BIO-ORGANIC CHEMISTRY
(Organic Chemistry for Biology Students)
(SQBS 1603)

Basic Compounds in Biomolecules: Saccharides in Carbohydrate

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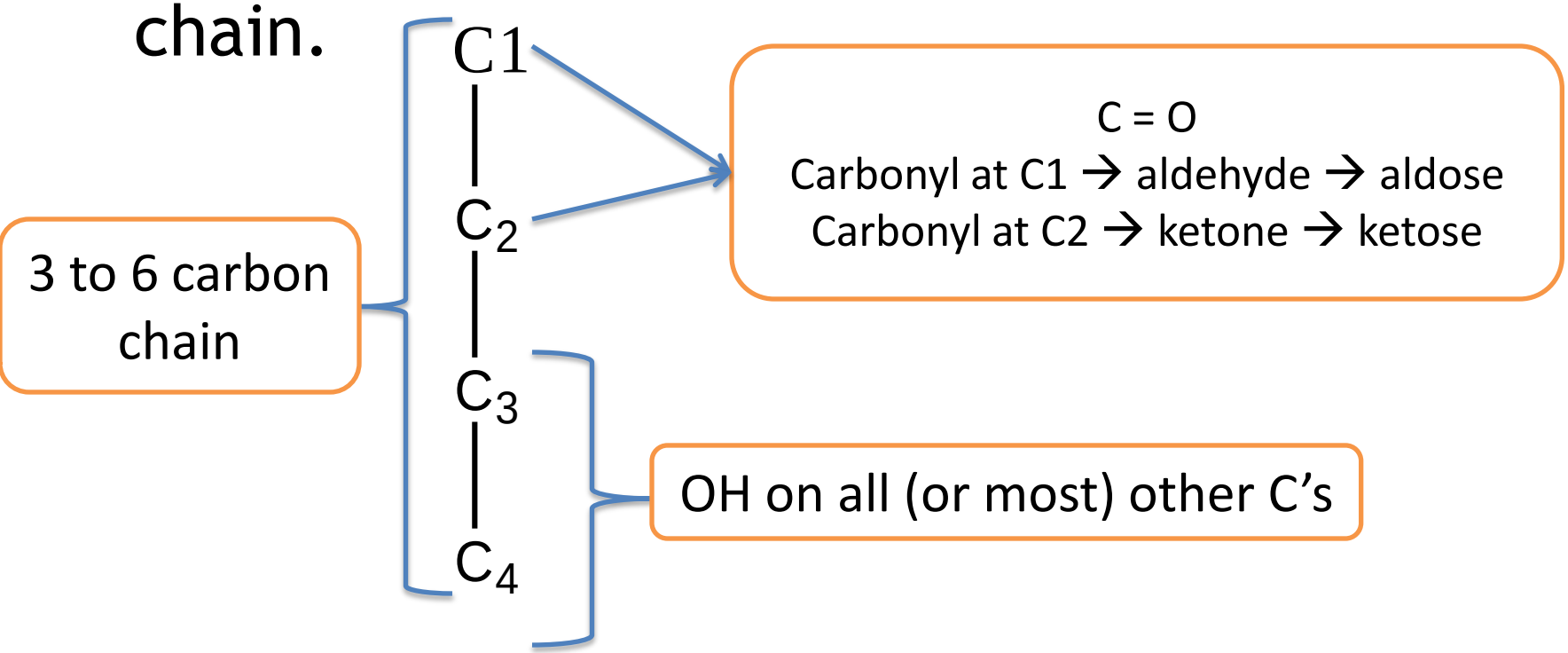
Carbohydrates

- Carbohydrates
  - Carbon + hydrates = carbohydrates
  - Hydration of carbon because of the molecular formula of simple carbohydrates could be written as $C_n(H_2O)_n$
- Monosaccharides: simple sugar
  - E.g: Glucose, fructose
- Disaccharides
  - E.g: lactose
- Polysaccharides
  - E.g: Starch

Monosaccharide

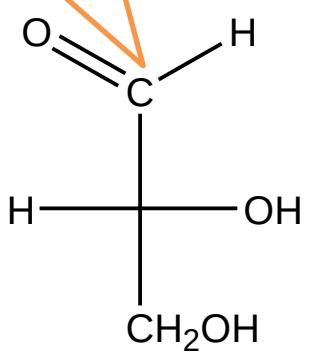
- The simplest carbohydrates.
- Generally have 3 to 6 carbon atoms in a chain.



