MONOSACCHARIDES
Monosaccharides usually have the general formula \((\text{CH}_2\text{O})_n\), where \(n\) can be 3, 4, 5, 6, 7, or 8, and have two or more hydroxyl groups. They either contain an aldehyde group \((\mathbf{\text{C}} = \mathbf{\text{O}})\) and are called aldoses or a ketone group \((\mathbf{\text{C}} = \mathbf{\text{C}})\) and are called ketoses.

**RING FORMATION**
In aqueous solution, the aldehyde or ketone group of a sugar molecule tends to react with a hydroxyl group of the same molecule, thereby closing the molecule into a ring.

**ISOMERS**
Many monosaccharides differ only in the spatial arrangement of atoms—that is, they are isomers. For example, glucose, galactose, and mannose have the same formula \((\text{C}_6\text{H}_{12}\text{O}_6)\) but differ in the arrangement of groups around one or two carbon atoms.

Note that each carbon atom has a number.
**α AND β LINKS**
The hydroxyl group on the carbon that carries the aldehyde or ketone can rapidly change from one position to the other. These two positions are called α and β.

![α hydroxyl and β hydroxyl](image)

As soon as one sugar is linked to another, the α or β form is frozen.

**DISACCHARIDES**
The carbon that carries the aldehyde or the ketone can react with any hydroxyl group on a second sugar molecule to form a disaccharide. The linkage is called a glycosidic bond.

Three common disaccharides are:
- maltose (glucose + glucose)
- lactose (galactose + glucose)
- sucrose (glucose + fructose)

The reaction forming sucrose is shown here.

**OLIGOSACCHARIDES AND POLYSACCHARIDES**
Large linear and branched molecules can be made from simple repeating sugar subunits. Short chains are called oligosaccharides, while long chains are called polysaccharides. Glycogen, for example, is a polysaccharide made entirely of glucose units joined together.

![Glycogen structure](image)

**COMPLEX OLIGOSACCHARIDES**
In many cases a sugar sequence is nonrepetitive. Many different molecules are possible. Such complex oligosaccharides are usually linked to proteins or to lipids, as is this oligosaccharide, which is part of a cell-surface molecule that defines a particular blood group.