

Endocrinology 3
Fox Chapter 11 part 3
Hypothalamic-Pituitary-Thyroid Axis

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Hypothalamic-Pituitary-Thyroid Axis

Hypothalamus secretes **Thyrotropin-Releasing Hormone (TRH)** into short portal vessels.

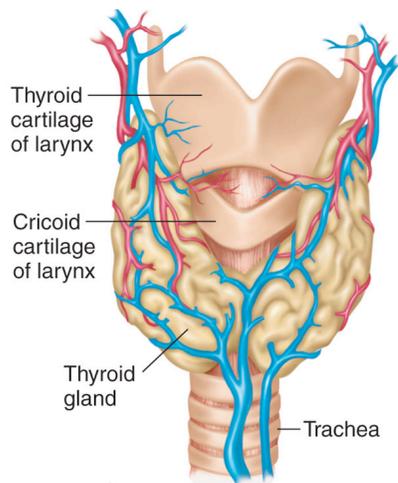
TRH stimulates thyrotroph cells in the pituitary to secrete **Thyroid-Stimulating Hormone (TSH)** into the blood

TSH stimulates **Thyroid Gland** to synthesize and release **thyroxine**.

Thyroxine (T₄) binds to nuclear thyroid hormone receptors to upregulate **metabolism**.

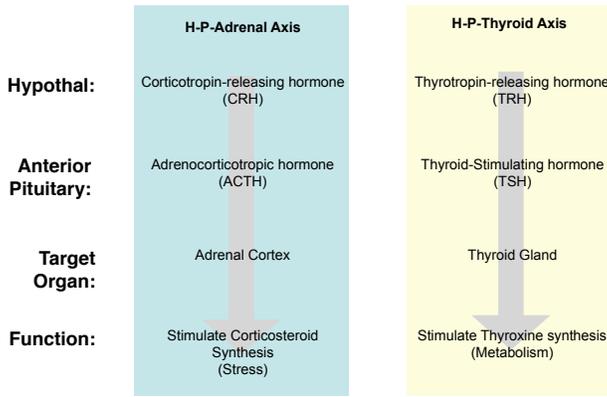
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Figure 11.21



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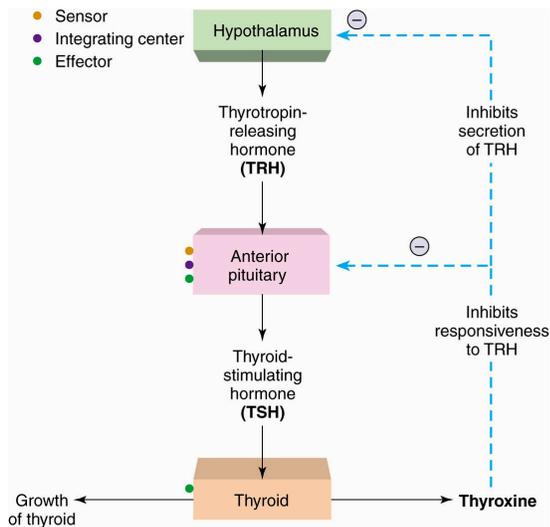
Examples of Hypothalamic Pituitary Axes



see Fox Table 11.6 & Table 11.7

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Figure 11.16



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Iodine & Thyroid Hormone Synthesis

Thyroid Gland:

Spherical follicles: **follicular cells** surrounding **colloid** (sticky glycoproteins).

Iodide (I⁻) concentrated in follicular cells by **Na⁺/I⁻ cotransporter**. I⁻ concentrated in colloid by transporter **pendrin**.

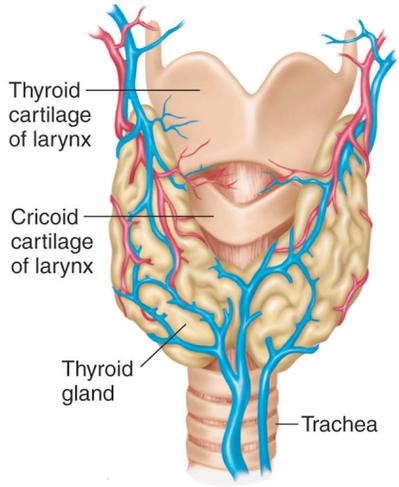
Synthetic enzymes and thyroglobulin secreted by follicular cells into colloid.

Thyroid peroxidase adds 1 or 2 iodine atoms to the amino acid tyrosine to form **monoiodotyrosine (MIT)** or **diiodotyrosine (DIT)**. MIT and DIT are coupled to form T₃ or T₄. (synthesis occurs while attached to thyroglobulin).

Thyroid Stimulating Hormone (TSH) causes follicular cells to take up thyroglobulin, hydrolyze and release T₃ and T₄ into blood.

