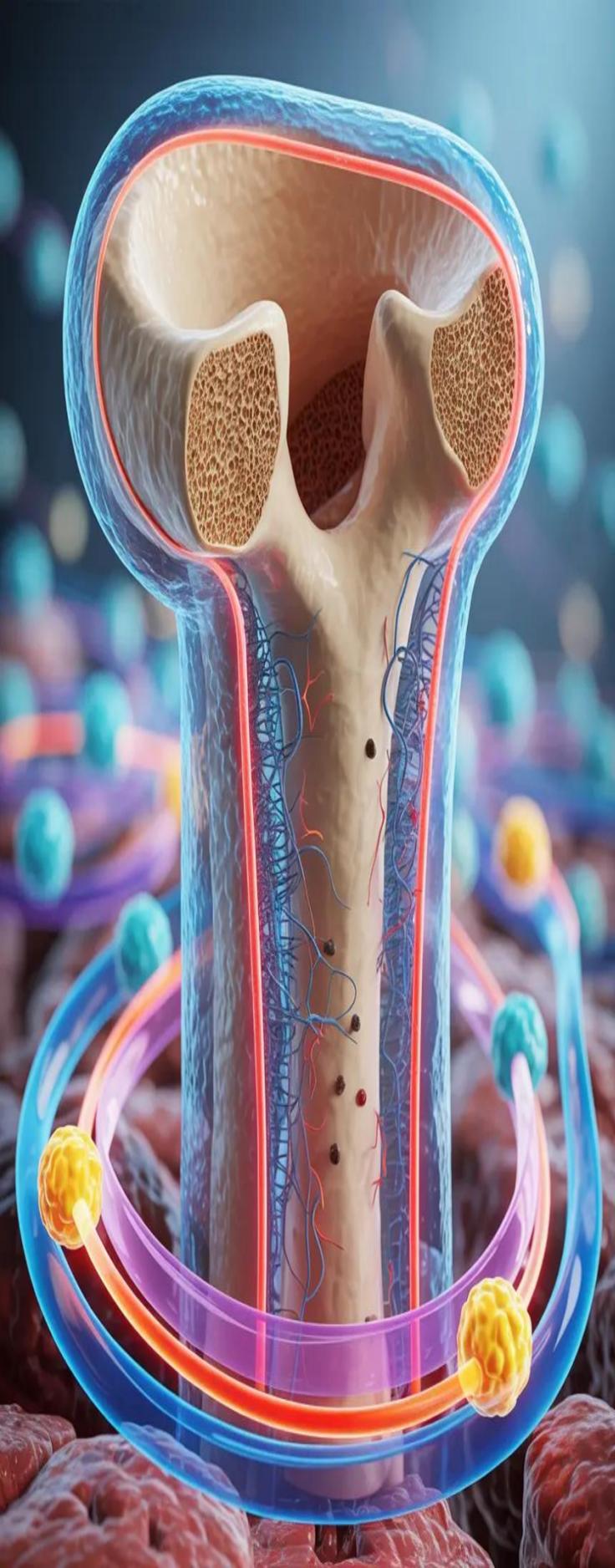


BONE & Calcium metabolism

Ass. Prof. Noura Bakr



□ Bone serves two critical functions :

- it provides the structural framework for the body (facilitation of movement, protection of internal organs, storage of minerals and fat, and hematopoiesis)

* bone and teeth → store the Ca^{2+}
* protection of vital organ

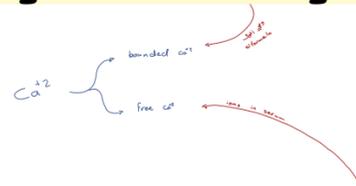
bone marrow form of blood
↳ RBC
↳ WBC
↳ platelet

- acts as the primary reservoir for maintaining calcium homeostasis (balance) in the blood

Bone as a Calcium Reservoir

teeth / bone ← موزعة بين ال
لكن نسبة ال teeth
* enamel most hardest tissue in
the whole body including bone
because the bone covered by many layers (muscles, tendons, ligaments, superficial fascia, and deep fascia)
that protect it, on other side the enamel exposed (not cover by any layer)
which composed of (99%) minerals most of them is (Ca²⁺)

