The Biochemistry Crash Course

Basically, almost all living things are made up of these 4 Elements:

- Carbon (C)

- Hydrogen (H)

- Nitrogen (N)

- Oxygen (O)

This exercise is designed to familiarize you with the biologically useful substances that these elements can form

1. INORGANIC COMPOUNDS

- This group of compounds **do not** contain Carbon (with the exception of Carbon Dioxide CO_2)
- These are substances are abundant in the natural world
- Water (H_2O) is the most essential Inorganic Compound that our bodies require (our bodies are 70% water)
- Our Bodies also require inorganic compounds (minerals) formed from Na, Mg, Zn, P, Cl, F, Fe, K

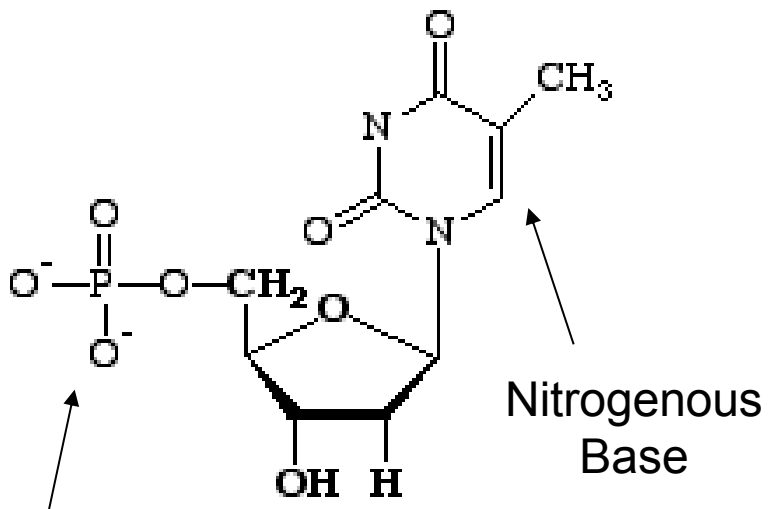
2. ORGANIC COMPOUNDS

- These compounds are **Carbon-Containing** compounds
- Carbon is a special element because it has the ability to bond covalently with a large number of elements in a large number of stable configurations (arrangements)
- Carbon also has the ability to form long stable chains and rings of atoms
- Organic Compounds are formed by **Polymerization**
  - Smaller compounds called **Monomers** (single units) bond together to form **Polymers**
  - **Polymers** are often referred to as **Macromolecules** because of their size

