GLUCOSE HEMI-ACETAL & ACETAL (GLYOSIDE) FORMATION: SOME COMMON CONCEPTS IN CARBOHYDRATE ("SUGAR") CHEMISTRY

Carbohydrates

- (*carbon + hydrate*) are molecules with three or more carbons and a general formula that approximates $C_nH_{2n}O_n$

Saccharides

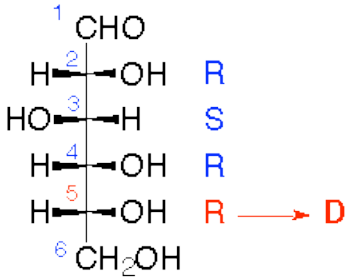
- are carbohydrates or sugars
- **monosaccharides** have one sugar moiety
- **disaccharides** have two sugars linked together
- **trisaccharides** have three sugars linked together
- **tetrasaccharides** have four sugars linked together, etc...
- **polysaccharide**s have an indeterminate number which can be hundreds of thousands or more

Prefixes and Suffixes

- the suffix (ending) for sugar names is: **-ose**
- the prefix defines the number of carbons:
  - **tri**ose (3 carbons)
  - **tetr**ose (4 carbons)
  - **pent**ose (5 carbons)
  - **hex**ose (6 carbons), etc…
- a further prefix defines the types of carbonyl group in the sugar:
  - **aldo-** (aldehyde) or
  - **keto-** (ketone)
  - for example glucose (shown below) is an "aldohexose" whereas fructose is a "ketohexose"
- the term **pyranose** means a six-membered sugar ring (hemiacetal or acetal - see below)
- the term **furanose** means a five-membered ring
- These terms are often prefixed as in "glucopyranose" which means glucose cyclized to its six-membered ring form (see below)

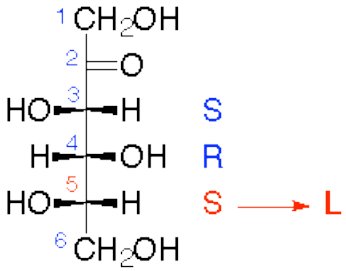
D- and L- Sugars

- This is a naming convention
- Using standard nomenclature numbering, determine the configuration (R or S) of **the highest numbered stereogenic center** ("chiral center" or "asymmetric center"):
  - if it has R-**configuration**, the sugar is **a D-sugar**
  - if it has **S-configuration**, the sugar is an **L-sugar**



