

DEPTH OF BIOLOGY

Advance Pharmacology-2nd

Unit-1

Endocrine Pharmacology

Molecular and cellular mechanism of action of hormones such as-

growth hormone, prolactin, thyroid, insulin and sex hormones

Anti-thyroid drugs, Oral hypoglycaemic agents, Oral contraceptives,
Corticosteroids.

Drugs affecting calcium regulation

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Endocrine Pharmacology

Ductless Gland



Don't have duct

Eg:

Pituitary Gland.

Thyroid.

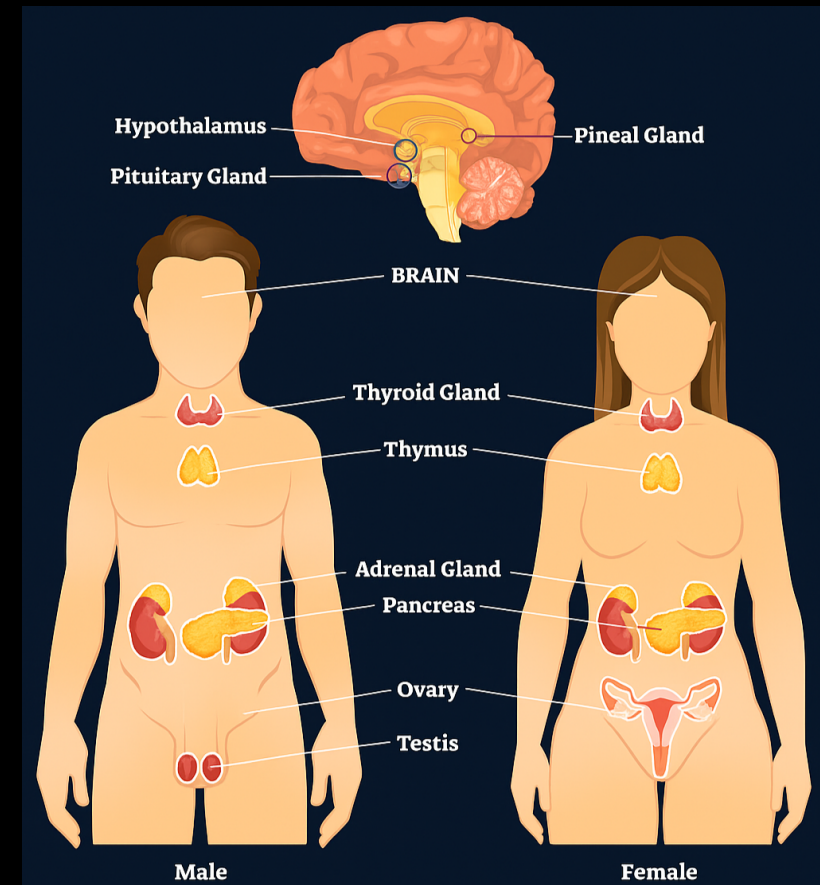
Pancreas.

Adrenal Gland.

Sex Gland.

That deal with
drug affecting the
Endocrine System.

Study How drug affect
Living Organism.



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Endocrine Pharmacology is the branch of pharmacology that deals with drugs affecting the endocrine system, which includes glands that secrete hormones directly into the bloodstream to regulate vital physiological functions.

The endocrine system includes glands like the pituitary, thyroid, pancreas, adrenal glands, and sex glands (ovaries/testes).

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1. Growth Hormone-

What is GH?

Growth Hormone (GH), also called Somatotropin, is a protein hormone.

Where is it produced?

GH is secreted by the anterior pituitary gland in the brain.

Main Function

GH stimulates growth of bones and tissues, especially during childhood and adolescence.