(a) Nucleic Acids

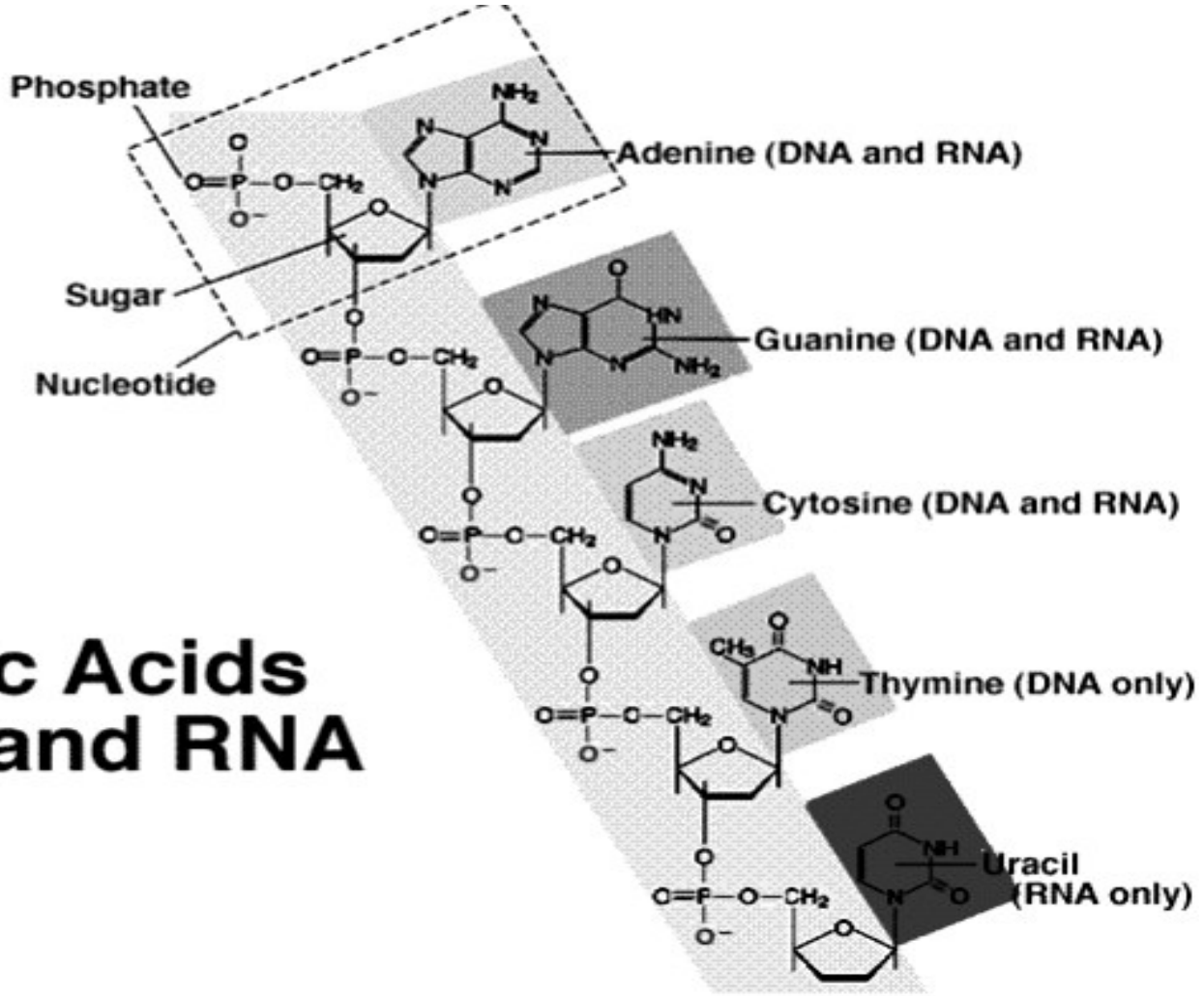
- **Composed of C, H, O, N and P atoms**
- Polymers of individual Monomers called **Nucleotides**
- Nucleic Acids are responsible for storing and transmitting genetic information
- There are 2 types of Nucleic Acids
  1. **Deoxyribonucleic Acid (DNA)**
  2. **Ribonucleic Acid (RNA)**
- Note: Nucleic acids are **NOT** strong acids

(a) Nucleic Acids



- Each Nucleotide is composed of:
  1. A 5-Carbon Sugar
  2. A Nitrogenous Base
  3. A Phosphate Group

