Endocrine System

An Introduction
Physiology 2

Endocrine System

The Human Endocrine System consists of tissue, mostly arranged into ***ductless glands***, which create **hormones** and release the hormones into the bloodstream.

A **Hormone** is a signaling molecule that exerts an effect on distant tissues. Because hormones are released into the bloodstream, they may have actions on many other tissues/organs or they may only have one target tissue/organ.

In humans, most hormones fall into these categories:

Proteins/peptides- insulin, oxytocin

Steroids - Estradiol (estrogen), Testosterone, Cortisol

Amino Acid Derivatives - Melatonin, Thyroxine

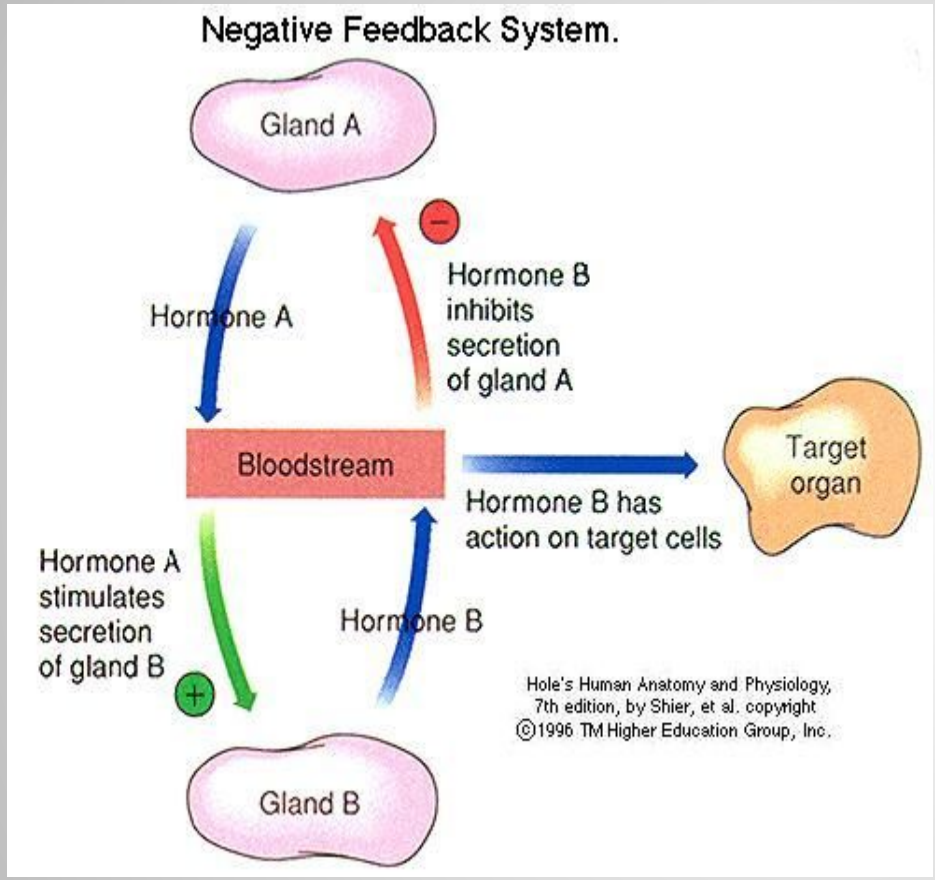
Eicosanoids - Prostaglandin and Thromboxanes [recall that NSAID medications block production of these chemicals (from Pharmacology)]

