



REGULATION OF THYROID HORMONES

OVERVIEW

- Thyroid hormones control metabolic activity; optimum level present at all times due to stringent feedback regulation.
- Triiodothyronine aka **T3** → potent and active.
- Thyroxine aka **T4** → less potent than T3.

Feedback mechanisms involving the **hypothalamus** and **anterior pituitary gland** control the rate of thyroid secretion.

REGULATION

- Thyroid stimulating hormone (**TSH**) aka **Thyrotropin** released from **ANTERIOR PITUITARY GLAND** → thyroid **follicular cells** → thyroid hormones secretion
- TSH, a **glycoprotein**, mediates its actions via **cAMP** on thyroid follicular cells → **proteolysis of thyroglobulin** (stored in these cells) → T3 and T4 release.
- Other effects of TSH on thyroid gland:
 - 1) Increased activity of the **iodide pump** → iodide trapping for hormone synthesis
 - 2) Increased **iodination of tyrosine** to form the thyroid hormones
 - 3) Increased gland size and vascularity

REGULATION

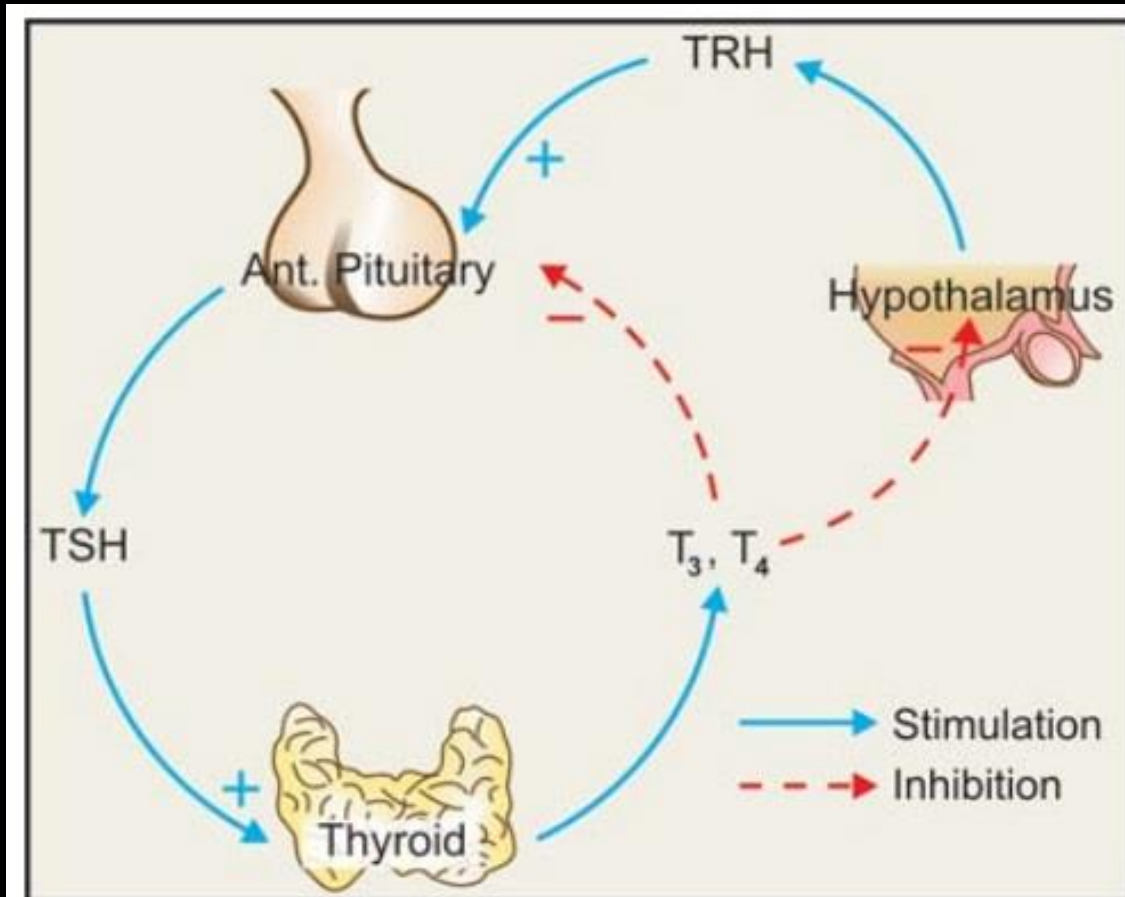
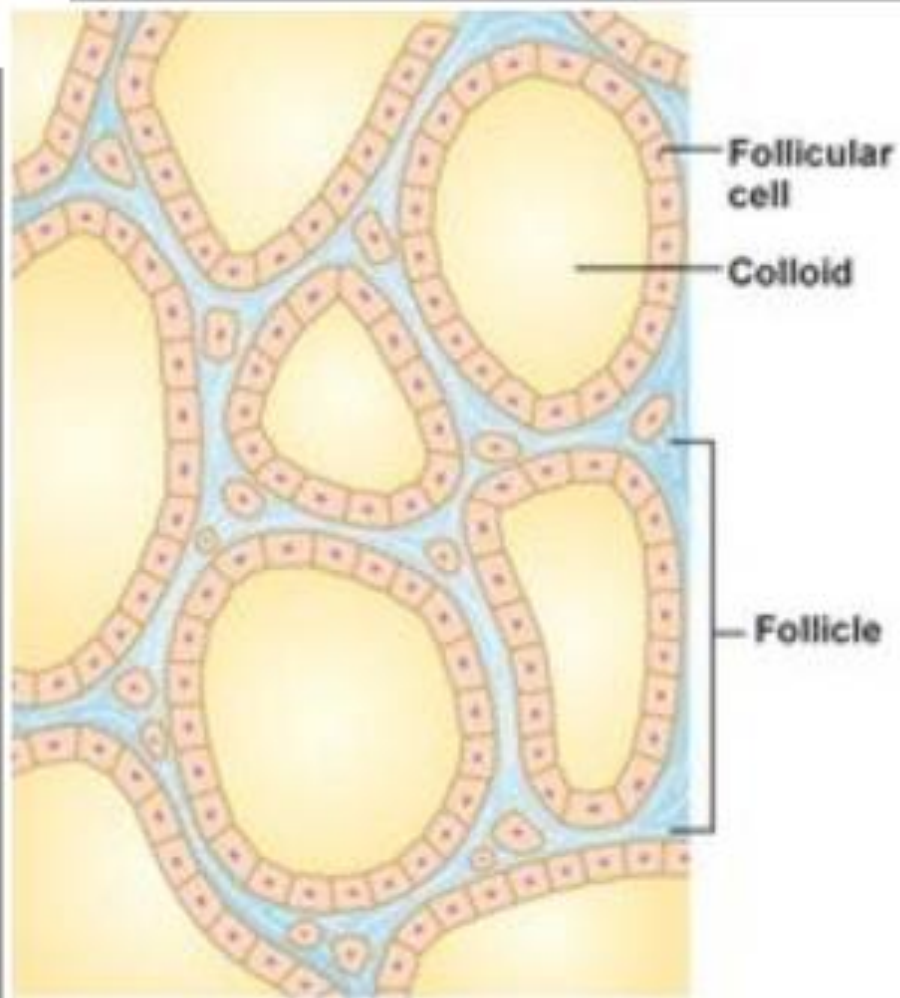


