

كلية المستقبل الجامعة قسم الفيزياء الطبية
المرحلة الثالثة

ANATOMY

L5

The Endocrine System

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INTRODUCTION : Homeostasis (from the Greek *homoios*, ‘similar’; and *histēmi*, ‘standing still’) refers to the process of maintaining a stable internal environment. In other words, homeostasis refers to the maintenance of normal physiological balance and functioning within the body. There are two major systems in the body for maintaining homeostasis: the nervous system and the endocrine system.

The endocrine system is not as closely linked as other systems, for example the circulatory system. Endocrine glands are groups of secretory cells that are surrounded by a large network of capillaries, this rich blood supply permits diffusion of hormones. In general, endocrine glands are ductless, vascular and most of them usually contain intracellular vacuoles or granules that store hormones. Exocrine glands however, for example the salivary glands, the mammary glands, sweat glands and those glands located within the gastrointestinal tract (for example, mucus glands), are usually much less vascular with a duct or lumen to a membrane surface.

The endocrine system is made up of a collection of small organs that are scattered throughout the body, each of which releases hormones into the blood supply (‘endo’ = within, ‘crine’ = to secrete). These hormone-releasing organs can be split into three main categories.

- **Endocrine glands** – organs whose only function is the production and release of hormones. These include:
 - pituitary gland
 - thyroid gland
 - parathyroid gland
 - adrenal gland.
- **Organs that are not pure glands** (as they have other functions as well as the production of hormones) but contain relatively large areas of

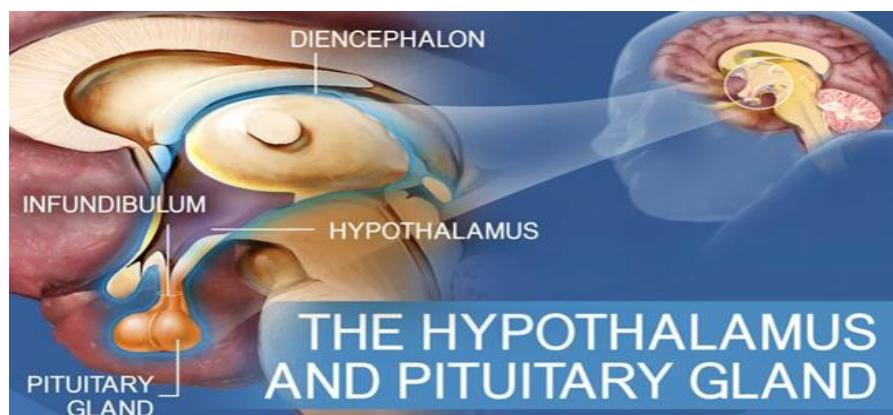
hormone-producing tissue. These include:

hypothalamus

pancreas.

