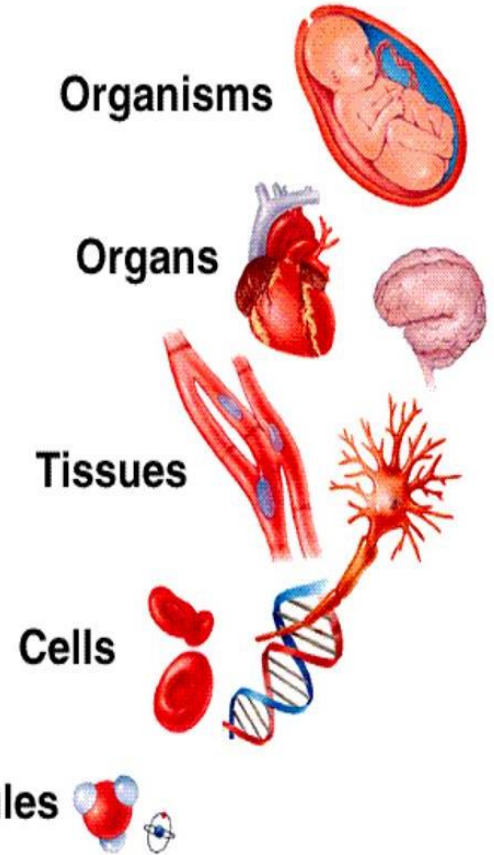


Human Biology

Lecture 1 Theory Introduction
to human biology course
Properties and elements of life

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Atoms and Molecules

Human Biology

Is the study of the anatomy and all the human activities such as growth, nutrition, reproduction, respiration, digestion, excretion, secretionetc.

Studying the human body involves the study of the anatomy, physiology, histology and embryology. Physiological study focuses on the systems and organs of the human body and their functions.

Many systems and mechanisms interact in order to maintain the homeostasis with safe levels of substances such as sugar and oxygen in the blood.

Main topics of human biology course

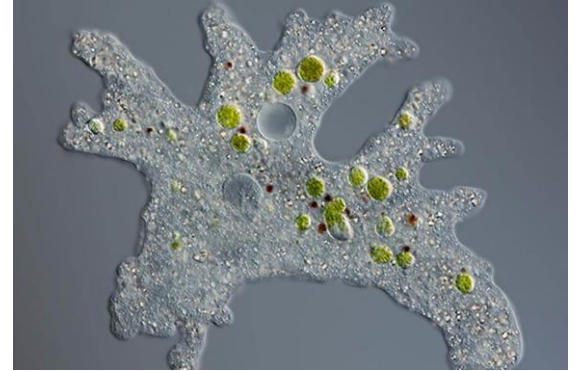
- **The properties and chemistry of Life**
- **Human cells and tissues**
- **The Integumentary System**
- **The skeletal System and muscular System**
- **Digestive systems**
- **Blood and Cardiovascular System**
- **Lymphatic system and Endocrine**
- **Respiratory system**
- **Urinary systems**
- **The human cycle**
- **The nervous system and senses**

Properties of Life

The living world is very diverse, but **all living things share five basic properties**

1- Cellular Organization

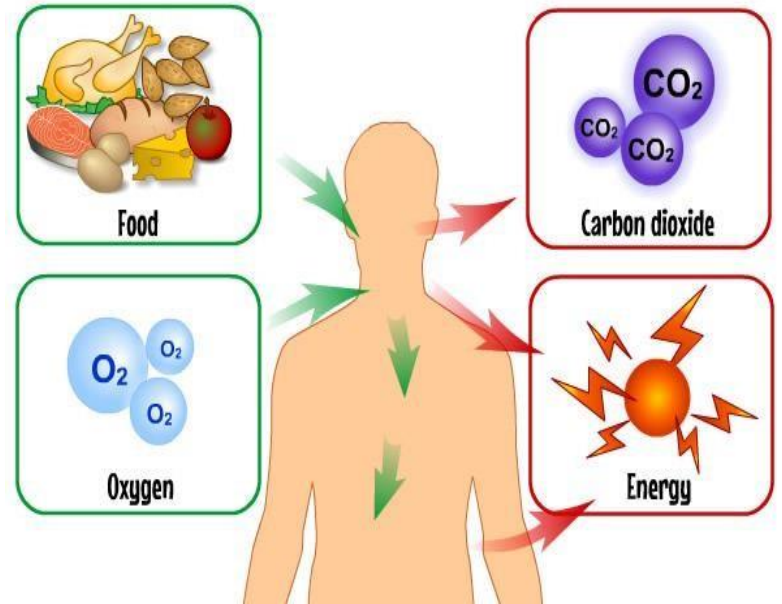
- All living things are composed of **ONE** or **MORE CELLS**.
- A **cell** is an organized unit that can live and reproduce by itself,
- **Cells are the smallest units that can be alive.**
- Some organisms are **unicellular** – they are made of only 1 cell.
- Other organisms are **multicellular**. they are made of many cells that function together.



