Elements of carbohydrates lipids proteins and nucleic acids

At the end of this section you will be able to: Describe the ways in which carbon is crucial for life Explain the impact of small changes in amino acids on organisms Describe the four main types of biological molecules Understand the functions of the four main types of molecules Watch a video about proteins and enzymes Large molecules needed for life, which are built from smaller organic molecules, are called biological macromolecules. There are four main classes of biological macromolecules (carbohydrates, lipids, proteins and nucleic acids), and each is an important part of the cell and performs a wide range of functions. Together, these molecules make up the majority of cellular matter. Biological macromolecules are organic, which means they contain carbon. In addition, they can contain hydrogen, oxygen, nitrogen, phosphorus, sear and other small elements. It is often said that life is based on carbon. This means that carbon atoms, bound to other carbon atoms or other elements, form the basic components of many, if not most, of the molecules found uniquely in living things. Other elements play an important role in biological molecules, but carbon certainly qualifies as the basis element for molecules in living things. It is the bonding properties of carbon atoms that are responsible for its important role. Carbon contains four electrons in the outer manhor. Therefore, it can form four coherent bonds with other atoms or molecules. The simplest molecule of organic carbon is methane (CH_4), in which four hydrogen atoms bind to a carbon atom. Figure 2.12 Carbon can form four covalent bonds to form an organic molecule. The simplest carbon molecule is methane (CH_4), which is shown here. However, structures that are more complex are made using carbon. Any of the hydrogen atoms can be replaced by another carbon atom covalently bound to the first carbon atom. In this way, long and branched chains of carbon compounds can be produced (Figure 2.13 a). Carbon atoms can be associated with atoms of other elements such as nitrogen, oxygen and phosphorus (Figure 2.13 b). Molecules can also form rings that themselves can connect with other rings (Figure 2.13 c). This diversity of molecular forms represents the diversity of functions of biological macromolecules and is largely based on the ability of carbon to form multiple bonds with itself and other atoms. Figure 2.13 These examples show three molecules (found in living organisms) that contain carbon atoms bound in different ways to other carbon atoms and atoms of other elements. (a) This stearic acid molecule has a long chain of carbon atoms. (b) Glycine, a protein component, contains atoms of carbon, nitrogen, oxygen and hydrogen. c) Glucose, sugar, has a ring of carbon atoms and one oxygen atom. Carbohydrates are macromolecules with which most consumers are somewhat familiar. To lose weight, some individuals adhere to low-carb diets. Athletes, in often carb-load before important competitions to ensure that they have enough energy to compete at a high level. Carbohydrates are actually an essential part of our diet; grains, fruits and vegetables are natural sources of carbohydrates. Carbohydrates provide energy to the body, especially through glucose, simple sugar. Carbohydrates also have other important functions in humans, animals, and plants. Carbohydrates can be represented by the formula $(CH_2O)_n$, where n is the number of carbon atoms in the molecule. In other words, the ratio of carbon to hydrogen to oxygen is 1:2:1 in carbohydrate molecules. Carbohydrates are divided into three subtypes: monosaccharides, disaccharides and polysaccharides. Monosaccharides (mono- = one; sucrose- = sweet) are simple sugars, the most common of which is glucose. For monosaccharides, the number of carbon atoms usually ranges from three to six. Most monosaccharide names end with the -axis suffix. Depending on the number of carbon atoms in sugar, they can be known as trioses (three carbon atoms), pentoses (five carbon atoms), and hexoses (six carbon atoms). Monosaccharides can exist as a linear chain or as annial molecules; in aqueous waters are usually found in the form of a ring. The chemical formula for glucose is $C_6H_{12}O_6$. In most living species, glucose is an important source of energy. During cellular respiration, energy is released from glucose, and that energy is used to help adenosine triphosphate (ATP). Plants synthesize glucose using carbon dioxide and water through the photosynthesis process, and glucose is used for the plant's energy requirements. Excess synthesized glucose is often stored as starch, which is divided by other organisms that feed on plants. Galactose (part lactose or milk sugar) and fructose (found in fruit) are other common monosaccharides. Although glucose, galactose and fructose have the same chemical formula ($C_6H_{12}O_6$), they differ structurally and