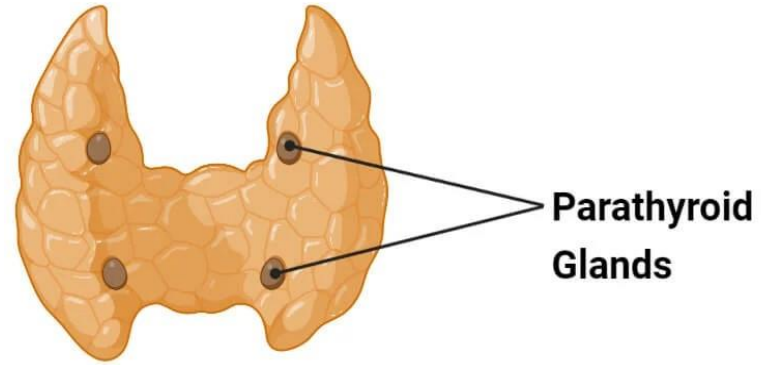
ORAL BIOLOGY AND PHYSIOLOGY

COURSE CODE: 1601106

2 CREDIT UNITS



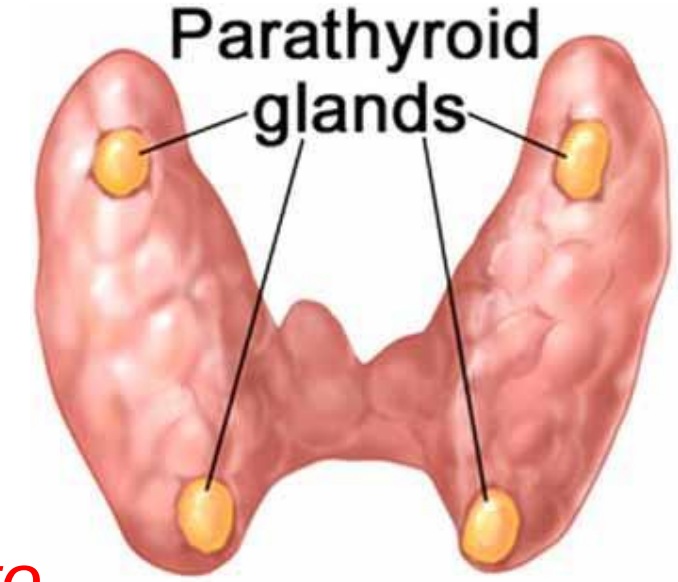
Dr Kasimu Ghandi Ibrahim & Dr Ahmad Taha
kibrahim@zu.edu.jo; ataha@zu.edu.jo

Week 10, Lecture 2

Intended Learning Outcomes

- Understand the physiological basis of parathyroid hormones (PTH)
- Understand the mechanism of action of PTH
- Understand the action of calcitonin

Parathyroid glands



- Four parathyroid glands on the posterior aspect of the thyroid gland.
- Each measures 3-5 mm in diameter
- The weight of the 4 glands about 120 mg.
- Secrete parathormone (PTH,84 aas)
- The normal plasma level of PTH is about *1.5 to 5.5 ng/dL*.
- Which is essential for life
- Have important role in the regulation of Ca2+ metabolism in the body.

