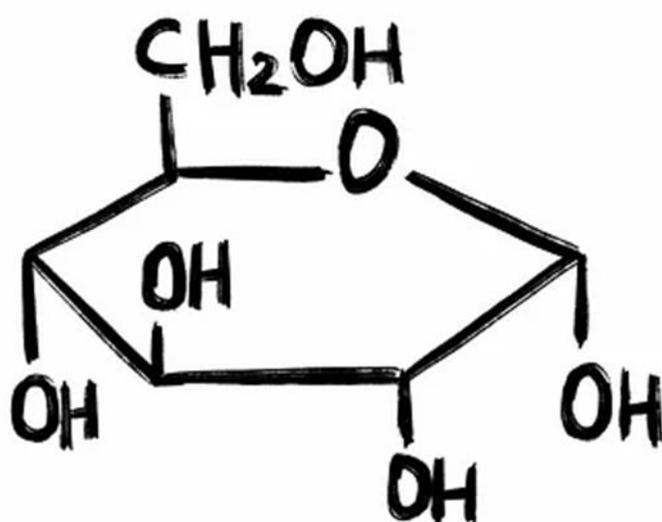


الصيدلة	الكلية
فرع العلوم المختبرية والسريرية	القسم
Biochemistry	المادة باللغة الانجليزية
الكيمياء الحياتية	المادة باللغة العربية
الثالثة	المرحلة الدراسية
م م اسامة حامد عبدالله	اسم التدريسي
Sugars	عنوان المحاضرة باللغة الانجليزية
السكريات	عنوان المحاضرة باللغة العربية
1	رقم المحاضرة
Abousalah, K. and Alnaser, A., 1996, Principles of Practical .1 .Biochemistry Farid Shokry Ataya, 2007, Practical Biochemistry. AlRoshd .2 .Publisher, Riyadh, Saudi Arabia Milio, F. R. and Loffredo, W. M., 1995, Qualitative Testing .3 for Amino Acids and Proteins, Modular Laboratory Program in	المصادر والمراجع

