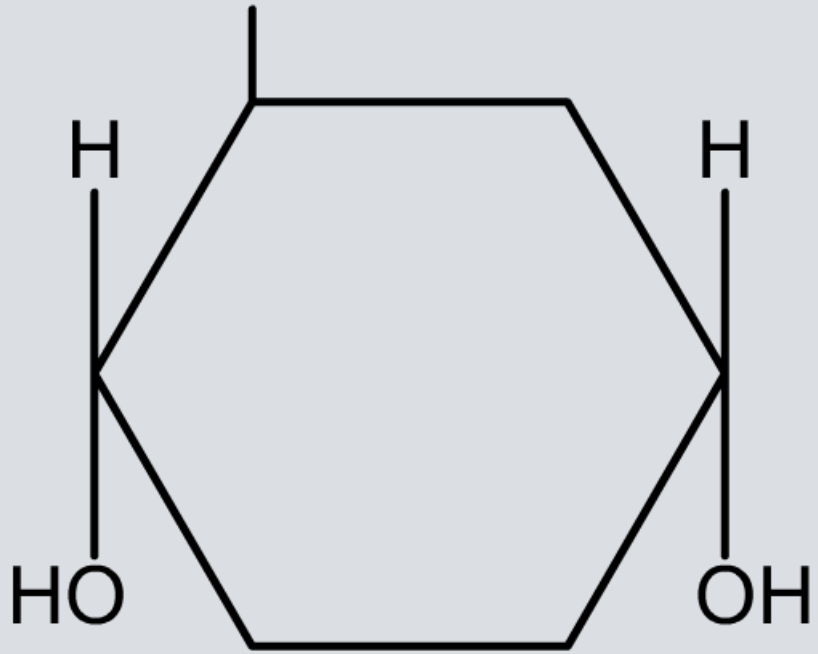
Monosaccharides



Introducing carbohydrates

Carbohydrates are a group of substances used as both energy sources and structural materials in organisms.

All carbohydrates contain carbon, hydrogen and oxygen, with the general formula: $\mathbf{C_x(H_2O)_y}$.

There are three main groups of carbohydrates:

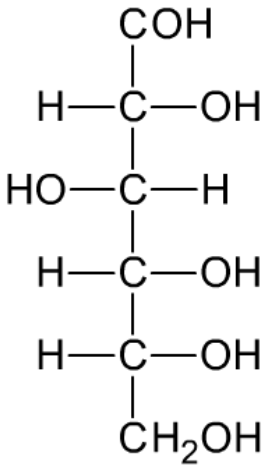
- **monosaccharides** – these are simple sugars, with the general formula $(CH_20)_n$, where *n* can be 3–7
- **disaccharides** – these are "double sugars", formed from two monosaccharides
- **polysaccharides** – these are large molecules formed from many monosaccharides.

Glucose

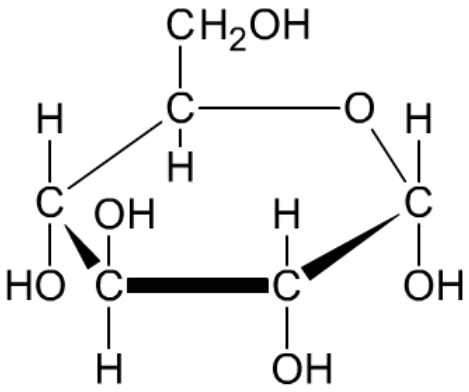
Glucose is an abundant and very important monosaccharide. It contains six carbon atoms, so it is a **hexose** sugar. Its general formula is $C_6H_{12}O_6$.

Glucose is the major energy source for most cells. It is highly soluble and is the main form in which carbohydrates are transported around the body of animals.

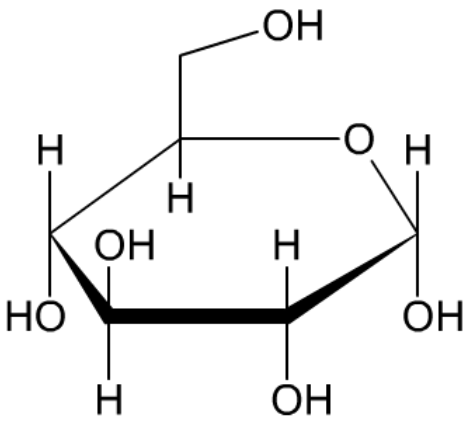
The structure of glucose can be represented in different ways:



straight chain



ring

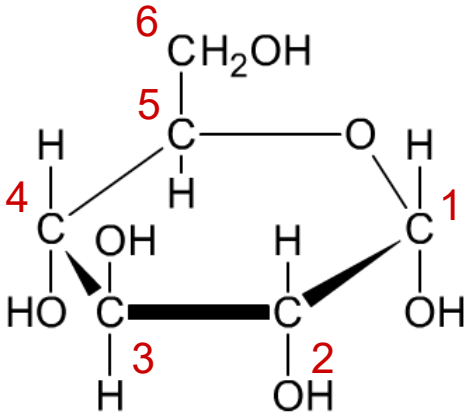


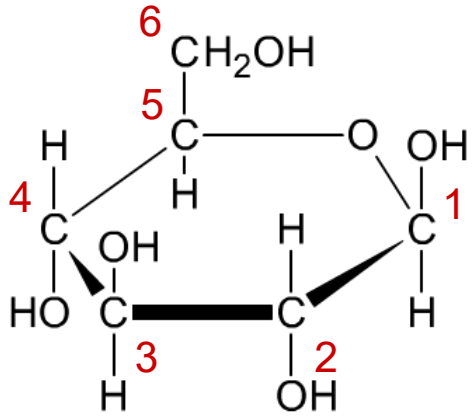
ring (simplified)

Alpha and beta glucose

Glucose exists in different forms called **structural isomers**. Two common isomers are **alpha glucose** and **beta glucose**.

alpha glucose





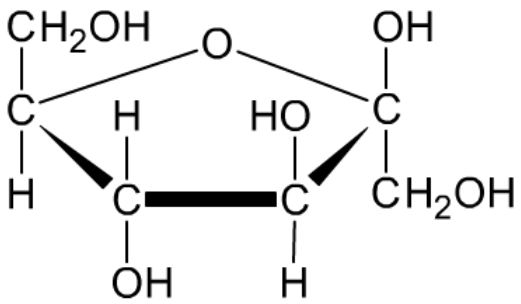
beta glucose

The only difference between these two isomers is the position of the –OH group attached to carbon 1. In alpha glucose it is **below** the carbon, and in beta glucose it is **above** the carbon.

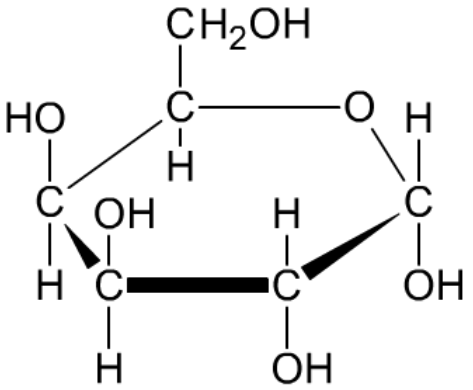
This minor structural difference has a major effect on the biological roles of alpha and beta glucose.

Fructose and galactose

Two other important hexose monosaccharides are **fructose** and **galactose**.



fructose



galactose

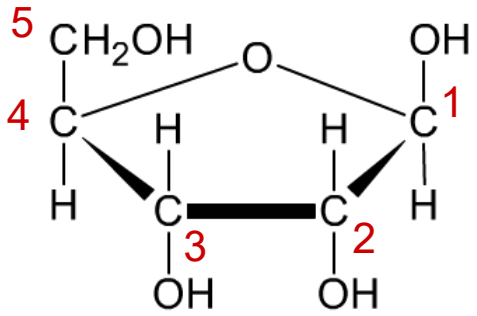
Fructose is very soluble and is the main sugar in fruits and nectar. It is sweeter than glucose.

Galactose is not as soluble as glucose and has an important role in the production of glycolipids and glycoproteins.

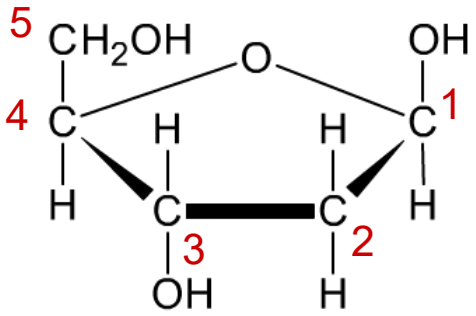
Pentoses

Pentose monosaccharides contain five carbon atoms. Like hexoses, pentoses are long enough to form a ring.

Two important pentose molecules are the structural isomers **ribose** and **deoxyribose**. These are important constituents of RNA and DNA.



ribose



deoxyribose

The only difference between them is that ribose has one H atom and one –OH group attached to carbon 2, whereas deoxyribose has 2 H atoms and no –OH group.

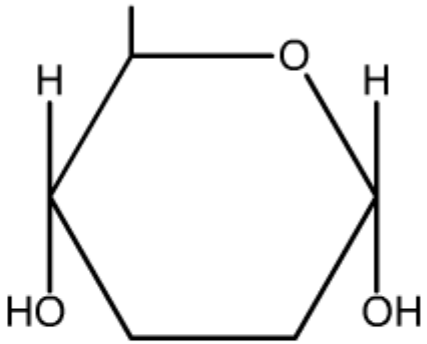
The formation of disaccharides

How are disaccharides formed?

