Dept. of Biochemistry

Introductory Biochemistry

Biomolecules_Carbohydrate _Lecture_3

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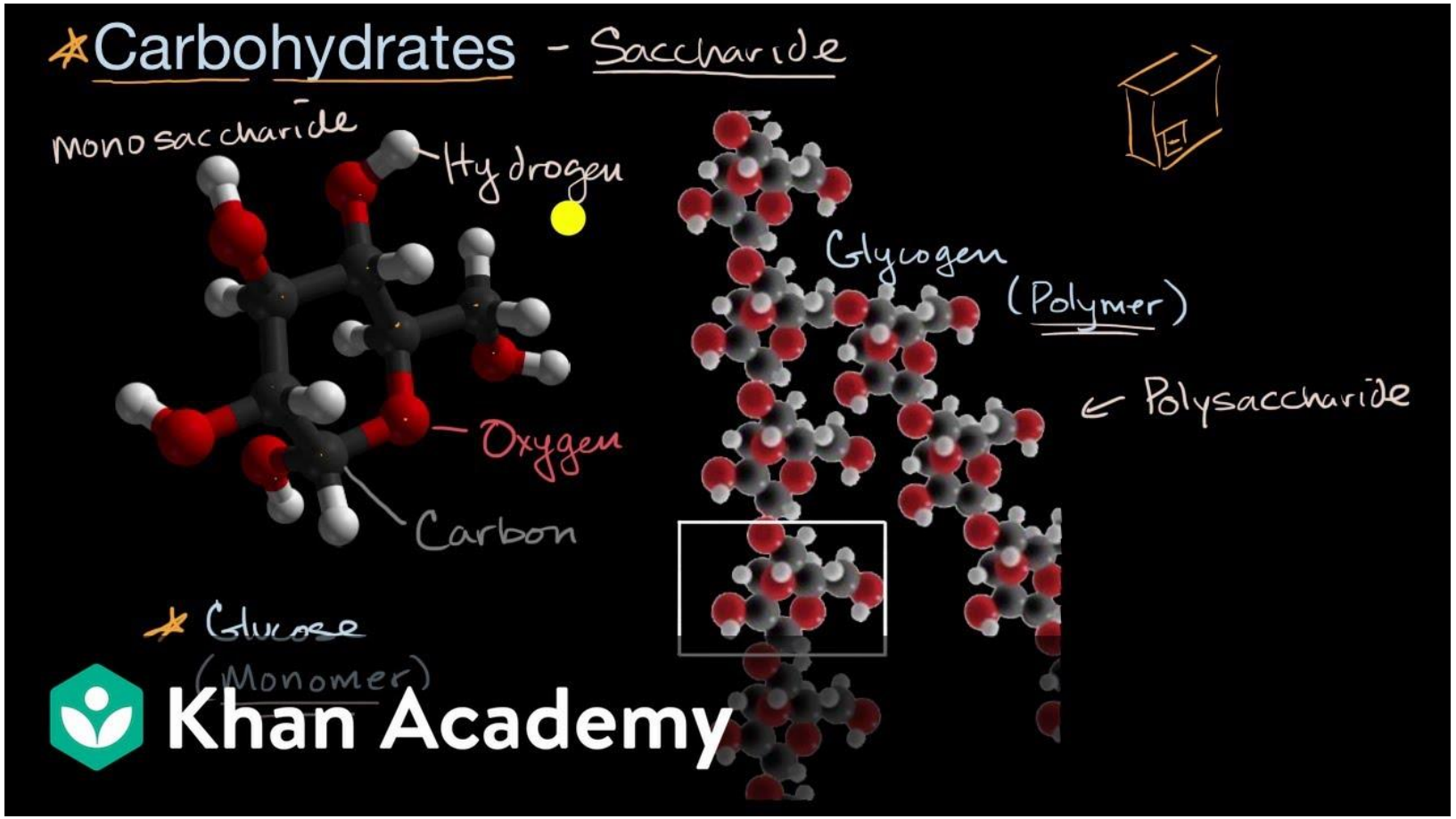
Biomolecules_Carbohydrat_Lecture_3



Structure of Glucose

Glucose is by far the most common carbohydrate and classified as a monosaccharide, an aldose, a hexose, and is a reducing sugar. It is also known as dextrose, because it is dextrorotatory (meaning that as an optical isomer is rotates plane polarized light to the right and also an origin for the D designation. Glucose is also called blood sugar as it circulates in the blood at a concentration of 65-110 mg/dL of blood.

Glucose is initially synthesized by chlorophyll in plants using carbon dioxide from the air and sunlight as an energy source. Glucose is further converted to starch for storage.