Monosaccharide

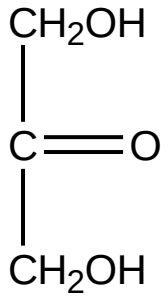
The simplest monosaccharide

Aldehyde → aldose



Glyceraldehyde

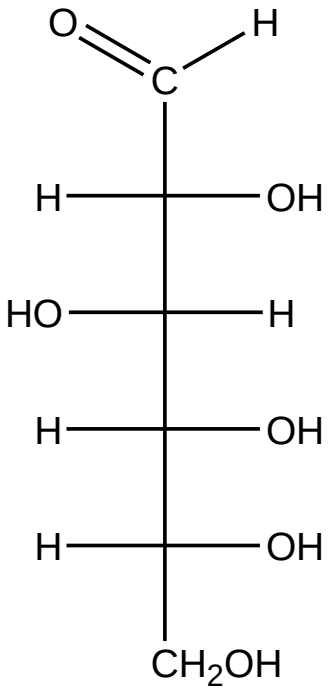
ketone → ketose



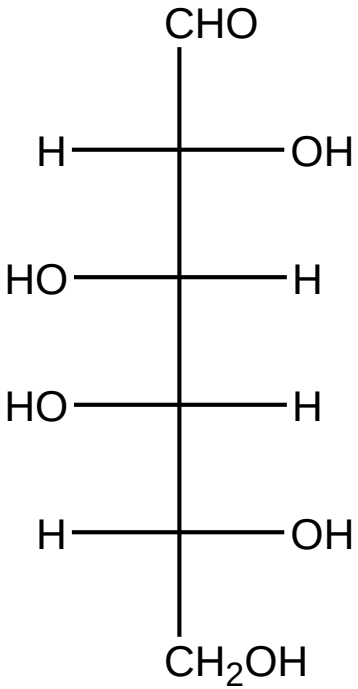
dihydroxyacetone

Monosaccharide

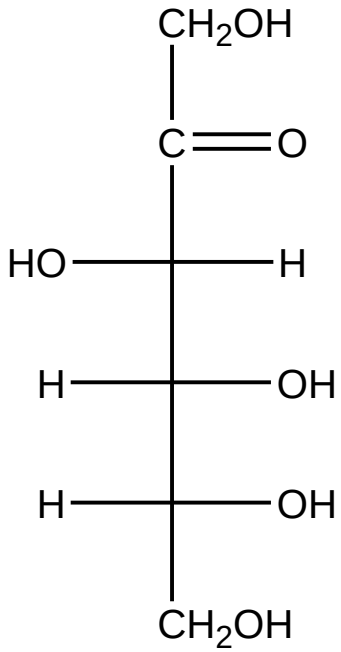
The most important monosaccharide



Glucose



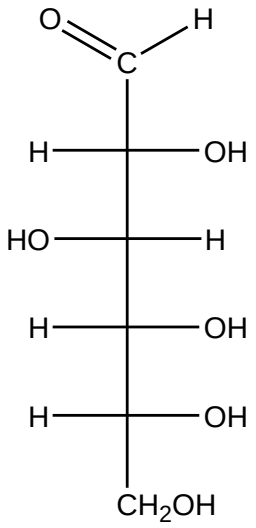
Galactose



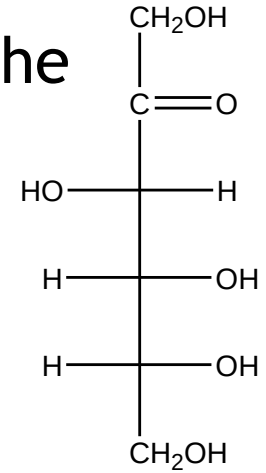
Fructose

Monosaccharide

- Two main group of monosaccharide according to the carbon atom to which the carbonyl group is attached
  1. Aldose :
     - ❖ carbonyl group is attached to the terminal (end) C atom.
  2. Ketoses :
     - ❖ carbonyl group is attached to the second C atom.



