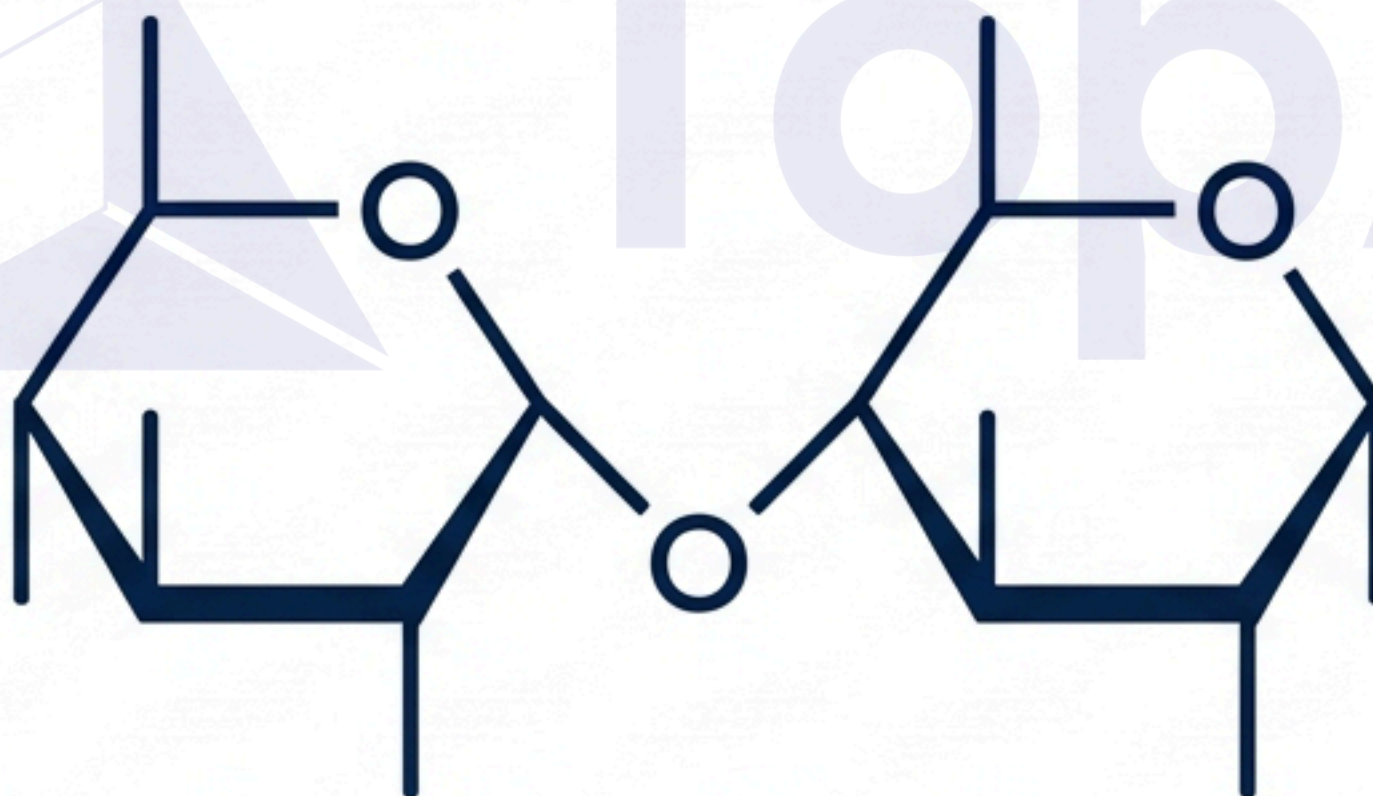


10.1.3 Disaccharides

The molecular architecture, glycosidic linkages, and chemical behaviors of Sucrose, Maltose, and Lactose.



CORE CONCEPT

The Glycosidic Linkage

Disaccharides are formed when two monosaccharides are joined together. This chemical union is accompanied by the loss of a single water molecule.



Loss of H₂O



The oxide linkage



This oxygen bridge holding two monosaccharide units together is the defining structural feature of all disaccharides and polysaccharides.

