LESSON 6

Main Biological Molecules

Vocabulary

Dr. NGUYEN MINH XUAN HONG
nmxhong@hcmuaf.edu.vn

1. Inorganic Compounds

Inorganic compounds are usually small, ionically bonded molecules.

Water, and many common acids, bases, and salts are examples of inorganic compounds

Organic vs. Inorganic

Organic	Inorganic
• Have C & H together	• Have C or H or neither, but never both at the same time.
• Made by living things	• Can be found in living things

Organic (adj) /ɔːrˈgæn.ɪk/

- **relating to, or belonging to a group of substances containing the chemical element carbon**

  Ex: Organic chemicals are used in the manufacture of plastics, fibres, solvents and paints.

- **not using artificial chemicals in the growing of plants and animals for food and other products**

  Ex: organic food/fruit/farms/farmers

→ **>< Inorganic (adj) vô cơ**

- Hữu cơ

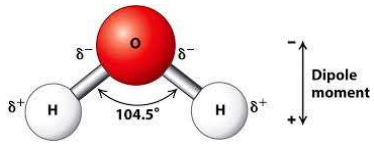
Identify the Organic & Inorganic Molecules

H_2O Inorganic	$NaOH$ Inorganic	FeO_3 Inorganic
CO_2 Inorganic	$C_6H_{12}O_6$ Organic	CO Inorganic
HCl Inorganic	C_2H_6 Organic	$C_{18}H_{36}O_2$ Organic
CaO Inorganic	H_2CO_3 Organic	C_3H_6 Organic
$CaCO_3$ Inorganic	C_2H_5OH Organic	$NaCl$ Inorganic
CH_3OH Organic	HNO_3 Inorganic	$CuSO_4$ Inorganic
NH_3 Inorganic	KCl Inorganic	$MnCl_2$ Inorganic
$KMnO_4$ Inorganic	H_2SO_4 Inorganic	NO_2 Inorganic
SO_3 Inorganic	HF Inorganic	C_8H_{18} Organic
Na_2SO_4 Inorganic	CH_3COOH Organic	HBr Inorganic

Water

Water is the most abundant substance in cells.

Because water is a polar molecule of the decomposition reactions of digestion, water is an excellent temperature buffer.

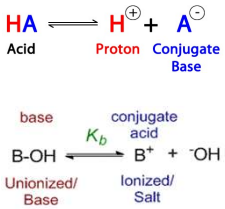


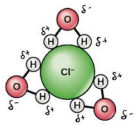
Acids, bases, and salts

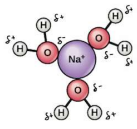
An acid dissociates into H+ ions and anions.

A base dissociates into OH- ions and cations.

A salt dissociates negative and positive ions, neither of which is H+ or OH-.







Dissociate (v)
/dɪˈsoʊ.ʃi.eɪt/

- **to consider as separate and not related**

→ **dissociation (n)**

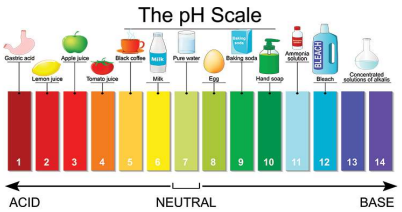
- Phân ly

Acid-base balance

The term pH refers to the concentration of H+ in a solution.

A solution with a pH of 7 is neutral; a pH below 7 indicates acidity; a pH above 7 indicates alkalinity.

A pH buffer, which stabilizes the pH inside a cell, can be used in culture media.



2. Organic Compounds

Organic Compounds always contain carbon and hydrogen.

Carbon atoms form up to four bonds with other atoms.

Organic Compounds are mostly or entirely covalently bonded, and many of them are large molecules.

Functional groups

A chain of carbon atoms forms a carbon skeleton.

The letter R may be used to denote a particular functional group of atoms are responsible for most of the properties of organic molecules.

Frequently encountered classes of molecules are R-OH (alcohols), R-COOH (organic acids), H_2N-RCOOH (amino acids).

Skeleton (n)
/ˈskel.ə.ʈən/

- **the most basic form or structure of something**
- **the frame of bones supporting a human or animal body**

→ **carbon skeleton (n): Carbon skeletons are chains of carbon atoms that make organic compounds.**

- Bộ khung, xương

denote (v)
/dɪˈnoʊt/

- **to represent or mean something:**

Ex: His angry tone denoted extreme displeasure.

- Biểu hiện, biểu thị, chứng tỏ, chỉ rõ; Bao hàm

Macromolecules

Small organic molecules may combine into very large molecules called macromolecules.

Monomers usually bond together by dehydration synthesis or condensation reactions that form water and a polymer.

3. Carbohydrates

Carbohydrates are compounds consisting of atoms of carbon, hydrogen, and oxygen, with hydrogen and oxygen in a 2:1 ratio.

Carbohydrates include sugars and starches.

condensation (n)
/ˌkɑn·dənˈseɪ·ʃən/

- **the change of a gas to its liquid or solid form**
- **the drops of water that appear on cold windows or other surfaces, as a result of hot air or steam becoming cool**
- **Condensation is also the process by which water vapor in the atmosphere (= air surrounding the earth) cools and changes into liquid water.**

• Ngưng tụ

Carbohydrates can be divided into three types, monosaccharides, disaccharides, and polysaccharides.

Monosaccharides contain from three to seven carbon atoms.

Monosaccharides may form disaccharides and polysaccharides by dehydration synthesis.

Polysaccharides and disaccharides may be broken down by hydrolysis, a reaction involving the splitting of water molecules.