Up until now we have been presenting the structure of glucose as a chain. In reality, an aqueous sugar solution contains only 0.02% of the glucose in the chain form, the majority of the structure is in the cyclic chair form. Since carbohydrates contain both alcohol and aldehyde or ketone functional groups, the straight-chain form is easily converted into the chair form - hemiacetal ring structure. Due to the tetrahedral geometry of carbons that ultimately make a 6 membered stable ring , the -OH on carbon #5 is converted into the ether linkage to close the ring with carbon #1. This makes a 6 member ring - five carbons and one oxygen.

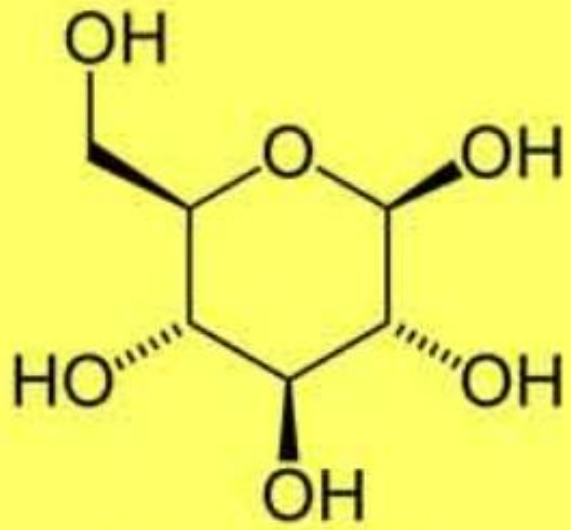
Glucose

Formula: $C_6H_{12}O6$

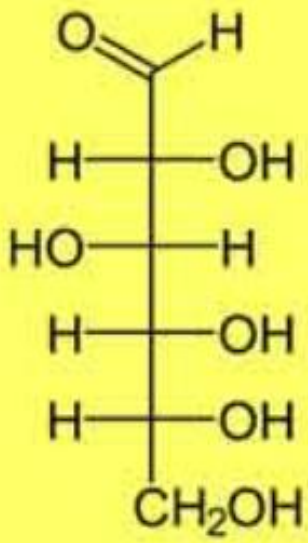
Molar mass: 180.156 g/mol

Melting point: 146 °C

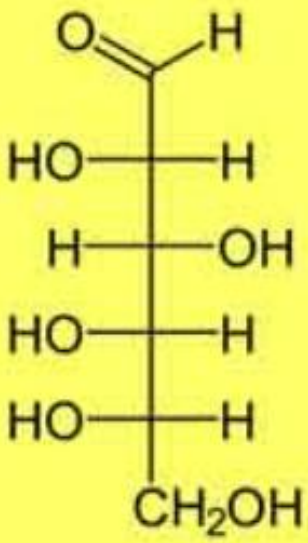
Heat capacity (C): 218.6 J K–1 mol–1



Beta-D-glucose

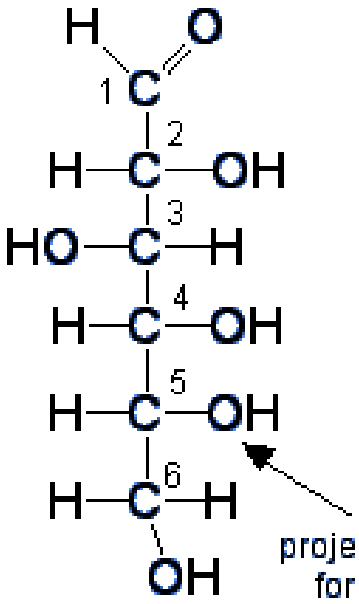


D-Glucose

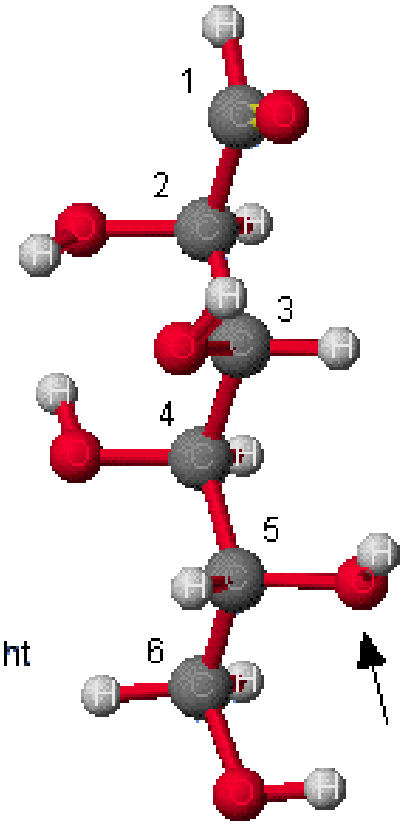


