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# TOPIC-3: CARBOHYDRATES





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**Carbohydrates** are polyhydroxy aldehydes or ketones of approximate composition  $(C.H_2O)_n$  that are important components of biological systems.

**Types:**

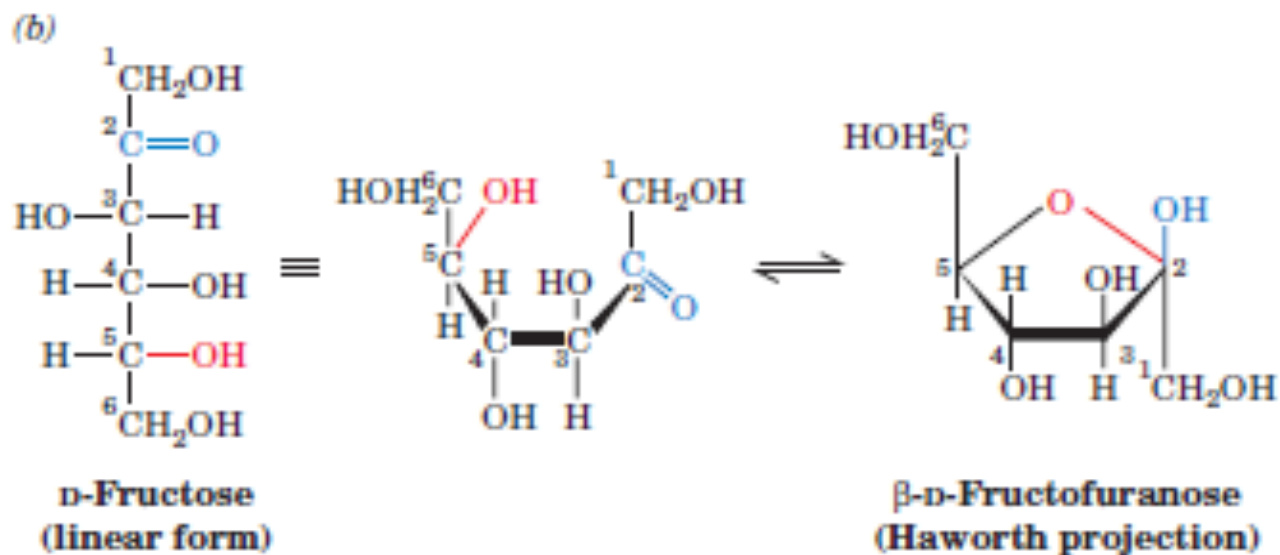
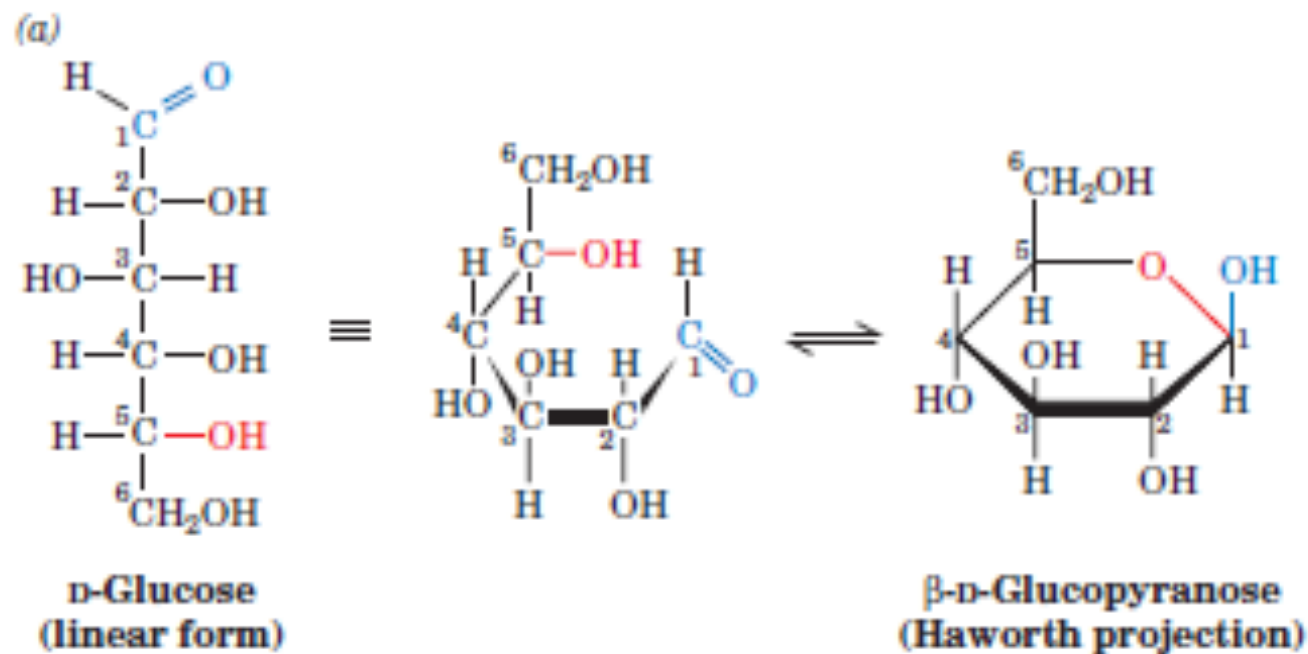
- Monosaccharides
- Oligosaccharides
- Polysaccharides