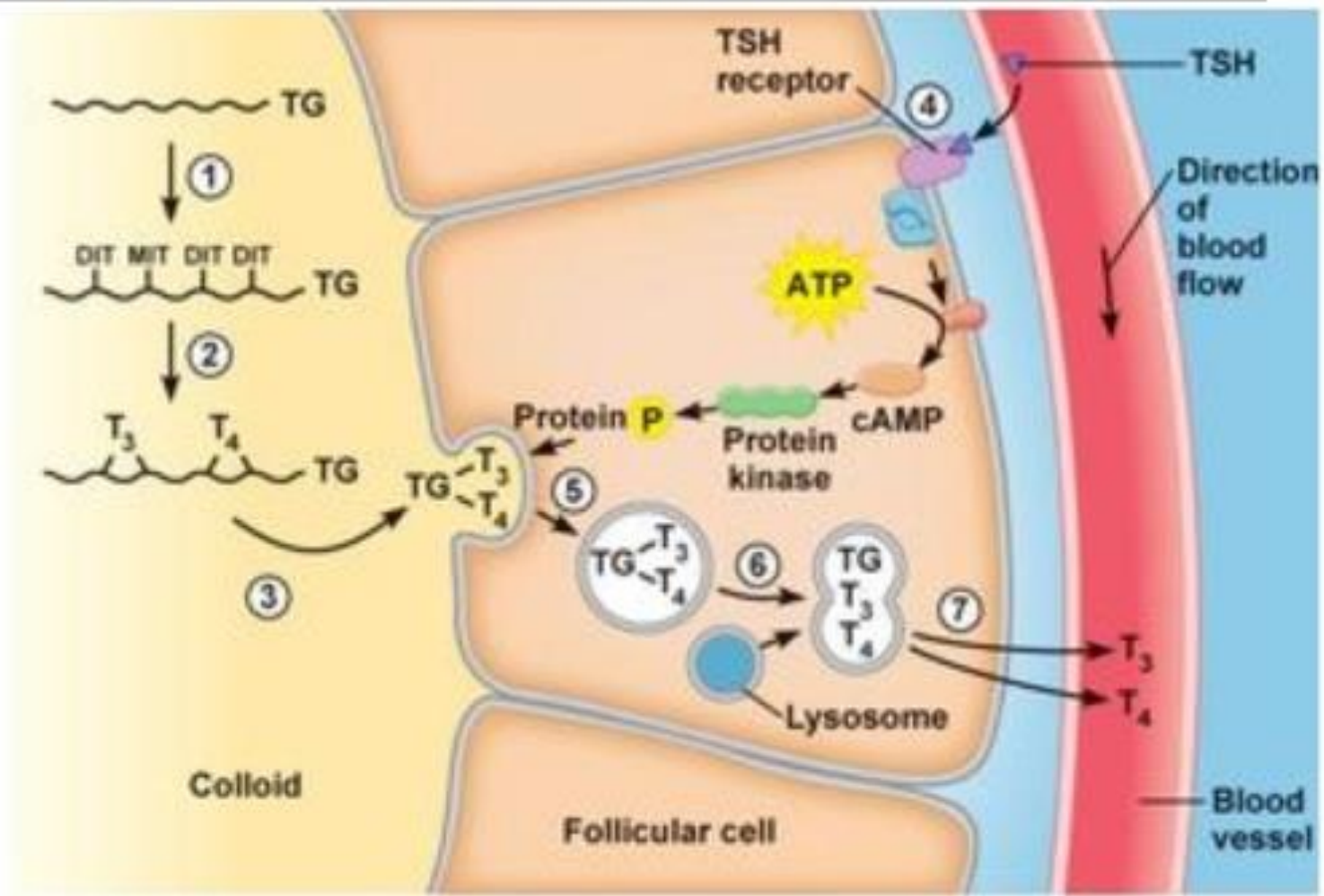
Fig. 18.3: Regulation of thyroid function

TSH—Thyroid stimulating hormone; TRH—Thyrotropin releasing hormone; T₃—Triiodothyronine; T₄—Thyroxine.

REGULATION



(a) Thyroid follicles



(b) Synthesis and secretion of thyroid hormones

REGULATION

- Anterior Pituitary secretion of TSH is regulated by **Thyrotropin releasing hormone (TRH)** from the **Hypothalamus**.
- TRH, synthesized by neurons in **paraventricular nucleus (PVN)** of hypothalamus.
- TRH → anterior pituitary gland via phospholipase c → secretes TSH → thyroid follicular cells → release thyroid hormones