2- Metabolism and energy

Human take in energy and materials by consuming food. Our bodies use the energy and raw materials to build and operate their parts in ways that keep us alive.

Metabolism is all the chemical processes that build-up or break down materials and create waste.



3- Sensation and responding

Living things sense and respond to changes in the environment.

Organisms react to stimuli:

- ✓ Light
- ✓ Temperature
- ✓ Odor
- ✓ Sound
- ✓ Heat
- ✓ Water
- ✓ Pressure



4- Homeostasis

Homeostasis is a state of chemical and physical stability inside the body that must be maintained in order for individual cells, and the whole body, to stay alive. Body cells are part of systems that maintain internal homeostasis.

Controlling body temperature

All mammals maintain a constant body temperature.

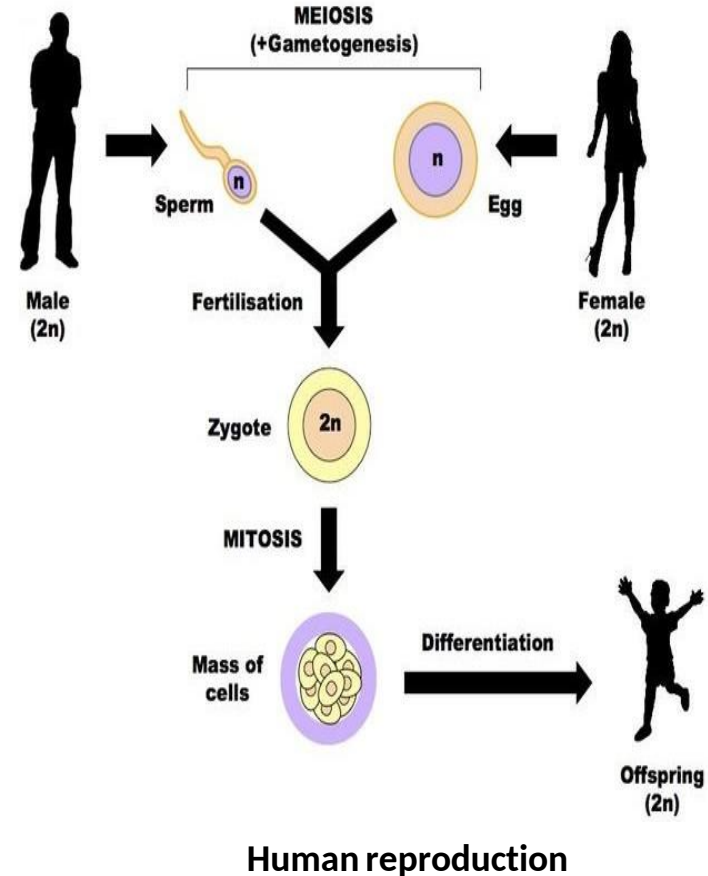
Human beings have a body temperature of about 37°C.