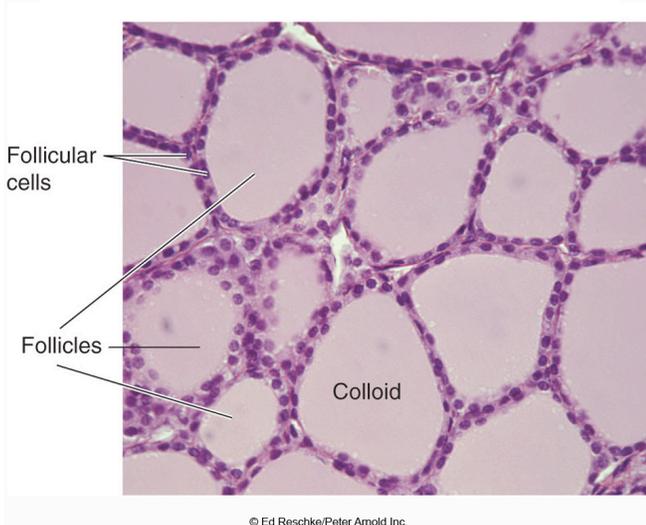
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Figure 11.21



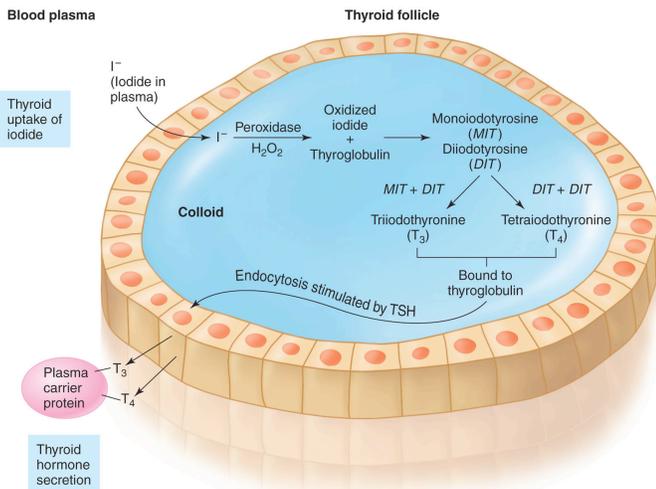
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Figure 11.22



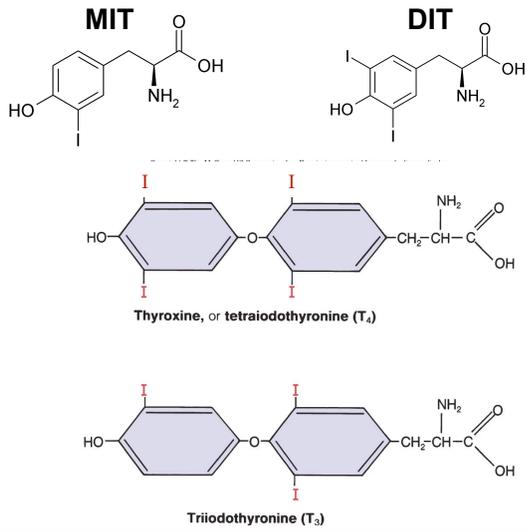
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Figure 11.23



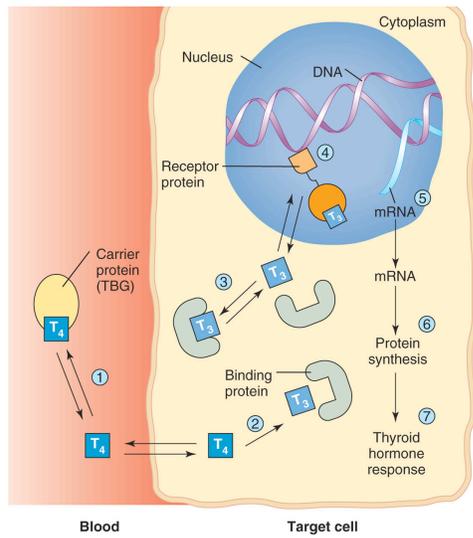
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T4 & T3 Thyroid Hormones



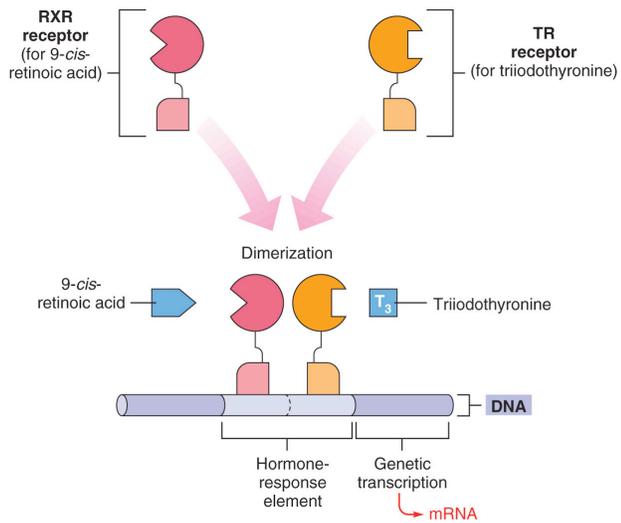
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Figure 11.6



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Figure 11.7



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Thyroid Diseases

Goiter: hypertrophy (excessive growth) of thyroid gland

Endemic Goiter:

Lack of iodine in diet (increased incident with distance from sea)

- > low levels of thyroxine
- > no negative feedback on pituitary
- > high levels of TSH

Hypothyroidism

Primary: thyroid gland defect.