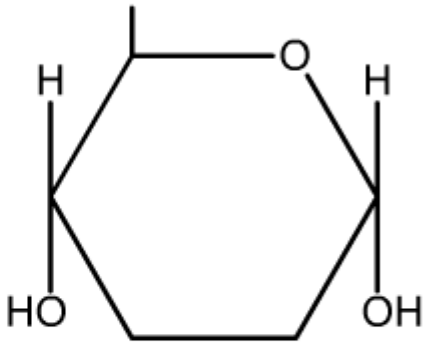
Disaccharides are 'double sugars' formed when two monosaccharide molecules join together with a **glycosidic bond**.

Click "**play**" to find out more.

monosaccharide

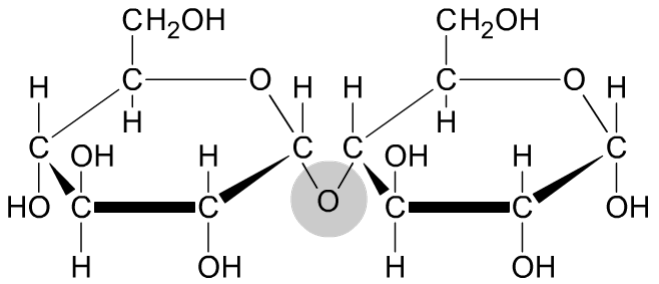


monosaccharide

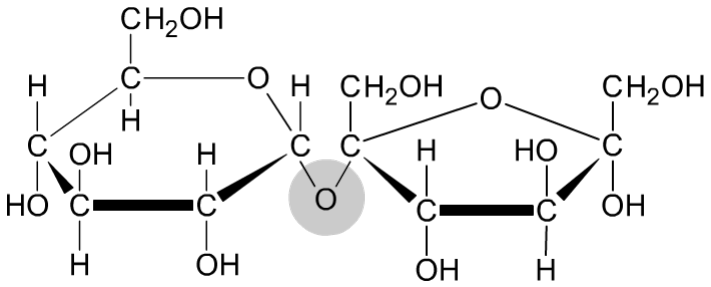


Maltose, sucrose and lactose

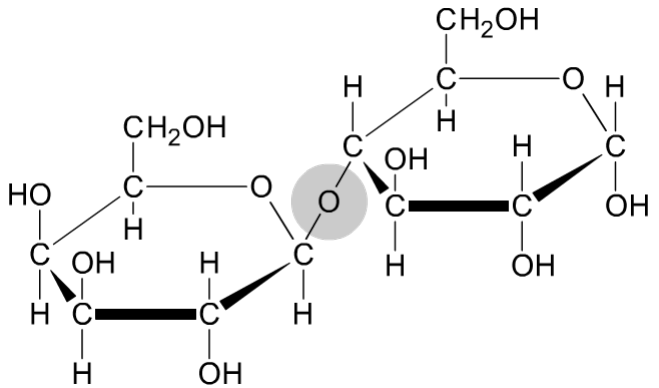
Maltose (malt sugar) is formed from two **glucose** molecules joined by an alpha 1–4 glycosidic bond.



Sucrose (table sugar) is formed from **glucose** and **fructose** joined by an alpha 1–4 glycosidic bond.



Lactose (milk sugar) is formed from **galactose** and **glucose** joined by a beta 1–4 glycosidic bond.

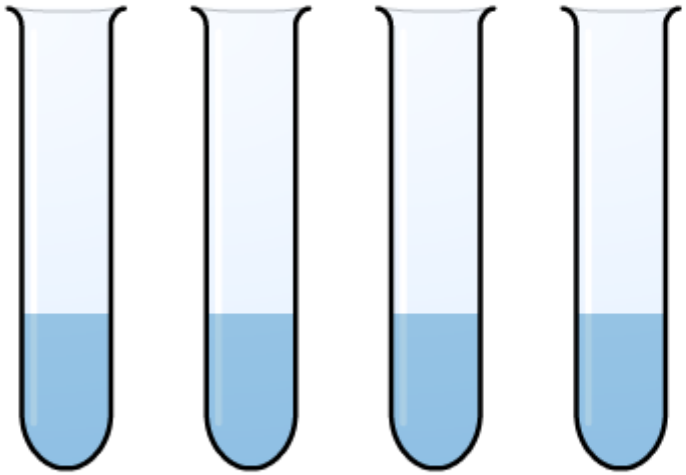


Benedict’s test for reducing sugars

What is the Benedict's test for reducing sugars?

Monosaccharides and some disaccharides are **reducing sugars**. Their presence in a solution can be detected by the **Benedict’s test**.

Click "**start**" or the test tubes to find out more.



Mono- and disaccharides

What are the missing words about mono- and disaccharides?

1. Monosaccharides are [A] sugars. Glucose and [B] are hexose sugars, and ribose and [C] are pentose sugars.

2. Alpha and beta glucose differ only in the position of the [D] group attached to carbon [E].

3. Disaccharides are formed when [F] monosaccharides join together in a [G] reaction. They are linked by a [H] bond.