



WHAT ARE CARBOHYDRATES?

In chemical terms, Carbohydrates are biological molecules containing carbon (C) hydrogen (H) and oxygen (O) atoms. In food science and in many informal contexts, the term “carbohydrate” often means any food that is particularly rich in the complex carbohydrate starch (such as cereals, bread and pasta) or simple carbohydrates, such as sugar)found in candy, jams and desserts.)

Their general formula is $C_nH_{2n}O_n$

WHAT ARE THE ROLES OF CARBOHYDRATES?

ENERGY STORAGE AND PRODUCTION

They are one of the main types of nutrients, the one needed the most by the body.

Carbohydrates are a quick source of energy (4,0 Kcal/g), needed by cells and tissues in the body to be converted into fuel for physical activity and brain function, but are often maligned for contributing to weight gain. Most of monosaccharides, disaccharides and some polysaccharides (starch, glycogen) are converted into energy.

The digestive system changes carbohydrates into glucose, also known as blood sugar. Some glucose is used for energy and the rest is stored in the liver and muscles for later use. As your blood sugar rises, your pancreas pumps out more and more insulin, a hormone that tells cells to absorb glucose for energy or storage.

STRUCTURAL FUNCTION

Formation of the structural framework of RNA and DNA (ribonucleic acid and deoxyribonucleic acid).

Are structural macromolecules in the cell walls of bacteria (peptidoglycan or murein), plants (cellulose) and animals (chitin).

They are linked to many proteins and lipids. Such linked carbohydrates are important in cell-cell communication and in interactions between cells and other elements in the cellular environment.



Are divided in



Monosaccharides

Disaccharides

Oligosaccharides

Polysaccharides

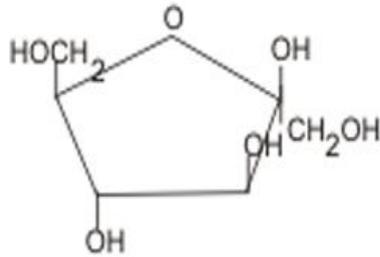


homopolysaccharide

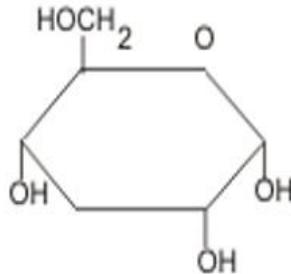
heteropolysaccharide

MONOSACCHARIDES

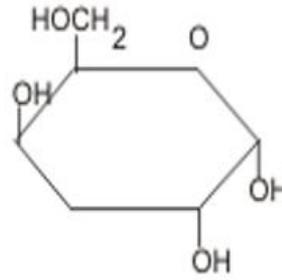
Monosaccharides are the simplest carbohydrates that cannot be [hydrolyzed](#) to smaller carbohydrates. They are aldehydes or ketones with two or more hydroxyl groups. The general [chemical formula](#) of an unmodified monosaccharide is $(C H_2O)_n$. Monosaccharides can be classified by the number x of [carbon](#) atoms they contain: [triose](#) (3), [tetrose](#) (4), [pentose](#) (5), [hexose](#) (6), [heptose](#) (7), and so on. They are the major source of fuel for the metabolism, used both as energy source and in biosynthesis.



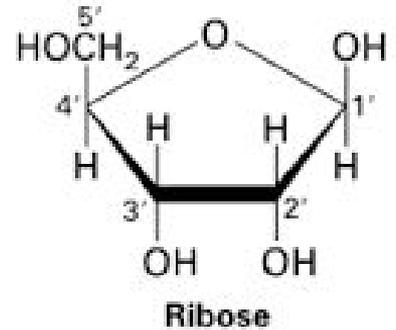
Fructose



Glucose

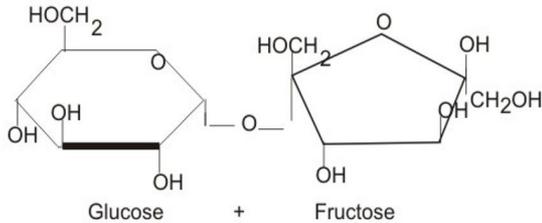


Galactose



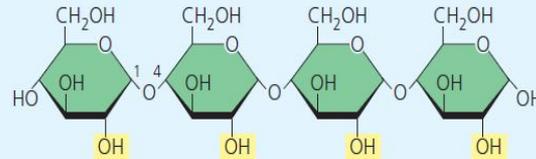
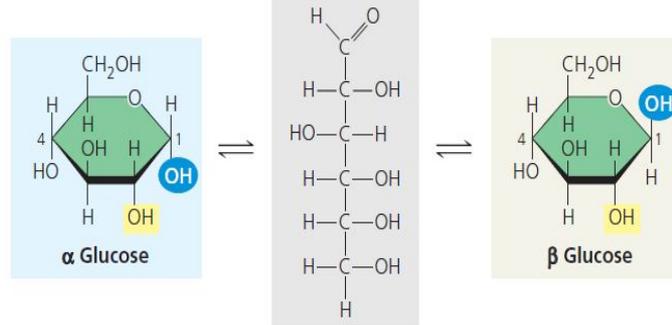
DISACCHARIDES

