

THYROID

Hypothalamus-Pituitary-Thyroid Axis

CELLS: Thyroid Follicles

SECRETION:

- T₃ triiodothyronine (more active)
- T₄ Thyroxine (90% of all thyroid secretions but is converted into T3)
- Secreted by follicular epithelial cells. Stored in follicle cavities. Derivative of tyrosine and iodine.
- TH = thyroid hormone.

STIMULATED BY:

- Anterior pituitary thyroid stimulating hormone, TSH.
- Indirectly by hypothalamus thyrotropin-releasing hormone.

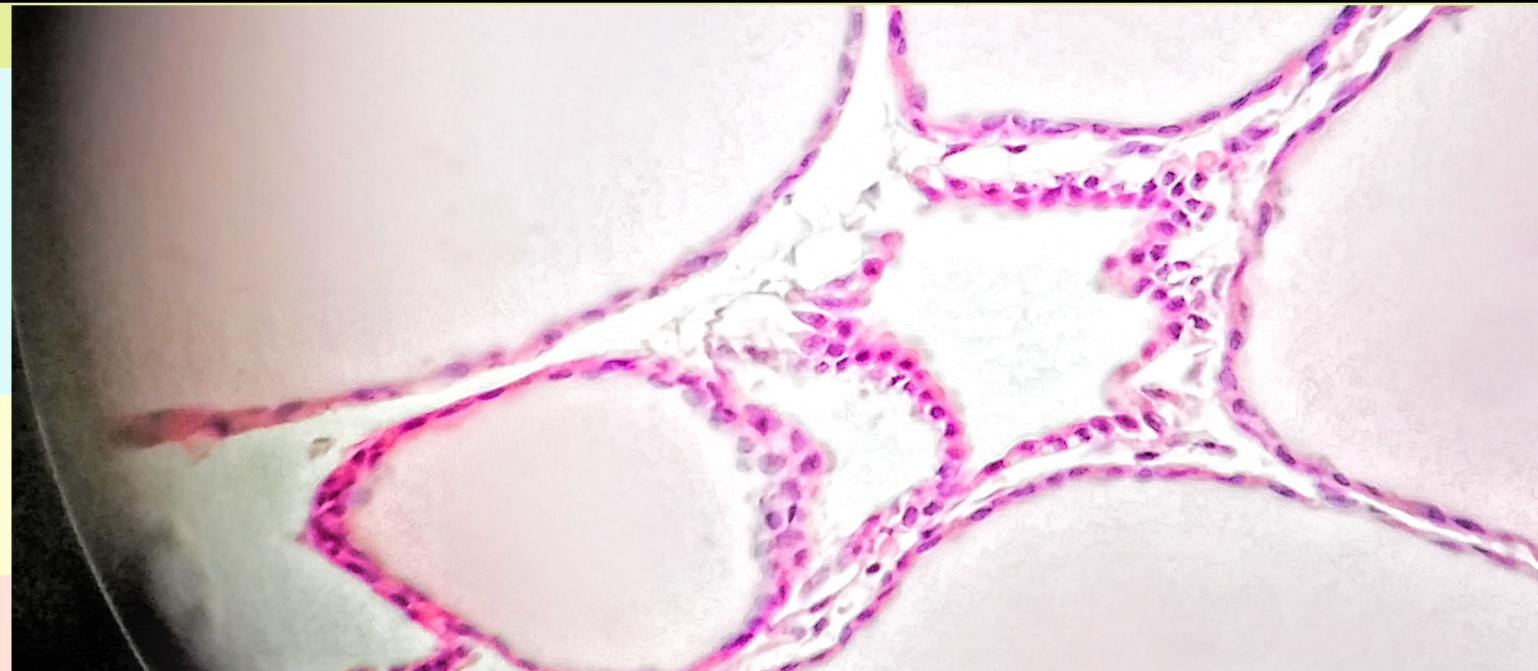
TARGETS:

Most cells.

EFFECTS:

- Increased energy use/metabolism.
- Stimulates basal metabolic rate via increasing ATP production, and by stimulating Na⁺/K⁺ and the Ca²⁺ gradients between the cytoplasm and sarcoplasmic reticulum.
- Binds to mitochondria to increase ATP production.
- Activate gene coding for enzyme synthesis.
- Increased oxygen consumption.
- Promotes growth/development.
- Calorigenic effect of T3/T4.
- Increase use of glucose and fatty acids.

- Stimulate B-oxidation of fatty acids.
- Breakdown triglycerides.
- Stimulates both lipogenesis and lipolysis, but when TH levels are elevated the net effect is fat loss.
- Cholesterol excretion (reduce blood glucose level).



CELLS: Parafollicular Cells (C-Cells)

SECRETION:

Calcitonin

STIMULATED BY:

Δ [blood calcium]. The concentration of blood calcium rises above normal range.

TARGETS:

Bone and kidney.

EFFECTS:

- Regulate calcium homeostasis.
- Decrease concentration of calcium in blood by inhibiting osteoclasts. Also decreases level of phosphates.
- Opposes the action of parathyroid hormone.
- Promotes the uptake of calcium and phosphates into bone extracellular matrix.
- Inhibits reabsorption of calcium in kidneys.

- Direct and indirect actions on regulating cholesterol production, disposal, and efflux.
- Stimulates gluconeogenesis especially in hyperthyroid state.
- T4 increases alanine transport into hepatocytes.
- Development of nervous system especially in late fetal and early postnatal stages.
- Promote thermogenesis to maintain core body temperature.
- Similar effect to growth hormone on bone growth/maturation.

- Needed for development of teeth, skin, and hair follicles.
- Needed for nervous, cardiovascular (via parvalbuminergic neurons PBN in anterior hypothalamus which regulate cardiovascular function), and gastrointestinal systems.

- Influences metabolic pathways (nutrient feedback, epigenetic modifications of histones, adrenergic signaling, ligand availability) controlling energy balance by regulating energy storage/expenditure.
- Mediates adaptations to preserve energy storage when organism is under duress.
- Alterations in neuroendocrine peptides related to energy intake, adipokines, nongenomic actions of TH within hypothalamus, decarboxylated/deiodinated analogs of TH.
- TH stimulation promotes transition to fast-twitch fibers and transition to a faster myosin heavy chain form.
- TH influences pancreatic islet cell development/function.
- T3 stimulates islet transcription factor Mafk.
- T3 is needed for transition of islets to glucose-responsive insulin secreting cells.