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# Cyclization reaction for hexoses





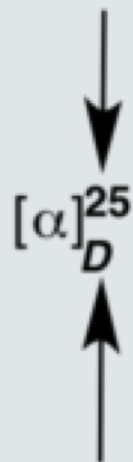
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# MUTAROTATION

Notations for temperature and wavelength are usually included

This # indicates that the experiment was run at 25 degrees Celsius



example, for *D*-(+)-glucose

$$[\alpha]_D^{25} = +52.7^\circ (c = 0.1, \text{ water})$$

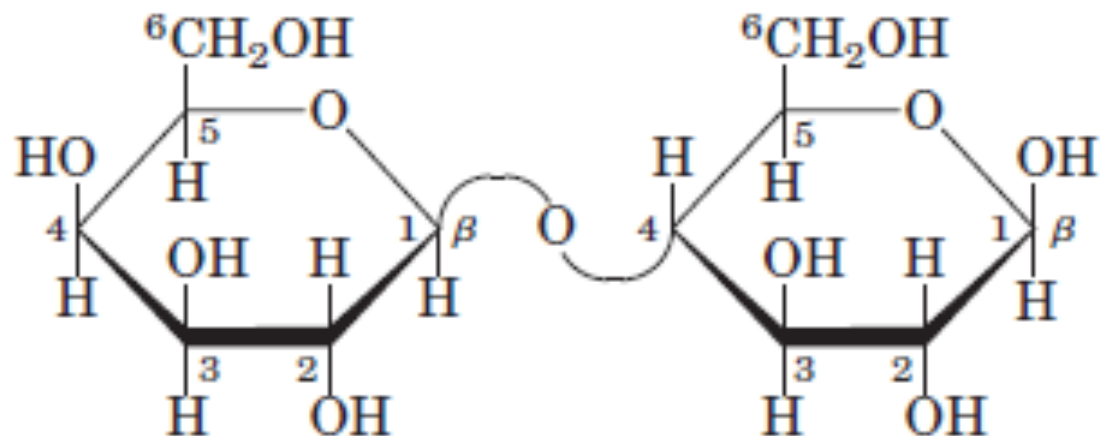
The capital letter "D" means the light used was the D line of the sodium spectrum (589.3 nm)



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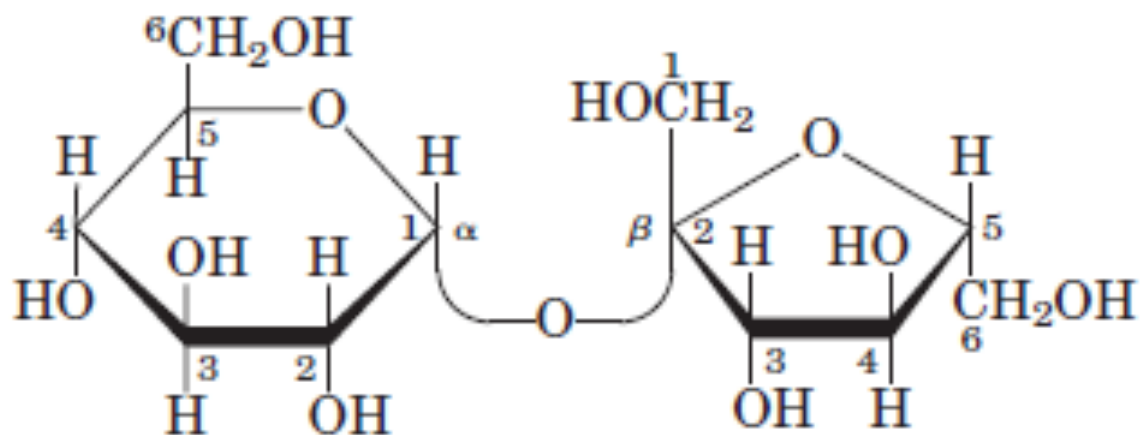
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# Disaccharides



Lactose ( $\beta$  form)

$\beta$ -D-galactopyranosyl-(1 $\rightarrow$ 4)- $\beta$ -D-glucopyranose  
Gal( $\beta$ 1 $\rightarrow$ 4)Glc



