Structure and function of biomolecules

All Biomolecules have certain functions and these molecules all have a unique structure which is why they function in these ways. These molecules are known collectively as macromolecules, these molecules are grouped into four main categories which each have their own structure. These structures are the key to the macromolecules functions as each of them do a specific task in the body.

Macromolecules are grouped into carbohydrates, nucleic acids, proteins, and lipids. In most cases macromolecules are polymers, which is a long molecule which are made by linking together a large number of small, similar compounds called monomers. Polymers are formed by a dehydration reaction, this happens by the -OH group being removed from one monomer, and a hydrogen atom (H) is removed from the other monomer, then the polymer is formed (as shown in Figure 1).

This reaction is also used in the linking of fatty acids to glycerol in lipids. This reaction is referred to as a condensation or dehydration reaction, because the reaction produces a water molecule from the -OH and -H groups removed, and for each monomer that is added a water molecule is given off. The opposite reaction is the hydrolysis reaction which breaks down polymer to there respective monomers. Water is added to the macromolecule splitting the bonds between the monomers and the -OH and -H are attached to form the monomers (as in Figure 2).

Carbohydrates

Carbohydrates are a group of molecules made of carbon, hydrogen, and oxygen in a molar ratio 1: 2: 1. Carbohydrates have a general formula of $(CH2O)n$, where n is the number of carbon atoms. These carbohydrates contain a lot of carbon-hydrogen bonds, which releases energy when oxidation occurs, as carbohydrates are well suited for energy storage. Sugars are some of the most important energy sources and they exist in several different forms, such as monosaccharides, disaccharides and polysaccharides. Monosaccharides are the simplest of carbohydrates, they may contain as few as three carbons but the ones that have a key role in energy storage have six carbons. Disaccharides serve as transport molecules in plants and provide nutrition in animals; they are used by plants for transporting glucose around the plant as disaccharides are not easily metabolised, but disaccharides are usually consumed by humans and animals. Polysaccharides provide energy storage, such as starch consists entirely of Î±-glucose molecules linked in a long chain. Cellulose is a structural polysaccharide which also consists of glucose linked in long chains, but these molecules are Î²-glucose. Carbohydrates are used as a source of energy for processes in the body such as muscle movement (Raven et al 2008).

Proteins

Proteins are linear polymers made up of a combination of 20 different amino acids, which contain amino group (-NH2) as well as an acidic carboxyl group (-COOH). The specific order of amino acids determines the proteins structure and function. The amino and acid carboxyl group go through a dehydration reaction to form a peptide bond which joins the amino acids together to form proteins. Proteins have many different functions which are placed into seven categories; Enzyme catalysis, Support, Defence, Motion, Transport, Regulation and Storage. Enzyme catalysis is when enzymes which are globular proteins with a three-dimensional shape that fit around some molecules to facilitate chemical reactions (Raven et al 2008). Support proteins fibres play a structural role, these fibres include keratin in hair fibrin in blood clots and collagen which forms the matrix of skin, ligaments, tendons, and bones, and is the most abundant protein in a vertebrate body (Raven et al 2008). Defence proteins are globular and use there shape to " recognise" foreign microbes and cancer cells, these cell-surface receptors are from the core of the body's endocrine and immune system (Raven et al 2008). Muscles contract through the sliding motion of two kinds of protein filaments: actin and myosin (Raven et al 2008). A variety of globular proteins transport small molecules and ions. The transport protein Haemoglobin, for example, transports oxygen in the blood stream (Raven et al 2008). Small proteins called hormones serve as intercellular messengers in animals. Proteins also play many regulatory roles within the cell-turning on and shutting off genes during development (Raven et al 2008). Calcium and iron are stored by binding as ions to storage proteins (Raven et al 2008).

Lipids

Lipids are varied in structure and function, most of them are non soluble in water. Lipids have a very high proportion of nonpolar carbon-hydrogen bonds; so long chain lipids cannot fold up like a protein to sequester their nonpolar portions away from the surrounding aqueous environment. Lipids are hydrophobic so when they are exposed to water there hydrophilic (polar) sections of the lipids cluster together while the hydrophobic (nonpolar) sections gather together with the inside the polar sections to stay away from the water. Fats and oils are a type of lipid which are formed from glycerol and three fatty acids. Fatty acids are long chain hydrocarbons with a carboxylic acid (COOH) at one end. Fats and oils, also known as triglycerides, can be saturated where the fatty acids contain at least one carbon to carbon double bond or they can be unsaturated which means there are no double bonds. Phospholipids are also lipids and they are composed of a polar head, a phosphate group, glycerol, and two fatty acids. Phospholipids form the cell membranes and they use the previously mentioned method for holding together cells. The hydrophobic heads gather towards the water inside and outside the cell forming the membrane, which certain molecules can go through to get inside or outside the cell.

Nucleic Acids

Nucleic acids are polymers of nucleotides and each nucleotide is made up of a sugar, a base and a phosphate group. Nucleic acids are the information carrying devices of each cell containing the code for all proteins. There are two main forms of nucleic acid which are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). Unique among macromolecules, nucleic acids are able to serve as a template to produce a perfect replicate of it. DNA is usually found in the nucleus of cells, which contains the genetic information necessary to build specific organisms (Raven et al 2008). Cells use RNA to read the DNA's encoded information and to direct the creation of the proteins. RNA and DNA are similar in structure and consist of duplicate copies of parts of DNA. The duplicates serve as a blueprint specifying the amino acid sequences of the proteins. In addition to serving as subunits of DNA and RNA, nucleotide bases play other critical roles in the life of a cell. For example adenine is a key component of the molecule adenosine triphosphate (ATP), the energy currency of a cell (Raven et al 2008). Two other important nucleotide-containing molecules are nicotinamide adenine dinucleotide (NAD+) and flavin adenine dinucleotide (FAD). These molecules function as electron carriers in a variety of cellular processes (Raven et al 2008).

So Biomolecules have certain functions which they carry out in the body because of there unique structures. These structures are unique as they contain certain bonds between molecules which are all formed in similar reactions. But the four groups of macromolecules are formed in similar reactions, dehydration and hydrolysis reactions, but they all act in different ways.