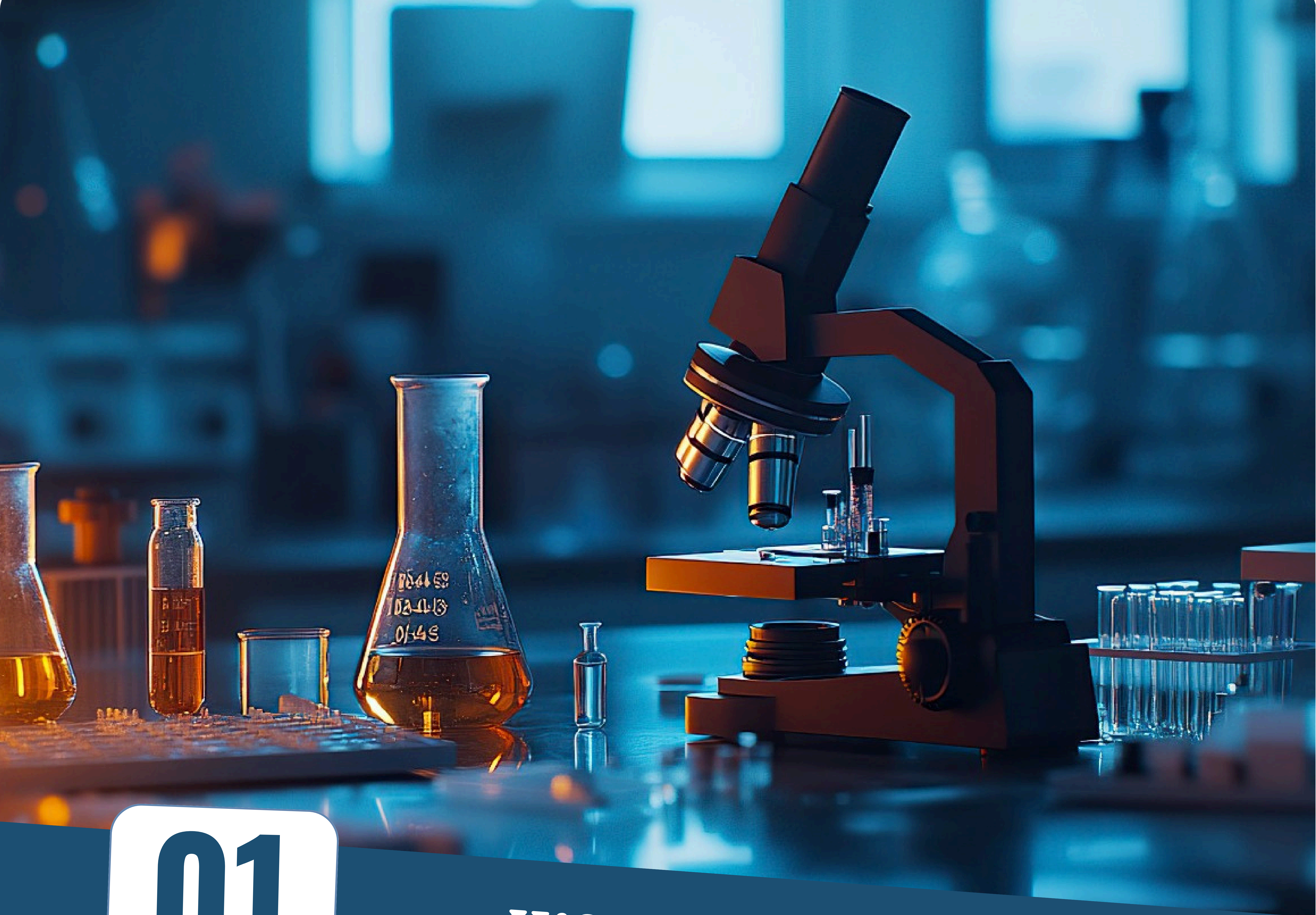


01

CHAPTER

WATER METABOLISM

استقلاب (أيض) الماء

TOPICS

Water Metabolism

Scientific content prepared by

Booknerd Team

Water H2O

- Tasteless, clear, odourless fluid.
- Humans can servive for 4-6 weeks without food, but for only few days without water.

Biological importance of water :

1- Water is the principle chemical constituents of the body. It represents about 65% of the body weight in an adult male (55% in female).
2- Water is the medium in which chemical reactions takes place inside the cells.
3- It is the universal solvent in the body.
4- It is the important in regulation and maintenance of constant body temperature.
5- It is the principle constituent of all body fluids “blood, lymph, tissue fluid”.
6- It is the transporting agent of the body.
7- Water is the main constituent of secretions as saliva, gastric juice, bile, intestinal juice, sweat.
8- Water is the main constituent of the excretory fluid “urine”.

