Endocrine System

Lac 12 G. Histology

MSC. ALI ALaaraji

Endocrine system:

Is a messenger system in an organism comprising feedback loops of hormones that are released by internal glands directly into the circulatory system and that target and regulate distant organs.

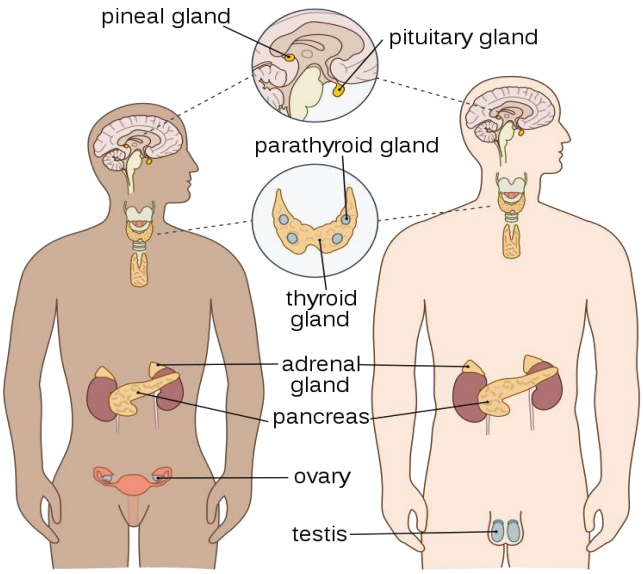
In vertebrates, the hypothalamus is the neural control center for all endocrine systems.

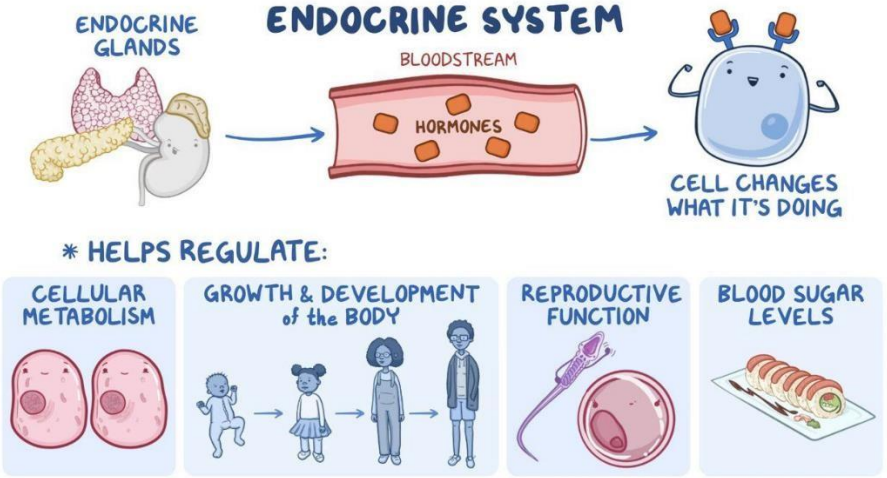
In humans, the major endocrine glands are the thyroid, parathyroid, pituitary, pineal, and adrenal glands, and the (male) testicles and (female) ovaries.

The hypothalamus, pancreas, and thymus also function as endocrine glands, among other functions. (The hypothalamus and pituitary glands are organs of the neuroendocrine system.

The endocrine system is contrasted both to exocrine glands, which secrete hormones to the outside of the body, and to the system known as paracrine signaling between cells over a relatively short distance.

Endocrine glands have no ducts, are vascular, and commonly have intracellular vacuoles or granules that store their hormones. In contrast, exocrine glands, such as salivary glands, sweat glands, and glands within the gastrointestinal tract, tend to be much less vascular and have ducts or a hollow lumen. Endocrinology is a branch of internal medicine.





What Are Hormones??

The word hormone comes from the Greek word hormone, which means to excite or stimulate Some hormones have only a few specific target cells, whereas other hormones affect numerous cell types throughout the body. A chemical substance produced in the body that controls and regulates the activity of certain cells or organs, the hormones can be

divided into three classes based on their structure:

1. ***Steroid hormones*** are lipid hormones that have the characteristic ring structure of steroids and are formed from cholesterol. (e.g., estrogen, testosterone, cortisone, and aldosterone).

2. ***Peptide hormones*** are composed of amino acids. The majority of hormones of this type are secreted by the pituitary gland (ACTH, TSH, FSH, GH, and prolactin) and parathyroid glands (PTH).