Other Functions



Increases height



Promotes muscle mass



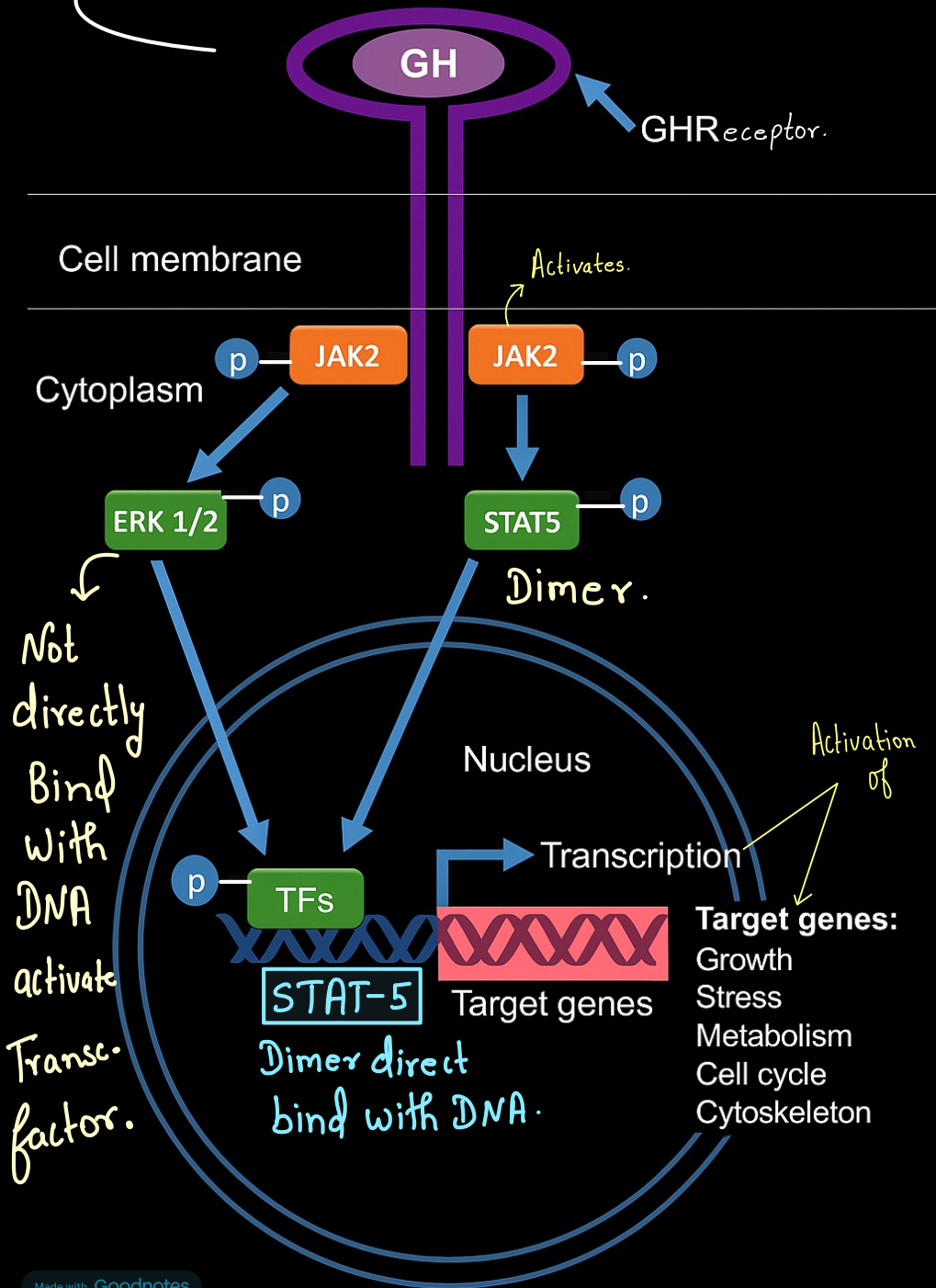
Boosts fat breakdown



Regulates metabolism (glucose, protein, and fat)

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Same diagram for Prolactin.



#GH Binds to Receptor-

1. Growth Hormone (GH) binds to the GH Receptor (GHR) on the cell membrane.

2. Activation of JAK2 Proteins

Binding of GH activates JAK2 proteins (Janus Kinases) inside the cell.

3. JAK2 Phosphorylates (activates) STAT5 & ERK1/2

-Activated JAK2 adds phosphate (P) to:

* Extracellular Signal Regulated Kinase.

