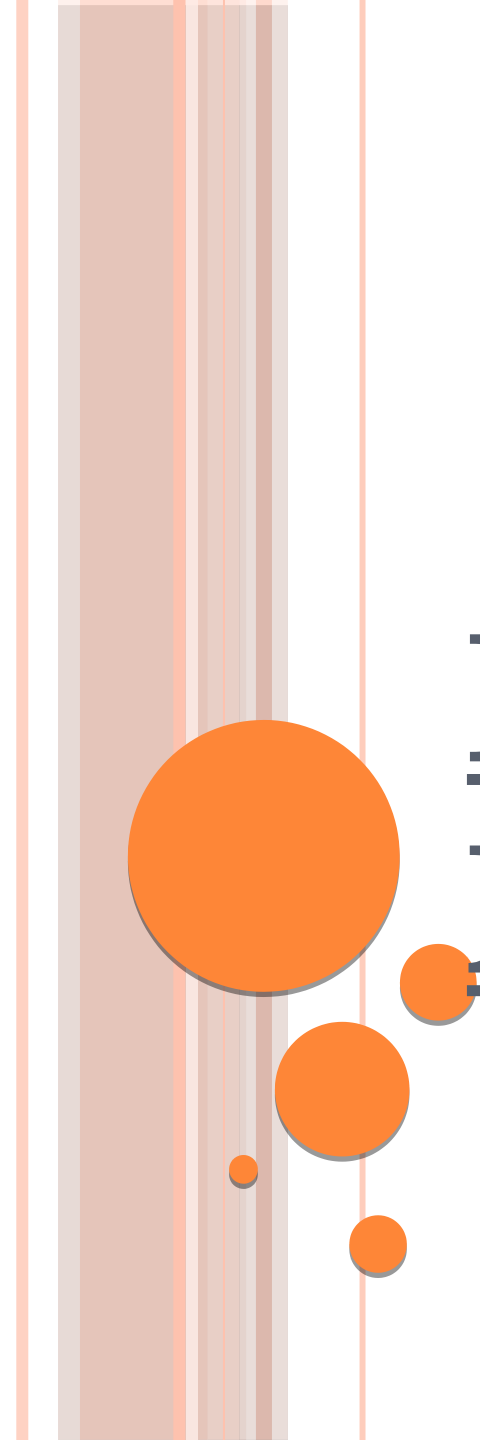




UNIT 2

Biochemical Molecules

INORGANIC AND ORGANIC MOLECULES

Inorganic molecules

Atoms the smallest particles of a chemical element.

Element a substance that is made of only one kind of atom.

Bond the energy that joins atoms together to form a molecule

Molecule a number of atoms bonded together.

Compound a substance made from molecules containing more than one kind of atom in a fixed ratio.

Valency the number of bonds an atom can make with other atoms.

WATER

- ✓ **Water is the name of a substance. It is the only substance that exists in three states solid, liquid and gas at temperatures commonly found on Earth. Solid water is ice, liquid water we call water and gaseous water is steam.**
- ✓ **It contains three-quarters of the planet.**
- ✓ **Most cells are about 70% water and some are as high as 90%.**
- ✓ **the molecule is not 'straight' it is bent into a 'v' shape.**
- ✓ **Also, the molecule forms what we call a 'dipole'.**
- ✓ **Part of the molecule has a slight negative charge (δ^-) and other parts have a slight positive charge (δ^+).**
- ✓ **The hydrogen bonds in water keep breaking and reforming as the molecules move around, but there is always some bonding between the molecules in a mass of water.**

WHY IS WATER SO IMPORTANT TO LIVING THINGS?

Water has many properties that make it important to living things in a number of ways, such as:

- **Water is a place to live in.**
- **Water is transparent.**
- **Water has a high specific heat capacity.**

specific heat capacity is the amount of energy needed to raise the temperature of 1 g of a substance by 1 degree Celsius.

- **Ice is less dense than liquid water.**
- **Water has a high latent heat of vaporization.**

latent heat of vaporization is the energy used in converting a liquid to a gas at the same temperature

- **Water has a high surface tension.**

surface tension is the tension at the surface of a liquid resulting from unbalanced forces acting on the molecules at the surface.

- **Water as a reactant.**
- **Water as a medium for chemical reactions.**

Water is an ideal medium for these reactions – for some of the reasons are;

- **It can dissolve many substances – the reactions will only take place effectively in solution.**
- **It has a low viscosity – the particles can move around and come easily into contact with each other.**

ORGANIC MOLECULES

Carbohydrates

- ✓ Is molecule that contains the elements carbon, hydrogen and oxygen.
- ✓ Carbohydrates have a range of functions:

They are used to release energy in respiration glucose is the main respiratory substrate of most organisms.