E.g. If your body is in a hot environment your body temperature is 37°C

If your body is in a cold environment your body temperature is still 37°C

5- Growth and Reproduction

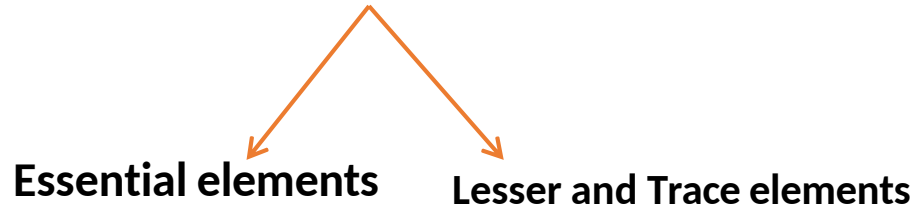
Living things reproduce and grow. Organisms can make more of their own kind, based on instructions in DNA, the genetic material. Only living things have DNA. Guided by the instructions in their DNA, most organisms develop through a series of life stages.



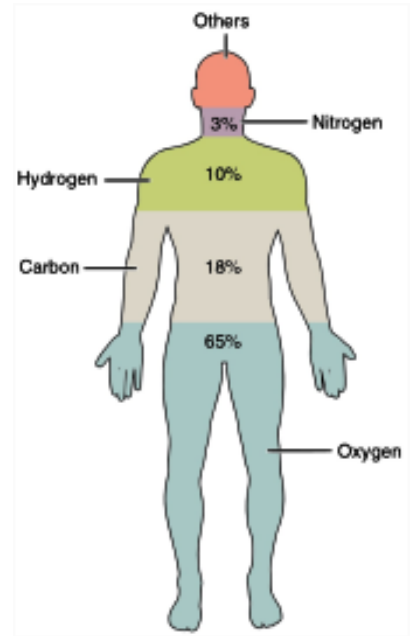
The Chemistry of Life

- Chemistry is the science of the structure and interactions of **matter**, which is anything that occupies space and has mass. **Mass** is the amount of matter in any living organism or nonliving thing.
- All forms of matter are made up of a limited number of building blocks called ***chemical elements***
- There are about 26 elements needed to build your body.
- There are about 112 elements occurring naturally in nature.

Chemical composition of cells



Elements aggregate to produce **compounds**



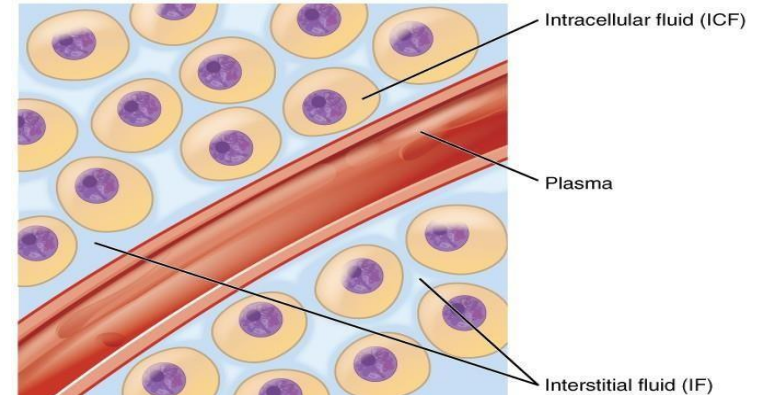
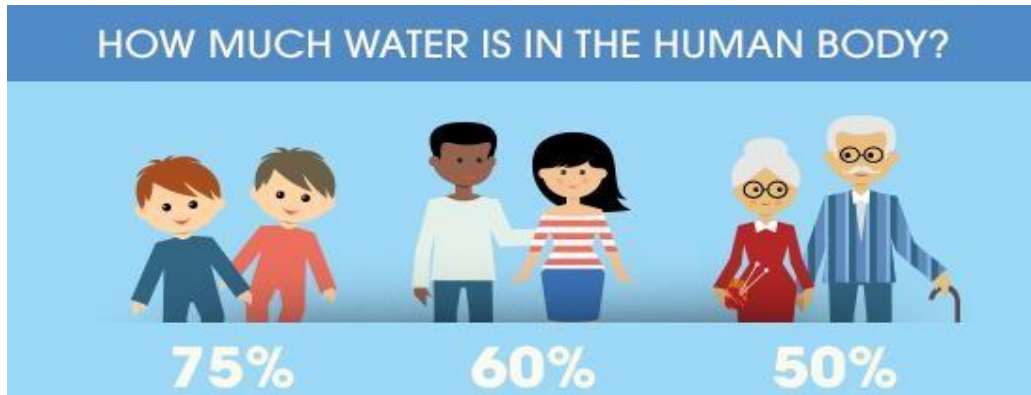
There are two types of compounds in human body:

Inorganic compounds: usually lack carbon. E.g water, salt, acids or bases ...