The reference daily intake of water :

- The daily needs of water depends on the water losses. Water losses are affected by the amount of physical exercise, the environmental temperature and humidity and the condition of the subject.
- The recommended daily intake is about 2500 ml – 3000 ml/day) for male.
- Normally the water input “intake should equal the water output losses” Input = output

Water input=intake

Water supply occur through the following :

- a) Ingestion of fluids “drinking" = 1200 ml/day
- b) Ingestion of goods = 1000 ml/day
- c) Metabolic water = 300 ml/day
- Total = 2500 ml/day

Ingestion of fluids “drinking” is regulated by thirst.

Water insufficiency → increase osmolarity of extra cellular fluid → stimulate osmoreceptors in the brain → increase thirst sensation.

Water output

Water losses or output occur through the following:

- a) **Urine** = 750-1500 ml/day
- b) **Perspiration "sweating" + water vapor in expired air** = 500-800 ml/day "insensible fluid losses as they can not be easily measured.
- c) **Water in the faeces** = 100-150 ml/day The sum of output 2500 ml/day

Water output is regulated by :

- a) **ADH = Anti Diuretic Hormone = Vasopressin ADH** is secreted by the hypothalamus and stored and released by the posterior pituitary gland.
    - If the body is deficient in water as in dehydration, the **secretion of ADH increases to suppress "decrease" the volume of urine.**
    - If the fluid "water: level in the body is increased, "Hydration", the **secretion of ADH is decreased and the urine volume increases.**
- b) **Aldosterone Hormone:**

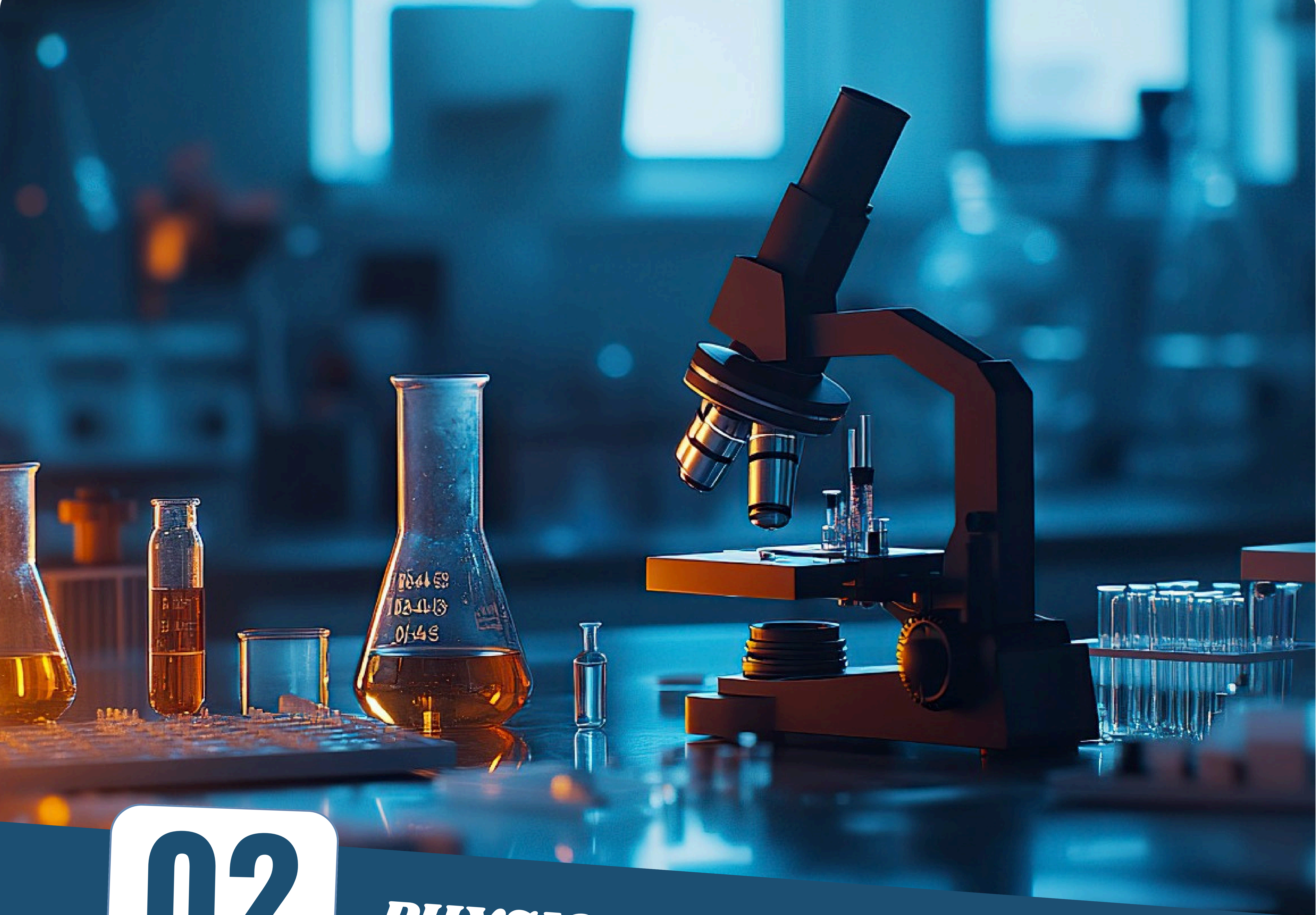
The decreases in water in the body

↓ Stimulates

Rennin-angiotensin system in the kidney

↓ Stimulates

Secretion of Aldosterone hormone from the adrenal cortex which stimulate the absorption of Na+ water form renal Tubules.



