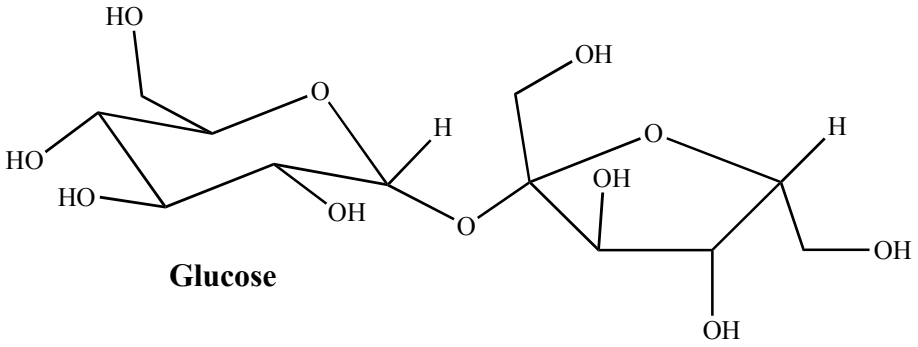
Carbohydrates (cont'd)

Sucrose: a disaccharide



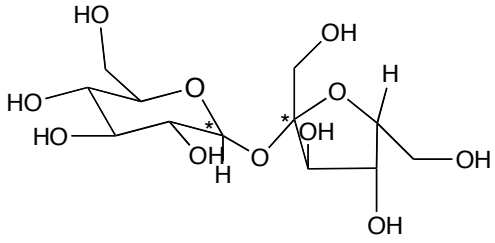
Glucose **Fructose**

The structure shown is sucrose (table sugar). It is made up of a glucose and a fructose molecule (sweetness index 100).

While Fructose has a sweetness index of 180.

Does this molecule have anomeric carbon?
Yes.

Identify the anomeric carbon.
They are highlighted with asterisks.



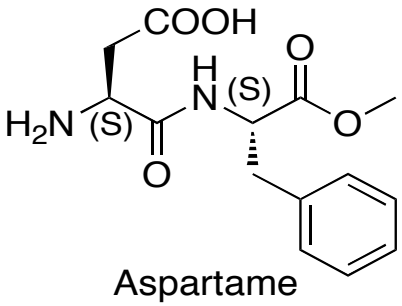
Glucose Fructose

Are they acetals or hemiacetals?
They are acetals. In both cases, the carbon has two OR group attached. There is no free OH group.

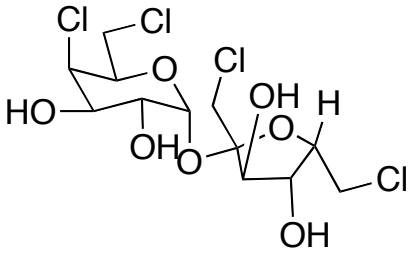
Is this sugar reducing or non-reducing?
Non-reducing since the anomeric carbons has acetal groups.

Taste and Sweetness:

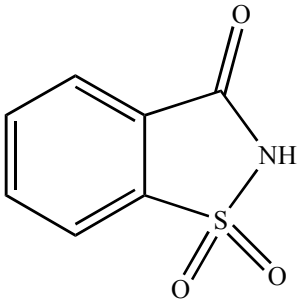
Some artificial sweeteners are shown below:



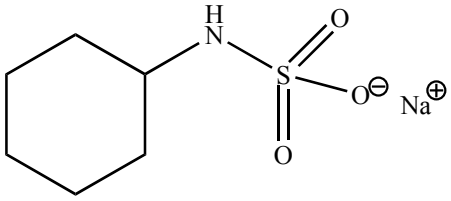
Aspartame
2000 times sweeter
than sugar



Splenda (sucralose)



saccharin

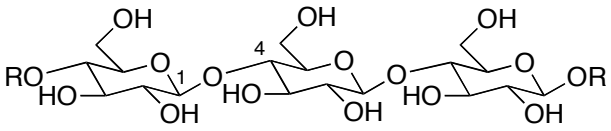


sodium cyclamate

Although a small amount tastes a lot sweeter than sugars, these are suggested to be carcinogenic in very large doses.