3. ***Amine hormones*** are derived from the amino acid tyrosine. (e.g., T3&T4 released by the thyroid and adrenaline & noradrenaline secreted by the adrenal medulla).

How does the endocrine system communicate?

The biochemical process, known as endocrine signaling, is what serves to regulate the body's organs. The endocrine system is like a news network for the body that broadcasts hormonal messages to regulate bodily functions.

Three different types of stimuli trigger actions of endocrine glands:

1. **Humoral stimuli**: An example is regulation of blood glucose by the pancreas. High blood glucose levels stimulate the pancreas to secrete insulin while low blood glucose levels stimulate the pancreas to secrete glucagon. Insulin lowers blood glucose while glucagon raises blood glucose.

2. **Neural stimuli:** An example is the response of the sympathetic nervous system to stress. In response to stress, the adrenal gland secretes epinephrine and norepinephrine; other names for these hormones are adrenaline and noradrenaline. In times of short-term stress, for example, narrowly escaping a bicycle accident, these hormones increase heart rate and blood glucose to prepare the body for a quick response.

3. **Hormonal stimuli:** An example is when the hypothalamus regulates the secretion of the anterior pituitary hormones, releasing hormones and inhibiting hormones. The cascade of events begins with environmental stress, such as cold environmental temperatures which stimulate the secretion of thyroidstimulating hormone-releasing hormone (TSH-RH) from the hypothalamus. TSH-RH then stimulates the release of thyroidstimulating hormone (TSH) from the anterior pituitary gland. TSH travels in the blood stream to the thyroid gland. Direct action of TSH on the thyroid gland is the secretion of thyroid hormone. The thyroid hormone
increases heat production to warm the body.

Glands of endocrine system:

Hypothalamus - The hypothalamus links our endocrine and nervous systems together. The hypothalamus drives the endocrine system.

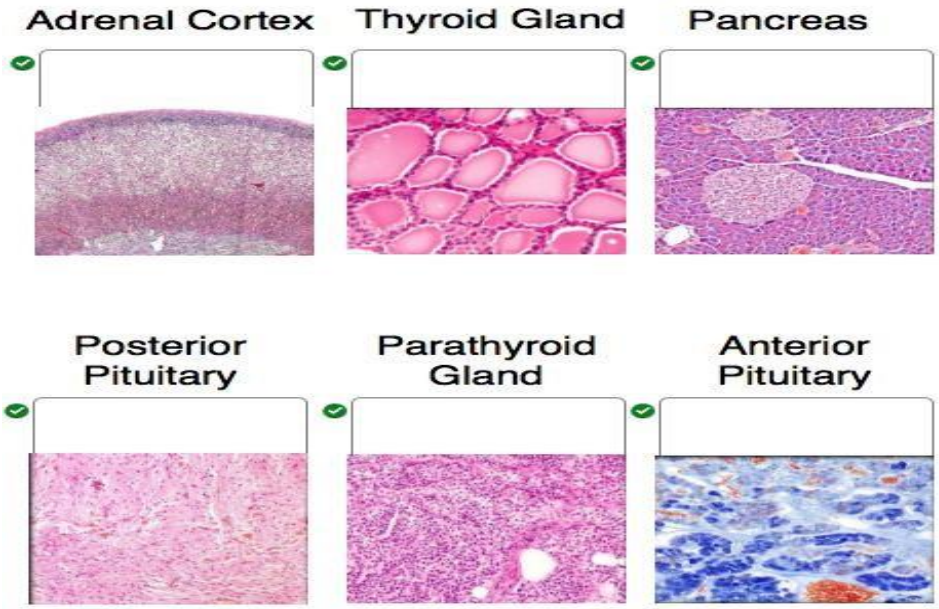
Pituitary gland - The pituitary gland receives signals from the hypothalamus. This gland has two lobes, the posterior and anterior lobes. The posterior lobe secretes hormones that are made by the hypothalamus. The anterior lobe produces its own hormones, several of which act on other endocrine glands.