Organic compounds: always contain carbon . E.g carbohydrates, proteins, lipids, vitamins and nucleic acids

Cell Water


- **Water** is the most abundant molecule in **cells**, accounting for **70%** or more of total **cell** mass. There are few exceptions like bone.
- Total body water is about **50 - 60%** of body weight in adults and **75%** in children.
- The **intracellular fluid** makes up about 60 percent of the total water in the human body, and **extracellular fluid** makes up about 40% of the total water.
- Extracellular water includes **plasma** and **interstitial water** (the fluid in the tissue spaces between cells).



Cell Ions (electrolytes)

- Electrolytes are substances that dissociate in solution.
- These substances are located in the extracellular and intracellular fluid.
- Within the **extracellular fluid**, the major cation is **sodium** and the major anion is **chloride**.
- The major cation in the **intracellular fluid** is **potassium**.

Extracellular Fluid		Intracellular Fluid	
Na⁺	142 mEq/L	10 mEq/L	
K⁺	4 mEq/L	140 mEq/L	
Ca⁺⁺	5 mEq/L	<1 mEq/L	
Mg⁺⁺	3 mEq/L	58 mEq/L	
Cl⁻	103 mEq/L	4 mEq/L	
HCO₃⁺	28 mEq/L	10 mEq/L	
Phosphates	4 mEq/L	75 mEq/L	
SO₄⁻	1 mEq/L	2 mEq/L	
Osmolality	281 mOsm/L	281 mOsm/L	

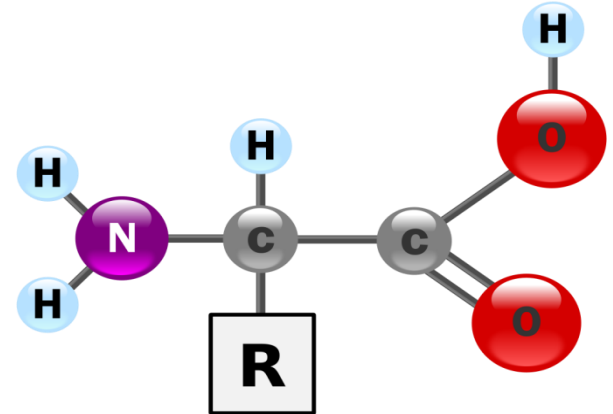
A diagram of a cell is shown on the right side of the table. The cell is represented by a purple oval. The table is divided into two main sections: 'Extracellular Fluid' on the left and 'Intracellular Fluid' on the right. The 'Extracellular Fluid' section is highlighted in yellow, and the 'Intracellular Fluid' section is highlighted in light blue. The table lists various ions and their concentrations in milliequivalents per liter (mEq/L) for both compartments. The ions listed are Na+, K+, Ca++, Mg++, Cl-, HCO3+, Phosphates, and SO4-. The concentrations are: Na+ (142 mEq/L extracellular, 10 mEq/L intracellular), K+ (4 mEq/L extracellular, 140 mEq/L intracellular), Ca++ (5 mEq/L extracellular, <1 mEq/L intracellular), Mg++ (3 mEq/L extracellular, 58 mEq/L intracellular), Cl- (103 mEq/L extracellular, 4 mEq/L intracellular), HCO3+ (28 mEq/L extracellular, 10 mEq/L intracellular), Phosphates (4 mEq/L extracellular, 75 mEq/L intracellular), and SO4- (1 mEq/L extracellular, 2 mEq/L intracellular). The Osmolality is listed as 281 mOsm/L for both compartments.