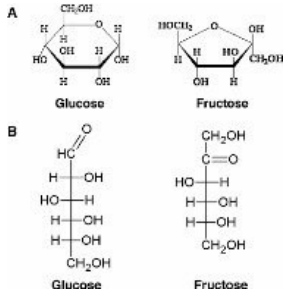
Isomers are two molecules with the same chemical formula but different structures and properties - for example, glucose ($C_6H_{12}O_6$) and fructose ($C_6H_{12}O_6$).

split (v)
/splɪt/

- **to (cause to) divide into two or more parts, especially along a particular line**
- **to form cracks**
- **(n) a long, thin tear, or a division.**

• Tách ra

Isomers: two molecules with the same chemical formula but different structures and properties



4. Lipids

Lipids are a diverse group of compounds distinguished by their insolubility in water.

Simple lipids (fats) consist of a molecule of glycerol and three molecules of fatty acids.

A saturated fat has no double bonds between carbon atoms in the fatty acids; an unsaturated fat has one or more double bonds.

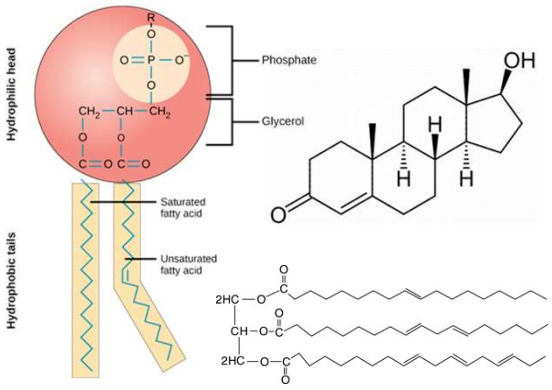
Phospholipids are complex lipids consisting of glycerol, two fatty acids, and phosphate.

Steroids have carbon ring systems with functional hydroxyl and carbonyl groups.

diverse (adj)
/dɪˈvɜːs/

- **including many different types of people or things**
- **very different from each other; varied**

• Đa dạng, phong phú; khác biệt



5. Proteins

Amino acids are the building blocks of proteins.

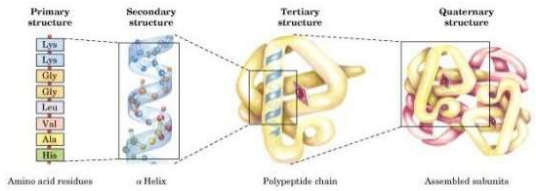
Amino acids consist of carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur.

Twenty amino acids, peptide bonds (formed by dehydration synthesis) allow the formation of polypeptide chains.

Protein have four levels of structure - primary (sequence of amino acids), secondary (regular coils or pleats), tertiary (overall three-dimensional structure of a polypeptide), and quaternary (two or more polypeptide chains).

Conjugated proteins consist of amino acids combined with other organic or inorganic compounds.

4 levels of protein structure



- Primary – sequence of amino acids
- Secondary – interactions between adjacent amino acids
- Tertiary – 3D folding of the polypeptide
- Quaternary – arrangements of multiple polypeptides

Conjugated proteins: consist of amino acids combined with other organic or inorganic compounds.

Conjugated protein	*Protein part*	*Prosthetic group*
Hemoglobin	Globin	Heme
Nucleoprotein	Histones	DNA
Rhodopsin	Opsin	11-cis-retinal
Succinate dehydrogenase	Protein	Riboflavin as FAD
Ferritin	Apoferritin	Iron
Ceruloplasmin	Apoceruloplasmin	Copper

6. Nucleic Acids

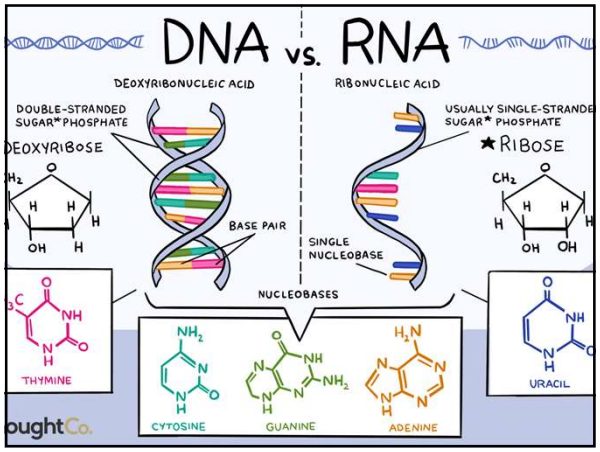
Nucleic acids, DNA and RNA, are macromolecules consisting of repeating nucleotides.

A nucleotide is composed of a pentose, a phosphate group, and a nitrogenous base.

A DNA nucleotide consists of deoxyribose (a pentose) and one of these nitrogenous bases: thymine or cytosine (pyrimidines) or adenine or guanine (purines).

DNA consists of two strands of nucleotides wound in a double helix. The strands are held together by hydrogen bonds between purine and pyrimidine nucleotides: A-T and G-C.

An RNA nucleotide consists of ribose (a pentose) and one of these nitrogenous bases: cytosine, guanine, adenine, or uracil.



Strand (n)
/strænd/

- **a thin thread of something, often one of a few, twisted around each other to make a string or rope**

- Sợi, chuỗi

7. Adenosine Triphosphate (ATP)

ATP stores chemical energy for various cellular activities.

When the bond to ATP's terminal phosphate group is broken, energy is released.

The energy from decomposition reactions is used to regenerate ATP from ADP and phosphate.