Al-Mustaqbal University

Pathophysiology 3rd stage

Endocrine Introduction & Disorders of Thyroid Function

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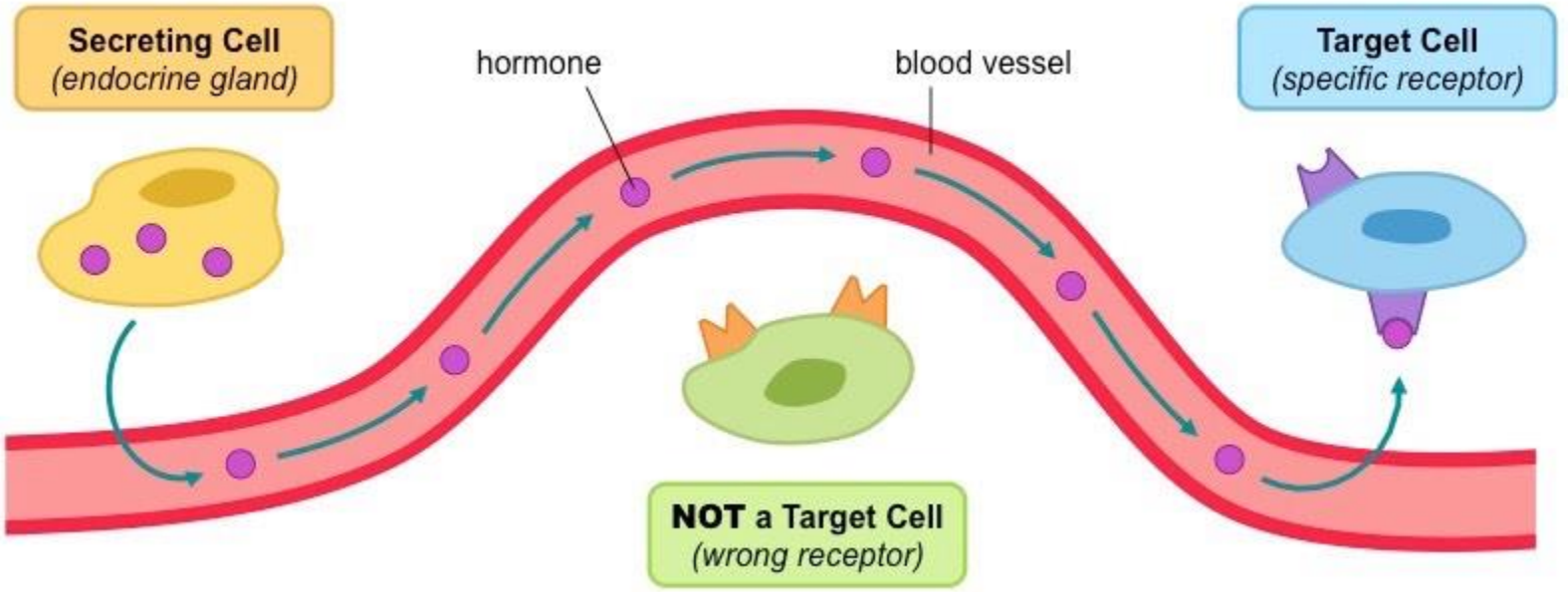
Endocrine System

The endocrine system, along with the nervous system, allows for communication between distant sites in the body.

There are three components to the endocrine system:

1- Endocrine glands. 2- Hormones. 3- Target cells or organs that respond to the hormones.



Endocrine Glands

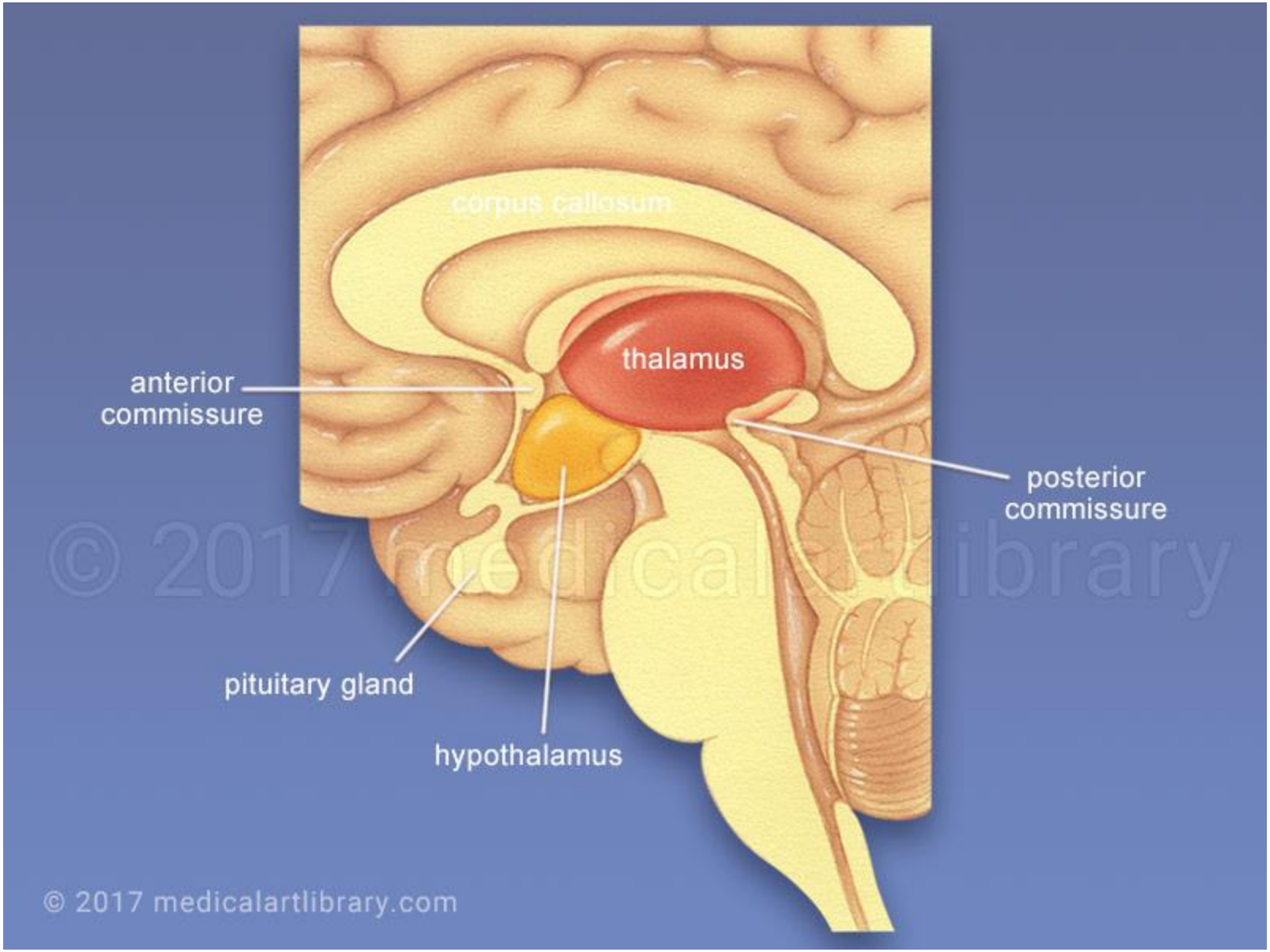
Endocrine glands are organs that synthesize, store, and secrete hormones into the bloodstream.

