Department of Anesthesiology

chemistry

Title of the lecture:

Scope of biochemistry in health and disease, cell and cell constituents.

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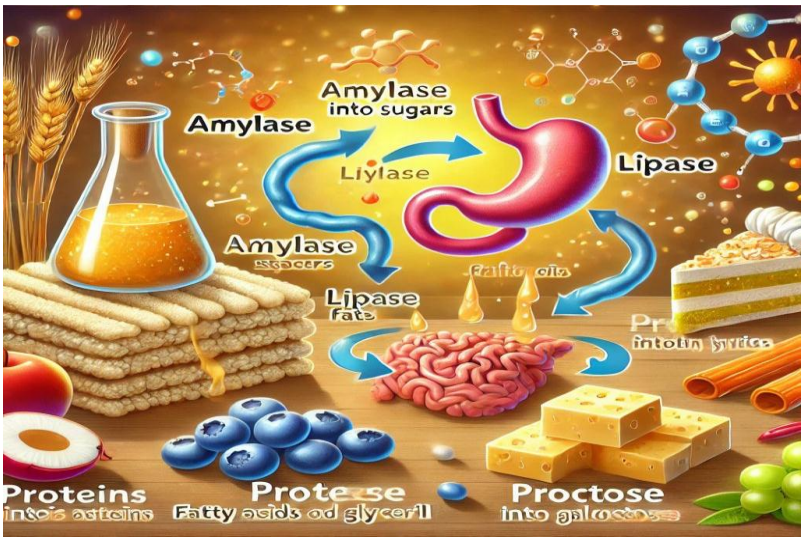
Definition: Biochemistry is the science that studies the biochemical processes within living organisms, and is a fundamental pillar in understanding how the body functions in both health and disease. Biochemistry plays a pivotal role in explaining cellular activities, and contributes to the discovery and development of diagnostic and therapeutic methods for many diseases.

Biochemistry is concerned with the study of cell components such as amino acids, proteins, carbohydrates, and other organic materials such as vitamins, hormones, and inorganic materials. And deeper studies on the processes of demolition and biosynthesis of these components as well as the processes of energy consumption or storage.

When carbohydrates, lipids and proteins enter the digestive tract, they go through the following stages:

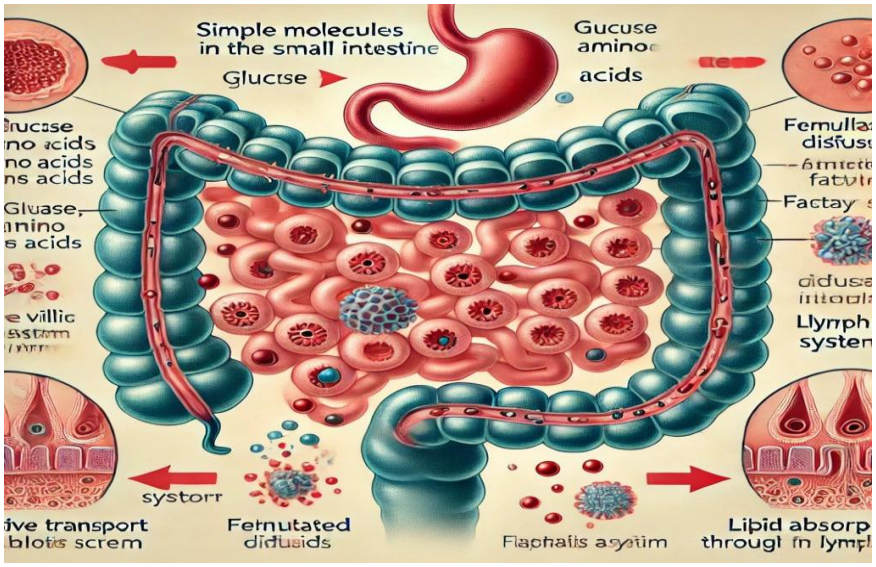
1. Digestion

Food is digested into simpler units that are easy to absorb and then utilize. This process is catalyzed by digestive enzymes in the mouth, stomach, pancreas and intestines.



2. Absorption

These simple units resulting from digestion are absorbed through the small intestine. The main goal of the digestion and absorption processes is to transport the simple (primary) units of food to the tissue cells through the blood. While some types of food do not need digestion and are absorbed as is, such as water, glucose, vitamins and minerals.