L-Glucose

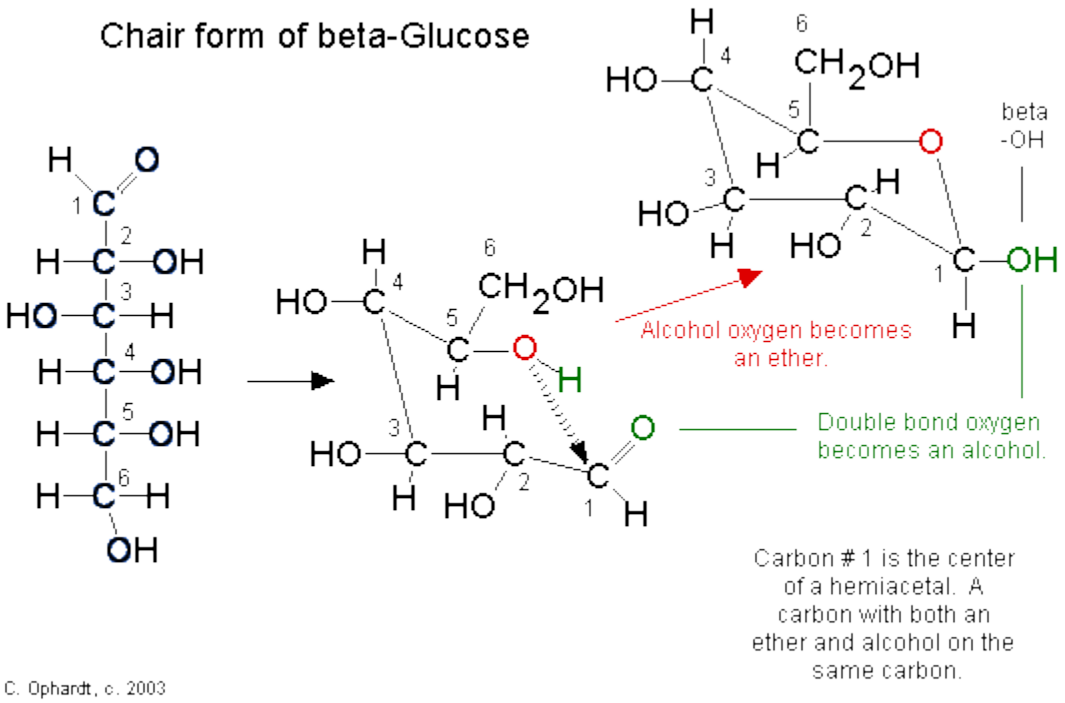
D-Glucose

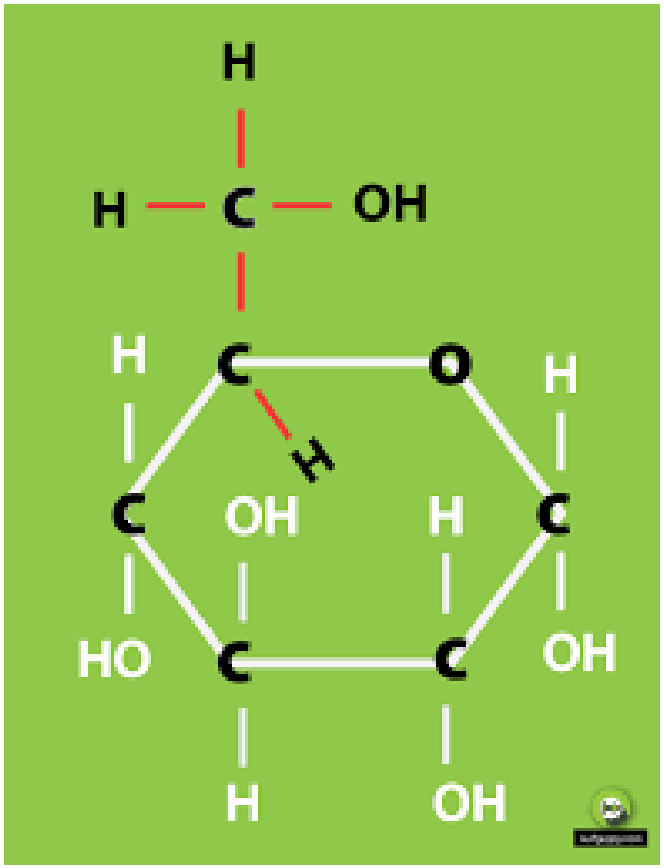


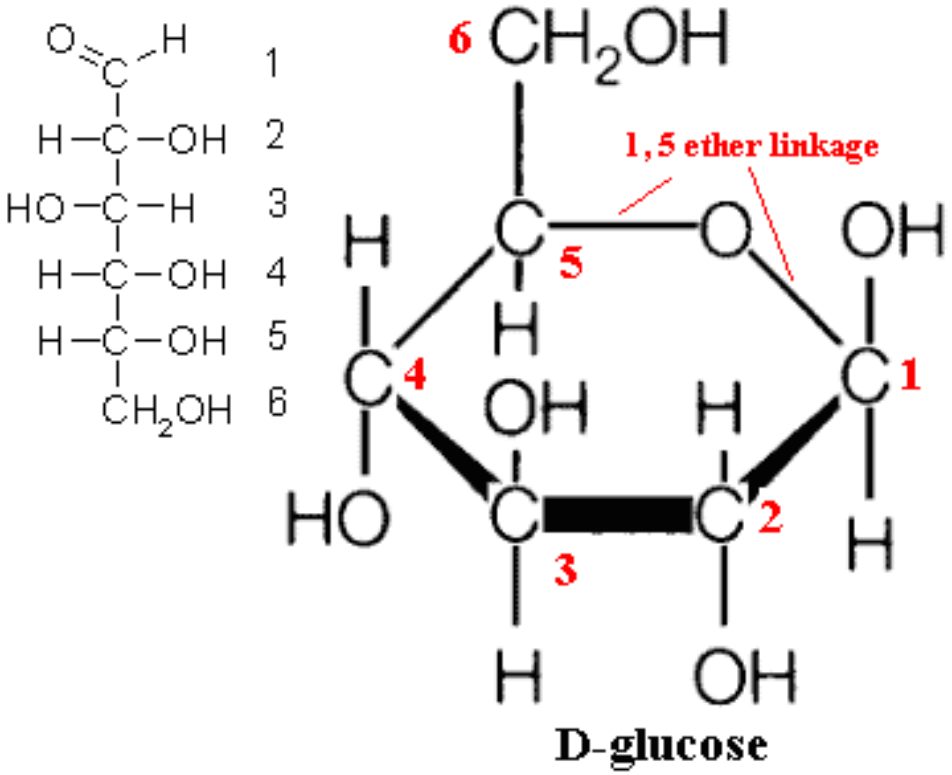
projects right for the D isomer



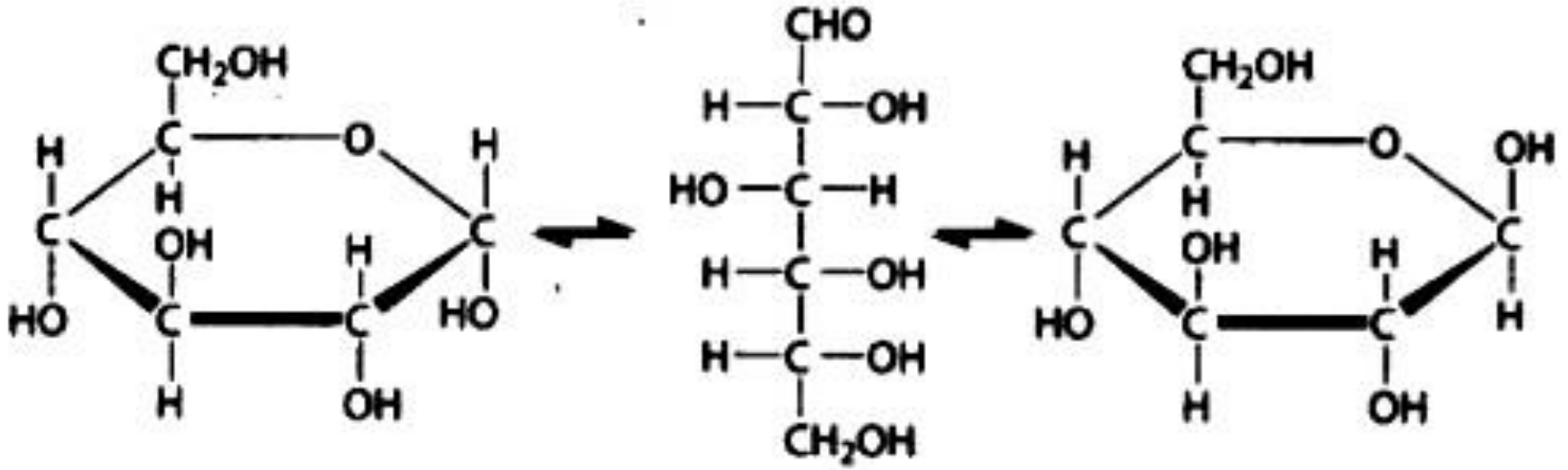
- **Steps in the ring closure (hemiacetal synthesis):**
- The electrons on the alcohol oxygen are used to bond the carbon #1 to make an ether (red oxygen atom).
- The hydrogen (green) is transferred to the carbonyl oxygen (green) to make a new alcohol group (green).