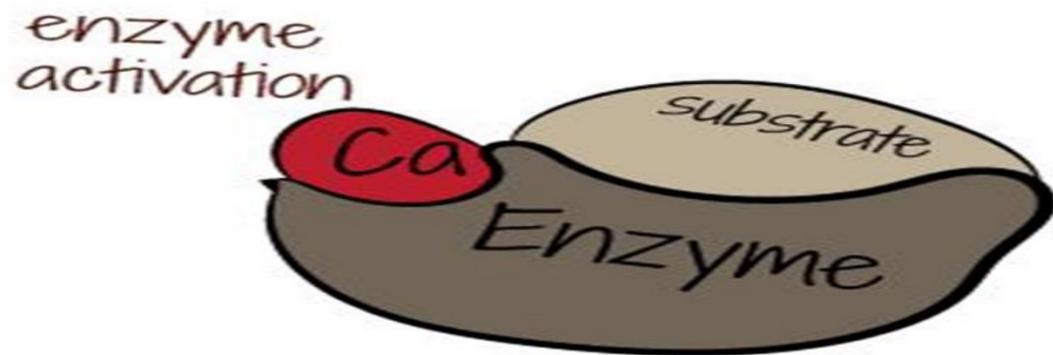
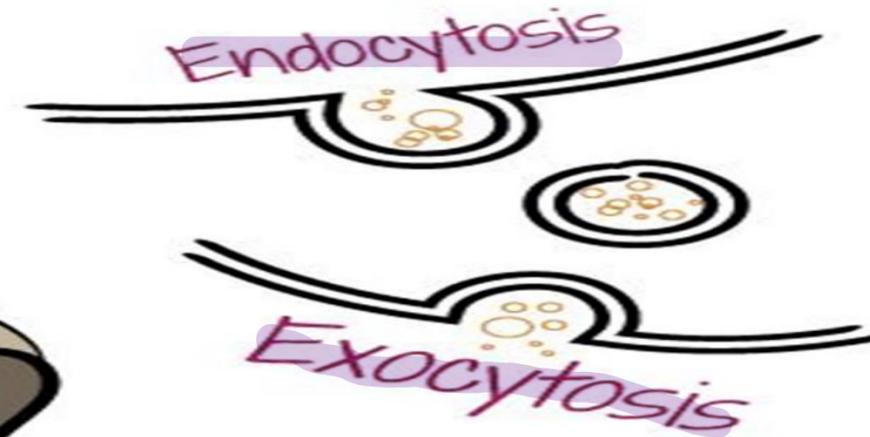
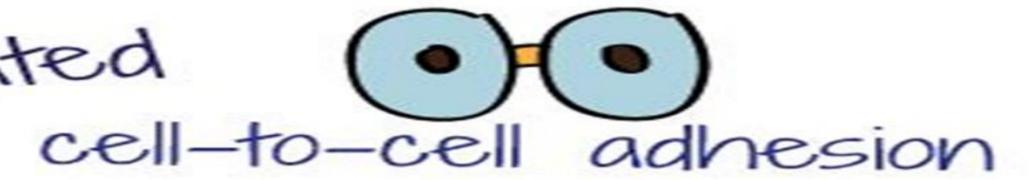
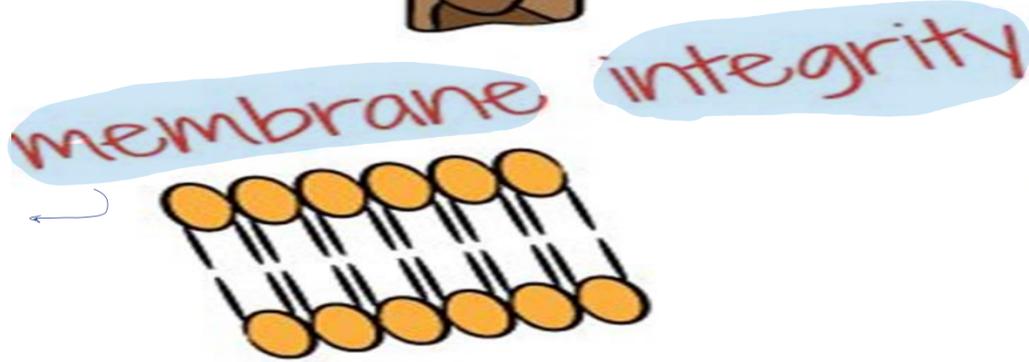
Over **99%** of the body's calcium is stored in the bones and teeth in the form of **hydroxyapatite crystals** ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$).



The **remaining 1%** circulates in the blood and soft tissues, which is vital for muscle contraction, nerve transmission, and blood clotting.