chemically (and are known as isomers) due to the different arrangements of atoms in the carbon chain. Figure 2.14 Glucose, galactose and fructose are isomeric monosaccharides, which means that they have the same chemical formula, but slightly different structures. Disaccharides (di- = two) form when two monosaccharides undergo a dehydration reaction (a reaction in which the water molecule is removed). During this process, the hydroxyl group (-OH) of one monosaccharide is combined with a hydrogen atom of another monosaccharide, releasing a water molecule (H_2O) and forming a kovalent bond between the atoms in both sugar molecules. Common disaccharides include lactose, maltose, and sucrose. Lactose is a disaccharide consisting of monomers of glucose and galactose. It occurs naturally in milk. Maltose, or malt sugar, is a disaccharide created from a dehydration reaction between two glucose molecules. The most common disaccharide is sucrose or table sugar, consists of monomers of glucose and fructose. The long chain of monosaccharides connected by kovalent bindings is known as polysaccharide (poly- = many). The chain can be branched or without branches and can contain different types of monosaccharides. Polysaccharides can be very large molecules. Starch, glycogen, cellulose and chitin are examples of polysaccharides. Starch is a stored form of sugars in plants and consists of amylose and amylopectin (both glucose polymers). Plants are able to synthesize glucose, and excess glucose is stored as starch in different parts of plants, including roots and seeds. Starch, which is consumed by animals, is broken down into smaller molecules such as glucose. The cells can then absorb glucose. Glycogen is a storage form of glucose in humans and other vertebrates and consists of glucose monomers. Glycogen is the animal equivalent of starch and is a highly branched molecule usually stored in the liver and muscle cells. Whenever glucose levels decrease, glycogen is broken down to release glucose. Cellulose is one of the most abundant natural biopolymers. The cell walls of plants are mostly made of cellulose, which provides structural support to the cell. Wood and paper are mostly cellulose in nature. Cellulose consists of glucose monomers, which are connected by links between individual carbon atoms in the glucose molecule. Each additional glucose monomer in cellulosis flips over and wraps tightly like elongated long chains. It gives cellulosis its firmness and high tensile strength–which is so important to plant cells. Cellulose passing through our digestive system is called fiber. While glucose bonds in cellulose cannot be broken down by human digestive enzymes, herbivores such as cows, buffaloes and horses are able to digest grass that is rich in cellulose and use it as a food source. In these animals, some types of bacteria are found in the rumen (part of the digestive system of herbivores) and secrete the cellulella enzyme. The supplement also contains bacteria that break down cellulose, which gives it an important role in the digestive system of the reeds. Cellulose can break down cellulose into glucose monomers, which the animal can use as an energy source. Carbohydrates serve additional functions in different animals. Arthropods, such as insects, spiders and crabs, have an external skeleton, called an exoskeleton, that protects their internal parts of the body. This exoskeleton is made from biological macromoleclic chitin, which is a nitrogenous carbohydrate. It is made from recurrent units of modified sugar containing nitrogen. Thus, due to differences in molecular structure, carbohydrates are able to serve very different functions of energy storage (starch and glycogen) and structural support and protection (cellulose and chitin). Figure 2.15 Although their structures and functions differ, all polysaccharide carbohydrates are monosaccharides and have formula $(CH_2O)_n$. Registered dietitian: Obesity is a global health problem and many diseases, such as diabetes and heart disease, are becoming more common due to obesity. This is one of the reasons why registered dieticians are increasingly sought for advice. Registered dieticians help plan food and nutrition programs for individuals in different environments. They often work with patients in medical institutions and propose nutrition plans for the prevention and treatment of diseases. For example, dietitians can teach a patient with diabetes how to manage blood sugar levels by eating the right types and amounts of carbohydrates. Dietitians can also work in nursing homes, schools and private practice. To become a registered dietitian, you need to obtain at least a bachelor's degree in dietetics, nutrition, food technology or related field. In addition, registered dieticians must complete a supervised traineeship programme and pass the state examination. Those who pursue a career in dietetics take courses in nutrition, chemistry, biochemistry, biology, microbiology