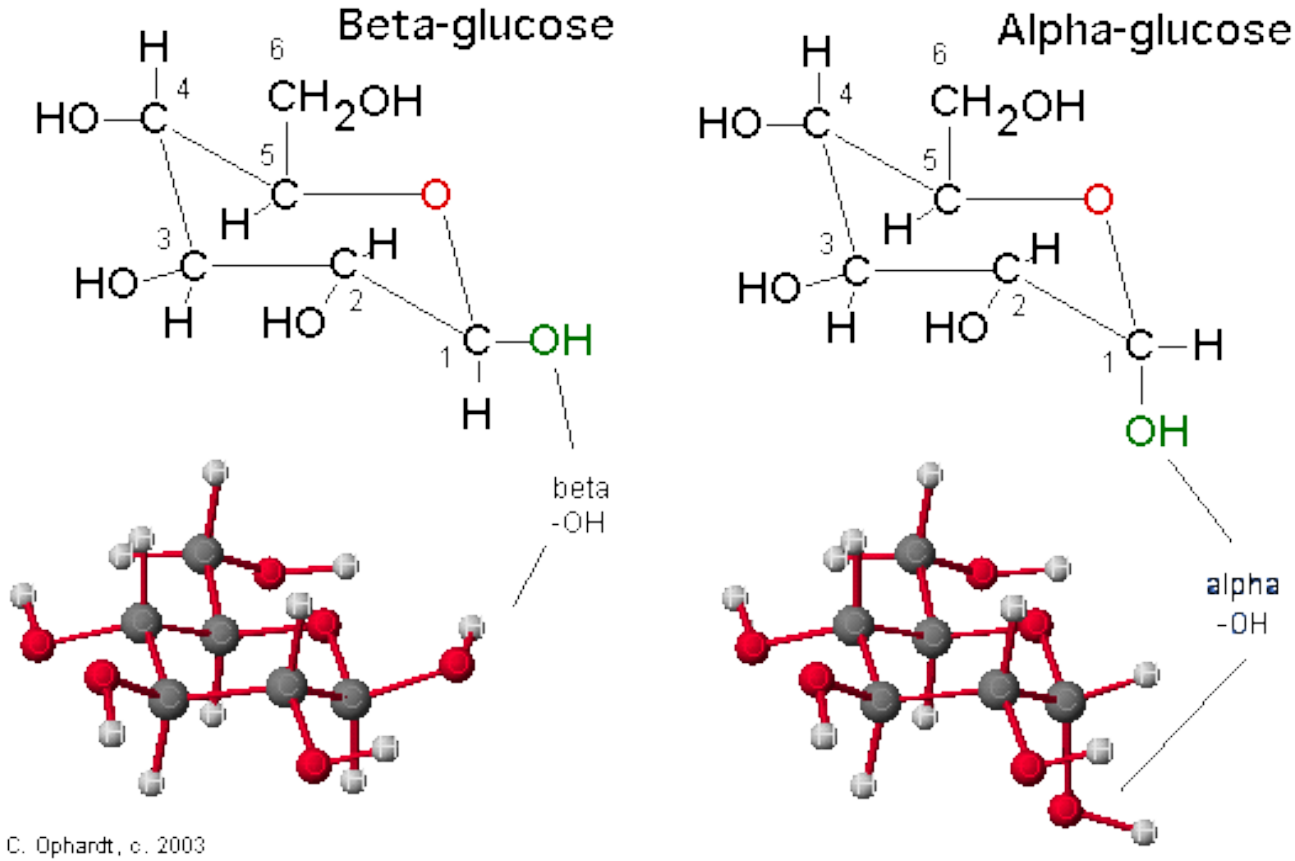



1,5 ether linkage
D-glucose

3.



(a) Mechanism of cyclic structure; (b) cyclic structure of glucose


Beta-glucose
Alpha-glucose
beta
-OH
alpha
-OH
C. Ophardt, c. 2003