

**Carbohydrates:** Contain **Carbon, Hydrogen** and **Oxygen** in the ratio **CH<sub>2</sub>O**

The simplest Carbohydrates are the **Simple Sugars**, these are classified by:

Type of **Carbonyl group** → Ketone → **Ketose**  
Aldehyde → **Aldose**

or by

Number of Carbon atoms:

**3 C's** → **Triose**

**4 C's** → **Tetrose**

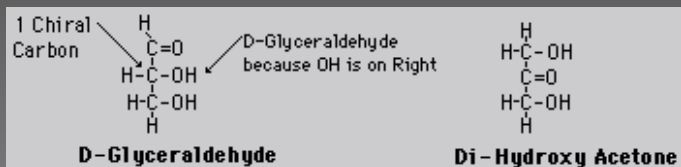
**5 C's** → **Pentose**

**6 C's** → **Hexose**

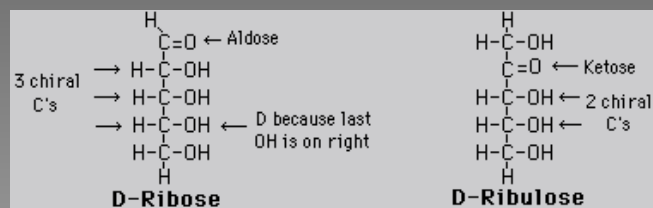
Note: suffix ...ose indicates a sugar

### Common Simple Sugars

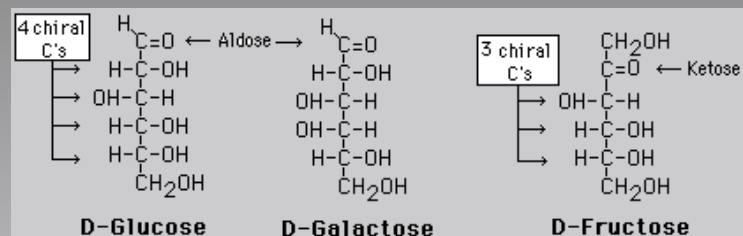
**Trioses**



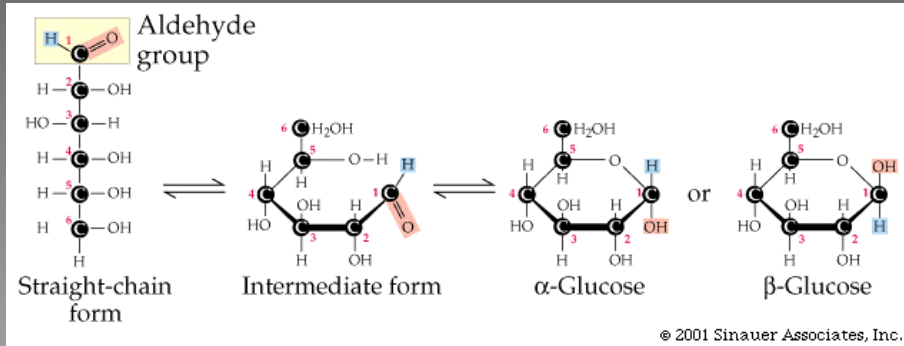
**Pentoses**



**Hexoses**

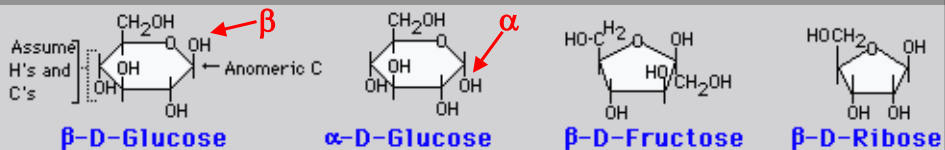
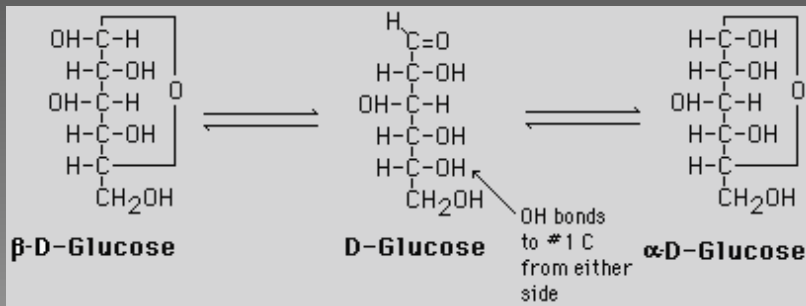


**Pentoses** and **Hexoses** form ring structures in water when one of the -OH groups forms a bond to the carbonyl group



**Figure 3.11: Linear and ring forms of glucose**

**Pentoses and Hexoses commonly form cyclic structures in solution**



In the ring form the arrangement of atoms around the "anomeric" C (the carbonyl C) can have two different configurations called  $\alpha$  and  $\beta$ .