and human physiology. Dietitians must become experts in the chemistry and function of food (proteins, carbohydrates, and fats). Lipids include a diverse group of compounds that are connected by a common feature. Lipids are hydrophobic (fear of water) or insoluble in water because they are nonpolar molecules. This is because these are hydrocarbons that only include non-global carbon-carbon or carbon-hydrogen bonds. Lipids perform many different functions in a cell. Cells store energy for long-term use in the form of lipids called fats. Lipids also provide isolation from the environment for plants and animals. For example, they help keep water birds and mammals dry because of their water-repellent nature. Lipids are also the building blocks of many hormones and are an important component of the plasma membrane. Lipids include fats, oils, waxes, phospholipids, and steroids. Figure 2.16 Hydrophobic lipids in the fur of aquatic mammals, such as this otter, protect them from the elements. A fat molecule, such as triglycerides, consists of two main components – glycerol and fatty acids. Glycerol is an organic compound with three carbon atoms, five hydrogen atoms and three hydroxyl (-OH) groups. Fatty acids have a long chain of hydrocarbons, to which an acidic carboxylic group is attached, hence the name fatty acid. The number of carbons in fatty acids can range from 4 to 36; the most common are those containing 12-18 carbons. In a fat molecule, fatty acid is attached to each of the three oxygen atoms in the -OH group of glycerol molecules with kovalent bonds. Figure 2.17 Lipids include fats such as triglycerides that hide from fatty acids and glycerol, phospholipids, and steroids. During this formation of a kovalent bond, three water molecules are released. The three fatty acids in fat may be similar or different. These fats are also called triglycerides because they have fatty acids. Some fatty acids have common names that determine their origin. For example, palmitic acid, a lactated fatty acid, is derived from palm trees. Arachic acid is derived from Arachis hypogaea, the scientific name for peanuts. Fatty acids can be saturated or unsaturated. In the fatty acid chain, if there are only individual links between adjacent carbons in the hydrocarbon chain, the fatty acid is carbonated. Saturated fatty acids are saturated with hydrogen; in other words, the number of hydrogen atoms attached to the carbon skeleton is maximized. If the hydrocarbon chain contains a double bond, the fatty acid is an unsaveable fatty acid. Most unsathed fats are liquid at room temperature and are called oils. If there is one double bond in the molecule, then it is known as monoused fat (e.g. olive oil) and if there is more than one double bond, then it is known as polyused fat (e.g. rapeseed oil). Saturated fats tend to wrap tightly and are firm at room temperature. Animal fats with stearic acid and palmitic acid contained in meat and fat with butyric acid contained in butter are examples of salinated fats. Mammals store fats in specialized cells called adipocytes, where fat globules occupy most of the cell. In plants, fat or oil is stored in seeds and used as a source of energy during embryonic development. Unsaturated fats or oils are usually of vegetable origin and contain unsaturated fatty acids. Double binding causes bending or breakage, which prevents fatty acids from wrapping tightly and keeping them liquid at room temperature. Olive oil, corn oil, rapeseed oil, and cod liver oil are examples of unsathed fats. Unsaturated fats help improve blood cholesterol levels, while saturated fats contribute to the formation of plaque in the arteries, which increases the risk of heart attack. In the food industry, oils are artificially hydrogenated to be semi-solid, resulting in less production and longer shelf life. Simply put, hydrogen gas is bubbling through oils to solidify them. During this hydrogenation process, double cis-conformation bonds in the hydrocarbon chain can be converted into double bonds in transconformation. It forms a trans fat of cis-fat. The orientation of double bonds affects the chemical properties of fat. Figure 2.18 During the hydrogenation process, the orientation around the double bonds changes, making the trans fat from cis-fat. This changes the chemical properties of the molecule. Margarine, some types of peanut butter, and shortening are examples of artificially hydrogenated trans fats. Recent studies have shown that increasing trans fats in the human diet can lead to an increase in low density lipoprotein (LDL) levels, or bad cholesterol, which, in turn, can lead to plaque deposits in arteries, leading to heart disease. Many fast food restaurants have recently eliminated the use of trans fats, and American food labels are their trans fat content. Essential fatty acids are fatty acids that are required but not synthesized by the human body. As a result, they must be