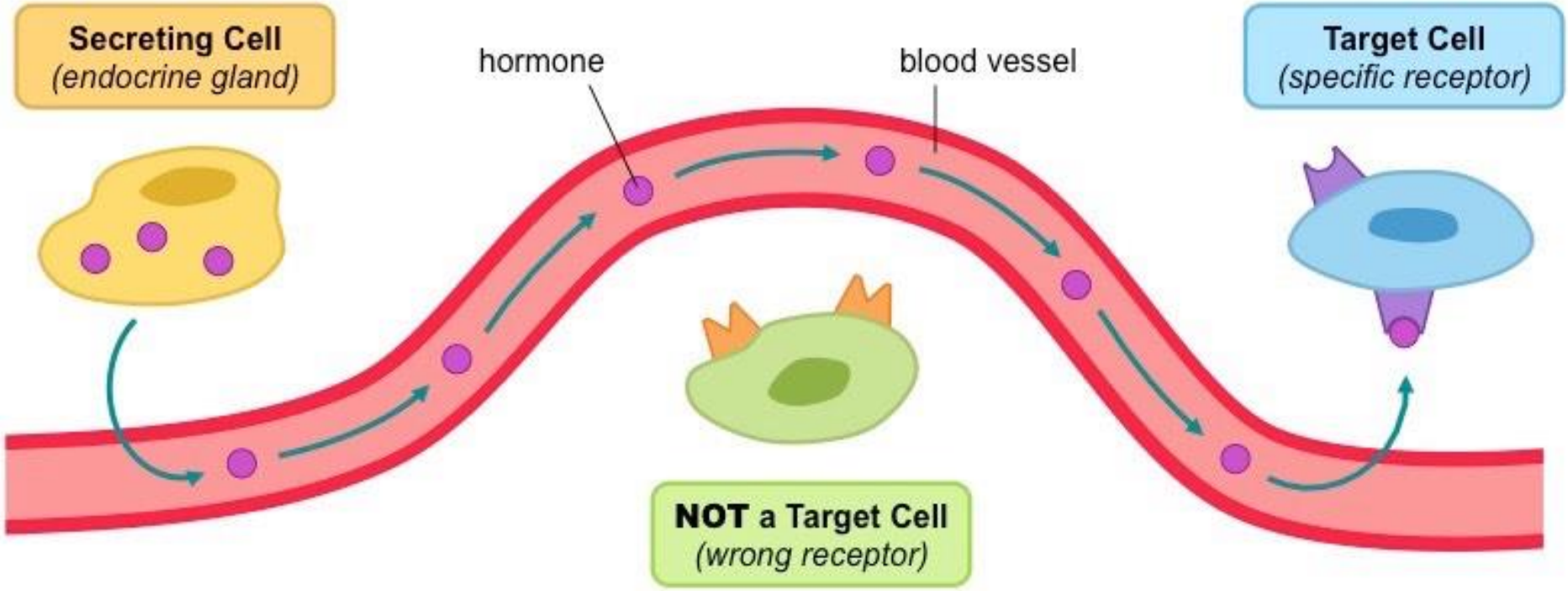
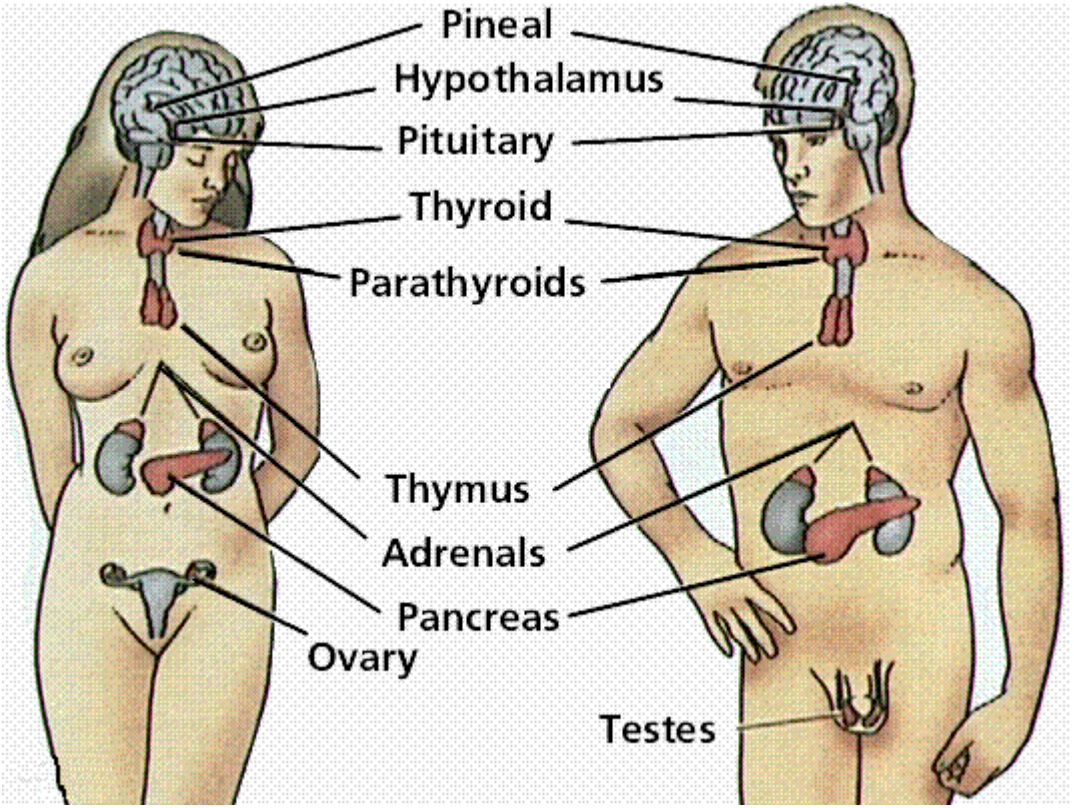
Endocrine system


Secreting Cell
(endocrine gland)
hormone
blood vessel
Target Cell
(specific receptor)
NOT a Target Cell
(wrong receptor)

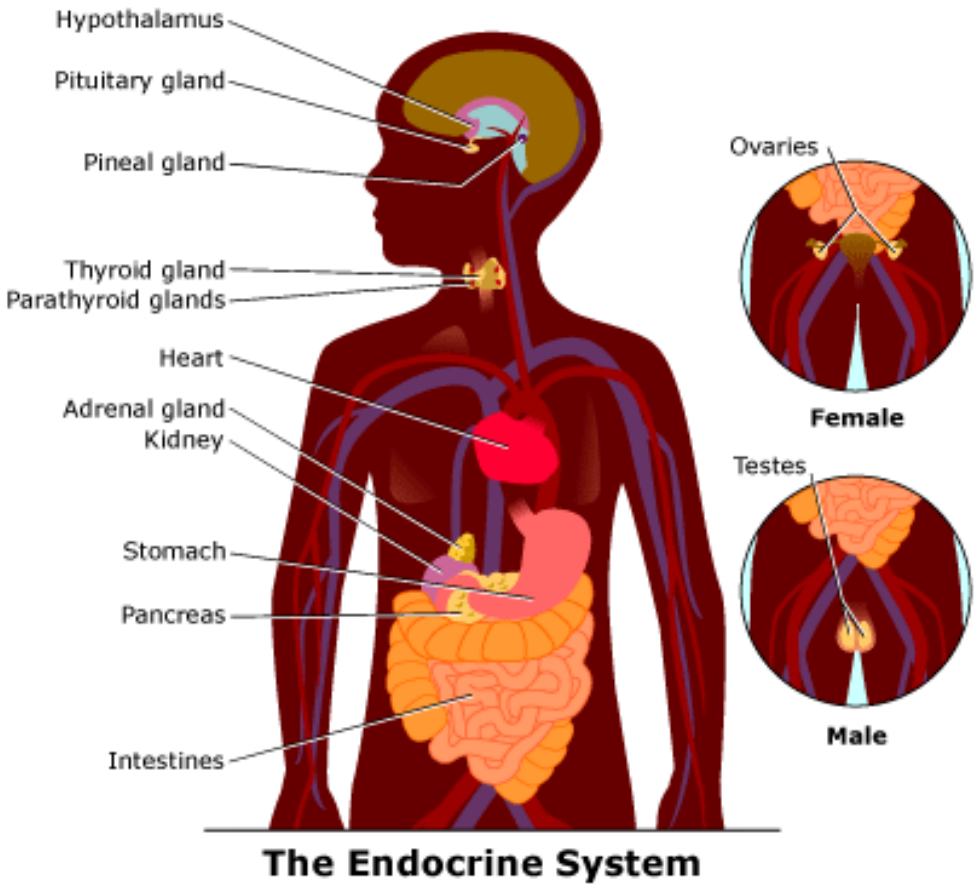
What is the endocrine system?



The endocrine system is made up of glands and the hormones they secrete. Although the endocrine glands are the primary hormone producers, the brain, heart, lungs, liver, skin, thymus, gastrointestinal mucosa, and placenta also produce and release hormones.

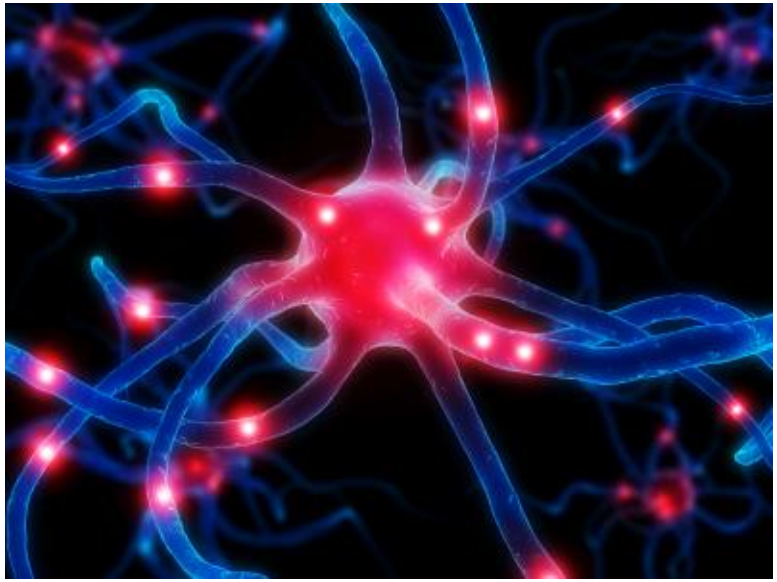
What is the endocrine system?

The primary endocrine glands are the pituitary (the master gland), pineal, thyroid, parathyroid, islets of Langerhans, adrenals, ovaries in the female and testes in the male.



The function of the endocrine system is the production and regulation of chemical substances called hormones.