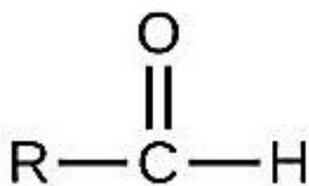
محتوى المحاضرة

UNIVERSITY OF ANBAR

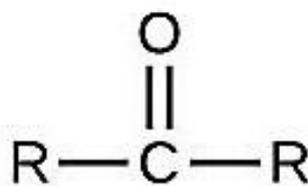


➤ Carbohydrates

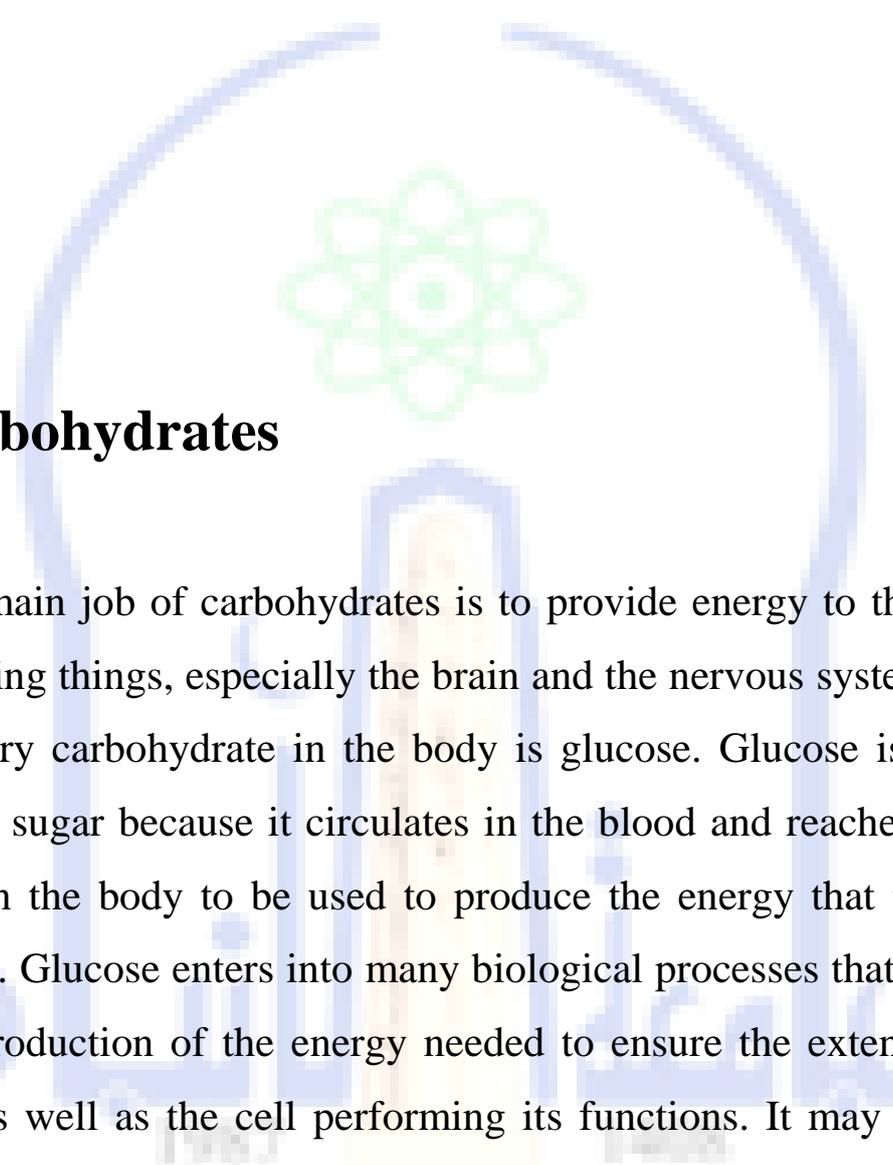
- Carbohydrates are organic compounds polyhydroxy aldehyde or ketone depending on the location of the carbonyl group or substances which give these on hydrolysis, carbohydrates consist of **C**, **H** and **O** atoms in their composition, the general formula for carbohydrate is $(\text{CH}_2\text{O})_n$, all carbohydrates have **C=O** or **CHO** as functional group.



Functional group
of an aldehyde



Functional group
of a ketone

The logo of the University of Anbar is centered in the background. It features a large blue archway. Inside the archway, there is a green molecular structure with a central atom and several surrounding atoms connected by lines. Below the archway, there is a stylized building with a central tower and two side wings, all in a light blue color.

➤ **Carbohydrates**

- The main job of carbohydrates is to provide energy to the body of living things, especially the brain and the nervous system. The primary carbohydrate in the body is glucose. Glucose is called blood sugar because it circulates in the blood and reaches every cell in the body to be used to produce the energy that the cell needs. Glucose enters into many biological processes that lead to the production of the energy needed to ensure the extension of life as well as the cell performing its functions. It may also be used in the manufacture of other types of monosaccharides, such as fructose and galactose. Glucose is stored in plant cells in the form of starch and in animals in the form of glycogen, where it is stored in the muscles and liver. The stored glucose in the liver can be a source of glucose for all tissues and organs of the body when needed.

➤ Importance of carbohydrates

1. Providing most the energy and carbon required in the biosynthesis of proteins, nucleic acids and lipids.
2. Glycoproteins and glycolipids are components of cell membranes and receptors.
3. They form structural basis of many organisms like cellulose in plants.
4. Starch and glycogen are the energy storage form.

➤ Classification of carbohydrates

- Carbohydrates are classified according to the number of sugar unites to:

1. **Monosaccharides** : Single sugar unite like (Glucose, and Fructose).

