two “ high energy” electron carrying molecules of NADH are produced. The ATP can then be used for processes in the cells that require energy, much as a battery powers a mechanical device.

The Krebs cycle occurs in the mitochondrial matrix and generates a pool of chemical energy (ATP, NADH, and FADH₂) from the oxidation of pyruvate, the end product of glycolysis.

The electron transport chain (ETC) consists of a series of molecules, mostly proteins, embedded in the inner mitochondrial membrane. The electron transport chain allows the release of the large amount of chemical energy stored in reduced NAD⁺ (NADH) and reduced FAD (FADH₂). The energy released is captured in the form of ATP (3 ATP per NADH and 2 ATP per FADH₂).

Cellular Organelles

The cell is the basic unit of life. All living cells can be divided into two groups: prokaryotic and eukaryotic. Prokaryotes include several kinds of microorganisms, such as bacteria. Eukaryotes include fungi, protozoa, and simple algae. Eukaryotic cells are generally larger and more complex than prokaryotic cells. They also contain a variety of cellular bodies called organelles.

Eukaryotic cells come in mainly two types: plant and animal cells. Plant cells, algae, and fungi have cell walls, usually composed of cellulose. But all cells

have a cell membrane, which provides support, protection, controls movement of materials in/out of cell, and barrier between cell and its environment. The nucleus holds DNA and controls cell activities. The Nucleolus is found inside the cell's nucleus and make ribosomes. The nuclear membrane surrounds and controls movement of materials in/out of the nucleus. The cytoplasm holds the organelles found inside cell membrane, it is a thick, jellylike material (cytosol). The Endoplasmic reticulum (ER) is either smooth or rough with embedded ribosomes. It carries materials through cell. Ribosomes are small bodies floating in the cytoplasm either free or attached to ER. They are made of RNA & protein, and synthesize proteins. The Mitochondrion has a double membrane with the inner membrane folded into cristae, it is the site of aerobic cellular respiration. The golgi apparatus is where the cell's proteins and lipids are processed and packaged before being sent to their final destination. Lysosomes are uncommon in plant cells but digests old cell parts. Chloroplast are found only in plant cells and contain chlorophyll (green pigment); the site of photosynthesis.

Prokaryotic cells lack a nucleus, nuclear membrane, endoplasmic reticulum (ER), mitochondrion, golgi apparatus and other membrane-bound organelles. Prokaryotes are probably the smallest living organisms. All prokaryotes have cytoplasm surrounded by a cell membrane. The cytoplasm of prokaryotic cells contains mostly ribosomes. The DNA is contained in the nucleoid. Prokaryotic cells have in their cytoplasm a single, looped chromosome, as well as numerous small loops of DNA called plasmids. Many prokaryotic cells

have at their surface a number of external structures that assist their function and movement such as flagella and pili.

Genetics

Genetics is the study of how genes bring about characteristics, or traits, in living things and how those characteristics are inherited. It was developed by an Augustinian monk Gregor who performed his experiments in the 1860s and 1870s; he believed that factors pass from parents to their offspring. He performed his work with pea plants, studying seven traits: plant height, pod shape, pod color, seed shape, seed color, flower color, and flower location. Over many years, Mendel formulated several principles Mendel's laws of genetics: Mendel's law of dominance, Mendel's law of segregation, and Mendel's law of independent assortment.

The gene is defined as the unit of inheritance. A gene is actually a sequence of DNA arranged along a chromosome. Each species has a genome, or characteristic set of genes, that contains the total genetic information for an individual organism. In many organisms two genes for each trait are present in each individual, and these paired genes, are called alleles. The two allelic genes may be alike (homozygous) or different (heterozygous). Diploid is the term that implies that the cells of plants and animals have two sets of chromosomes. In humans there are 46 chromosomes, or 23 homologous pairs.

In the process of meiosis, by which ova and sperm are produced, the chromosomes in cells are divided so each mature sex cell (gamete) contains half the original number of chromosomes. These cells are haploid, meaning “

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single.” The term implies that each gamete contains a single set of chromosomes. Therefore during reproduction, when two gametes unite, the original diploid condition of 46 chromosomes is reestablished.

The Human Genome Project (HGP) was the international, collaborative research program whose goal was the complete mapping and understanding of all the genes of human beings. The HGP has revealed that there are probably about 20, 500 human genes. The completed human sequence can now identify their locations. This ultimate product of the HGP has given the world a resource of detailed information about the structure, organization and function of the complete set of human genes.

Biotechnology

“ Biotechnology” refers to the use of living organisms or their products to modify human health and the human environment. Humans have used biotechnology since the beginnings of time. Simple things such as planting their own crops and breed their own animals, the discovery that fruit juices fermented into wine or that milk could be converted into cheese or yogurt, or that beer could be made by fermenting solutions of malt and hops. Within the last 100 years biotechnology has morphed to permit scientists to manipulate desired traits. This has resulted in three major branches of biotechnology: genetic engineering, diagnostic techniques, and cell/tissue techniques.

Biotechnology is identical to genetic engineering because the genes of an organism are changed during the process. Because the genes are changed, the DNA of the organism is said to be recombined. The result of the process

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is recombinant DNA. Recombinant DNA and biotechnology can be used to form proteins not normally produced in a cell, to produce drugs or vaccines, or to promote human health. Biotechnology is currently being used in many areas including agriculture, bioremediation, food processing, and energy production. Biotechnology and recombinant DNA can also be used in forensic medicine to “fingerprint” individuals and identify DNA at a crime scene. The basic process of recombinant DNA technology revolves around DNA activity in the synthesis of protein. During this synthesis, DNA provides the genetic code for the placement of amino acids in proteins. By intervening in this process, scientists can change the nature of the DNA, thereby changing the nature of the protein expressed by that DNA.

Although biotechnology has the power to completely change the way humans live, some processes are highly controversial. Research has showed promising hope that neural stem cells (NSCs) might be of benefit to individuals with severe spinal cord injury and other diseases. Humans can also have the genes in their cells modified to produce proteins that relieve health-related deficiencies. But to open up this market would led to other research, into things like selecting genes, and cloning.