supplemented through a diet. Omega-3 fatty acids fall into this category and are one of only two known essential fatty acids for humans (the others are omega-6 fatty acids). It is a type of polynessed fat and is called omega-3 fatty acids because the third carbon from the end of fatty acids is involved in double binding. Salmon, trout and tuna are good sources of omega-3 fatty acids. Omega-3 fatty acids are important for brain function and normal growth and development. They can also prevent heart disease and reduce the risk of cancer. Like carbohydrates, fats have received a lot of bad publicity. It is true that eating excess fried foods and other fatty foods leads to weight gain. However, fats have important functions. Fats serve as long-term energy storage. They also provide insulation for the body. Therefore, healthy unsaturated fats in moderate amounts should be consumed regularly. Phospholipids are the main component of the plasma membrane. Like fats, they are composed of fatty acid chains attached to glycerol or similar spine. Instead of the three fatty acids attached, however, there are two fatty acids and a third carbon glycerol spine is bound to the phosphate group. The phosphate group is changed by the addition of alcohol. Phospholipid has hydrophobic and hydrophilic areas. Fatty acid chains are hydrophobic and are excreted from water, while phosphate is hydrophilic and interacts with water. The cells are surrounded by a membrane that has a double top of phospholipids. Phospholipid fatty acids are directed inwards, out of water, while the phosphate group can face either the external environment or the inside of the cell, which are both aqueous. Unlike phospholipids and fats discussed before, steroids have a ring structure. Although they do not resemble other lipids, they are grouped with them, because they are also hydrophobic. All steroids have four, joined carbon rings and several of them, like cholesterol, have a short tail. Cholesterol is a steroid. Cholesterol is mainly synthesized in the liver and is a precursor to many steroid hormones such as testosterone and estradiol. It is also a precursor to vitamins E and K. Cholesterol is a precursor to bile salts that help in fat loss and their subsequent absorption by cells. Although cholesterol is often spoken in a negative sense, it is necessary for the proper functioning of the body. It is a key component of the plasma membranes of animal cells. Waxes are associated from the hydrocarbon chain with the alcohol group (-OH) and fatty acids. Examples of animal waxes include beeswax and lanolin. Plants also have waxes, such as a coating on their leaves, which helps prevent them from icing out. For another look at the Explore Biomolecules: Lipids through this interactive animation. Proteins are one of the most abundant organic molecules in living systems and have a variety of functions of all macromolecules. Proteins can be structural, regulatory, contractile or protective; can be used in transport, storage or membranes; or may be toxins or enzymes. Each cell in a living system can contain thousands of different proteins, each of which has a unique function. Their structures, as well as their functions, vary greatly. However, they are all polymers of amino acids, arranged in linear order. Protein functions are very diverse because there are 20 different chemically distinct amino acids that make up long chains and amino acids can be in any order. For example, proteins can act as enzymes or hormones. Enzymes produced by living cells are catalysts in biochemical reactions (such as digestion) and are usually proteins. Each enzyme is specific to the substrate (reactant that binds to the enzyme) to which it acts. Enzymes can work by breaking molecular bonds, reorganizing bonds, or creating new bonds. An example of an enzyme is salivary amylase, which decomposes amylose, part of starch. Hormones are chemical signaling molecules, usually proteins or steroids, secreted endocrine glands or groups of endocrine cells that act to control or regulate specific physiological processes, including growth, development, metabolism, and reproduction. For example, insulin is a protein hormone that maintains blood glucose levels. Proteins have different shapes and molecular weights; some proteins have a spherical shape, while others are fibrous in nature. For example, hemoglobin is a globular protein, but collagen, found in our skin, is a fibrous protein. The shape of protein is crucial for its function. Changes in temperature, pH and exposure to chemicals can lead to permanent changes in the shape of the protein, leading to loss of function or denaturing (discussed in more detail later). All proteins are taken from different arrangements of the same 20 types of amino acids. Amino acids are monomers that make up proteins. Each amino acid has the same basic structure, consisting of a central carbon atom bound to the amino group ($-NH_2$), a carboxyl