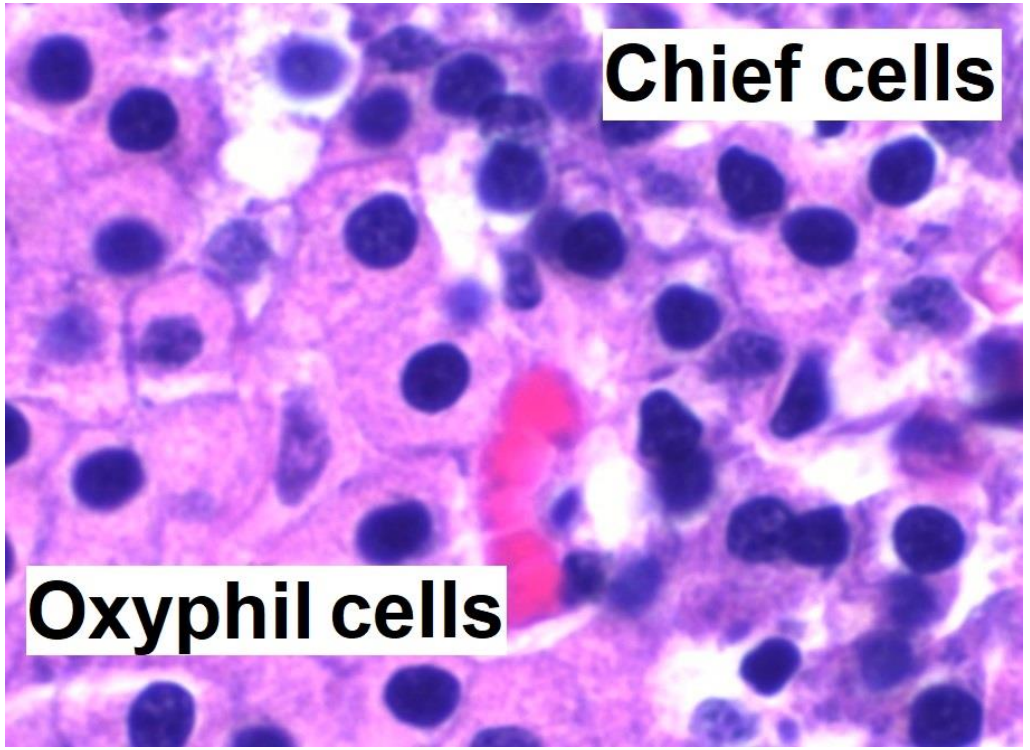
Parathyroid glands

- The parathyroid glands are formed of columns of ***chief cells*** and ***oxyphil cells:***

a) **The chief cells**: More numerous and secrete the PTH.

b) **The oxyphil cells:** appear in the gland at 10th year of life.

- These cells represent inactive chief cells.
- The function of the oxyphil cell is not known. It is believed that oxyphil cells are the degenerated chief cells.