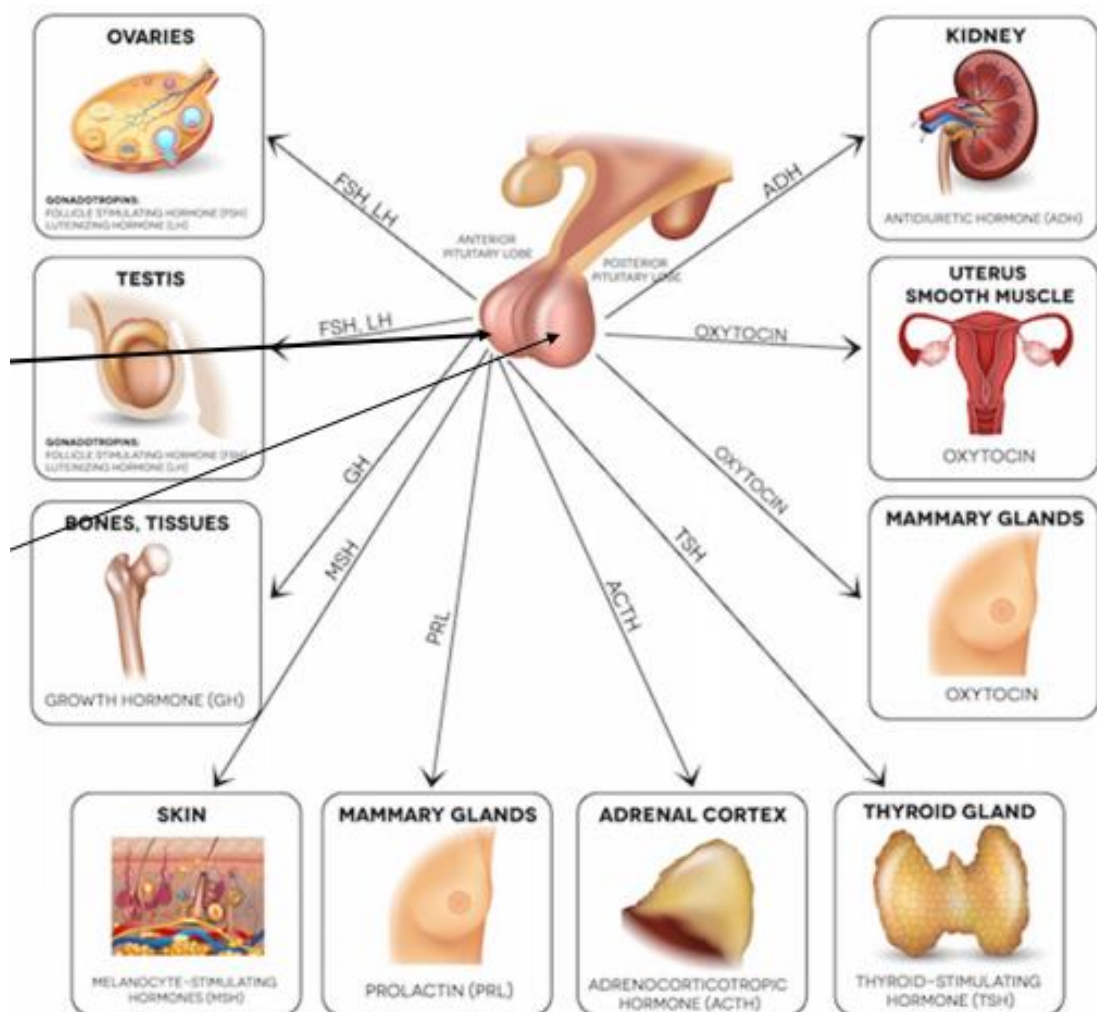
- **Other tissues and organs** that also produce hormones – areas of hormone-producing cells are found in the wall of the small intestine and the stomach.

The hypothalamus and the pituitary gland are part of the diencephalon region of the brain. The hypothalamus connects the nervous system to the endocrine system. It receives and processes signals from other brain regions and pathways and translates them into hormones, the chemical messengers of the endocrine system. These hormones flow to the pituitary gland, which is connected to the hypothalamus by the **infundibulum**. Some hormones are stored in the pituitary stores for later release; others spur it to secrete its own hormones. The hormones released by the pituitary gland and the hypothalamus control the other endocrine glands and regulate all major internal functions.



MASTER GLAND

The pituitary is the most influential gland in the endocrine system. It is actually two distinct glands in one. Its front, or anterior lobe manufactures 7 major hormones and releases them into the bloodstream. Behind it is the posterior (back) lobe which receives its two main hormones from the hypothalamus, which lies above it and then it releases 3 hormones, as shown.



The pineal gland is small and pine cone- shaped, (which is how it got its name) located at the back of the diencephalon region in the brain. At night, in the absence of light, the pineal gland secretes the hormone melatonin. Melatonin regulates the body's sleep patterns in both circadian (daily) and seasonal patterns. In the morning, when light hits the eye, photo receptors in the retina send signals to the pineal gland, which then decreases melatonin production and we wake up.

