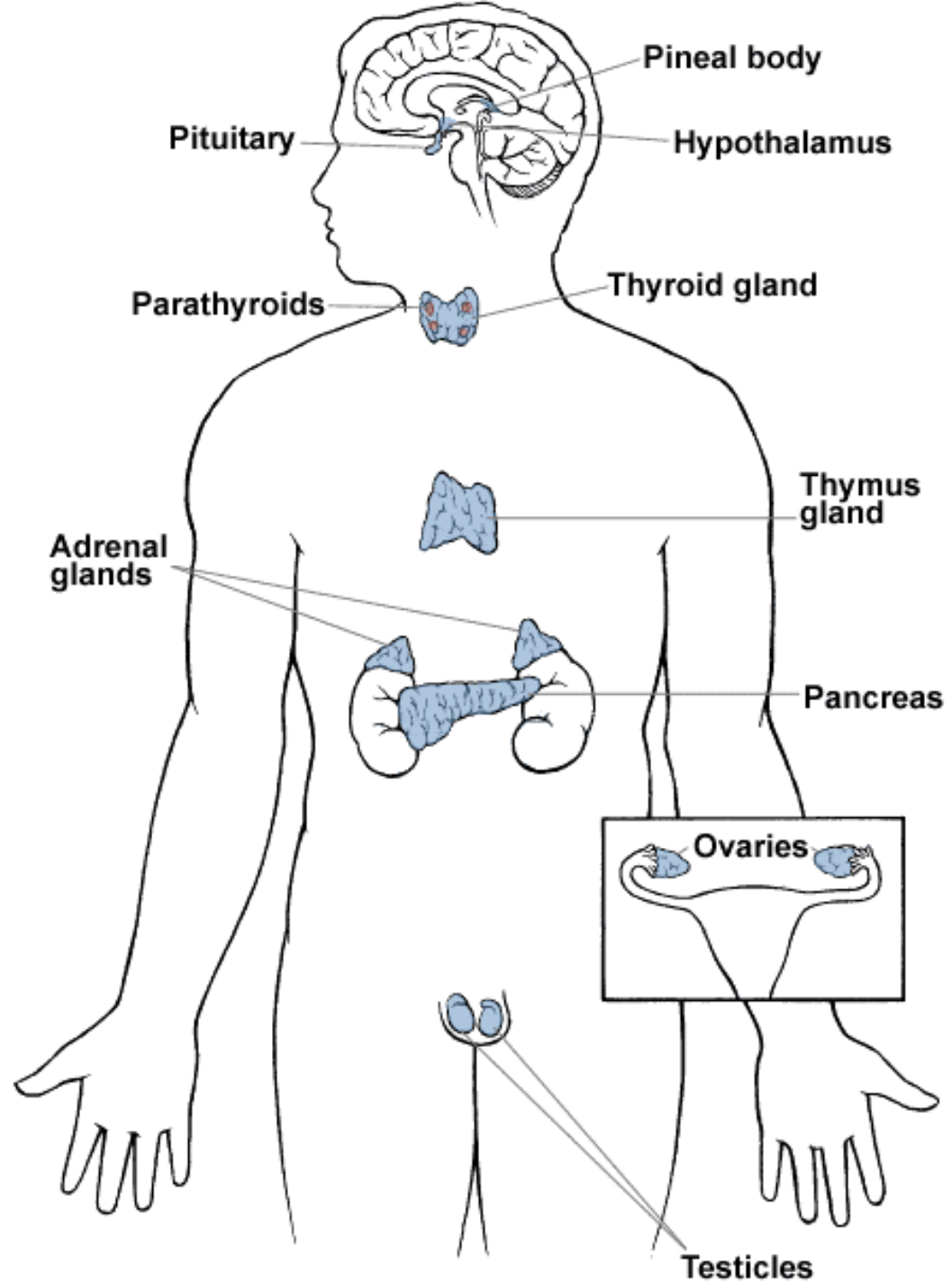


Endocrine System



Endocrine Function = coordinates and controls the body with hormones

- Homeostasis is the tendency to maintain a stable internal environment.
- Endocrine—parts of the body that secrete hormones directly into the body.
- Exocrine—parts of the body that make secretions which travel through tubes to the outside of the body.