Functions of Parathormone

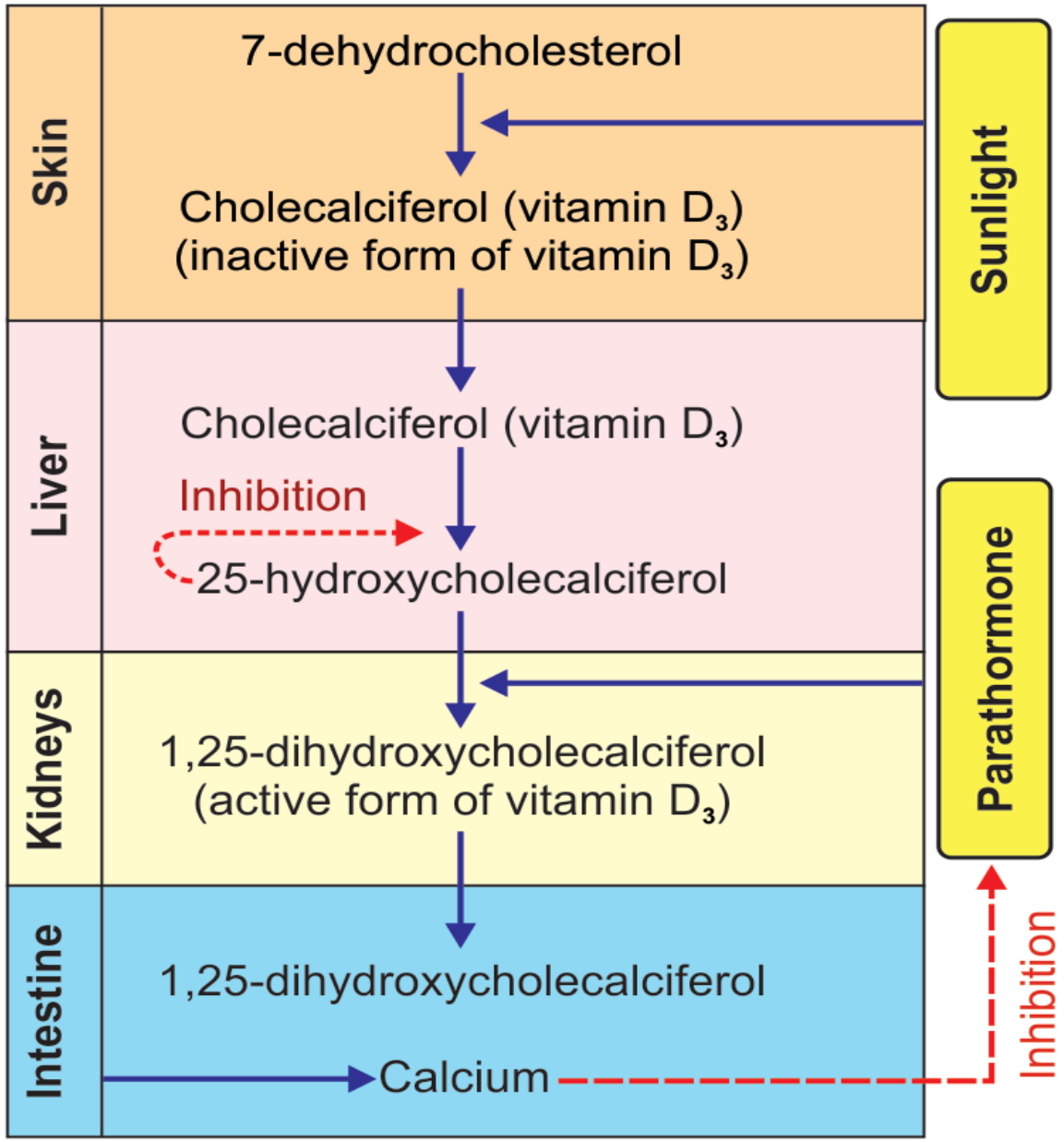
- The main function is to keep a ***normal plasma Ca^{2+} level (9-11 mg %).*** mg/dL
- It increase the blood Ca2+ level.
- It maintains a constant ratio between plasma Ca^{2+} & PO4
- **How does PTH perform these effects?**

A. On the small intestine

- Increases the absorption of Ca2+ , mediated by active vitamin D (1,25 dihydroxy cholecalciferol)
- Increases the absorption of PO4 and Mg.