(a) Nucleic Acids

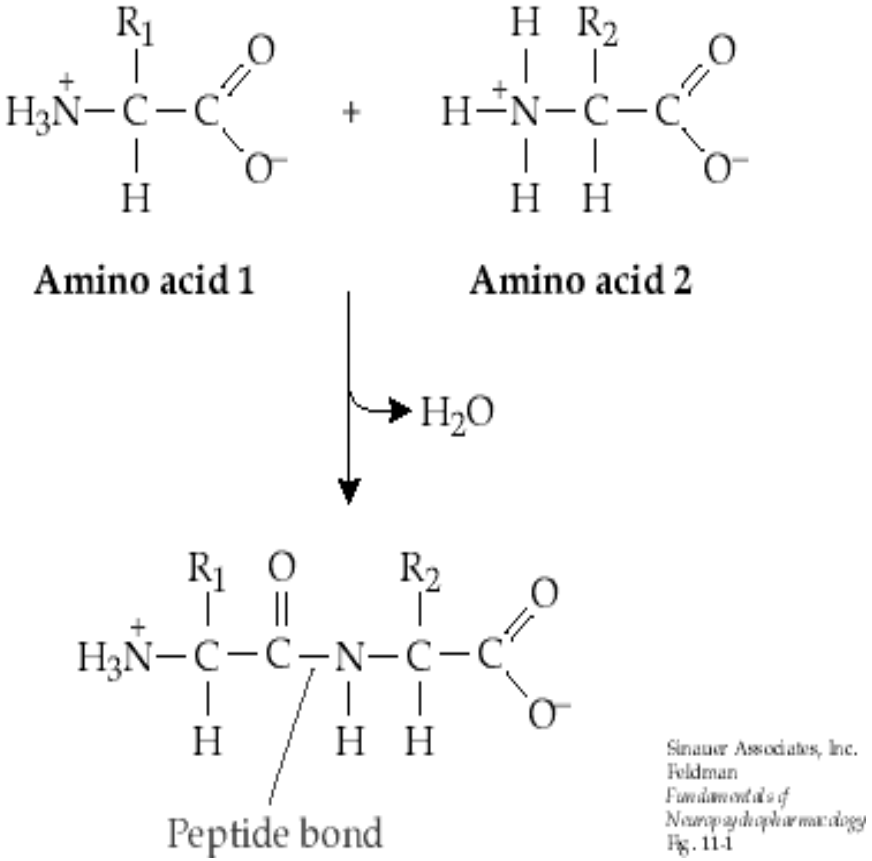


Nucleic Acids in DNA and RNA

(b) Proteins

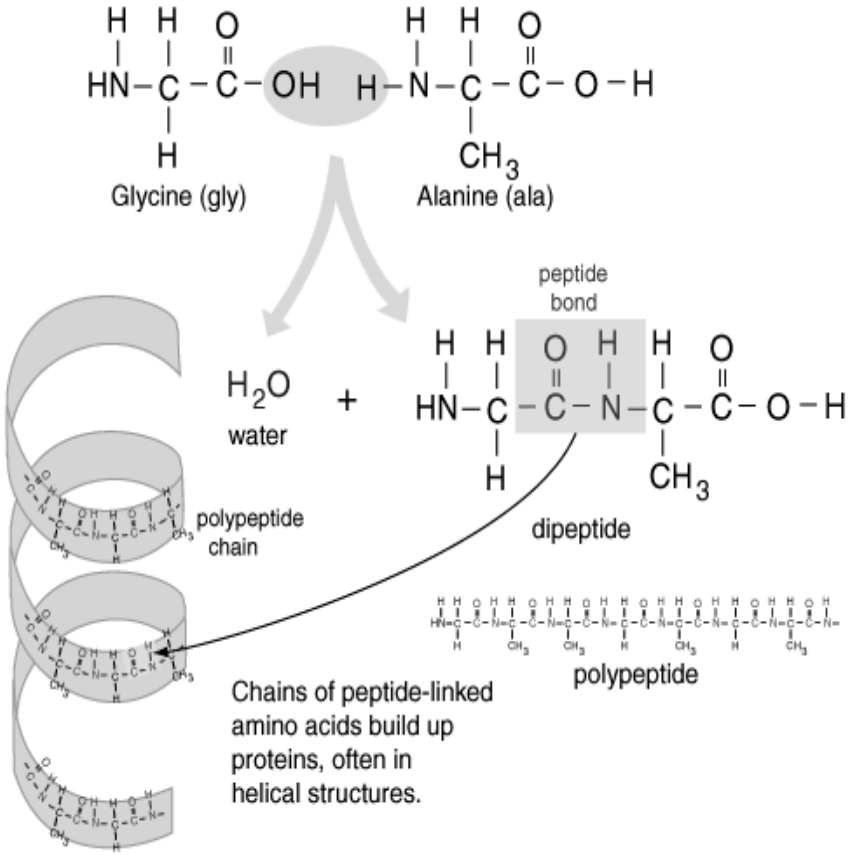
- These organic compounds contain N, C, H and O
- Proteins are responsible for most chemical functions that take place in the cells of our bodies
- A Protein is a Polymer of **Amino Acids**
  - An Amino Acid is an acid with an Amino Group at one end ($-NH_2$) and a Carboxyl Group at the other end (-COOH)
  - These groups can bond to each other creating long chains

(b) Proteins



- Amino acids form covalent bonds with each other called **Peptide Bonds**
- This process is called a **Dehydration Synthesis** as a molecule of Water is released