2. Disaccharides : Two sugar unites like (Lactose, Maltose, and Sucrose).

3. Polysaccharides :Three or more sugar unites like (Starch, and Glycogen).

➤ **Monosaccharides**

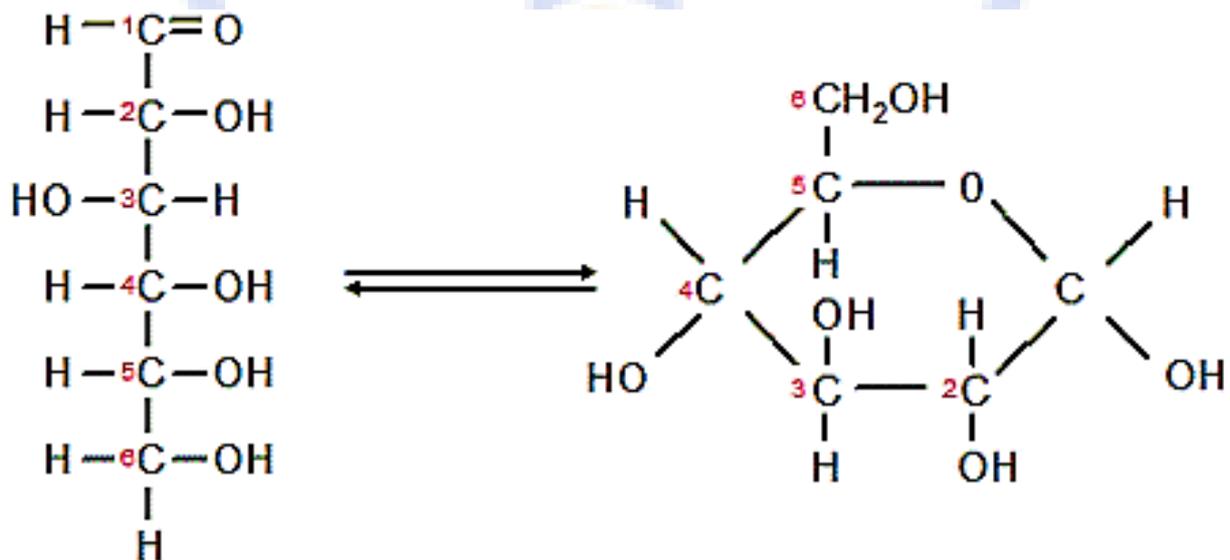
➤ Monosaccharides are also called simple sugars which can't be broken down into simpler substances . They have only one potential sugar unite also they consist of single aldehyde or ketone group, so they consider reducing agents.

➤ Monosaccharides can be classified depending on the number of carbon atoms in the chain into:

No. of Carbon Atoms	Type of Sugar	Aldoses	Ketoses
3	Trioses	Glyceraldehyde	Dihydroxyacetone
4	Tetroses	Erythrose	Erythrulose
5	Pentoses	Ribose	Ribulose
6	Hexoses	Glucose	Fructose

➤ Glucose

- Glucose is a monosaccharide containing six carbon atoms with the molecular formula (C₆H₁₂O₆) and one aldehyde group, glucose molecule can exist in an open-chain (acyclic) as well as ring (cyclic) form, glucose also called blood sugar because it circulates in the blood and reaches every cell in the body to be used to produce the energy that the cell needs.



