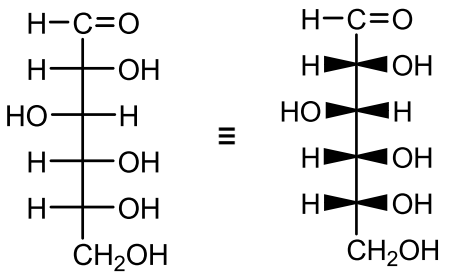
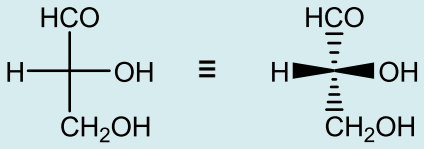
Carbohydrates

Molecules with formula $C_nH_{2n}O_n$.



D-*glucose*
($C_6H_{12}O_6$)

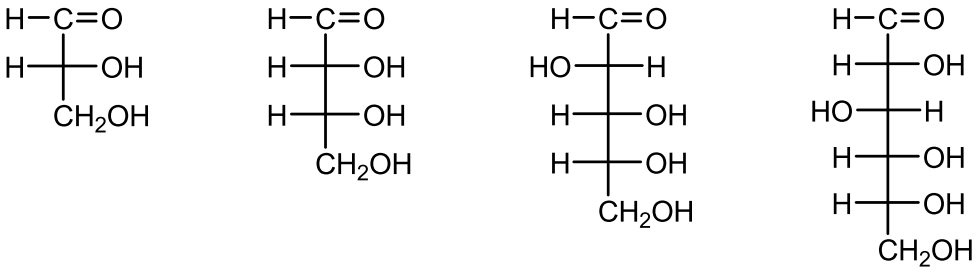
Fisher projections:



D-/L- notation: After placing most-oxidized carbon on top, sugars with last chiral –OH on right are D-sugars.

Monosaccharides: Aldoses and Ketoses

Aldoses are polyhydroxy-aldehydes.



D-*glyceraldehyde*
($C_3H_6O_3$)

an aldo**triose**

D-*erythrose*
($C_4H_8O_4$)

an aldo**tetrose**

D-*arabinose*
($C_5H_{10}O_5$)

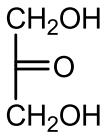
an aldo**pentose**

D-*glucose*
($C_6H_{12}O_6$)

an aldo**hexose**

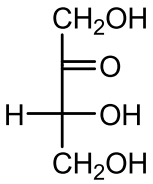
Monosaccharides: Aldoses and Ketoses

Ketoses are polyhydroxy-ketones.



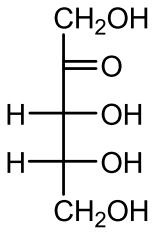
dihydroxyacetone
($C_3H_6O_3$)

a keto**triose**



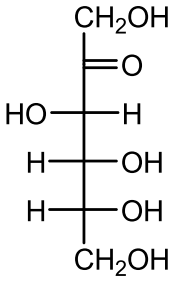
D-*erythrulose*
($C_4H_8O_4$)

a keto**tetrose**



D-*ribulose*
($C_5H_{10}O_5$)

a keto**pentose**

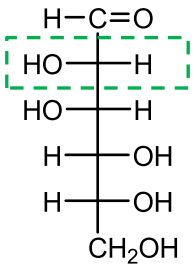


D-*fructose*
($C_6H_{12}O_6$)

a keto**hexose**

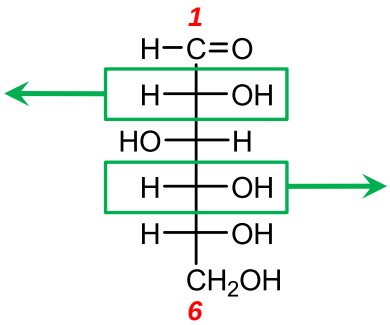
Epimers

Epimers differ in stereochemistry at one carbon.