(b) Proteins

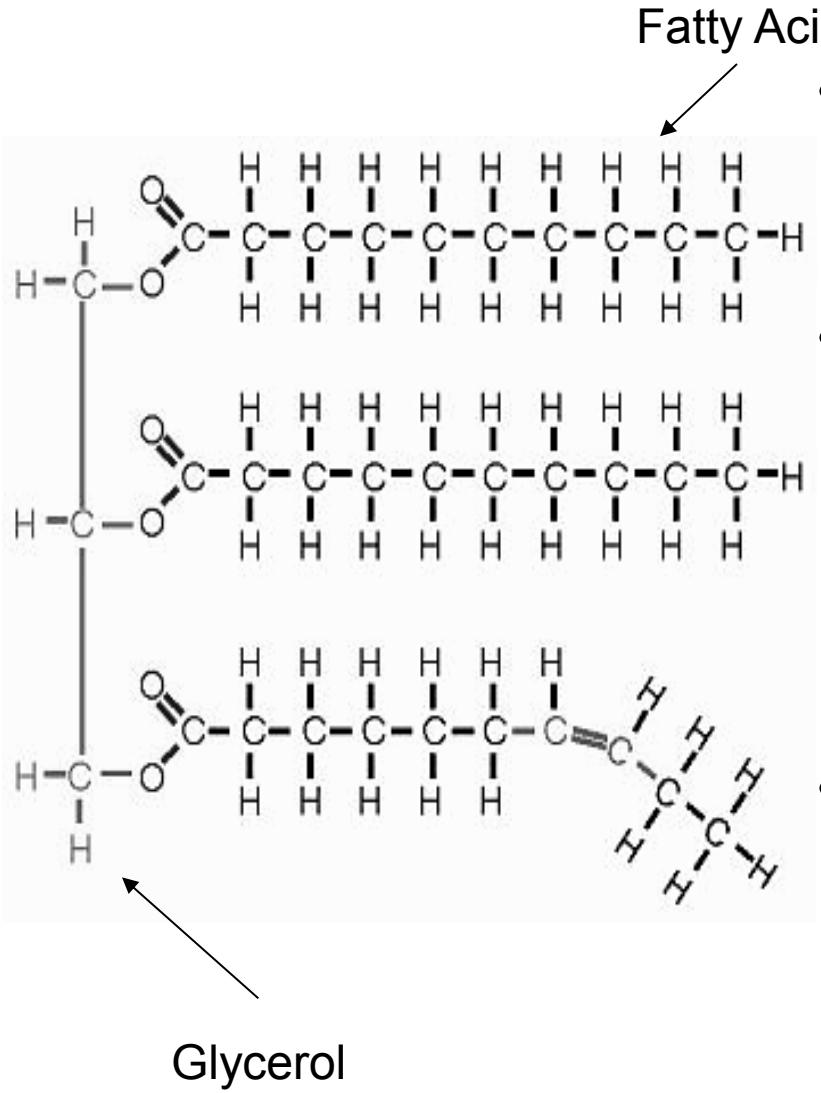


- A **Dipeptide** is a peptide made up of 2 amino acids
- A **Tripeptide** is made up of 3 amino acids
- A complete Protein contains one or more polypeptide chains

(c) Lipids

- These waxy, oily organic molecules are basic components of fats
- They are important for energy storage
- They are used to build cell membranes
- They are used as chemical messangers

(c) Lipids

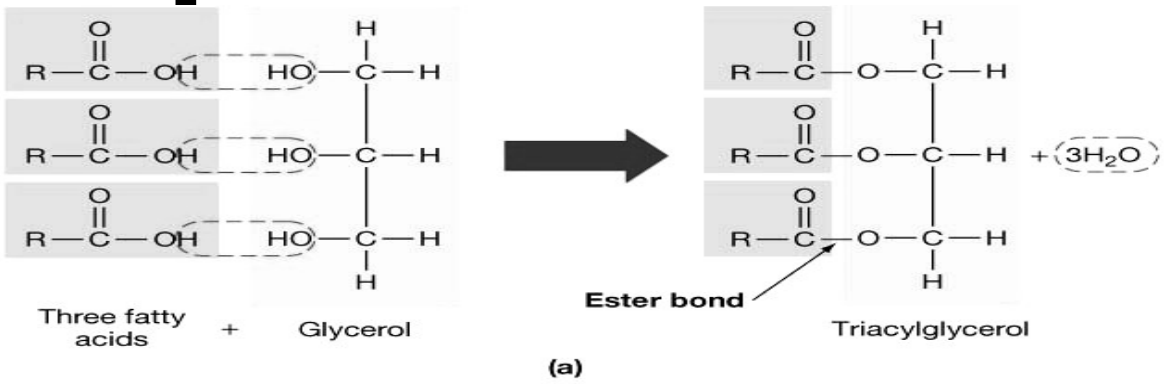


- The basic subunit of a Lipid (Fat) is called a **Monoglyceride**
- Monoglycerides are composed of a **glycerol molecule** and 2 or 3 **Fatty Acid Molecules**
- A Monoglyceride is formed by a **Dehydration Synthesis** in which the carboxyl group (-COOH) on the fatty acid bonds with the Hydroxyl Groups (-OH) on Glycerol releasing Water Molecules
- Lipid (Fat) molecules are created from chains of monoglycerides called **polyglycerides** in which the end of one glycerol molecule binds to the end of a glycerol molecule in a neighbouring monoglyceride

