

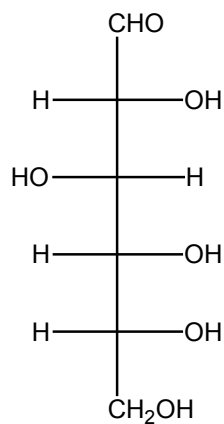
Tutorial 19: Monosaccharides

Goals:

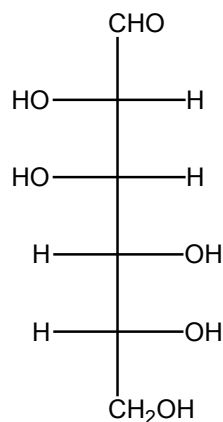
- ✓ To recognize the functional groups found in monosaccharides.
- ✓ To understand the structure of monosaccharides, including the acyclic and anomeric cyclic forms.
- ✓ To be able to draw the acyclic forms of D and L-glucose in Fischer projection.
- ✓ To understand the reactions involved in mutarotation.

Monosaccharides

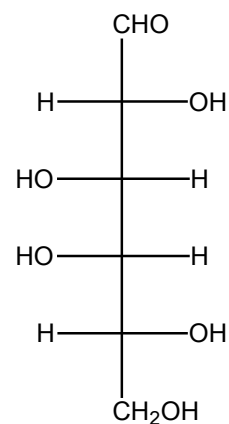
- Simple sugars (simplest carbohydrates)
- Contain 3-7 carbon atoms
- Have one aldehyde or ketone functional group making them an aldose or ketose, respectively
- Fischer Projection is drawn with the aldehyde or ketone at the top
- If the alcohol on the lowest chiral carbon is to the right, it is the D enantiomer
- If the alcohol on the lowest chiral carbon is to the left, it is the L enantiomer
 - NOTE: This **DOES NOT** tell you which direction the compound rotates plane polarized light. This just gives us a way to distinguish between carbohydrates that exist as enantiomers. The (+) and (-) are used to distinguish dextrorotatory and levorotatory, respectively.



