Mon Tue Wed Thu Fri Sat Sun

Date

General Science & Ability
Assignment #1

Topic:
Classification/Types of Carbohydrates/ Proteins and Fats..... Definitions/Characteristics and Examples.

1. CARBOHYDRATES:

Definition: Carbohydrates are organic compounds made up of the elements carbon, hydrogen and oxygen. The hydrogen and oxygen atoms are present in the ratio 2:1.

Characteristics:

Carbohydrates, also called sugars, are naturally occuring sweetners. They are generally soluble in water except polysaccharides. It means that when dissolved in water, they will lower the water potential of the solution. They contain the carbon, hydrogen and oxygen atoms in the ratio 1:2:1 and thus have the chemical formula as $(CH_2O)_n$.

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Mon Tue Wed Thu Fri Sat Sun

Date

Classification of Carbohydrates:

Carbohydrates can be classified into monosaccharides, disaccharides and polysaccharides.

- **Monosaccharides:**

Monosaccharides is a Greek word – "monos" meaning "single" and "sachar" meaning "sugar." Monosaccharides or single sugars are small molecules that cannot be further digested into smaller molecules. They are the fundamental units, or building blocks, that make up other carbohydrates. They typically have a chain of carbon atoms linked together called a "carbon backbone." These single sugars can pass through cell membranes and be absorbed into the cells. The common single sugars are **glucose, fructose** and **galactose**. Glucose, also called blood sugar, is the most abundant monosaccharide in the human body. Fructose is most abundant in fruits. Galactose is present in milk sugar in mammals. These single sugars have the same chemical formula, $C_6H_{12}O_6$, but their atoms are arranged differently within the molecules giving them different chemical and biological properties.

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Mon Tue Wed Thu Fri Sat Sun

Date

- **Disaccharides:**

A disaccharide or a double sugar is formed when two monosaccharides are bonded together. The process of linking the two monosaccharide molecules together to form a disaccharide molecule removes a hydrogen atom and an oxygen bonded to a hydrogen (-OH). This process is called dehydration synthesis because the atoms removed from the sugar bond to form water. Disaccharides are also soluble in water but they are too big to pass through the cell membrane by diffusion.

There are three common disaccharides; **lactose, sucrose** and **maltose**. Maltose consists of two glucose molecules bonded together. It occurs in germinating grains and is also called malt sugar. Sucrose consists of a glucose and a fructose molecule combined. It is also called cane sugar or table sugar. Lactose, also called milk sugar, is formed from a glucose and a galactose molecule combined.

Also draw the structures

- **Polysaccharides:**

Polysaccharides are the most abundant carbohydrates in nature. They serve as reserve

Also add the sources separately

Mon Tue Wed Thu Fri Sat Sun

Date

food or energy storage. They are composed of hundreds or thousands of monosaccharide units linked together to form a long molecule. Starch, glycogen and cellulose are polysaccharides, or complex carbohydrates, made up of numerous glucose molecules. The glucose molecules are linked in different ways, giving rise to different structures with different chemical and biological properties. Starch is a storage form of carbohydrates in plants and is the most important source of carbohydrates in the human diet. Glycogen, also called animal starch, is the storage form of carbohydrates in animals. Cellulose is the structural component of plant cell walls.

2. PROTEINS:

Definition: Proteins are organic molecules made up of carbon, hydrogen, oxygen and nitrogen. Other elements, such as phosphorus, sulphur, iron, copper, iodine and zinc may also be present.

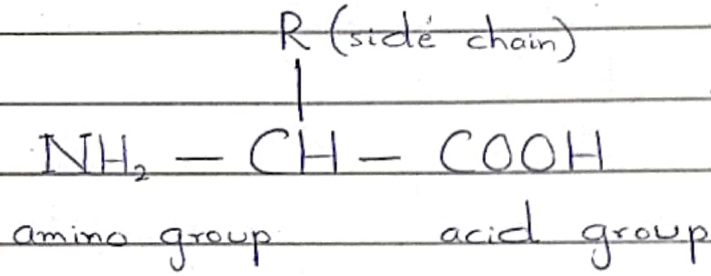
A protein molecule is built up from simpler compounds known as amino acids linked

AGP

Mon Tue Wed Thu Fri Sat Sun

Date

together by peptide bonds. An amino acid is made up of an amino group ($-NH_2$), an acidic group (-COOH), and a side chain (denoted by R). R may sometimes contain sulphur, acidic groups, amino groups, and/or hydroxyl groups in place of one or more hydrogen atoms. The general formula of an amino acid is:



Characteristics:

Proteins are the polymers of amino acids. They are colourless and tasteless. The solubility of proteins depends on the pH, that is, solubility increases with the increase in acidity or alkalinity. Moreover, proteins are high molecular weight biomolecules. There are 10,000 different kinds of proteins in human body. There are twenty different naturally occuring amino acids that are combined in various ways to form millions of different 3-D shaped protein molecules. Proteins contain the elements

AGP

Mon Tue Wed Thu Fri Sat Sun

Date

carbon, hydrogen, oxygen and nitrogen. They may also contain phosphorus, iron, copper, iodine, sulphur and zinc.