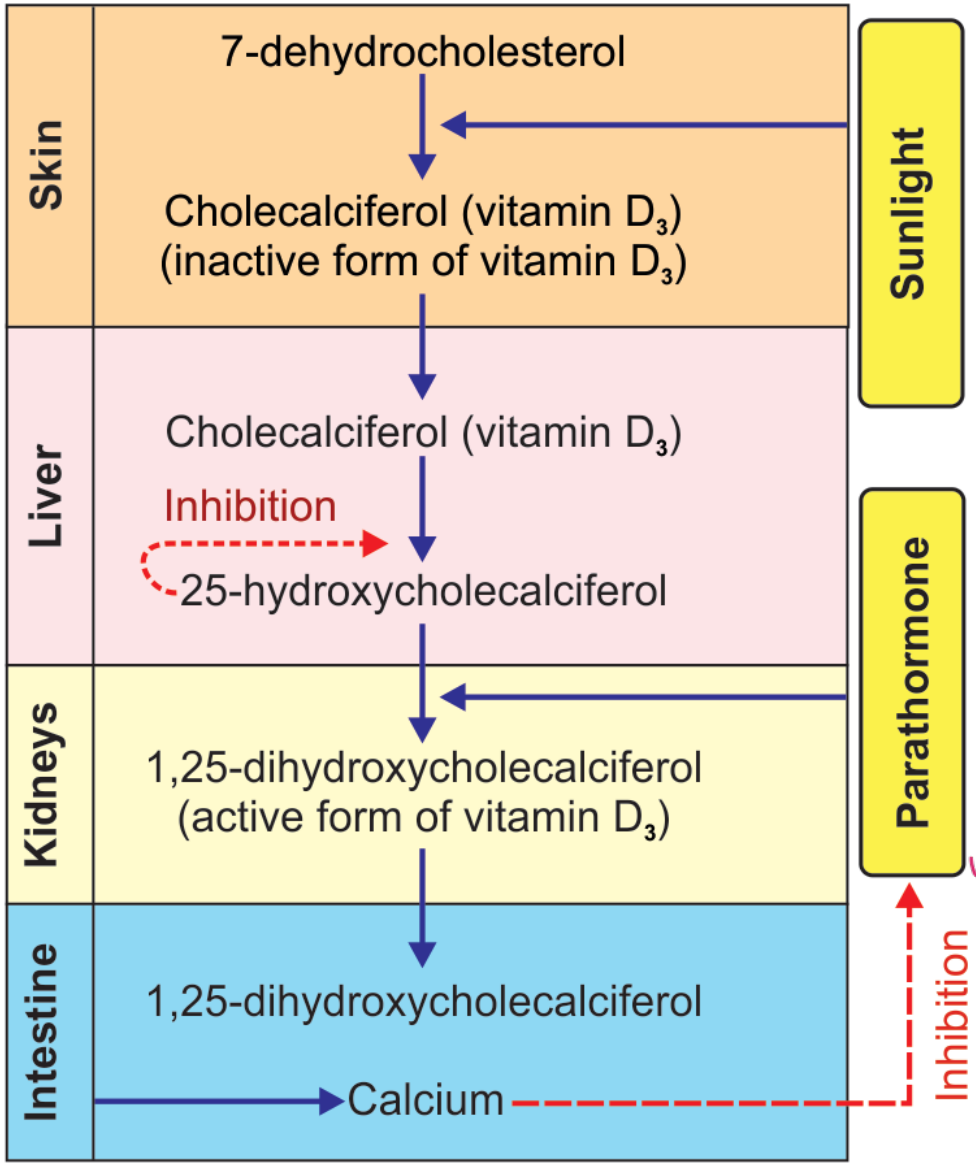
Functions of Parathormone

- **Activation of vitamin D:** the most important one is vitamin D3. It is also known as cholecalciferol.
- Vitamin D3 is synthesized in the skin from 7-dehydrocholesterol by the action of ultraviolet rays from the sunlight.
- **The activation of vitamin D3 occurs in two steps .**
- **The first step:** cholecalciferol (vitamin D3) is converted into 25-hydroxycholecalciferol in the liver.



Functions of Parathormone

- **The second step:** 25-hydroxycholecalciferol is converted into 1,25-dihydroxycholecalciferol (***calcitriol***) in the kidney,
- It is the active form of vitamin D3. This step needs the presence of PTH.
- The 1,25-dihydroxycholecalciferol increases the absorption of calcium and phosphate from intestine.