➤ Disaccharides

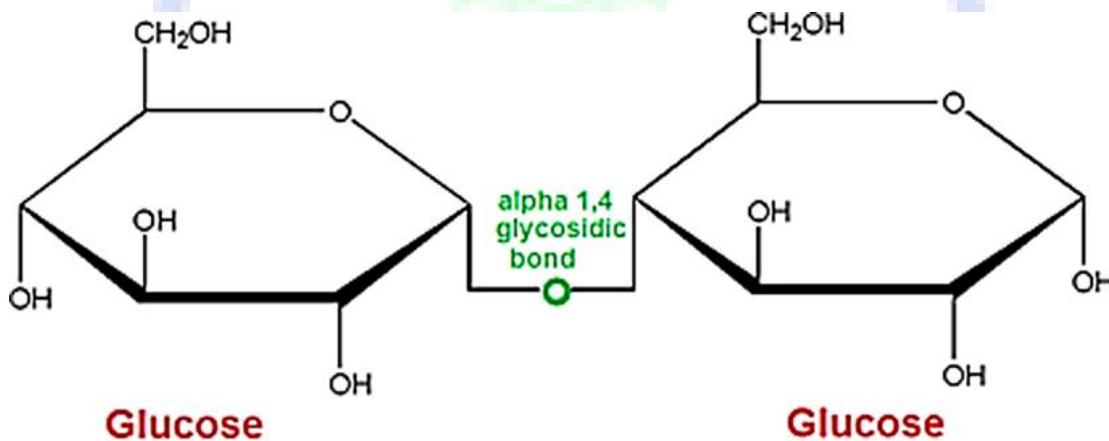
➤ Disaccharides can be formed when two monosaccharides combined together by a glycosidic bond. A glycosidic bond (also known as glycosidic linkage) is created when hemiacetal of a saccharide reacts with the hydroxyl group of another substance, such as alcohol. Only sugars with the cyclic forms have an anomeric carbon and capable of forming a glycosidic link. So this bond is a result of condensation between the alcohol of one group and sugar's anomeric carbon. A water molecule is released and an O-linkage between the two molecules is produced.

➤ **Classification of disaccharides**

1. Reducing disaccharides: One of the functional groups is free (free aldehyde or ketones that are capable of reducing an oxidizing agents) like Maltose (two glucose molecules), and Lactose (glucose and galactose).
2. Non- reducing disaccharides: Do not have free functional group. The potential functional groups are involved in glycosidic linkage like Sucrose (glucose and fructose).

➤ **Maltose**

- Maltose is made up of two molecules of glucose linked together by α -1,4-glycosidic bond. C1 (anomeric carbon) and C4 of the other molecule join together by α -1,4-glycosidic bond. When the OH on C1 pointed down α -1,4-glycosidic bond develop. Maltase, enzyme that catalyzes the hydrolysis of the disaccharide maltose to the simple sugar glucose. The enzyme is found in plants, bacteria, yeast, and in humans.

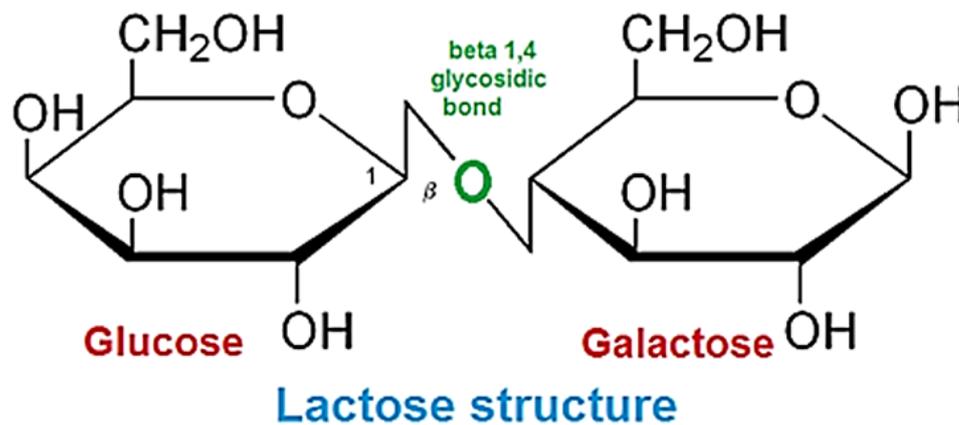


Maltose structure

➤ **Lactose (Milk Sugar)**

- Lactose is made up of a galactose molecule linked to a glucose molecule by β -1,4-glycosidic bond. Bonding between the oxygen of C1 of glucose ring and C4 of galactose ring make the β -1,4-

