

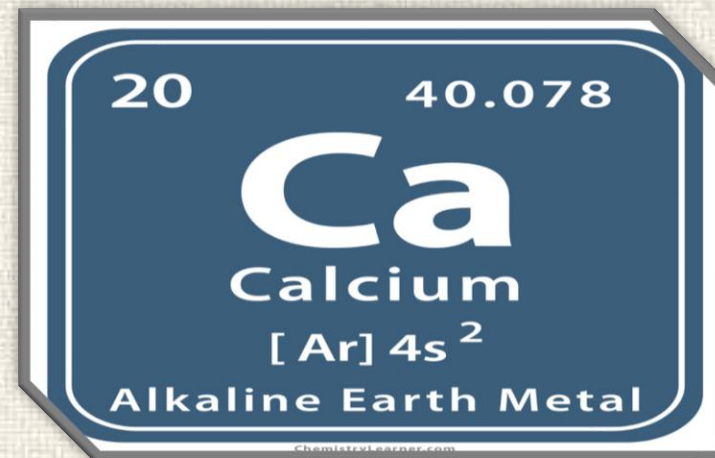


Al-Mustaqbal University College Pharmacy Department – Third Class



Practical Biochemistry

Estimation of Calcium

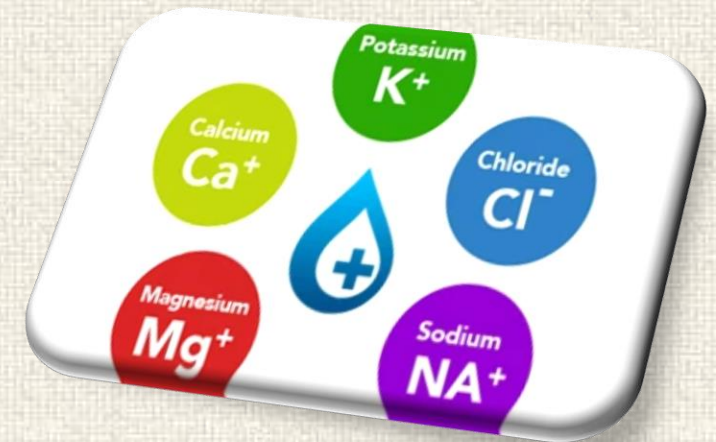


Fifth Lec.

Assist. Lec. ZAINAB GHALEB

Out Line

- ✓ **Electrolytes & Electrolytes Functions.**
- ✓ **Calcium.**
- ✓ **Distribution of Calcium.**
- ✓ **Functions of Calcium.**
- ✓ **Regulation of Calcium.**
- ✓ **Normal Value & Clinical significance.**
- ✓ **Determination of calcium in Serum.**



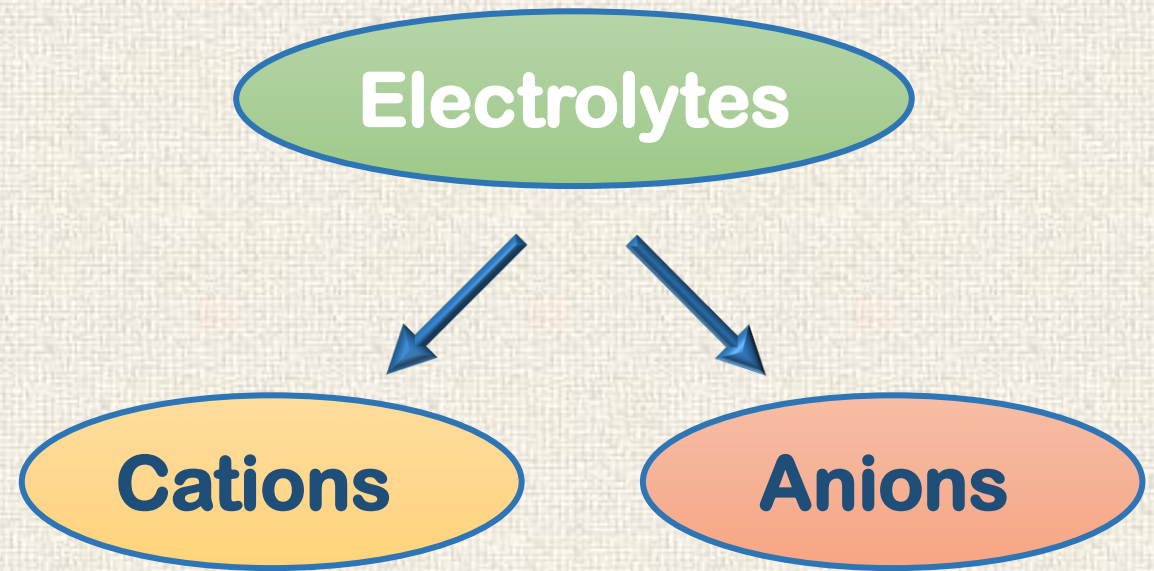
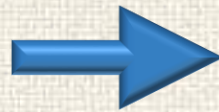
WHAT ARE
ELECTROLYTES

?