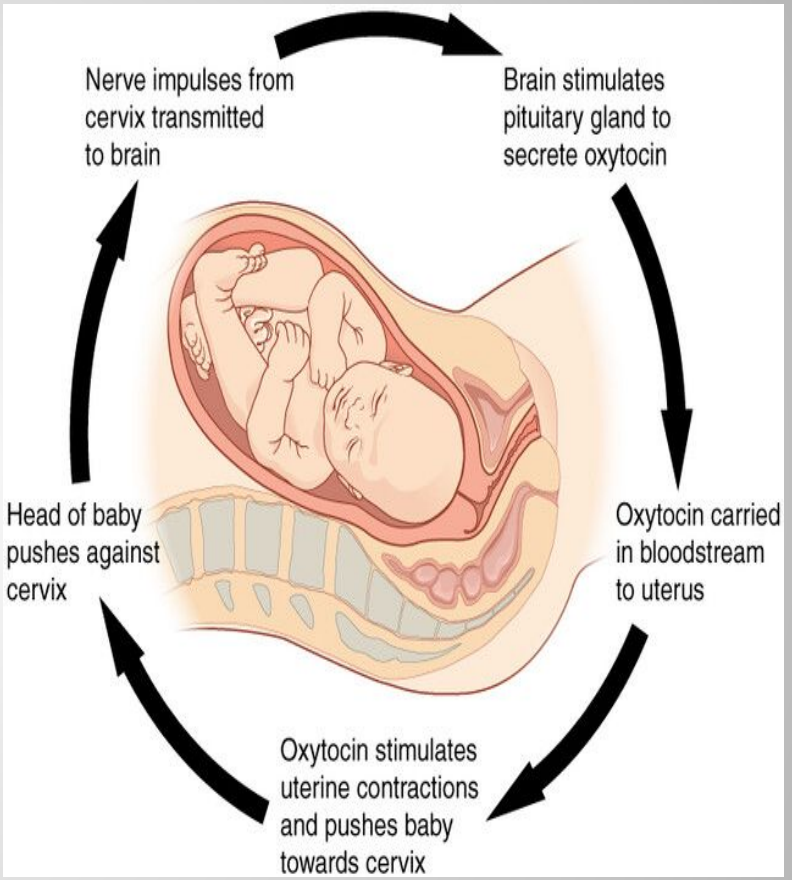
Hormone Receptors & Control Mechanisms

Hormones affect their **target tissues** by binding to receptors, either on the surface of cells (most protein hormones) or within the cell (most steroid hormones - remember that lipids can pass through plasma membranes easily)

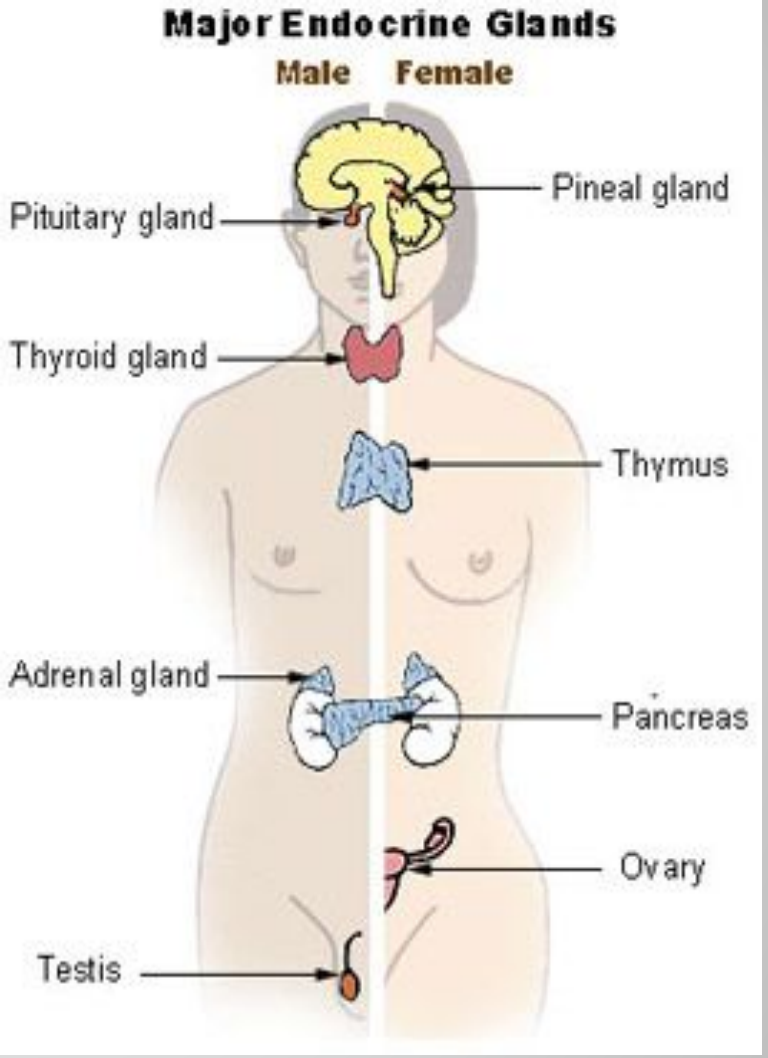
Most hormone levels are controlled by **negative feedback loops,** where high circulating hormone causes less to be produced.