Glucose

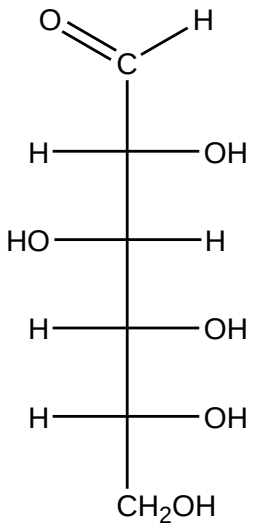


Fructose

Monosaccharide

- A monosaccharide is characterized by the number of carbons in its chain
  - 3 C's → triose
  - 4 C's → tetrose
  - 5 C's → pentose
  - 6 C's → hexose

Aldose + hexose = aldohexose

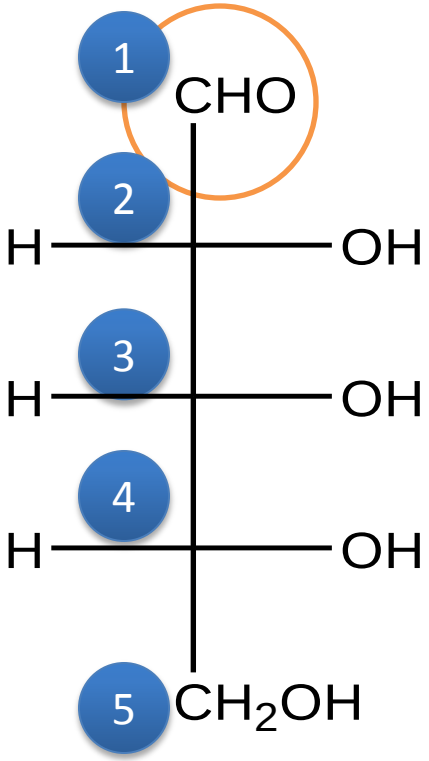


Glucose

Monosaccharide

- Classification of this monosaccharide by the type of carbonyl group and the number of carbons in chain.

Ribose



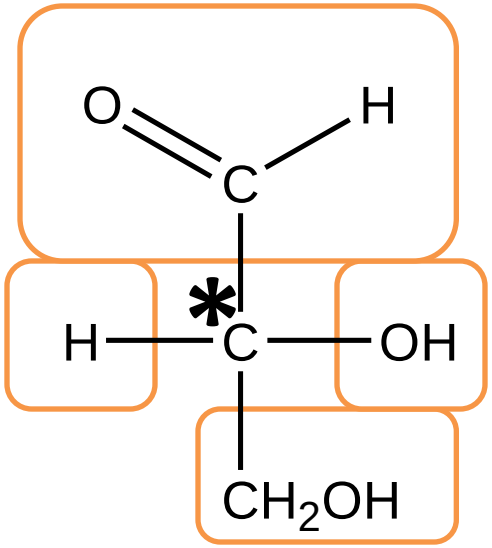
Carbonyl at the terminal → aldose

5 C's→ pentose

Aldopentose

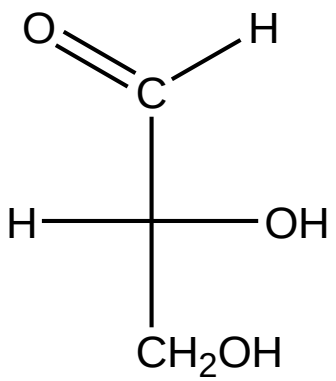
Monosaccharide

- The presence of chirality centers
  - Chirality center → C atom is bonded to 4 different elements
  - example