Organic compounds

The five major macromolecules essential forms of **CELL** are proteins, nucleic acids, carbohydrates, vitamin and lipid

1- proteins

- Proteins are macromolecules that carry many functions in the cell.
- They are produced by linking together of **amino acid** with covalent bond called **Peptide bond**
- There are 20 amino acids used for the synthesis of proteins by the mRNA directed process that occurs on ribosomes.
- Each amino acid (except for proline) has a **carboxyl group**, an **amino group**, and a distinctive side chain ("**R-group**") bonded to the α -carbon atom.



Example of human body proteins and their functions

- Some proteins are **enzymes** (amylase, lipase, polymerase) or **hormones** (insulin, thyroid hormone, oxytocin): direct and regulate metabolism in the body.
- **Contractile proteins** (actin and myosin): in muscle permit movement
- **Collagen**: It is the major component of connective tissues
- In the bloodstream, proteins, such as:
 - **Hemoglobin**: transporting gases
 - **Plasma albumin**: regulating osmotic pressure.
 - **Immunoglobulins**: fight infectious bacteria and viruses
 - **Fibrinogen**: responsible for normal blood clotting
- **Keratin**: form a protective layer on the outside of the skin

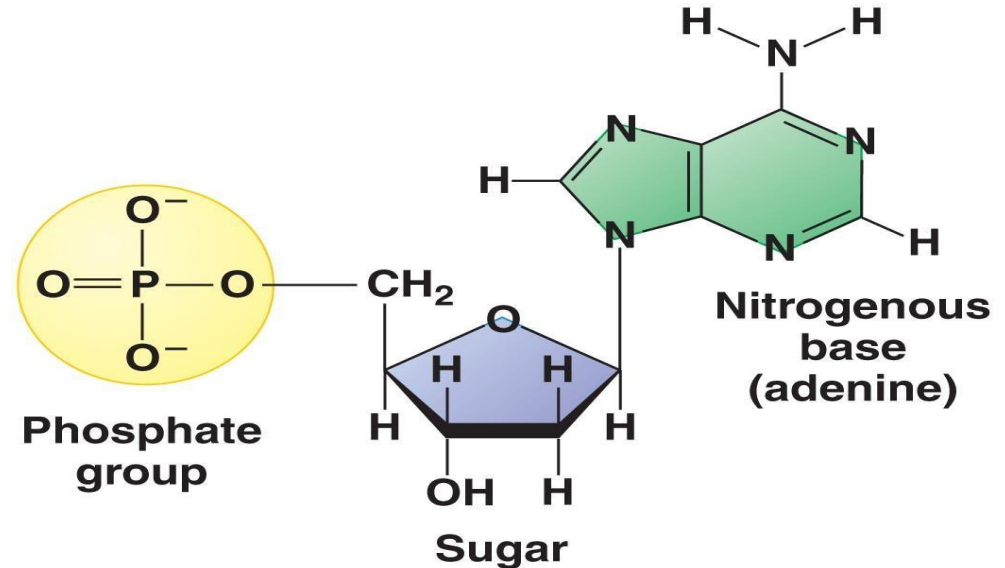
2- Nucleic acids

DNA (Deoxyribonucleic acid)

DNA is the molecule that carries **the genetic information** in all cellular forms of life and some viruses. It belongs to a class of molecules called the nucleic acids, which are polynucleotides - that is, long chains of nucleotides.

