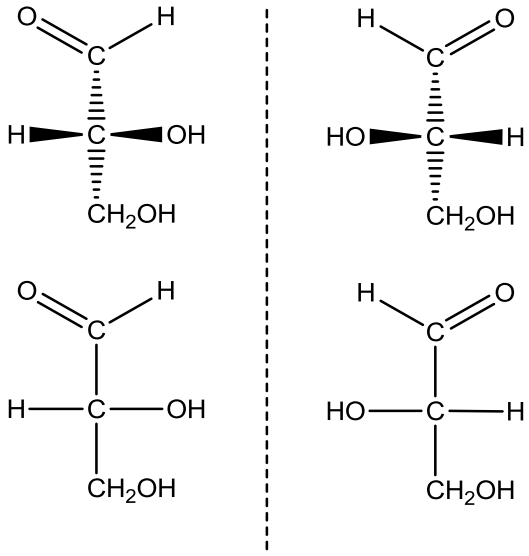
CHEM1611 Worksheet 12: Sugars

Model 1: D and L Sugars

The simplest sugar is glyceraldehyde. This is a chiral molecule and the two enantiomers are shown opposite with wedges and dashes and as **Fischer projections**.



To distinguish these isomers, chemists call them L-glyceraldehye and D-glyceraldehyde. By convention:

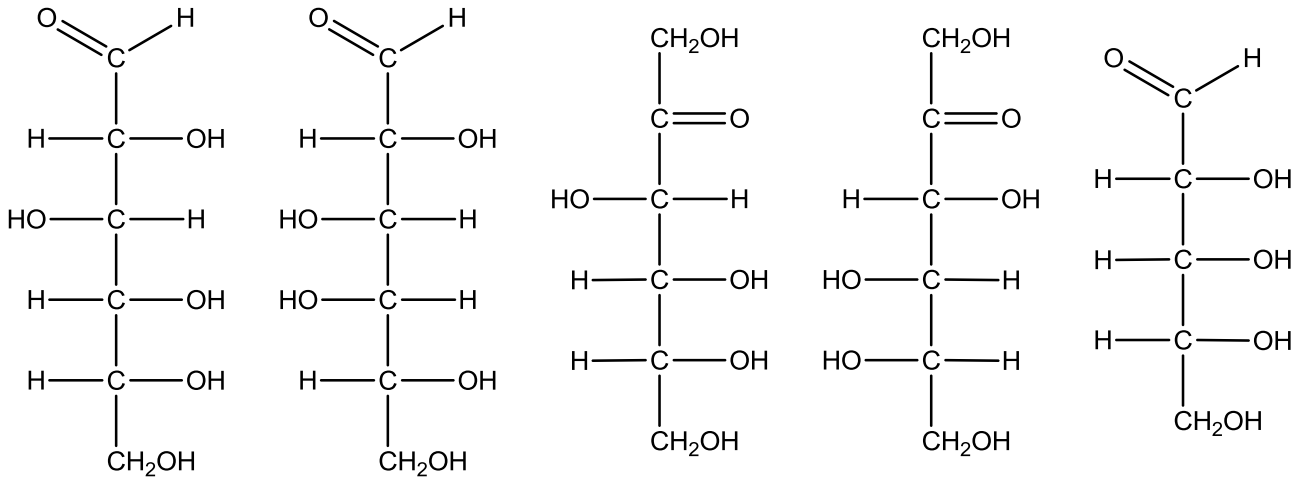
- D sugars have the OH group on the *bottom* chiral carbon on the right in the Fischer projection and
- L sugars have the OH group on the *bottom* chiral carbon on the left in the Fischer projection.

Nearly all naturally occurring sugars have the D configuration.

Critical thinking questions

1. Label the stereogenic carbon atoms in the structures above with an asterisk.
2. By using the convention, label the two forms above as either D-glyceraldehyde or L-glyceraldehyde.

Five sugars are shown below.



glucose **galactose** **fructose** **fructose** **ribose**

3. Using the convention, add the appropriate "D" or "L" label to the name of each of these sugars.
4. Label all of the stereogenic carbon atoms in the structures with an asterisk.
5. Two forms are fructose are shown. What is the relationship between the stereogenic centres in the L and D isomers of a simple sugar?