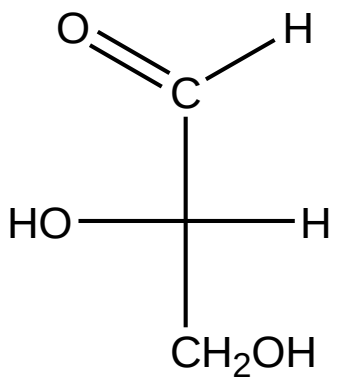


Glyceraldehyde

Two enantiomers



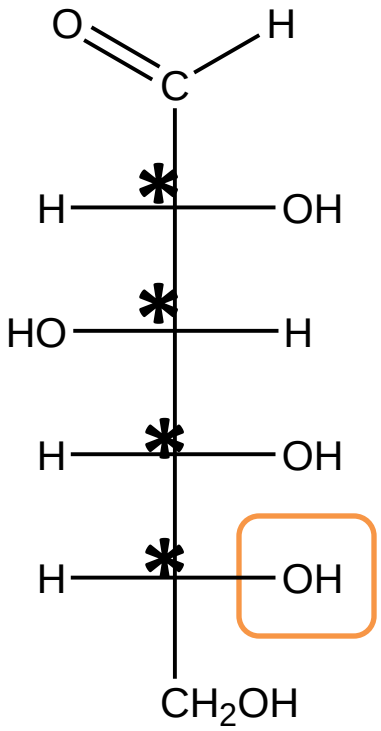
D-glyceraldehyde



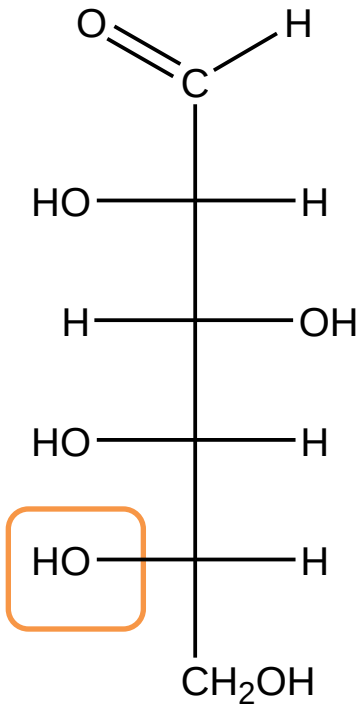
L-glyceraldehyde

Monosaccharide

- Monosaccharides with more than one chirality centers



D-glucose



L-glucose

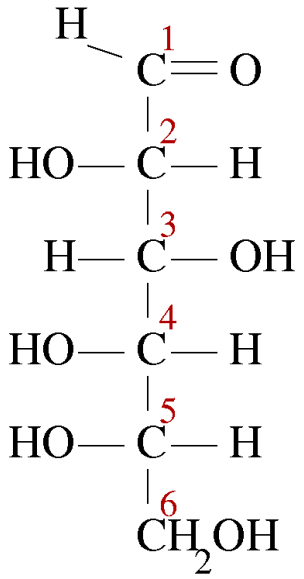
Chirality center farthest from the C=O

D → OH group on the right
L → OH group on the left

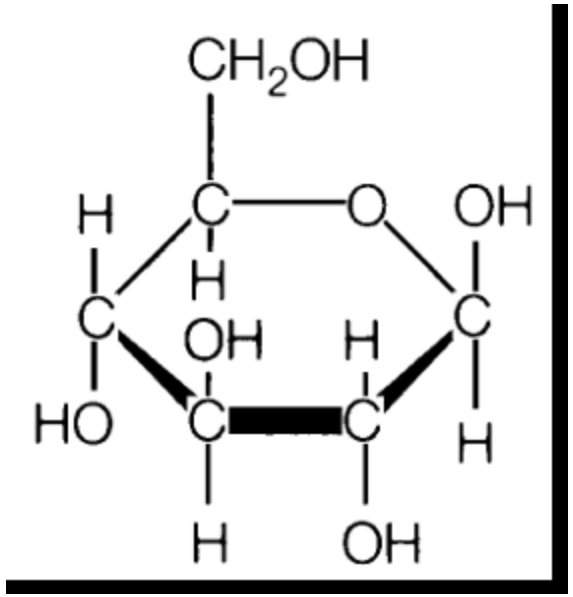
Monosaccharide

- Two distinct structural formula of monosaccharide
  1. Straight chain (or open chain) structure
  2. Cyclic (ring) structure