Sucrose (Cane Sugar)

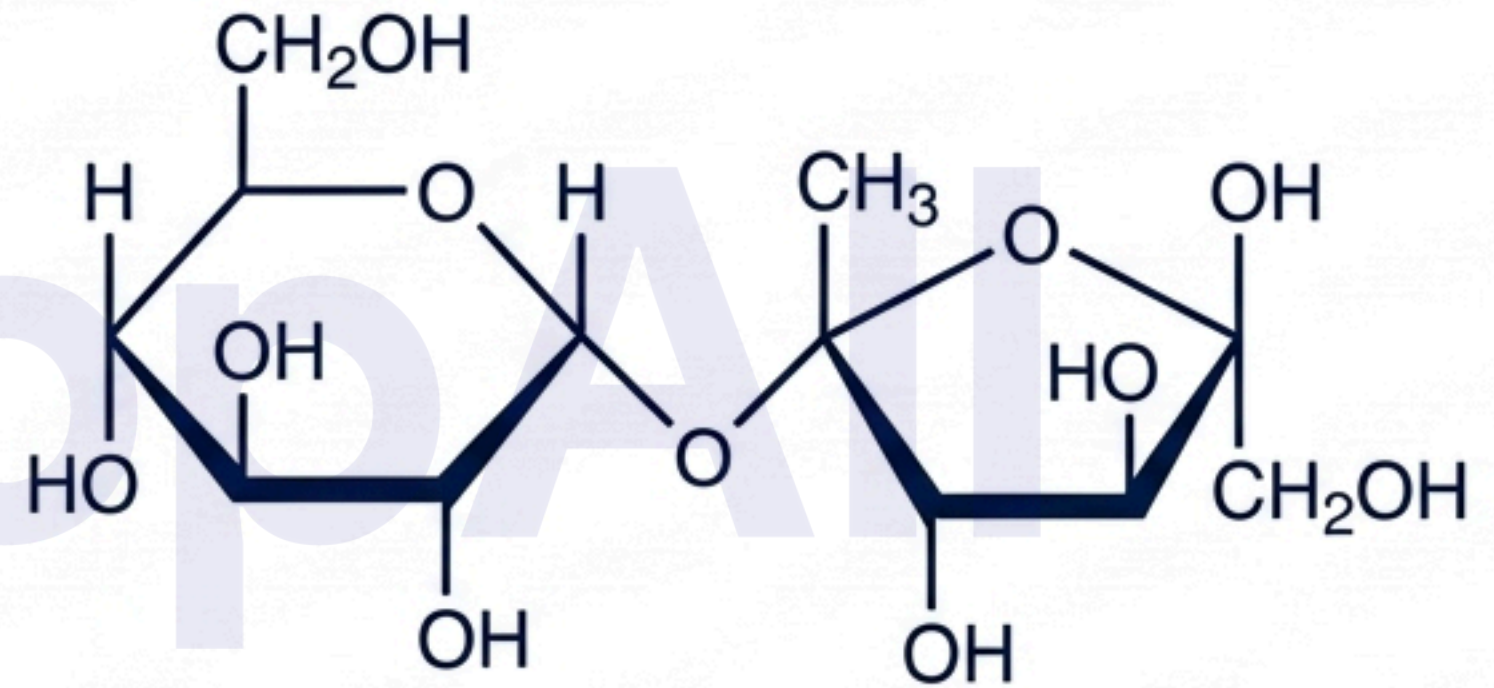
Components:

An equimolar mixture of D-(+)-glucose and D-(-)-fructose.

Invert Sugar Insight:

Hydrolysis changes the specific rotation from dextro (+) to laevo (-).

Why? The laevorotation of fructose (-92.4°) exceeds the dextrorotation of glucose ($+52.5^\circ$), making the resulting mixture an "invert sugar".