Hormones

A hormone is a chemical messenger released by an endocrine gland into the circulation.

Once released, a hormone travels in the bloodstream and affects only cells (target cells) in the body that have receptors (binding sites) specific to it.

Typically, a hormone is released in a pattern that often follows an inherent daily (diurnal) rhythm.


corpus callosum
thalamus
anterior commissure
posterior commissure
pituitary gland
hypothalamus
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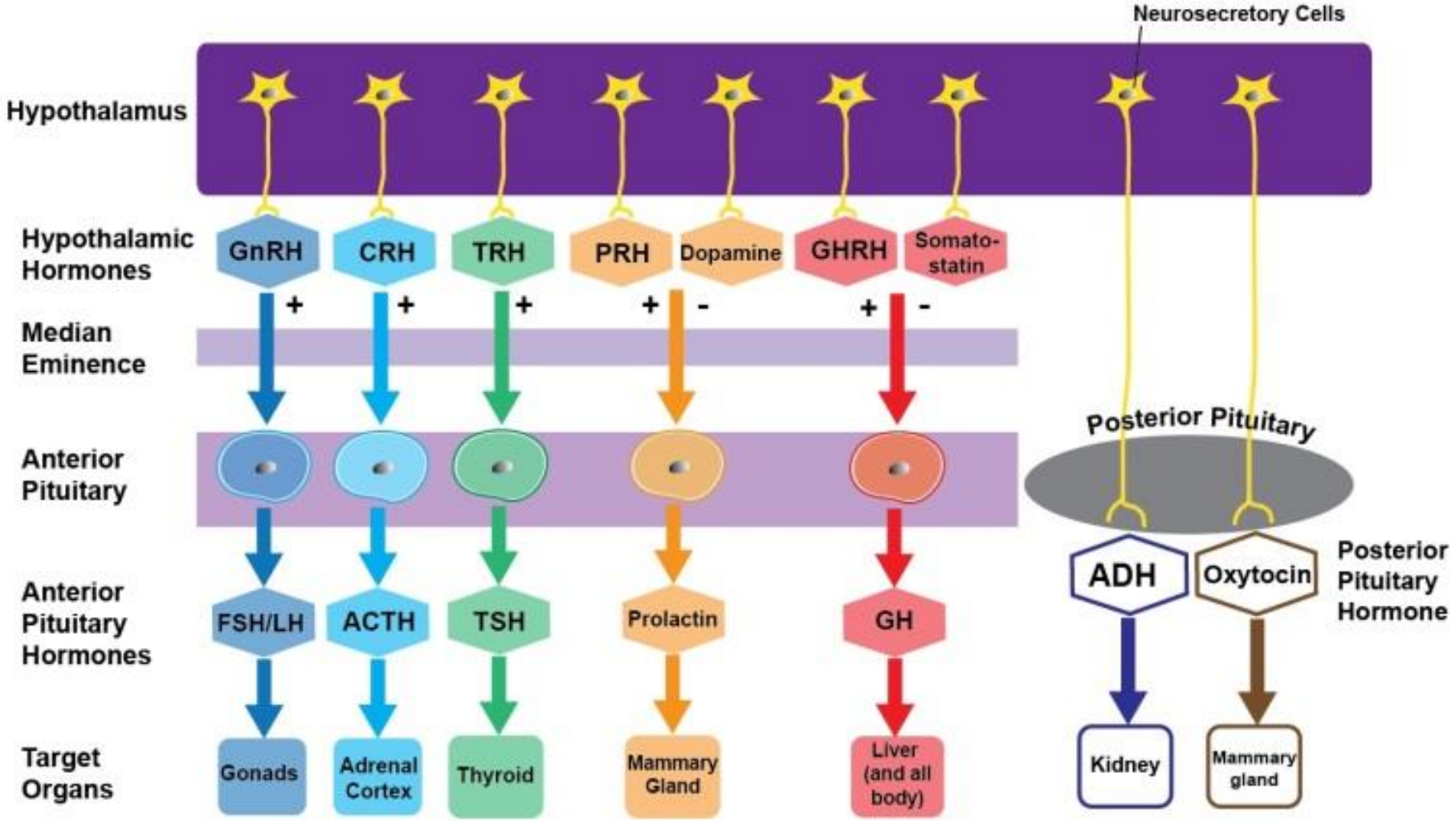


Hypothalamic & Pituitary Hormones and Their Target Organs

Amine hormone:

tyrosine derivatives (thyroid hormone, epinephrine, norepinephrine, and dopamine).

