

The Endocrine System

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The Endocrine System: An Overview

- ◆ A system of ductless glands
 - Secrete messenger molecules called **hormones** into the bloodstream
- ◆ Interacts closely with the nervous system
 - It is lower than the nervous system
- ◆ **Endocrinology**
 - Study of hormones and endocrine glands

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The Endocrine System: An Overview

- ◆ Endocrine system – all endocrine glands that are in the body
 - Overseen by the hypothalamus
- ◆ Hormone – chemical messenger that regulates activity of other body cells

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The Endocrine System: An Overview

- ◆ Hormone levels are constantly adjusted by feedback loops
 - **Negative feedback loop:** a stimulus causes an endocrine organ to release hormones
 - The hormone helps bring the body back to homeostasis
 - Once homeostasis is achieved, the hormone release stops

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Endocrine Organs

- ◆ Scattered throughout the body
- ◆ Pure endocrine organs
 - Pituitary, pineal, thyroid, parathyroid, and adrenal glands
- ◆ Organs containing endocrine cells
 - Pancreas, thymus, gonads, and the hypothalamus

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The Major Endocrine Glands

The diagram shows a human figure with various endocrine glands highlighted and labeled. The glands are: Pineal gland (in the brain), Hypothalamus (in the brain), Pituitary gland (below the hypothalamus), Thyroid gland (in the neck), Parathyroid glands (four small spots on the thyroid gland), Thymus (in the upper chest area), Adrenal glands (two glands, each sitting atop a kidney), Pancreas (in the abdominal area), Ovary (female) (in the female pelvic region), and Testis (male) (in the male pelvic region).

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Hormones

- ◆ Classes of hormones
 - Amino acid-based hormones
 - Steroids – derived from cholesterol
 - What happens to people taking Lipitor?
- ◆ Basic hormone action
 - Circulate throughout the body in blood vessels
 - Influences only specific tissues – **target cells**
 - A hormone can have different effects on different target cells

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Control of Hormone Secretion

- ◆ Always controlled by feedback loops
 - Blood concentration declines below a minimum
 - More hormone is secreted
 - Blood concentration exceeds maximum
 - Hormone production is halted

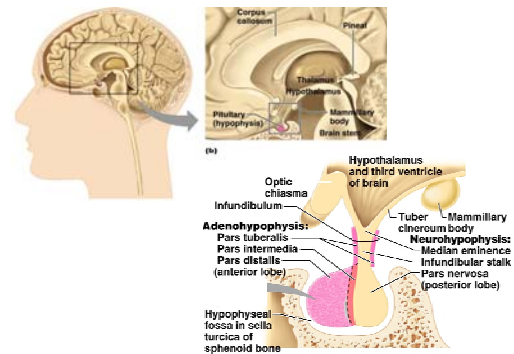
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The Pituitary Gland (Hypophysis)

- ◆ Secretes nine major hormones
- ◆ Attached to the hypothalamus by the infundibulum
- ◆ Two basic divisions of the pituitary gland
 - Adenohypophysis (Anterior Pituitary)
 - Neurohypophysis (Posterior Pituitary)

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The Pituitary Gland



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The Anterior Pituitary

Contains 7 different hormones

1. Growth Hormone (GH)
 - Stimulates cell growth & mitosis in most cells
2. Thyroid Stimulating Hormone (TSH)
 - Targets the thyroid gland
 - Stimulates thyroid to produce/release its own hormones

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The Anterior Pituitary

3. Adrenocorticotropic Hormone (ACTH)
 - Targets the adrenal cortex
 - Stimulates adrenal cortex to release its own hormones
4. Melanocyte stimulating hormone (MSH)
 - Targets melanocytes
 - Stimulates melanin production

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The Anterior Pituitary

5. Follicle Stimulating Hormone (FSH)
 - Targets the gonads (ovaries and testes)
6. Luteinizing Hormone (LH)
 - Targets ovaries and testes
7. Prolactin (PRL)
 - Targets mammary glands
 - Stimulates breast milk production

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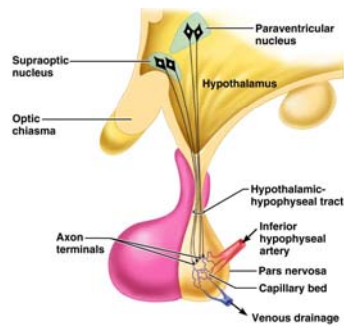
Hypothalamus & Anterior Pituitary

- ◆ Hypothalamus
 - Regulates secretion of hormones
 - Secretes **releasing factors** to release hormones
 - Secretes **inhibiting hormones** to turn off secretion of hormones

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The Posterior Pituitary

- ◆ Structurally part of the brain



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The Posterior Pituitary

- Secretes two hormones
 1. Antidiuretic hormone (ADH)
 - Targets the kidneys
 - Inhibits urine formation/production
 2. Oxytocin
 - Stimulates uterine contractions
 - Stimulates milk release
 - In males: stimulates smooth muscle contraction in reproductive tract