Formula/Structure Strip

Monomer 1: C1 of α -D-glucose

Linkage : 1,2-Glycosidic Bond

Monomer 2: C2 of β -D-fructose



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Maltose

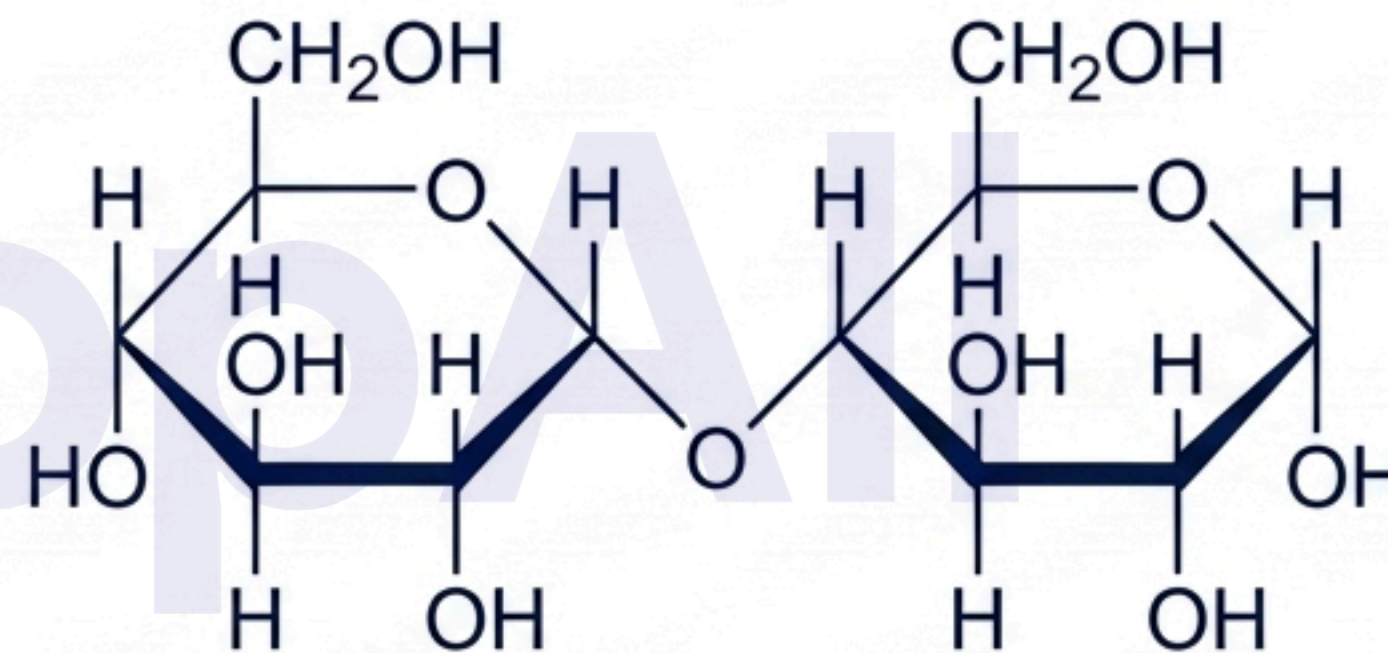
Components:

Composed strictly of two identical α -D-glucose units.

Chemical Nature:

The free aldehyde group can be produced at C1 of the second glucose molecule in solution.

Because this functional group remains free, maltose acts as a reducing agent.