Carbohydrates are a convenient form in which to store chemical energy; storage carbohydrates include:

- starch in plants
- glycogen in animals

Some carbohydrates are used to build structures; structural carbohydrates include:

- cellulose, which is the main constituent of the primary cell wall of plants
- chitin, which occurs in the cell walls of fungi and in the exoskeletons of insects
- peptidoglycan, which occurs in bacterial cell walls.

TYPES OF CARBOHYDRATES

Monosaccharaides

- ✓ Monosaccharaides are the simplest carbohydrates.
- ✓ It can be classified according to how many carbon atoms are present in the molecule;
 - triose monosaccharide has three carbon atoms – formula $C_3H_6O_3$.
 - pentose monosaccharide has five carbon atoms – formula $C_5H_{10}O_5$.
 - hexose monosaccharide has six carbon atoms – formula $C_6H_{12}O_6$.
- ✓ Also can be classified in a different way according to the functional group that they possess.
 - the aldehyde group with the formula CHO and
 - the ketone group, with the formula $C=O$

Disaccharides

- ✓ Disaccharide carbohydrate molecules are made by two monosaccharide molecules joining together.
- ✓ the formula is $C_{12}H_{22}O_{11}$.
- ✓ A molecule of water (H_2O) is formed from a hydroxyl group from one monosaccharide and a hydrogen atom from the other. This allows a bond to be formed between the two monosaccharide units to make a disaccharide. The process is *condensation*.
- ✓ The bond that holds the two monosaccharide units together is a *glycosidic bond*.
- ✓ It is formed between carbon atom 1 of one α -glucose molecule and carbon atom 4 of the other α -glucose molecule. The full name of the bond is, therefore, a α -1,4-glycosidic bond.

Polysaccharides

- ✓ Are complex carbohydrates.
- ✓ Their molecules are built as many hundreds of monosaccharide molecules join together by forming condensation links.
- ✓ Some polysaccharides are storage molecules.
 - Starch is not a single compound but a mixture of amylose and amylopectin.
 - Glycogen is a storage carbohydrate in animal cells. It has a similar structure to that of amylopectin – but there are more α -1,6 links, making it much more highly branched.
 - Cellulose is a polymer of β -glucose molecules joined by β -1,4-glycosidic bonds, formed by condensation reactions.

Lipids

- ✓ Contain only the elements carbon, hydrogen and oxygen, but they contain much less oxygen than carbohydrates.
- ✓ Lipids are a varied group of compounds that include:
 - Triglycerides formed from glycerol and three fatty acids.
 - Phospholipids formed from glycerol, two fatty acids and a phosphate group.
 - Waxes formed from fatty acids and long-chain alcohols.
- ✓ A triglyceride molecule is an ester of three fatty acid molecules and one glycerol molecule; the ester bonds are formed by condensation.
- ✓ A phospholipid molecule consists of two fatty acids and a phosphate group bonded to a molecule of glycerol. The phosphate group gives the molecule a hydrophilic 'head' and the fatty acids give the molecule hydrophobic 'tails'.

PROTEINS

- ✓ **Are polymers of amino acids.**
- ✓ **They have several levels of structure:**
 - the primary structure is the sequence of amino acids in a polypeptide chain**
 - the secondary structure is determined by the folding of the primary structure into either an α -helix or a β -pleated sheet; these structures are held in shape by hydrogen bonds**
 - the tertiary structure is determined by the further folding of the secondary structure into either a fibrous or a globular shape; these structures are held in place by further hydrogen bonds, disulphide bridges and ionic bonds**
 - some have a quaternary structure in which two or more polypeptide chains, each with a tertiary structure, are bonded together; a hemoglobin molecule consists of four polypeptide chains bonded together.**

NUCLEIC ACIDS

- ✓ **Nucleic acids are made from nucleotides.**
- ✓ **DNA is a double-stranded nucleic acid; RNA is a single stranded nucleic acid.**
- ✓ **Reducing sugars react with Benedict's solution when heated to give a yellow/orange/red precipitate.**
- ✓ **Non-reducing sugars must first be hydrolyzed by boiling with HCl and then neutralized before they will react with Benedict's solution; they then give the same yellow/orange/red precipitate as reducing sugars.**
- ✓ **Proteins react with Biuret reagent to give a mauve/purple color.**
- ✓ **The emulsion test for lipids produces a milky-white color in water.**