Hormones…

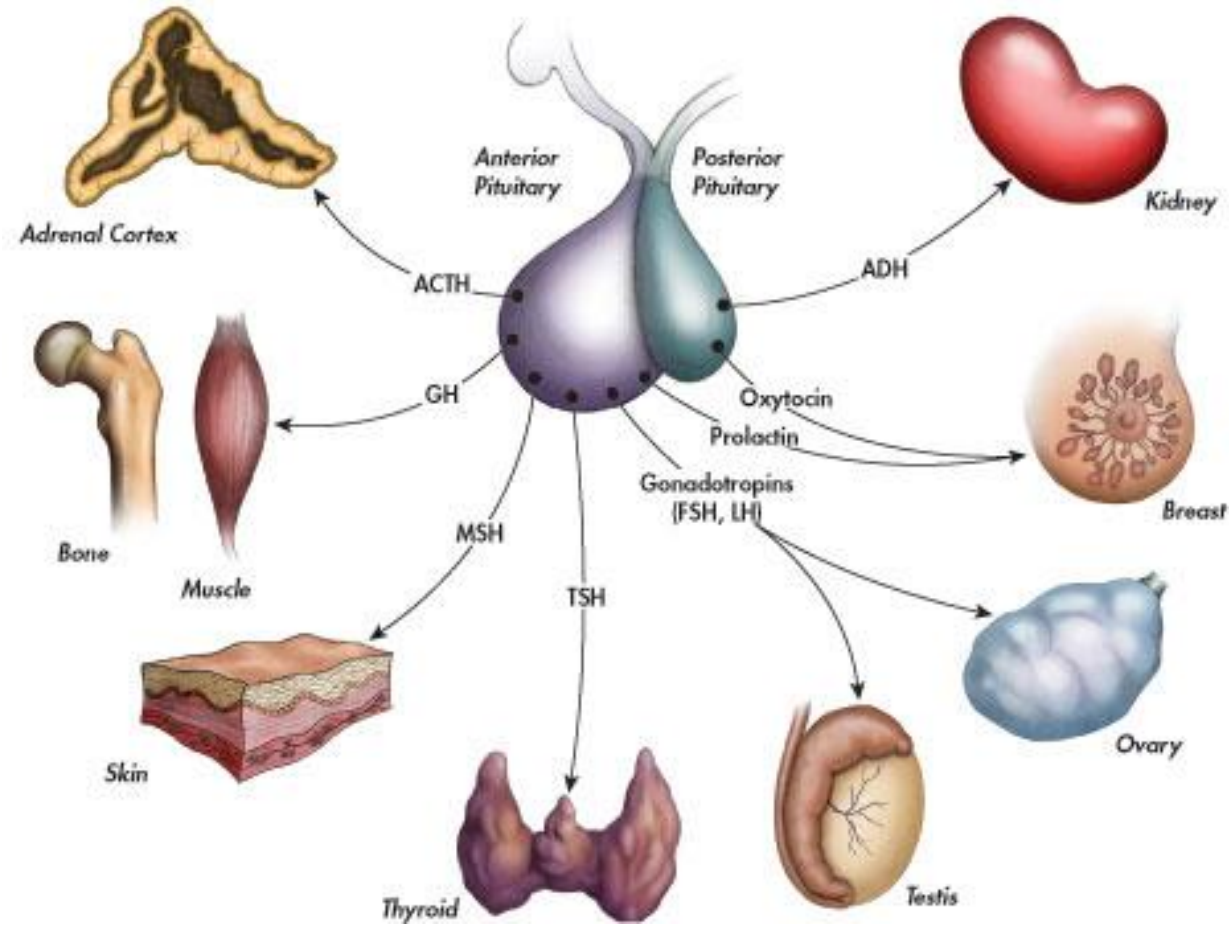


A hormone is a chemical transmitter. It is released in small amounts from glands, and is transported in the bloodstream to target organs or other cells. Hormones are chemical messengers, transferring information and instructions from one set of cells to another.

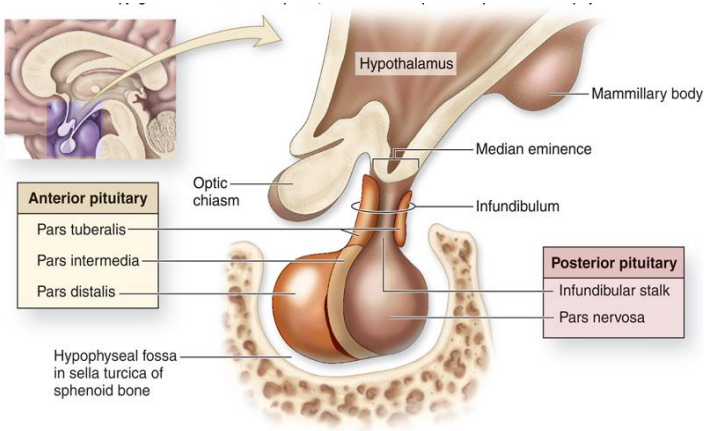
Hormones…

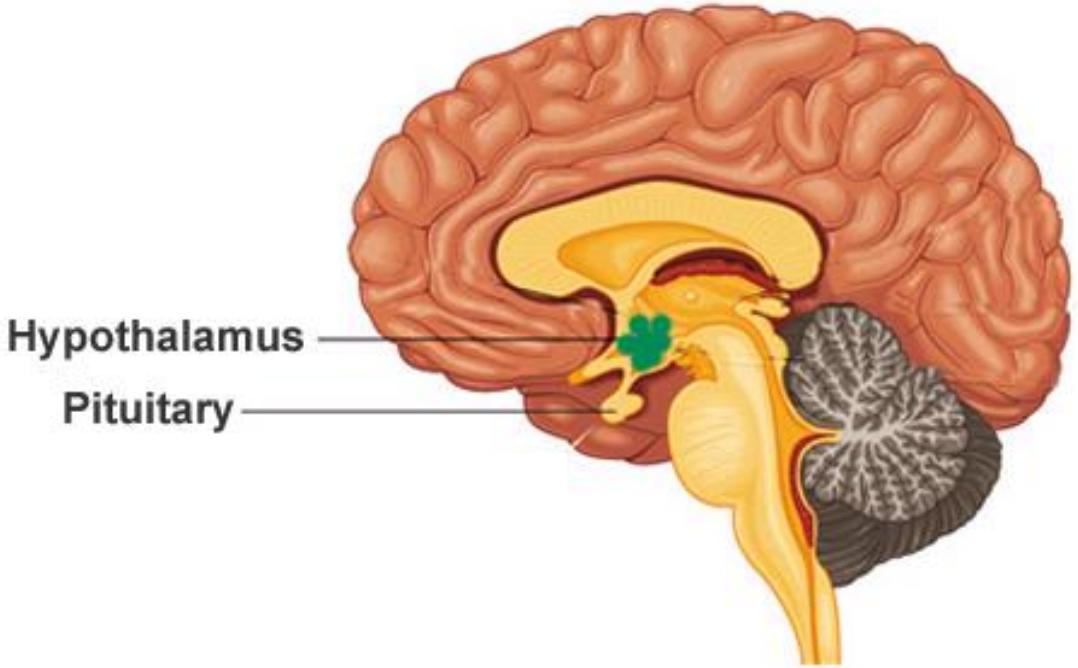
Hormones regulate growth, development, mood, tissue function, metabolism, and sexual function.

Hyposecretion or hypersecretion of any hormone can be harmful to the body. Controlling the production of hormones can treat many hormonal disorders in the body.



Hormones…



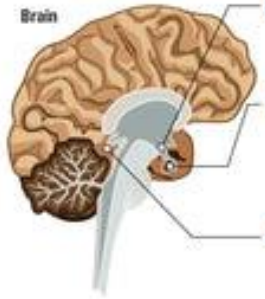


The pituitary gland has 2 lobes…

The endocrine system and nervous system work together to help maintain **homeostasis**… balance. The hypothalamus is a collection of specialized cells located in the brain and is the primary link between the two systems. It produces chemicals that either stimulate or suppress hormone secretions of the pituitary gland.

Human Body: Endocrine System

The endocrine system contains 9 major glands and organs that produce, store, and secrete hormones.



1 Hypothalamus

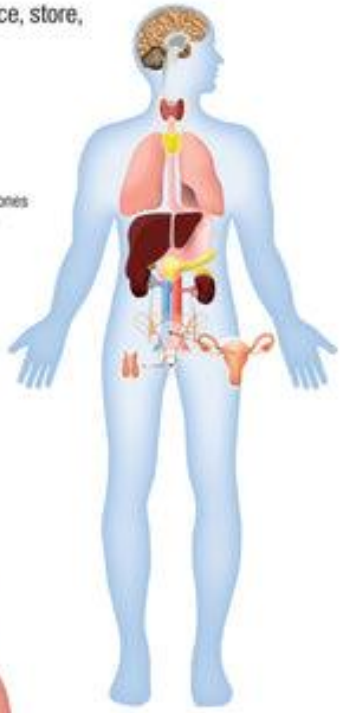
Maintains the body's homeostasis and regulates body temperature, heart rate, and blood pressure.

2 Pituitary Gland

Composed of 2 lobes: the anterior, which secretes hormones involved in the body's growth and development, and the posterior, which secretes hormones that increase the reabsorption of water into the kidneys.

3 Pineal Gland

Responsible for the production of melatonin, which plays a major role in the body's sleep-wake cycle.



4 Thyroid

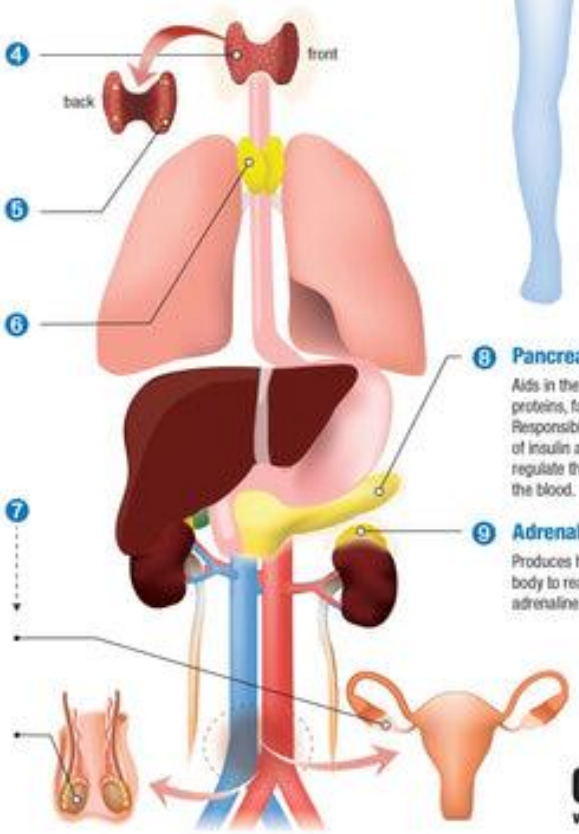
This butterfly-shaped gland produces 3 major hormones: calcitonin, triiodothyronine (T3), and thyroxine (T4). They help regulate the body's energy and metabolism.

5 Parathyroid

The parathyroid, also referred to as the hypophysis, secretes hormones necessary for calcium absorption.

6 Thymus

The thymus controls production of T-cells (white blood cells) and plays a vital role in the body's ability to fight diseases.



7 Ovaries/Testes

The male and female reproductive organs release hormones responsible for blood circulation, mental vigor, and sex drive.

Ovary

Secretes estrogen and progesterone, which play a key role in the health of the female reproductive system.

Testis

Secretes testosterone, which is vital for physical development, bone density, and libido in males.

8 Pancreas

Aids in the digestion of proteins, fats, and carbohydrates. Responsible for the production of insulin and glucagon, which regulate the level of glucose in the blood.

9 Adrenal Gland

Produces hormones that allow the body to react to stress, such as adrenaline and cortisol.