group (-COOH) and a hydrogen atom. Each amino acid also has another variable atom or group of atoms bound to a central carbon atom known as group R. Group R is the only difference in structure between 20 amino acids; otherwise, the amino acids are identical. Figure 2.19 Amino acids shall be made up of central carbon bound to the amino group ($-NH_2$), carboxyl group (-COOH) and hydrogen atom. The fourth bond of central carbon varies between different amino acids, as can be seen in these examples of alanine, valine, lysine and aspartic acid. The chemical nature of group R determines the chemical nature of the amino acid in its protein (that is, is acidic, basic, polar or non-polar). The sequence and number of amino acids eventually determine the shape of the protein, size, and function. Each amino acid is attached to another amino acid by a kovalent bond, known as a peptide bond, which is formed by a dehydration reaction. The carboxyl group of one amino acid and the amino group of the other amino acids combine to release the water molecule. The resulting binding is a peptide binding. Products formed by such a connection are called polypeptides. While the terms polypeptide and protein are sometimes used interchangeably, polypeptide is technically a polymer of amino acids, while the term protein is used for polypeptides or polypeptides that come together, have a different shape, and have a unique function. The evolutionary significance of cytochrome cCytochrome c is an important part of molecular machines that take energy from glucose. Since the role of this protein in the production of cellular energy is essential, it has changed very little over millions of years. Protein sequencing has shown that there is a significant similarity of sequences between cytochrome c molecules of different species; evolutionary relationships can be assessed by measuring similarities or differences between protein sequences of different species. For example, scientists have found that human cytochrome c contains 104 amino acids. For each cytochrome c molecule that has been sequenced from different organisms so far, 37 of these amino acids appear in the same position in each cytochrome c. This means that all these organisms are descendants of a common edite. No sequential difference was found when comparing human and chimpanzee protein sequences. When the sequences of human and rhesus monkeys were compared, a single difference was found in one amino acid. By contrast, comparisons between humans and yeast show a difference in 44 amino acids, suggesting that humans and chimpanzees have a newer common edivar than humans and rhesus monkeys or humans and yeasts. As previously described, the shape of the protein is crucial for its function. In order to understand how a protein acquires its final shape or conformation, we need to understand four levels of protein structure: primary, secondary, tertiary and quaternary. The unique sequence and number of amino acids in the polypeptide chain is its primary structure. The unique sequence for each protein is ultimately determined by the gene that encodes the protein. Any change in the gene sequence can lead to the addition of another amino acid to the polypeptide chain, causing a change in the structure and function of the proteins. With sickle cell anaemic disease, hemoglobin has β a single substitution of amino acids, causing a change in the structure and function of the protein. What is most remarkable to consider is that the hemoglobin molecule consists of two alpha chains and two beta chains, each consisting of about 150 amino acids. Thus, the molecule has about 600 Acid. The structural difference between normal hemoglobin molecules and sickle cell molecules, which dramatically reduces life expectancy in affected individuals, is a single amino acid of 600. Due to this change in one amino acid in the chain, normally biconcaual, or disk-shaped, red blood cells assume a crescent or sickle shape that clos the arteries. This can lead to a myriad of serious health problems such as shortness of breath, dizziness, headaches and abdominal pain for those who have this disease. Folding patterns resulting from interactions between parts of amino acids outside group R lead to a secondary protein structure. The most common are alpha (α)-helix and beta (β)-sheet metal structures. Both structures are held in the form of hydrogen bonds. In alpha helix, bonds form between every fourth amino acid and cause twisting in the chain of amino acids. In β-folded sheet, folds are formed by hydrogen bonding between atoms on the spine of the polypeptide chain. Groups R are attached to embers and extend above and below the folds of the fold. The stacked segments align with each other and hydrogen bonds form between the same pairs of atoms on each aligned amino acid. A-helix and β-sheet metal structures are found in many spherical and fibrous proteins. The unique three-dimensional structure