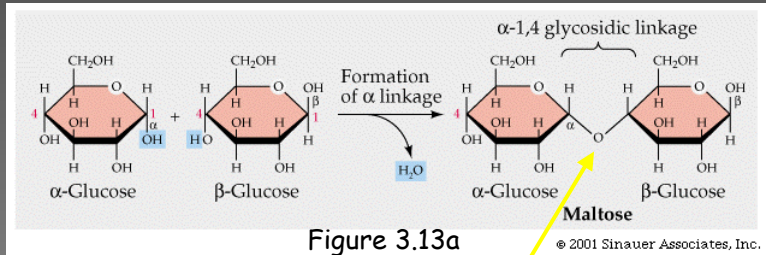
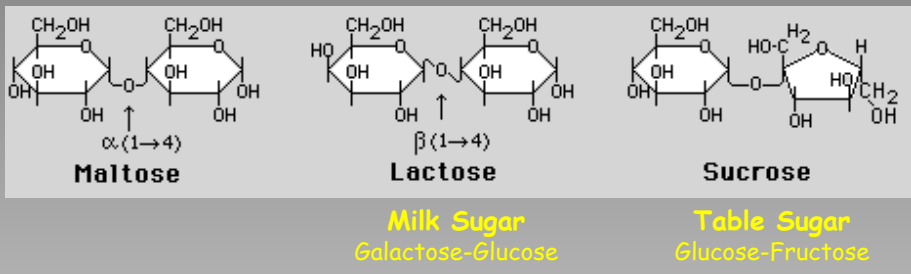


Figure 3.13a

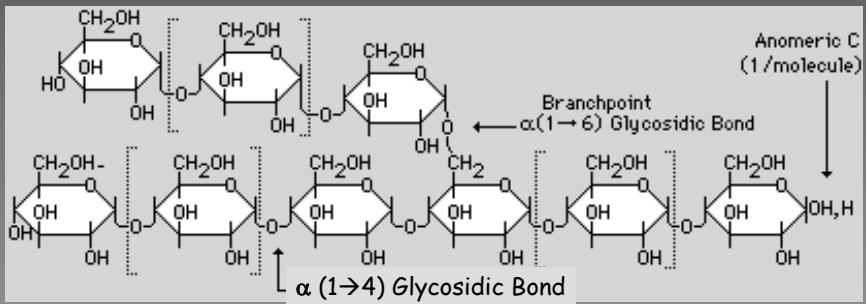
**Disaccharides** contain two simple sugars joined by a **Glycosidic Bond**

**Common Disaccharides**

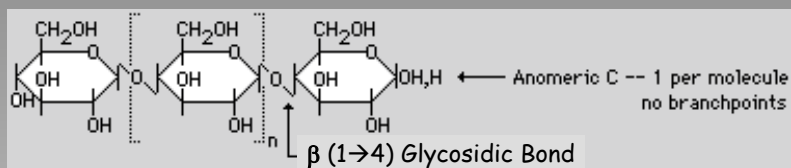


**Polysaccharides (Glycans):**

**Starch and Glycogen:** Fuel storage polysaccharides

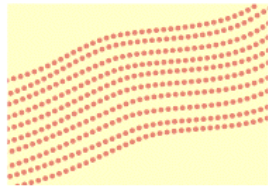


**Cellulose:** Structural polysaccharide



(b) **Macromolecular structure**

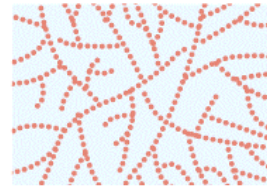
Linear (cellulose)



Branched (starch)



Highly branched (glycogen)



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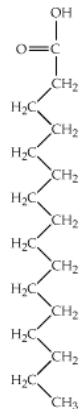
The only chemical differences between cellulose and starch/glycogen are:

- The configuration of the **Glycosidic Bond**,  $\alpha$  in starch and  $\beta$  in cellulose
- The Branchpoints in starch and glycogen

This gives the polymers very different shapes and properties.

**Fatty Acids** are important building blocks of lipids  
**Saturated Fatty Acids** have a straight conformation  
**Unsaturated Fatty Acids** have a bent conformation