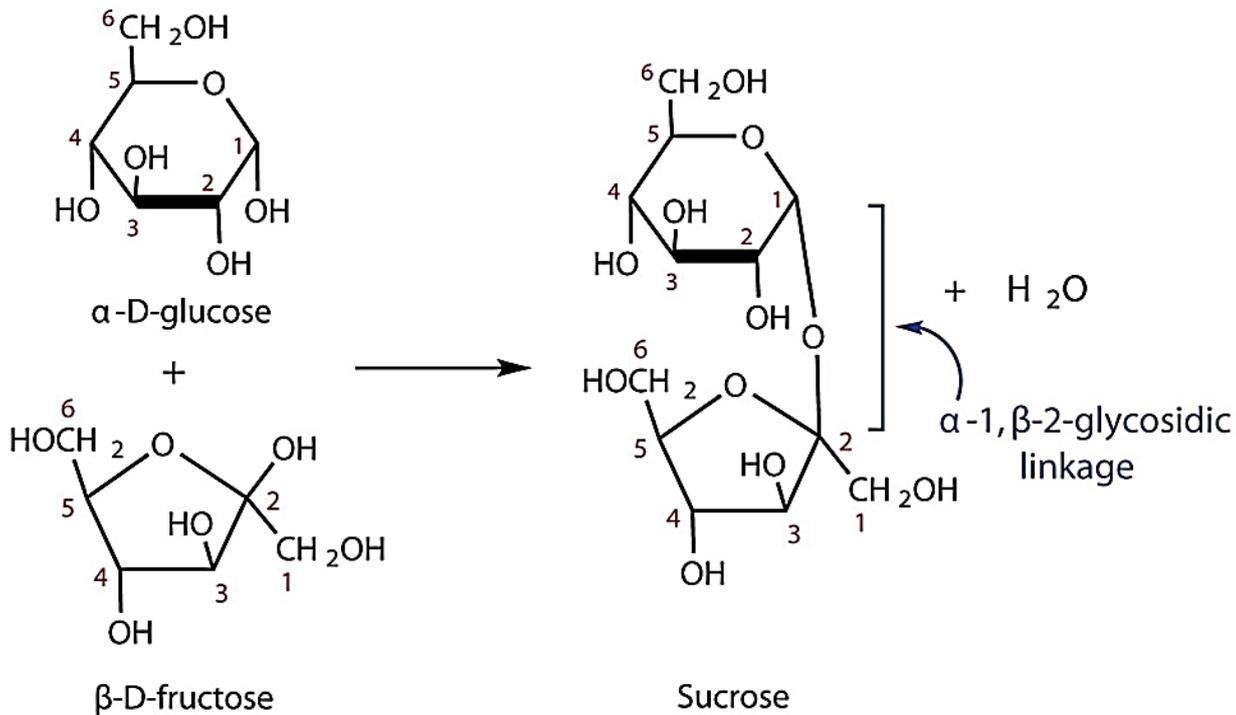
glycosidic bond. The beta-1,4-glycosidic bond has the hydroxyl group pointing up. This bond occurs when the two carbons have different stereochemistry. Normally, when we eat something containing lactose, an enzyme in the small intestine called lactase breaks it down into simpler sugars called glucose and galactose. These simple sugars absorbed into the blood stream and transform into energy.



➤ Sucrose

- Sucrose, is known as beet sugar, cane sugar, and table sugar. The sucrose molecule is unique among the common disaccharides in having an α -1, β -2-glycosidic(head-to-head) linkage. Because this glycosidic linkage is formed by the OH group on the anomeric carbon of α -D-glucose and the OH group on the anomeric carbon of β -D-fructose, it ties up the anomeric carbons of both glucose

and fructose, and lose the reducing property. An enzyme called “sucrase isomaltase” exist in the small intestine cells digests sucrose molecules, then absorbed into the blood stream.