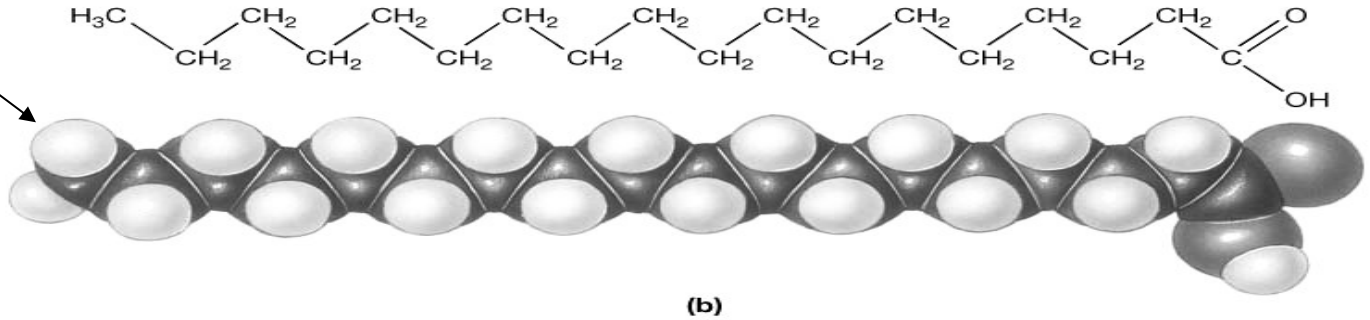
(c) Lipids

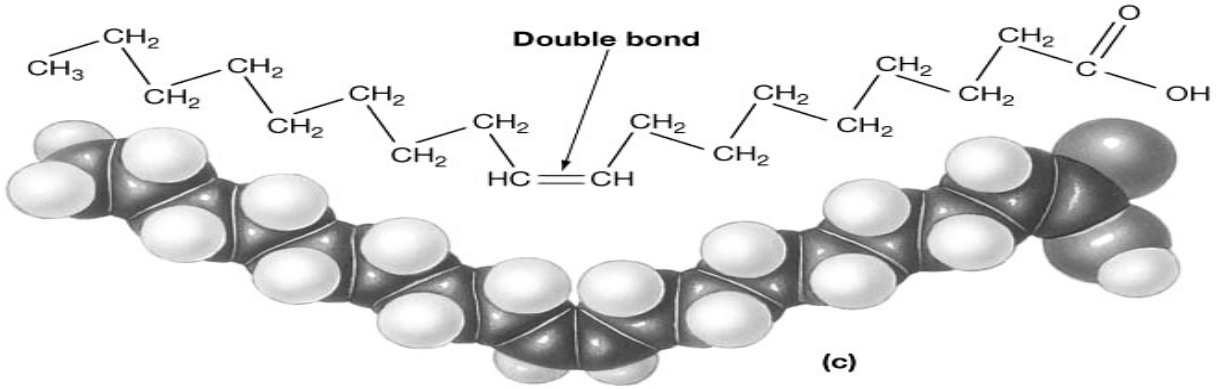
- A Fatty acid in which **every Carbon atom is joined by a single bond** is called a **Saturated Fatty Acid**
- A Lipid made from saturated fatty acids is called a **Saturated Fat**
- A fatty acid that contains a double bond is called an Unsaturated Fatty Acid
- A Lipid made from unsaturated fatty acids is called an **Unsaturated Fat**
- A Lipid made from an unsaturated fatty acid with more than one double bond is called a **Polyunsaturated Fat**

(c) Lipids



Saturated Fat





Unsaturated Fat

(d) Carbohydrates

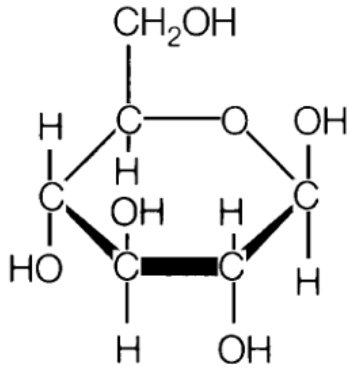
- These organic molecules are commonly called **Sugars**
- Although they do not hold as much energy as Lipid Molecules, they are used to store energy
- Carbohydrates are made up of Carbon, Hydrogen and Oxygen
  - There are 2 H atoms for every 1 O atom