Straight chain

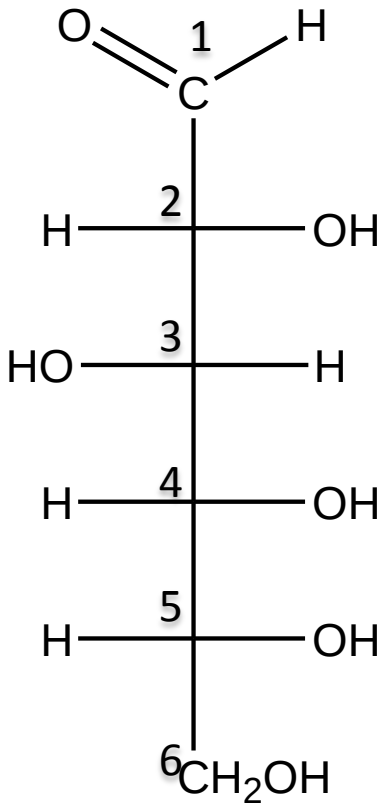


Cyclic



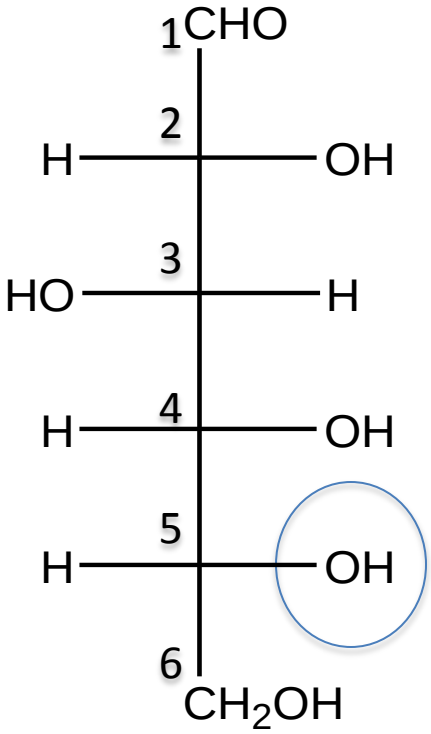
Monosaccharide

- Formation of the cyclic form of $_D$-glucose

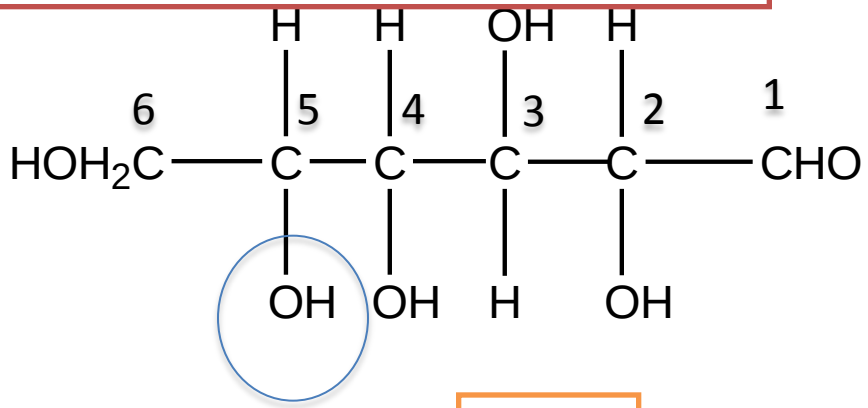


This OH group is the right distance away from the carbonyl for cyclization to a six-membered ring