⚡ excess (Ca²⁺) → excreted by kidney in urine

Calcium

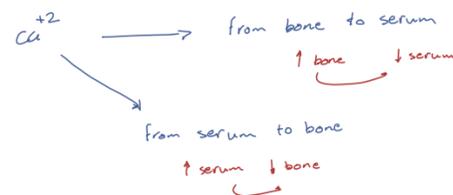


There is the biological buzzle between BONE and Ca blood level

- Calcium is the most abundant mineral in the body many important functions in the body and its levels must be tightly regulated to stay around 10 mg/dL.



- Bone acts as a "bank" for calcium. When blood calcium levels drop (hypocalcemia), the body withdraws calcium from the bones. When levels are high, calcium is deposited into bone tissue.



The Remodeling Cycle

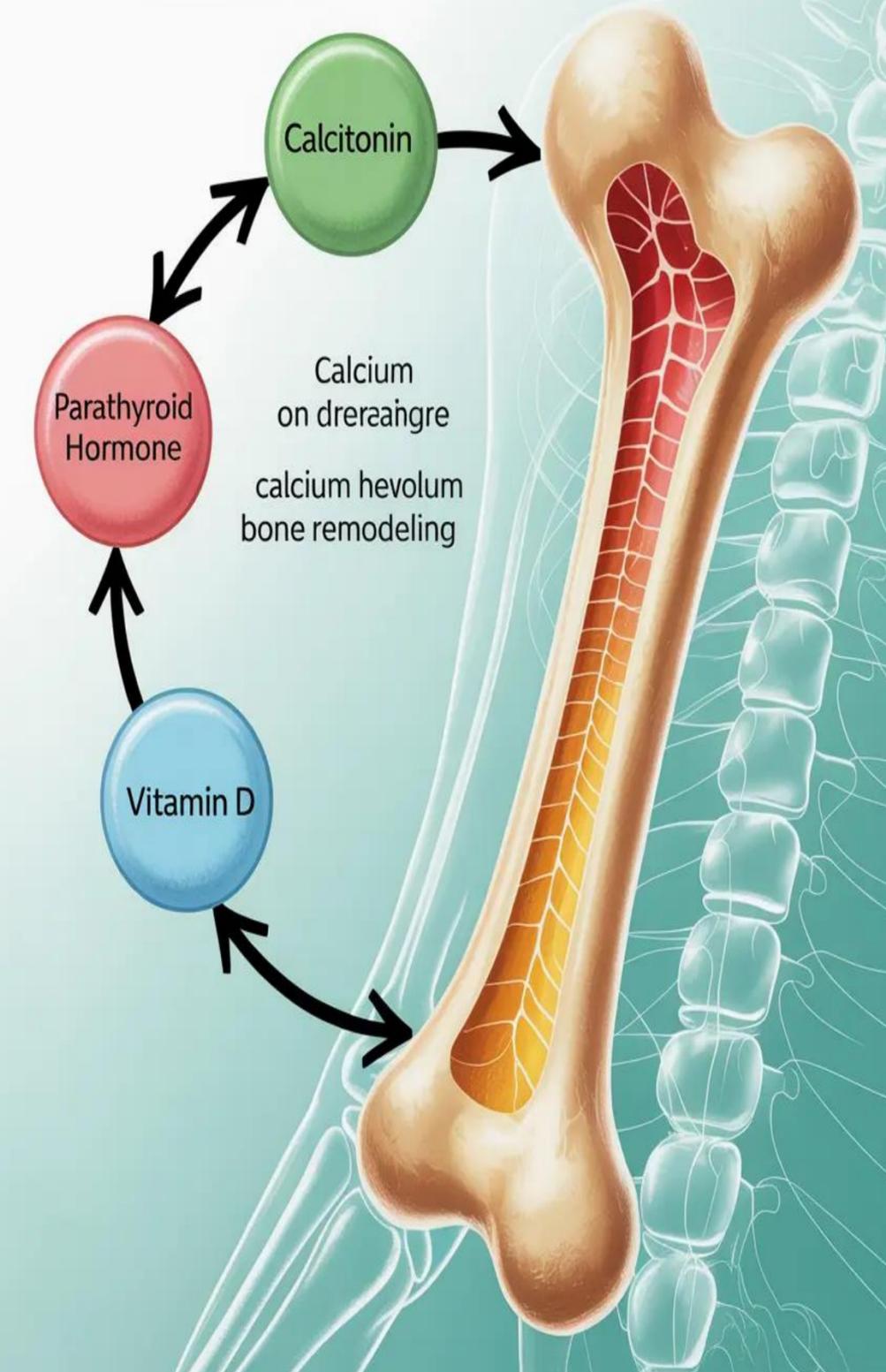
Bone is a **dynamic tissue** that **undergoes constant remodeling**—**balance between breaking down old bone and building new bone**.