➤ Polysaccharides

- They are polymer of glucose unites linked together by glycosidic bonds (α or β) in the linear sequence or at branch points in the polymer.
- Polysaccharides differ from one to another according to monosaccharide composition, molecular weight, and other structural features.
- Polysaccharides are classified based on the type of monosaccharide units in their composition.

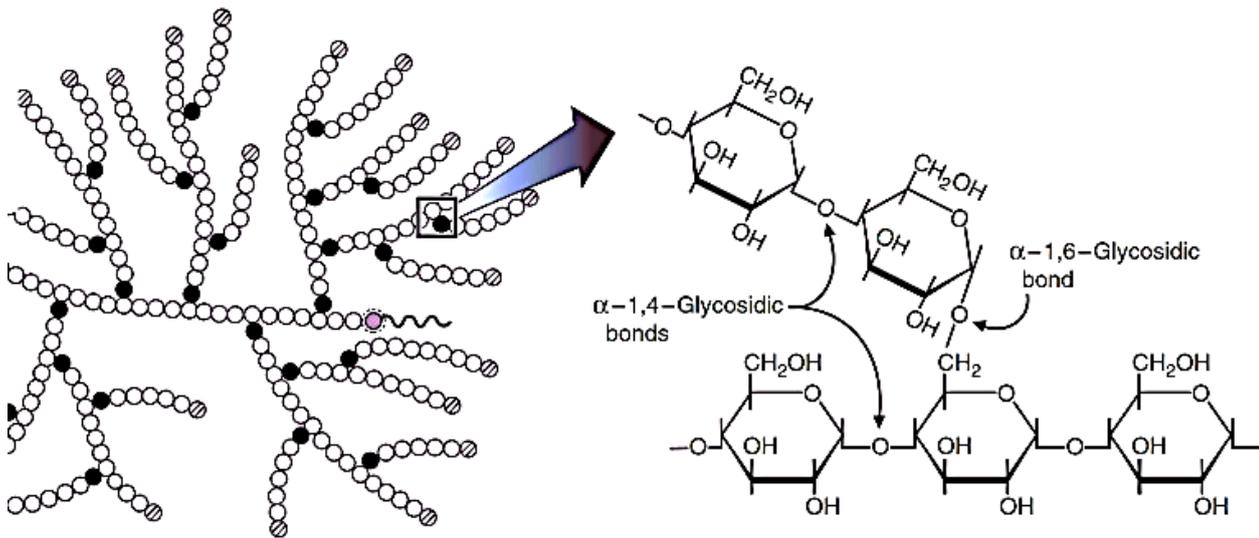
➤ **Classification of polysaccharides**

1. Homo-polysaccharide: Contains only one type of monosaccharide units in the chain, like Starch, glycogen, cellulose, and dextrans.
2. Hetero-polysaccharide: Contains more than one type of monosaccharide units in the chain, like agar, gum, and pectins.