(d) Carbohydrates

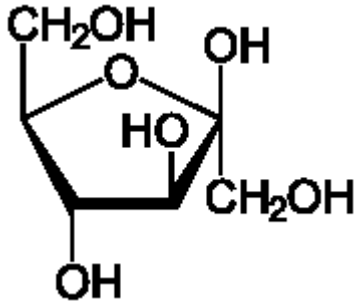
- The simplest Carbohydrates are called **Monosaccharides**
  - **(ex) Glucose, Fructose, Galactose**
- Through **Dehydration Synthesis**, 2 Monosaccharides can bond to each other and form a **Disaccharide**
  - **(ex) Glucose + Fructose = Sucrose (table sugar)**
- **Polysaccharides** are Macromolecules formed from many Monosaccharides
  - **(ex) Starch, Cellulose, Glycogen**

(d) Carbohydrates

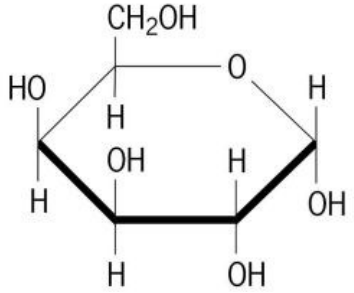
Monsaccharides (single sugars)



glucose

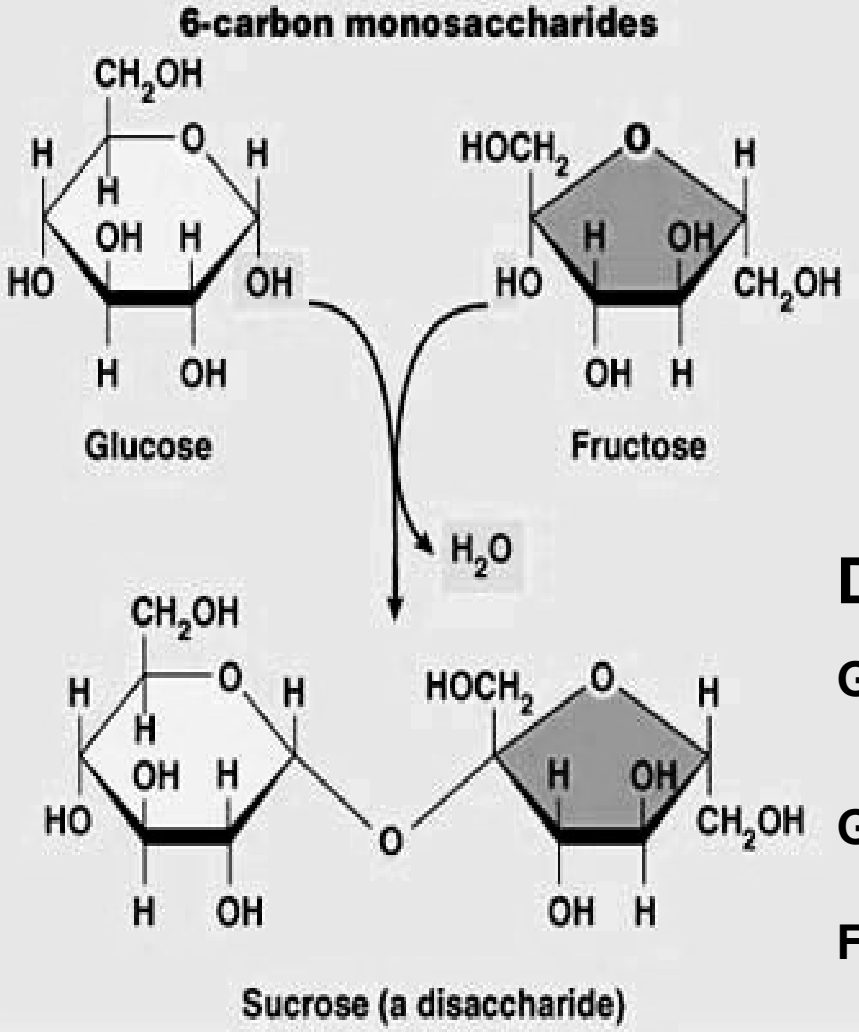