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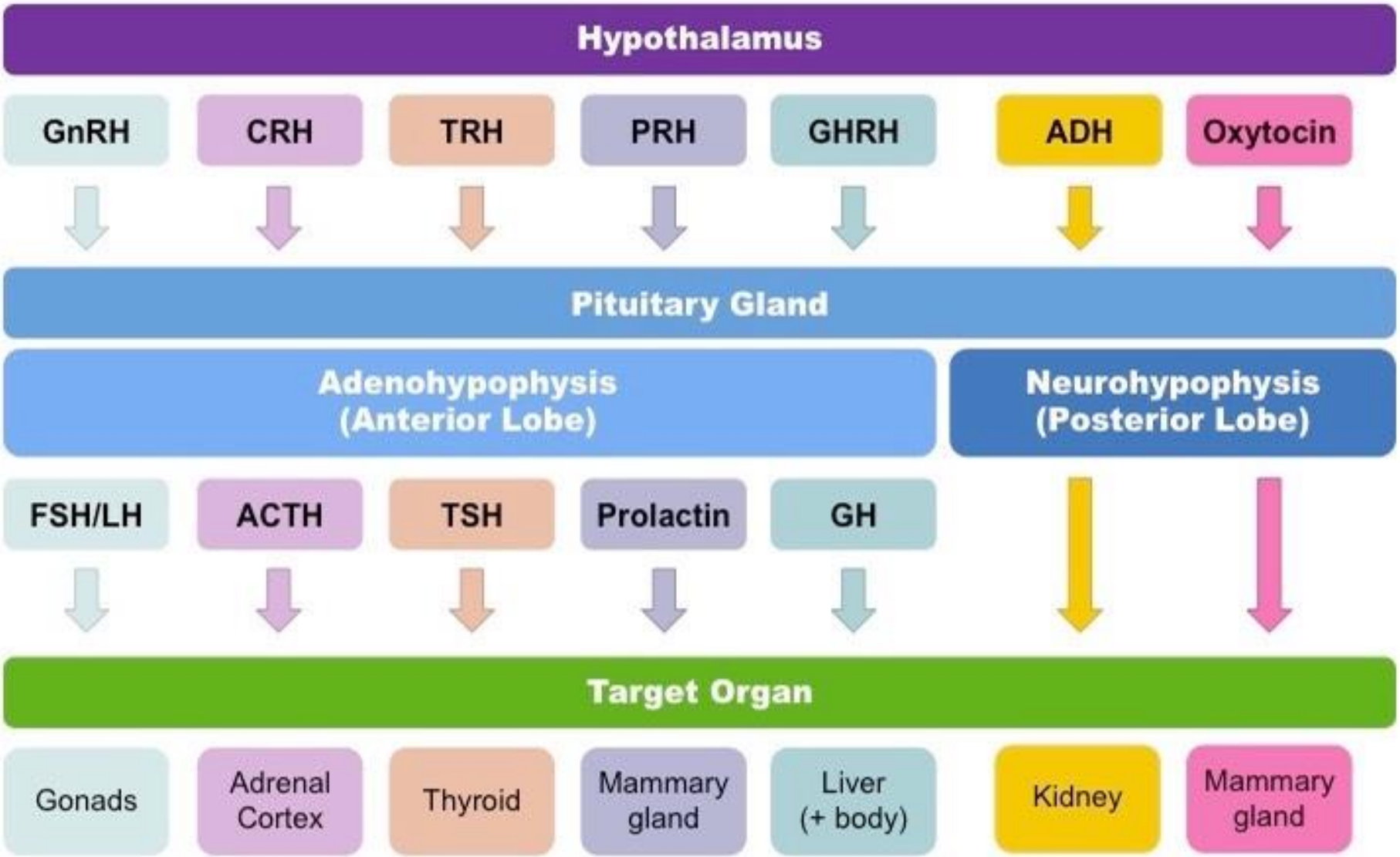

Hypothalamus
GnRH
CRH
TRH
PRH
GHRH
ADH
Oxytocin
Pituitary Gland
Adenohypophysis
(Anterior Lobe)
Neurohypophysis
(Posterior Lobe)
FSH/LH
ACTH
TSH
Prolactin
GH
Target Organ
Gonads
Adrenal
Cortex
Thyroid
Mammary
gland
Liver
(+ body)
Kidney
Mammary
gland

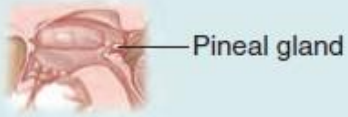
TABLE 10.2 Endocrine Glands, Hormones, and Their Target Tissues

Gland	Hormone	Target Tissue	Response
Pituitary gland			
Anterior	Growth hormone	Most tissues	Increases gene expression, breakdown of lipids, and release of fatty acids from cells; increases blood glucose levels
	Thyroid-stimulating hormone (TSH)	Thyroid gland	Increases thyroid hormone secretion (thyroxine and triiodothyronine)
	Adrenocorticotropic hormone (ACTH)	Adrenal cortex	Increases secretion of glucocorticoid hormones, such as cortisol; increases skin pigmentation at high concentrations
	Melanocyte-stimulating hormone (MSH)	Melanocytes in skin	Increases melanin production in melanocytes to make skin darker in color
	Luteinizing hormone (LH) or interstitial cell-stimulating hormone (ICSH)	Ovary in females, testis in males	Promotes ovulation and progesterone production in ovary; promotes testosterone synthesis and support for sperm cell production in testis
	Follicle-stimulating hormone (FSH)	Follicles in ovary in females, seminiferous tubules in males	Promotes follicle maturation and estrogen secretion in ovary; promotes sperm cell production in testis
	Prolactin	Ovary and mammary gland in females, testis in males	Stimulates milk production and prolongs progesterone secretion following ovulation and during pregnancy in women; increases sensitivity to LH in males
Posterior	Antidiuretic hormone (ADH)	Kidney	Conserves water; constricts blood vessels
	Oxytocin	Uterus	Increases uterine contractions
		Mammary gland	Increases milk letdown from mammary glands

TABLE 10.2 Endocrine Glands, Hormones, and Their Target Tissues

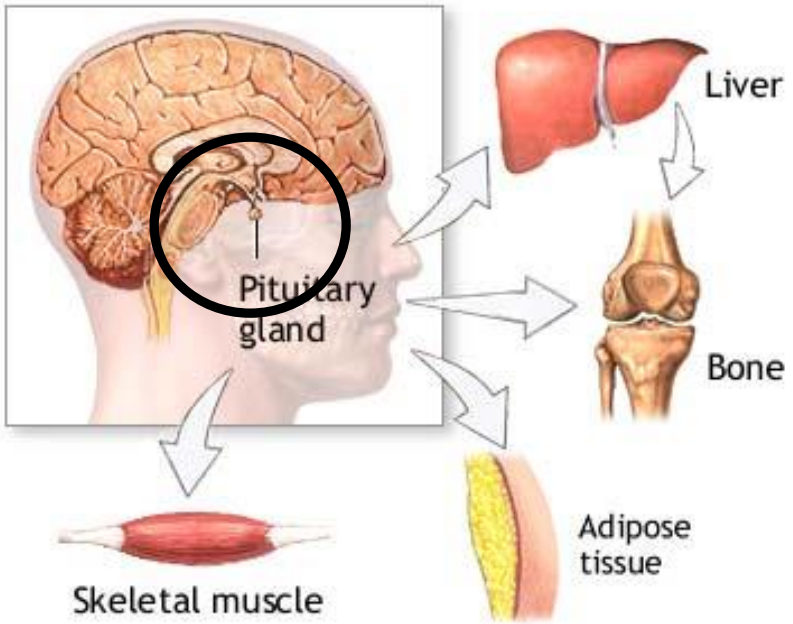
Gland	Hormone	Target Tissue	Response
Thyroid gland 	Thyroid hormones (thyroxine, triiodothyronine)	Most cells of the body	Increase metabolic rates, essential for normal process of growth and maturation
	Calcitonin	Primarily bone	Decreases rate of bone breakdown; prevents large increase in blood Ca^{2+} levels following a meal
Parathyroid glands 	Parathyroid hormone	Bone, kidney	Increases rate of bone breakdown by osteoclasts; increases vitamin D synthesis, essential for maintenance of normal blood calcium levels
Adrenal medulla 	Epinephrine mostly, some norepinephrine	Heart, blood vessels, liver, fat cells	Increases cardiac output; increases blood flow to skeletal muscles and heart; increases release of glucose and fatty acids into blood; in general, prepares body for physical activity
Adrenal cortex 	Mineralocorticoids (aldosterone)	Kidneys; to lesser degree, intestine and sweat glands	Increase rate of sodium transport into body; increase rate of potassium excretion; secondarily favor water retention
	Glucocorticoids (cortisol)	Most tissues (e.g., liver, fat, skeletal muscle, immune tissues)	Increase fat and protein breakdown; increase glucose synthesis from amino acids; increase blood nutrient levels; inhibit inflammation and immune response
	Adrenal androgens	Most tissues	Insignificant in males; increase female sexual drive, growth of pubic and axillary hair
Pancreas 	Insulin	Especially liver, skeletal muscle, adipose tissue	Increases uptake and use of glucose and amino acids
	Glucagon	Primarily liver	Increases breakdown of glycogen and release of glucose into the circulatory system

TABLE 10.2 *continued*

Gland	Hormone	Target Tissue	Response
Reproductive organs			
Testes 	Testosterone	Most tissues	Aids in sperm cell production, maintenance of functional reproductive organs, secondary sexual characteristics, sexual behavior
Ovaries 	Estrogens, progesterone	Most tissues	Aid in uterine and mammary gland development and function, external genitalia structure, secondary sexual characteristics, sexual behavior, menstrual cycle
Uterus, ovaries, inflamed tissues 	Prostaglandins	Most tissues	Mediate inflammatory responses; increase uterine contractions and ovulation
Thymus 	Thymosin	Immune tissues	Promotes immune system development and function
Pineal gland 	Melatonin	Among others, hypothalamus	Inhibits secretion of gonadotropin-releasing hormone, thereby inhibiting reproduction

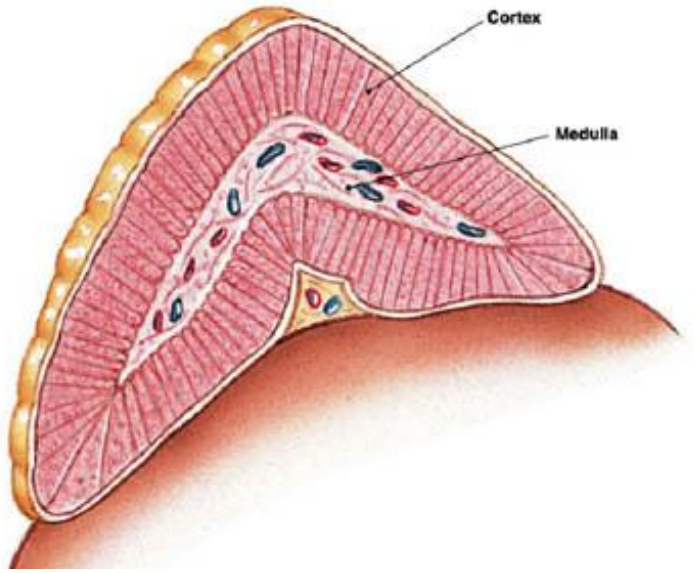
Secretions from the anterior pituitary gland…

Growth Hormone (GH): essential for the growth and development of bones, muscles, and other organs. It also enhances protein synthesis, decreases the use of glucose, and promotes fat destruction.