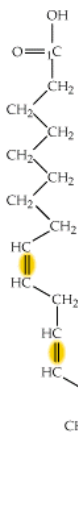
(a) Saturated fatty acid



Palmitic acid



(b) Unsaturated fatty acid



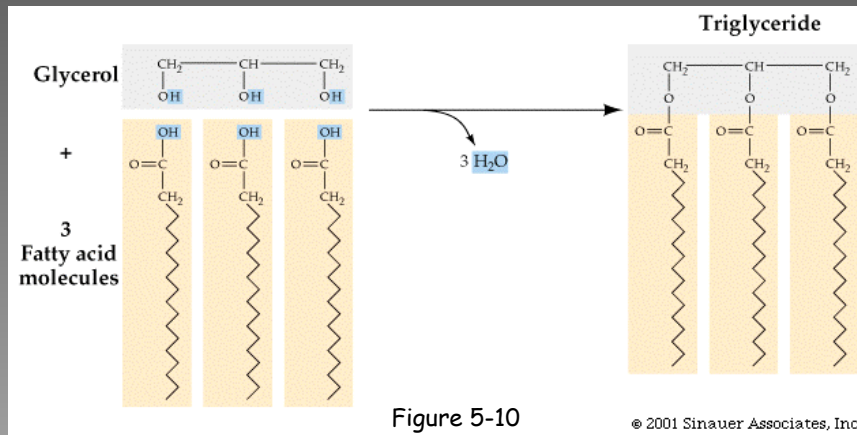
Linoleic acid



Figure 3.20

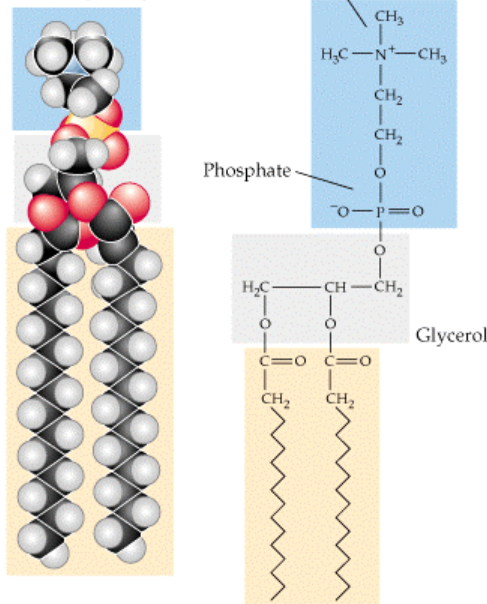
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**Triglyceride:** consist of 3 fatty acids bonded to the three -OH groups of a molecule of **Glycerol** via ester bonds.



**Fats** are triglycerides from animals with mostly saturated fatty acids.  
**Oils** are triglycerides from plants with mostly unsaturated fatty acids.

(a) Phosphatidyl choline



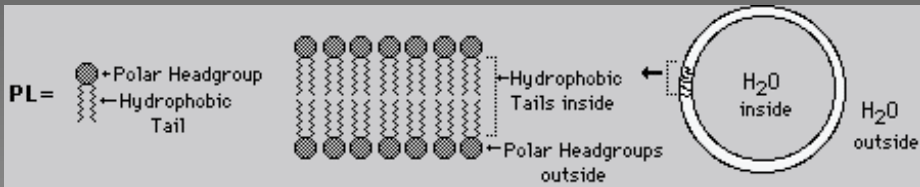
**Phospholipids** are an important class of membrane lipids composed of:

Glycerol + 2 Fatty Acids + Phosphate → **Phosphatidic Acid**

The structure is completed with an alcohol, Choline in this figure → **Phosphatidyl Choline** or **PC**

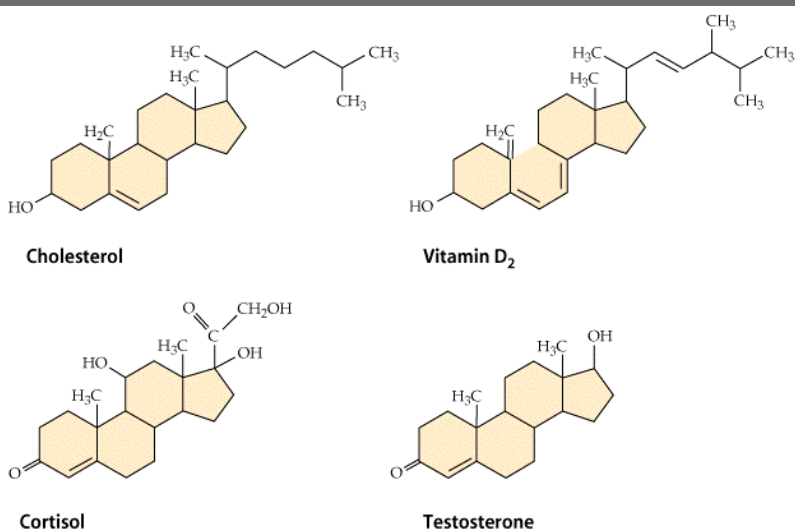
- Other PL's have other alcohols
- Phosphatidyl Ethanolamine** → **PE**
- Phosphatidyl Serine** → **PS**
- Phosphatidyl Inositol** → **PI**

## Phospholipids spontaneously form **Lipid Bilayers**



**Lipid bilayers** form the structural framework of **biological membranes**

**Steroids** are another class of lipids with a very different structure. **Cholesterol** is found in biological membranes along with phospholipids and alters the physical properties of the membranes.



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