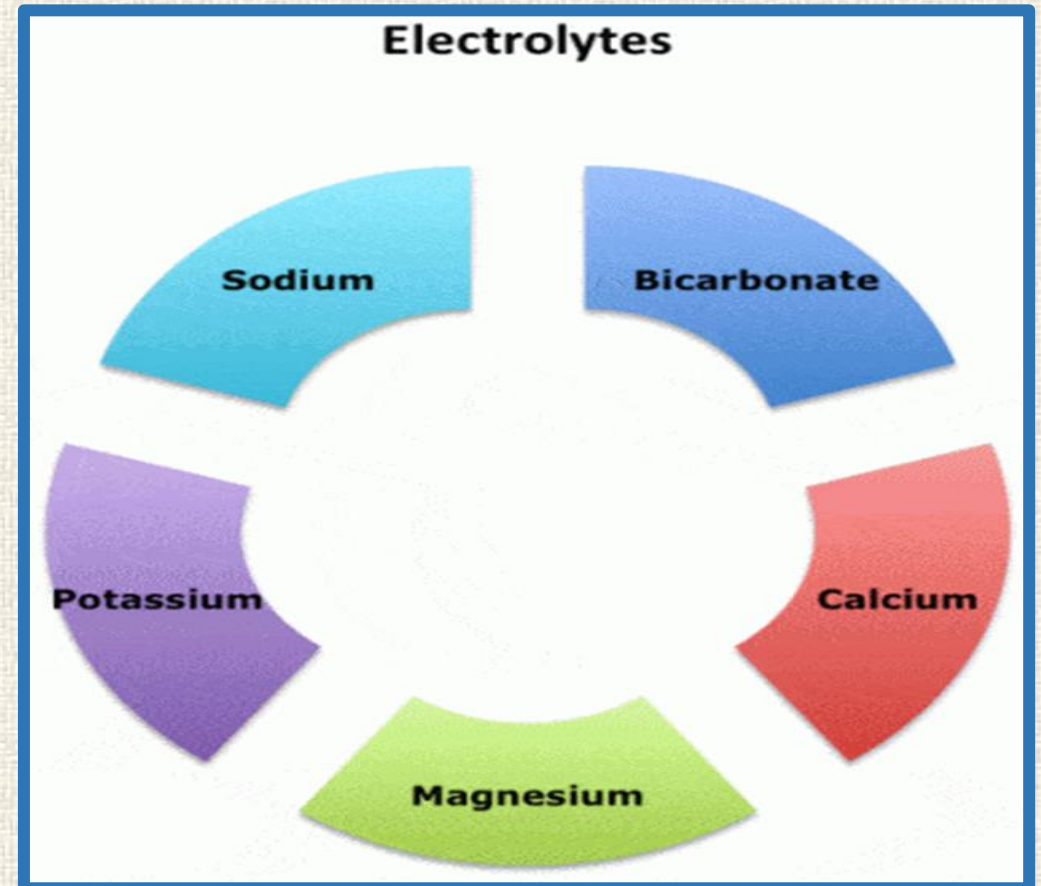
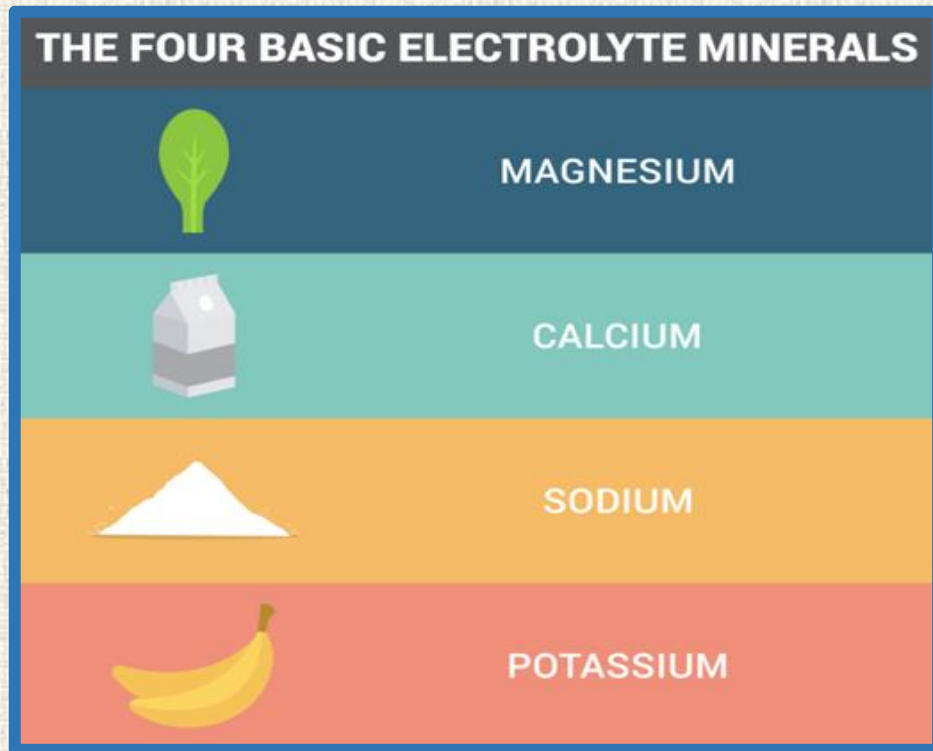


