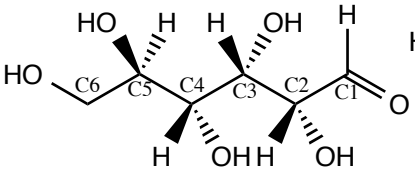
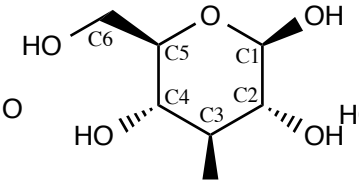
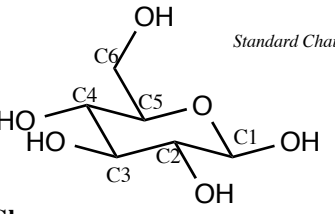
CHEM 215 Review: Aldohexose Nomenclature, Epimers, D/L, Alpha/Beta

Carbohydrate names are dependent on the relative stereochemical configuration at numbered carbons. Beginning at the carbon that was the aldehyde of our open-chain form, carbons are numbered in order.



D-Glucose



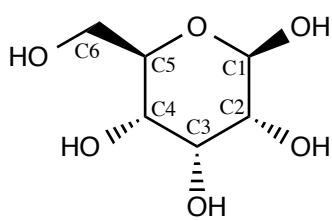


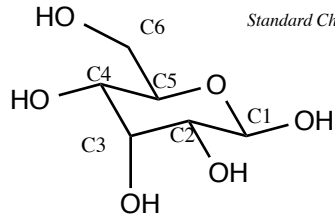
Standard Chair Form in pKa Table

D-Beta-Glucopyranose

Epimers: Interconversion of a single R/S stereocenter from either R to S or S to R while retaining the other R/S configurations present in a molecule. Epimers at C2, C3, and/or C4 are different sugar names. An epimer at the anomeric carbon (Carbon 1) is known as an **anomer**. The epimer at Carbon 5 is a more specialized case we discuss below with regards to D/L labeling.

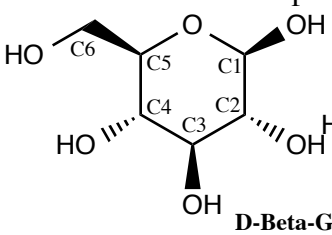
D-Beta-Allopyranose, C3 Epimer of Glucose

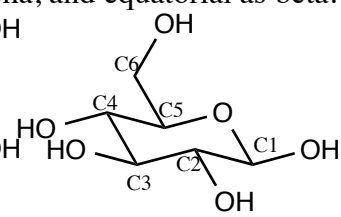




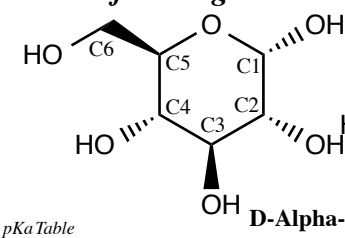
Standard Chair Form in pKa Table

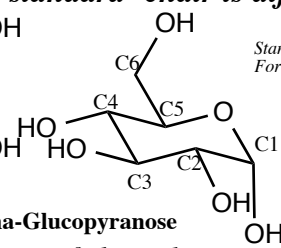
Alpha vs. Beta: These are epimers at C1 (the anomeric carbon) of a cyclic glycoside, and describes a relationship between C1 and C5. If C1 OH and C5 CH_2OH groups are *cis* across the ring, it is a beta sugar. If C1 and C5 groups are trans, this is an alpha sugar. In our D-glycoside chair shown above, that translates to axial as alpha, and equatorial as beta. ***Note that for L sugars the 'standard' chair is different.***





D-Beta-Glucopyranose *Standard Chair Form in pKa Table*



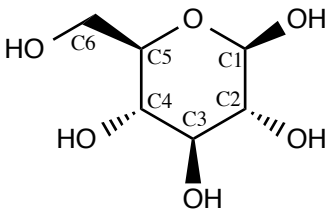


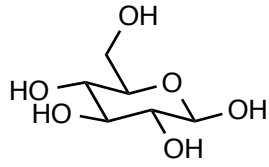
Standard Chair Form in pKa Table

D-Alpha-Glucopyranose

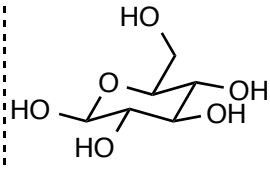
D vs. L: This is a specific stereochemical designation based on the *geometry of the substituent at C5*. This is **NOT** an artifact of R vs. S stereochemistry - instead, consider the geometry with respect to the rings found in our sample problem. For aldohexoses *drawn in the standard chair shown on the pKa table*, C5 equatorial is D, axial would be L. D-Beta-Glucopyranose and L-Beta-Glucopyranose are enantiomers. As such, one can easily convert between D and L by drawing a mirror image. Clarification on this can be found in the sample problem below.

Mirror Plane

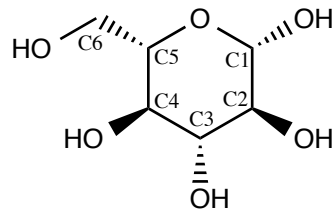




D-Beta-Glucopyranose

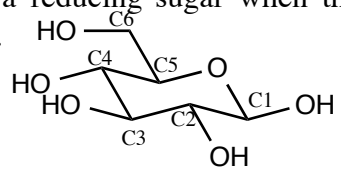


L-Beta-Glucopyranose



Reducing Sugars: A sugar is considered to be a reducing sugar when there is a hemiacetal that can convert to an aldehyde via acetal/ketal conversion.