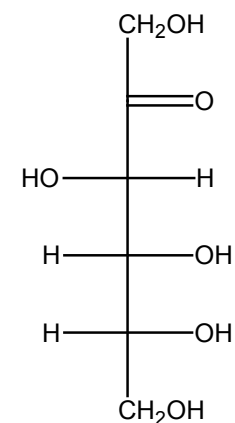
D-(+)-Glucose



D-(+)-Mannose



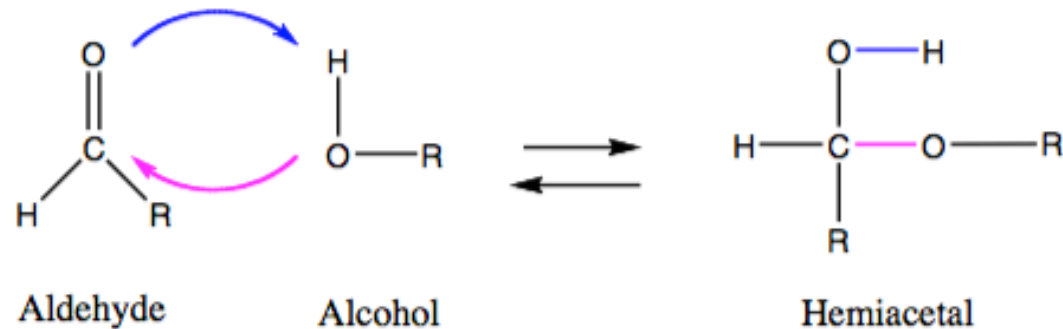
D-(+)-Galactose



D-(-)-Fructose

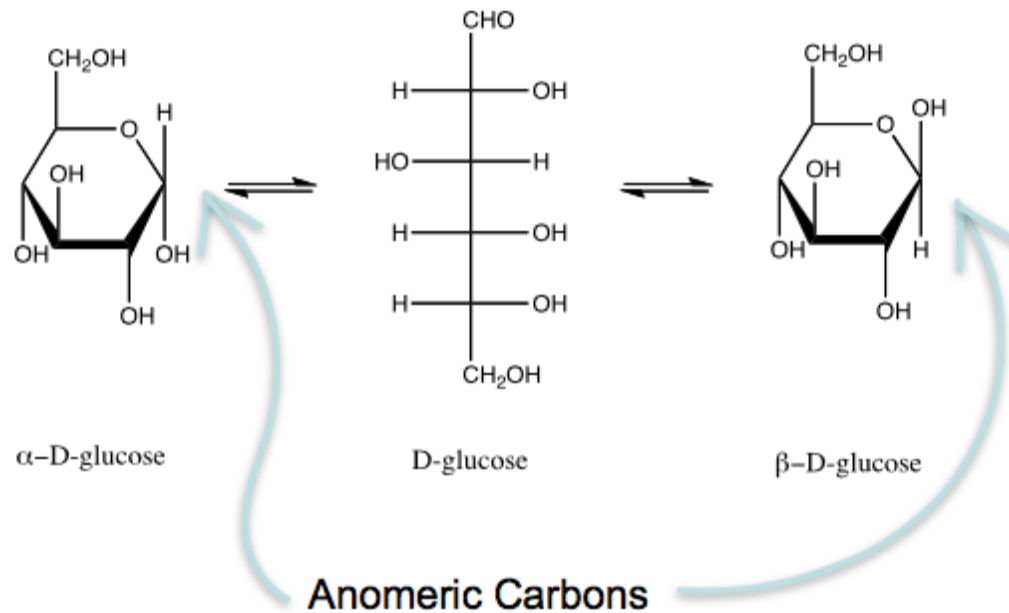
Hemiacetal Formation

- Aldehydes and ketones react with alcohols to form hemiacetals
- A hemiacetal has an –OH and an –OR group bonded to the same carbon
- Note that when a hemiacetal is formed from a ketone, the more specific term of hemiketal is sometimes used
- This reaction is important for understanding mutarotation in monosaccharides

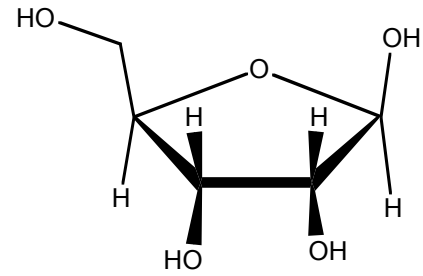
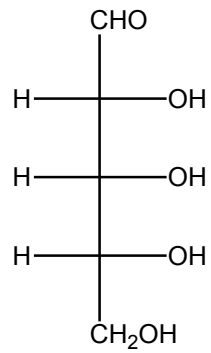


Mutarotation

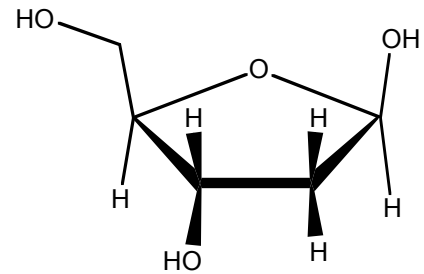
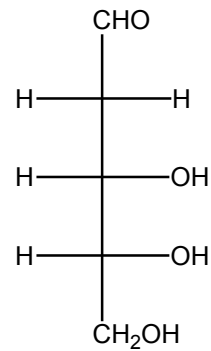
- The alcohol of C-4 or C-5 can react with the aldehyde to form a five or six membered ring, respectively. For fructose the reaction is between the ketone and the alcohol from C-5 or C-6
- Five membered cyclic hemiacetals of carbohydrates are called furanose forms, while six membered rings are called pyranose forms
- Notice that this results in a stereogenic center at the hemiacetal carbon where the alcohol can point down (alpha) or up (beta); the alpha and beta forms are called anomers
- In solution mutarotation occurs, so you would find the open chain and the cyclic forms of a monosaccharide



A Look Ahead at D-Ribose and D-Deoxyribose



Ribose: found in RNA



Deoxyribose: found in DNA