Introduction

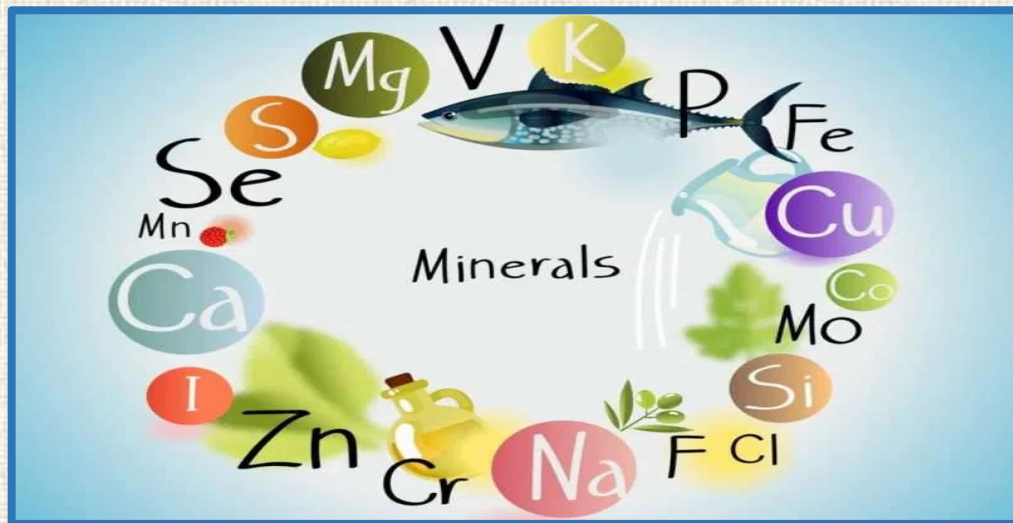
- Electrolytes are **Ionic Minerals** in the **Blood** and other **Body Fluids**.
- Electrolytes carry an **Electric Charge** and classified as:



- They are **Essential Component** of All Living matter.
- The major Electrolytes such as **Cations** (Na – Ca – K – Mg) and **Anions** (HCO₃ – Cl – HPO₄).



- ❑ The **Trace Elements** or **Trace Mineral** or **Micromineral** are (**Fe – Cu – Mn – Cr – Cd – Zn – I – Mo**).
- ❑ Require only in **Small amounts** than **Vitamins and Minerals**



What are the essential trace minerals?

IRON

- Helps transfer oxygen around the body
- Essential for a healthy immune system
- Female RDA: 18mg. Male RDA: 8mg.

ZINC

- Needed for enzyme and immune function throughout the body
- Female RDA: 11mg. Male RDA: 8mg.

SELENIUM

- A powerful antioxidant that protects cells from free radical damage
- RDA: 55mcg

FLUORIDE

- Helps remineralise the surface of teeth & strengthen enamel
- Female RDA: 3.1mg. Male RDA: 8.8mg.

COPPER

- Aids the absorption of iron
- Also a component of many enzymes
- RDA: 900mcg

CHROMIUM

- Enhances insulin action and helps break down carbohydrates
- Female RDA: 25mcg. Male RDA: 35mcg.