They are composed of two monosaccharide units bound together by a **covalent** bond known as a **glycosidic linkage** formed between a reaction of a hydroxyl group (OH) of the carbon atom (C1) of a monosaccharide and the hydroxyl group (OH) of the next monosaccharide and loses H₂O. This glycosidic bond can be either α or β and it depends on the position of the bond between (OH) on the C1.

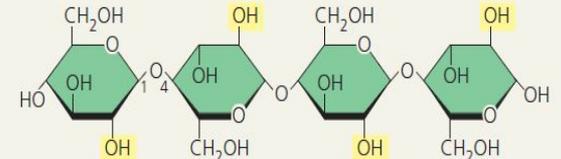


Sucrose

(a) **α and β glucose ring structures.** These two interconvertible forms of glucose differ in the placement of the hydroxyl group (highlighted in blue) attached to the number 1 carbon.



(b) **Starch: 1-4 linkage of α glucose monomers.** All monomers are in the same orientation. Compare the positions of the $-OH$ groups highlighted in yellow with those in cellulose (c).



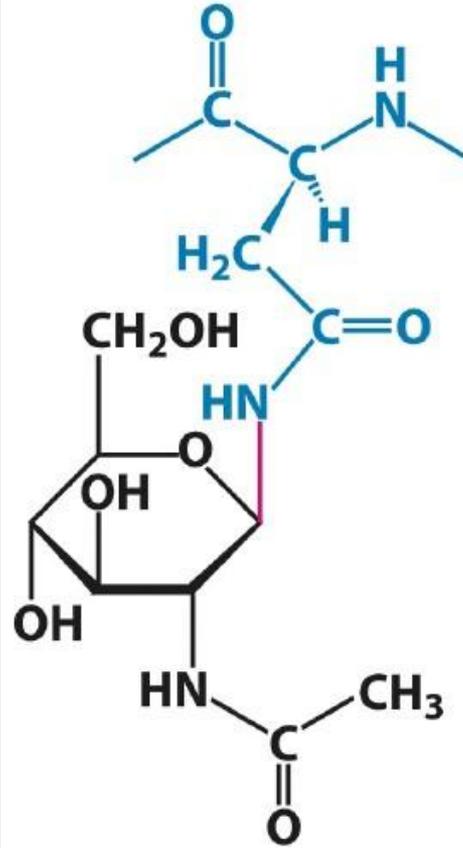
(c) **Cellulose: 1-4 linkage of β glucose monomers.** In cellulose, every β glucose monomer is upside down with respect to its neighbors. (See the highlighted $-OH$ groups.)

▲ Figure 5.7 Starch and cellulose structures.

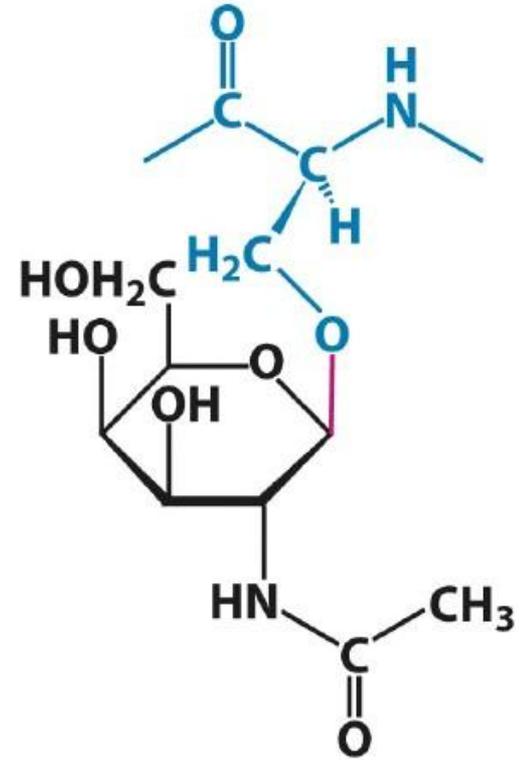
OLIGOSACCHARIDES

An **oligosaccharide** is a saccharide polymer composed by short chains of 3 to 20 monomer containing a small number of simple sugars. Oligosaccharides can have many functions including cell recognition and cell binding. For example, glycolipids have an important role in the immune response.