Peptide Hormones:

e.g. hormones of hypothalamic-pituitary hormonal system

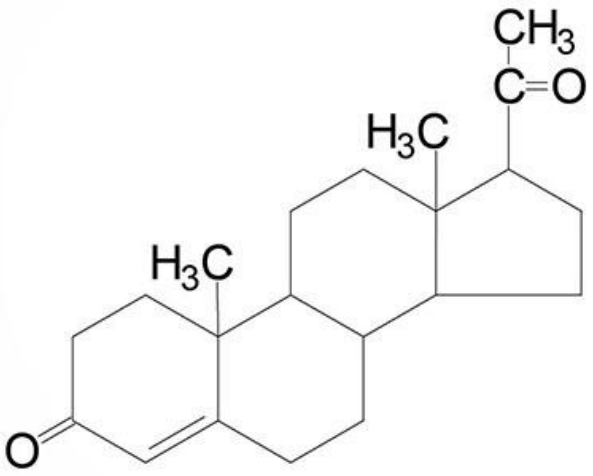
Steroid Hormones (mostly target intracellular receptor).

e.g. Estrogens, Progesterone

Androgens (primarily testosterone)

Aldosterone

Glucocorticoids



Target Glands

The third group of endocrine glands are outside the brain that respond to the anterior and posterior pituitary hormones with the release of their own hormones.

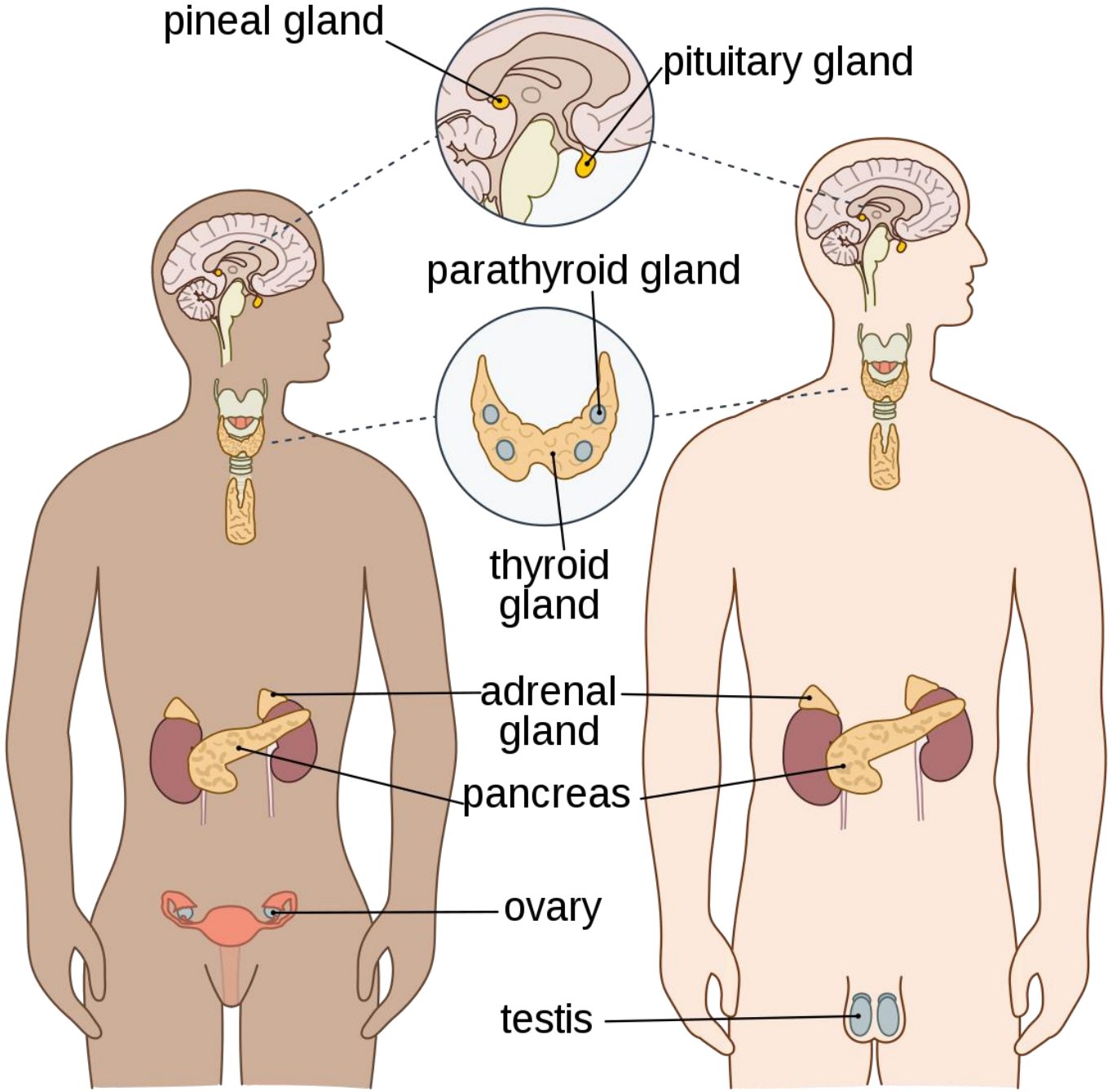
These include:

the thyroid gland,

the adrenal gland,

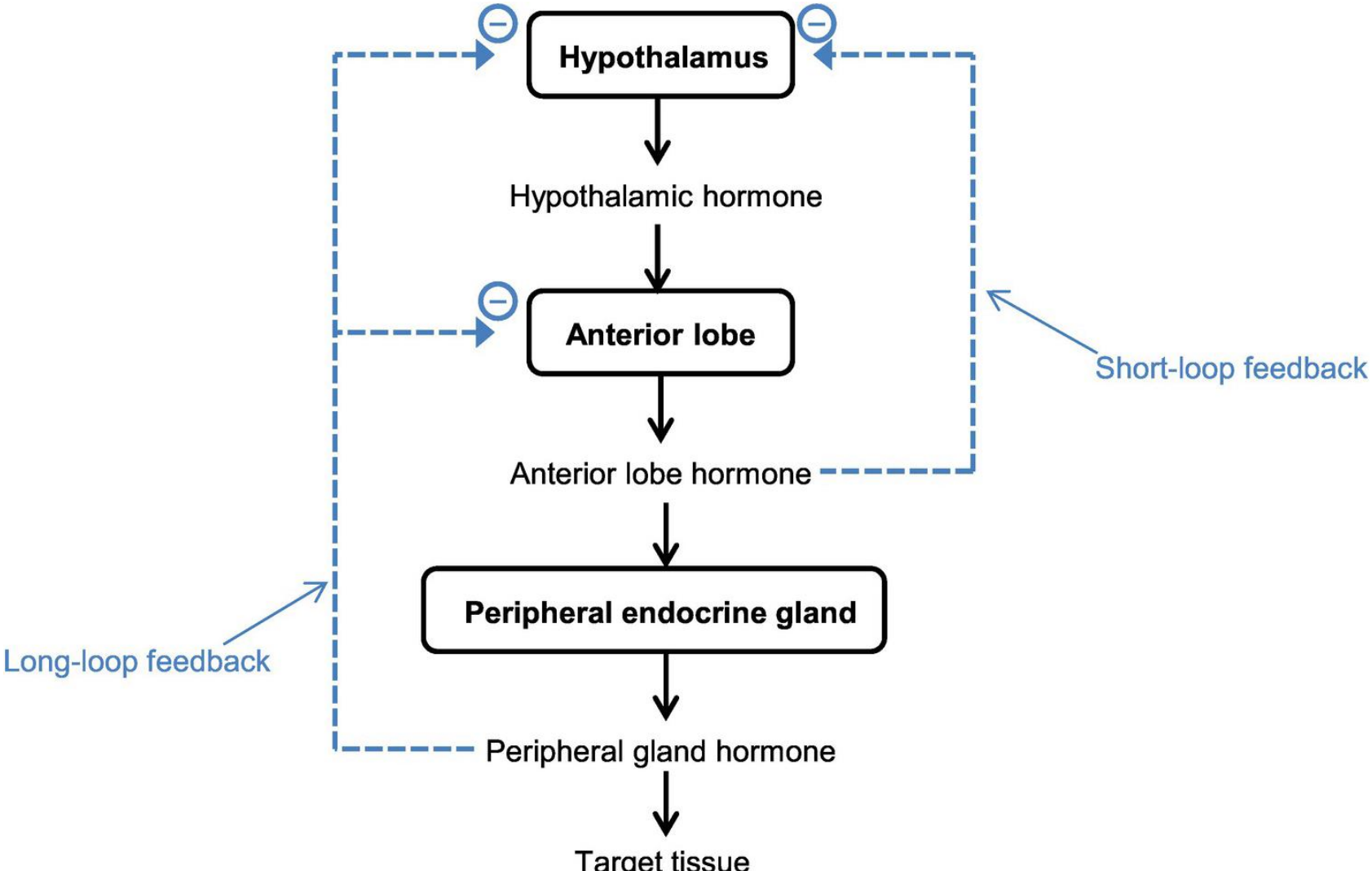
the testes and ovaries,

and the pancreas.


pineal gland
pituitary gland
parathyroid gland
thyroid gland
adrenal gland
pancreas
ovary
testis

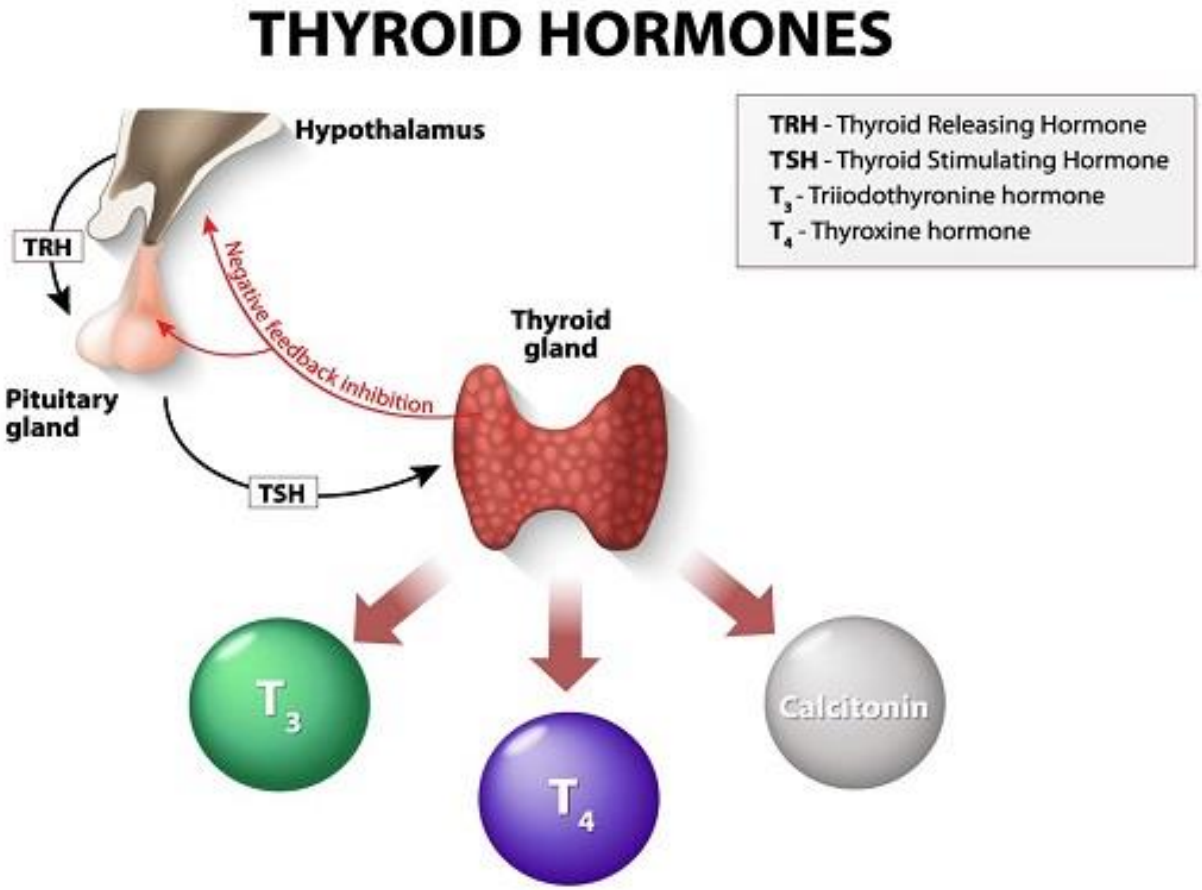
Feedback mechanism of endocrine system

In the endocrine system, feedback refers to the response of a target tissue after stimulation by a specific hormone that then influences the continued release of that hormone.



