EXPERIMENT NO.: 14. e **DATE:**

AIM: TO STUDY THE ENDOCRINE SYSTEM USING CHARTS & SPECIMENS.

REQUIRMENT: - Human endocrine system chart & model.

THEORY:

- The nervous and endocrine systems act together to coordinate functions of all body systems.
- The endocrine system also controls body activities by releasing mediators, called hormones, but the means of control of the two systems are very different.
- A hormone is a mediator molecule that is released in one part of the body but regulates the activity of cells in other parts of the body.
- Most hormones enter in interstitial fluid and then the bloodstream.
- The circulating blood delivers hormones to cells throughout the body.
- Both neurotransmitters and hormones exert their effects by binding to receptors on or in their "target" cells.
- Several mediators act as both neurotransmitters and hormones.
- One familiar example is norepinephrine, which is released as a neurotransmitter by sympathetic postganglionic neurons and as a hormone by chromaffin cells of the adrenal medullae.

The body contains two kinds of glands:

1. Exocrine glands &
2. Endocrine glands

Sr. no	Exocrine glands	Endocrine glands.
1	Exocrine glands (exo- _ outside) secrete their products into ducts that carry the secretions into body cavities, into the lumen of an organ, or to the outer surface of the body.	Endocrine glands (endo- _ within) secrete their products (hormones) into the interstitial fluid surrounding the secretory cells rather than into ducts.
2	Exocrine glands include sudoriferous (sweat), sebaceous (oil), mucous, and digestive glands.	From the interstitial fluid, hormones diffuse into blood capillaries and blood carries them to target cells throughout the body.

- The endocrine glands include:
  - ✓ 1- The Pituitary,
  - ✓ 1- Thyroid,
  - ✓ 4- Parathyroid,
  - ✓ 2- Adrenal
  - ✓ 1-Pineal glands
  - ✓ 1- Pancreatic gland
  - ✓ 2- Ovaries
  - ✓ 2- Testis
  - ✓ 1- Thymus

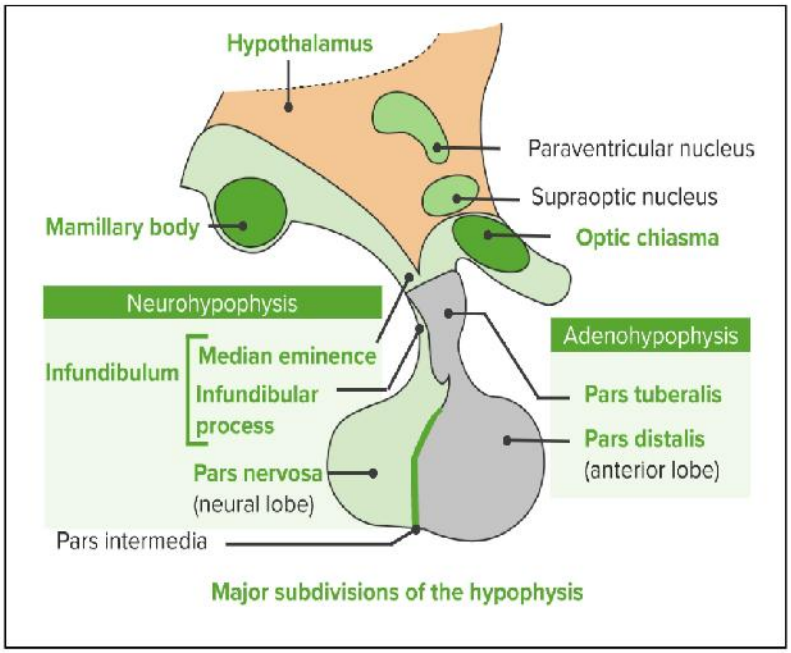
HYPOTHALAMUS AND PITUITARY GLAND

- The pituitary gland (or hypophysis) was called the "master" endocrine gland because it secretes several hormones that control other endocrine glands.
- The pituitary gland itself has a master—the hypothalamus.
- This small region of the brain below the thalamus is the major link between the nervous and endocrine systems.