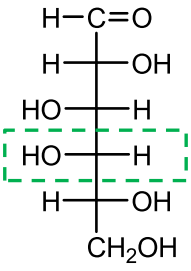


D-*mannose*

the **C2**-epimer of glucose



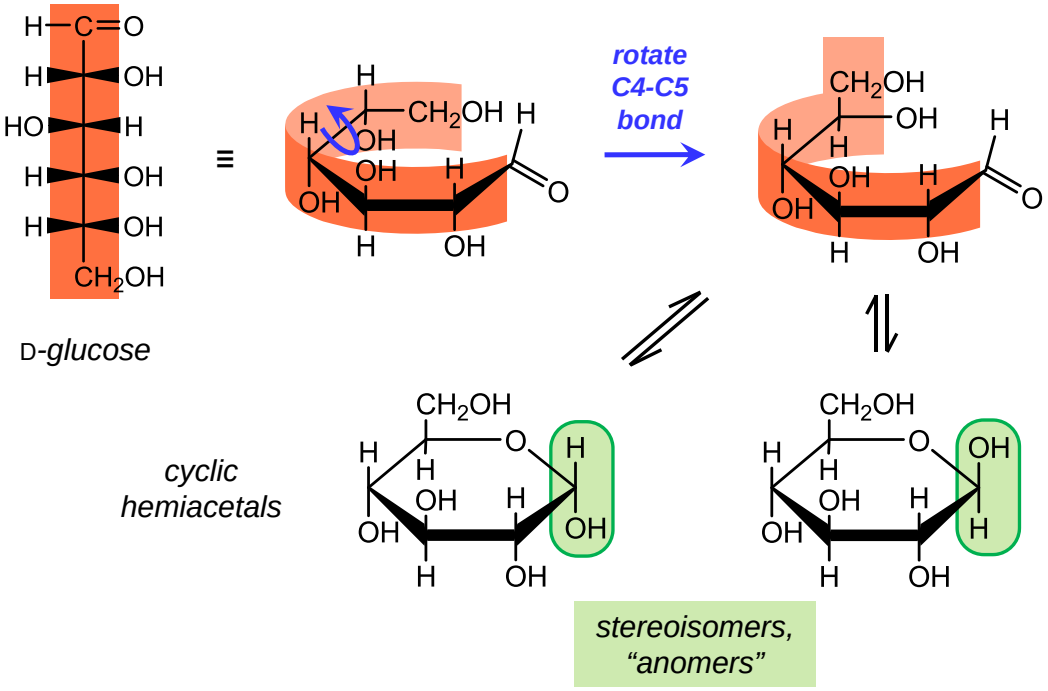
D-*glucose*



D-*galactose*

the **C4**-epimer of glucose

Monosaccharides Equilibrate Between Acyclic and Cyclic Forms



D-*glucose*

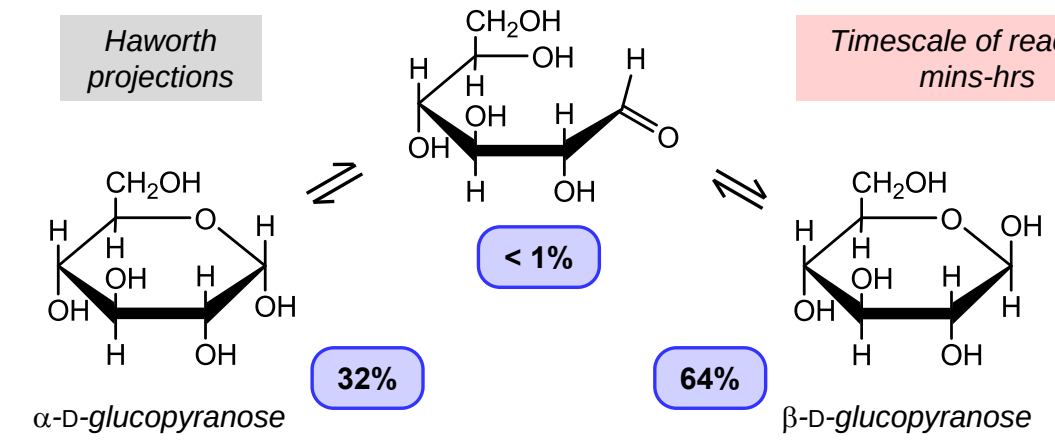
cyclic hemiacetals

stereoisomers, "anomers"

Equilibrating Glucose Anomers

Haworth projections

Timescale of reaction: mins-hrs

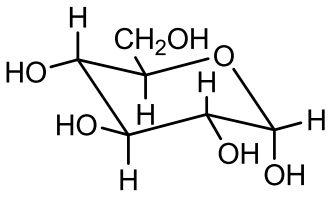


α-D-*glucopyranose*

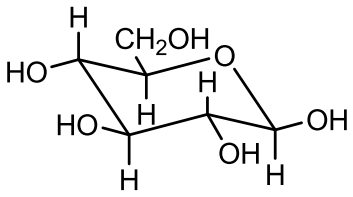
β-D-*glucopyranose*

The Anomeric Effect

α-D-*glucopyranose* **32%** ⇌ **64%** β-D-*glucopyranose*

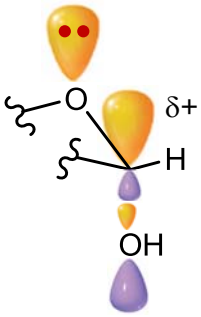


"mutarotation"



Advantage:
The anomeric effect.

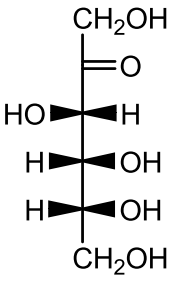
Interaction between O_{sp^3} lone pair and C1-O σ* antibonding orbital is stabilizing, and orbitals are oriented correctly.



Advantage:
Hydroxyl group is equatorial.

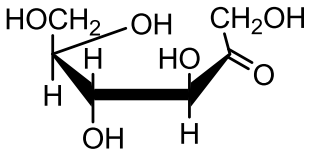
Anomeric effect not possible for β-anomer; orbitals don't line up.

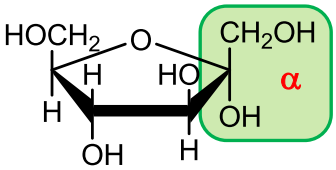
Ketoses Also Equilibrate Between Acyclic and Cyclic Forms



D-*fructose*

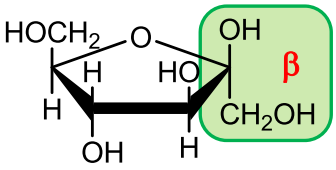
≡





cyclic hemiketals

α-D-*fructofuranose*



β-D-*fructofuranose*

Also forms pyranose (6-membered) rings.

70%

30%, *but found most often in complex sugars.*