STAT5 (Signal Transducer and Activator of Transcription 5)

-ERK 1/2 (part of MAPK pathway - for growth signals)

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STAT5 & ERK1/2 Move to the Nucleus

Both phosphorylated STAT5 and ERK1/2 go inside the nucleus.

Activation of Transcription Factors (TFs)

Inside the nucleus, STAT5 and ERK1/2 activate Transcription Factors (TFs).

TFs Bind to DNA

TFs bind to specific regions of DNA and start the process of transcription (copying genes to make mRNA).

Gene Expression Begins

This leads to activation of Target Genes involved in:

✓ Growth

✓ Stress response. ✓ Metabolism. ✓ Cell cycle ✓ Cytoskeleton structure

2. Prolactin-

Prolactin is a peptide hormone secreted by the anterior pituitary gland (specifically by lactotroph cells).

Its primary role is to stimulate milk production (lactation) in the mammary glands after childbirth.

Mechanism.

-Prolactin Binds to Receptor

Prolactin binds to the Prolactin Receptor (PRLR) on the cell membrane.

-Activation of JAK2 Protein

PRLR is linked to JAK2 (Janus Kinase 2).

Binding of prolactin activates JAK2.

-JAK2 Phosphorylates STAT5

Activated JAK2 adds a phosphate (P) to STAT5 (a signaling protein).

-STAT5 Dimerizes & Moves to Nucleus

Two STAT5 proteins join together (dimerize) and enter the nucleus.

-STAT5 Binds to DNA

STAT5 acts as a Transcription Factor, binding to specific regions of DNA.

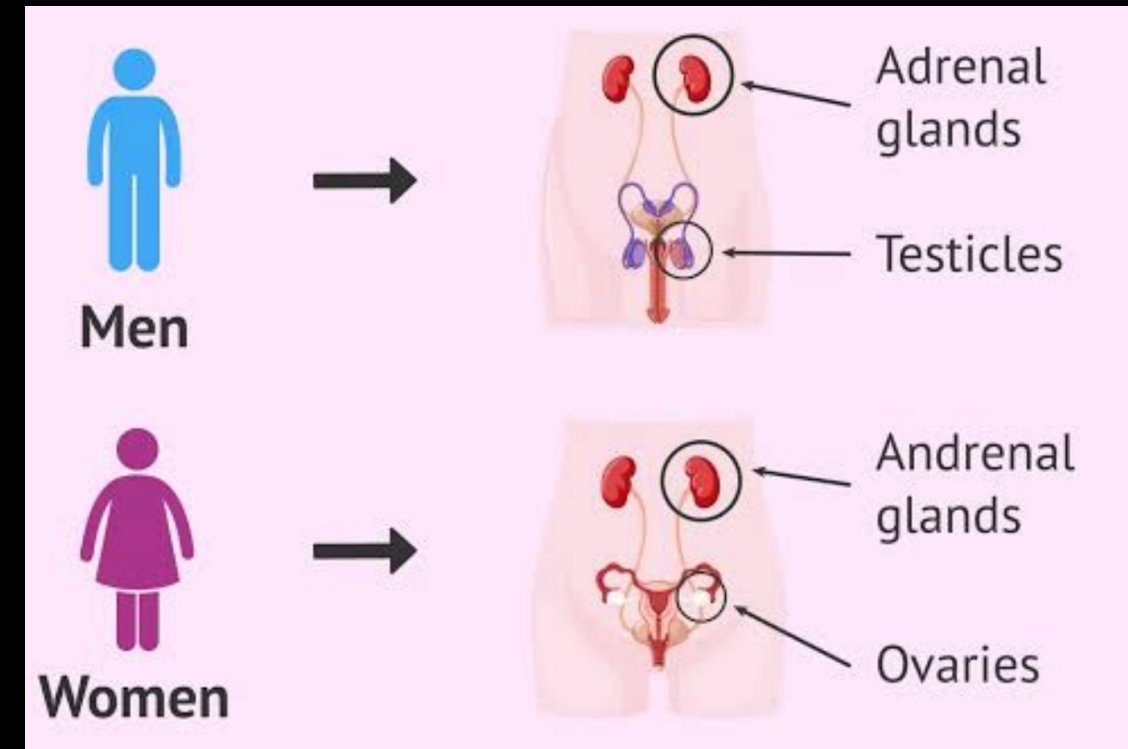
-Transcription of Target Genes

It promotes gene transcription, especially genes responsible for:

- ✓ Milk protein production (like casein)
- ✓ Mammary gland development
- ✓ Immune regulation

3. Sex Hormone–

Sex hormones are steroid hormones that play a crucial role in sexual development, reproduction, and the development of secondary sexual characteristics. They are primarily produced by the gonads (testes in males and ovaries in females) and the adrenal glands.