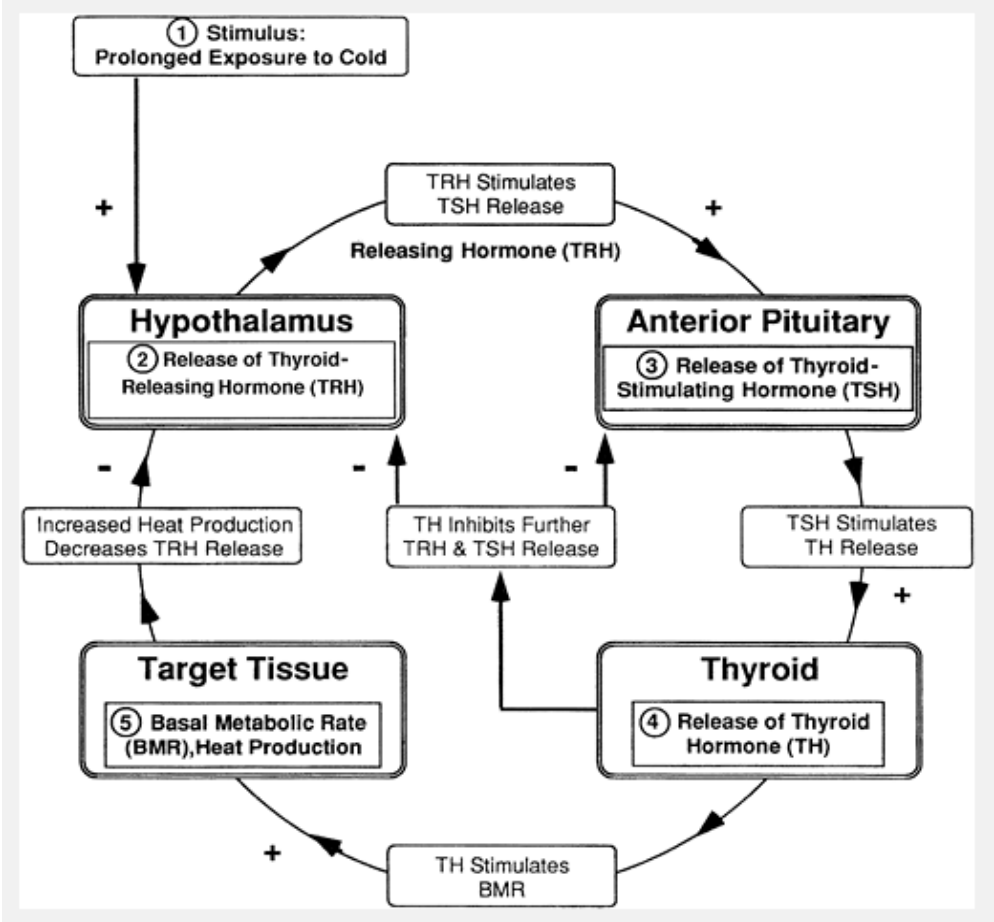
Thyroid Hormone

Thyroid hormone (TH) is an amine hormone synthesized and released from the thyroid gland (25 T3 and 75% T4) then T4 converted peripherally to T3 the more active form..



Effects of Thyroid Hormone

Target cells for TH include almost all cells of the body. The primary effect of TH is to stimulate the metabolic rate of all target cells by increasing the metabolism of protein, fat, and carbohydrate.



The stimuli responsible for increasing TRH secretion include exposure of the body to:

cold temperature, physical and perhaps psychological stress, and low levels of TH.

When the secretion of TRH is stimulated by cold temperature, the result is an increase in TH, which increases basal metabolic rate.

Effects of Thyroid Hormone

The thyroid hormone is essential to:

1- Normal body growth in infancy and childhood.

2- Controlling body temperature.

3- Regulating protein, fat and carbohydrate catabolism in all cells.

4- It keeps up growth hormone release, skeletal maturation, and heart rate ,force and output.

5- It promotes central nervous system growth.