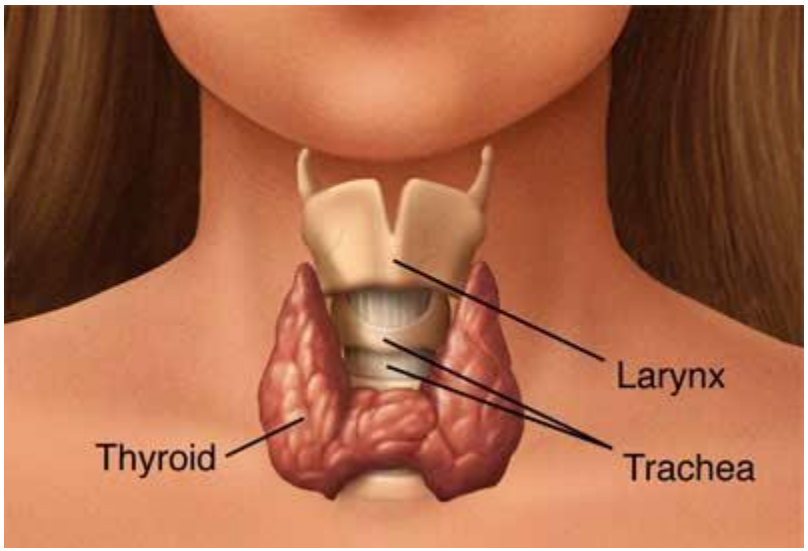


Secretions from the anterior pituitary gland…

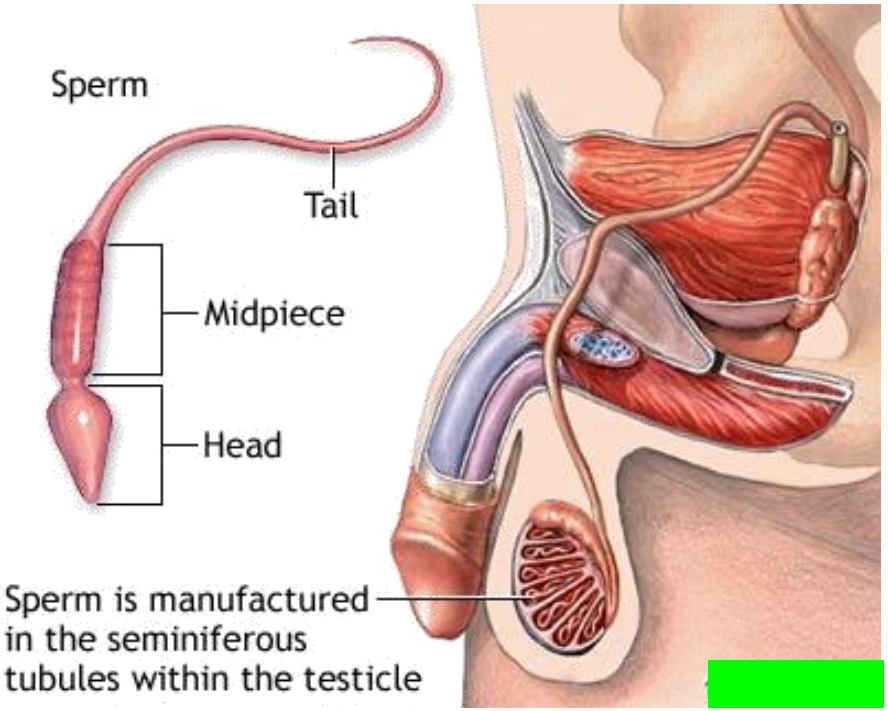
Adrenocorticotropin (ACTH): essential for the growth of the adrenal cortex.



Thyroid-Stimulating Hormone (TSH): essential for the growth and development of the thyroid gland.

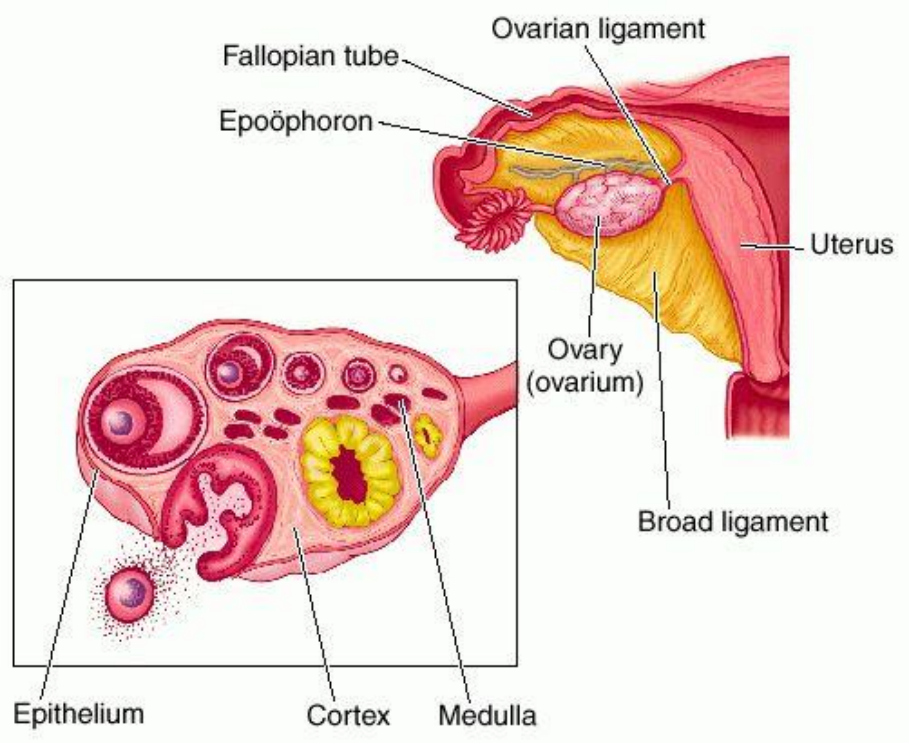


Secretions from the anterior pituitary gland…

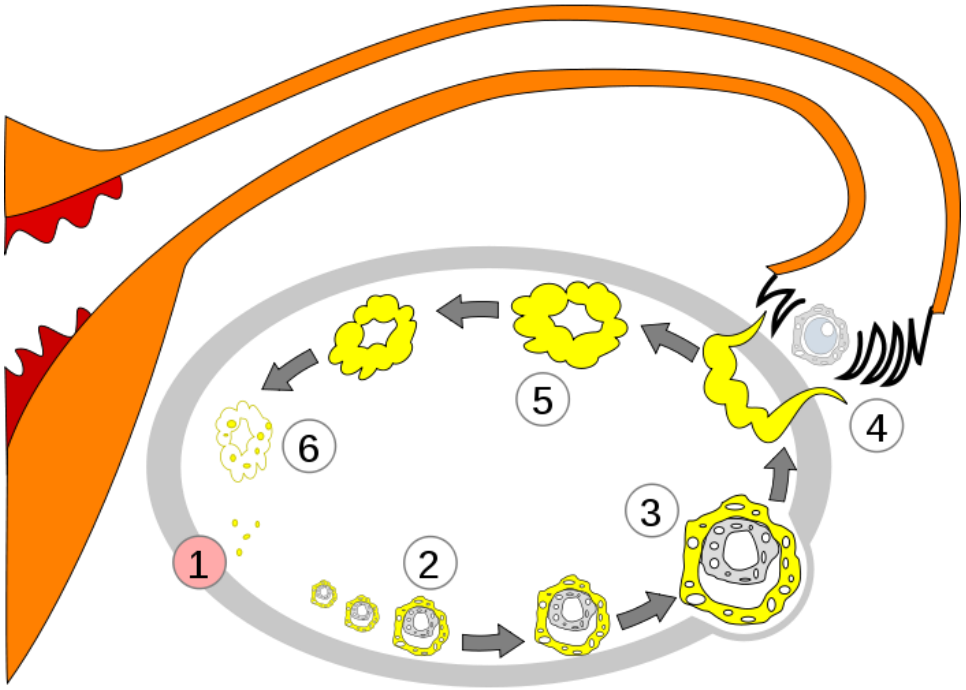


Follicle-Stimulating Hormone (FSH): is a gonadotropic hormone.

It stimulates the growth of ovarian follicles in the female and the production of sperm in the male.



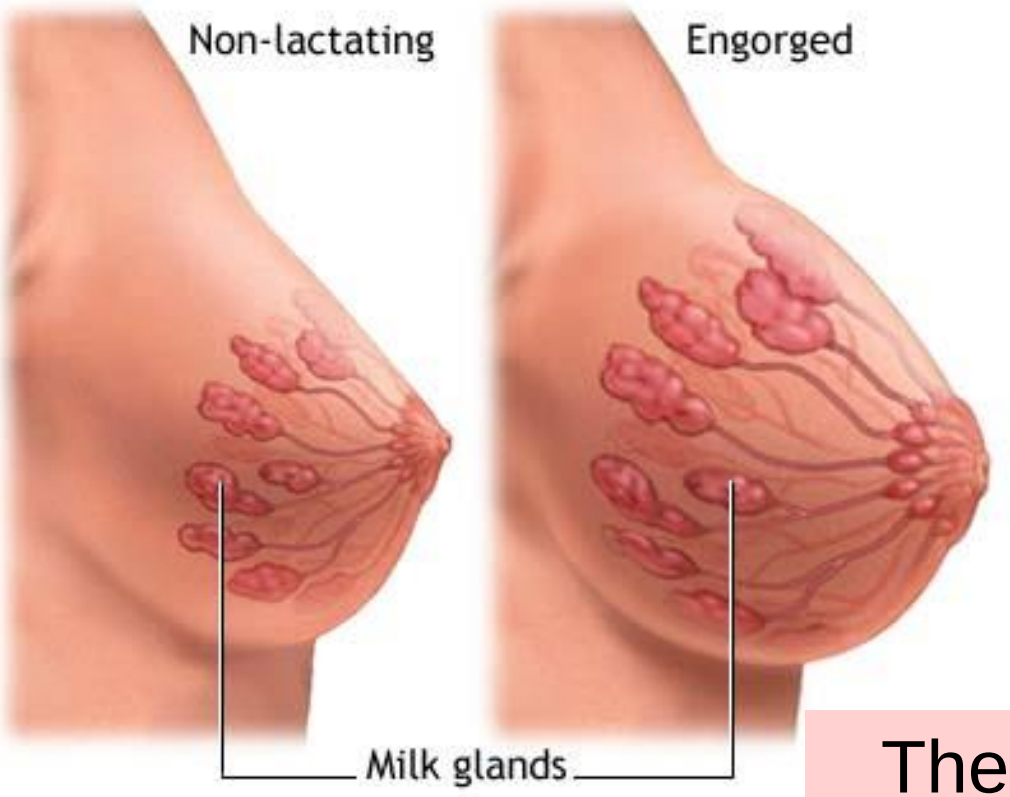
Secretions from the anterior pituitary gland…



The yellow corpus luteum remains after ovulation; it produces **estrogen** and **progesterone**.

Luteinizing Hormone (LH): is a gonadotropic hormone stimulating the development of corpus luteum in the female ovarian follicles and the production of testosterone in the male.

Secretions from the anterior pituitary gland...



Prolactin (PRL): stimulates the development and growth of the mammary glands and milk production during pregnancy.