IODINE

- Essential part of thyroid hormones which regulate metabolism & growth
- RDA: 150mcg

MANGANESE

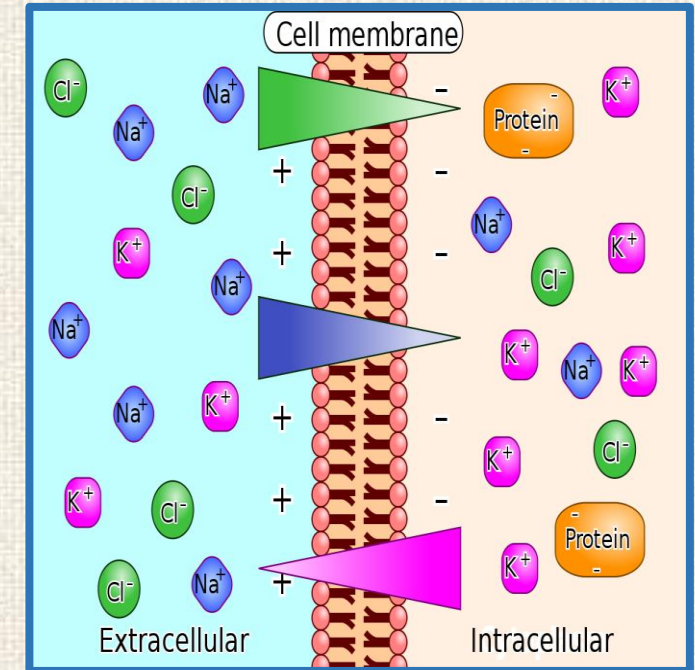
- Found in several important enzymes, e.g. those that break down carbohydrates
- Female RDA: 1.8mg. Male RDA: 2.3mg.

MOLYBDENUM

- Component of enzymes, including those that break down proteins
- RDA: 45mcg

Functions of Electrolytes

- ✓ Regulation of the most **Metabolic Pathways** in the **Body**.
- ✓ Maintain of **Osmotic Pressure** and **Hydration** of the various **Body Fluid** compartment.
- ✓ Maintain of the **Proper Body PH**.
- ✓ Regulation of the Proper Function of **Heart** and **Muscles**.
- ✓ Involvement in **Oxidation – Reduction** reaction.
- ✓ Participation as **Essential part of Co-factor** of **Enzyme**.