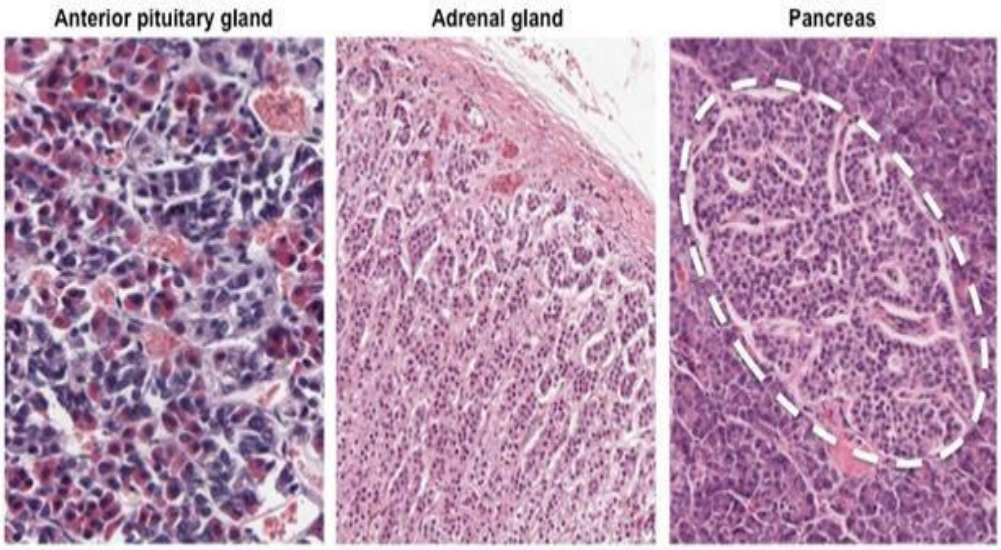
Thyroid gland - The thyroid gland is critical to the healthy development and maturation of vertebrates and regulates metabolism.

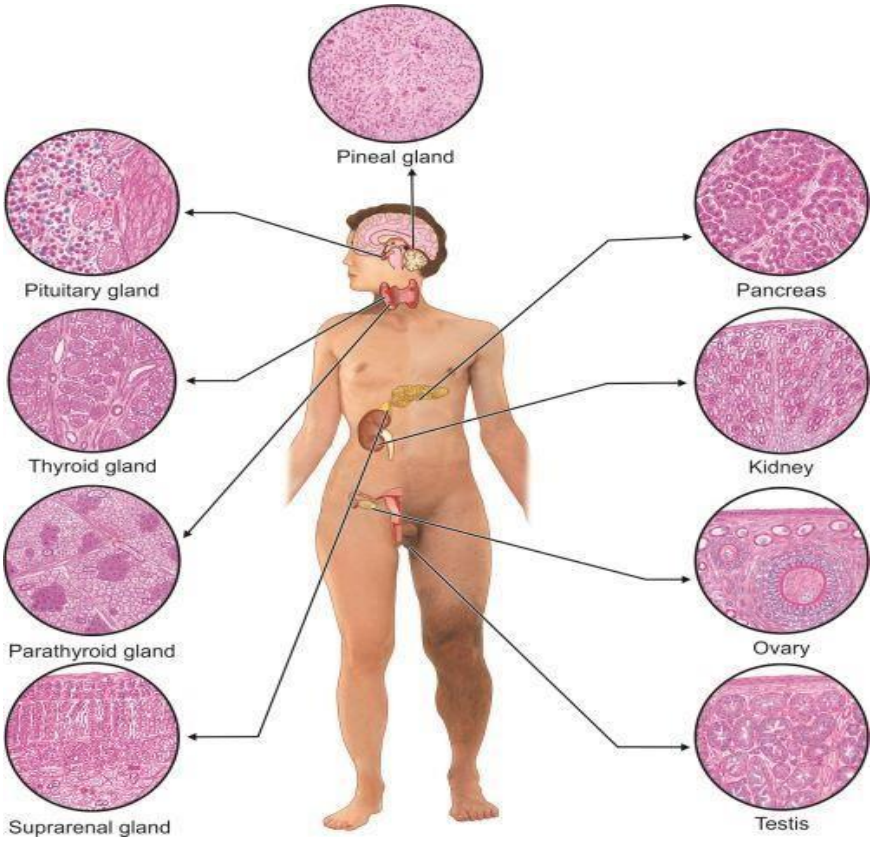
Adrenal glands - The adrenal gland is made up of two glands: the cortex and medulla. These glands produce hormones in response to stress and regulate blood pressure, glucose metabolism, and the body's salt and water balance.

Pancreas - The pancreas is responsible for producing glucagon and insulin. Both hormones help regulate the concentration of glucose (sugar) in the blood.