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Types of Sex Hormones:

Estrogens:

Primarily produced in the ovaries, they are crucial for female sexual development and reproductive function.

Progesterone:

Also produced in the ovaries, it plays a vital role in the menstrual cycle and pregnancy.

Testosterone:

Produced in the testes, it is the primary male sex hormone responsible for male sexual development and reproductive function.

Androgens:

A group of hormones that includes testosterone, they also play a role in both males and females.

Mechanism of Action of Sex Hormones-

-Hormone enters the cell

Sex hormones are lipid-soluble, so they freely cross the cell membrane.

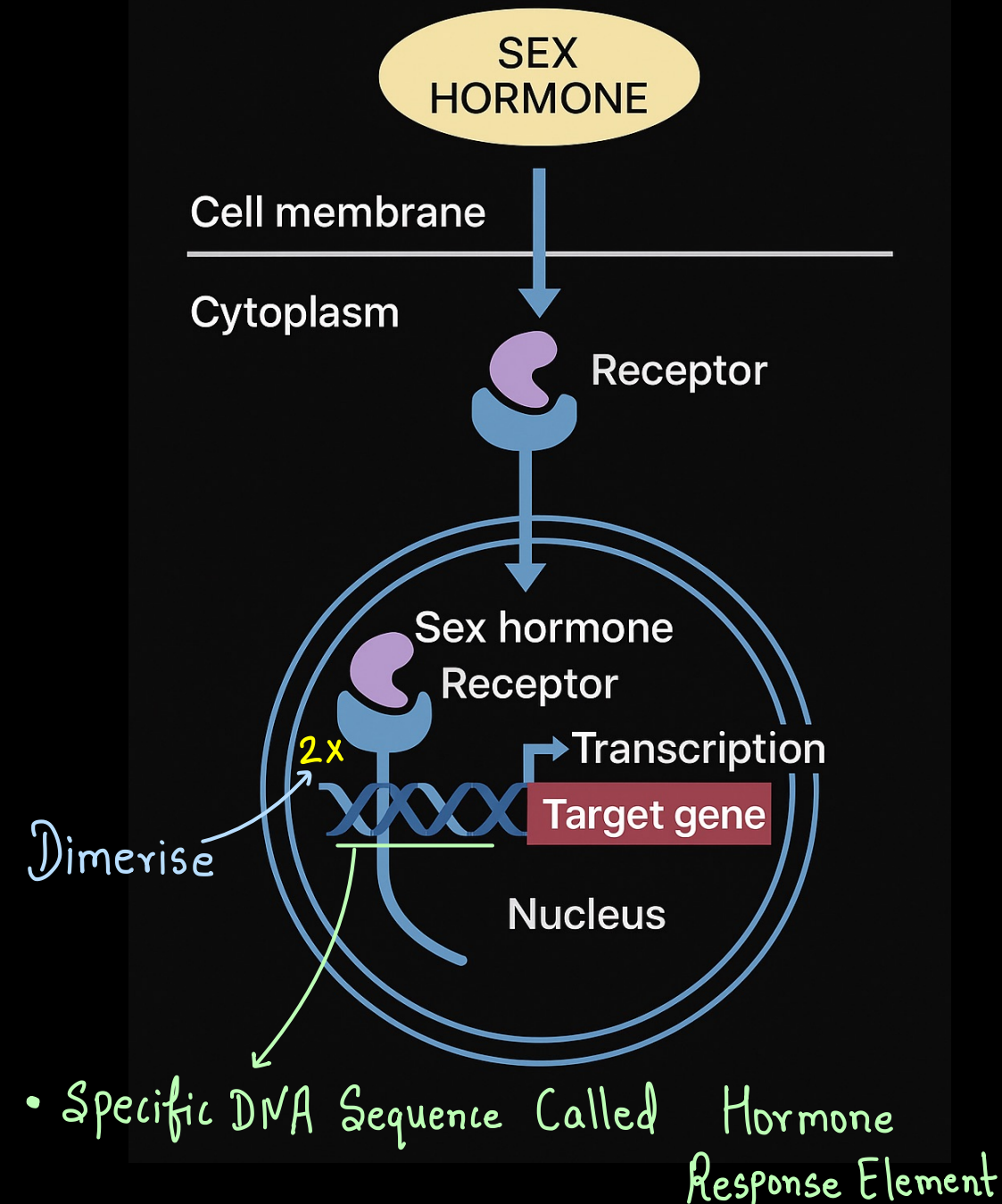
-Bind to intracellular receptors

Inside the cytoplasm hormone binds to specific intracellular receptors:

-Estrogen receptor (ER)

Progesterone receptor (PR)