of the polypeptide is known as its tertiary structure. This structure is caused by chemical interactions between different amino acids and areas of the polypeptide. In particular, interactions between groups R create a complex three-dimensional tertiary structure of the protein. There may be ionic bonds formed between groups of R on different amino acids, or hydrogen bonding beyond what are involved in secondary structures. When protein is folded, hydrophobic R groups of nonpolar amino acids lay in the interior of the protein, while hydrophilic groups R lay on the outside. The first types of interactions are also known as hydrophobic interactions. In nature, some proteins are made up of several polypeptides, also known as subunits, and the interactions of these subunits form a quaternit structure. Weak interactions between subunits help stabilize the overall structure. For example, hemoglobin is a combination of four polypeptide subunits. Figure 2.20 In these pictures, four levels of protein structure can be observed. Each protein has its own unique sequence and shape that holds together chemical interactions. When a protein is exposed to changes in temperature, pH or exposure to chemicals, the structure of the protein may change and lose its shape in what is known as denaturing as described above. Denaturing is often reversible, since the primary structure is preserved if the denaturing agent is removed, allowing the protein to restore its function. Sometimes denaturing is irreversible, which leads to loss of function. One example Denaturing can be seen when the egg is fried or boiled. The albumin protein in the liquid egg white is denatured when placed in a hot pan and changes from a clear substance to an opaque white substance. Not all proteins are denatured at high temperatures; for example, bacteria that survive in hot springs have proteins that are adapted to function at these temperatures. For another look at proteins, explore Biomolecules: Proteins through this interactive animation. Nucleic acids are key macromolecules in the continuity of life. They carry the genetic plan of the cell and carry instructions for the functioning of the cell. The two main types of nucleic acids are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). DNA is genetic material found in all living organisms, from single-celled bacteria to multi-celled mammals. The second type of nucleic acid, RNA, is mostly involved in protein synthesis. DNA molecules never leave the nucleus, but instead use an RNA intermediary to communicate with the rest of the cell. Other types of RNA are also involved in protein synthesis and regulation. DNA and RNA come from monomers known as nucleotides. Nucleotides combine to form polynucleotide, DNA or RNA. Each nucleotide consists of three components: nitrogen base, pentose (five-carbon) sugar and phosphate group . Each nitrogen base in the nucleotide is attached to a sugar molecule that is attached to the phosphate group. Figure 2.21 Nucleotide consists of three components: nitrogen base, pentose sugar and phosphate group. DNA has a double helix structure. It consists of two strands, or polymers of nucleotides. The strands are formed by links between phosphate and sugar groups of adjacent nucleotides. The strands are connected to each other on their foundations by hydrogen bindings, and the strands wind each other along their entire length, and therefore the description of the double helix, which means a double spiral. Figure 2.22 Chemical structure of DNA with a colour label identifying four bases, as well as phosphate and deoxyribose components of the spine. Alternating sugar and phosphate groups lie on the outside of each strand and form the backbone of DNA. Nitrogen bases are loaded in the interior, as well as the steps of the staircase, and these bases pair; pairs are bound to each other by hydrogen ties. The basics are paired so that the distance between the spines of both strands is the same throughout the molecule. As a rule, nucleotide A is paired with nucleotide T and G with C, see section 9.1 for more information. Living things are carbon-based because carbon plays such an important role in the chemistry of living things. Four coherent bonding positions of a carbon atom can lead to a wide variety of compounds with many functions, representing the importance of carbon in living things. Carbohydrates are a group of which are a vital source of energy for the cell, provide structural support to many organisms and can be found on the surface of the cell as receptors or for cell recognition. Carbohydrates are classified as monosaccharides, disaccharides and polysaccharides, depending on the number of monomers in the molecule. Lipids are a class of macromolecules that are non-dolary and hydrophobic in nature. The main types include fats and oils, waxes, phospholipids, and steroids. Fats and oils are a stored form of energy and may include triglycerides. Fats and