This process is **directly tied to calcium metabolism**:

• **Resorption (Releasing Calcium)**: Specialized cells called **osteoclasts** break down bone tissue, releasing calcium and phosphate into the bloodstream.

• **Formation (Storing Calcium)**: Specialized Cells called **osteoblasts** build new bone matrix and mineralize it by depositing calcium and phosphate from the blood.

Endocrine Feedback Loop Calcium Metabolism



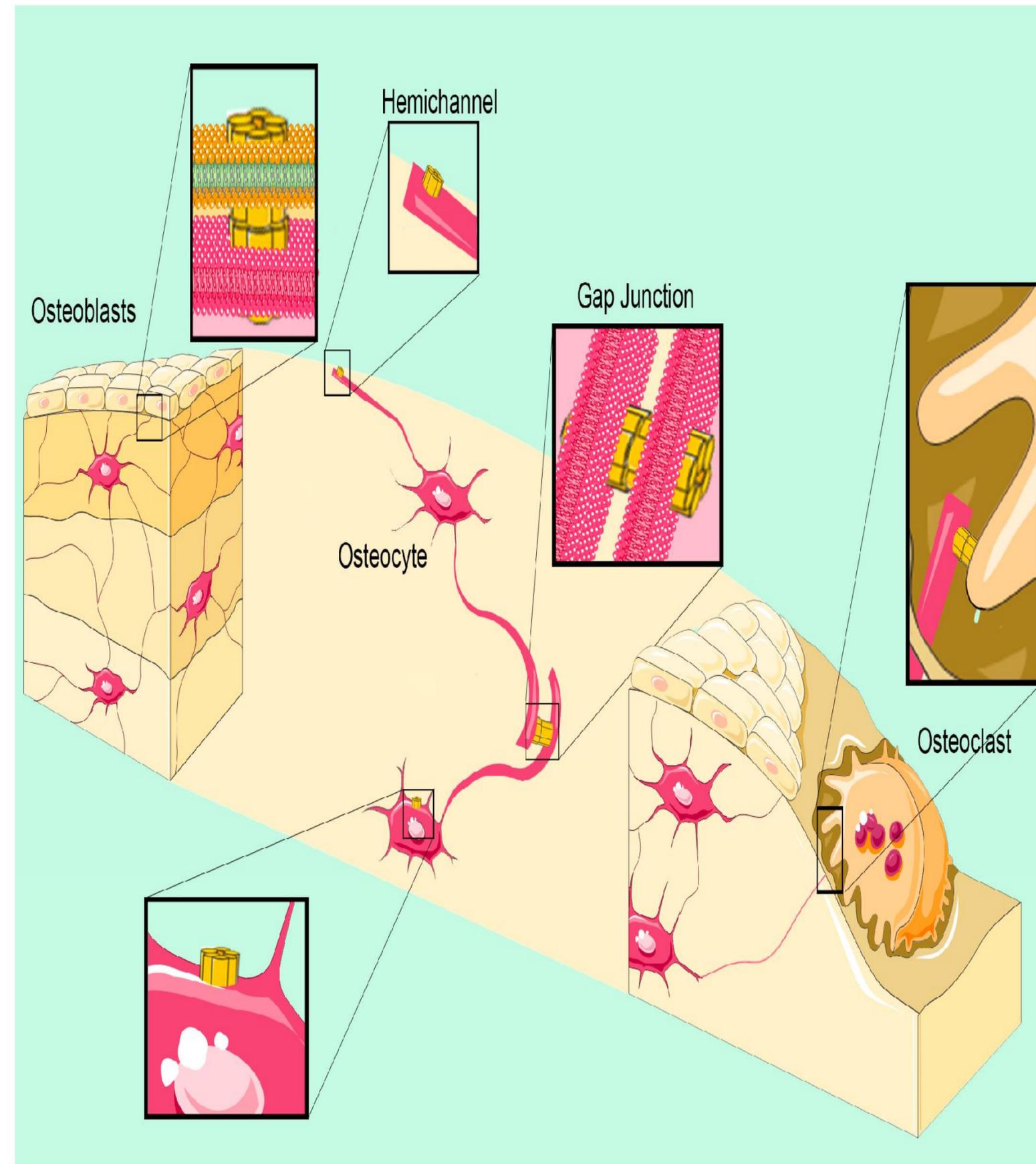
Osteocyte cells

→ sensor that determine when I have to formation and when I have to resorption so have role in maintain the Ca^{2+} in serum (calcium) in bone (deposit)

They are osteoblast entrapped cell within the bone matrix.