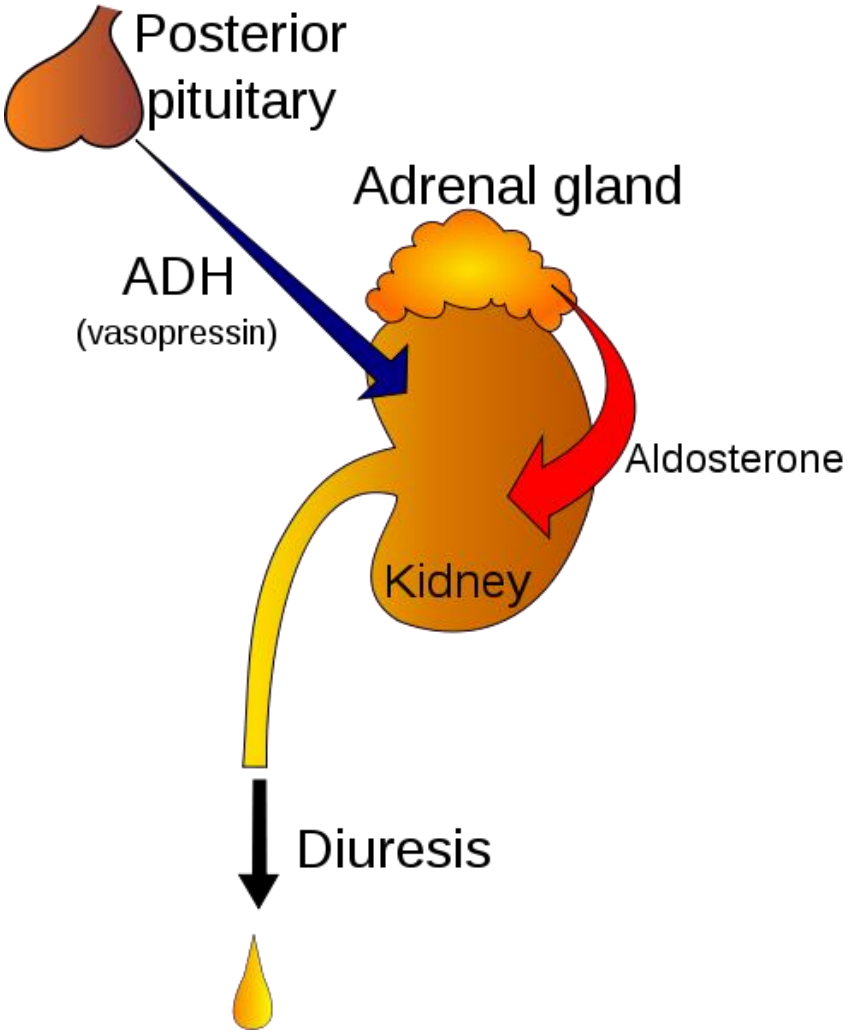
The sucking motion of the baby stimulates prolactin secretion.

Secretions from the anterior pituitary gland...

Melanocyte-stimulating hormone (MSH): regulates skin pigmentation and promotes the deposit of melanine in the skin after exposure to sunlight

Secretions from the posterior lobe of the pituitary gland…

Antidiuretic Hormone (ADH): stimulates the reabsorption of water by the renal tubules. Hyposecretion of this hormone can result in diabetes insipidus.



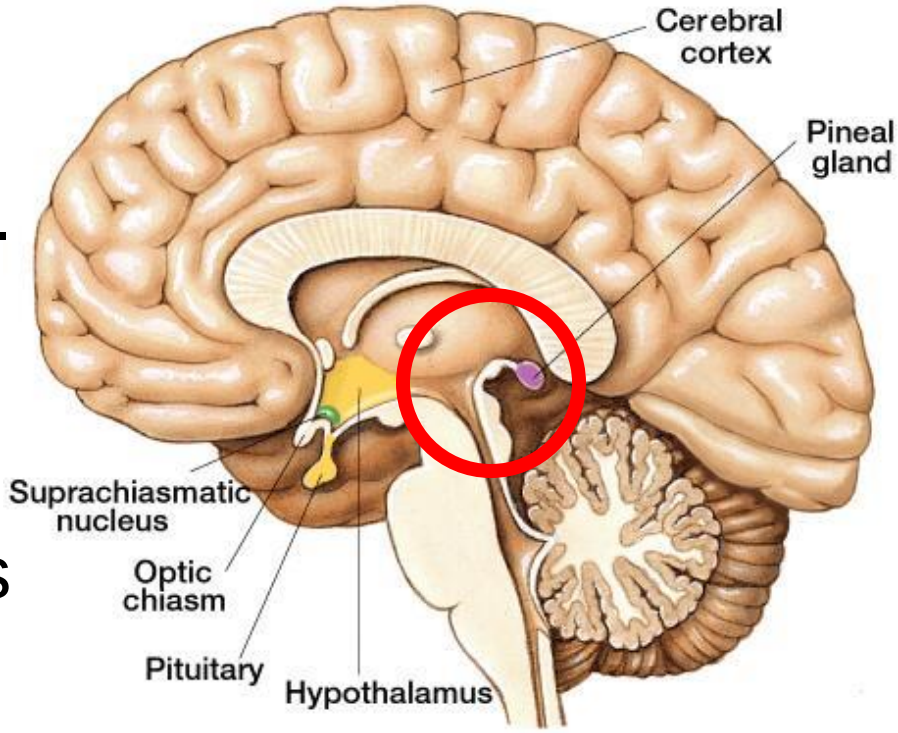
Secretions from the posterior lobe of the pituitary gland…

Oxytocin: stimulates the uterus to contract during labor, delivery, and parturition. A synthetic version of this hormone, used to induce labor, is called Pitocin. It also stimulates the mammary glands to release milk.

Secretions from the pineal gland…

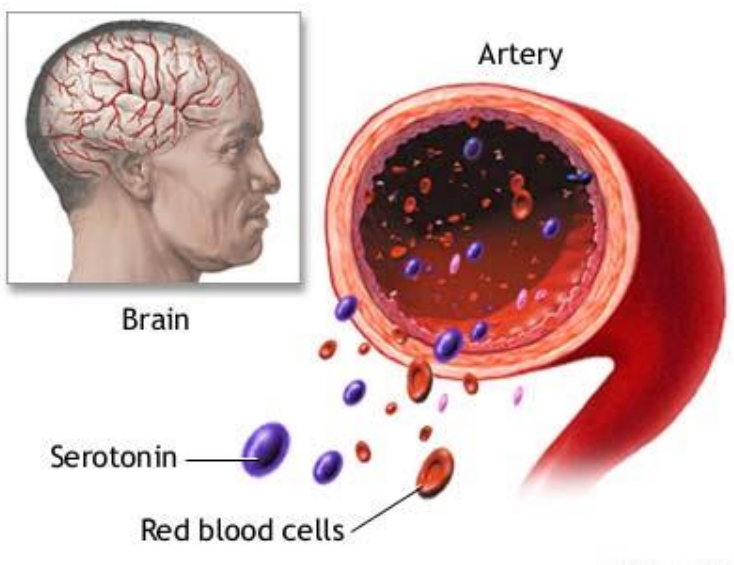
The pineal gland is pine-cone-shaped and only about 1 cm in diameter.

Melatonin: communicates information about environmental lighting to various parts of the body. Has some effect on sleep/awake cycles and other biological events connected to them, such as a lower production of gastric secretions at night.



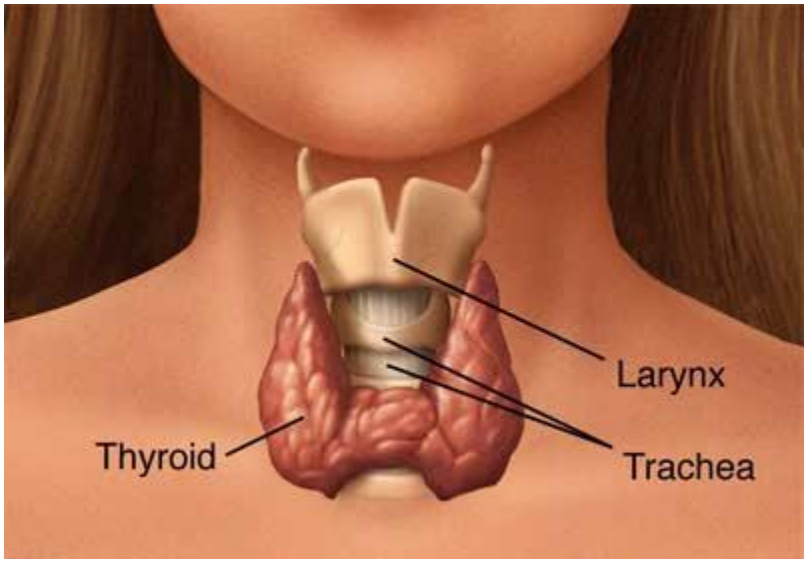
Secretions from the pineal gland…

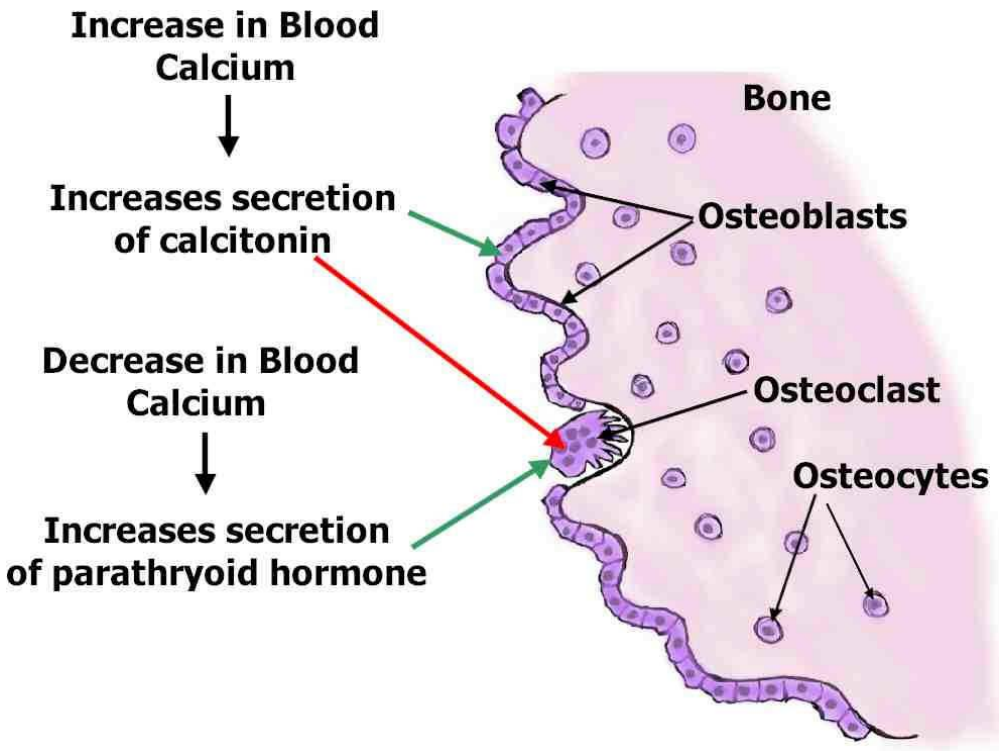
Serotonin: a neurotransmitter that regulates intestinal movements and affects appetite, mood, sleep, anger, and metabolism.



Secretions of the thyroid gland…

The thyroid gland plays a vital role in metabolism and regulates the body's metabolic processes.