In general, they are found either N- or O-linked to compatible amino acid side-chains in proteins or to lipid moieties.



N-linked GlcNAc

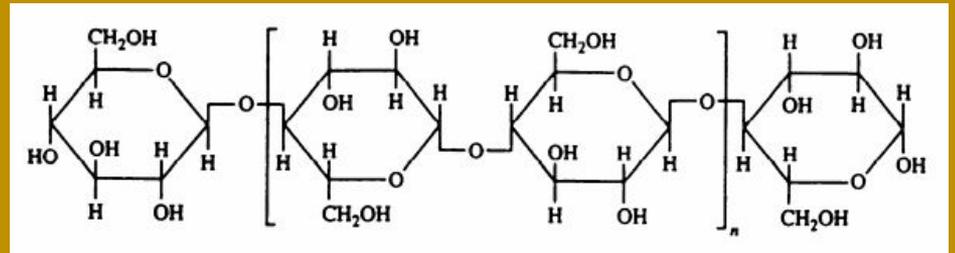
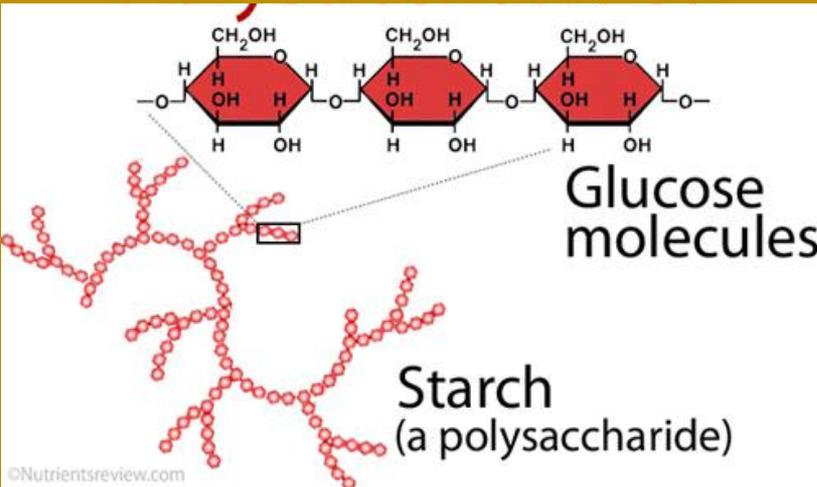


O-linked GalNAc

POLYSACCHARIDES

Polysaccharides are polymeric carbohydrate molecules composed of long chains of more than 20 monosaccharide units bound together by glycosidic linkages and on hydrolysis give the constituent monosaccharides or oligosaccharides

Examples include storage polysaccharides such as starch and glycogen, and structural polysaccharides such as cellulose and chitin.



HOMOPOLYSACCHARIDE

It is a polysaccharide that forms just one type of monosaccharide by hydrolysis.

Starch, for example, only forms glucose because it is formed by the repetition of that monosaccharide.

HETEROPOLYSACCHARIDE

Heteropolysaccharides are formed by combination of many different monosaccharides through glycosidic bonds.

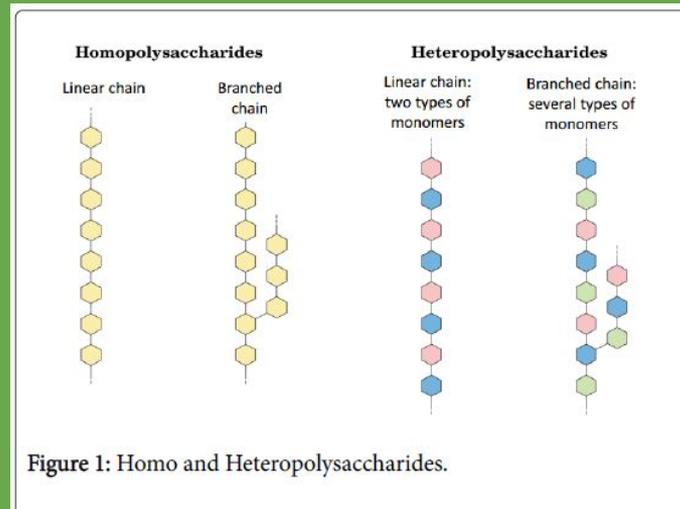


Figure 1: Homo and Heteropolysaccharides.