Remember that the classic example of a body **positive feedback loop** is the production of the hormone oxytocin during childbirth.


Negative Feedback System.
Gland A
Hormone A
Hormone B inhibits secretion of gland A
Bloodstream
Target organ
Hormone B has action on target cells
Hormone A stimulates secretion of gland B
Hormone B
Gland B
Hole's Human Anatomy and Physiology, 7th edition, by Shier, et al. copyright ©1996 TM Higher Education Group, Inc.


Nerve impulses from cervix transmitted to brain
Brain stimulates pituitary gland to secrete oxytocin
Head of baby pushes against cervix
Oxytocin carried in bloodstream to uterus
Oxytocin stimulates uterine contractions and pushes baby towards cervix

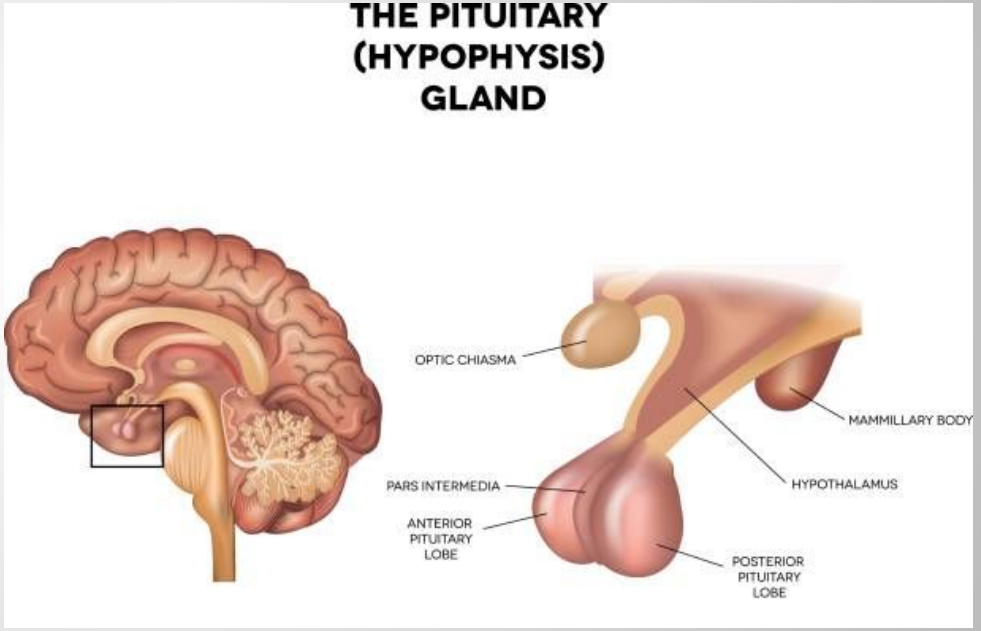
The Glands of the Endocrine System



The Pituitary Gland

The pituitary gland is located just underneath the hypothalamus in the Diencephalon region of the brain.

It is divided into the **anterior and posterior pituitary glands.**



Anterior Pituitary - The Master Gland

The anterior pituitary gland is known as the ***"master gland"***, because it secretes **6 major hormones** that influence many other glands.

Growth hormone- stimulates the growth of all tissues & organs, esp. Bone, cartilage & skeletal muscle

Thyroid Stimulating Hormone (TSH) - stimulates the ***thyroid*** gland to produce (T3 & T4)

Adrenocorticotropic hormone (ACTH) - stimulates the ***adrenal*** glands to produce steroid hormones, esp. Cortisol

Prolactin- Stimulates ***breast*** tissue to grow & mammary glands to produce milk

Follicular Stimulating Hormone (FSH) - Stimulates the development of ***ova*** (in females) and ***sperm*** (in males)

Luteinizing Hormone - Stimulates ***progesterone*** production and triggers ***ovulation*** in females. Stimulates ***testosterone*** production in males.