Calcitonin: influences bone and calcium metabolism; maintains a homeostasis of calcium in the blood plasma

Secretions of the thyroid gland…

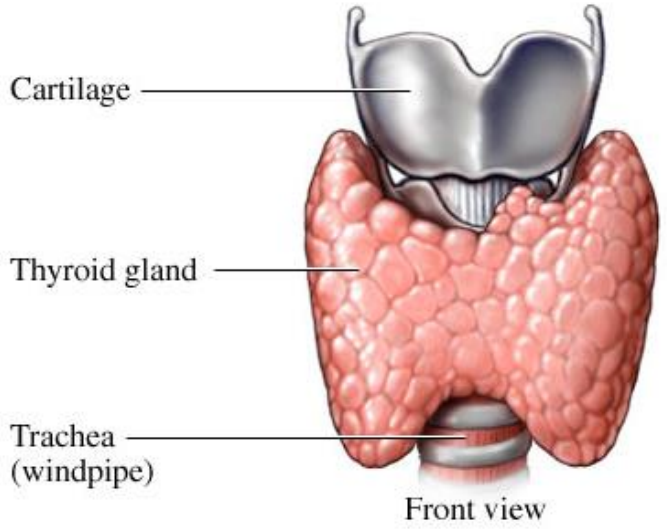
Thyroxine (T4) and **triodothyronine (T3):** essential to BMR – basal metabolic rate (the rate at which a person's body burns calories while at rest); influences physical/mental development and growth

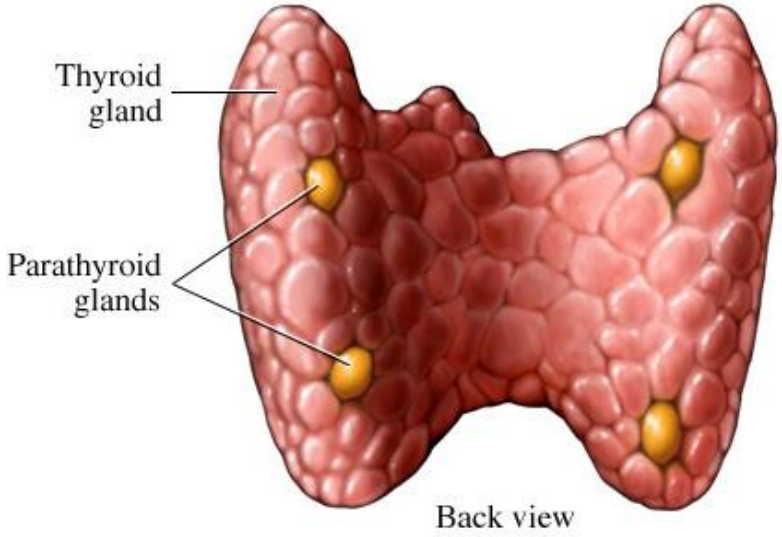
Hyposecretion of T3 and T4 = cretinism, myxedema, Hashimoto's disease

Hypersecretion of T3 and T4 = Grave's disease, goiter, Basedow's disease

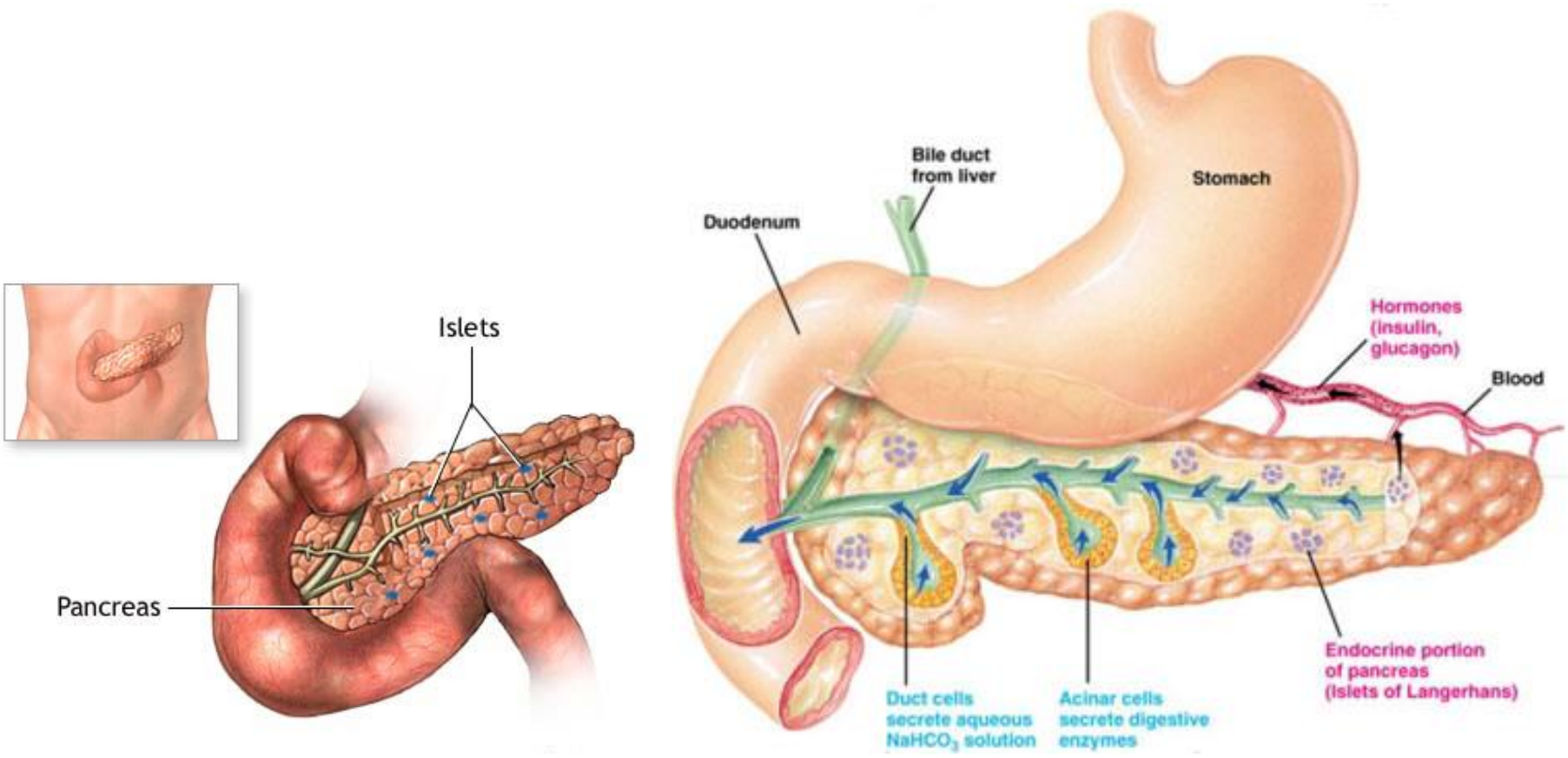
Secretions of the parathyroid gland…

The two pairs of parathyroid glands are located on the dorsal or back side of the thyroid gland. They secrete **parathyroid (PTH)** which plays a role in the metabolism of phosphorus. Too little results in cramping; too much results in osteoporosis or kidney stones.





The islets of Langerhans…



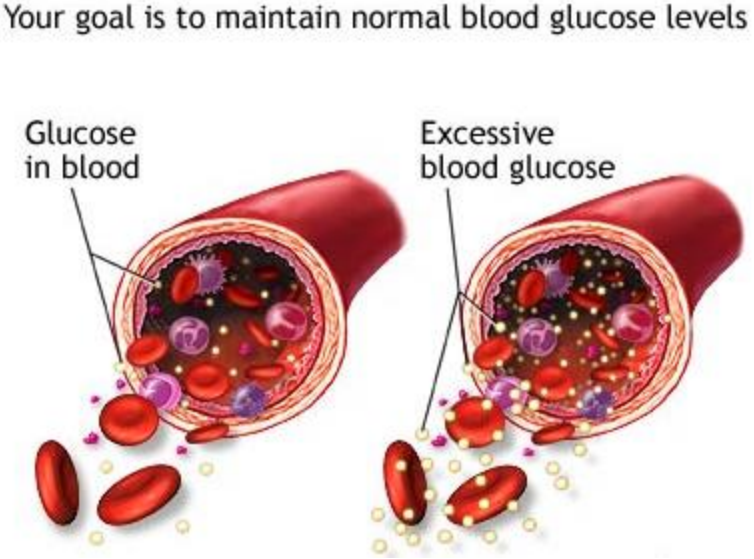
The islets of Langerhans are small clusters of cells located in the pancreas.

Secretions from the islets of Langerhans…

Alpha cells facilitate the breakdown of glycogen to glucose. This elevates the blood sugar.

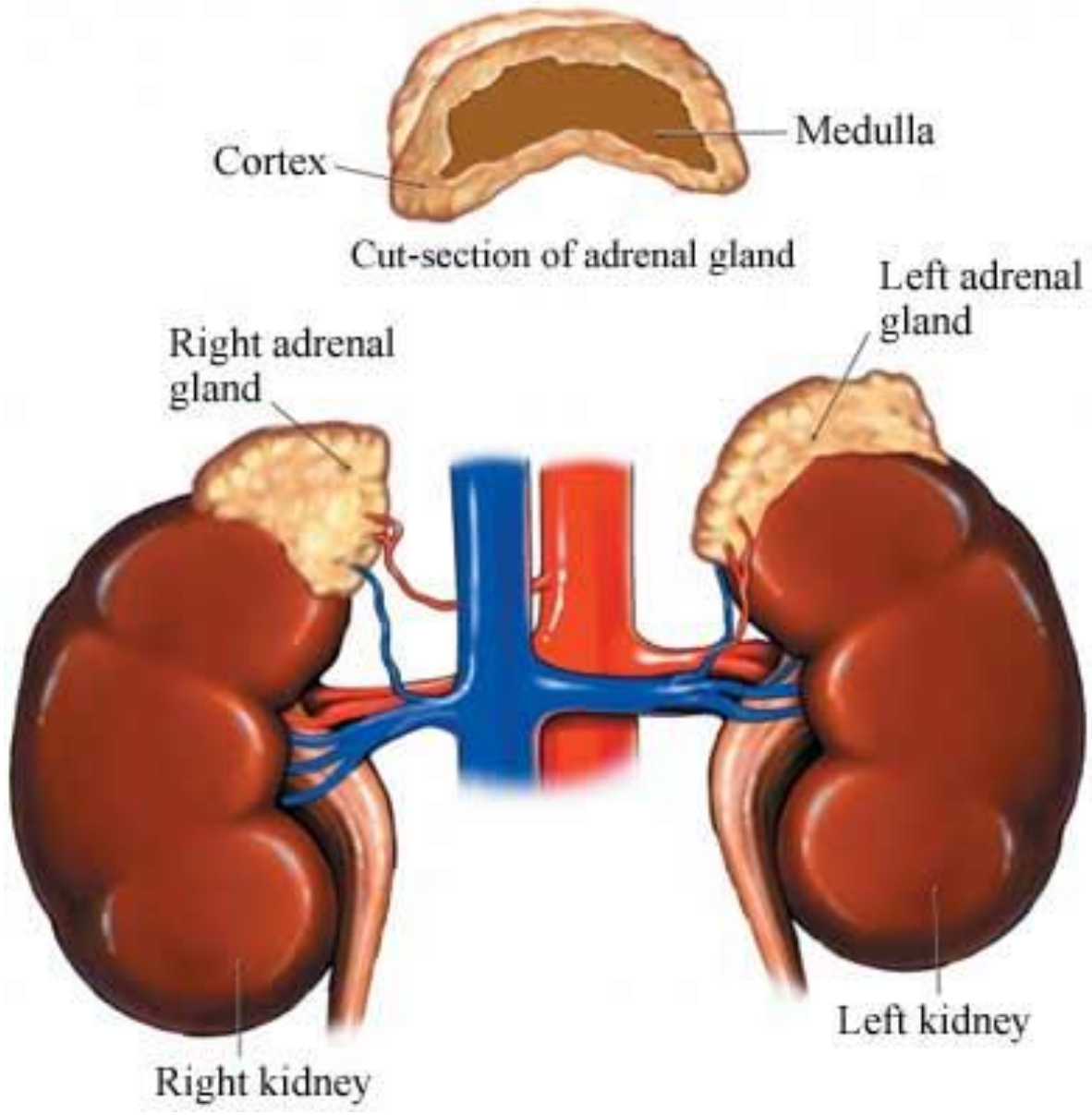
Beta cells secrete the hormone insulin, which is essential for the maintenance of normal blood sugar levels. Inadequate levels result in diabetes mellitus.

