Week Two

Carbohydrates

Carbohydrates composed of carbon, hydrogen and oxygen and are often known as sugars. They are classified into various groups based upon number of sugar molecules that are linked together.

Monosaccharides (one molecule)

Pentoses (5 carbons): e.g.

$C_5H_{10}O_5$ - arabinose, xylose, ribose.

Hexoses (6 carbons): e.g.

$C_6H_{12}O_6$ - glucose, fructose, galactose

While we represent ribose as $C_5H_{10}O_5$ or glucose $C_6H_{12}O_6$. In actuality they are ring structures.

Disaccharides: (2 monosaccharides linked together)

$C_{12}H_{22}O_{11}$ (note loss of one H_2O)

Sucrose (glucose+ fructose)

Lactose (glucose + galactose)

Cellobiose (glucose+ glucose)

Trisaccharides: (3 monosaccharides linked together)

$C_{18}H_{32}O_{16}$ (note loss of one more H_2O)

Raffinose (glucose+ fructose+ galactose)

Polysaccharides

Many pentoses or hexoses linked together

Xylan: (xylose--------xylose)

Starch: (glucose----------glucose) alpha linked

Cellulose: (glucose --------glucose) beta linked

Functions of carbohydrates:

It provides cells with energy.

It gives structural support for living plants.

They are major constituents of plant and animal tissues.

Supply carbon for biosynthesis

Storage of chemical energy

Cellulose has no nutritive value because it cannot be digested by humans, but it is essential for bulk fiber movement to eliminate waste from the gut..

Lipids

The term lipid comprises of a diverse range of molecules.

They are relatively water-insoluble or nonpolar compounds of biological origin.

They including waxes, fatty acids, fatty acid- derived phospholipids, sphingolipids, glycolipids and terpenoids (eg. retinoids and steroids).

Some lipids are linear aliphatic molecules, while others have ring structures.

Some are aromatic, while others are not.

Some are flexible, while others are rigid.

Lipids are an integral part of our daily diet.

Most oils and milk products that we use for cooking and eating like butter, cheese, ghee etc, are comprised of fats.

Vegetable oils are rich in various polyunsaturated fatty acids (PUFA).

Lipid-containing foods undergo digestion within the body and are broken into fatty acids and glycerol.

These are the final degradation products of fats and lipids.

Most lipids have some polar character in addition to being largely non polar.

Generally, the bulk of their structure is non polar or hydrophobic ("water-fearing"), meaning that it does not interact well with polar solvents like water.

Another part of their structure is polar or hydrophilic ("water-loving") and will tend to associate with polar solvents like water.

This makes them amphiphilic molecules (having both hydrophobic and hydrophilic properties).

In the case of cholesterol, the polar group is a mere -OH (hydroxyl or alcohol).

In the case of phospholipids, the polar groups are considerably larger and more polar.

Simplest fatty acid is a 2 carbon structure: e.g. (acetic acid - CH_3. COOH.)

Longest is 24 carbons in length. e. g. CH_3. CH_2.CH_2----------COOH.

(1) **Fatty acids** may be:

Saturated (no double bonds) -C-C-C-C

Monounsaturated (one double bond) -C-C=C- or

Polyunsaturated (more than one double bond) -C=C=C-C

(2) **Glycerol** structure is:

$HOCH_2$

I

HOCH

I

$HOCH_2$

Mono, di and tri glycerides are esters of fatty acids and glycerol e g

Monoglyceride:

$HOCH_2$

I

HOCH

I

Fatty acid--------OCH_2

Diglyceride:

$HOCH_2$

I

Fatty acid-------OCH

I

Fatty acid-------OCH_2

Phospholipids

The only difference between triglycerol and phospholipids is that one of the hydroxyl groups of the glycerol is linked to a phosphate.

Steroids:

Steroids are composed of four interconnected carbon rings.

They are soluble in water due to their polarity, e.g. sex hormones such as testosterone and oestrogen.

Lipids have 5 major functions:

Supply of energy

Source of essential fatty acids (linoleic and linolenic)

They carry fat soluble vitamins

They are component of membranes.

They are components and precursors of hormones and vitamin D.

Carbohydrate

DEFINITION: carbohydrates are derivative of aldehydes and ketones. They are polyhydroxyl in nature. On hydrolysis they yield these compounds

Carbohydrates are grouped into 4 main classes: Monosaccharides, Disaccharides, Oligosaccharides and Polysaccharides.

Monosaccharides

Monosaccharides are the most basic units of biologically important carbohydrates. They are the simplest form of sugar and are usually colorless, water-soluble, crystalline solids. Some monosaccharides have a sweet taste. Examples of monosaccharides include glucose (dextrose), fructose (levulose), galactose, xylose and ribose. Monosaccharides are the building blocks of disaccharides such as sucrose and polysaccharides (such as cellulose and starch). Further, each carbon atom that supports a hydroxyl group (except for the first and last) is chiral, giving rise to a number of isomeric forms all with the same chemical formula. For instance, galactose and glucose are both aldohexoses, but have different chemical and physical properties.