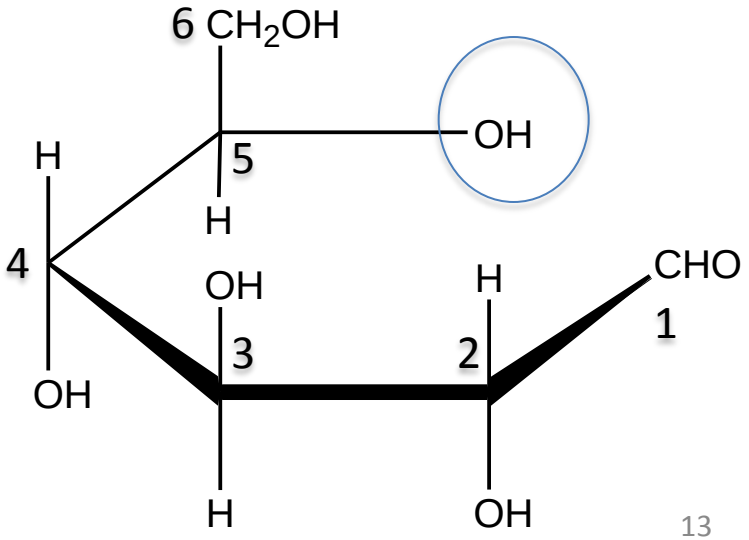
Monosaccharide



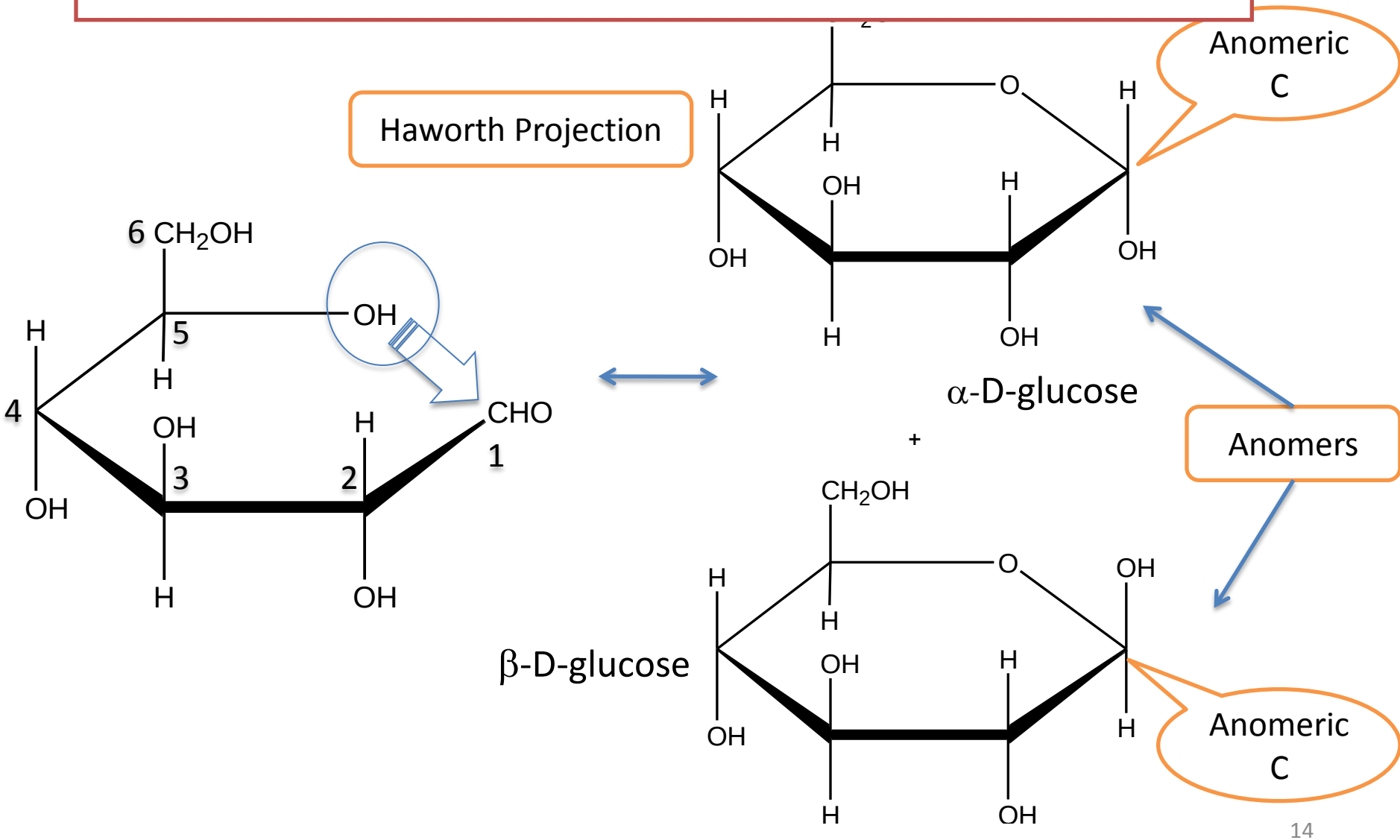
rotate



Twist

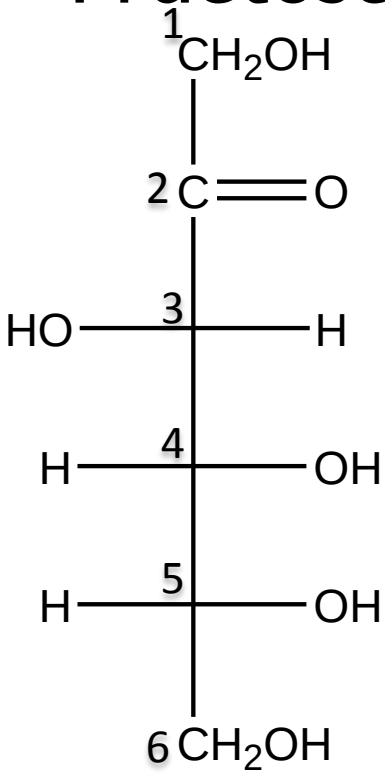


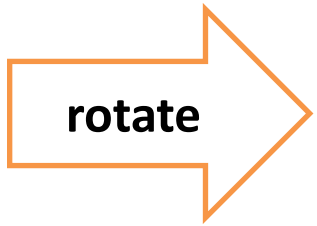
Monosaccharide

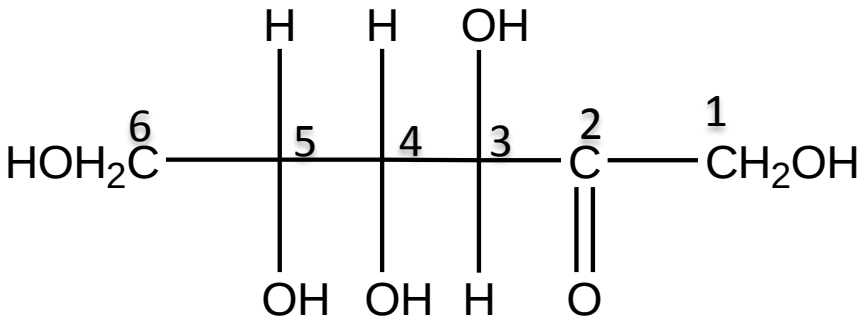


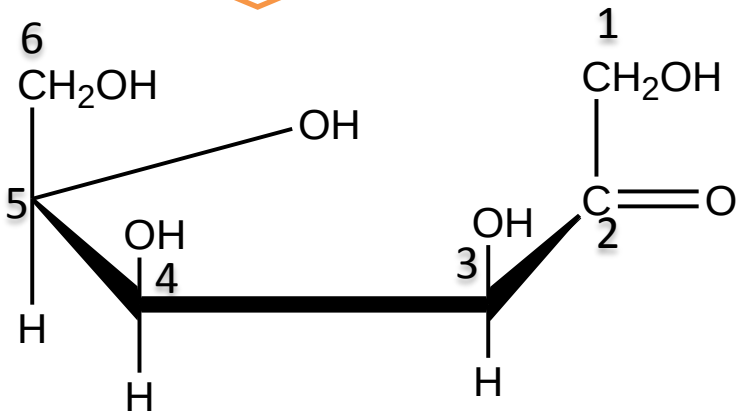
