WEEK EIGHT

DISACCHARIDE

is the carbohydrate formed when two monosaccharides undergo a condensation reaction which involves the elimination of a small molecule, such as water, from the functional groups only. Like monosaccharides, disaccharides also dissolve in water, taste sweet and are called sugars. There are two basic types of disaccharides: reducing disaccharides, in which the monosaccharide components are bonded by hydroxyl groups; and non-reducing disaccharides, in which the components bond through their anometric centers.

It is formed when two monosaccharides are joined together and a molecule of water is removed. For example; milk sugar (lactose) is made from glucose and galactose whereas cane sugar (sucrose) is made from glucose and fructose.

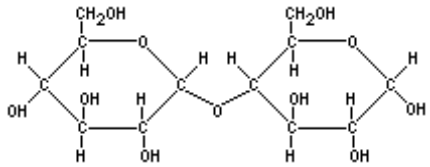
The two monosaccharides are bonded via a dehydration reaction (also called a condensation reaction or dehydration synthesis) that leads to the loss of a molecule of water and formation of a glycosidic bond.

Common disaccharides

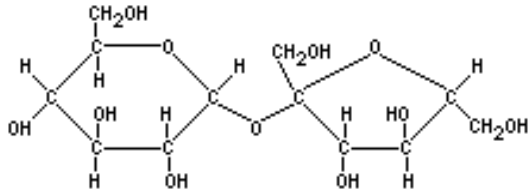
Disaccharide	Unit 1	Unit 2	Bond
Sucrose (*table sugar*, *cane sugar*, *saccharose*, or *beet sugar*)	glucose	fructose	α(1→2)
Lactulose	galactose	fructose	β(1→4)
Lactose (*milk sugar*)	galactose	glucose	β(1→4)
Maltose	glucose	glucose	α(1→4)
Trehalose	glucose	glucose	α(1→1)α

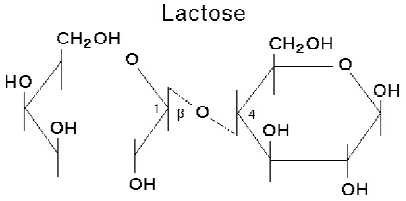
Cellobiose glucose glucose β(1→4)