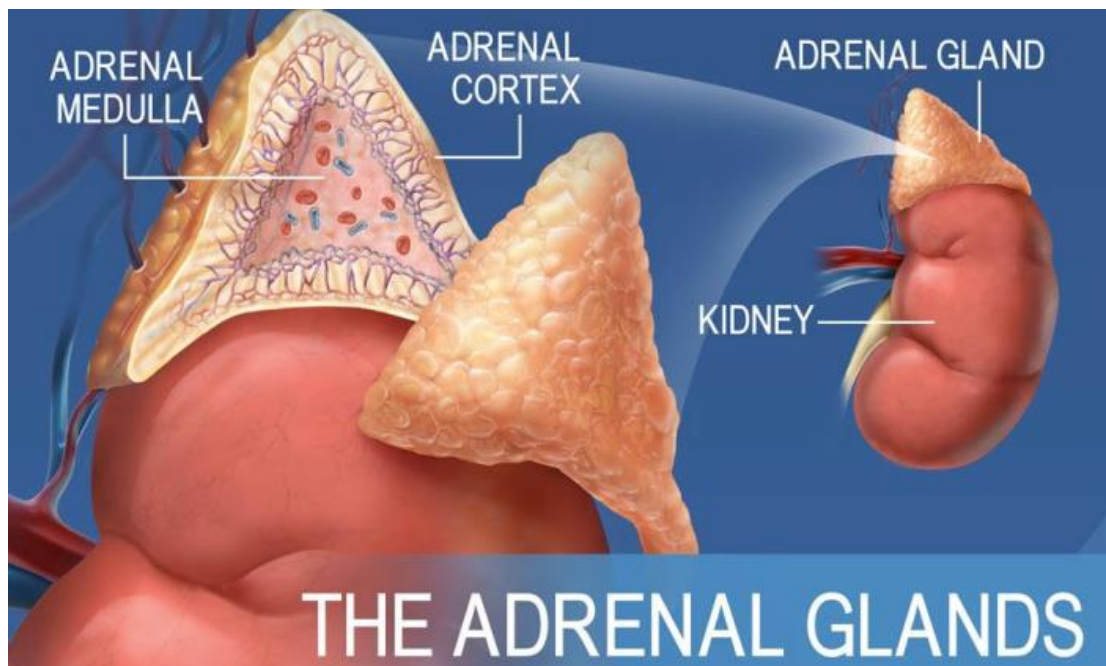


The adrenal glands are pyramid-shaped organs that sit at the top of each kidney. Each adrenal gland consists of two structures: an outer adrenal cortex and an inner adrenal medulla. The adrenal cortex is a network of fine connective tissues that makes up most of the gland. It secretes a range of steroid hormones.

Cortisol which manages protein and glucose levels.

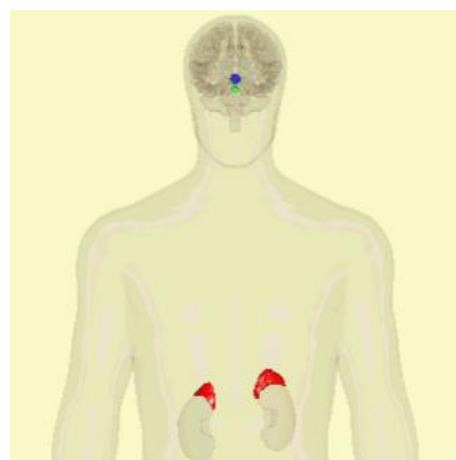
Aldosterone which adjusts our levels of water and salt.

Androgens and estrogens are secreted by the adrenal cortex in small amounts by both sexes. The adrenal medulla (inside the gland) produces epinephrine and nor-epinephrine (NE). These chemicals promote “fight-or-flight,” the body's initial response to stress.



The kidneys make two main hormones, vitamin D and erythropoietin.