Gonads - The male reproductive gonads, or testes, and female reproductive gonads, or ovaries, produce steroids that affect growth and development and also regulate reproductive cycles and behaviors. The major categories of gonadal steroids are androgens, estrogens, and progestins, all of which are found in both males and females but at different levels.




Anterior pituitary gland
Adrenal gland
Pancreas


Pineal gland
Pituitary gland
Thyroid gland
Parathyroid gland
Suprarenal gland
Pancreas
Kidney
Ovary
Testis

Cells:

There are many types of cells that make up the endocrine system and these cells typically make up larger tissues and organs that function within and outside of the endocrine system.

- Hypothalamus
- Anterior pituitary gland
- Pineal gland
- Posterior pituitary gland

The posterior pituitary gland is a section of the pituitary gland. This organ does not produce any hormone but stores and secretes hormones such as antidiuretic hormone (ADH) which is synthesized by supraoptic nucleus of hypothalamus and oxytocin which is synthesized by paraventricular nucleus of hypothalamus. ADH functions to help the body to retain water; this is important in maintaining a homeostatic balance between blood solutions and water. Oxytocin functions to induce uterine contractions, stimulate lactation, and allows for ejaculation. **Thyroid gland**

follicular cells of the thyroid gland produce and secrete T_3 and T_4 in response to elevated levels of TRH, produced by the hypothalamus, and subsequent elevated levels of TSH, produced by the anterior pituitary gland, which further regulates the metabolic activity and rate of all cells, including cell growth and tissue differentiation.

Parathyroid gland

Epithelial cells of the parathyroid glands are richly supplied with blood from the inferior and superior thyroid arteries and secrete parathyroid hormone (PTH). PTH acts on bone, the kidneys, and the GI tract to increase calcium reabsorption and phosphate excretion. In addition, PTH stimulates the conversion of Vitamin D to its most active variant,

1,25dihydroxyvitamin D_3, which further stimulates calcium absorption in the GI tract.

Thymus Gland

Adrenal glands: Adrenal cortex. Adrenal medulla

Pancreas

Pancreas contain nearly 1 to 2 million islets of Langerhans (a tissue which consists cells that secrete hormones) and acini. Acini secretes digestive enzymes.

Alpha cells

The alpha cells of the pancreas secrete hormones to maintain homeostatic blood sugar. Insulin is produced and excreted to lower blood sugar to normal levels. Glucagon, another hormone produced by alpha cells, is secreted in response to low blood sugar levels; glucagon stimulates glycogen stores in the liver to release sugar into the bloodstream to raise blood sugar to normal levels.

Beta cells

60% of the cells present in islet of Langerhans are beta cells. Beta cells secrete insulin. Along with glucagon, insulin helps in maintaining glucose levels in our body. Insulin decreases blood glucose level (a hypoglycemic hormone) whereas glucagon increases blood glucose level.

Delta cells: which inhibit secretion of glycogen and insulin.

Glucagon increases the blood glucose level by stimulating the liver causing convert Glycogen into Glucose (sugar)

F Cells

Ovaries: Granulosa cells

Testis: Leydig cells

Function of endocrine system:

Cell signalling

The typical mode of cell signalling in the endocrine system is endocrine signaling, that is, using the circulatory system to reach distant target organs. However, there are also other modes, i.e., paracrine, autocrine, and neuroendocrine signaling. Purely neurocrine signaling between neurons, on the other hand, belongs completely to the nervous system.

Autocrine

Autocrine signalling

Autocrine signaling is a form of signaling in which a cell secretes a hormone or chemical messenger (called the autocrine agent) that binds to autocrine receptors on the same cell, leading to changes in the cells.

Paracrine

Paracrine signalling

Some endocrinologists and clinicians include the paracrine system as part of the endocrine system, but there is not consensus. Paracrines are slower acting, targeting cells in the same tissue or organ. An example of this is somatostatin which is released by some pancreatic cells and targets other pancreatic cells.

Juxtacrine

Juxtacrine signalling

Juxtacrine signaling is a type of intercellular communication that is transmitted via oligosaccharide, lipid, or protein components of a cell membrane, and may affect either the emitting cell or the immediately adjacent cells.

It occurs between adjacent cells that possess broad patches of closely opposed plasma membrane linked by transmembrane channels known as connexons. The gap between the cells can usually be between only 2 and 4 nm.