Macromolecules
Organic Compounds

- **Compounds** that contain **CARBON** are called organic.

- **Macromolecules** are large **organic molecules**.
Carbon (C)

- **Carbon** has **4 electrons** in outer shell.

- **Carbon** can form **covalent bonds** with as many as **4** other atoms (elements).

- Usually with **C, H, O or N**.

- **Example:** **CH₄**(methane)
Macromolecules

• **Large organic molecules.**
• Also called **POLYMERS.**
• Made up of smaller “building blocks” called **MONOMERS.**
• **Examples:**
  1. Carbohydrates
  2. Lipids
  3. Proteins
  4. Nucleic acids (DNA and RNA)
Question:

• How are Macromolecules formed?
**Answer: Dehydration Synthesis**

- Also called “condensation reaction”
- Forms **polymers** by combining **monomers** by “removing water”.

![Diagram showing dehydration synthesis process](image)
Question:

• How are Macromolecules separated or digested?
Answer: Hydrolysis

- Separates monomers by “adding water”.

![Diagram of hydrolysis process]
1. Carbohydrates

- Small sugar molecules to large sugar molecules.

- **Examples:**
  A. monosaccharide
  B. disaccharide
  C. polysaccharide
1. Carbohydrates

A. monosaccharide: one sugar unit

- **Examples:** glucose \((C_6H_{12}O_6)\)
deoxyribose
ribose

![Hexagon diagram with glucose]
1. Carbohydrates

B. disaccharide: two sugar unit

- **Example**: maltose - 2 glucose molecules
1. Carbohydrates

C. polysaccharide: many sugar units

- **Examples:**
  - starch (bread, potatoes)
  - glycogen (beef muscle)
  - cellulose (lettuce, corn)
2. Lipids

- General term for compounds which are **not soluble in water**.
- Lipids are **soluble in hydrophobic solvents**.
- **Remember**: “stores the most energy”
- **Examples**: 1. Fats  
  2. Phospholipids  
  3. Oils  
  4. Waxes  
  5. Steroid hormones  
  6. Triglycerides
2. Lipids

- **Six functions of lipids:**
  1. **Long term energy storage**
  2. **Protection against heat loss (insulation)**
  3. **Protection against physical shock**
  4. **Protection against water loss**
  5. **Chemical messengers (hormones)**
  6. **Major component of membranes**

(phospholipids)
2. Lipids

- **Triglycerides**: composed of 1 glycerol and 3 fatty acids.

![Chemical structure of triglycerides]
There are two kinds of fatty acids you may see these on food labels:

1. **Saturated fatty acids:** no double bonds (bad)

2. **Unsaturated fatty acids:** double bonds (good)
3. Proteins (Polypeptides)

- Amino acids (20 different kinds of aa) bonded together by **peptide bonds** (polypeptides).

- **Six functions of proteins:**
  1. Storage: albumin (egg white)
  2. Transport: hemoglobin
  3. Regulatory: hormones
  4. Movement: muscles
  5. Structural: membranes, hair, nails
  6. Enzymes: cellular reactions
3. Proteins (Polypeptides)

- Four levels of protein structure:
  
  A. Primary Structure (1°)
  B. Secondary Structure (2°)
  C. Tertiary Structure (3°)
  D. Quaternary Structure (4°)
A. Primary Structure (1°)

- Amino acids bonded together by peptide bonds.
B. Secondary Structure (2°)

- 3-dimensional folding arrangement of a primary structure into coils and pleats held together by hydrogen bonds.
- **Two examples:**
  - Alpha Helix
  - Beta Pleated Sheet
  - Hydrogen Bonds
C. Tertiary Structure (3°)

- Secondary structures bent and folded into a more complex 3-D arrangement.
- Bonds: H-bonds, ionic, disulfide bridges (S-S)
- Call a “subunit”.

Alpha Helix
Beta Pleated Sheet
D. Quaternary Structure (4°)

- Composed of 2 or more “subunits”.
- Example: enzymes (hemoglobin)
4. Nucleic acids

- **Two types:**
  a. deoxyribonucleic acid (DNA-double helix)
  b. ribonucleic acid (RNA-single strand)

- **Nucleic acids**
  are composed of long chains of *nucleotides* linked by *dehydration synthesis*.
4. **Nucleic acids**

- **Nucleotides:**
  - phosphate group
  - sugar (5-carbon)
  - nitrogenous bases
    - adenine (A)
    - thymine (T) - uracil (U) RNA
    - cytosine (C)
    - guanine (G)
DNA - double helix