Function: -

- maintenance of bone matrix, and prevent hypermineralization.
(formation of functional syncytium (osteocyte – osteoblast complex) to prevent (sclerosis))
- Help in Ca release from bone to blood.
- controlling bone remodeling.
- Contain alkaline phosphatase to prevent dissolution of bone salts





Hypocalcaemia causes **hyper-excitability of the neuromuscular junction.**

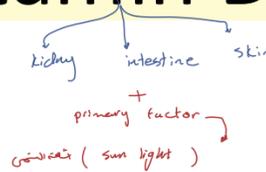
Symptoms include **pins and needles, tetany, paralysis, and convulsions.**

Hypercalcaemia can lead to **renal calculi, kidney damage, constipation, dehydration, tiredness, and depression**, remembered by the phrase "**stones, moans, and groans**",

- **Stones** – **renal calculi** (kidney stones)
- **Moans** – **depression** and **tiredness**
- **Groans** – **constipation**

Hormonal Regulation

Three primary hormones regulate the exchange of calcium between the bone and the blood: PTH, Calcitonin, vitamin D (calcitriol)

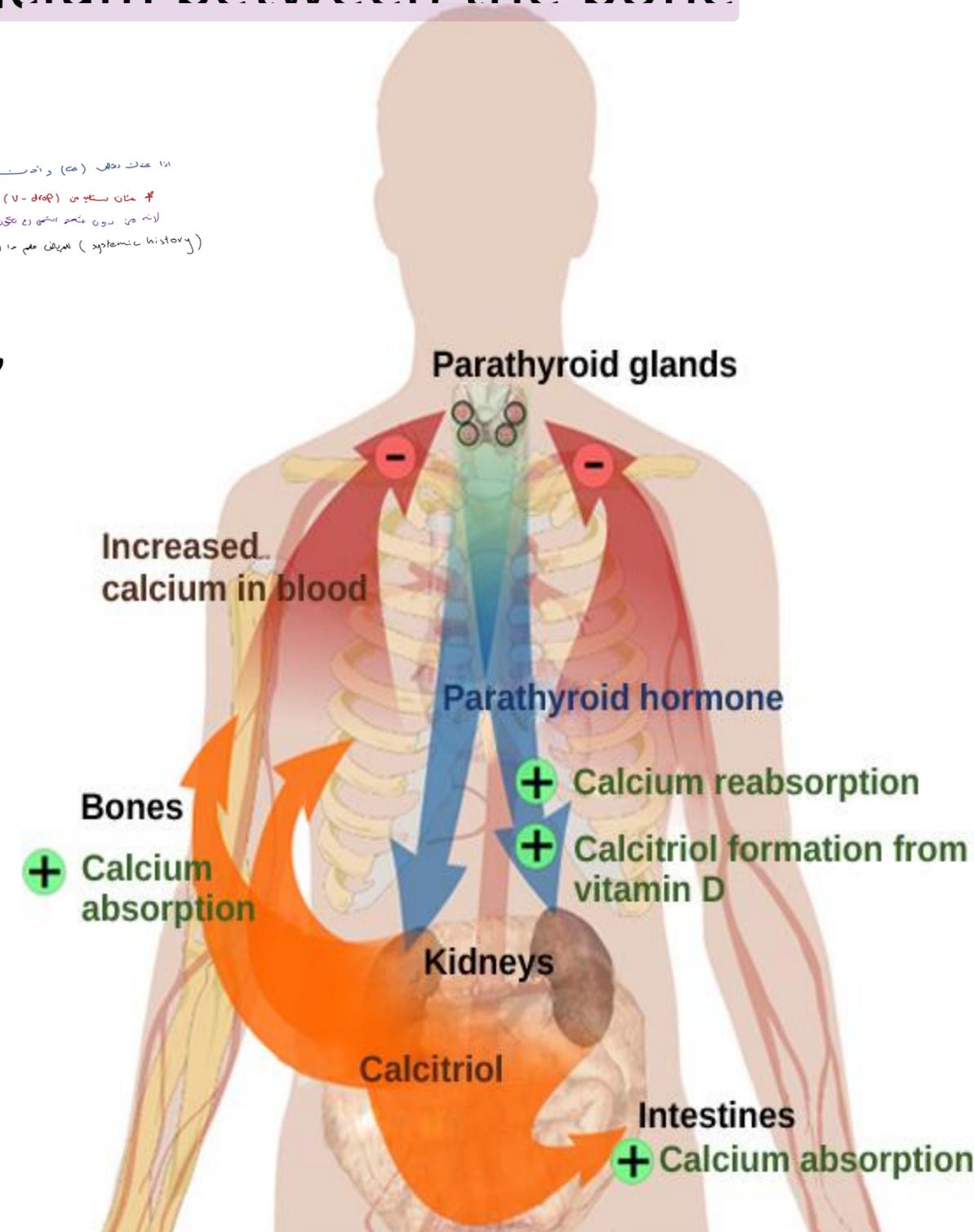


انا عدت دطوب (ص) رادنت بضم علاج لي هو (V-drop)
* حبان بستان من (V-drop) بجد استفاد لانه حسي
لانه من روت بضم استمر مع بكون في مزاج (ص) انه اكل راحة وممكن يلو اكله قبل
(معل)
(histology) تعريف مع ما وده في حال انه كان حده بضم روي دهمه ونهركي حنرة
سكو بكون من مر او صحت بسبب مزاج او صحت بكونه و drop

Organs regulate calcium metabolism: bone, PT gland, kidney and intestine

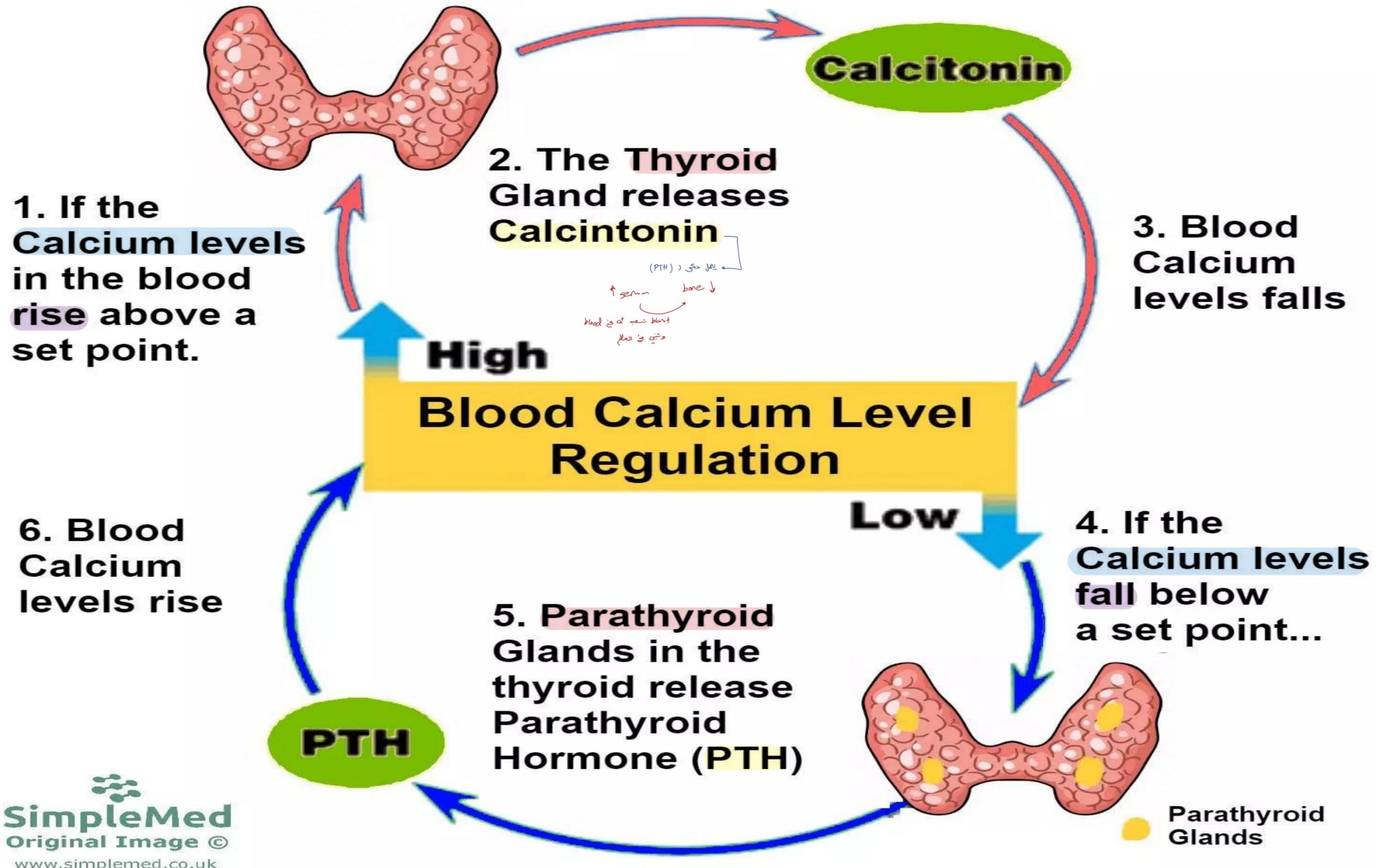
Parathyroid hormone (PTH) is released in response to low blood calcium levels. It increases blood calcium levels by targeting the skeleton, the kidneys, and the intestine