It begins with the use of raw materials absorbed into tissue cells, and the tissues use these materials in one of the following two ways:

- **Breakdown or Catabolic Reaction:** The process itself is called demolition. **Such: glycolysis**

$$Glucose + 2ADP + 2NAD^{+} \longrightarrow 2pyruvate + 2ATP + 2NADH$$

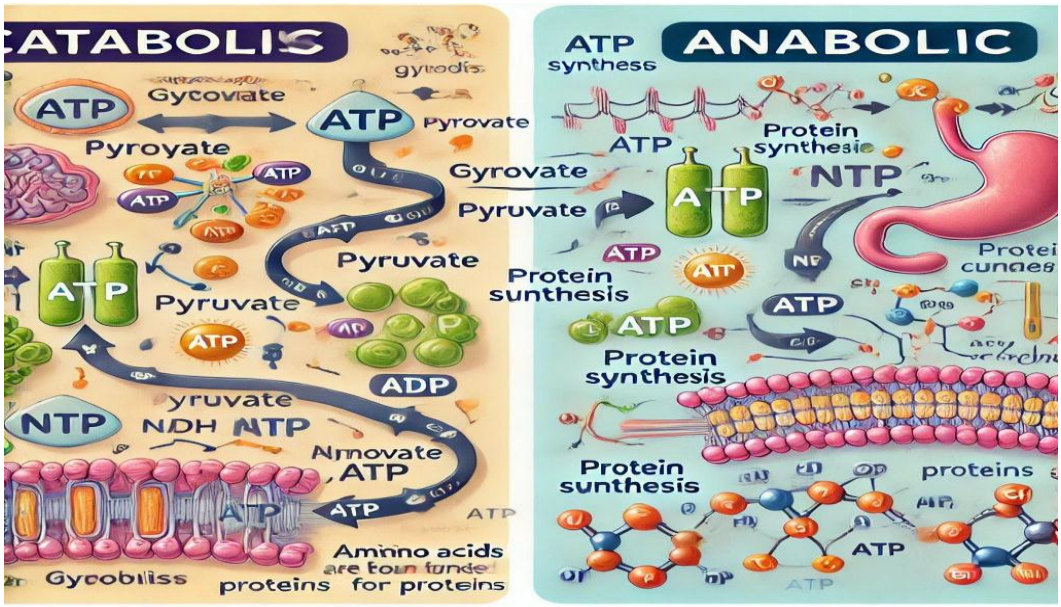
- **Anabolic Reaction:** New material formation processes

Such: Protein Synthesis

$$Amino\ acid + ATP \longrightarrow protein + ADP$$

The processes of demolition and construction together are called metabolism. It includes a series of reactions that occur in tissue cells. As a result of metabolic reactions in tissues, new substances are produced, some of which are useful. Others may be harmful or toxic.

Accordingly, the body gets rid of toxic or harmful substances through the process of excretion or detoxification.



again to the blood and from there to the kidneys where all the blood contents are filtered, and the filtered part reaches the urinary tract, while the useful part is reabsorbed. From the above, the importance of biochemistry in identifying each of:

Biochemistry and its importance in

- **Carbohydrates and metabolism**
- **Lipids and metabolism**
- **Amino acids and proteins**
- **Enzymes and enzyme cofactors**
- **Vitamins and hormones**
- **Bio-relevant for biomolecules.**

The cell and its components

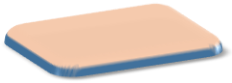
The cell is: the unit of structure and function of all living organisms.
There are two types of it:

1

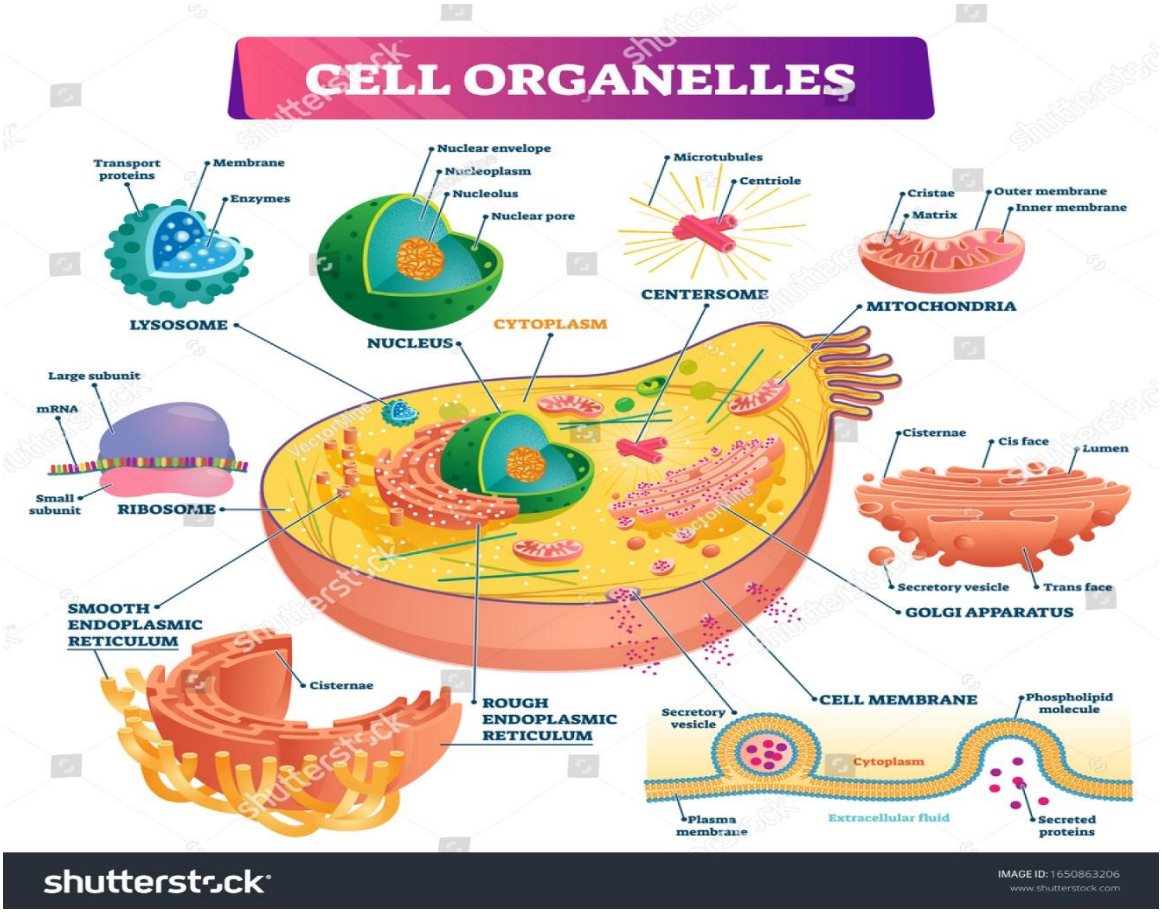
A eukaryotic cell contains a membrane separating the nucleus and the components of the cell.

A prokaryotic cell does not contain a membrane separating the nucleus and the rest of the components of the cell.

2



There are two types of eukaryotic cells: animal cells and plant cells.



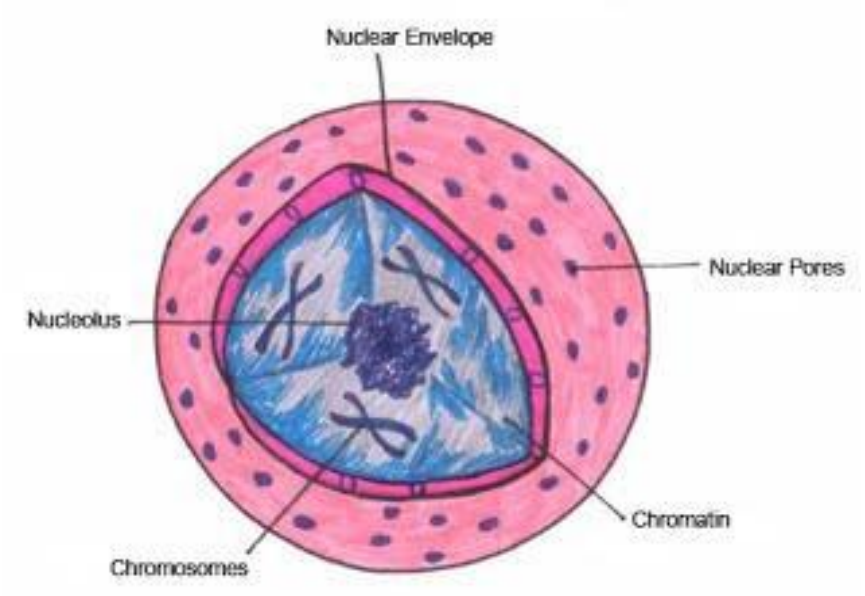
Animal cell contains

1. Cell membrane

It protects the cell and is a selectively permeable membrane. It consists of 40% lipids, 60% proteins, and some specialized enzymes. It is linked to some special components such as enzymes, as there are receptors for each of them on its membrane.