➤ **Glycogen**

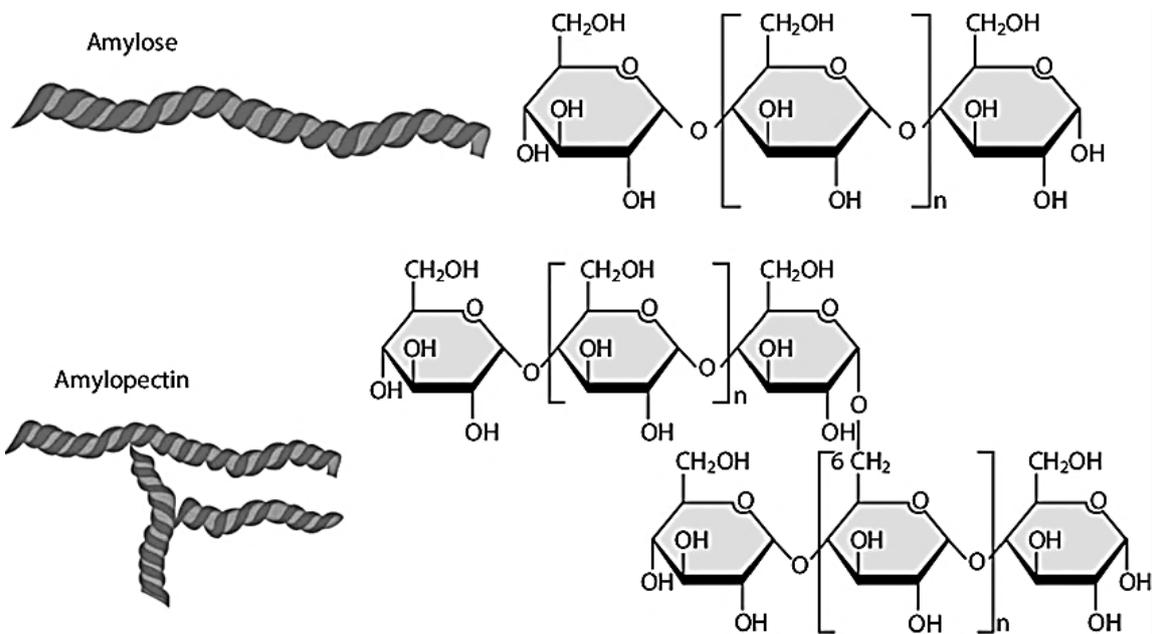
- Glycogen is a strong form of glucose in animals and stored mainly in liver and muscles. It is composed of branched chain of glucose units join by α 1-4 and α 1-6 glycosidic bonds.
- Glycogen got more branching than amylopectin, branching occur every 10 units of glucose, so glycogen molecules are more spherical in shape.

UNIVERSITY OF ANBAR



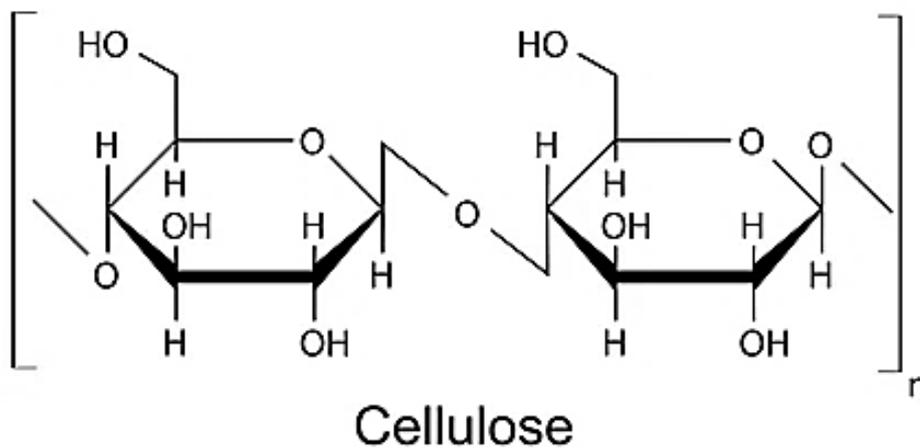
➤ Starch

- Starch is made up of long chains of sugar molecules that are connected together. The linear polymer amylose is the most basic form of starch, while amylopectin is the branched form, and the branches occur every 30 or 50 units of glucose. Main job of starch is to help plants in storing energy.
- Amylase, an enzyme contained in saliva and the pancreas that breaks down starch to get energy from it.



➤ Cellulose

- Cellulose are made up of monomers linked to each other by B(1-4) glycosidic bond and that give its rigidity property for plant.



➤ Reducing properties of carbohydrates

1. All monosaccharides are reducing sugars; they all have a free reactive carbonyl group.
2. Disaccharides some of it are reducing sugars like lactose, and some of it are not like sucrose.
3. Polysaccharides which have large polymers of glucose, such as starch, are not reducing sugars, due to concentration of hemiacetal groups is very low.