Formula/Structure Strip

Monomer 1: C1 of α -D-glucose

Linkage : 1,4-Glycosidic Bond

Monomer 2: C4 of α -D-glucose

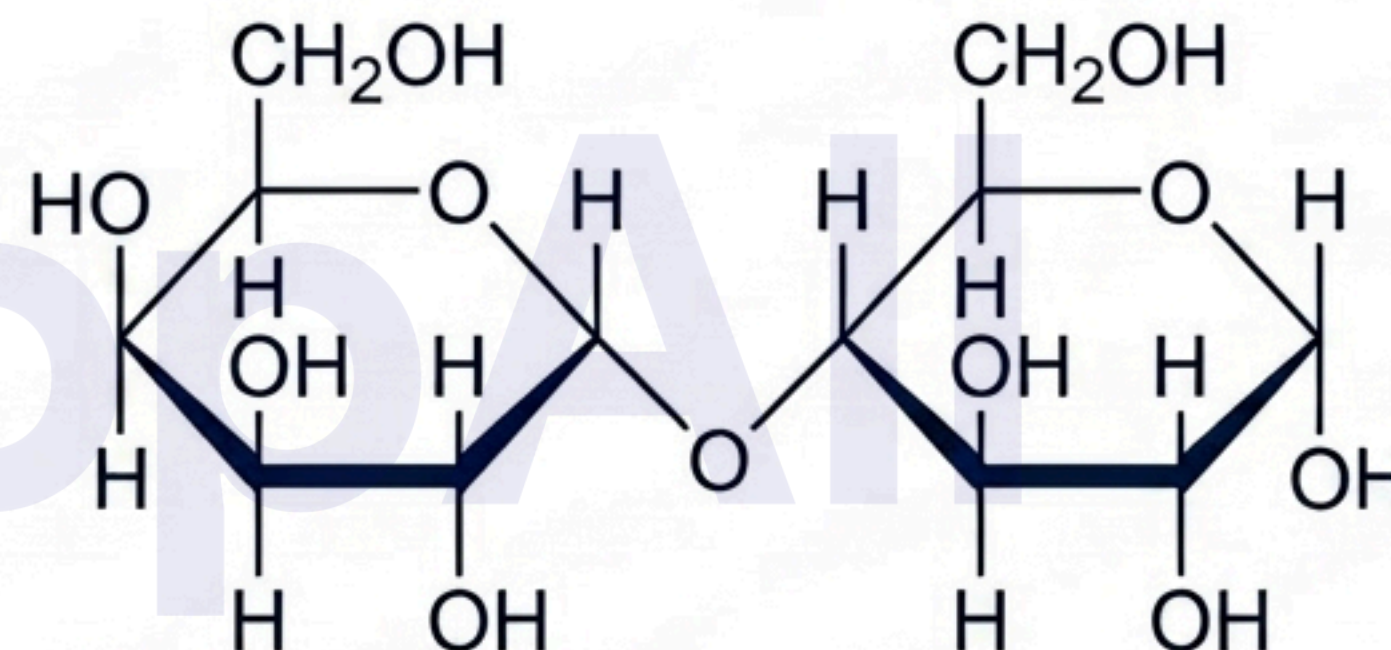
Lactose (Milk Sugar)

Components:

Composed of β -D-galactose and β -D-glucose. Most commonly found in mammalian milk.

Chemical Nature:

Similar to maltose, the free aldehyde group may be produced at the C1 position of the glucose unit, preserving its reducing properties.



Formula/Structure Strip

Monomer 1: C1 of β -D-galactose

Linkage : 1,4-Glycosidic Bond

Monomer 2: C4 of β -D-glucose

Reducing vs. Non-Reducing Nature

Panel A: Non-Reducing (e.g., Sucrose)



Rule: If the reducing groups (aldehydic/ketonic) of BOTH monosaccharides are locked in the glycosidic linkage.



Diagnostic Result: No free functional groups = Cannot reduce Fehling's or Tollens' reagents

Panel B: Reducing (e.g., Maltose, Lactose)



Rule: If the functional group (aldehyde/ketone) of at least one monosaccharide remains free (not involved in the bond).



Diagnostic Result: Free functional group = Successfully reduces Fehling's and Tollens' reagents

The involvement of the anomeric carbon in the glycosidic bond is the sole determinant of a disaccharide's chemical reactivity.

Final Recap: Linkage Decides Behavior

Disaccharide	Monosaccharide Units	Glycosidic Linkage	Chemical Nature
Sucrose	α -D-Glucose + β -D-Fructose	C1 — C2	[NON-REDUCING]
Maltose	α -D-Glucose + α -D-Glucose	C1 — C4	[REDUCING]
Lactose	β -D-Galactose + β -D-Glucose	C1 — C4	[REDUCING]

To master disaccharides, look at the bond. A C1-C2 bond (Sucrose) completely locks the active groups. A C1-C4 bond (Maltose/Lactose) always leaves a reducing group free.



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