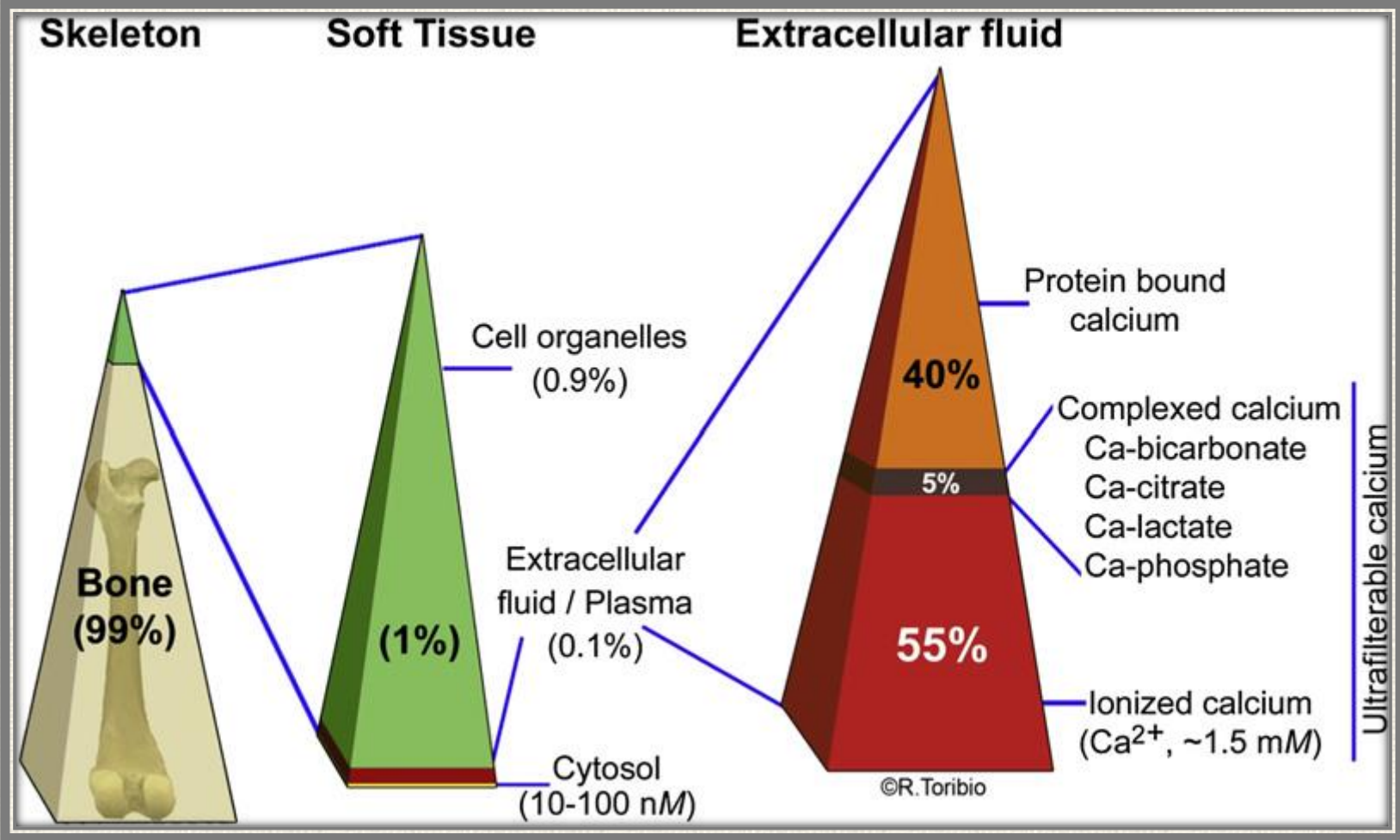
Asst. Lec. ZAINAB GHALEB ABDUL KAREEM

Calcium

- ❑ Calcium is the **most abundant Mineral** found in the **Body** and play many vital roles
- ❑ Calcium average in **Adult Body** is approximately **1 Kg**.
- ❑ About **99%** of **Calcium** in the body are found in **Bones** and **Teeth** as **Hydroxyapatite $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$** .
- ❑ The remaining **1%** is mostly found in the **Blood** and other **ECF**.



Distribution of Calcium in the body

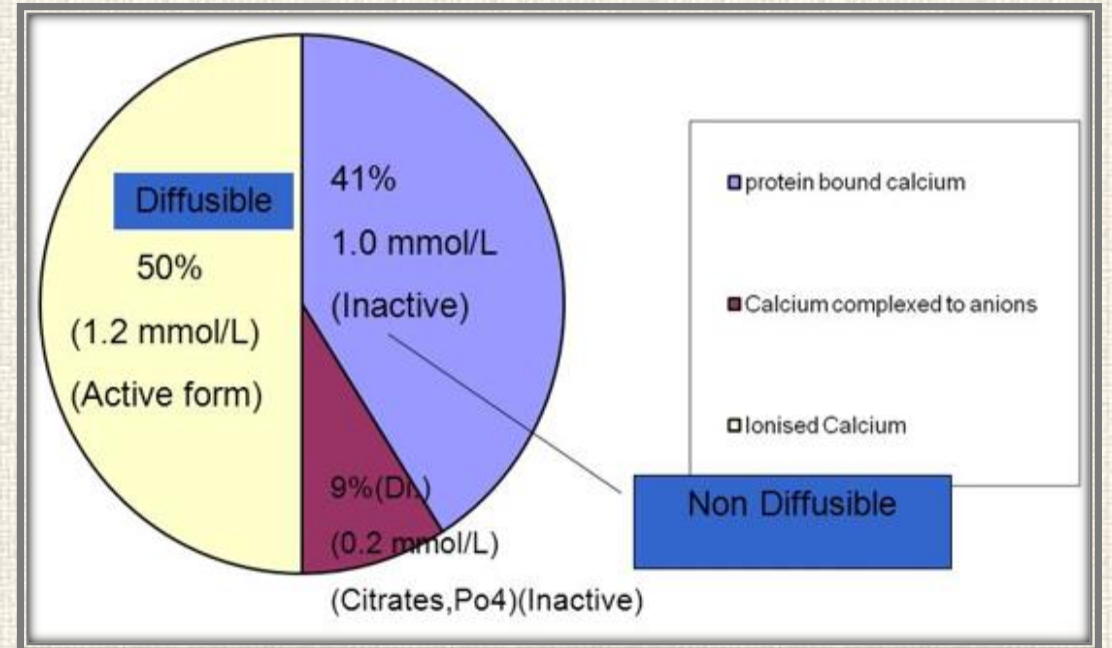


□ **Ca²⁺** in **Blood** is distributed among **Several Forms**.

✓ About **50%** as **Free Ca²⁺** ions (referred to as **Ionized Ca²⁺**).

✓ **40%** is bound to **Protein**, mostly **Albumin**.

✓ **10%** is bound to **Anions**, such as **HCO₃**, **Citrate**, **PO₄** and **lactate**.



□ Clearly, this **Distribution** can Change in **Disease**.

- ❑ It is noteworthy that **Concentrations** of **Citrate**, **HCO₃⁻**, **Lactate**, **PO₄⁻** and **Albumin** can **Change** dramatically during **Surgery** or **Critical Care**.
- ❑ This is why **Ionized Ca²⁺** **Cannot** be reliably **Calculated** from **Total Ca²⁺** Measurements, especially in acutely Disease individuals.
- ❑ Although both **Total Ca²⁺** and **Ionized Ca²⁺** measurements are available in many labs, **Ionized Ca²⁺** is usually a more **Sensitive** and **Specific marker** for **Ca²⁺ Disorders**.