Monosaccharide

- The cyclic form of ketohexose, e.g: Fructose

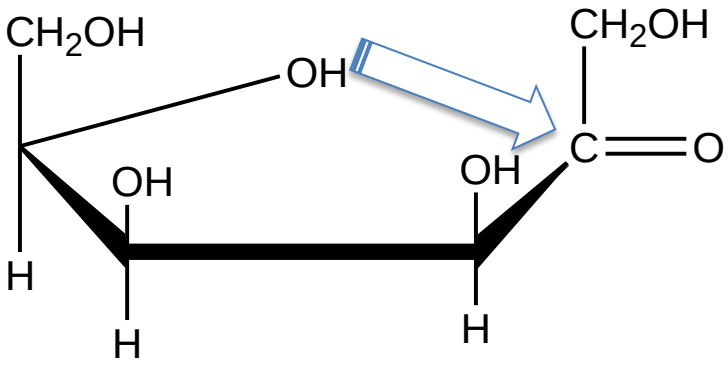


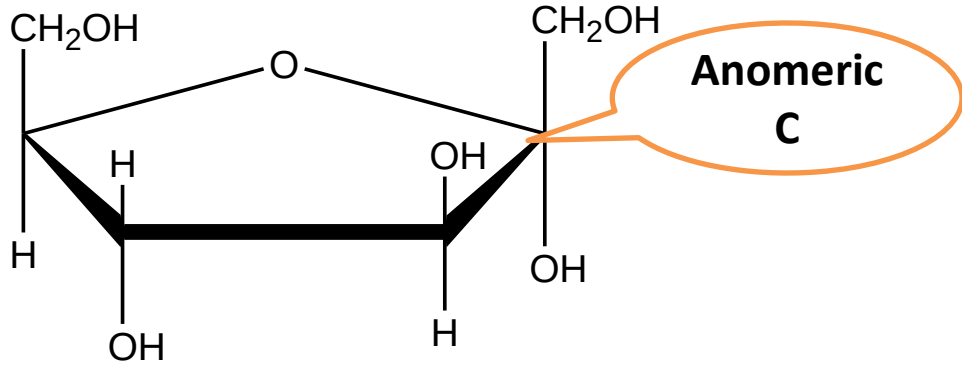






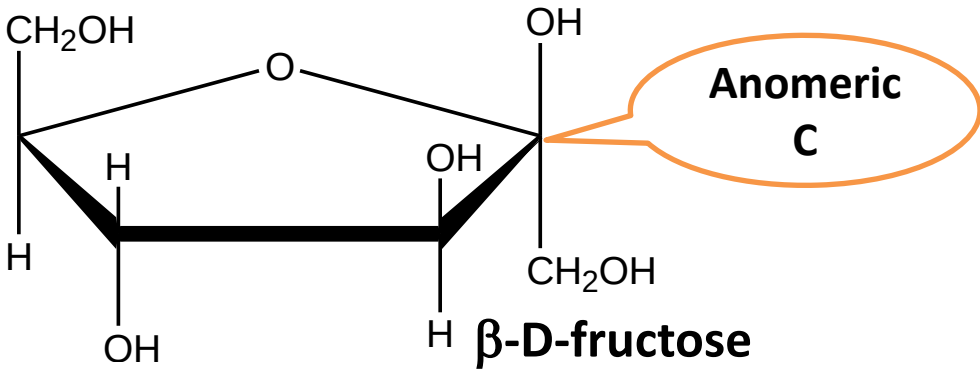
Monosaccharide





α-D-fructose

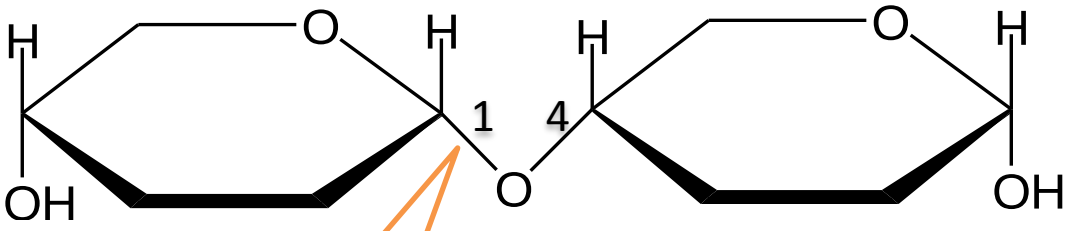
+