Delta cells suppress the release of **glucagon** and **insulin**.



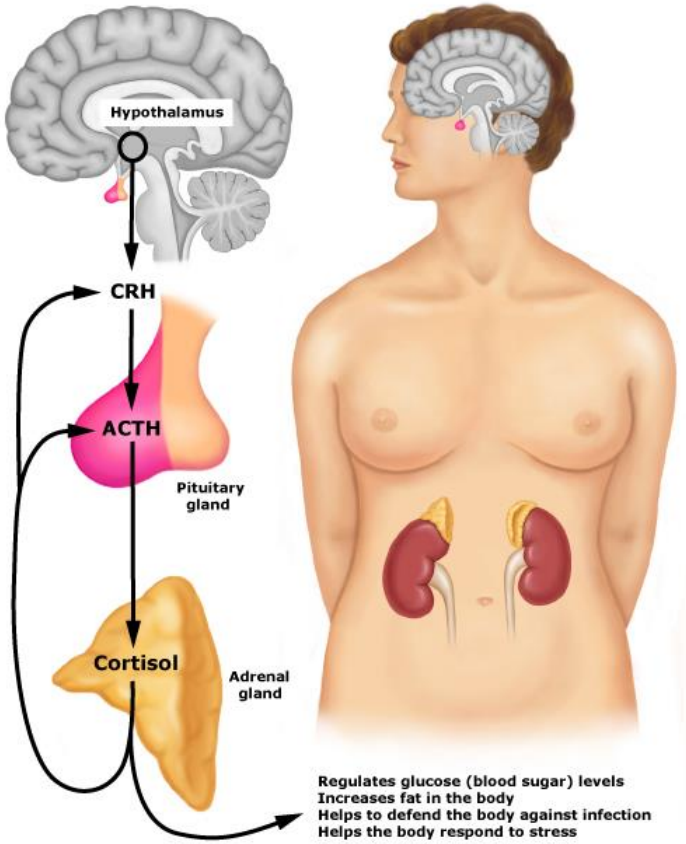
The adrenal glands…

The triangular-shaped adrenal glands are located on the top of each kidney. The inside is called the medulla and the outside layer is called the cortex.



Secretions from the adrenal cortex…

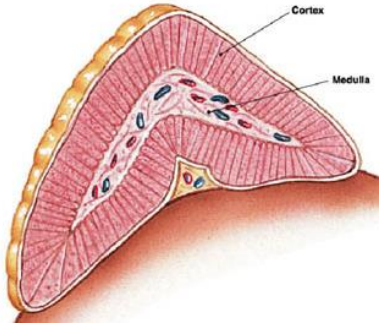
Cortisol: regulates carbohydrate, protein, and fat metabolism; has an anti-inflammatory effect; helps the body cope during times of stress



Hyposecretion results in Addison's disease; hypersecretion results in Cushing's disease

Corticosterone: like cortisol, it is a steroid; influences potassium and sodium metabolism

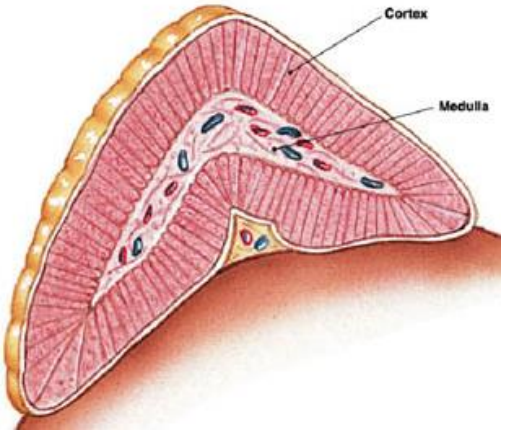
Secretions from the adrenal cortex…



Aldosterone: essential in regulating electrolyte and water balance by promoting sodium and chloride retention and potassium excretion.

Androgens: several hormones including testosterone; they promote the development of secondary sex characteristics in the male.

Secretions from the adrenal medulla…



Dopamine is used to treat shock. It dilates the arteries, elevates systolic blood pressure, increases cardiac output, and increases urinary output.

Secretions from the adrenal medulla…

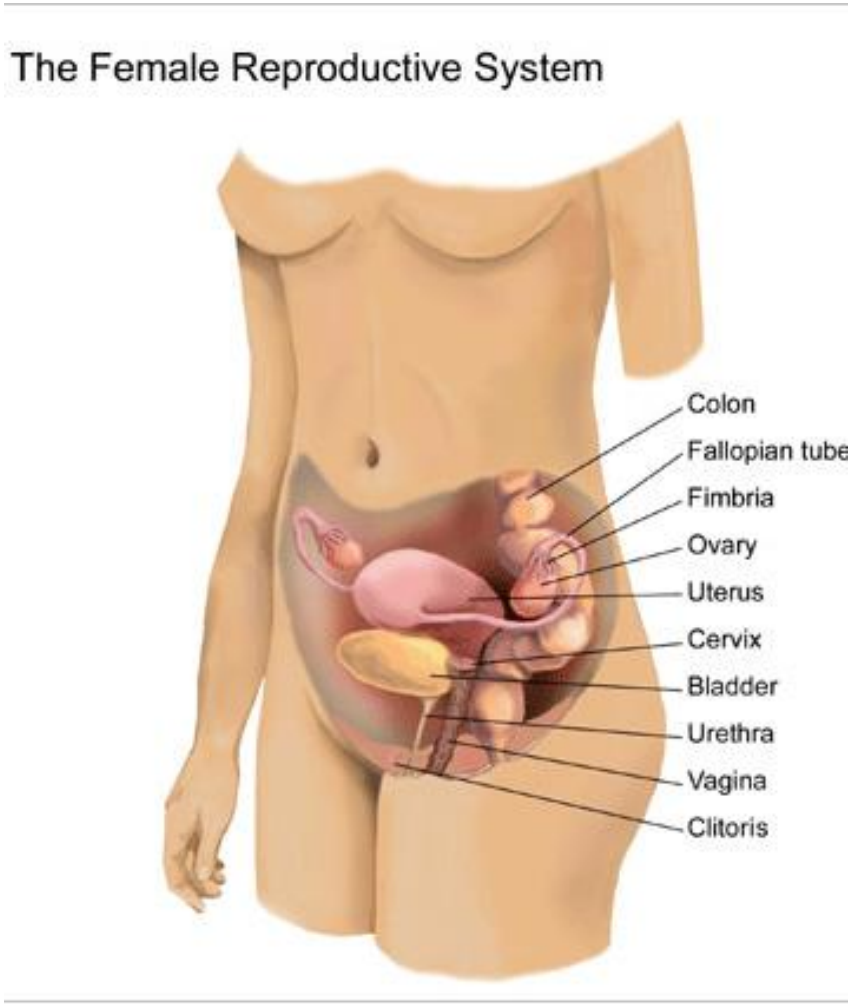
Epinephrine is also called adrenalin. It elevates systolic blood pressure, increases heart rate and cardiac output, speeds up the release of glucose from the liver… giving a spurt of energy, dilates the bronchial tubes and relaxes airways, and dilates the pupils to see more clearly. It is often used to counteract an allergic reaction.

Secretions from the adrenal medulla…

Norepinephrine, like epinephrine, is released when the body is under stress. It creates the underlying influence in the *fight or flight response*.

Secretions of the ovaries…

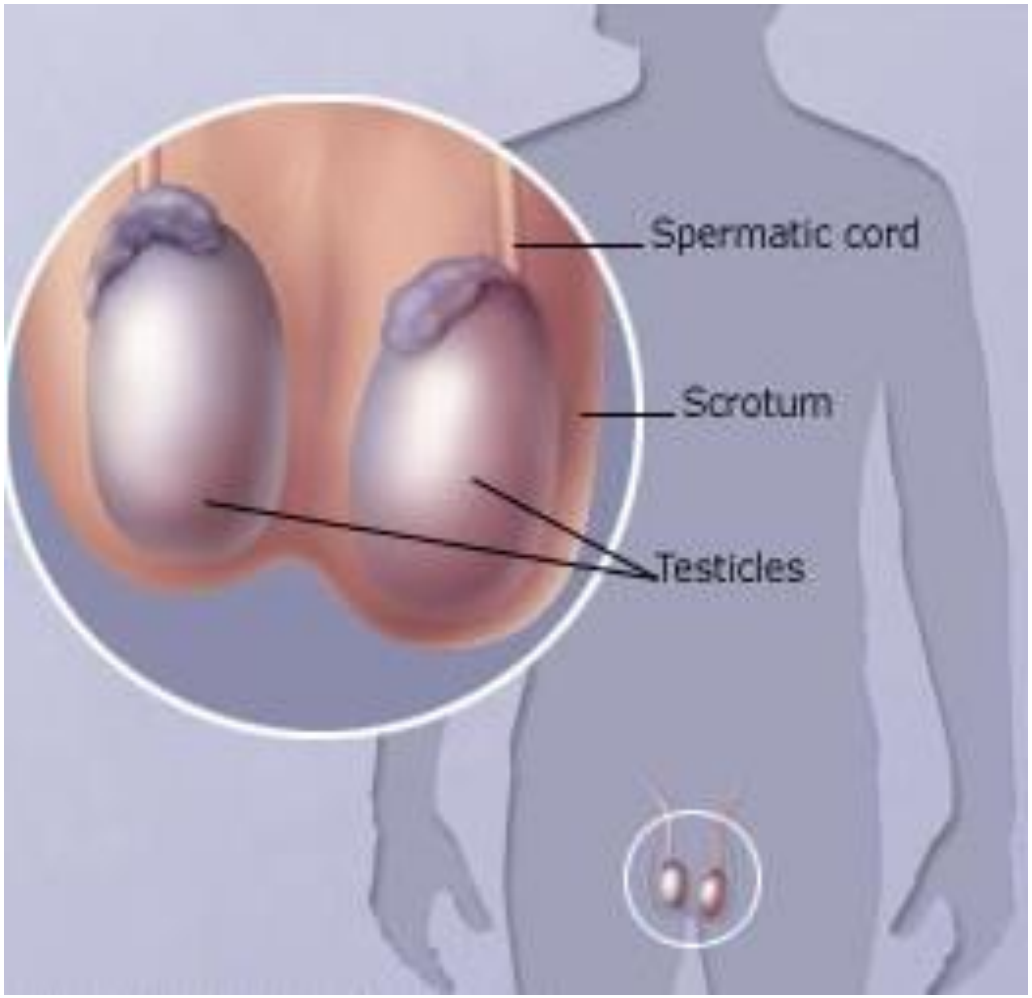
The ovaries produce several **estrogen** hormones and **progesterone**. These hormones prepare the uterus for pregnancy, promote the development of mammary glands, play a role in sex drive, and develop secondary sex characteristics in the female.



Estrogen is essential for the growth, development, and maintenance of female sex organs.