Posterior Pituitary Gland

Producer of two important hormones:

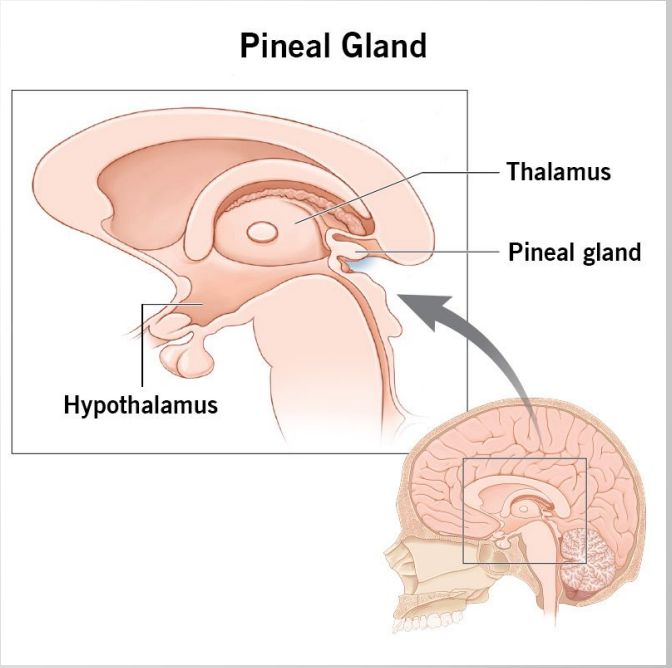
Antidiuretic hormone (ADH)- Stimulates water reabsorption by the ***kidneys*** & constriction of the blood vessels

Oxytocin- Stimulates uterine contraction during ***childbirth***; stimulates breast milk release; the “love hormone” that is released during cuddling and sexual arousal

Pineal Gland

A tiny gland located above the hypothalamus in the brain.

Secretes the hormone **Melatonin,** which helps regulate our sleep-wake cycles.



The Thyroid Gland

A butterfly shaped gland located in the neck.

It produces hormones associated with controlling the body's metabolism.

Thyroxine (T4) - The "storage" form of thyroid hormone

Triiodothyronine (T3) - The "active" form of thyroid hormone

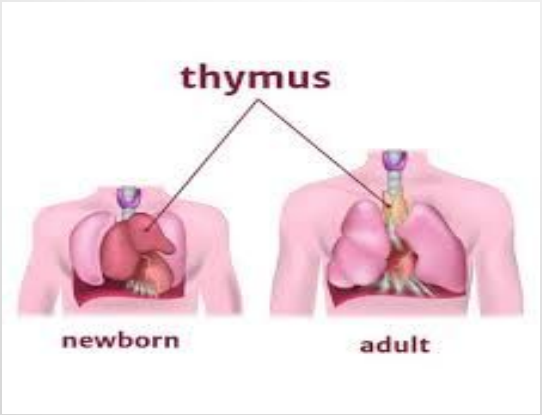
Calcitonin- A hormone that helps ***lower*** the amount of ***Calcium*** in the bloodstream. It opposes **parathyroid hormone (**produced by the ***parathyroid glands)*** which acts to **increase** the amount of **calcium** in the blood

Thymus Gland

Located behind the sternum.

The thymus gland is large in childhood & shrinks after early adulthood.

The thymus gland is where your **T lymphocytes mature,** so it has an important role in the body's immune system.



Pancreas

The Pancreas has the unique feature of being both an **exocrine and an endocrine** gland.

As an exocrine gland, the pancreas produces many digestive enzymes that it secretes into the duodenum through the pancreatic duct.

As an endocrine gland, it produces important hormones that it releases into the bloodstream, that work to **control blood glucose levels**. The two most important are:

Insulin - Helps to get glucose into cells. Secreted when blood glucose is ***high***

