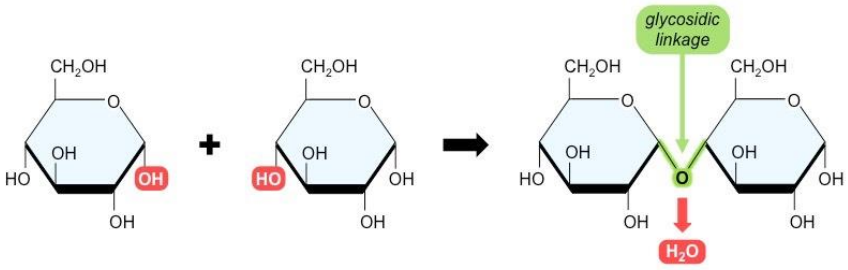
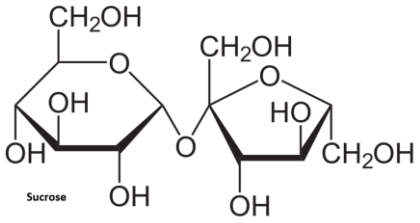
DISACCHARIDES

- A **disaccharide** (also called a **double sugar** or ***biose***) is the sugar formed when two monosaccharides are joined by glycosidic linkage.
- The two monosaccharides are joined together by an oxide linkage formed by the loss of a water molecule. Such a linkage
- between two monosaccharide units through oxygen atom is called *glycosidic linkage*
- The joining of monosaccharides into a double sugar happens by a condensation reaction, which involves the elimination of a water molecule from the functional groups only

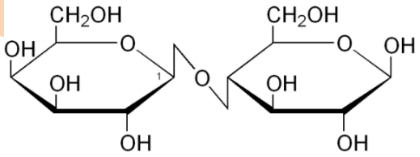


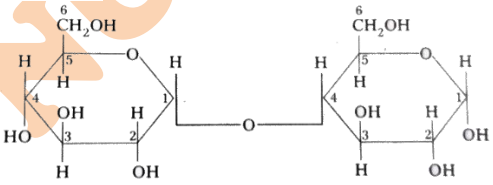
Monosaccharide Subunits **Disaccharide**

- Like monosaccharides, disaccharides are simple sugars soluble in water. Three common examples are sucrose, lactose, and maltose.
- Disaccharides are one of the four chemical groupings of carbohydrates (monosaccharides, disaccharides, oligosaccharides, and polysaccharides).
- The most common types of disaccharides—sucrose, lactose, and maltose—have 12 carbon atoms, with the general formula $C_{12}H_{22}O_{11}$. The differences in these disaccharides are due to atomic arrangements within the molecule. (all are Haworth structures)
  - → Sucrose = Glucose + Fructose
  - → Lactose = Galactose + glucose
  - → Maltose = Glucose + Glucose


Sucrose

Lactose




(I) α – D – Glucose (II) α – D – Glucose

Maltose

- In disaccharides, if the reducing groups of monosaccharides i.e., aldehydic or ketonic groups are bonded, these are non-reducing sugars, e.g., sucrose. On the other hand, sugars in which these functional groups are free, are called reducing sugars, for example, maltose and lactose.
- When disaccharide breaks into its two monosaccharides is accomplished by hydrolysis with the help of a type of enzyme called a disaccharidase.
- As formation of larger sugar removes a water molecule, breaking it down consumes a water molecule.
- Each disaccharide is broken down with the help of a corresponding disaccharidase (sucrase, lactase, and maltase).