oils are usually merged from fatty acids and glycerol. Proteins are a class of macromolecules that can perform a diverse range of functions for a cell. They help in metabolism by providing structural support and acting as enzymes, carriers or as hormones. The building blocks of protein are amino acids. Proteins are organized on four levels: primary, secondary, tertiary and quaternary. The shape and function of proteins are intricately linked; any change in shape caused by changes in temperature, pH or chemical exposure may lead to protein denaturing and loss of function. Nucleic acids are molecules formed by recurrent units of nucleotides that control cellular activities such as cell division and protein synthesis. Each nucleotide consists of pentose sugar, nitrogen base and phosphate group. There are two types of nucleic acids: DNA and RNA. An example of a monosaccharide is ______. Fructose glucose galactose all of the above cellulose and starch are examples _____. monosaccharides disaccharides lipids polysaccharides Phospholipids are important components ___. Plasma membrane cells ring structure of steroids wax covering on the leaves of double bonds in hydrocarbon chains Monomers that make up proteins are called ___. Nucleotides disaccharides amino acids&nbs chaperone explain at least three functions that lipids serve in plants and / or animals. Explain what happens when even one amino acid is replaced by another in the polypeptide chain. Give a specific example. Answers D D A C Fat serves as a valuable way for animals to store energy. It can also provide insulation. Phospholipids and steroids are important components of cell membranes. Changing the gene sequence can lead to the addition of another amino acid to the polypeptide chain instead of the normal one. This causes a change in the structure and function of proteins. For example, in sickle cell anaemic anaemic, hemoglobin β a single substitution of amino acids. Because of this change, disc-shaped red blood cells assume a crescent shape, which can result in serious health problems. amino acid: protein carbohydrate monomer: a biological macromomole in which the ratio of carbon to hydrogen and oxygen is 1:2:1; Carbohydrates serve as energy sources and structural support in cellulose cells: polysaccharide, which forms the cell walls of plants and provides structural support for cell chitin: and carbohydrates that form the outer skeleton of arthropods, such as insects and crustaceans, and cell walls of fungi denaturing: loss of shape in protein due to changes in temperature, pH or exposure to deoxyribonucleic acid (DNA) chemicals: a two-strand nucleotide polymer that carries hereditary information on cellular disaccharide: two sugars that are linked by a peptide binding enzyme : a catalyst in a biochemical reaction that is usually complex or conjugated protein fat : a lipid molecule composed of three fatty acids and glycerol (triglycerides), which usually exists in solid form at room temperature glycogen: carbohydrate storage in animals hormone: chemical signalling molecule, usually protein or steroid, secreted by the endocrine gland or a group of endocrine cells; acts on the control or regulation of specific physiological processes of lipids: a class of macromolecules that are non-dolary and insoluble in water macromolecule: a large molecule, often formed by polymerization of smaller monomers of the monosaccharide: one unit or monomer of carbohydrates of nucleic acid: a biological macromolecule that carries the genetic information of the cell and carries instructions for the functioning of cell nucleotide acid : monomer nucleic acid; contains pentose sugar, phosphate group and nitrogen base oil: unsathed fat, which is a liquid at room temperature of phospholipide: the main component of cell membranes; consists of two fatty acids and a phosphate group attached to glycerol spinal polypeptide: a long chain of amino acids connected by peptide bindings of polysaccharide: a long chain of monosaccharides; may be a forked or unsent protein: a biological macromomolecula composed of one or more ribonucleic ribonucleic acid (RNA) chains: a single-fibre nucleotide polymer that is involved in the synthesis of rich fatty acid proteins: a long-chain hydrocarbon hydrocarbon with single-stage links in the carbon chain; the number of hydrogen atoms attached to the carbon skeleton is maximized by starch: storage of carbohydrates in steroid plants: a type of lipid composed of four fused hydrocarbon rings of trans fats: a form of unsaten fats with hydrogen atoms adjacent to the double bonds across from each other, rather than on the same side of the double bond of triglycerides: a fat molecule; consists of three fatty acids associated with an unsaturated fatty acid glycerol molecule: a long-chain hydrocarbon that has one or more double doses in the Media Attribution Attribution hydrocarbon chain

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