02

CHAPTER

PHYSIOCHEMICAL PRINCIPLES

المبادئ الفيزيائية والكيميائية

TOPICS

Physiochemical Principles

Scientific content prepared by

Booknerd Team

Expression of Concentration:

A **solution** is formed of a **substance dissolved n a liquid**. The **dissolved substance** is called a **solute**. The liquid in which the **solute is dissolved** is called the **solvent**. Together **(solute + solvent) they represent a solution**.

Concentration

Concentration of a solute in solution can be expressed in many ways including the **percent solutions, molarity, molality and normality**.

1 Percent solutions

- It is **equal** to the amount of solute per **100** total units of solution.
- The expression of percent solution can be done in three ways, namely
  - **Weight/weight (W/W)**
  - **Volume/volume (V/V)**
  - **Weight/volume (W/V).**
  - **This is the most commonly used unit.**

Examples of percent solution:

- Glucose solution (%%) contains **5 grams of glucose dissolved in 100 ml of distilled water.**
- Saline (NaCl solution 0.9%) contains **0.9 grams of NaCl salt in 100 ml distilled water.**

2 Molarity (M):

- Molarity is expressed as the **number of moles per liter of solution.**
- **One more** of a substance **equals** its **gram molecular weight (the molecular weight expressed in grams).**
- The system **International d'Unites (SI)** used **mole/litre (mol/L)** to express the concentration of a solution.
- **Millimoles/liter (mmol/L), micromoles/Liter (□ mol/L) and nauromoles/ Liter (nmol/L) are commonly used units.**

!

- One liter = **1000 milliliter (ml)**
- One mole = **1000 millimole (mmol).**
- One millimole = **1000 micromole (mmol)**
- One micromole = **1000 nanomole (n mol)**

3 Molality

- Molality represents the **amount of solute per one kilogram of the solvent.**
- It is always expressed as **moles per kilogram of the solvent.**

4 Normality

Normality is defined as the **number of gram equivalent weight per liter of solution.** An **equivalent weight of a substance** is **equal** to the **molecular weight of that substance** divided by its **valence**. Normality is **no longer used to express concentrations.**

- Dilute solution contains very little solute.
- Concentrated solution contains large quantity of solute in solution.
- Saturated solution contains excess of undissolved solute particles.

Law of Mass Action:

This law describes the **relation between the velocity of a chemical reaction and the product of concentration of the reacting substances**. In a **reversible reaction.**

$$A+B \underset{\text{Velocity (V2)}}{\overset{\text{Velocity (V1)}}{\rightleftharpoons}} C+D$$

- V1 is proportional to [A] X [B]
- V2 is proportional to [C] X [D]

- **V1 = K1 X [A] X [B]**
- **V2 = K2 X [C] X [D]**

At equilibrium

- V1 = V2
- K1 X [A] X [B] = K2 X [C] X [D]

$$\frac{K1}{K2} = \frac{[C] \times [D]}{[A] \times [B]} = K \text{ (equilibrium contant)}$$

Applying this law for the dissociation of water, we get the following at equilibrium :

$$H2O \underset{V2}{\overset{V1}{\rightleftharpoons}} H+ - OH-$$

$$\frac{V1}{V2} = \frac{[H+] \times [OH-]}{[H2O]} = K$$

K X [H2O] = [H+] X [OH-]

As the concentration of H2O is **nearly constant due to its weak ionization, its concentration can be considered a unit (1 mole/litre)**

K X 1 = [H+] X [OH-]

- The [H+] at equilibrium is very small and equals 10-7 mol/L. Also [OH-] equals 10-7 mol/L
- The pH of water is defined as negative log its hydrogen ion concentration.

- pH = - log [H+]
- pH of water = - log 10-7 = - X – 7 =7

True and titrable acidity :

- An acid is defined as a proton (H+) donor and a base is a proton acceptor.
- True acidity is the amount of free hydrogen ion in solution. It determines the pH of the solution.
- True acidity is low in weak acids and high in strong acids.
- Combined acidity represent the non-ionized hydrogen in a substance in solution.
- The term Titrable acidity represent all the hydrogen in a solution whether free or combined.
- All these hydrogen ions can be used during neutralization (Titration) with a base.