REGULATION

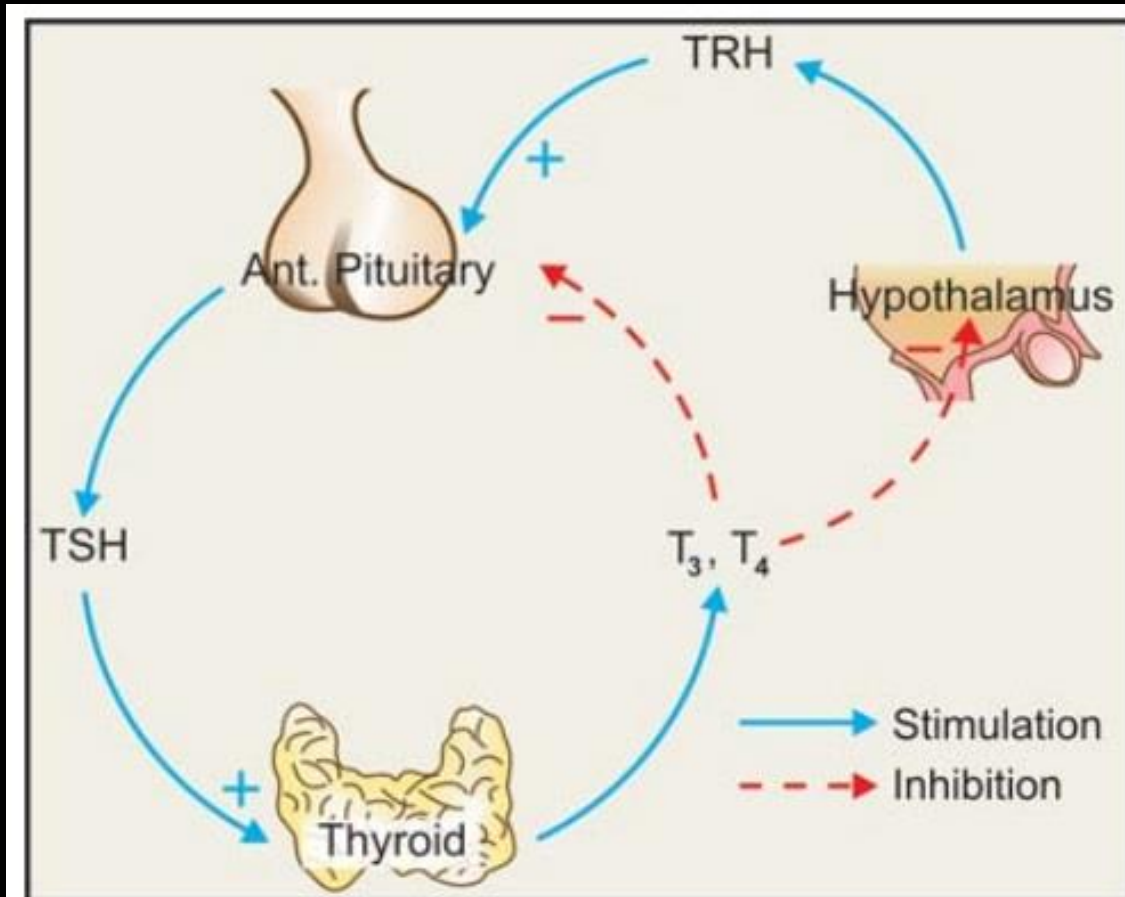


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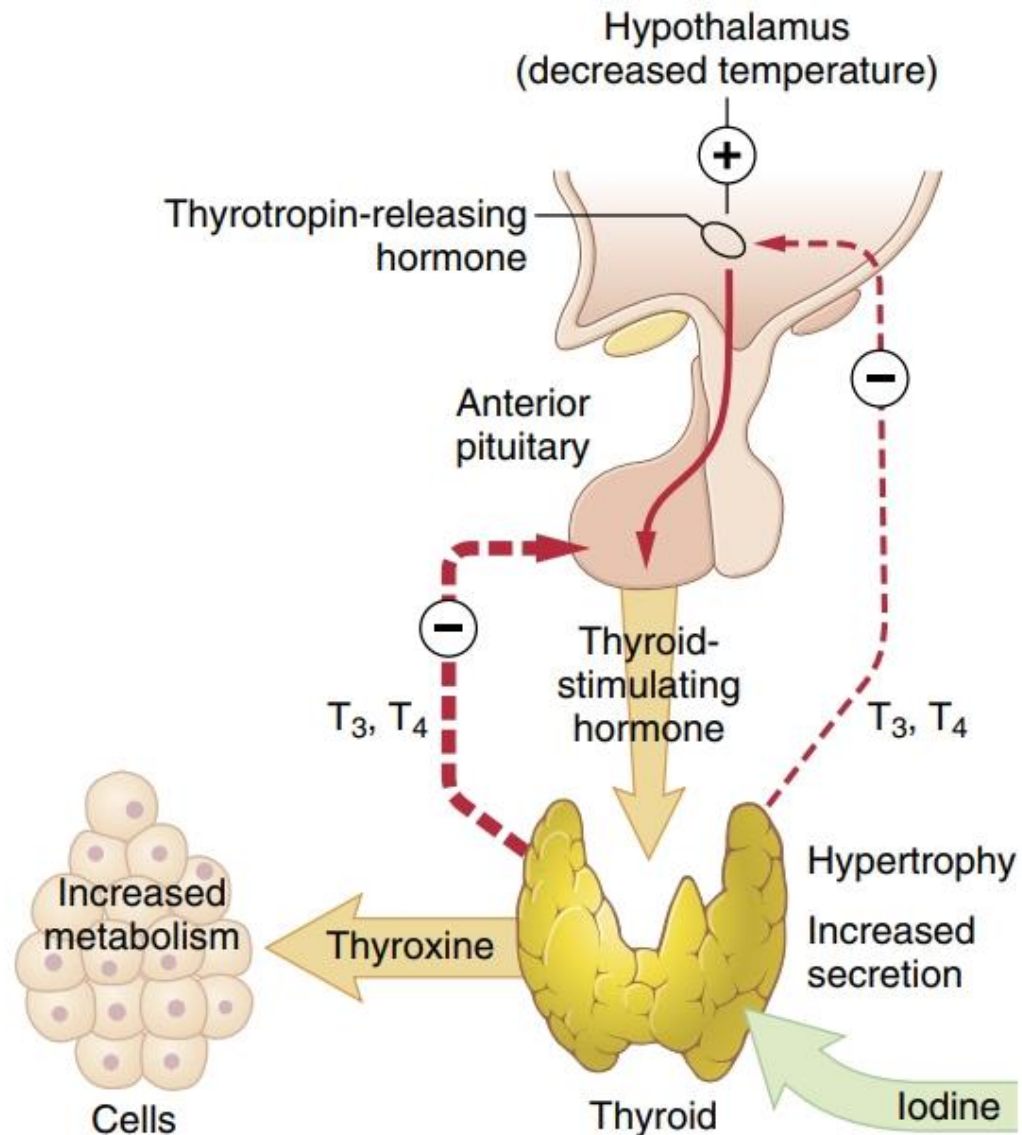


Figure 77-7 Regulation of thyroid secretion. T₃, triiodothyronine; T₄, thyroxine.

EFFECTS OF COLD AND OTHER NEUROGENIC STIMULI ON TRH AND TSH SECRETION

- **Cold exposure** → increase TRH and TSH secretion; person moving to colder climates (e.g. Arctic) will have increased BMR.
- Prolonged fasting → reduces plasma **leptin** (satiety hormone) levels
- Decreased levels of leptin may also directly inhibit **TRH neurons**.
- Together these effects reduce expression of **TRH, TSH, and thyroid hormone secretion** → reduced metabolic rate and conservation of energy when food supplies are scarce.
- Excitement and anxiety → sympathetic nervous system stimulation → acute decrease in secretion of TSH because these states increase the **metabolic rate and body heat** and therefore exert an inverse effect on the heat control center.

REGULATION

- Thyroid hormones exert a **negative feedback** effect on TRH and TSH secretion.