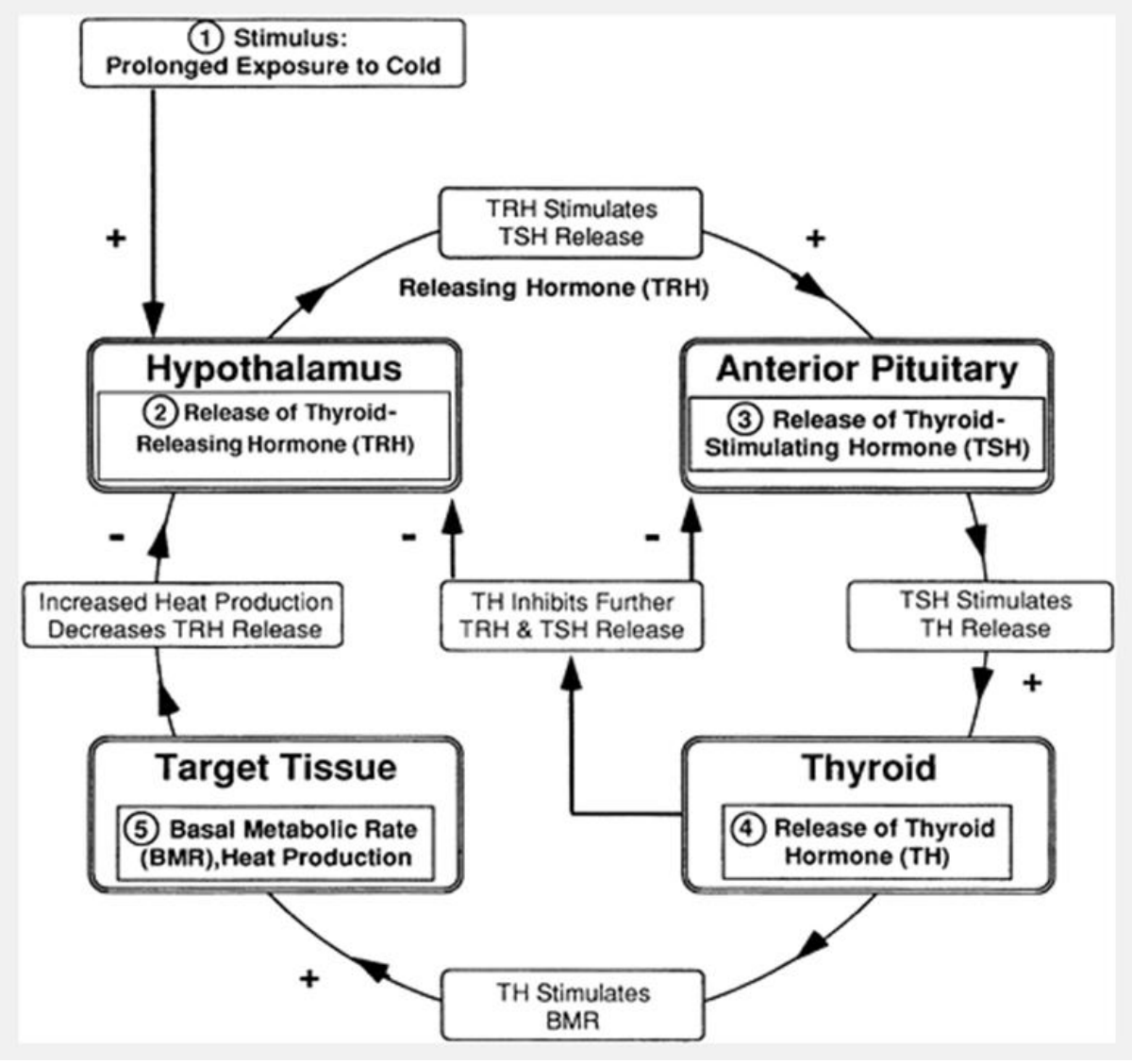
6- Stimulate synthesis of many enzymes.

7- Thyroid is necessary for muscle tone and vigor.

Disorders of thyroid function

Hypothyroidism: Hypothyroidism results from decreased levels of circulating thyroid hormone.

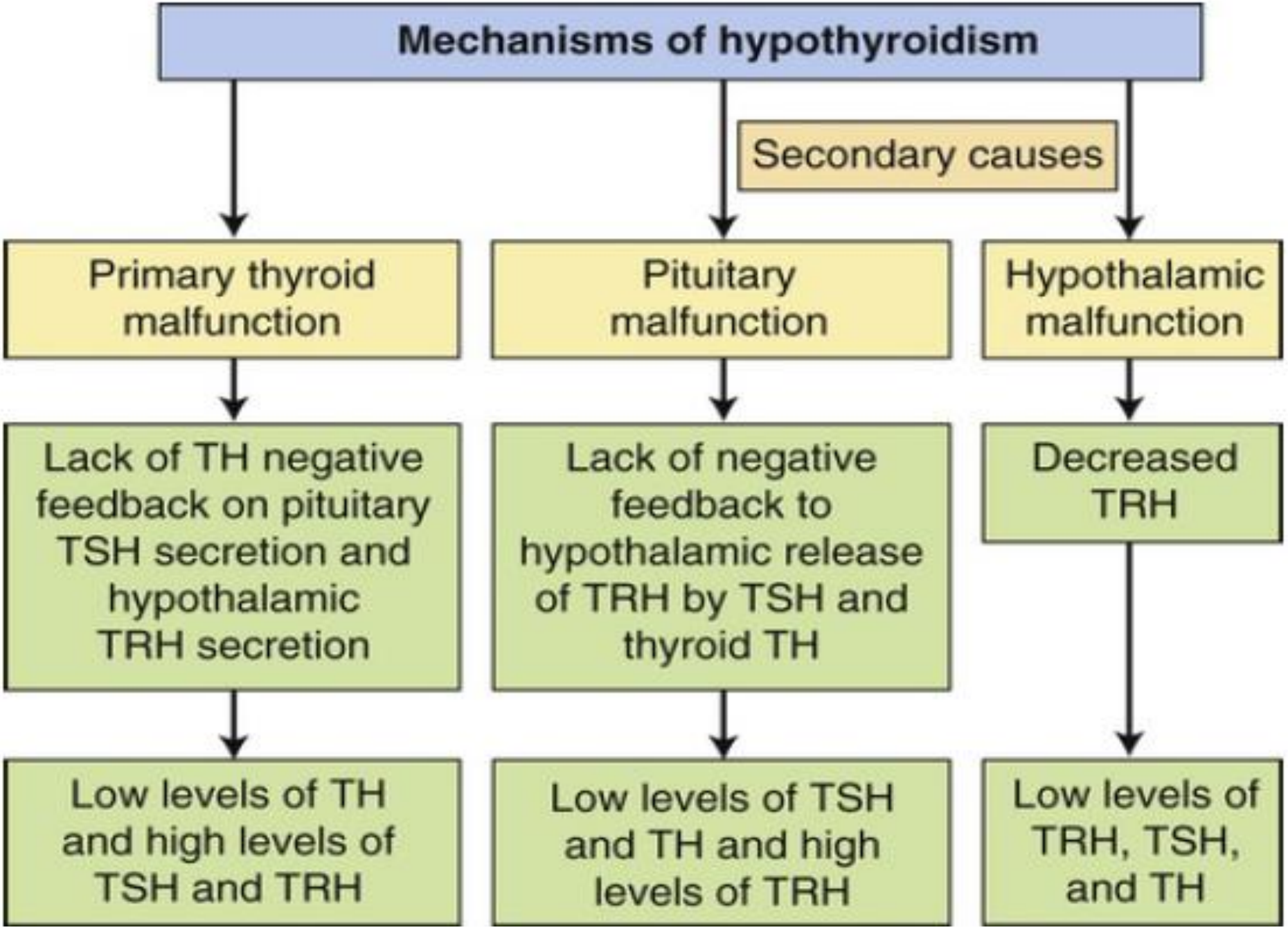
Hypothyroidism may result from malfunction of the thyroid gland, the pituitary, or the hypothalamus.