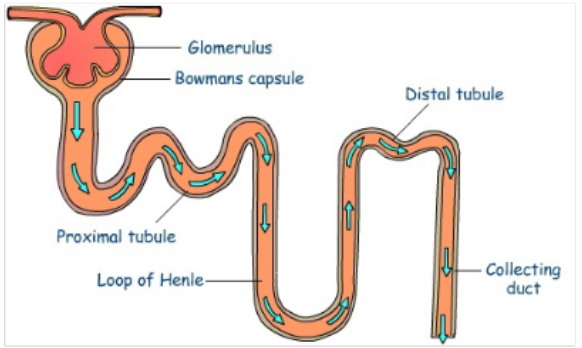


Schematic diagram showing activation of vitamin D

Functions of Parathormone

B. On the kidney

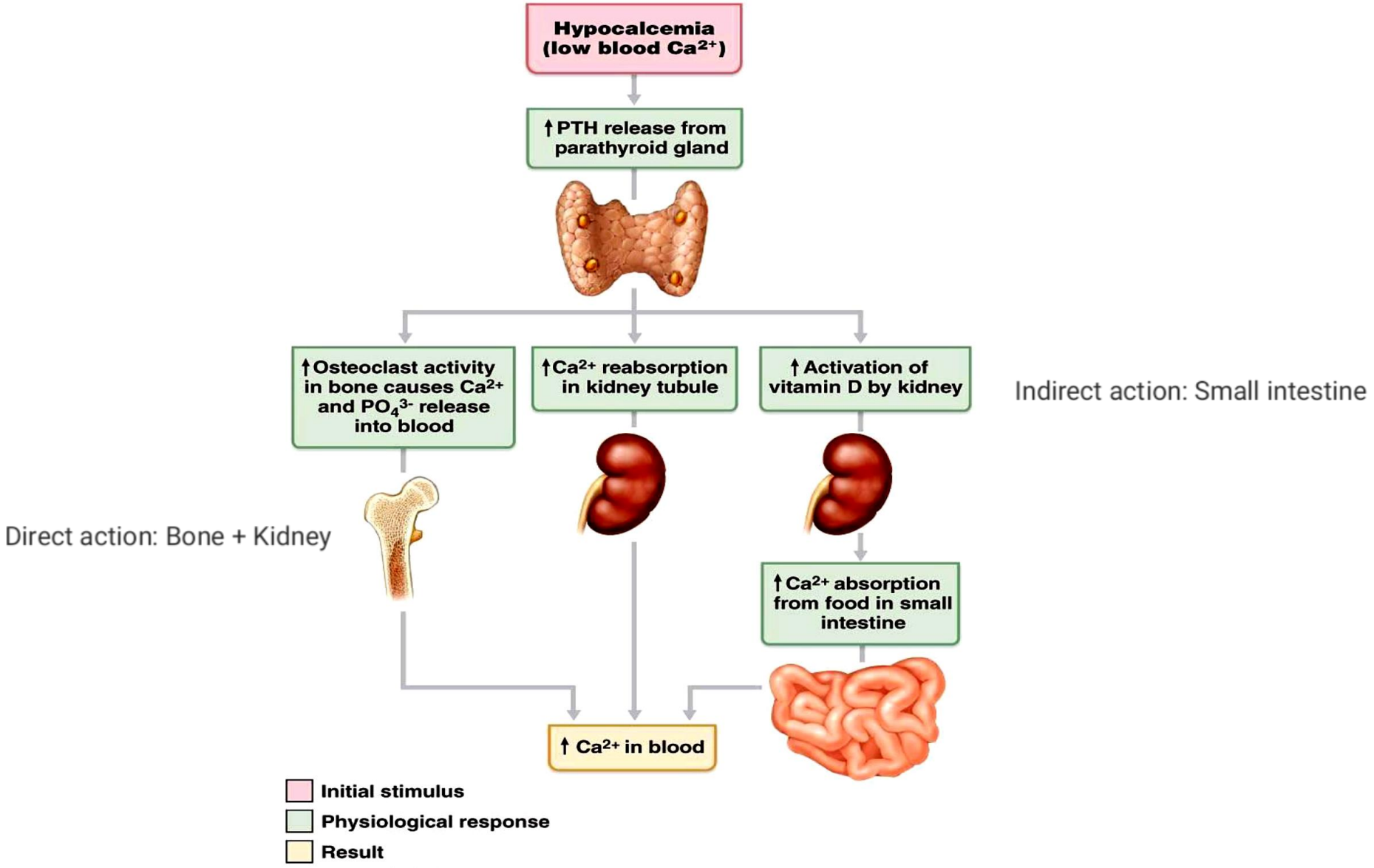
- **On the ascending limb of the loop of Henle and distal CT:** Increases the reabsorption of Ca^{2+} & increases PO_4 excretion.
- **On the proximal CT**
  - Increases the reabsorption of Mg
  - Activates vitamin D to (1,25 dihydroxycholecalciferol)