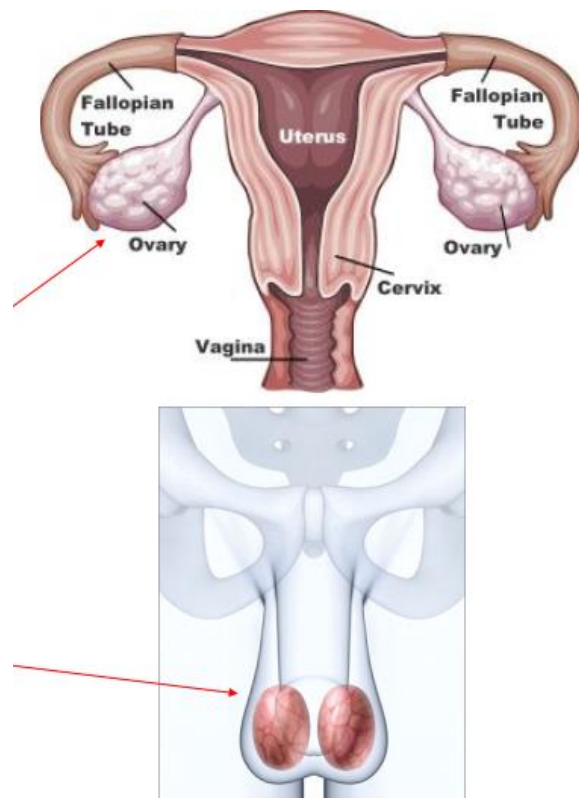
Vitamin D is essential for a number of different functions in the body. Active vitamin D stimulates the uptake of calcium from food, is important for the maintenance of healthy bones and also helps to regulate the response of the immune system to infection. Erythropoietin is produced when oxygen levels in the blood are low. It acts in bone marrow to stimulate the production of mature red blood cells and to maintain healthy oxygen levels in our tissues.



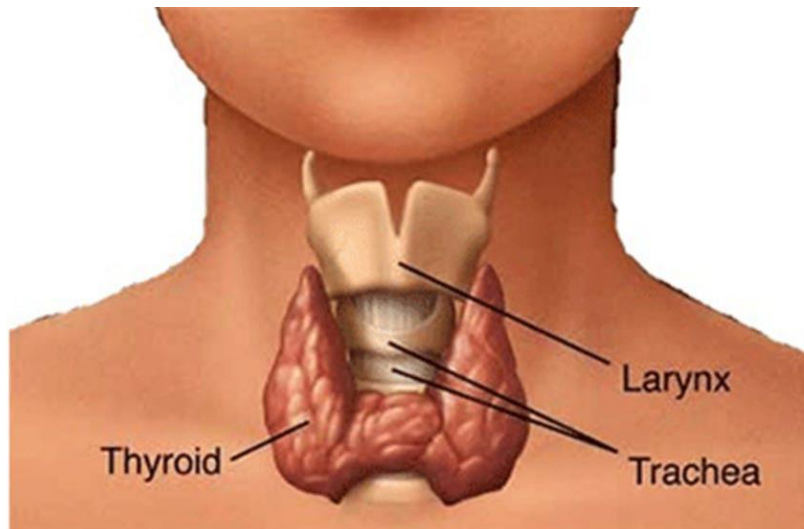
(The left kidney is located slightly higher than the right kidney due to the larger size of the liver on the right side of the body)

SEX GLANDS AND HORMONES

The main sex glands are the ovaries in females and testes in males. The sex hormones they produce stimulate the production of eggs and sperm respectively and influence the early development of the embryo into a boy or girl. After birth, the circulating levels remain low until puberty. Then, in males, the testes increase their output of androgens (male sex hormones), such as testosterone.