Sucrose

$\alpha$ -D-glucopyranosyl  $\beta$ -D-fructofuranoside  
Glc( $\alpha$ 1 $\leftrightarrow$ 2 $\beta$ )Fru



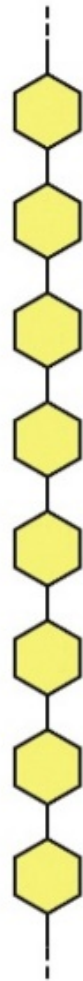
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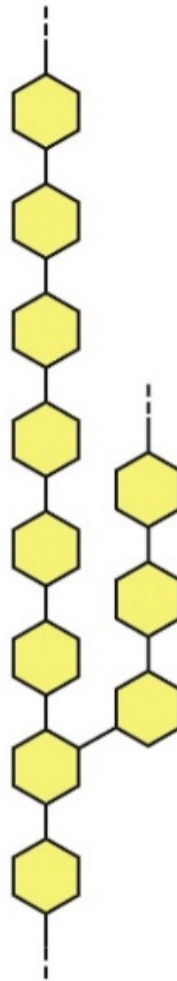
# Polysaccharides

## Homopolysaccharides

### Unbranched

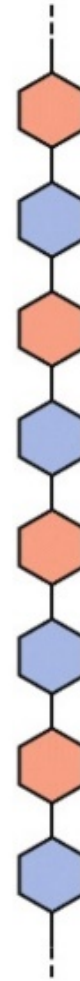


### Branched

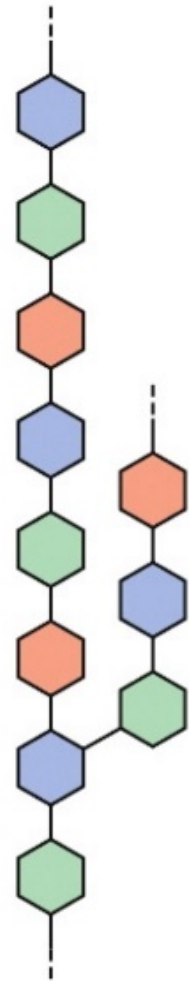


## Heteropolysaccharides

### Two monomer types, unbranched



### Multiple monomer types, branched





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# ...Polysaccharides

**TABLE 7-2 Structures and Roles of Some Polysaccharides**

Polymer	Type*	Repeating unit <sup>†</sup>	Size (number of monosaccharide units)	Roles/significance
<b>Starch</b>				Energy storage: in plants
Amylose	Homo-	( $\alpha 1 \rightarrow 4$ )Glc, linear	50–5,000	
Amylopectin	Homo-	( $\alpha 1 \rightarrow 4$ )Glc, with ( $\alpha 1 \rightarrow 6$ )Glc branches every 24–30 residues	Up to $10^6$	
Glycogen	Homo-	( $\alpha 1 \rightarrow 4$ )Glc, with ( $\alpha 1 \rightarrow 6$ )Glc branches every 8–12 residues	Up to 50,000	Energy storage: in bacteria and animal cells
Cellulose	Homo-	( $\beta 1 \rightarrow 4$ )Glc	Up to 15,000	Structural: in plants, gives rigidity and strength to cell walls
Chitin	Homo-	( $\beta 1 \rightarrow 4$ )GlcNAc	Very large	Structural: in insects, spiders, crustaceans, gives rigidity and strength to exoskeletons
Dextran	Homo-	( $\alpha 1 \rightarrow 6$ )Glc, with ( $\alpha 1 \rightarrow 3$ ) branches	Wide range	Structural: in bacteria, extracellular adhesive
Peptidoglycan	Hetero-; peptides attached	4)Mur2Ac( $\beta 1 \rightarrow 4$ )GlcNAc( $\beta 1$	Very large	Structural: in bacteria, gives rigidity and strength to cell envelope
Agarose	Hetero-	3) $\beta$ -Gal( $\beta 1 \rightarrow 4$ )3,6-anhydro-L-Gal( $\alpha 1$	1,000	Structural: in algae, cell wall material
Hyaluronan (a glycosamino-glycan)	Hetero-; acidic	4)GlcA( $\beta 1 \rightarrow 3$ )GlcNAc( $\beta 1$	Up to 100,000	Structural: in vertebrates, extracellular matrix of skin and connective tissue; viscosity and lubrication in joints

\*Each polymer is classified as a homopolysaccharide (homo-) or heteropolysaccharide (hetero-).

<sup>†</sup>The abbreviated names for the peptidoglycan, agarose, and hyaluronan repeating units indicate that the polymer contains repeats of this disaccharide unit. For example, in peptidoglycan, the GlcNAc of one disaccharide unit is ( $\beta 1 \rightarrow 4$ )-linked to the first residue of the next disaccharide unit.