C. On the bone

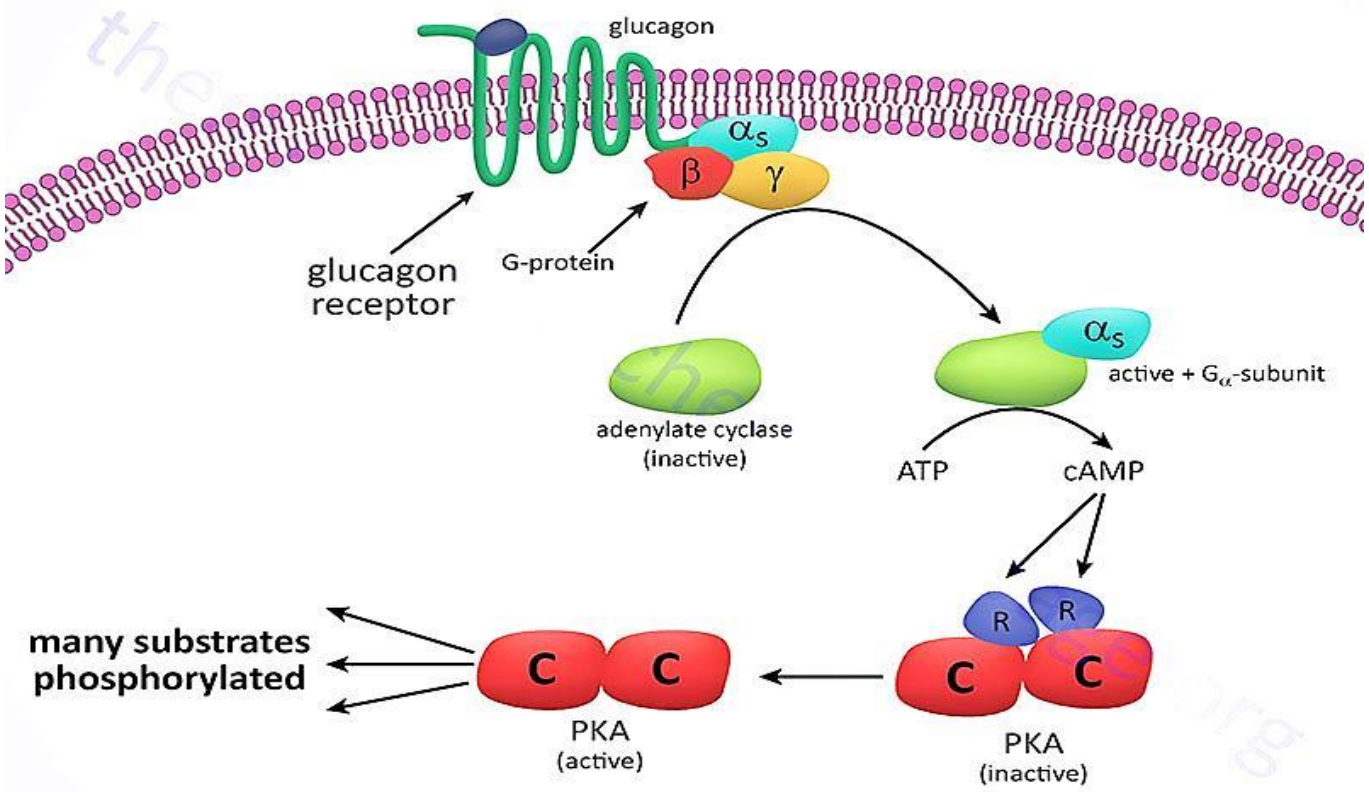
- Increases the number and activity of osteoclasts (bone destroying cells)
- This results in:
  - resorption of bone
  - release of Ca2+ into the blood and
  - hypercalcemia.