Androgen receptor (AR – for testosterone)



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Hormone-receptor complex forms

This complex dimerizes (two units join) and becomes active.

Enters nucleus (if not already there)

The complex moves into the nucleus (if it formed in the cytoplasm).

Binds to DNA (HREs)

Binds to specific DNA sequences called Hormone Response Elements (HREs).

Activates transcription

Starts transcription of target genes involved in:

Growth of reproductive tissues

Protein synthesis

Development of secondary sexual characteristics

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Drugs affecting calcium regulation

Calcium plays a vital role in bone health, nerve conduction, muscle contraction, and blood clotting.

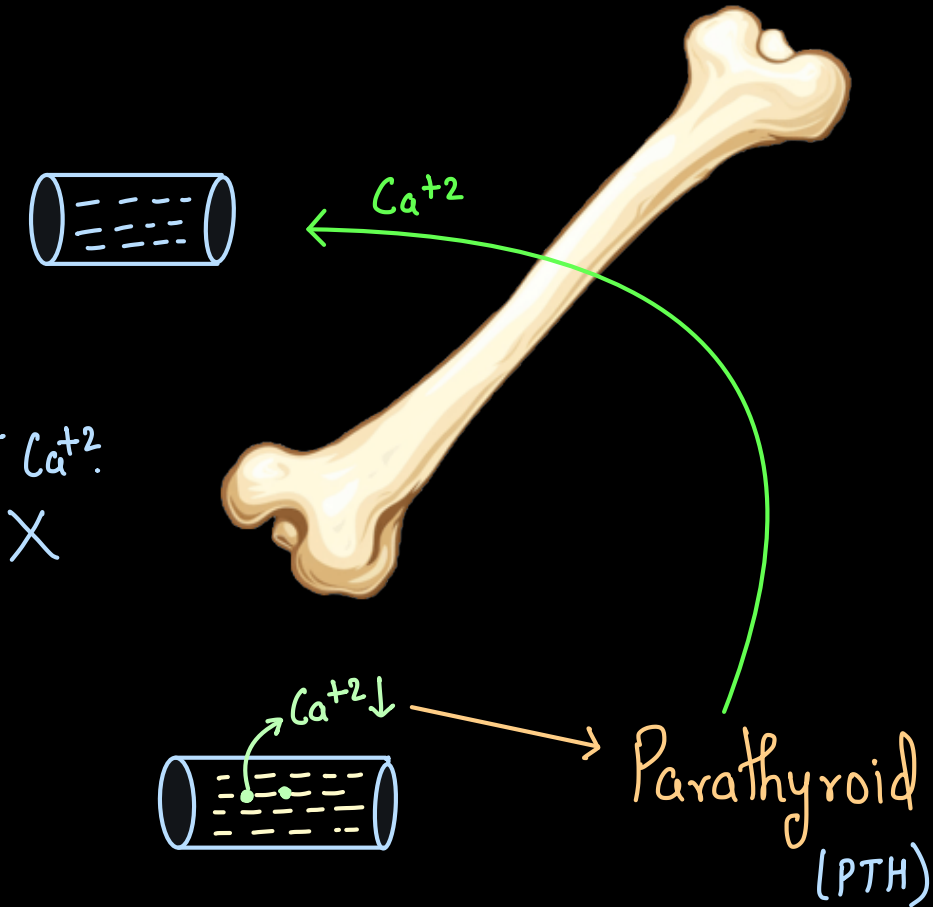
Its regulation in the body is maintained by parathyroid hormone (PTH), vitamin D, and calcitonin.