Purpose of the endocrine system:

- Works with nervous system to coordinate and direct activities of the body
- Helps maintain homeostasis by regulating the following:
 - H₂O/electrolyte balances, reproductive processes, material transport, and metabolic processes
- Does this by producing hormones and moving them throughout the body

Endocrine Anatomy

Location:

- Small areas of endocrine tissue found throughout the body

Hormones:

- Chemical substance that is produced and secreted by cells that has a specified effect on other cells
- A given hormone only acts on a specific target cell or organ (contain special receptors)
- Hormones are released into the extracellular space and are then transported to the area in which it is needed

Types of Hormones

Steroid Hormones

- Formed of cholesterol they are soluble in lipids, giving them easy access to cells they are activating.
- Responsible for triggering the manufacture of many proteins
- May speed or slow processes in the body
- Ex) sex hormones

Types of Hormones

Non-steroid Hormones

- Consists of many types of hormones that need assistance in entering cells
- May cause a secondary reaction that will eventually lead to the production of proteins or secretions of other hormones

Types of Hormones

Prostaglandins

- Similar to hormones – modified fatty acids
- Regulate processes on a local level and are produced when it is needed
- Many times these are responsible for triggering the use of other hormones

Mechanism of Hormone Activity

- One or more of the following occurs when a hormone binds to a cell:
 - Changes in membrane permeability or electrical state
 - Synthesis of proteins or certain regulatory molecules (enzymes)
 - Activation or inactivation of enzymes
 - Stimulation of mitosis

Steroidal Hormones

- Diffuse across cell membrane into cell
- Enters nucleus
- Binds to specific receptor proteins
- Binds to DNA
- Activates certain genes to transcribe into RNA
- RNA leaves nucleus and makes a protein in the ribosome

Non-steroidal Hormones

- Binds to receptors on cell membrane
- Sets off a series of reactions that activates enzymes
- Enzymes cause production of second messenger
- Second messenger causes additional changes to promote the typical reaction by the cell

Hormonal Secretions

- Hormones are potent and powerful substances working in very small amounts so your body must have an accurate way of determining how much is needed and when.
- What prompts the endocrine glands to release or not release their hormones?

- *Negative Feedback System*—the need for a particular hormone is sensed and the gland in charge of regulating that need goes into action. Once the need is met the gland stops. If the action of the hormone acts in the opposite direction of the need it is considered a negative feedback.

Three categories of endocrine stimulation:

- Hormonal stimulus – endocrine organs are prodded into action by other hormones
 - Ex) Hypothalamic hormones activate the anterior pituitary hormones
- Humeral stimulus – changes in blood levels of certain chemicals
 - Ex) release of parathyroid hormone is triggered by low blood calcium levels
- Neural stimulus – nerve fibers stimulate hormone release
 - Ex) sympathetic nervous system releases norepinephrine during times of stress

Actions of Major Glands

Pituitary Gland

- **Pituitary**: “master gland” connected to the base of the hypothalamus. It is formed of two lobes the anterior and posterior.
- ***Anterior*** - the anterior pituitary is controlled by hormones that are released by the hypothalamus. These hormones travel to the pituitary through the hypophyseal portal vein
 - All hormones are proteins, act through second messengers, and regulate by hormonal stimuli

- *Growth hormone (GH)* – GH controls growth of skeletal muscles and long bones
 - Release of GH is controlled by either GH releasing hormone or GH inhibiting hormone, both of the hypothalamus
- *Prolactin (PRL)* - causes the continuing production of milk after birth. It is activated by the hypothalamus hormones.

- *Thyroid-stimulating hormone (TSH)* - controls the secretions of the thyroid. It is activated by both the hypothalamus and thyroxine in blood.
- *Adrenocorticotrophic Hormone (ACTH)* – controls secretions of the adrenal cortex
 - Stress and the hypothalamus control the release of this hormone

- Gonadotropic hormones – *Follicle Stimulating hormone (FSH)* and *Luteinizing hormone (LH)* - control the gonads or sex organs and activated by hypothalamus hormones
 - Females: produces estrogen, readies eggs for ovulation
 - Males: produces testosterone, sperm development

- Disorders:
 - Pituitary dwarfism – hyposecretion of GH during childhood
 - Gigantism – hypersecretion of GH

- ***Posterior*** - the posterior pituitary is controlled by nervous messages coming in from the hypothalamus.
- *Antidiuretic Hormone (ADH)* - formed in the hypothalamus and moves to the pituitary for secretion. Functions to decrease the diuretic process of the kidneys
 - Certain situations may increase or decrease the release of this hormone

