CARBOHYDRATES: STRUCTURE

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CLASSIFICATION

- **Monosaccharides**: Simple sugar
- **Disaccharides**: 2 monosaccharide units
- **Oligosaccharides**: 3-10 monosaccharide units
- **Polysaccharides**: more than 10 sugar units

  Homopolysaccharides & Heteropolysaccharides

Monosaccharides

Further classified based on:

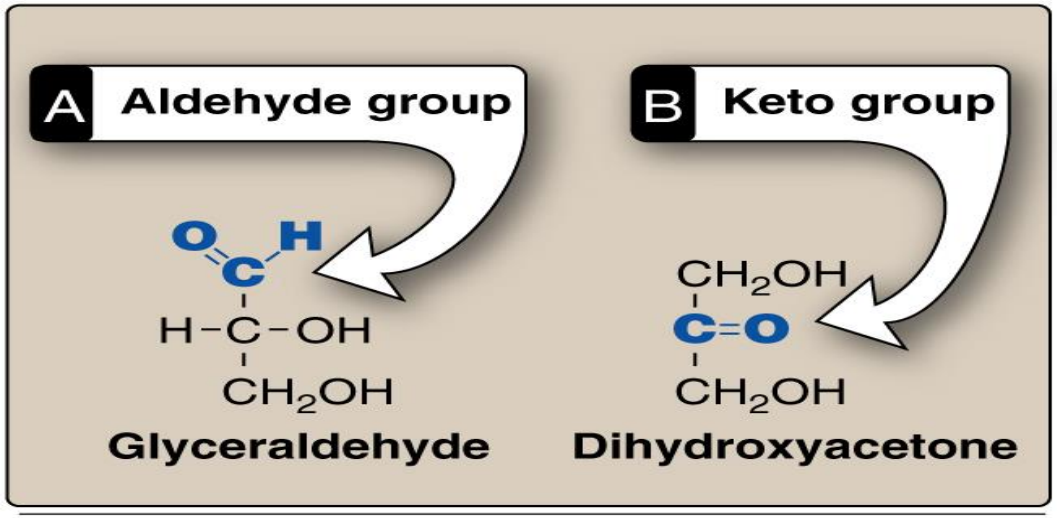
1. No. of carbon atoms

Generic names	Examples
3 carbons: trioses	Glyceraldehyde
4 carbons: tetroses	Erythrose
5 carbons: pentoses	Ribose
6 carbons: hexoses	Glucose
7 carbons: heptoses	Sedoheptulose
9 carbons: nonoses	Neuraminic acid

2. Functional sugar group:

Aldehyde group – aldoses

Keto group – ketoses



Monosaccharides

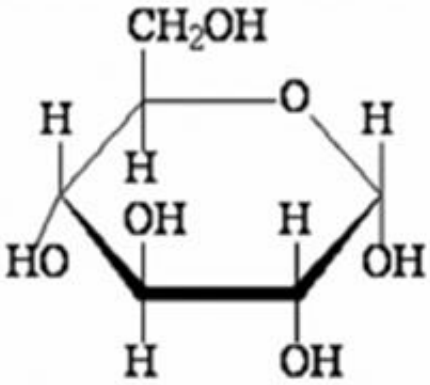
CONT'D

	Aldose	Ketose
Triose	Glyceraldehyde	Dihydroxyacetone
Pentose	Ribose	Ribulose
Hexose	Glucose	Fructose