D-Glucose

an aldohexose

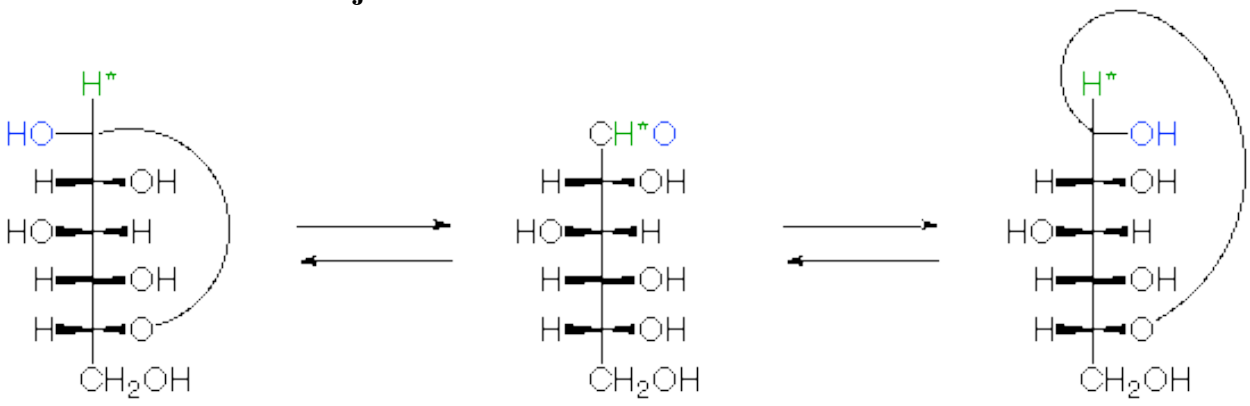


L-Sorbose

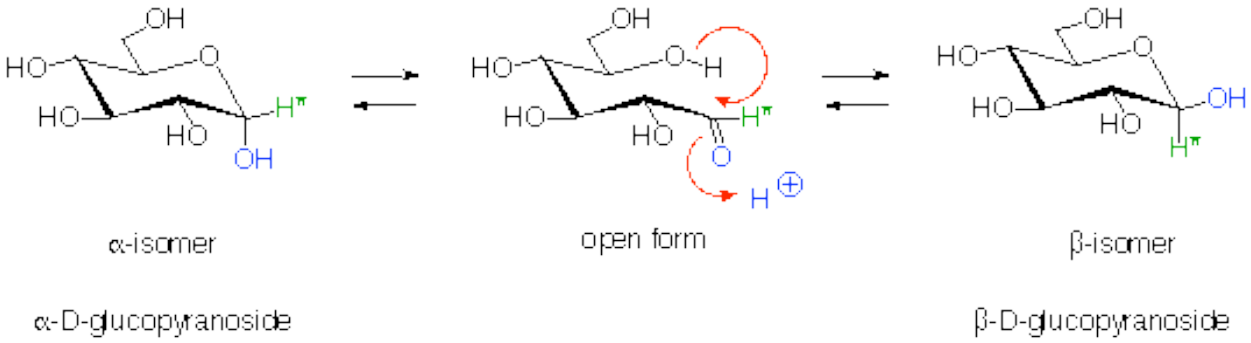
a ketohexose

Glucose Hemi-Acetal Formation

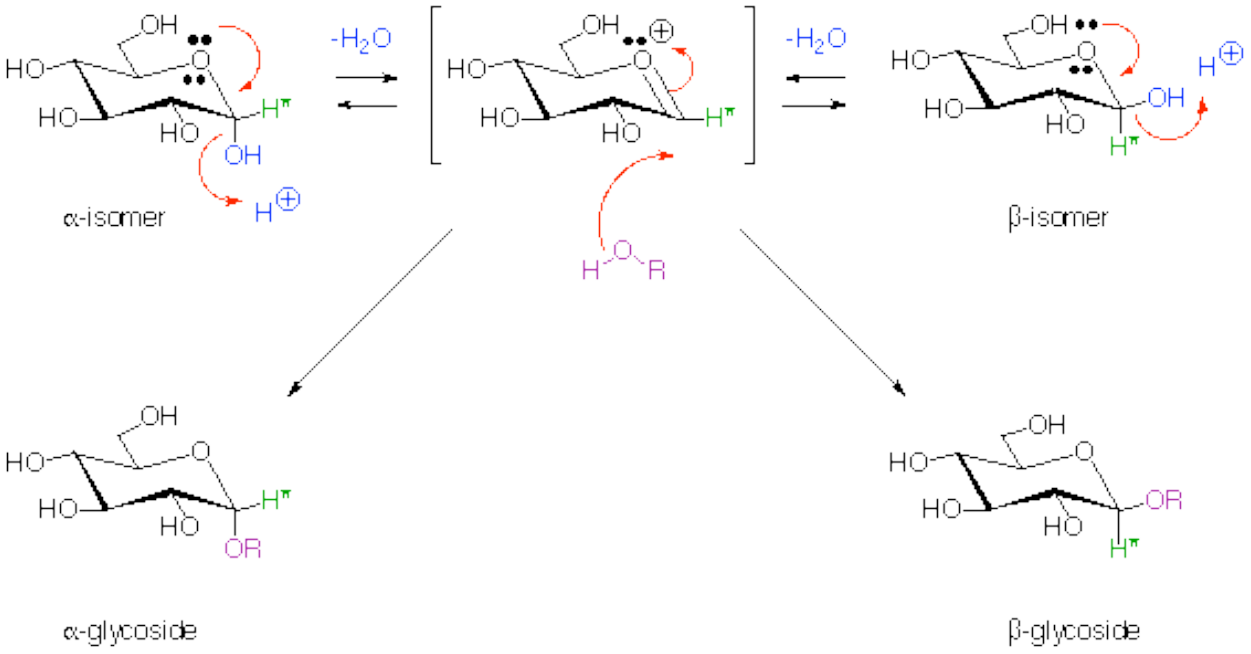
- The open form of D-glucose (and many other sugars) can cyclize to form **hemiacetals**.
- Under acidic conditions the hemiacetal form of glucose can react with other alcohols to give acetals known as **glycosides**. These are widely distributed in nature.
- These open form and cyclized structures can be depicted in different ways. All of these structure can be referred to as "D-glucose"
  - **Fischer Projection**:



- **3D Projection:**

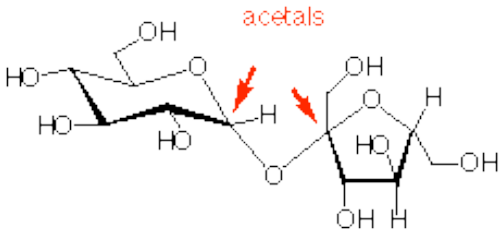


Glucose Acetal (Glycoside) Formation



Examples of Disaccharides

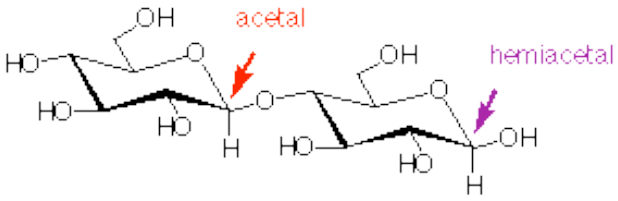
- In the following structures, the anomeric carbons (acetal or hemiacetal) are indicated by coloured arrows.
- The full systematic names of the sugars are given below their common names.



Sucrose (Table Sugar)

α-D-glucopyranosyl-β-D-fructofuranoside

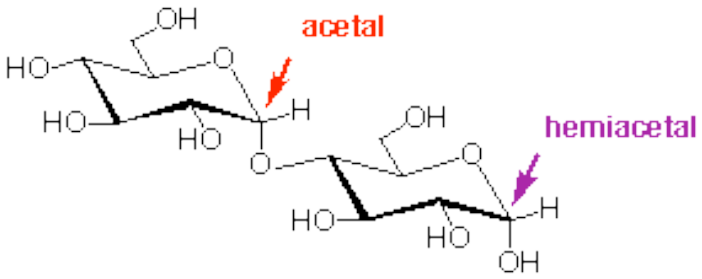
a non-reducing sugar



Cellobiose (from Cellulose)

β-D-glucopyranosyl-β-D-glucopyranoside

a reducing sugar



Maltose (a disaccharide made from starch)

α-D-glucopyranosyl-α-D-glucopyranoside

a reducing sugar