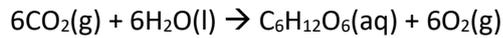


Lesson 1-carbohydrates [Click](#) to revise carbohydrates

Carbohydrates are organic molecules composed of carbon, hydrogen, and oxygen that serve as an energy source for both plants and animals and as a structural material for plant cells.

Glucose is a simple sugar formed by plants during the endothermic process of photosynthesis according to the chemical equation below.



Monosaccharides are simple carbohydrates composed of a single molecule such as glucose or fructose, shown on the right.

Consider the structure of monosaccharides, they have a number of polar hydroxyl groups which makes them very soluble in water.

Disaccharides, such as sucrose, are formed from two monosaccharides joined by an oxygen atom. This bond between the two monosaccharides is known as an **ether link (C-O-C)** and is formed when two hydroxyl (OH) groups react during a condensation reaction. An ether link that joins two saccharide molecules is known as a **glycosidic bond**

Consider the two isomers of glucose shown on the right.

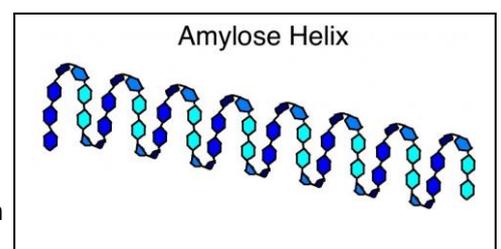
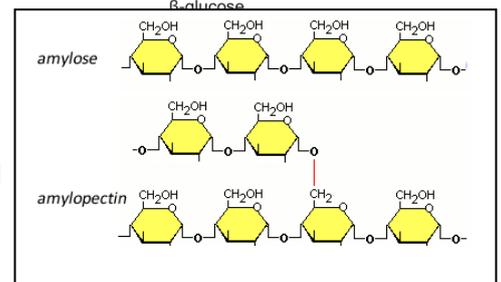
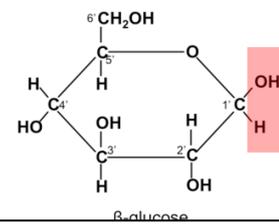
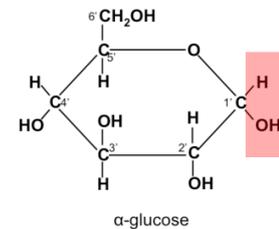
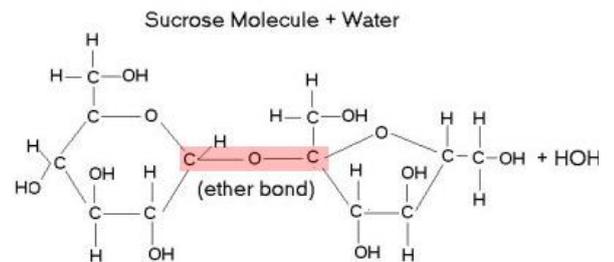
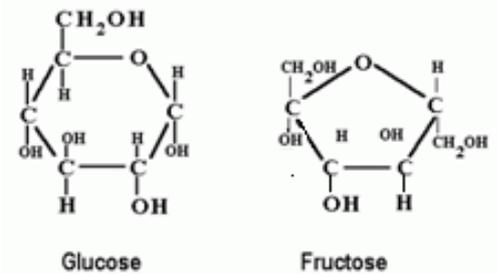
Each isomer undergoes a condensation polymerisation reaction to form a **polysaccharide**.

The three polysaccharides that will be covered are:

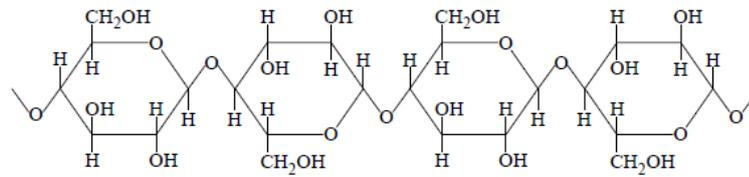
- glycogen, found in animals and used as a store of glucose in the liver and muscle. It is formed from alpha glucose molecules.
- cellulose, found in plant cell walls and used as a structural material. It is formed from beta glucose molecules and cannot be digested by animals.
- starch which is formed by plants and used by plants as a store of glucose. It is formed from alpha glucose molecules. It contains a mixture of amylopectin and amylose.