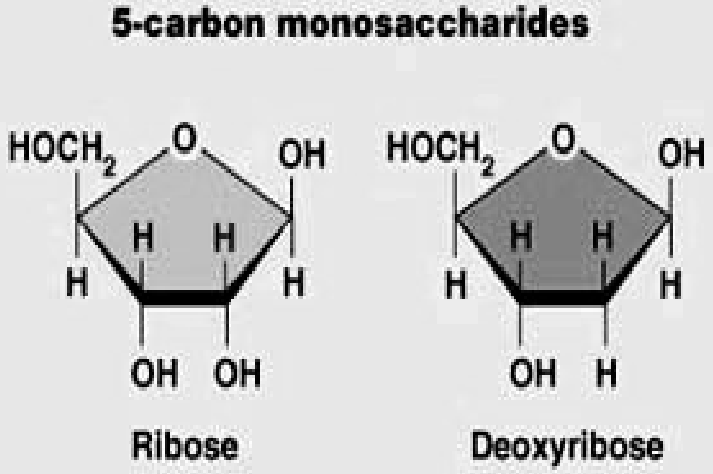
fructose



galactose

(d) Carbohydrates





Disaccharides (double sugars)

Glucose + Fructose = Sucrose
(table sugar)

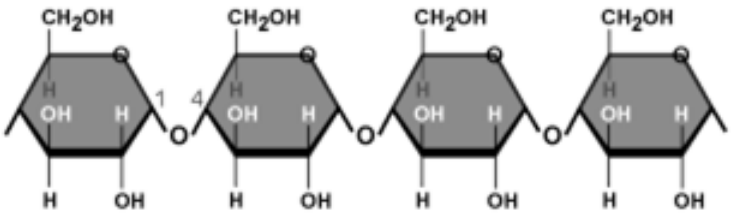
Glucose + Glucose = Maltose

Fructose + Galactose = Lactose

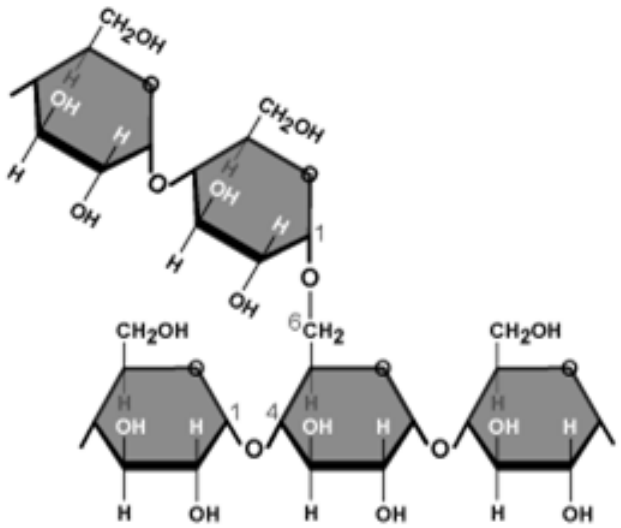
(d) Carbohydrates

Polysaccharides:

α-glucose subunits

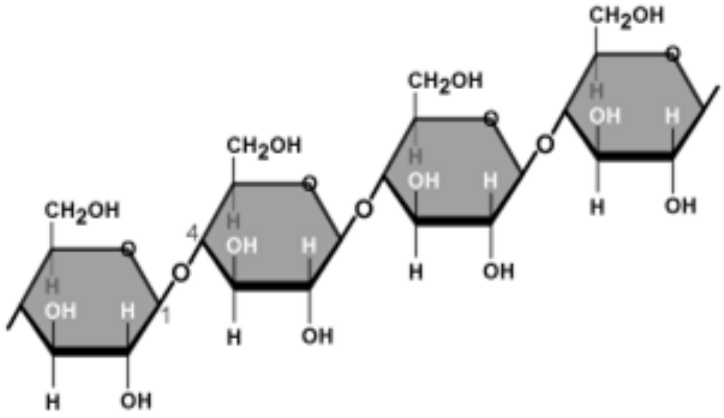


Starch: Chain of α-glucose subunits



Glycogen: Branched chain of α-glucose subunits

β-glucose subunits



Cellulose: Chain of β-glucose subunits