(↑)se Absorb. of Ca^{+2}

Kidney \nrightarrow Ca^{+2}
reabsorb. X

Various drugs influence calcium levels either by increasing absorption, enhancing deposition in bones, or reducing bone resorption.

Breakdown of Bone Tissue.



1. Vitamin D Analogues-

Function: Increase calcium absorption from the intestine and reduce calcium loss in urine.

Examples:

Calcitriol (active form of Vit D)

Cholecalciferol (Vitamin D₃)

Ergocalciferol (Vitamin D₂)

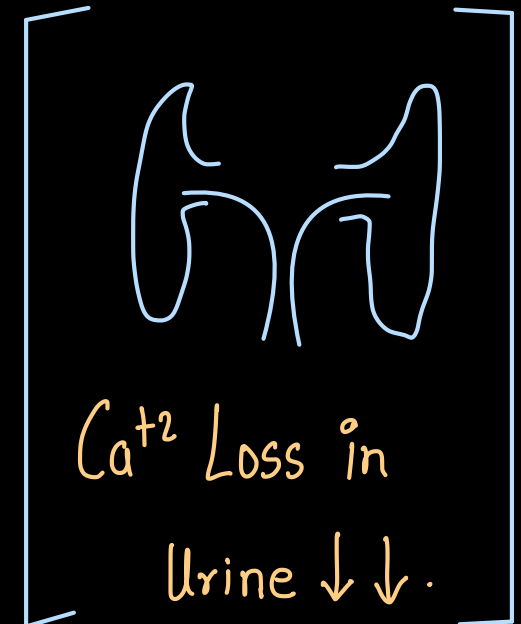
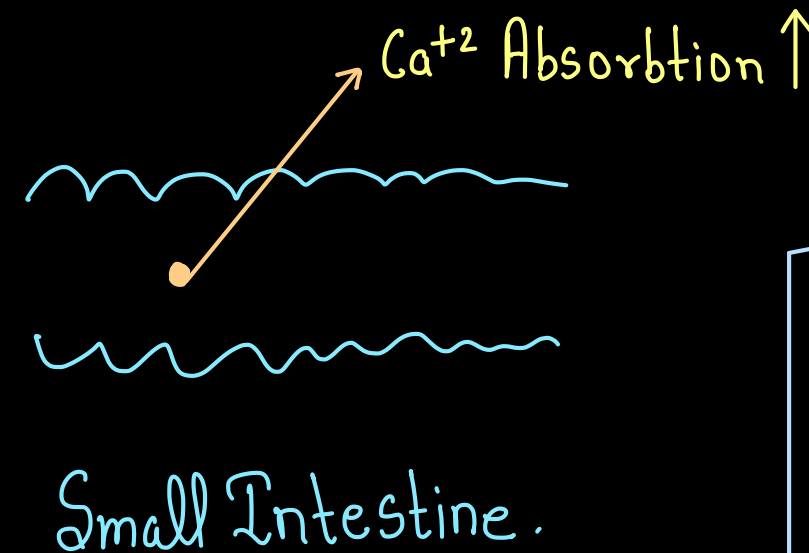
Uses:

Rickets (children)

Osteomalacia (adults)

Chronic kidney disease

Hypocalcemia



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-Calcitonin

Function: Reduces calcium levels in the blood by decreasing bone breakdown and increasing calcium excretion by kidneys.

Source: Hormone secreted by the thyroid gland

Use:

Hypercalcemia

Osteoporosis (especially postmenopausal)

Paget's disease

-Parathyroid Hormone (PTH) Analogues

Function: In low doses, they stimulate new bone formation by activating osteoblasts.

Example:

Teriparatide (synthetic PTH)

Use:

Severe osteoporosis

Osteoporosis not responding to other treatments