Functions of Calcium

- ✓ It is important for **Developing** and **Maintaining Bone Structure** and **Function**.
- ✓ Acts as a **Cofactor** for many **Enzyme** in Metabolic processes in the body.
- ✓ It is important for **Blood Coagulation**.
- ✓ Maintenance of Normal **Muscle Contractility**.
- ✓ Is important in the **Transmission of Nerve Impulses**.
- ✓ It also plays a role in **Hormone Secretion**.

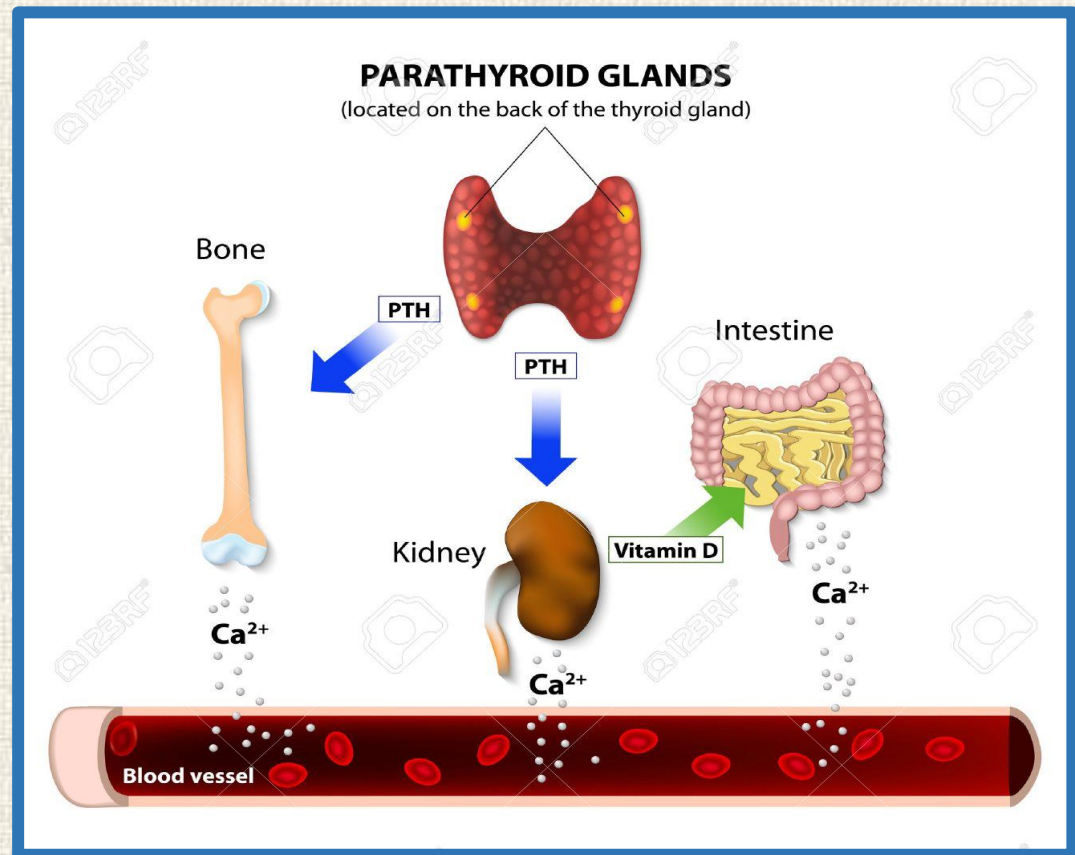
Regulation of Calcium

□ Three Hormones are known to **Regulate Serum Ca^{2+}** by **Altering their Secretion Rate** in response to **Changes in Ionized Ca^{2+}** :

✓ **PTH Hormone.**

✓ **Vitamin D.**

✓ **Calcitonin.**



PTH Hormone

- **PTH Secretion in Blood is Stimulated** by a **Decrease in Ionized Ca²⁺**. Conversely, PTH Secretion is **Stopped** by an **Increase in Ionized Ca²⁺**.

Vitamin D

- The **Active** form of **Vitamin D Increases Ca²⁺** Absorption in the **Intestine** and enhances the effect of **PTH** on **Bone resorption**.

Calcitonin

- ❑ **Calcitonin**, which originates in the **Medullary Cells** of the **Thyroid Gland**.
- ❑ **Is Secreted** when the **Concentration of Ca^{2+}** in Blood **Increases**.
- ❑ **Calcitonin** exerts its **Ca^{2+} -lowering** effect by **Inhibiting** the **Actions** of both **PTH** and **Vitamin D**.