Maltose



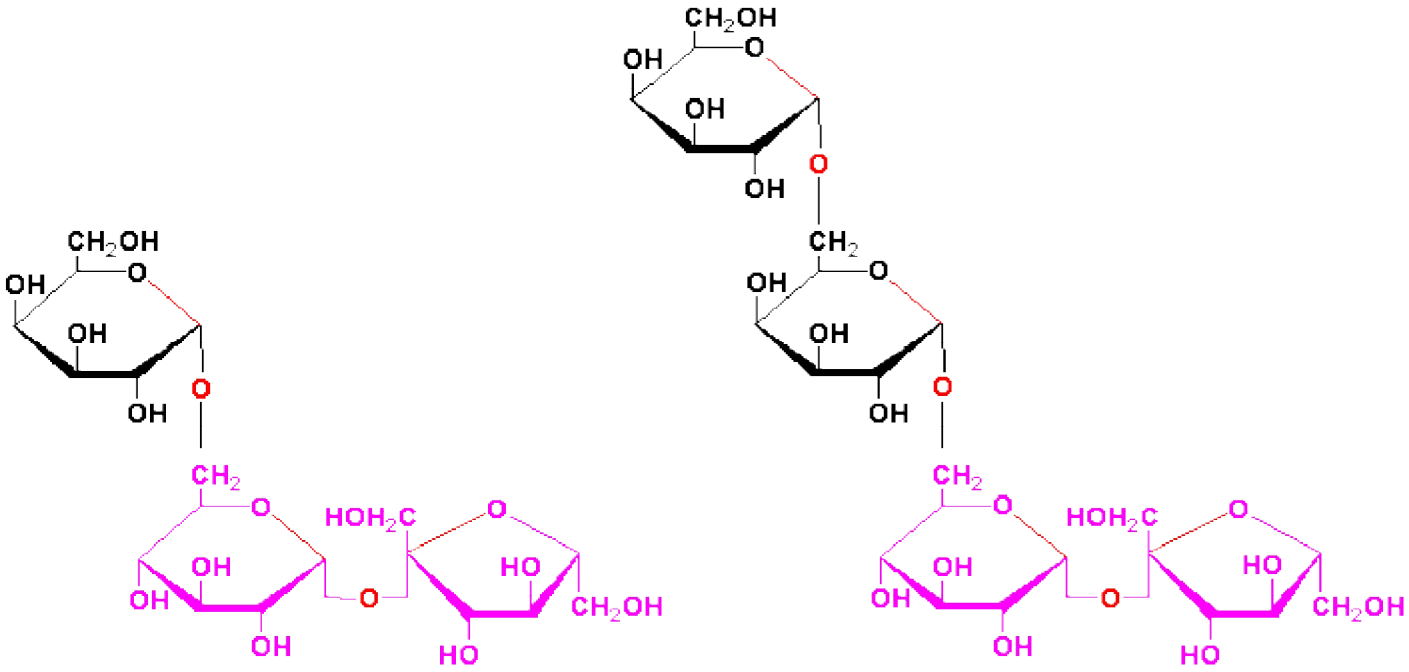
Sucrose





Oligosaccharides are also found as part of **glycoproteins** and play a role in cell recognition/identity. **Oligosaccharides** form the blood group antigens. In some cells, these antigens are attached as O-linked glycans to membrane proteins. Alternatively, the **oligosaccharide** may be linked to a lipid molecule to form a glycolipid. These **oligosaccharides** determine the blood group types in humans.

Sucrose is a precursor to a group of carbohydrates in plants known as the **raffinose family of oligosaccharides** found in many plant seeds especially legumes. This family contains the trisaccharide raffinose, the tetrasaccharide **stachyose** and the pentasaccharide **verbascose**:



Oligosaccharides play a role in cell recognition/identity. **Oligosaccharides** form the blood group antigens) by linkage to proteins in blood cell membranes forming glycoproteins or, in some cases, to lipids, forming glycolipids. Three different oligosaccharide structures give rise to the blood groups - A, B, and O. The base structure of each contains the structure of the O antigen. Specific glycosyltransferases add the extra monosaccharide to the O antigen to give rise to either the A or B antigen.

Polysaccharides

Polysaccharides are polymers of **monosaccharide** units. The monomeric units of a **polysaccharide** are usually all the same (called homopolysaccharides (polymer of one sugar)), though there are exceptions (called heteropolysaccharides (more than one sugar in polymer chain)

In some cases, the monomeric units are modified monosaccharides. **Polysaccharides** differ in the composition of the monomeric unit, the linkages between them, and the ways in which branches from the chains occur. Common polymers, their monomeric units, and linkages/branches are shown below:

Polysaccharide Name	**Monomeric Unit**	**Linkages**
Glycogen	**D-Glucose**	alpha 1->4 links with extensive alpha1->6 branches
Cellulose	**D-Glucose**	beta 1->4
Chitin	**N-Acetyl-D-glucosamine**	beta 1->4
Amylopectin	**D-Glucose**	alpha 1->4 links with some alpha 1->6 branches
Amylose	**D-Glucose**	alpha 1->4

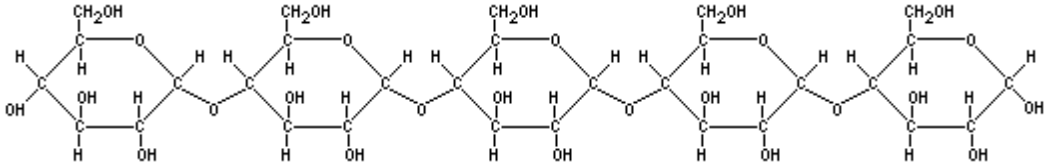
Linkages between the individual units require special enzymes to break them down. For example, the alpha 1-> 4 linkages between glucose units in glycogen, amylose, and amylopectin, are readily broken down by all animals, but only ruminants (cows) and related animals contain symbiotic bacteria with an enzyme (cellulase) that can break down the beta 1-> 4 linkages between individual glucose units in cellulose. As a result, the huge amount of cellulose in the biosphere is unavailable as an energy source to most animals.

Storage Polysaccharides

Polysaccharides are used to some extent for energy storage in almost all higher organisms. Plants use starch, Starches are insoluble in water and thus can serve as storage depots of glucose. Plants convert excess glucose into starch for storage. Rice, wheat, and corn are also major sources of starch in the human diet.

Starch composed of amylose and amylopectin

- **amylose** consists of linear, unbranched chains of several hundred glucose residues (units). The glucose residues are linked by a glycosidic bond between their #1 and #4 carbon atoms.



- **amylopectin** differs from amylose in being highly branched. At approximately every thirtieth residue along the chain, a short side chain is attached by a glycosidic bond to the #6 carbon atom (the carbon above the ring). The total number of glucose residues in a molecule of amylopectin is several thousand.