So we have to raise it (sodium)
so resorption of bone (cost) → break down the bone to release the Ca²⁺



- ❖ The parathyroid glands release parathyroid hormone (PTH) in response to a decrease in serum calcium.
- ❖ PTH acts on the kidneys to increase calcium reabsorption in the distal convoluted tubule, and the collecting duct.
- ❖ The kidney also responds to PTH by increasing secretion of Vitamin D3, which in turn stimulates calcium absorption through the gut.
intestine ←
لحمه ادى الى عظمى نستعمله من / Vit D3 لايقل الى وجود لحمه منى
لحمه ادى الى عظمى نستعمله من
vit D3 increase intestinal absorption of calcium and phosphate
- ❖ PTH acts on the bones to stimulate osteoclasts involved in bone reabsorption and the release of free calcium.

All of these processes contribute to the rise in serum calcium



calcitonin hormone

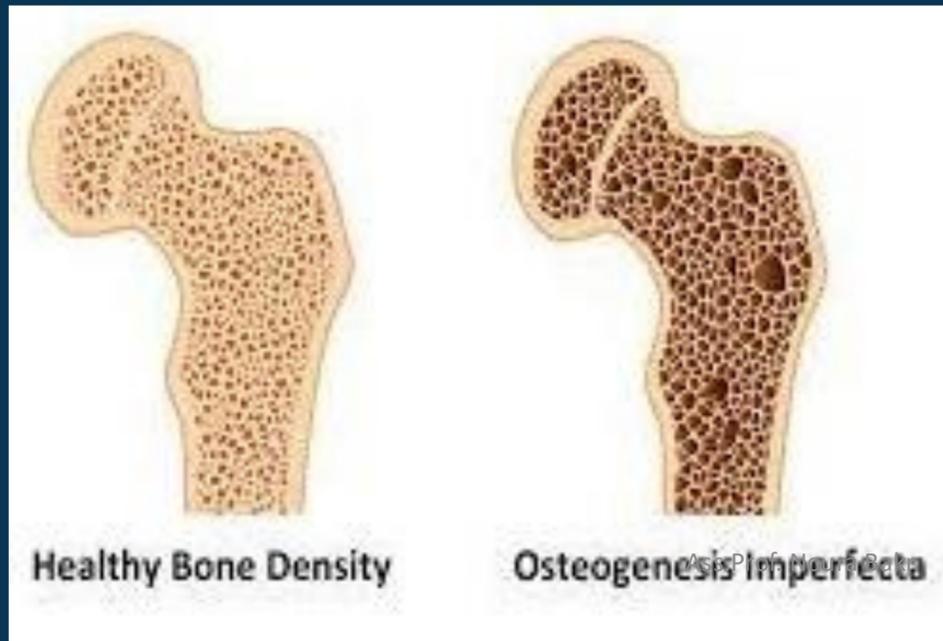
- produced by the **parafollicular (C cells)** of the **thyroid gland**
- **Calcitonin decreases blood calcium levels** by **inhibiting osteoclasts**, **stimulating osteoblasts**, and **stimulating calcium excretion** by the **kidneys**
- also **inhibits calcium absorption** in the **intestine** (**inhibits renal reabsorption** of calcium).
- This results in **calcium being added to the bones** to **promote structural integrity** and **decrease in serum calcium**.
- **Calcitonin is most important in children** (when it stimulates **bone growth**), **during pregnancy** (when it **reduces maternal bone loss**), and **during prolonged starvation** (because it **reduces bone mass loss**).