Amylose is a straight chain polymer whereas amylopectin is a branched polymer similar to glycogen. Grains have starches made of different proportions of amylose and amylopectin. Carbohydrates are ranked according to the rate molecules are hydrolysed in the digestive tract and how quickly blood sugar levels rise. This is called the glycaemic index (GI) of foods. A carbohydrate that is quickly digested and absorbed is labelled a high GI food. Amylopectin is a more soluble polymer than amylose which forms helical structures which are hard to dissolve. The helical formation of the polymer chain of amylose shields a large number of the OH groups from the water and hence makes the polymer less soluble. Amylopectin, on the other hand, is quickly broken down into its glucose monomers due to its branched structure, and relative high solubility. A branched structure allows for rapid hydrolysis of the polymer by enzymes. [Glycogen](#) is also a branched carbohydrate, similar to amylopectin, but found in animals. Glycogen is an energy source that must be broken down quickly when needed.

Foods with a high starch ratio of amylopectin to amylose are known as high GI foods.



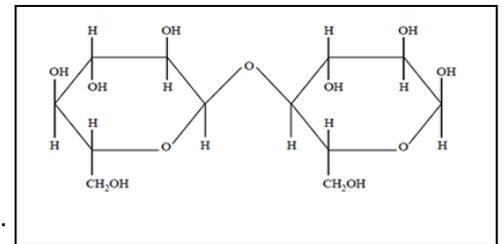
1) Consider the polymer shown below.



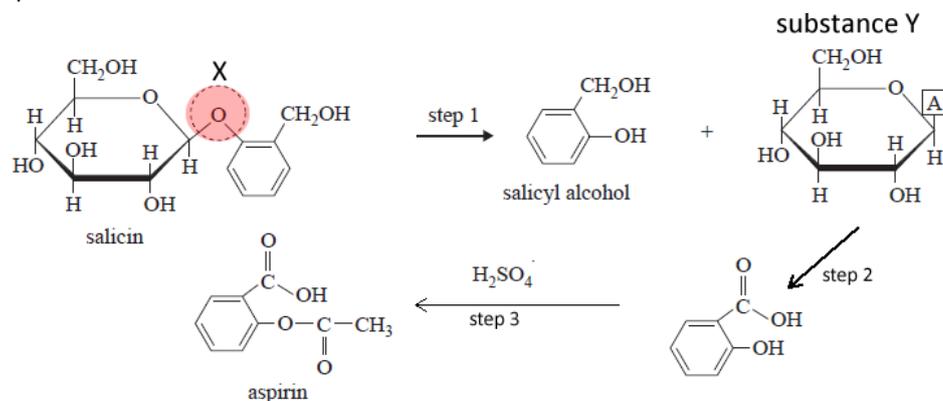
- What type of reaction formed this polymer.
- What functional group links the monomers of this polymer.
- A reaction between what two functional groups produced the link between the monomers in this polymer.
- Draw the structural formula of the monomer for this polymer.
- Ethanol is produced from the monomer of this polymer in an anaerobic reaction called fermentation. Write a balanced chemical equation for this reaction.

2) Consider the disaccharide maltose, shown on the right.

- Identify the monomers of maltose.
- What type of bond links the two monomers.
- Write a balanced chemical reaction for the formation of maltose.
- Calculate %atom economy for the formation of maltose.



3) Salicin was isolated from Willow trees and used to make aspirin.



- What type of bond is "X" in salicin?
 - What type of reaction is step 1?
 - To what group of food molecules does substance Y belong to?
 - What group of atoms are represented by "A" in substance Y?
 - What type of reaction is step 3?
 - What type of reaction converts salicylic alcohol into salicylic acid, in step 2?
 - What reagents are needed for step 2?
- 4) Which of the following four carbohydrates has the least available energy to humans when consumed? Sucrose, maltose, starch, cellulose.
- 5) The starch of two particular grains is analysed. Grain "A" is found to contain 80% amylopectin and 20% amylose while grain "B" is found to contain 40% amylopectin and 60% amylose. Which grain should be recommended as Low GI?

[Solutions](#)