Functions of Parathormone



Mechanism of action of Parathormone

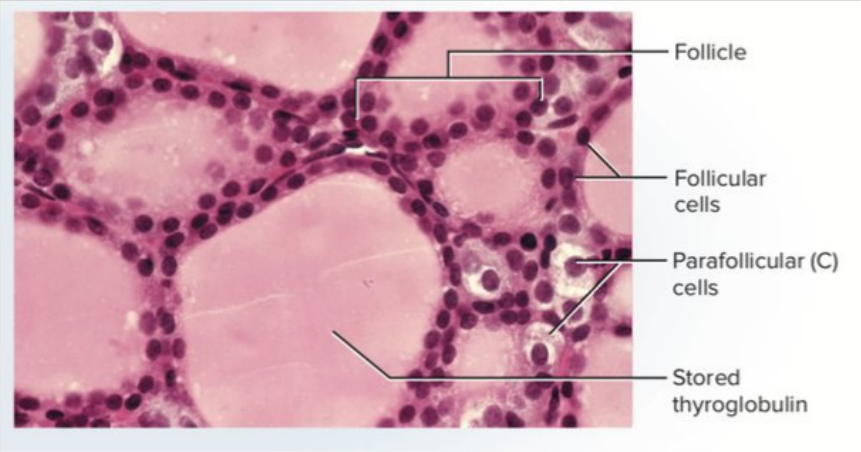
- Through cell membrane receptor:
- Activation of adenyl cyclase enzyme & increase the intracellular cAMP.
- Increase intracellular Ca^{2+} , where it acts as a second messenger or modulate adenyl cyclase response



Calcitonin

- **Site of secretion**
- Calcitonin is secreted by the parafollicular cells or clear cells (C cells) situated amongst the follicles in the thyroid gland.

- **Chemistry and plasma level**
- It is a polypeptide chain with 32 amino acids.
- Its molecular weight is about 3,400.
- Plasma level of calcitonin it 1 to 2 ng/dL.



Actions of Calcitonin

- **On Blood Calcium Level**
- Plays an important role in the control of the blood calcium level.
- It decreases the blood calcium level and thereby counteracts parathormone.
- Calcitonin reduces the blood calcium level by acting on bones, kidneys and intestine.

Actions of Calcitonin

A. On the bones

- Calcitonin stimulates osteoblastic activity and facilitates the deposition of calcium on bones.
- At the same time it suppresses the activity of osteoclasts.
- It inhibits the resorption of calcium from bones.
- It inhibits even the development of new osteoclasts in bones.

Actions of Calcitonin

B. On the kidney

- It increases the excretion of calcium through the urine, by inhibiting the reabsorption of calcium from the renal tubules.

C. On the intestine

- It prevents the absorption of calcium from the intestine into the blood.

Actions of Calcitonin

- **On Blood Phosphate Level**
- With respect to calcium, calcitonin is an antagonist to PTH.
- But it has similar actions of PTH with respect to phosphate.
- It decreases the blood level of phosphate by acting on bones and kidneys.

A. On the bone

- It inhibits the resorption of phosphate from bone and stimulates deposition of phosphate on bones.

B. On the kidney

- It increases the excretion of phosphate through urine, by inhibiting the reabsorption of calcium from the renal tubules.

Regulation of Calcitonin secretion

- High calcium content in the plasma stimulates calcitonin secretion through calcium receptors in parafollicular cells.
- Gastrin also is known to stimulate release of calcitonin.

Useful links

- https://www.youtube.com/watch?v=y64aXKCkHk4
- https://www.youtube.com/watch?v=EEM0iRJNhU8