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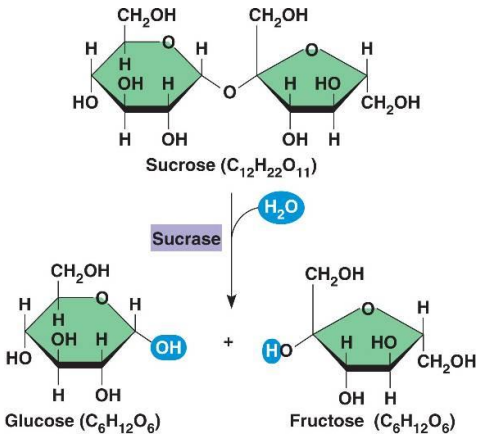
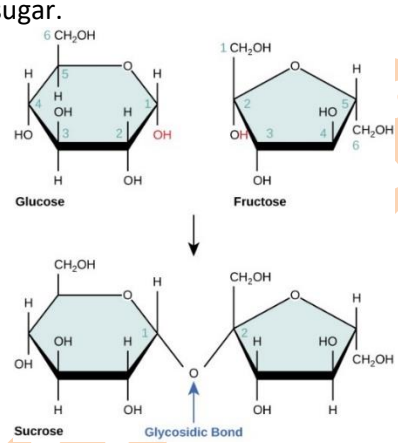
1. **SUCROSE structure**
   - One of the common disaccharides is sucrose which on hydrolysis gives equimolar mixture of D-(+)-glucose and D-(-) fructose.

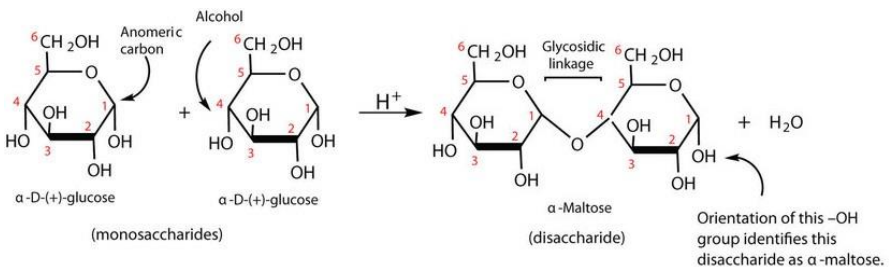


   - These two monosaccharides are held together by a glycosidic linkage between C1 of α-D-glucose and C2 of β-D-fructose.
   - Since the reducing groups of glucose and fructose are involved in glycosidic bond formation, sucrose is a non reducing sugar.



   - Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose.
   - Since the laevorotation of fructose (–92.4°) is more than dextrorotation of glucose (+ 52.5°), the mixture is laevorotatory. Thus, hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as invert sugar.

2. **Maltose Structure**
   - Maltose is composed of two α-D-glucose units in which C1 of one glucose (I) is linked to C4 of another glucose unit (II).
   - The free aldehyde group can be produced at C1 of second glucose in solution and it shows reducing properties so it is a reducing sugar



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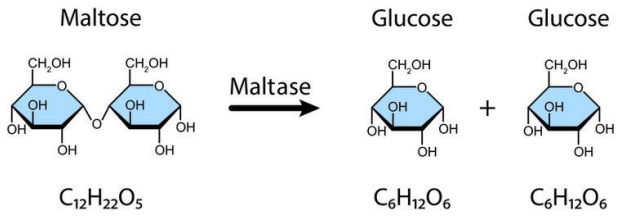
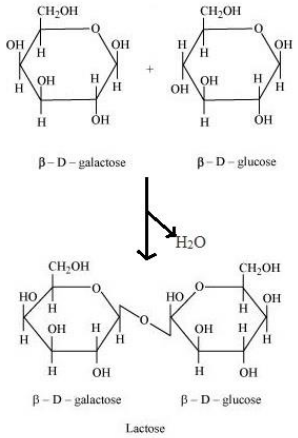
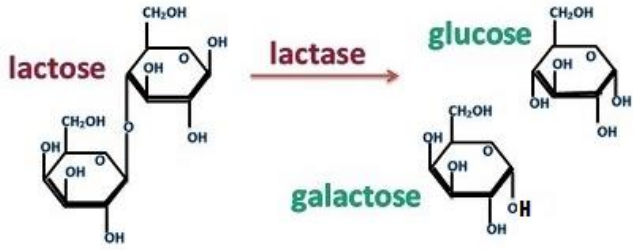
- Hydrolysis of maltose



3. **Lactose structure**
   - It is more commonly known as milk sugar since this disaccharide is found in milk.
   - It is composed of β-D-galactose and β-D-glucose.
   - The linkage is between C1 of galactose and C4 of glucose.
   - Free aldehyde group may be produced at C-1 of glucose unit, hence it is also a reducing sugar.



- **Hydrolysis of lactose**



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