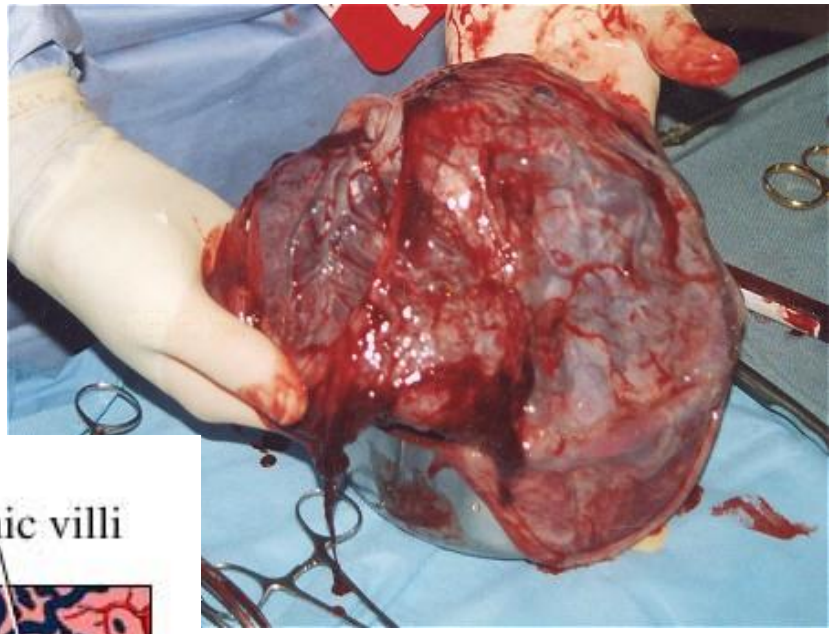
Secretions of the testes…

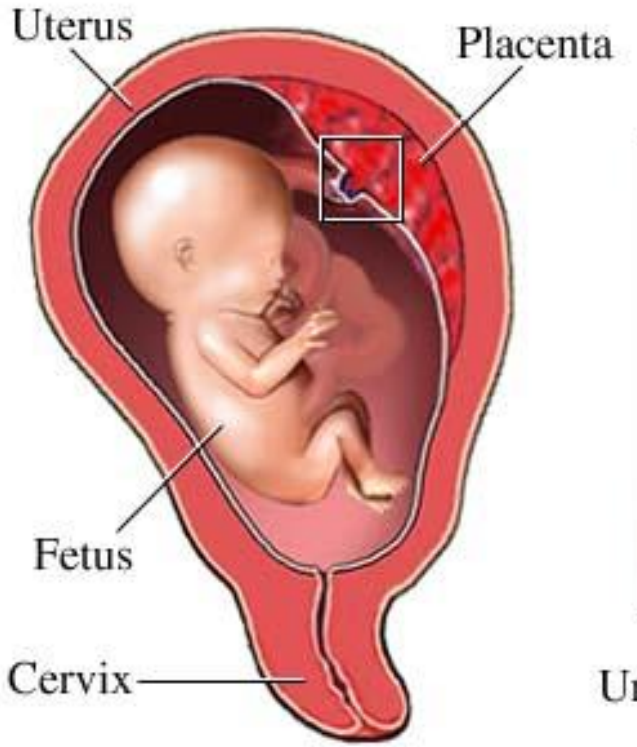
The testes produce the male sex hormone called **testosterone**. It is essential for normal growth and development of the male sex organs. Testosterone is responsible for the erection of the penis.

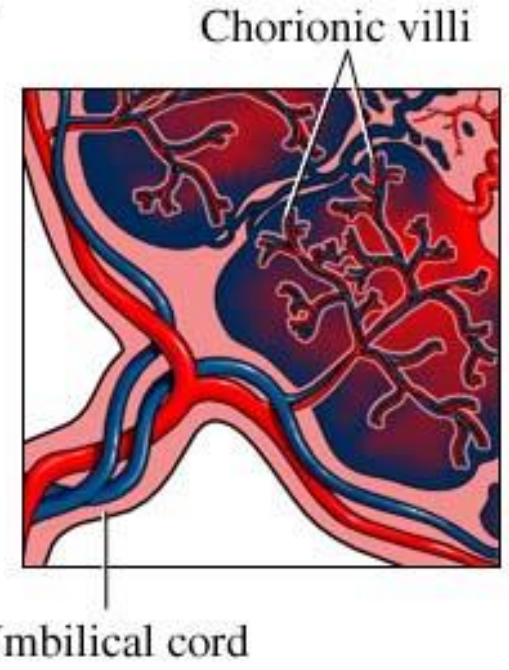


Secretions of the placenta…

During pregnancy, the placenta serves as an endocrine gland.



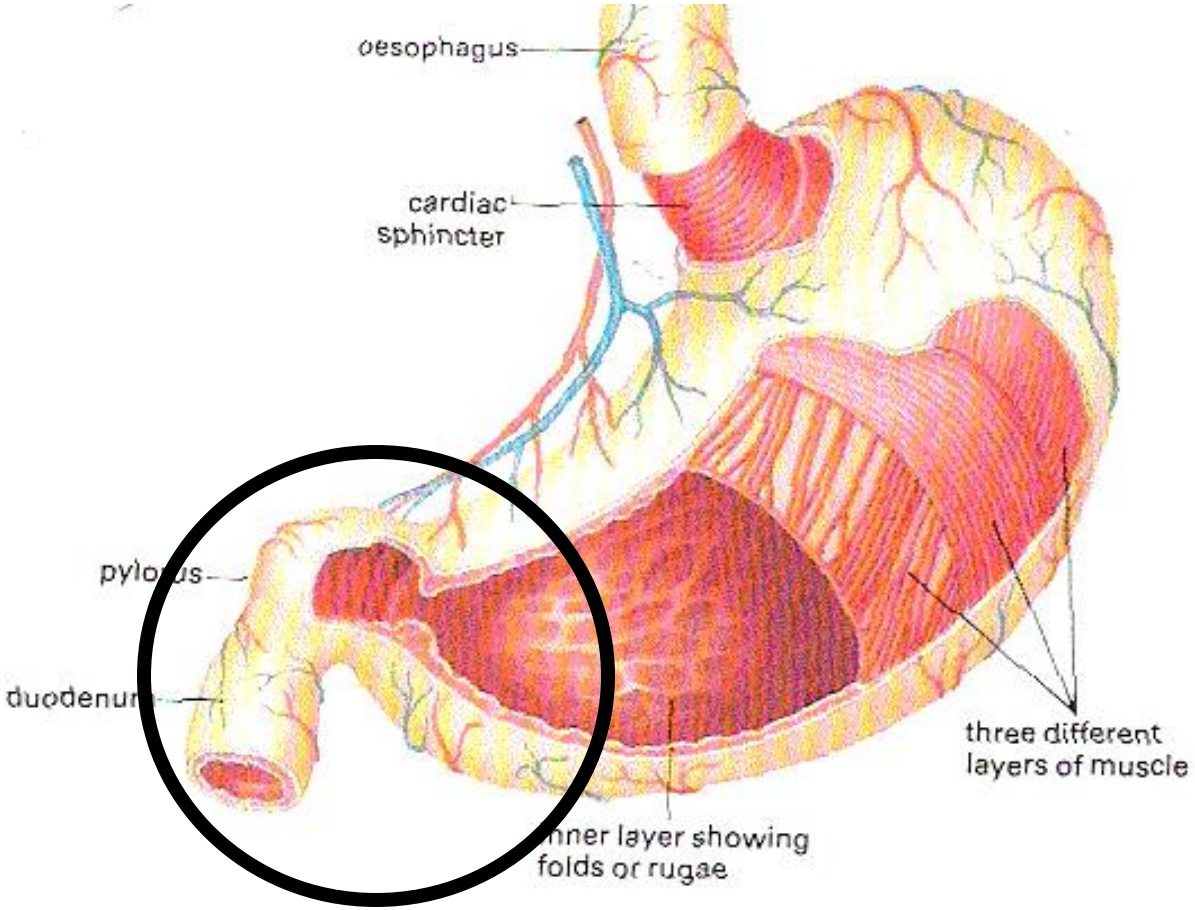




It produces chorionic **gonadotropin hormone, estrogen**, and **progesterone**.

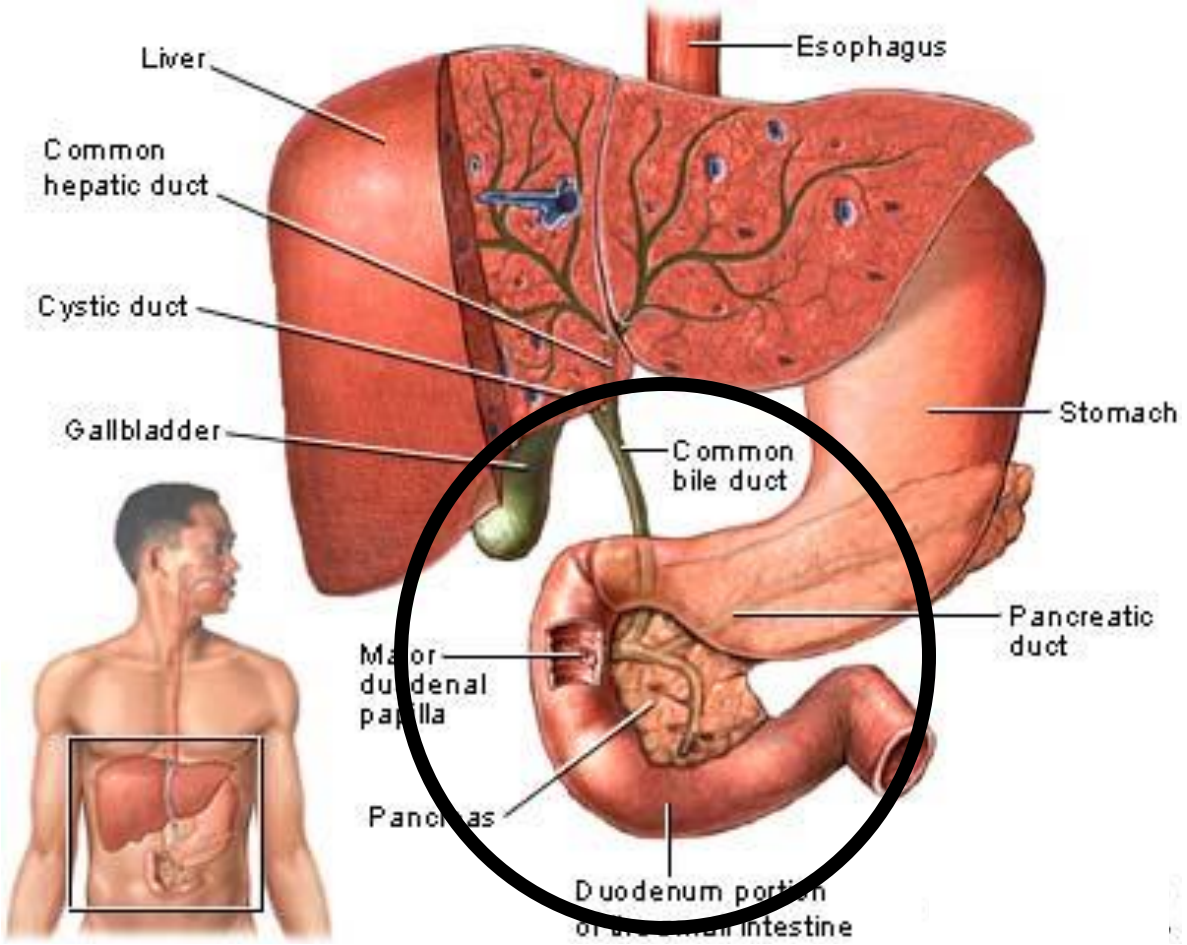
Secretions of the gastrointestinal mucosa…

The mucosa of the pyloric area of the stomach secretes the hormone **gastrin**, which stimulates the production of gastric acid for digestion.



Secretions of the gastrointestinal mucosa…

The mucosa of the duodenum and jejunum secretes the hormone **secretin**, which stimulates pancreatic juice, bile, and intestinal secretion.



Secretions of the thymus...

The thymus gland has two lobes, and is part of the lymphatic system. It is a ductless gland, and secretes **thymosin**. This is necessary for the Thymus' normal production of T cells for the immune system.