β-D-fructose

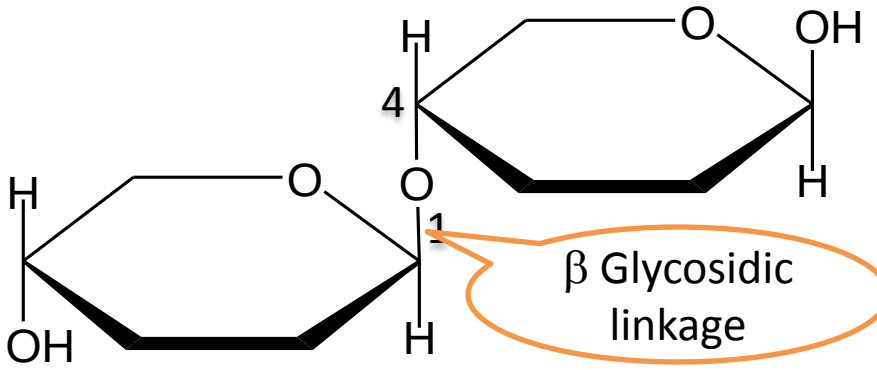
Disaccharide

- Disaccharides → carbohydrates composed of 2 monosaccharides.



α Glycosidic linkage

1 → 4-α-glycosidic linkage



β Glycosidic linkage

1 → 4-β-glycosidic linkage

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