Normal Value

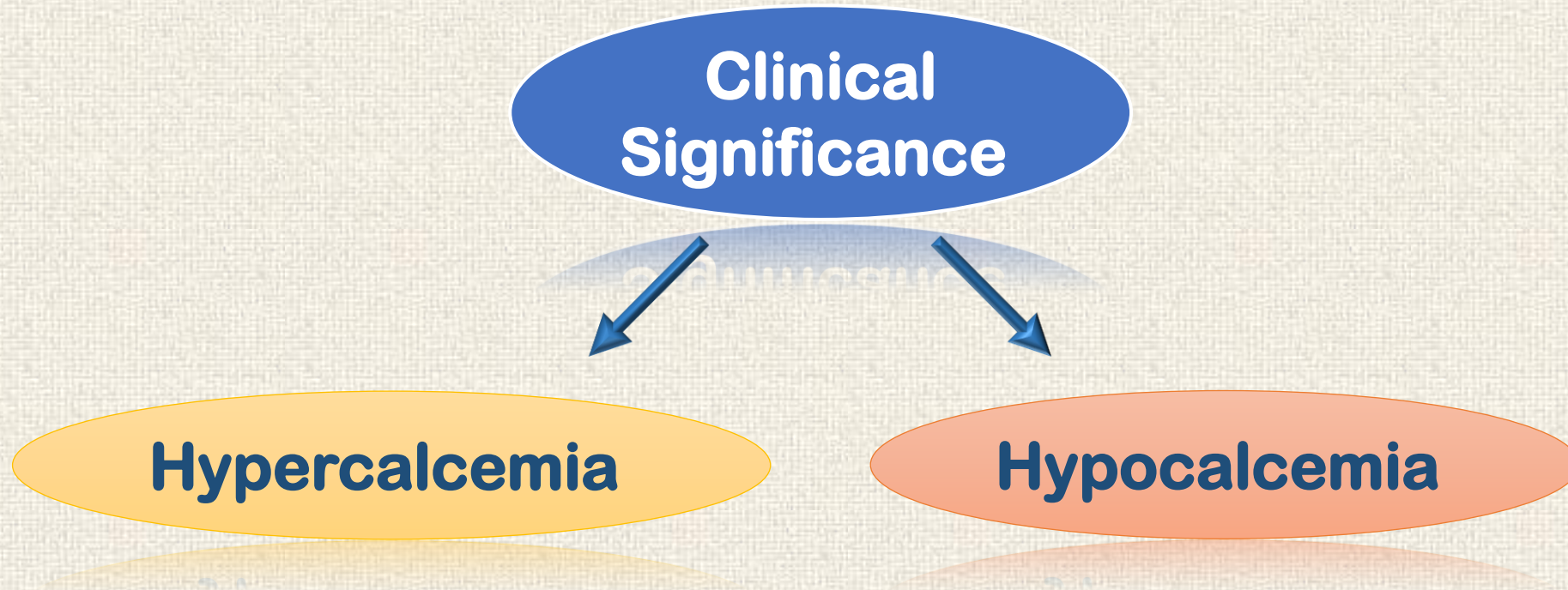
➤ The **Normal Value** of **Calcium** is must be between:

Child

8.8 – 10.8 mg/dl

Adult

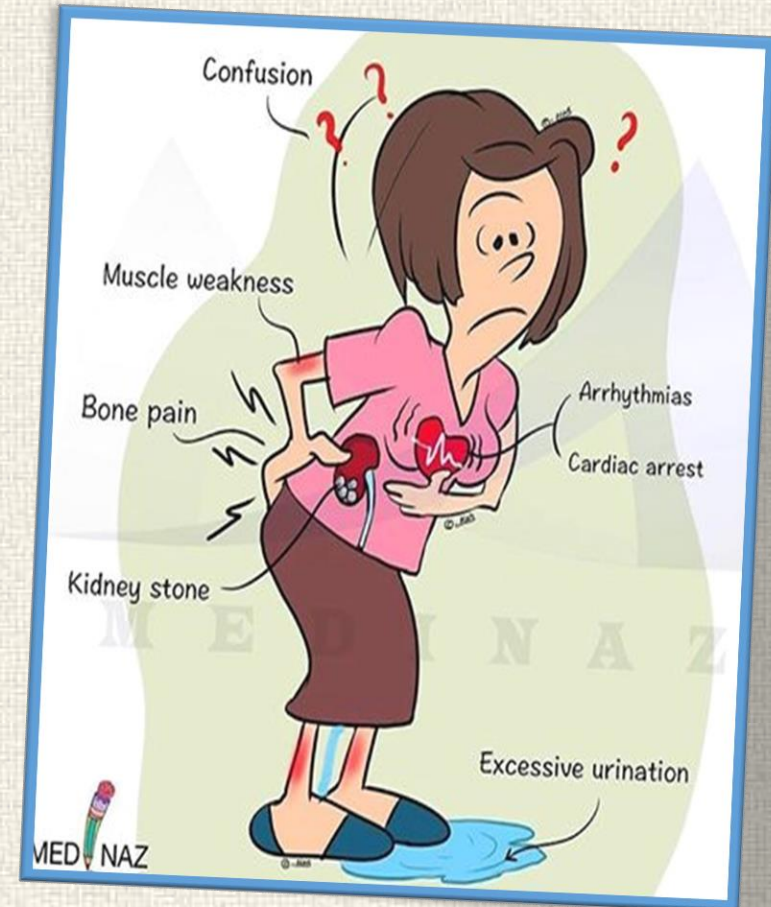
8.6 – 10.0 mg/dl



Hypercalcemia

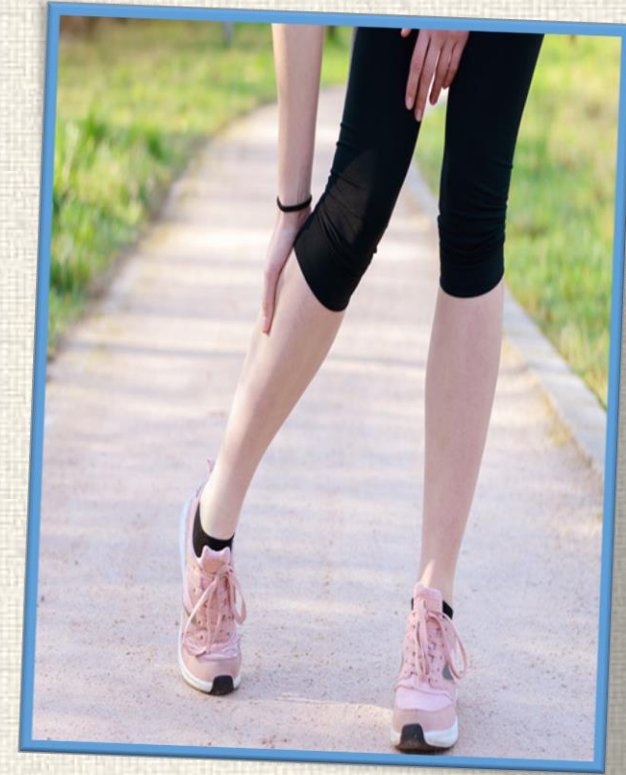
1. Primary Hyperparathyroidism—Adenoma or Glandular Hyperplasia

- 2. Malignancy.**
- 3. Increased Vitamin D.**
- 4. Multiple Myeloma.**
- 5. Benign Familial Hypocalciuria.**
- 6. Sarcoid.**
- 7. Thiazide Diuretics.**
- 8. Carcinoma.**
- 9. Prolonged immobilization.**



Hypocalcemia

1. **Primary hypoparathyroidism—glandular aplasia, destruction, or removal.**
2. **Hypomagnesemia.**
3. **Hypermagnesemia.**
4. **Hypoalbuminemia.**
5. **Acute pancreatitis.**
6. **Vitamin D deficiency.**
7. **Renal disease.**



8. Tetany.

9. Pseudohypoparathyroidism.



Procedure

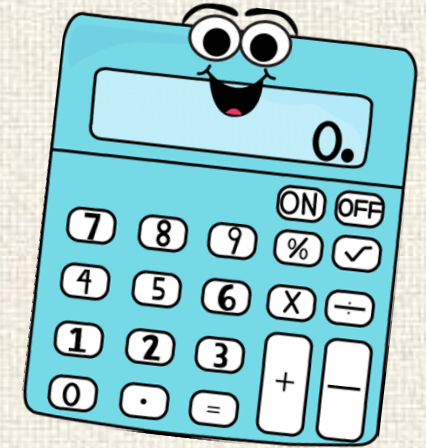
- In this test (**Calcium test**) Wavelength used is **570 nm**. Sample used is Serum.

Solutions	Blank	Standard	Sample
Reagent	1 ml	1 ml	1 ml
Standard	-	20 μ l	-
Sample	-	-	20 μ l

Mix, incubate for 5 min at room temperature. Read the absorbance of sample.

The coloration is stable for 1 hour.

Calculations



- The **Calcium Concentration** in the **Sample** is calculated by using the following general formula:

$$C_{\text{sample}} = \frac{\text{Absorbance of Sample}}{\text{Absorbance of Standard}} \times \text{Standard conc.}$$

- The Concentration of the **Standard** is:

10 mg/dl



Asst. Lec. ZAINAB GHALEB ABDUL KAREEM