Secondary: insufficient TSH, or insufficient iodine in diet.

Lethargy, low metabolic rate, weight gain, sensitive to cold stress.

Cretinism: mental retardation due to hypothyroidism during pregnancy and after birth.

Hyperthyroidism

Over stimulation of thyroid gland; thyroid gland tumor

Graves Disease: autoimmune disease

antibodies bind to TSH receptors on thyroid

- > activate thyroid (antibodies **not** controlled by negative feedback)
- > hypertrophy of thyroid and **hyperthyroxemia**
- > goiter and **exophthalmos**

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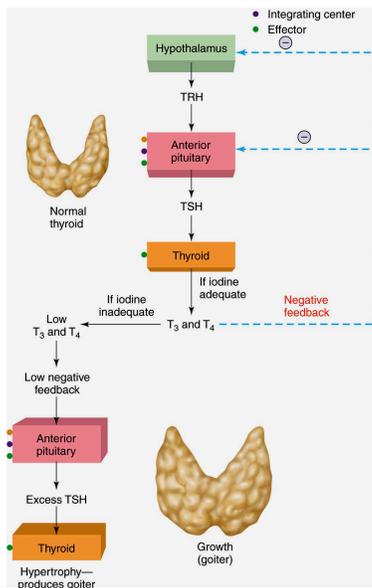


Figure 11.25

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Goiter



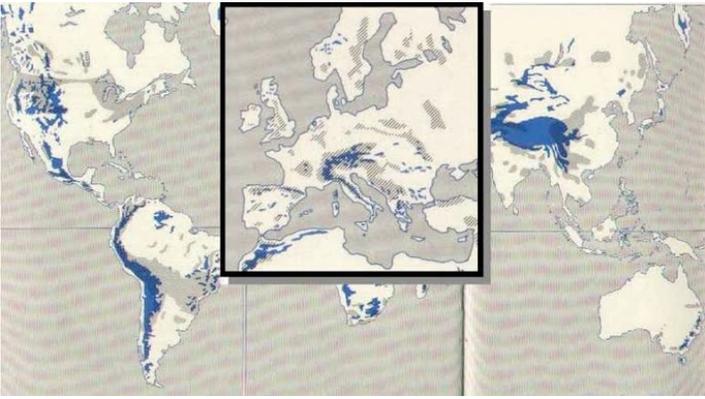
Many children in southern Albania, like this 12 year old girl from Korçe, have visible goiter.

http://www.icidd.org/media/IDD%20Newsletter/1991-2006/v22n1_0206.htm

Figure 11.24

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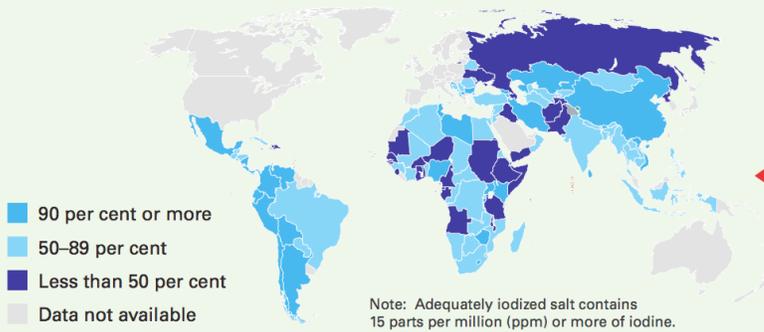
World map of prevalence of iodine-deficient goitre before iodine-prophylaxis



From Venturi 1985, <http://sites.google.com/site/iodinestudies/epi>

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FIGURE 3. Household consumption of adequately iodized salt, worldwide, 2000–2006



Source: United Nations Children's Fund, *Progress for Children: A World Fit for Children statistical review*, UNICEF, New York, December 2007, p. 8.

34 countries have reached the universal salt iodization goal

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Figure 11.26

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Table 11.8

Table 11.8 | Comparison of Hypothyroidism and Hyperthyroidism

Feature	Hypothyroid	Hyperthyroid
Growth and development	Impaired growth	Accelerated growth
Activity and sleep	Lethargy; increased sleep	Increased activity; decreased sleep
Temperature tolerance	Intolerance to cold	Intolerance to heat
Skin characteristics	Coarse, dry skin	Normal skin
Perspiration	Absent	Excessive
Pulse	Slow	Rapid
Gastrointestinal symptoms	Constipation; decreased appetite; increased weight	Frequent bowel movements; increased appetite; decreased weight
Reflexes	Slow	Rapid
Psychological aspects	Depression and apathy	Nervous, "emotional" state
Plasma T_4 levels	Decreased	Increased

Hypothyroid Treatment: Iodized salt, T4 injections

Hyperthyroid Treatment: radioactive Iodine to kill thyroid gland cells