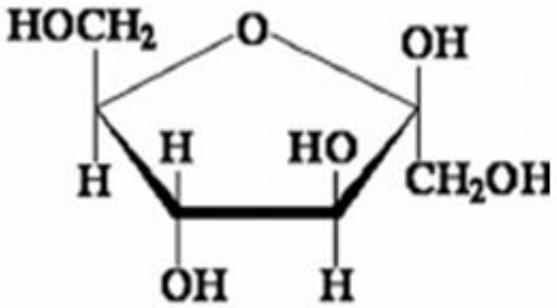
Isomerism

- Isomers

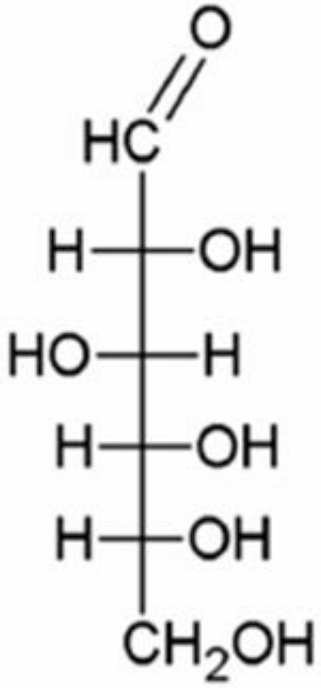
Compounds having same chemical formula but different structural formula



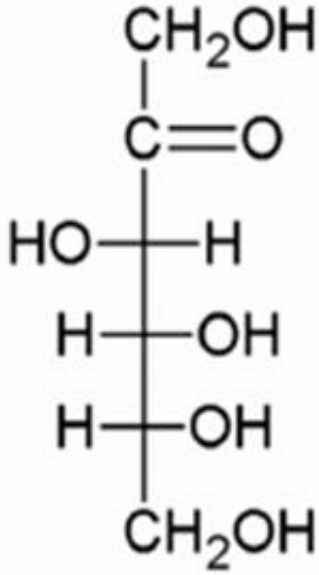
Glucose



Fructose



Glucose



Fructose

Aldo-Keto Isomers

Example:

Glucose (Aldose)