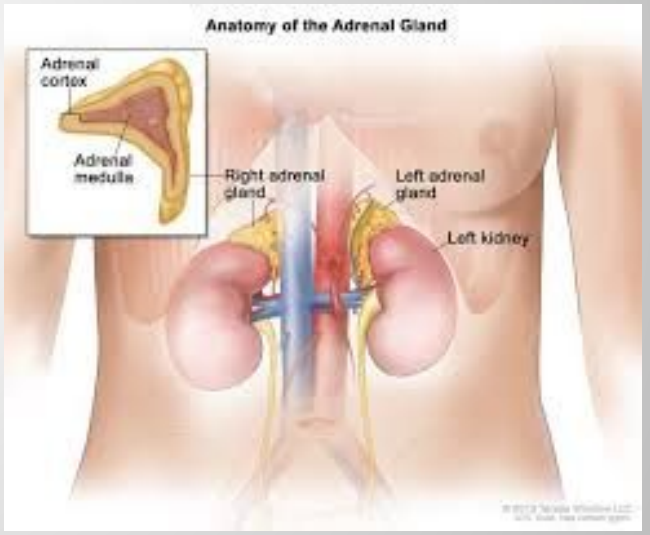
Glucagon - Helps stimulate breakdown of glycogen to release glucose. Secreted when blood glucose levels are ***low***

Adrenal Glands

Small triangular organs located on top of each kidney.

The adrenal gland consists of two parts that each produce very different hormones.

The **adrenal medulla** is the inner part of the gland. It produces the fight or flight hormones **epinephrine and norepinephrine.**



Adrenal Cortex

The **adrenal cortex** is the outermost layer of the adrenal gland. It produces the hormones:

Aldosterone: a ***mineralocorticoid*** hormone, it's function is to regulate the balance of water and salts in the body by telling the kidney to retain sodium and release potassium.

Cortisol: a *glucocorticoid* hormone is your body's natural steroid. It reduces inflammation throughout the body. It also affects blood sugar balance, weight distribution, sleep-wake cycles & blood pressure.

DHEA: an ***androgen*** hormone that is a building block for making estrogen and testosterone.

Gonads - Ovaries

The ovaries are two small, oval organs located in the abdomen, one to to each side of the uterus, in biological females.

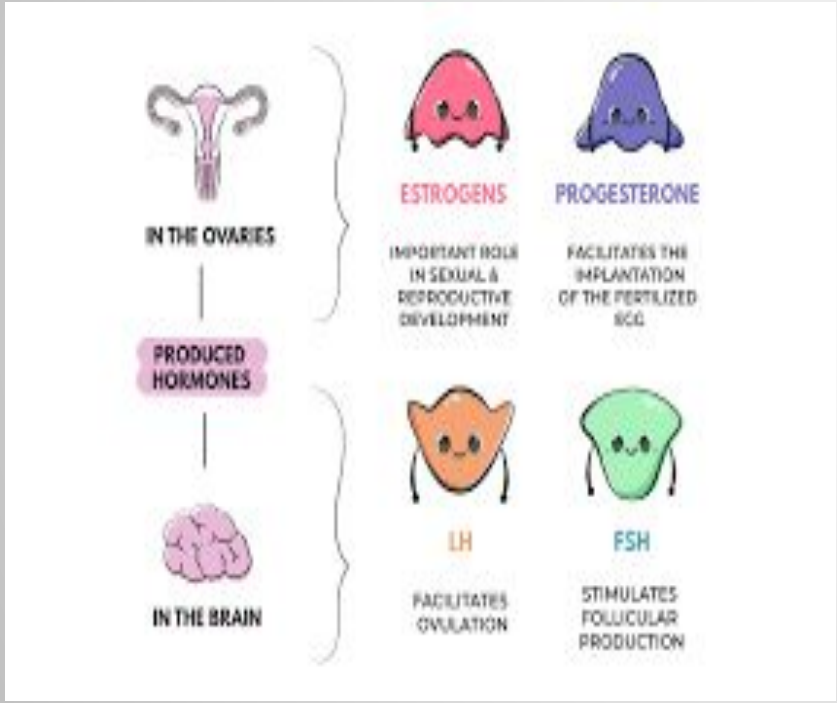
The ovaries make and store the ova (eggs) and release an ovum (egg) once a month in the process called **ovulation**.