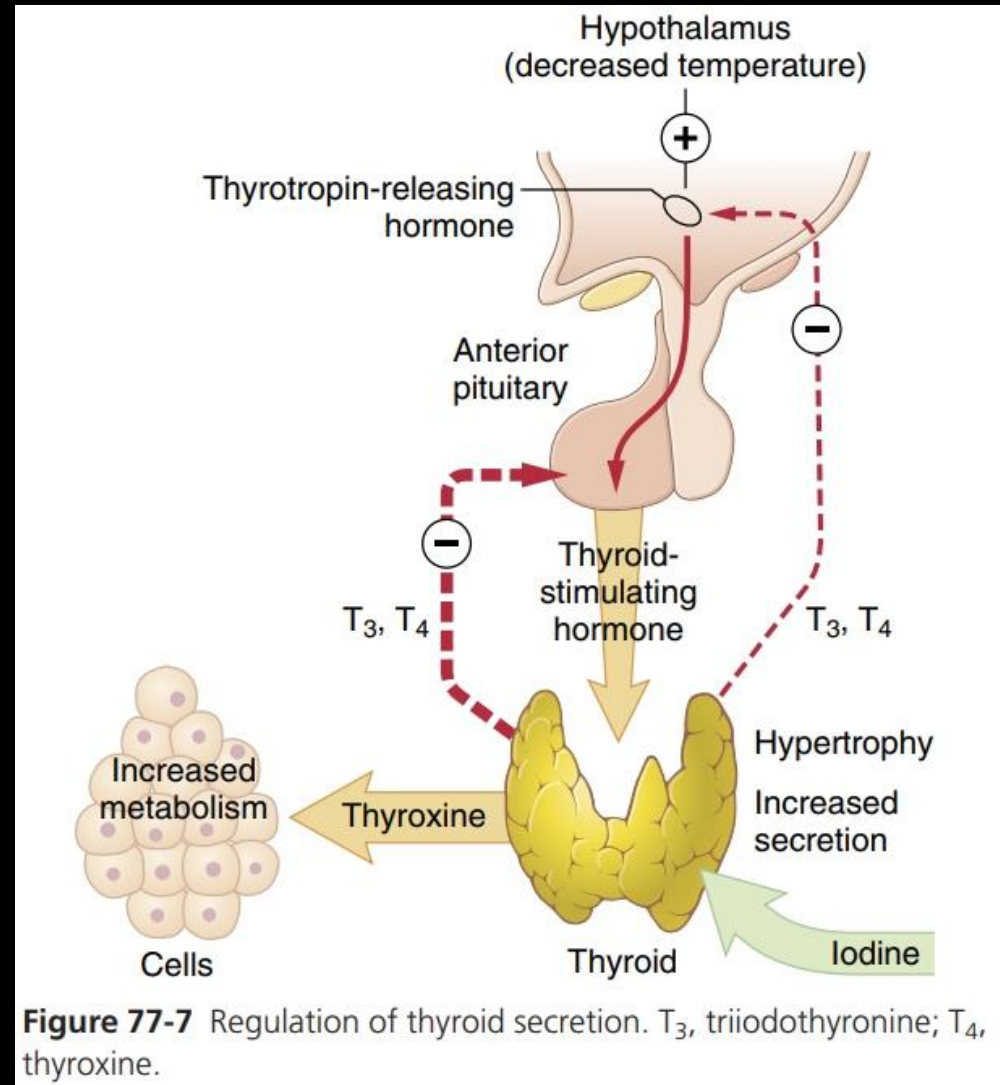
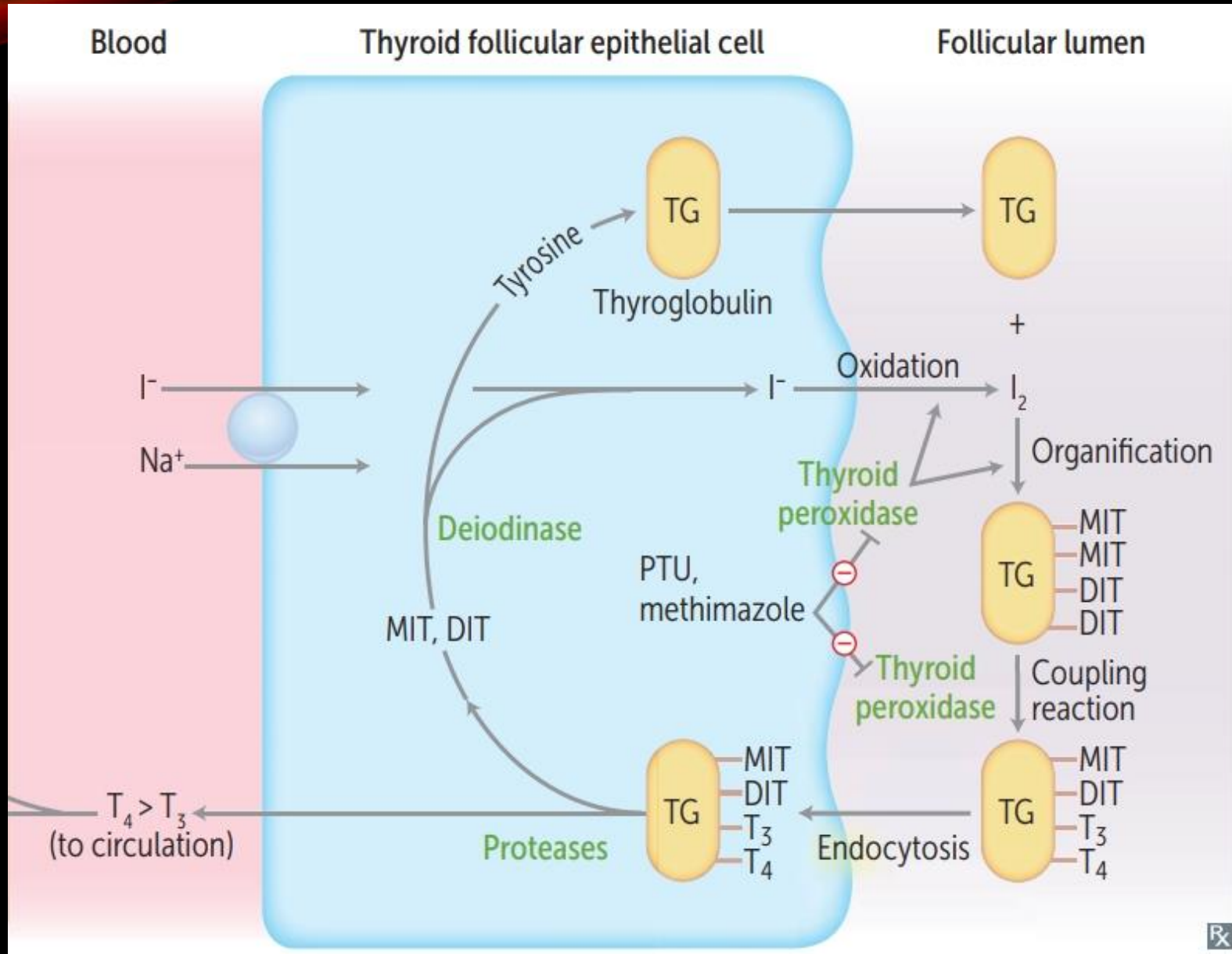


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ANTITHYROID SUBSTANCES SUPPRESS THYROID SECRETION

- The same active pump that transports **iodide ions** into the thyroid cells (**sodium iodide symporter; NIS**) can also pump **thiocyanate ions**, **perchlorate ions**, and **nitrate ions**.
- Administration of one of these ions → competes with iodide ion for this pump → no iodide is pumped into the cell → no thyroid hormone synthesis.

ANTITHYROID SUBSTANCES SUPPRESS THYROID SECRETION



EFFECT OF EXCESS IODIDE

- **Iodides in High Concentrations** Decrease Thyroid Activity and Thyroid Gland **Size** and its **blood supply**
- Given 2-3 weeks before thyroid surgery to decrease size of thyroid gland and minimize bleeding during surgery.
- **Nuclear accidents:** Give Iodide to inhibit **radiation induced damage** to thyroid gland and **thyroid cancer** → iodide competes with the radioactive iodine. **Chernobyl??**

JARED HARRIS
STELLAN SKARSGÅRD
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