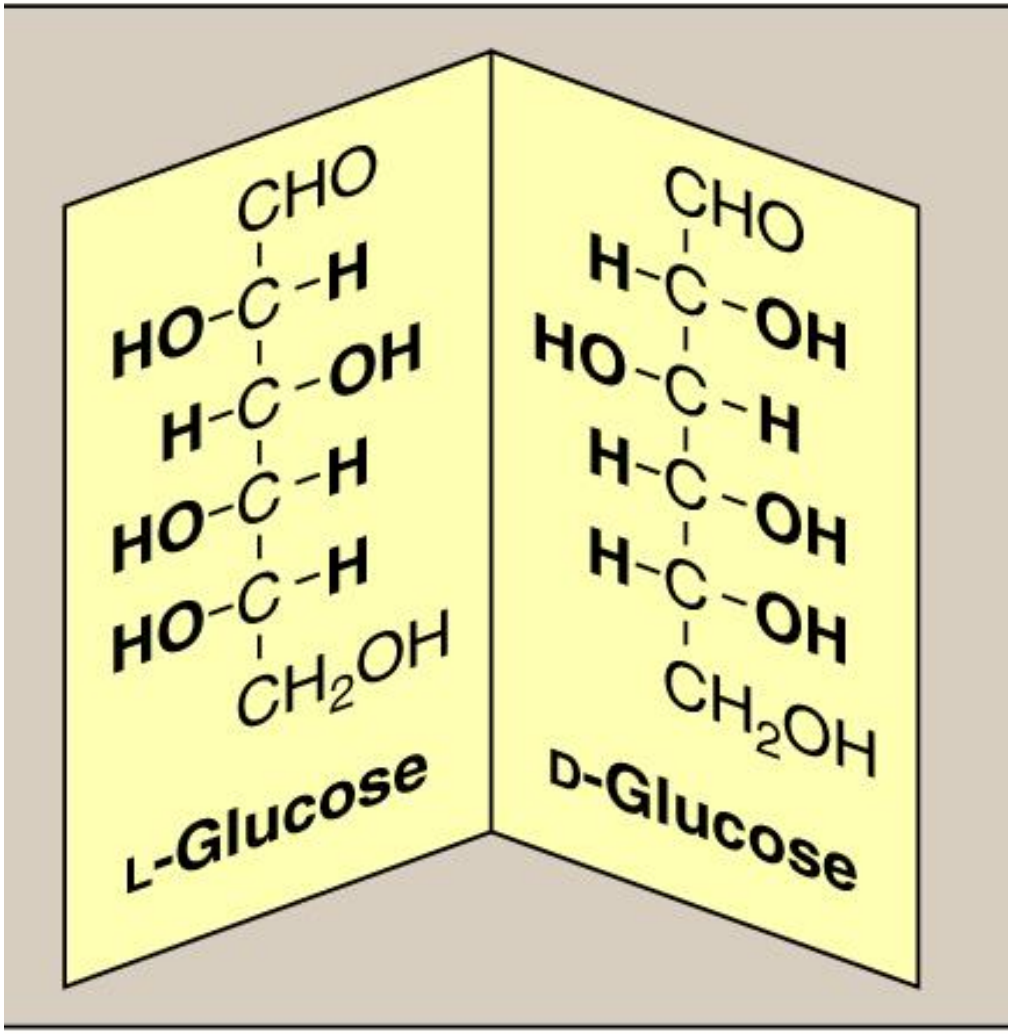
and

Fructose (Ketose)

Enantiomers (D- and L-Forms)

Structures that are **mirror images** of each other and are designated as D- and L- sugars based on the position of –OH group on **carbonyl carbon**

Majority of sugars in humans are **D-sugars**

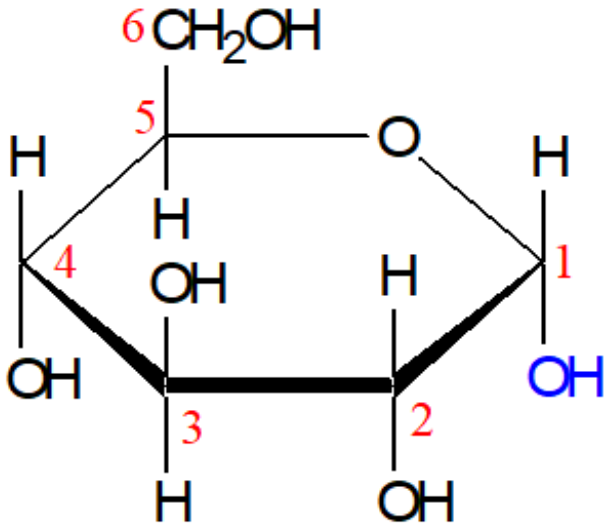


α- and β-Forms

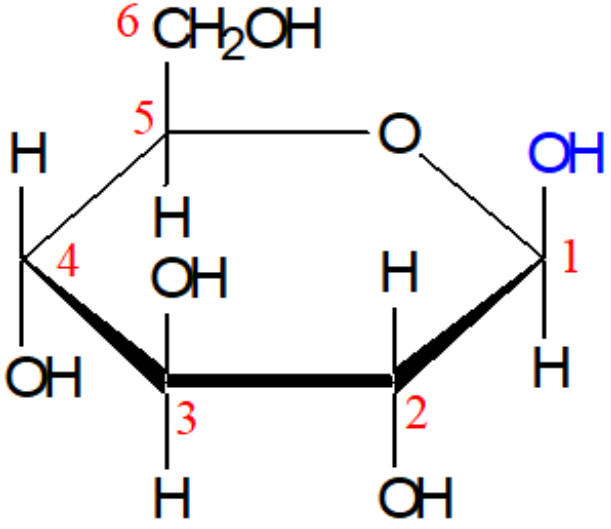
❑ **Cyclization of Monosaccharides**
Monosaccharides with 5 or more carbon are predominantly found in the ring form

-The aldehyde or ketone group reacts with the –OH group on the same sugar

-Cyclization creates an **anomeric carbon** (former carbonyl carbon) generating the α and β configurations



α-D-glucose



β-D-glucose

Disaccharides

- Joining of 2 monosaccharides by glycosidic bond:

Maltose (α-1, 4) = glucose + glucose

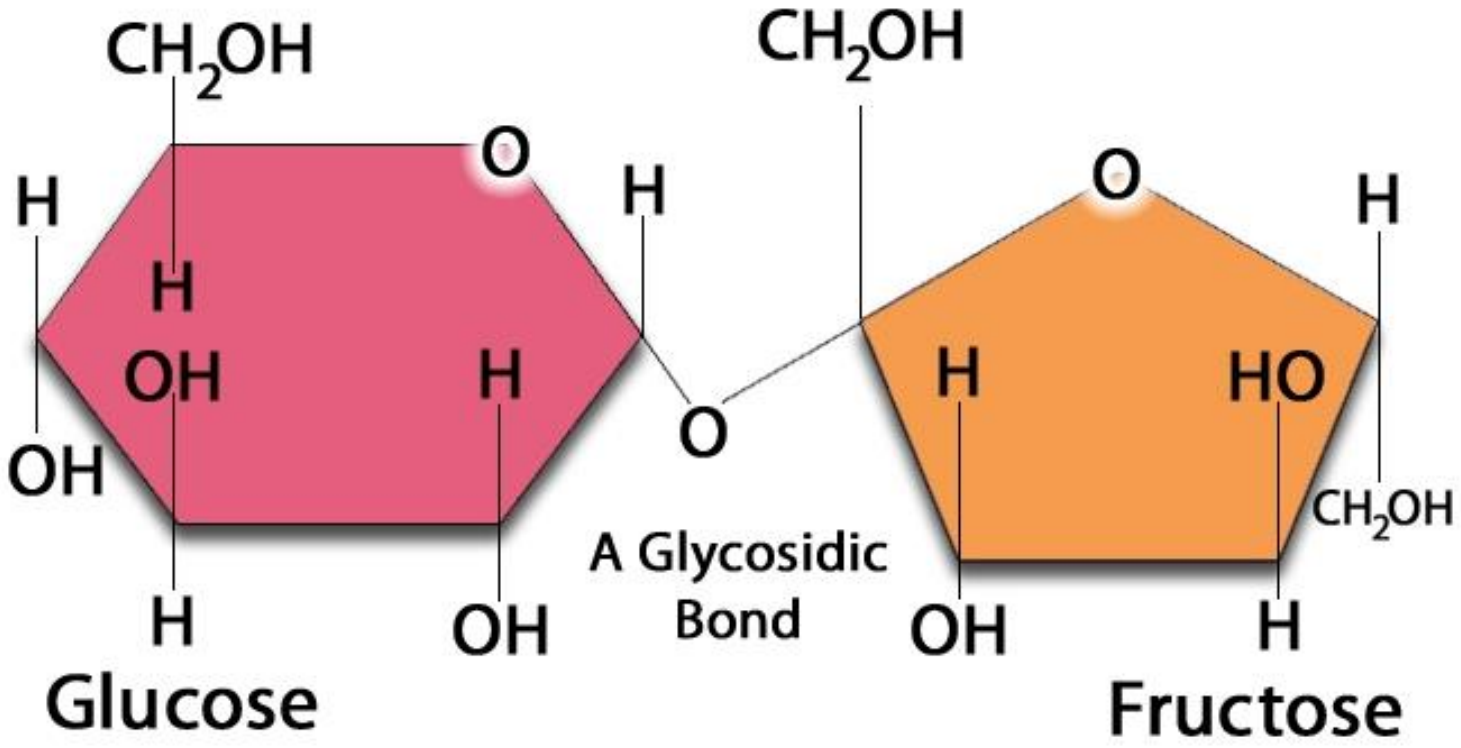
Sucrose (α-1,2) = glucose + fructose

Lactose (β-1,4)= glucose + galactose

Disaccharides

CONT'D

Sucrose



Polysaccharides

- **Homopolysaccharides:**

  Branched:

  Glycogen and starch (α-glycosidic polymer)

  Unbranched:

  Cellulose (β-glycosidic polymer)