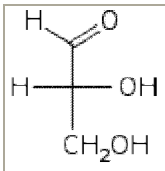
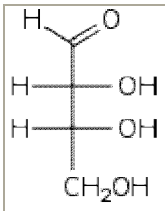
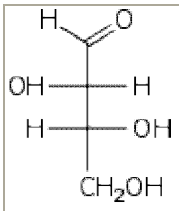
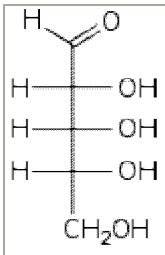
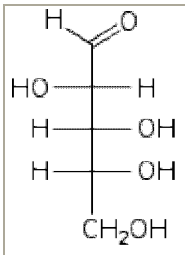
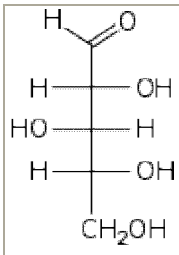
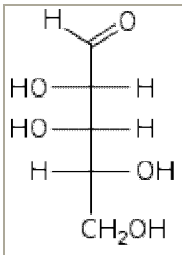
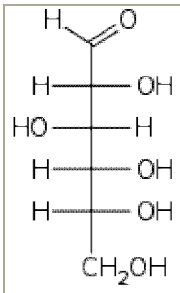
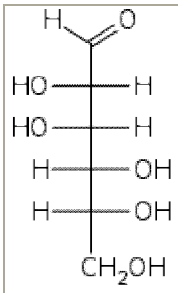
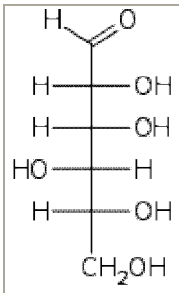
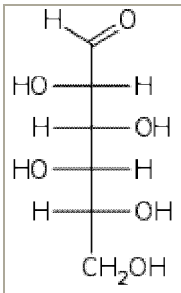
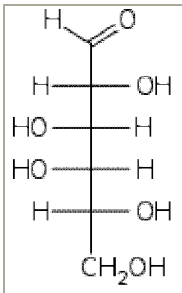
Monosaccharides can be categorized according to their value of 'n,' (number of carbon atom) as shown below:

n	**Category**
3	Triose
4	Tetrose
5	Pentose
6	Hexose
7	Heptose
8	Octose

Monosaccharides can exist as aldehydes (CHO or H C=O) or ketones (CO or C=O) and are called **aldoses** or **ketoses**, respectively. For example, below are the structures of **glyceraldehyde**, an aldo-triose, and **dihydroxyacetone**, a **keto-triose**. Glyceraldehyde and dihydroxyacetone have the same atomic composition, but differ only in the position of the hydrogens and double bonds.

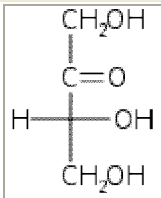
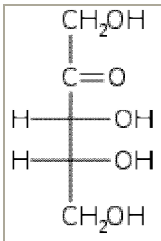
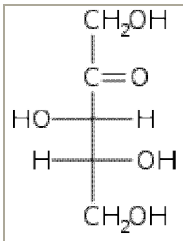
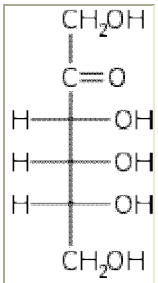
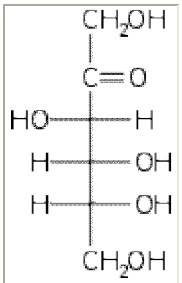
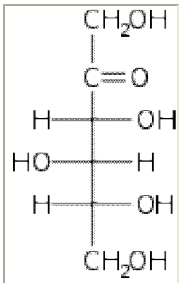
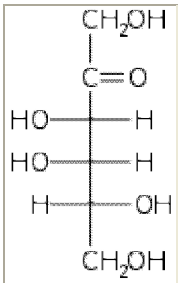
Carbons in a monosaccharide are numbered such that the aldehyde group is carbon number one or the ketone group is carbon number two.

Aldoses

Aldotriose	 D-Glyceraldehyde			
Aldotetroses	 D-Erythrose	 D-Threose		
Aldopentoses	 D-Ribose	 D-Arabinose	 D-Xylose	 D-Lyxose
Aldohexoses	 D-Glucose	 D-Mannose	 D-Gulose	 D-Idose	 D-Galactose

Ketoses

Ketotriose	 Dihydroxyacetone

ketotetrose	 D-Erythrulose			
ketopentoses	 D-Ribulose	 D-Xylulose		
ketohexoses	 D-Psicose	 D-Fructose	 D-Sorbose	 D-Tagatose