2. Nucleus

It is the information center in the cell, and contains a large percentage of nucleoproteins. In which the DNA molecule constitutes approximately half, while the protein constitutes the other half, which is the type of histones and protamine. The nucleus contains more than 95% of the nucleic acids present in the cell. Inside the nucleus there is a small circular body called the nucleolus. These nuclei consist of large compounds of RNA molecules, which account for 20-25% of the total RNA molecules present in the nucleolus. It is mRNA, which carries the genetic information from the DNA molecule, which plays a prominent role in the manufacture of protein inside the cell.



3. Cytoplasm

It contains RNA, glucose and metabolites such as urea, uric acid. Creatinine, enzymes, etc. The following components are found in the cytoplasm:

a. Mitochondria:

It is the energy generation center in the cell, due to its ability to manufacture ATP molecules. Oxidation and reduction reactions, oxidation of fatty acids, proteins, and others also take place in it.

b. endoplasmic reticulum

- **smooth endoplasmic reticulum (SER):** It consists of steroids, lipids and complex sugars, and it can be used to get rid of toxic compounds.
- **Rough Endoplasmic Reticulum (RER):** It contains ribosomes and manufactures the protein required to be secreted from the cell or absorbed into the cell membrane itself.

c. Ribosome

It contains RNA and protein and is the site of the production of polypeptide compounds.

d. Golgi Apparatus

It performs temporary emergency storage of proteins.

e. Lysosomes

Contains digestive enzymes and inactive enzyme compounds.

related in the early 17th century, the gas laws have been around to assist scientists in finding volumes, amount, pressures and temperature when coming to matters of gas. The gas laws consist of three primary laws: Charles' Law, Boyle's Law and Avogadro's Law (all of which will later combine into the General Gas Equation and Ideal Gas Law).

Introduction

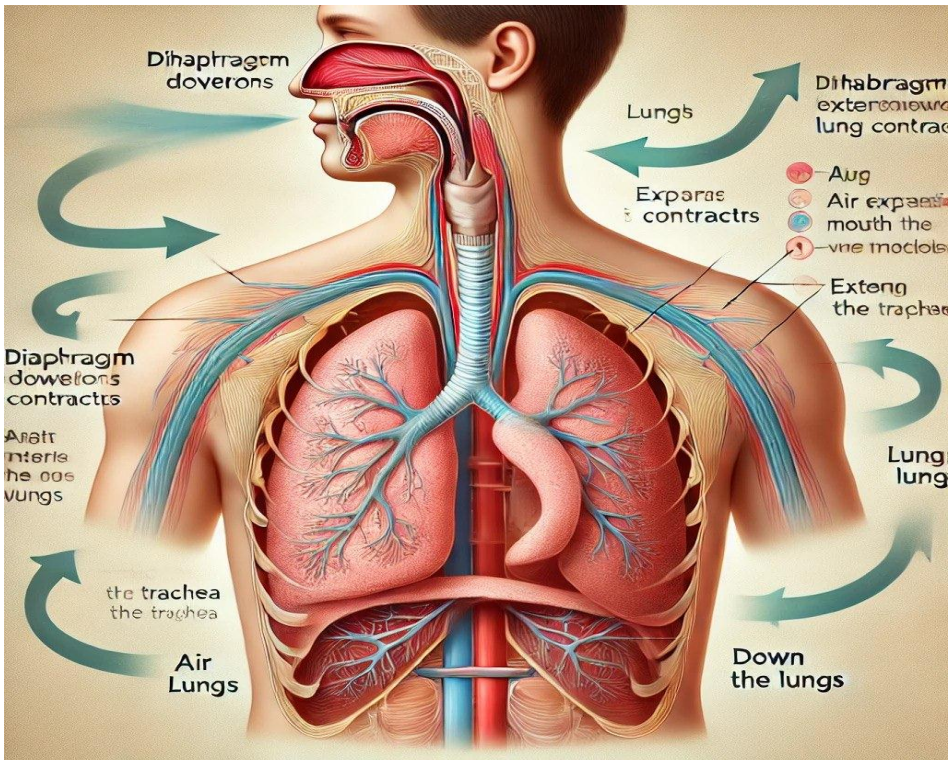
The three fundamental gas laws discover the relationship of pressure, temperature, volume and amount of gas.