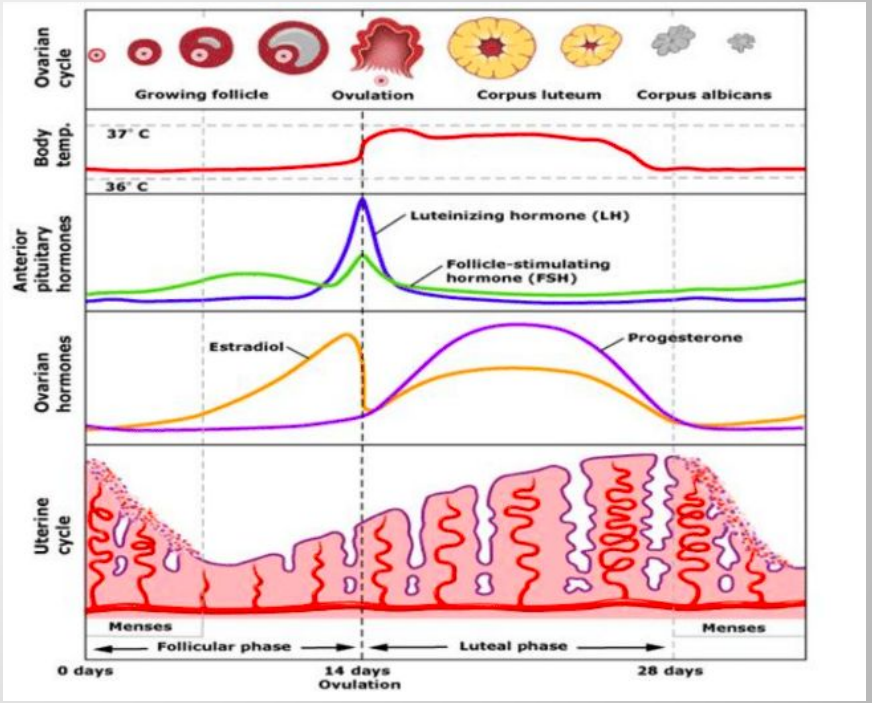
The ovaries produce the hormones:

Estrogen - responsible for the development of female secondary sex characteristics such as breast development, helps control the menstrual cycle and fertility, helps keep bones strong

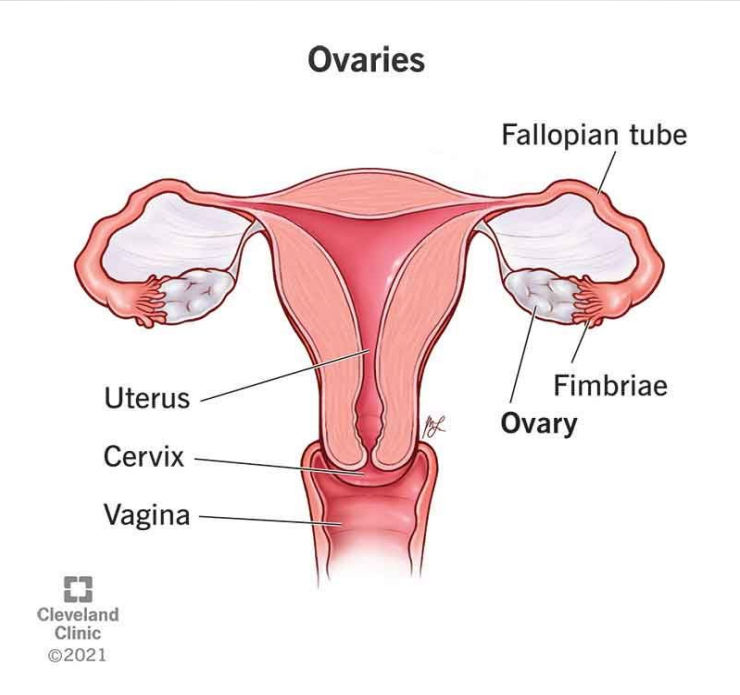
Progesterone- helps to prepare the lining of the uterus (endometrium) to support a pregnancy & continues to increase if a pregnancy occurs. Also influences mood & thyroid function.