18-21
نه توشن جنم

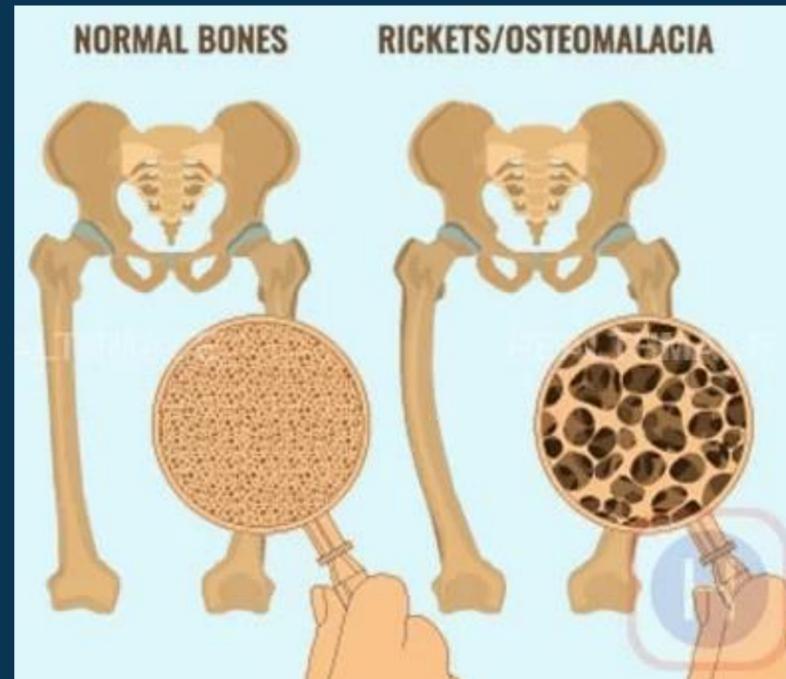
که ممکنه بدست
maternal hypocalcemia
فصح لوده بعد از وضع
این (چونکه در پیچیدگی)
در این مرحله خونده بفرستد زنانه، جنم
نظیر آن برای ریشه کردن
معمولاً در زمانه که مادران باردار و
مخاطب جنم



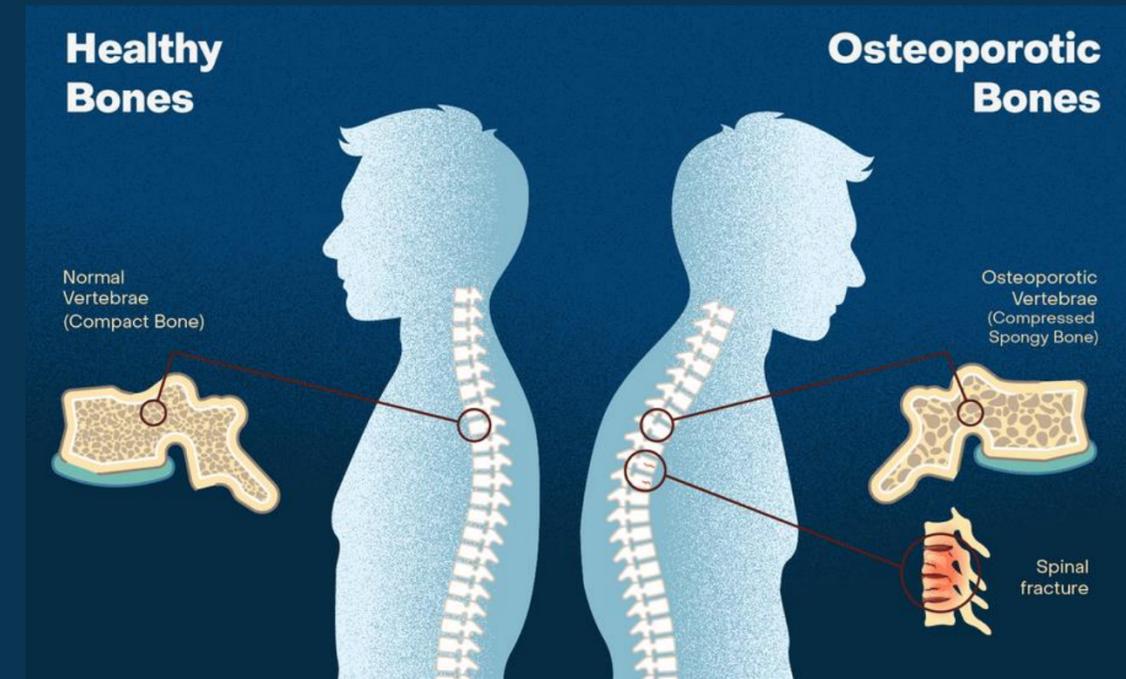
CLINICAL RELEVANCE:



Osteogenesis imperfecta:
defect in collagen →
brittle bones



Rickets/Osteomalacia:
poor mineralization →
soft bones



Osteoporosis:
imbalance in matrix
breakdown and
formation



THE ANIK

YOUNG

Ass.Prof. Noura Bakr