Boyle's Law:

The volume of a gas is inversely proportional to the pressure exerted on it when the temperature and quantity of gas are constant.

$$P_1 V_1 = P_2 V_2$$

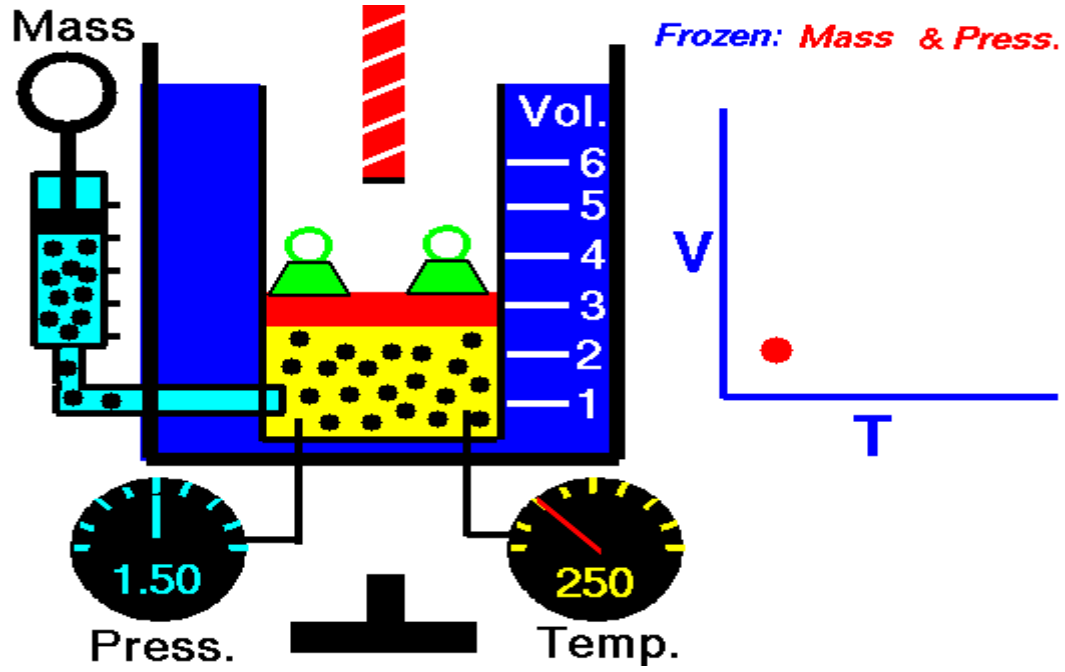
Such The human breathing process is carried out according to Boyle's law. When the diaphragm moves down, it leads to an increase in the volume of the lungs and a decrease in the pressure inside them, which in turn leads to the entry of air into the lungs and the process of inhalation takes place.



Charles' Law:

The volume of a finite quantity of gas is directly proportional to the temperature measured in Kelvin when the pressure and quantity of gas are constant.

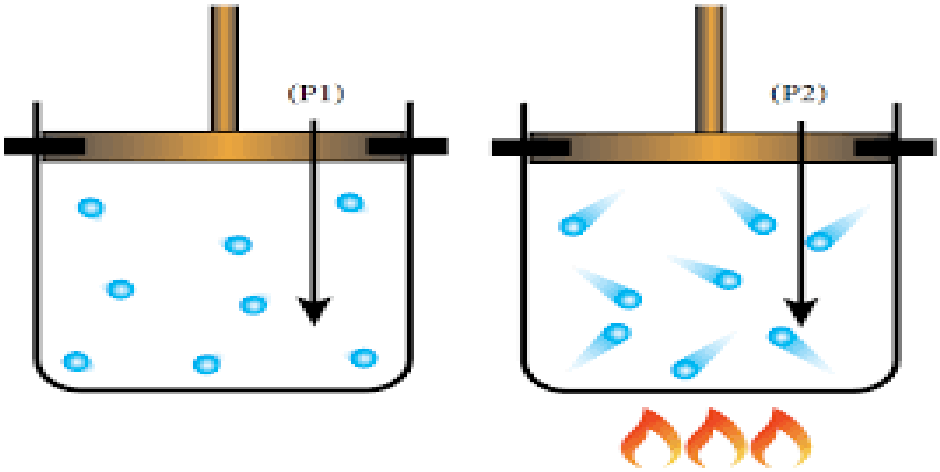
$$V_1 T_2 = V_2 T_1$$



Gay-Lussac's law:

The pressure of a given mass of gas varies directly with its temperature if its quantity and volume are constant.

$$P_1 T_2 = P_2 T_1$$



Ideal Gases

Ideal gas, or perfect gas, is the theoretical substance that helps establish the relationship of four gas variables, pressure (P), volume (V), the amount of gas (n) and temperature(T). It has characters described as follow:

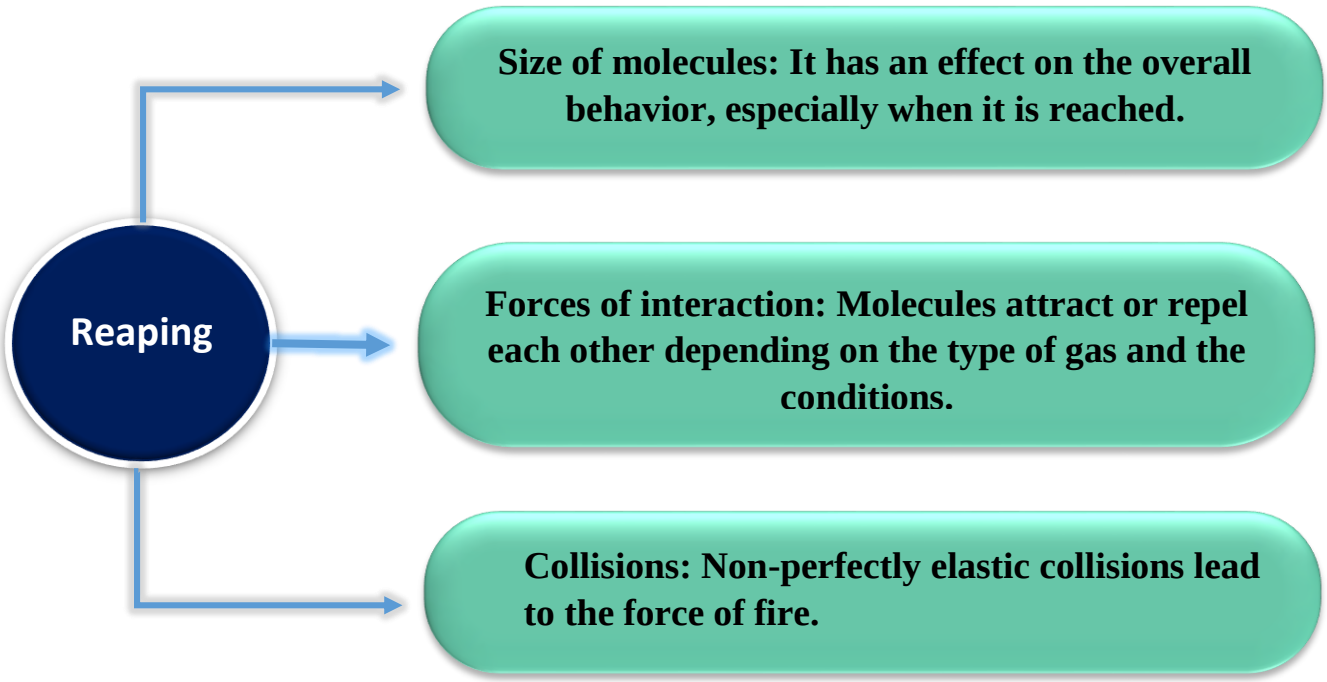
1. The particles in the gas are extremely small, so the gas does not occupy any spaces.

2. The ideal gas has constant, random and straight-line motion.

3. **No forces between the particles of the gas. Particles only collide elastically with each other and with the walls of container.**

Real Gas

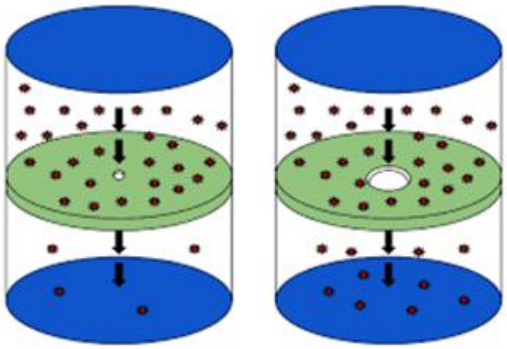
Definition: A model describing gases as they are in reality, taking into account the size of the molecules and the forces of interaction otherwise.