Model 2: Aldohexoses, aldopentoses, ketohexoses and ketopentoses

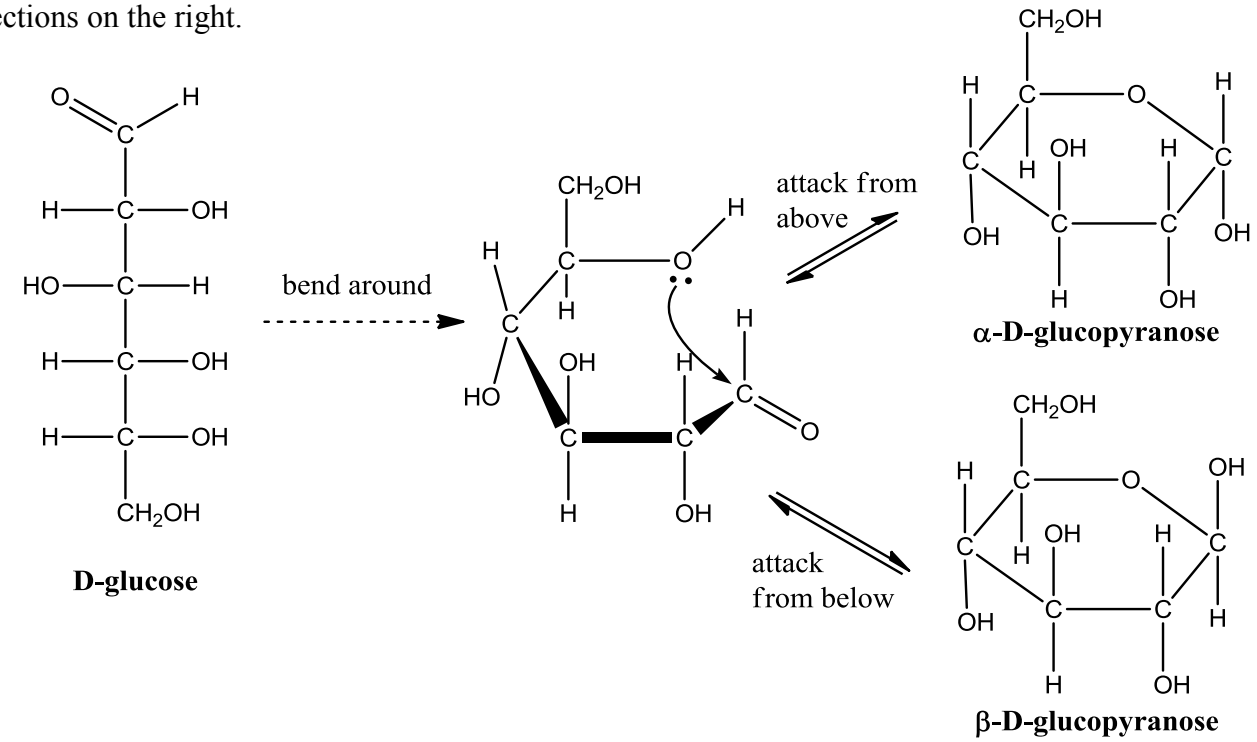
Aldoses contain an aldehyde group. Ketoses contain a ketone group. Most common sugars have 5 or 6 carbons and so are called pentoses or hexoses. These terms are mixed to produce the names aldohexoses, aldopentoses, ketohexoses and ketopentoses.

Critical thinking questions

1. Label each sugar above as an aldohexose, aldopentose, ketohexose or ketopentose.

Model 3: Cyclic structures and Haworth Projections

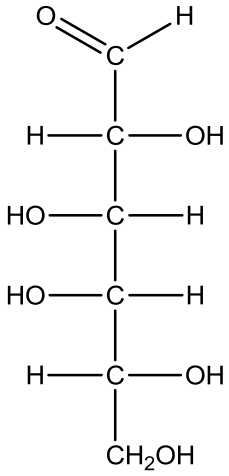
As you saw in Worksheet 8, alcohols can react with carbonyls to form hemiacetals. The sugars in Model 1 contain both of these groups and can react with themselves to form 5 and 6 membered hemiacetal rings. These are the forms in which sugars usually exist. The cyclic structures are represented using **Haworth projections**. The formation of the cyclic structures from D-glucose is shown below with the Haworth projections on the right.



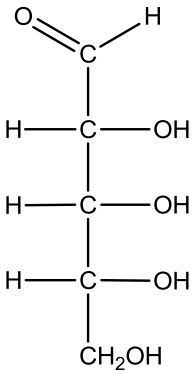
In D sugars, the CH_2OH group points upwards. In L sugars, the CH_2OH group points downwards.

Critical thinking questions

1. Starting at the carbonyl carbon, label the carbon atoms in the Fischer projection as C1, C2, C3, C4, C5 and C6.
2. Add these labels to the equivalent carbon atoms in the bent structure and to the Haworth projections.
3. Circle the OH group in the Fischer projection which ends up as the O in the ring structure.
4. By following what happens to the position of the other OH groups, complete the following:
   - an OH group on the right in the Fischer projection is **up / down** in the Haworth structure
   - an OH group on the left in the Fischer projection is **up / down** in the Haworth structure
5. By using your answers to the Q1 – Q4, draw the Haworth structures* for the two sugars below.



D-galactose



D-ribose

* 5 and 6 membered rings are possible for ribose.