- *Oxytocin (OT)* - weak antidiurectic also helps in uterine contractions used in child birth and in breast feeding
- Disorders: Diabetes Insipidus – hyposecretion of ADH

Thyroid Gland

- **Thyroid Gland:** located in the anterior part of the throat is wraps about $\frac{1}{2}$ way around the pharynx.
- *Thyroxine & Triiodothyroxine* - these hormones share the same purpose and are activated by TSH
 - Increase the rate at which cells release energy from carbohydrates (metabolism) and rate of protein synthesis
 - Important in maintaining proper growth
 - Proper amount of iodides are needed in the system for the thyroid to produce these hormones.

- *Calcitonin* - acts to lower blood calcium and phosphate levels. This regulation is sensed and controlled by the body measuring the Ca level in the body.
- Disorders:
 - Goiters – deficiency of iodine in diet causes an enlarged thyroid
 - Cretinism – hyposecretion of thyroxine that leads to dwarfism
 - Hyperthyroidism – results from a tumor of the thyroid

Parathyroid Gland

- **Parathyroid Glands:** four total, two located on the posterior side of each of the thyroid lateral lobes. On each side there is one superior and one inferior.
- *Parathyroid Hormone* (PTH) - used to increase the amount of Ca in the blood and decrease the concentration of phosphate. PTH is activated on a negative feedback system between the blood and Calcitonin secretions.

Adrenal Gland

- **Adrenal Glands**: sit on top of the kidneys and is composed of two different portions (medulla and cortex). The medulla (inner core) is related to the sympathetic nervous system and the cortex (outer layer) is responsible for producing over 30 hormones that carry out various functions in the body.

- Adrenal Medulla - *Epinephrine and Norepinephrine* - act in speeding the processes of the body and may last for quite some time.
 - They can cause increased heart rate, increased blood pressure, increased breathing rate and a decrease in digestive processes.
 - These hormones are one cause of the fight or flight reaction of the body.

Adrenal Cortex:

- Aldosterone—*mineralcorticoid* produced and secreted from the outer layer of the cortex. Maintains a Na and K balance through re-absorption and secretion. This ultimately causes the blood volume to remain high and maintains a proper blood pressure.
- Cortisol—*glucocorticoid* that affects the metabolism of glucose, protein and fats. This hormone also stimulates the liver to produce glucose from amino acids and glycerol (simple fat). This hormone aids in the maintenance of a normal blood sugar level that fluctuates according to the demands of the body.

Adrenal Cortex:

- Adrenal Androgens—male sex hormone produced in the adrenals that may be converted into female hormone. May play a role in early sexual development (7-13 years) and the female sex drive and provide estrogen for women after menopause.

Pancreas

- **Pancreas**: a dual functioning organ that secretes digestive enzymes into the intestine but also produces and secretes hormones used for regulating homeostasis. The pancreas is located behind the stomach attached to the beginning of the intestines.

- *Pancreatic islets*—endocrine portion of the pancreas made of two groups of cells (alpha and beta) that help regulate blood sugar levels.
 - Alpha cells—secrete glucagon, causes liver to convert glycogen and some amino acids into glucose. This raises the blood glucose level, preventing hypoglycemia.
 - Beta cells—release insulin, causes the formation of glycogen in liver. Insulin also aids in the facilitated diffusion of glucose into certain cells. These processes lower the blood sugar level.
 - Beta and alpha cells act in a negative feedback loop to maintain a steady blood sugar level.

Pineal Gland

- **Pineal Gland**: many things are still unclear about the pineal gland.
- *Melatonin* - secreted in the absence of light controlled by nervous impulses coming from the eyes.
 - An imbalance or disruption of the release of this hormone may result in insomnia or tiredness which may be related to irritability and depression.
 - Melatonin is also believed to control many of the cycling functions of the body including the menstrual cycle involved in female reproduction.

Thymus Gland

- **Thymus Gland**: releases thymosin which aids in the production of white blood cells involved with the immune system.

Ovaries and Testes

Gonads:

- **Ovaries and Placenta** - female the sex hormones *estrogen* and *progesterone* are produced.
 - Stimulates the uterine lining growth; development and maintenance of female secondary sex characteristics
- **Testes** - the male sex hormone *androgens* (*testosterone*) is produced.
 - Support sperm formation; development and maintenance of male secondary sex characteristics