If it results from thyroid gland malfunction, low TH levels with high TSH and high TRH because of the lack of negative feedback on the pituitary and hypothalamus by TH.

If hypothyroidism results from pituitary malfunction, low levels of TH are caused by low TSH. TRH from the hypothalamus is high because there is no negative feedback on its release by TSH or TH.

Hypothyroidism caused by hypothalamic malfunction results in low TH, low TSH, and low TRH.


Mechanisms of hypothyroidism
Secondary causes
Primary thyroid malfunction
Pituitary malfunction
Hypothalamic malfunction
Lack of TH negative feedback on pituitary TSH secretion and hypothalamic TRH secretion
Lack of negative feedback to hypothalamic release of TRH by TSH and thyroid TH
Decreased TRH
Low levels of TH and high levels of TSH and TRH
Low levels of TSH and TH and high levels of TRH
Low levels of TRH, TSH, and TH

Diseases of Hypothyroidism

. **1- Hashimoto's disease**, also called autoimmune thyroiditis, results from autoantibody destruction of thyroid gland tissue. This results in decreased TH, with increased TSH and TRH levels caused by minimal negative feedback.

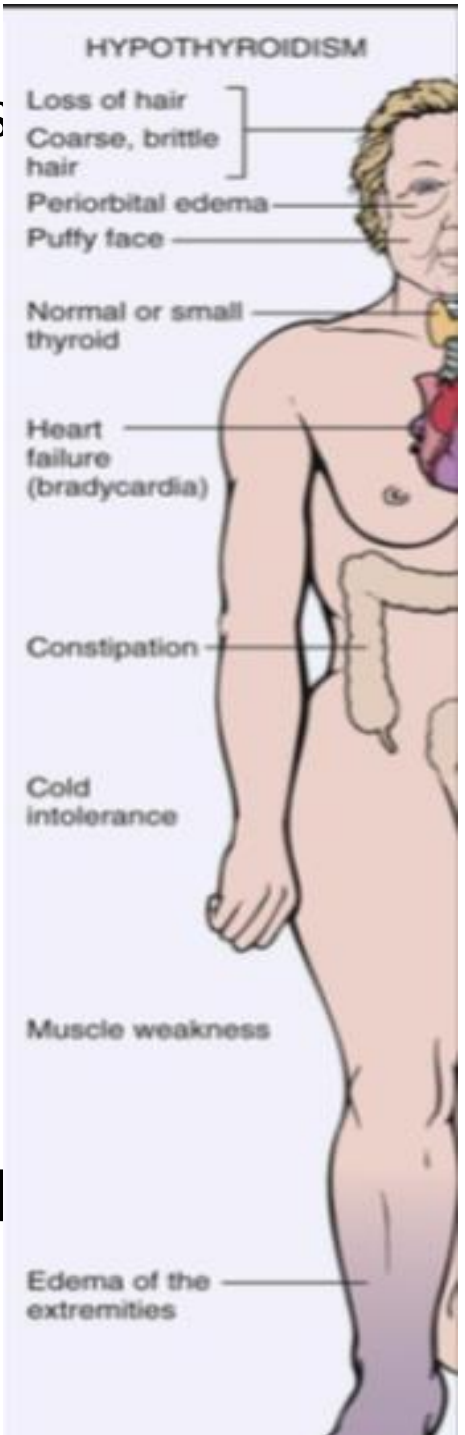
2- Thyroid carcinoma may cause hypothyroidism or hyperthyroidism.

- **3- Endemic goiter** is hypothyroidism caused by a dietary deficiency of iodide. A goiter is an enlargement of the thyroid gland.

Diagnosis: early change is T3 & T4 ↓ , TSH ↑, subclinical hypoth. Show normal T3 & T4, TSH ↑, & should be treated early before complications start.

Clinical Manifestations

- Sluggishness, slow thinking, slow movements
- Decreased heart rate and cardiac output, enlarged heart.
- Edema of the skin.
- Intolerance to cold temperatures.
- Decreased metabolic rate, decreased caloric requirements, decreased appetite and nutrient absorption across the gut.
- Constipation.
- Change in reproductive function.
- Dry, flaky skin and brittle, thin body and head hair.



Thyrotoxicosis

Thyrotoxicosis is a condition that results from any cause of increased TH levels.

Hyperthyroidism is a form of thyrotoxicosis in which excess amounts of TH are secreted from the thyroid gland.

Hyperthyroidism include Graves disease, toxic multinodular goiter.

Thyrotoxicosis not associated with hyperthyroidism like ingestion of excessive TH.