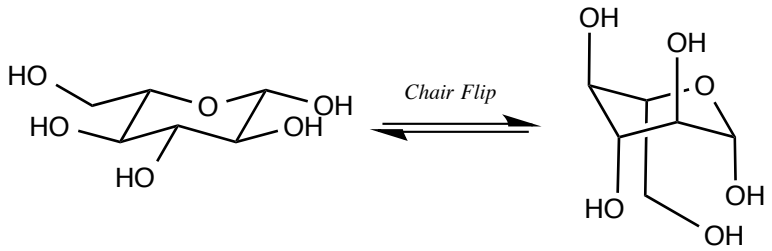
D-Beta Glucopyranose, a Reducing Sugar



Final Thoughts: As noted in these descriptions, we are using the "Standard Chair Form" as shown in the pKa Tables distributed with exams. These descriptions of axial vs. equatorial as describing either the alpha/beta or the D/L are **ONLY** accurate when using this specific chair form where numbered carbons are as shown.

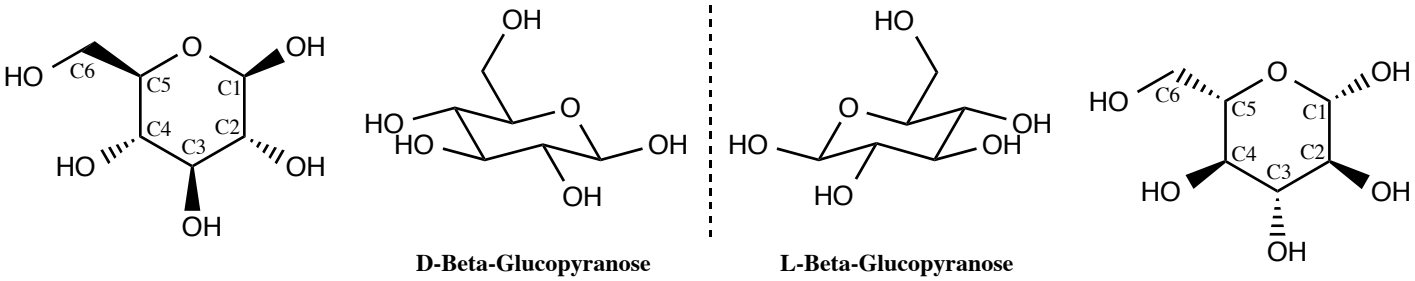
Sample Problem:
Allose is the C-3 Epimer of Glucose. Provide Drawings of the open chain form of L-Allose and its Beta-Pyranose Form.

Another representation of the L-Beta- Glucopyranose Sugar, this time in our typical "D-Sugar" pKa table conformation. Note the Beta cis relationship of C5 and C1 substituents, as well as the relative stereochemistry of C5 in our standard chair. ***NOTE: While we can flip the L-chair to an all-axial conformation where we have C5 equatorial, this is <u>NOT</u> our standard pKa table chair! The chair shown on the right is: note the geometry at C5: axial.***



L-Beta-Glucopyranose **L-Beta-Glucopyranose**

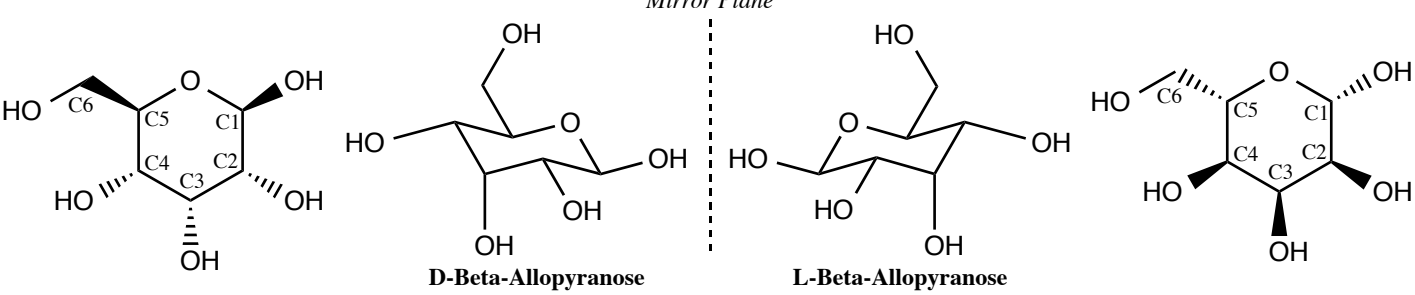
Mirror Plane



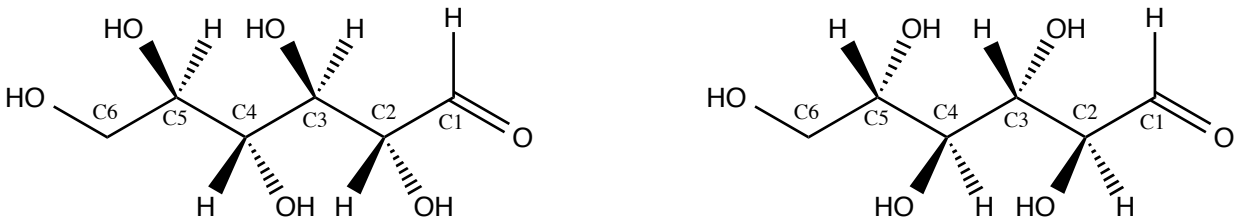
D-Beta-Glucopyranose **L-Beta-Glucopyranose**

C3-Epimer C3-Epimer

Mirror Plane



D-Beta-Allopyranose **L-Beta-Allopyranose**



D-Allose **L-Allose**