Polysaccharides = polymers of sugars
Disaccharides = 2 sugar linked
Trisaccharides = 3 sugar linked
Tetrasaccharides = 4 sugar linked
Oligosaccharides = Polysaccharides

Example: Cellulose



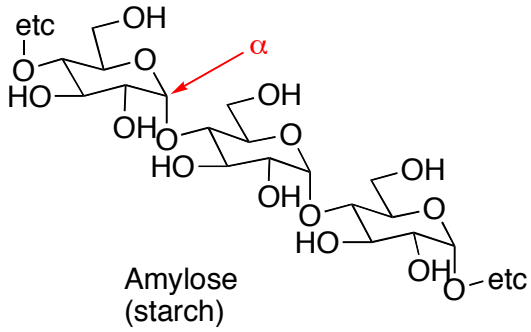
Cellulose (β-1,4-linkages)

Contains acetals (non-reducing sugars)

Cellulose is a polymer of simple repeating monosaccharide units (D-glucose) linked by β-1,4-linkages.

Many mammals cannot digest cellulose directly. Ruminants such as cows or goats have bacteria in their stomach to break it down to its simpler unit. The bacteria have a cellulose hydrolysis enzyme called cellulase which we do not have. Humans cannot metabolize β linkages.

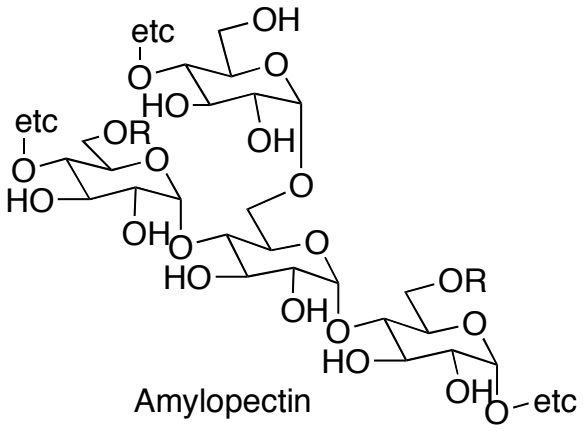
Example: Amylose



Amylose
(starch)

In contrast, amylose is a polysaccharide with α linkage between each monosaccharide units. Amylose can be digested by humans. Starch is comprised of approximately 20% amylose.

Example: Amylopectin



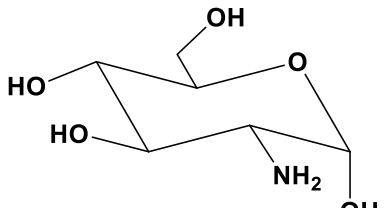
Amylopectin

Amylopectin is the other component in starch (~ 80%), which is similar to glycogen. Amylopectin (20-30 units in linear chain) above, in starch has additional α-1,6 linkages crosslinking the chains (approx every 20 units) into sheets. MW ~ 1 to 6 million $gmol^{-1}$

Glycogen often has a MW of ≥ 100 million.

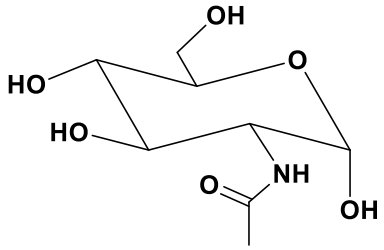
-has sheets similar to those of amylopectin; but about 12 units in a chain with 1,6-α-crosslinks every 6 to 12 units.

Glucosamine:



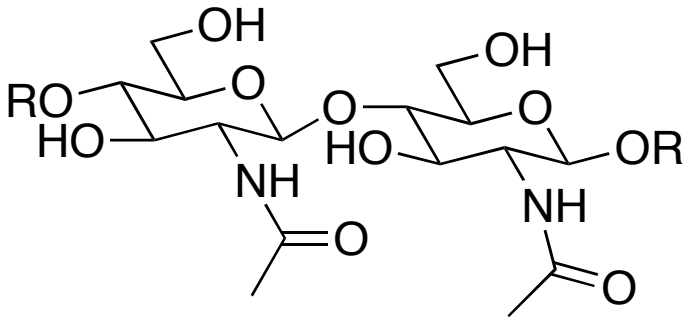
Glucosamine

N-Acetyl Glucosamine:



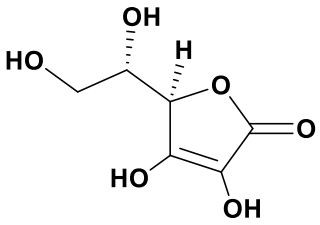
N-Acetyl Glucosamine

N-Acetyl Glucosamine polymer: Chitin



Chitin – The main constituent of exoskeletons of crustaceans and insects, a polymer of N-acetyl glucosamine.

Vitamin C: L-ascorbic Acid



Vitamin C

-from fruits and vegetables
-deficiency leads to Scurvy: soft, rotting skin
pain, bruises
convulsions, coma, death
-an antioxidant