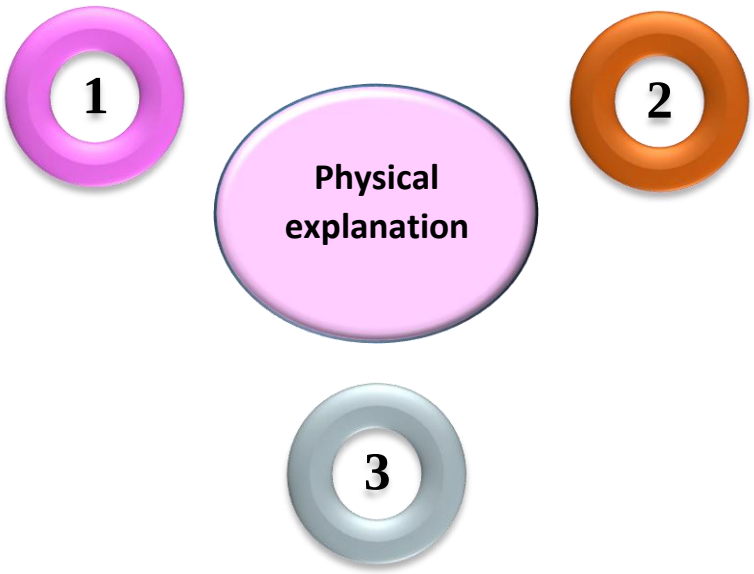
(Graham's Law of Diffusion)

The rate of diffusion of a gas is inversely proportional to the square root of the molar mass of the gas at constant temperature and pressure.

$$\frac{R_1}{R_2} = \sqrt{\frac{M_2}{M_1}}$$



Diffusion depends on the speed of movement of gas molecules, which is inversely proportional to the square root of the molar mass



Gases with lower molar mass diffuse faster than gases with higher molar mass.

r_1, r_2: **The rate of diffusion of the two gases (volume of gas diffused per unit time).**

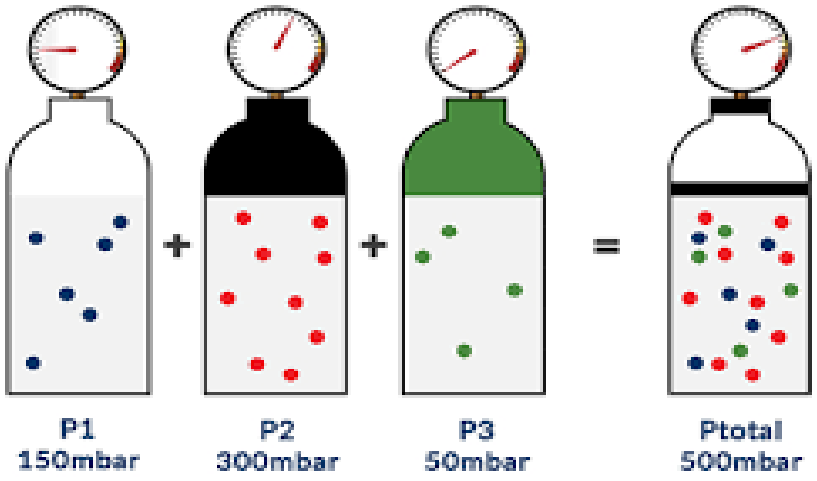
M_1, M_2**: the molar masses of the two**

Dalton's Law of Partial Pressures

If several gases that do not chemically react with each other are mixed in a closed container, the total pressure resulting from this mixture is equal to the sum of the partial pressures contributed by each of these gases, as if each gas were present alone in the container.

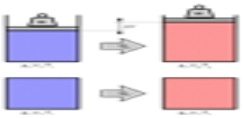
Partial pressures:

The partial pressure of any gas in a mixture depends on the ratio of its moles to the total number of moles according to the formula:



$$P_{Total} = P_A + P_B + P_C + \ldots = \sum_i P_i$$

$$P_a = \chi_a P_{total}$$



Calculate partial pressures of gases in a mixture.

Study the behavior of gases in chemical reactions.

Applications in industrial gases and mixtures such as air.