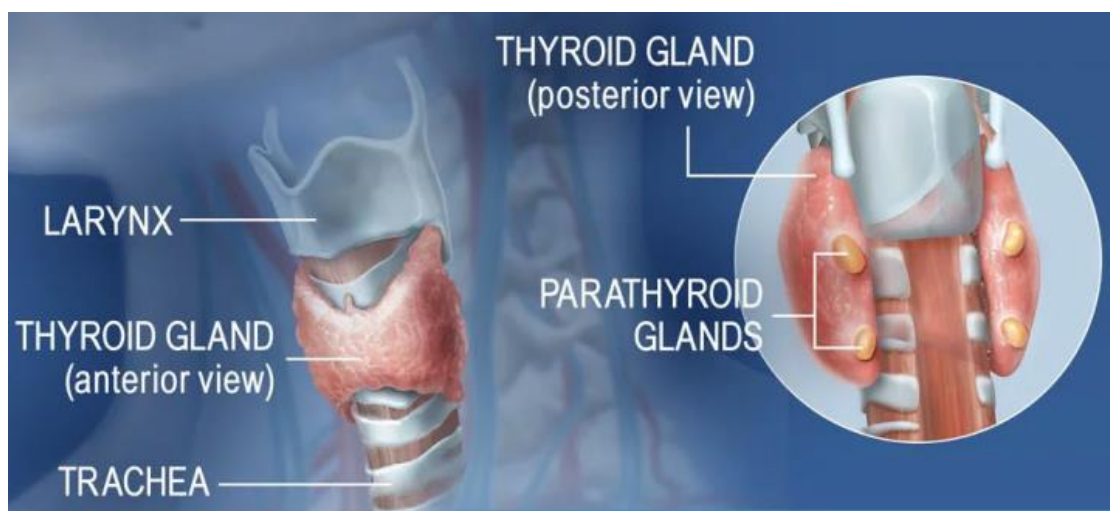


The thyroid gland sits in the throat region, just below the larynx, secretes thyroid hormone, thyroxine.



It also releases Calcitonin, which helps maintain blood calcium homeostasis by causing calcium to be removed from the blood and deposited into bones when blood (calcium) levels are too high.

On the posterior (back) surface of the thyroid sit much smaller, separate glands: the **parathyroids**. Typically there are four parathyroid glands, a superior and inferior pair on the left and right sides of the thyroid. They secrete parathyroid hormone (PTH), which stimulates bones to release calcium into the blood when blood (calcium) levels are low.

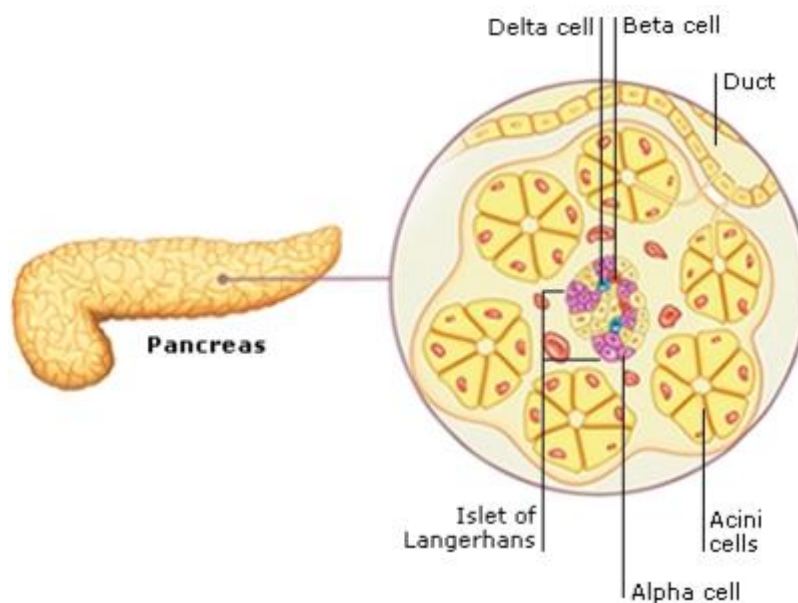


PANCREAS – A DUAL-PURPOSE GLAND

It is also a part of the digestive system. It excretes pancreatic juice into the small intestine via the pancreatic duct. Scattered within the pancreas there are also tiny cell clusters called pancreatic islets (or islets of Langerhans) that release hormones into the bloodstream. These islets make up less than 2% of pancreatic tissue, but their specialized cells regulate blood glucose levels (or blood sugar).