Diseases of Hyperthyroidism

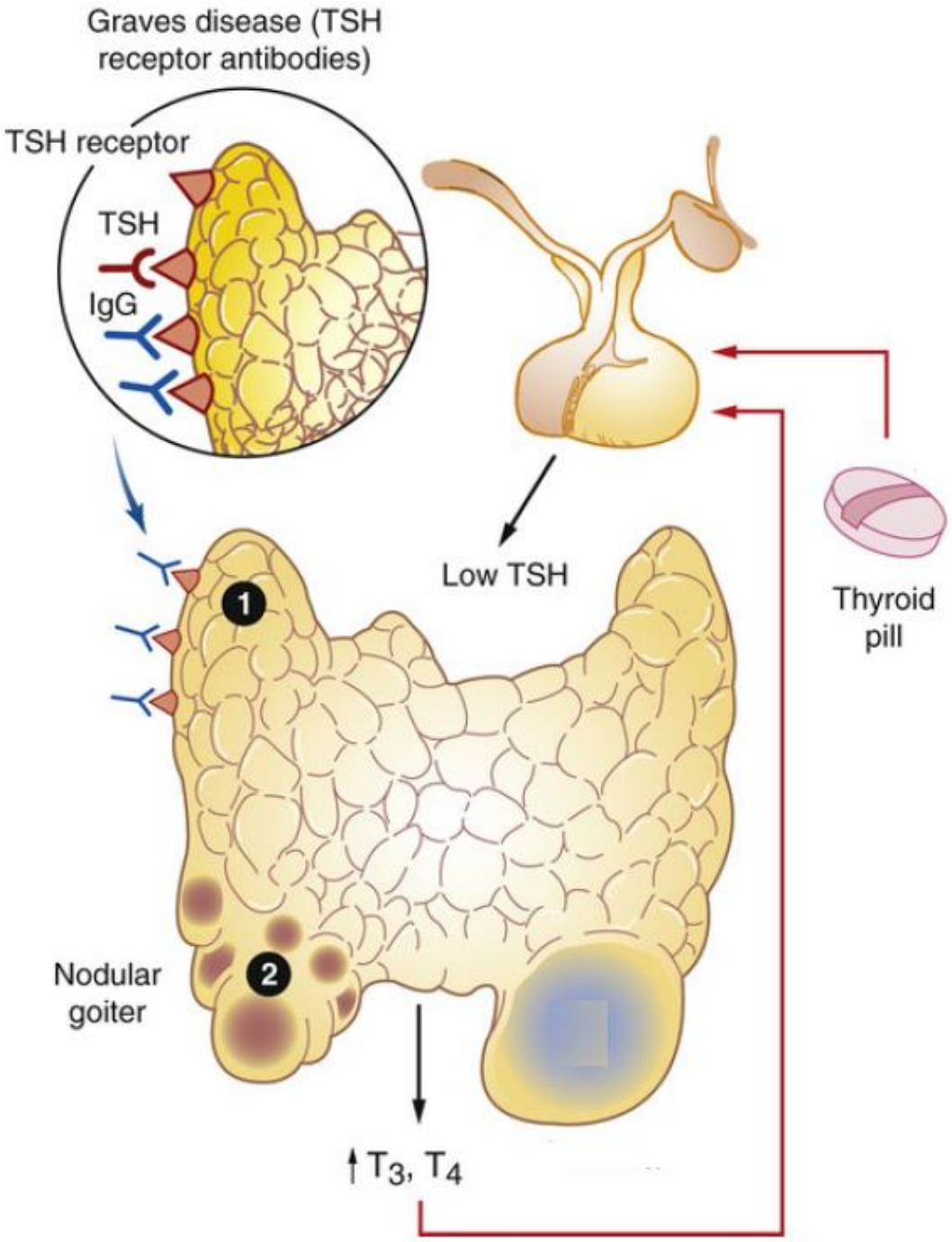
Graves' disease, the most common cause of hyperthyroidism, is an autoimmune disorder usually characterized by production of autoantibodies that mimic the action of TSH on the thyroid gland.

The cause of Graves' disease is unknown; however, there appears to be a genetic predisposition to autoimmune disease.

Women in their 20s and 30s are most often diagnosed, although the disease may start during the teen years.

These IgG autoantibodies, termed thyroid-stimulating immunoglobulins, turn on the production of TH, but are not inhibited by rising levels.

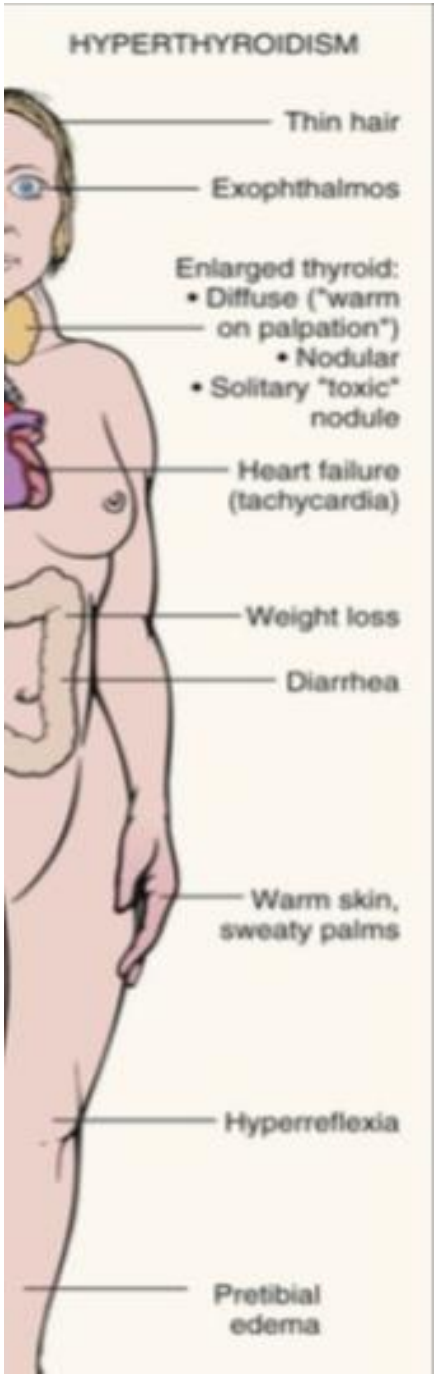
TSH and TRH levels are low because they are inhibited by high TH.



Clinical Manifestations

The clinical features of thyrotoxicosis are attributable to the metabolic effects of increased circulating levels of thyroid hormones.

- Increased heart rate.
- Increased muscle tone, tremors, irritability, increased sensitivity to catecholamines.
- Increased basal metabolic rate and heat production, intolerance to heat, excess sweating.
- Weight loss, increased hunger.



- A staring appearance.
- Exophthalmos (bulging of the eyes) may develop.
- Increased number of bowel movements.
- Goiter (usually).
- Changes in skin and hair condition may occur.
- Reproductive irregularities.

Complications

- Arrhythmias are common

Thyrotoxic crisis (thyroid storm) is a rare but dangerous worsening of the thyrotoxic state in which death can occur within 48 hours without treatment.

The systemic symptoms of thyrotoxic crisis include hyperthermia; tachycardia, especially atrial tachydysrhythmias; high-output heart failure; agitation or delirium; and nausea, vomiting, or diarrhea contributing to fluid volume depletion.

Reference: Corwin , Pathophysiology, 3rd Edition