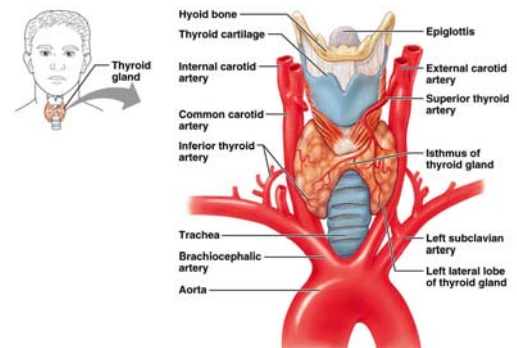
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The Thyroid Gland

- ◆ Located in the anterior neck
 - In front of trachea & below larynx
- ◆ Largest pure endocrine gland
- ◆ Produces two hormones
 - Thyroid hormone (TH) – increases cellular activity in most cells of the body
 - Calcitonin – causes calcium & phosphorus FROM bloodstream to be deposited into bone tissue (Lowers blood calcium)

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The Thyroid Gland



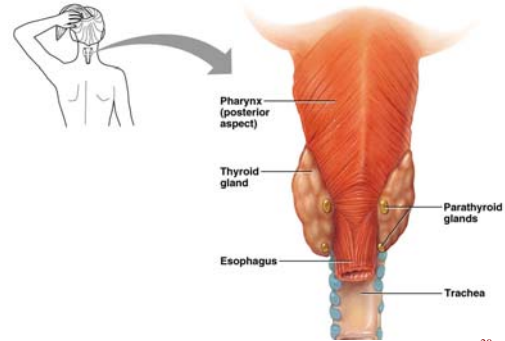
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The Parathyroid Gland

- ◆ 4 tiny oval masses that lie on the posterior surface of the thyroid gland
 - Produce parathyroid hormone (PTH)
 - Increases blood concentration of Ca^{2+}

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The Parathyroid Gland



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The Adrenal Medulla

- ◆ Secretes catecholamines
 - Epinephrine (adrenaline)
 - Norepinephrine (noradrenaline)
- ◆ Active in “fight or flight” response

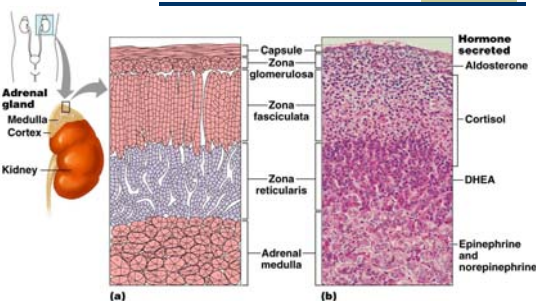
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The Adrenal Cortex

- ◆ Secretes a variety of hormones
 - All are steroids
- ◆ Cortex is composed of three layers
 - Zona glomerulosa
 - Zona fasciculata
 - Zona reticularis

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The Adrenal Gland



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Adrenal Corticosteroids

- Body's major source of steroid hormones
1. Mineralocorticoids
 - Aldosterone (Main mineralocorticoid)
 - Controls balance of sodium (Na^+) and potassium (K^+) ions in body fluids

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Adrenal Corticosteroids

2. Glucocorticoids

- Cortisol – helps body deal with stress
 - Fasting, anxiety, trauma, infection
- DHEA (dehydroepiandrosterone)
 - Converts to sex hormones

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The Pineal Gland

- ◆ Located on the roof of the diencephalon
- ◆ Shaped like a pinecone
- ◆ “Pineal sand” is radiopaque
 - Used as a landmark to identify other brain structures in X-Rays
- ◆ Pinealocytes secrete **melatonin**
 - A hormone that regulates circadian rhythms

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The Pancreas

- ◆ Located in the posterior abdominal wall
- ◆ Contains endocrine and exocrine cells
 - Exocrine cells
 - Acinar cells – secrete digestive enzymes
 - Endocrine cells
 - Pancreatic islets – islets of Langerhans
 - About one million islets – scattered throughout the pancreas

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The Pancreas

- ◆ Main endocrine cell types
 - **Alpha cells** (α cells) – secrete glucagon
 - Signals liver to release glucose from glycogen
 - Raises blood sugar
 - **Beta cells** (β cells) – secrete insulin
 - Signals most body cells to take up glucose from the blood
 - Promotes storage of glucose as glycogen
 - Lowers blood sugar

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The Thymus

- ◆ Located in the lower neck and anterior thorax
- ◆ Important immune organ
- ◆ Site at which T-lymphocytes mature

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The Gonads

- ◆ Main sources of sex hormones
 - Testes and ovaries
- ◆ Male
 - Interstitial cells secrete androgens
 - Primarily testosterone
 - Promotes the formation of sperm
 - Maintains secondary sex characteristics

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The Gonads

- ◆ Female
 - Ovaries
- ◆ Androgens secreted by the **theca folliculi**
 - Converted to estrogen
 - Estrogen
 - ◆ Maintains secondary sex characteristics
 - Progesterone
 - ◆ Prepares the uterus for pregnancy

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Disorders of the Pancreas: Diabetes Mellitus

- ◆ Caused by
 - Insufficient secretion of insulin
 - Resistance of body cells to the effects of insulin
- ◆ **Type 1 diabetes**
 - Develops suddenly, usually before age 15
 - T cell-mediated autoimmune response destroys beta cells

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Diabetes Mellitus

- ◆ **Type 2 diabetes**
 - Adult onset
 - Usually occurs after age 40
 - Cells have lowered sensitivity to insulin
 - Controlled by dietary changes, regular exercise & supplementation to resensitize the cells of the body to insulin

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