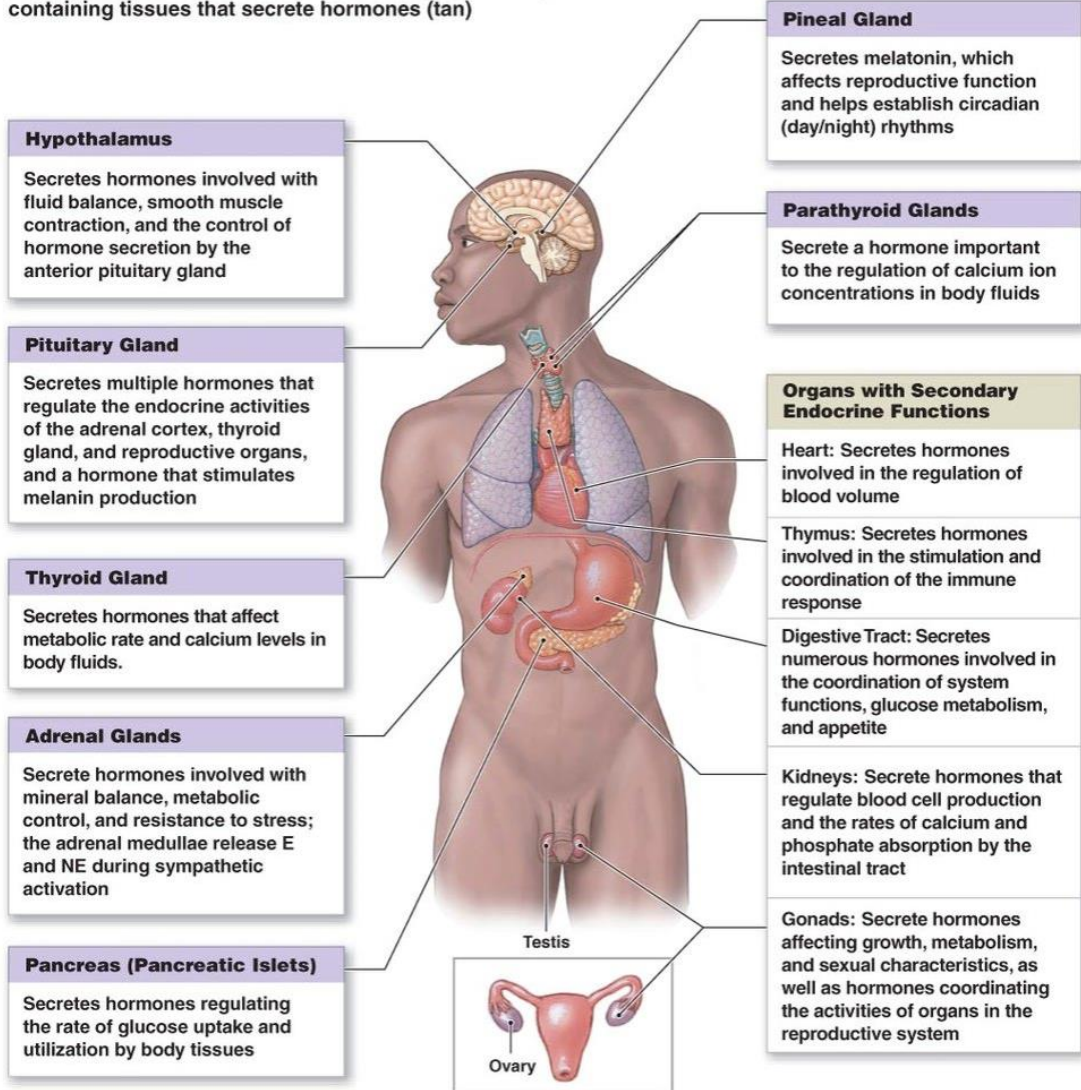
When blood sugar is low, **alpha** cells in the islets release **glucagon**. Glucagon spurs the liver to break down glycogen and release more glucose into the blood.

When blood sugar is high, **beta** cells in the islets release **insulin**, which increases glucose reuptake.



The Pancreas Regulates Blood Sugar Surrounded by enzyme-producing acini cells, the tiny pancreatic islets contain three types of cells: alpha, beta, and delta. The secretions of the latter help regulate insulin and glucagon production.

Organs of the endocrine system (purple) and other organs containing tissues that secrete hormones (tan)



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A SUMMARY OF THE ENDOCRINE SYSTEM