Hormones that regulate the menstrual cycle





Female Reproductive Anatomy

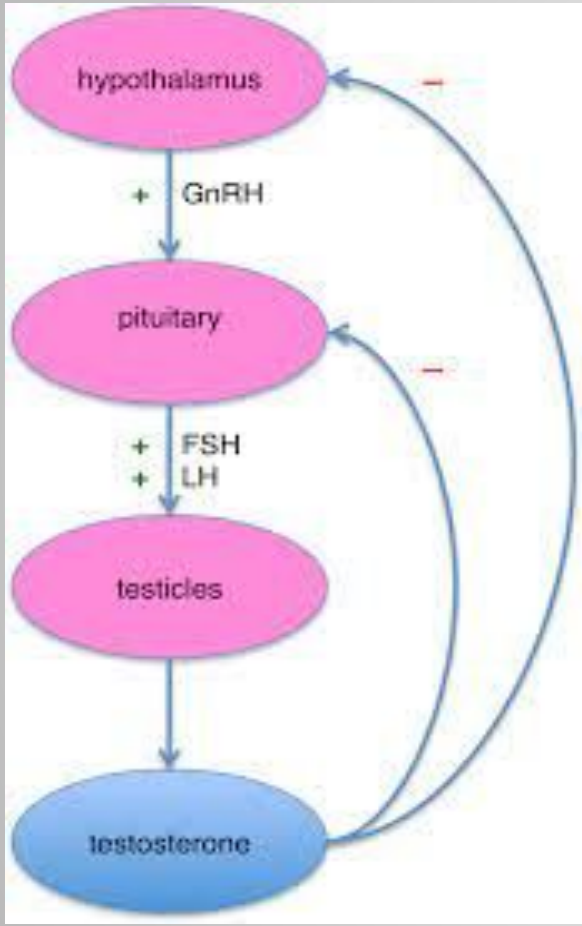


Gonads - Testes

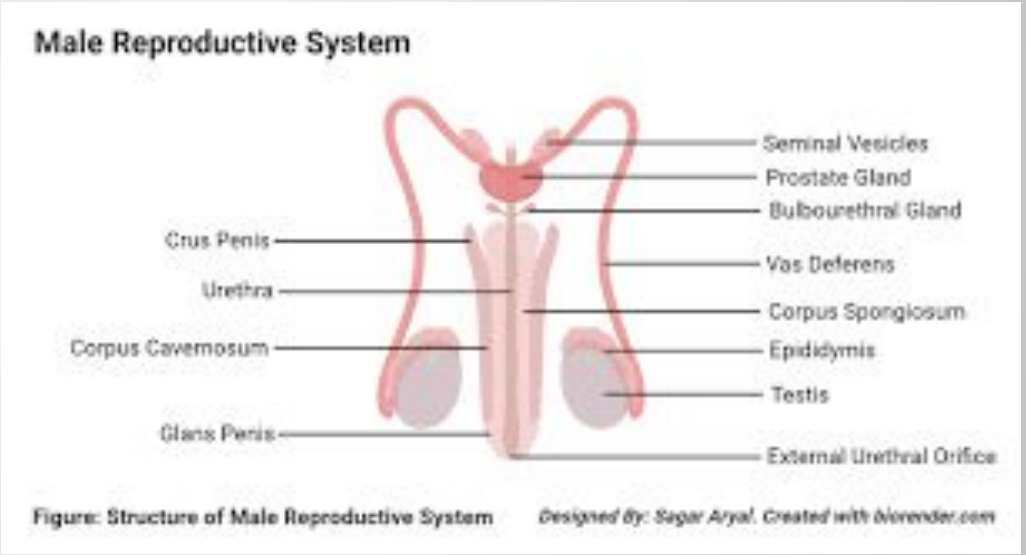
Two small organs located in the scrotum of biological males. They are responsible for producing and storing sperm.

The main hormone produced by the testes is:

Testosterone - responsible for the development of male secondary sex characteristics (beard, body hair, muscle mass). It also is responsible for libido and bone density.