Classification of Proteins:

- **On the basis of physical-chemical properties:**

(i) Simple proteins:

Simple proteins are made up of only one type of amino acid as their structural component. They are mostly globular type of proteins. They are the most abundant protein in animal kingdom. Examples include albumin, globulin, collag[illegible] etc.

(ii) Compound or Conjugated Proteins:

They are the proteins which are attached to some non-protein groups (prosthetic groups). For example, phospho-protein, lipo-protein, etc.

(iii) Derived Proteins:

Derived proteins are derived from simple or conjugated proteins from the action of heat, enzyme or chemical agents. Examples include proteases, enzyme peptones, oligo peptides, etc.

AGP

Mon Tue Wed Thu Fri Sat Sun

Date

- **On the basis of the structure:**

(i) **Primary Proteins:**

Primary proteins consist of the chain of amino acids forming a linear structure. The amino acids are linked up by peptide bonds to form a polypeptide chain.

(ii) **Secondary Proteins**

The linear, unfolded structure of polypeptide chain assumes helical shape to produce the secondary structure. The secondary structure refers to the regular folding pattern of twists and bends of the polypeptide chain.

(iii) **Tertiary Proteins:**

Tertiary structure of proteins is the three dimensional structure formed by the bending and twisting of the polypeptide chain. The linear sequence of polypeptide chain is folded into compact globular structure in such proteins.

Proteins can be found in both plant and animal foods such as milk, eggs, seafood, meat, soya beens, nuts, grains, vegetables,

AGP

Mon Tue Wed Thu Fri Sat Sun

Date

etc. Proteins are vital for the growth, development and proper functioning of the body as they are involved in the synthesis of new protoplasm, the growth and repair of worn-out body cells, and the synthesis of enzymes, hormones and antibodies to combat diseases.

3. FATS:

Definition: Fats are organic compounds containing the elements carbon, hydrogen and oxygen. But unlike carbohydrates, fats contain much less oxygen in proportion to hydrogen.

Primary building blocks of fats are fatty acids and glycerol. In other words, fats can be broken down into fatty acids and glycerol by the process of hydrolysis. Hydrolysis involve the addition of water molecules and occurs readily with an enzyme:

Fat molecule + Water $\xrightarrow{\text{enzyme}}$ Glycerol + fatty acid molecules

Characteristics:

Fats are the most heterogenous group of substances. They are insoluble in water but are soluble in organic solvents like ether,

AGP

Mon Tue Wed Thu Fri Sat Sun

Date

alcohol, chloroform, benzene, etc. They are poor conductors of heat and electricity. Fats not only occupy the place in human diet, but are also used as raw materials in the manufacturing of soaps, detergents, varnishes, paints, polishes, cosmetics and pharmaceuticals.

Classification of Fats:

Fats can be classified into saturated fats, unsaturated fats and trans fats.

- **Saturated Fats:**

The bonds between carbon atoms in saturated fats are single bonds. There is no double bond. The fatty acid chain is straight. The sources of saturated fats include animal products (meat, butter, cheese) and some plant oil (coconut oil, palm oil). Saturated fats can raise LDL cholesterol levels in the body, potentially increasing the risk of heart disease.

- **Unsaturated Fats:**

Unsaturated fats can furthur be divided into two types:

(i) **Monounsaturated Fats:**

Their carbon chain contains only one

double bond. Such type of fats are found in olive oil, avocados, nuts and seeds. They can help reduce bad cholesterol levels, lowering the risk of heart disease.

(ii) Polyunsaturated Fats:

Polyunsaturated fats contain more than one double bond in their carbon chain. Sources of polyunsaturated fats are fatty fish, flaxseeds, walnuts, sunflower oil and corn oil. They contain essential fats like omega-3 and omega-6 fatty acids which are beneficial for heart health and brain function.

- **Trans fats:**

Trans fats are created through the industrial process of hydrogenation, which adds hydrogen to liquid vegetable oils to make them more solid. They may be formed from unsaturated fats during food production. The sources of trans fats include processed foods, baked foods, margarine and fried foods. Trans fats are bad for health as they increase the risk of coronary heart disease.

Good structure and presentation

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