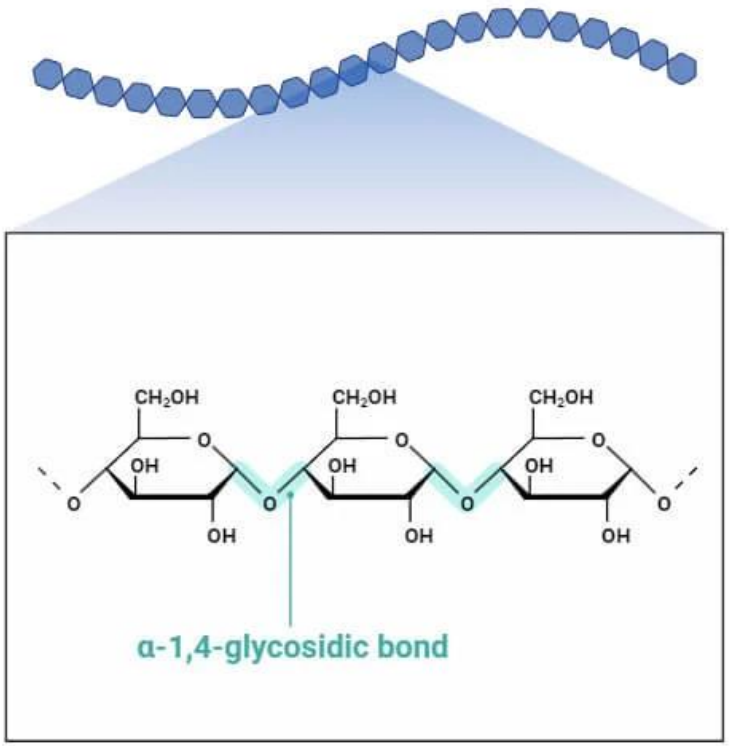
- **Heteropolysaccharides:**

  e.g., Peptidoglycans

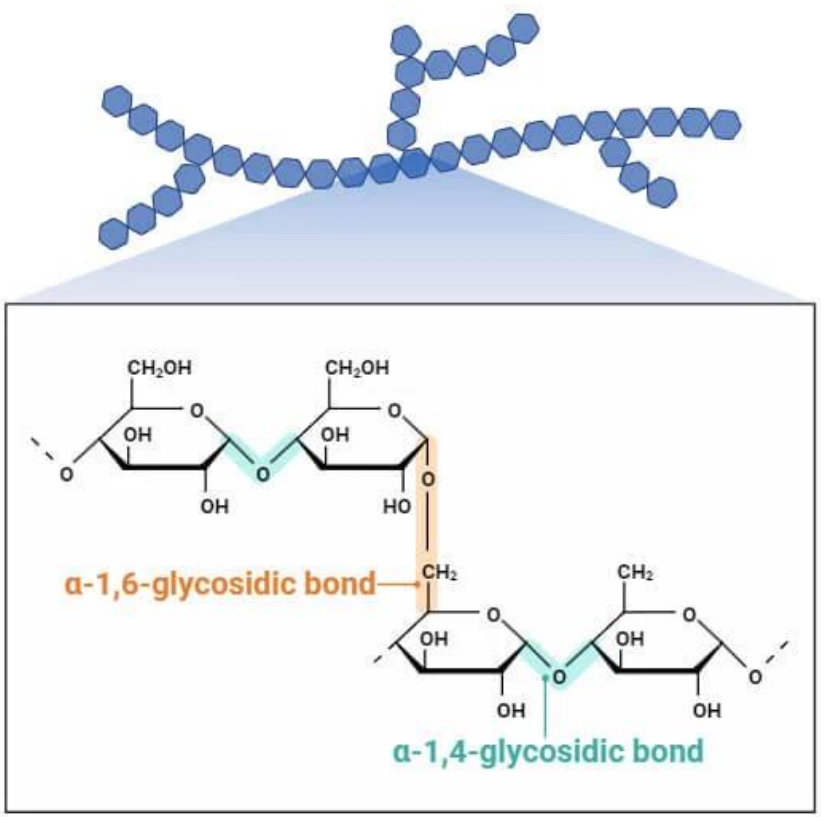
Polysaccharides

Starch

Amylose



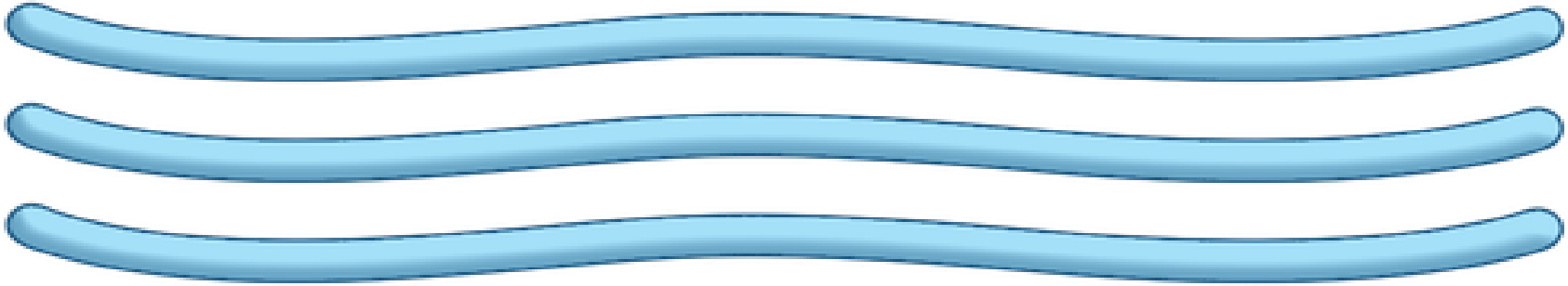
Amylopectin



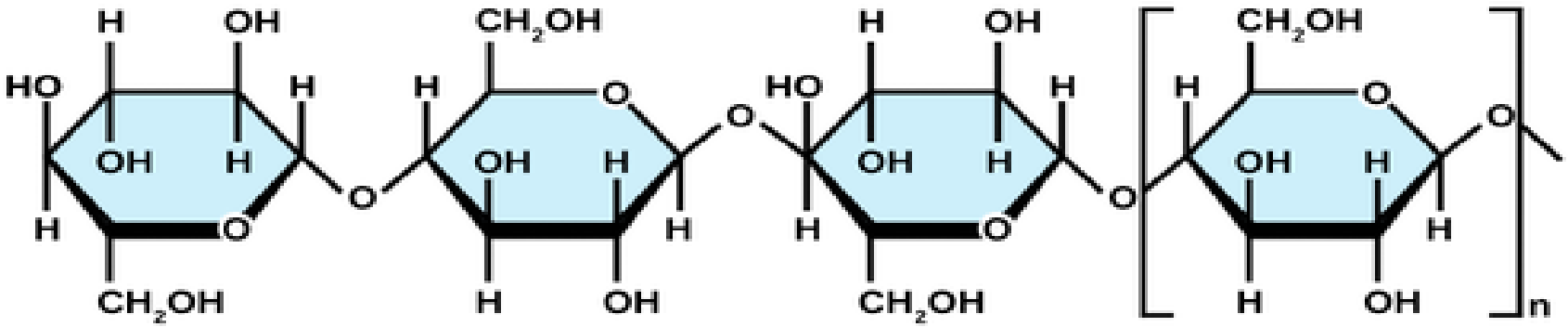
Polysaccharides

Cellulose

Cellulose Fibers



Cellulose Structure



Reducing Sugars

- If the O on the anomeric C of a sugar is not attached to any other structure **(Free)**, that sugar can act as a reducing agent

- **R**educing sugars reduce chromogenic agents like Benedict's reagent or Fehling's solution to give a colored precipitate

- **U**rine is tested for the presence of reducing sugars using these colorimetric tests

Reducing Sugars

CONT'D

- **Examples:**

  Monosaccharides

  Maltose and Lactose

  Sucrose is Non-Reducing, Why?