Male Reproductive System



How Anterior Pituitary Hormones Affect the Gonads

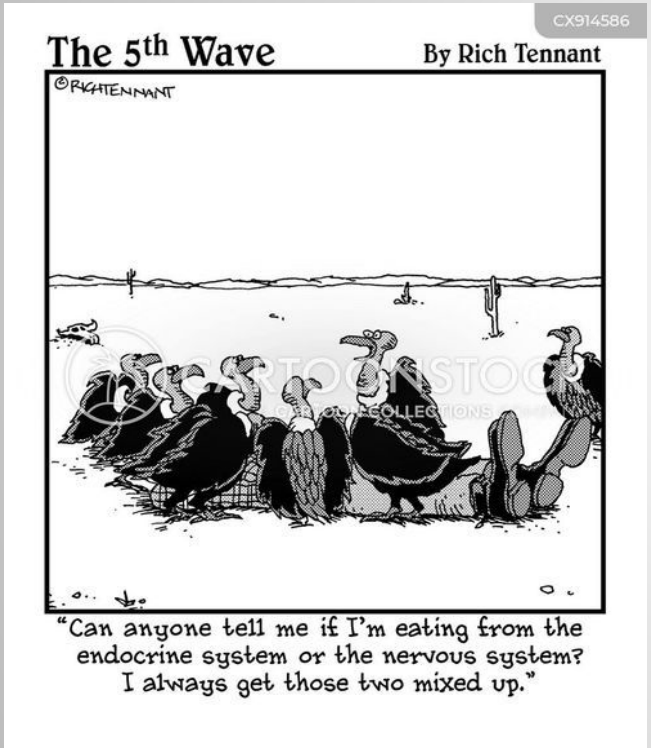
Luteinizing Hormone (LH) -

- In ***females,*** LH triggers Estrogen production by the ovary & the release of an egg (ova) at ovulation. LH peaks
- In ***males***, LH stimulates the testes to produce testosterone.

Follicle Stimulating Hormone (FSH) -

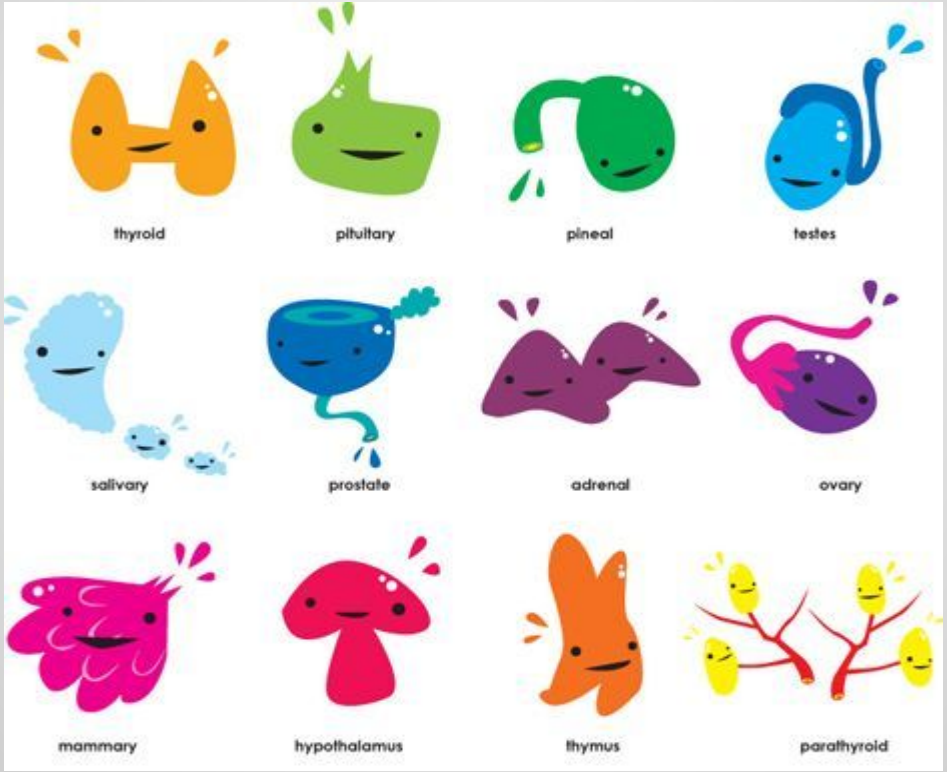
- In ***females,*** FSH helps control the health of the follicle surrounding the ova.
- In ***males,*** FSH helps control the amount and health of the sperm

Endocrine vs Nervous System



Feature	Nervous System	Endocrine System
Signals	electrical impulses (action potentials)	chemical impulses (hormones)
Pathways	transmission by neurons	transported by blood
Speed of information	fast	slow
Duration of effect	short lived	short or long lived
Type of action and response	voluntary or involuntary	always involuntary
Target	localized (cells connected to neuron)	often distant (many cells can be effected)

The End


thyroid
pituitary
pineal
testes
salivary
prostate
adrenal
ovary
mammary
hypothalamus
thymus
parathyroid