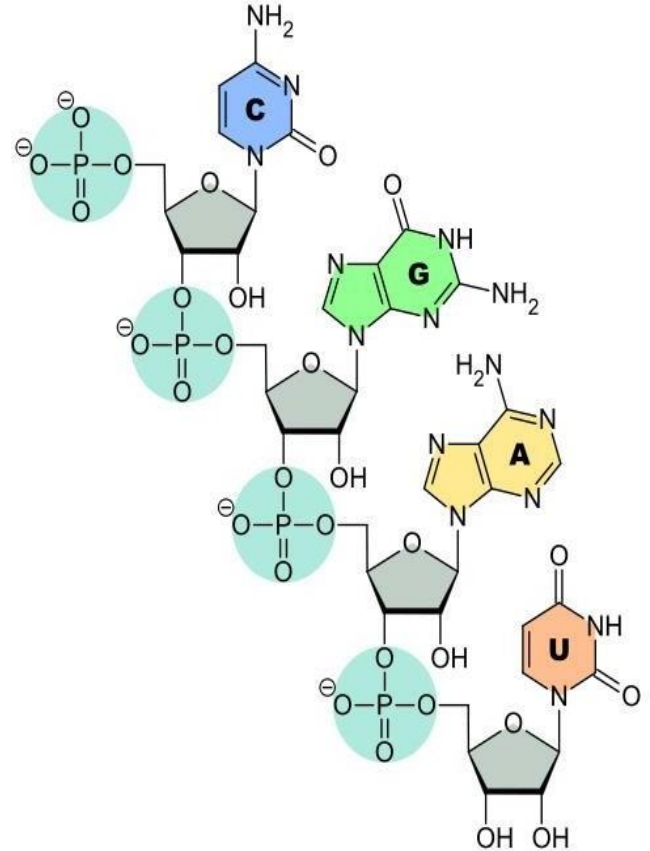
Each nucleotide consists of three components:

- a nitrogenous base:
- a five-carbon sugar molecule (deoxyribose in the case of DNA)
- a phosphate molecule



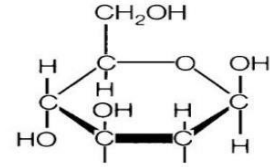
Ribonucleic acid (RNA)

- RNA is typically single stranded and is made of ribonucleotides that are linked by **phosphodiester** bonds.
- A ribonucleotide in the RNA chain contains ribose (the **pentose sugar**), one of the four nitrogenous bases, and a phosphate group.

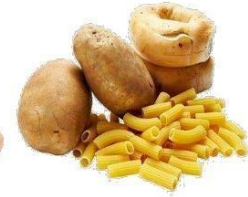


3- Carbohydrates

- Carbohydrates are made of **carbon**, **hydrogen** and **oxygen**.
- Functions: Carbohydrates are the main sources of energy in the body. **Ribose** and **deoxyribose** are used to make **RNA and DNA**. They make **glycoproteins** and **glycolipids** (**components of cell membranes and receptors**).
- Storage form of energy is glycogen.
- **In body, excess carbohydrate is converted to fat.**

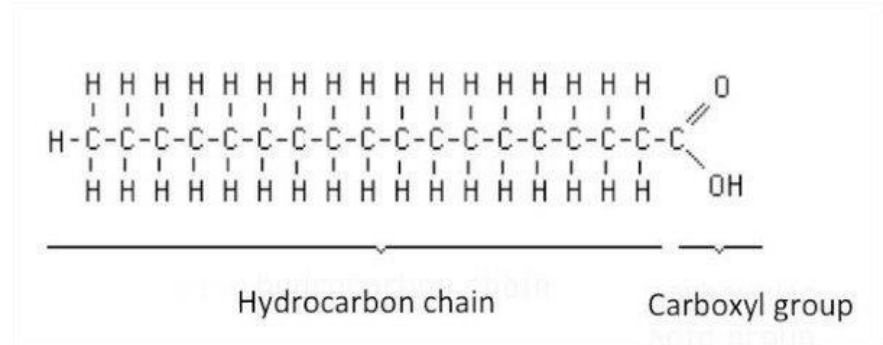


CARBOHYDRATES



4- Lipids

- Lipids a diverse group of substance that contain carbon, hydrogen and oxygen. The proportion of oxygen is lower than that in carbohydrates.
- The classification of lipid:
 - a) Simple lipids (**triglyceride**)
 - b) Compound lipids (**phospholipid**)
 - c) Derived lipids (**steroids**)
 - d) Fat-soluble vitamins (**vitamins A, D, E, and K**).



5- Vitamins

- Vitamins are chemically unrelated organic compounds that cannot be synthesized in adequate quantities by humans and, therefore, must be supplied by the **diet**.
- Nine vitamins** (including non-B complex and B complex vitamins) are classified as water soluble. Because they are readily excreted in the urine.

- Four vitamins** (A, D, K, and E) are termed fat soluble. They are released, absorbed, and transported with dietary fat. They are not readily excreted, and significant quantities are stored in the liver and adipose tissue.