- Cells in the hypothalamus synthesize at least nine different hormones, and the pituitary gland secretes seven.
- Together, these 16 hormones play important roles in the regulation of virtually all aspects of growth, development, metabolism, and homeostasis.
- Hypothalamus secreting following hormones
    1. Thyrotropin-releasing hormone (TRH)
        - Stimulates release of TSH (thyrotropin) and Prolactin
    2. Corticotropin-releasing hormone (CRH)
        - Stimulates release of ACTH (corticotropin)
    3. Gonadrotropin-releasing hormone (GnRH)
        - Stimulates release of FSH and LH (gonadotropins)
    4. Growth hormone-releasing hormone (GHRH)
        - Stimulates release of growth hormone
    5. Growth hormone release inhibiting hormone (GHRIH)
        - Inhibits release of growth hormone
    6. Prolactin-releasing hormone (PRH)
        - Stimulates release of prolactin
    7. Prolactin release inhibitory hormone (PRIH)
        - Inhibits release of prolactin
    8. Dopamine
- Pituitary glands secreting-
    1. Growth hormone (GH)
    2. Prolactin
    3. Adrenocorticotropic hormone (ACTH, Corticotrophin)
    4. Thyroid stimulating hormones (TSH, Thyrotrophin)
    5. Gonadotrophins- Follicle stimulating hormone (FSH)
    6. Luteinizing hormone (LH)
    7. Oxytocin
    8. Antidiuretic hormone (ADH, Vasopressin)

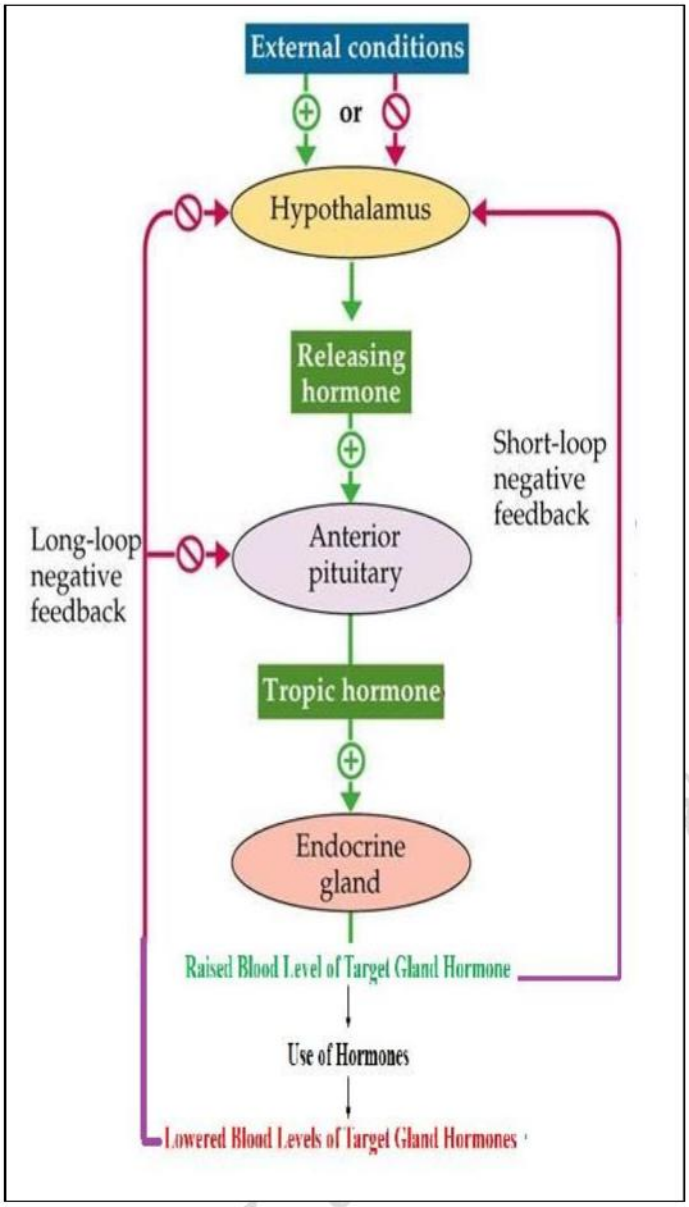
Structure of pituitary gland

- The pituitary gland is a pea-shaped structure that measures 1–1.5 cm (0.5 in.) in diameter
- It lies in the hypophyseal fossa of the sphenoid bone.
- It attaches to the hypothalamus by a stalk, the infundibulum.
- It has two anatomically and functionally separate portions:
    - ✓ Anterior pituitary
    - ✓ Posterior pituitary
- The anterior pituitary (anterior lobe), also called the adenohypophysis, accounts for about 75% of the total weight of the gland.

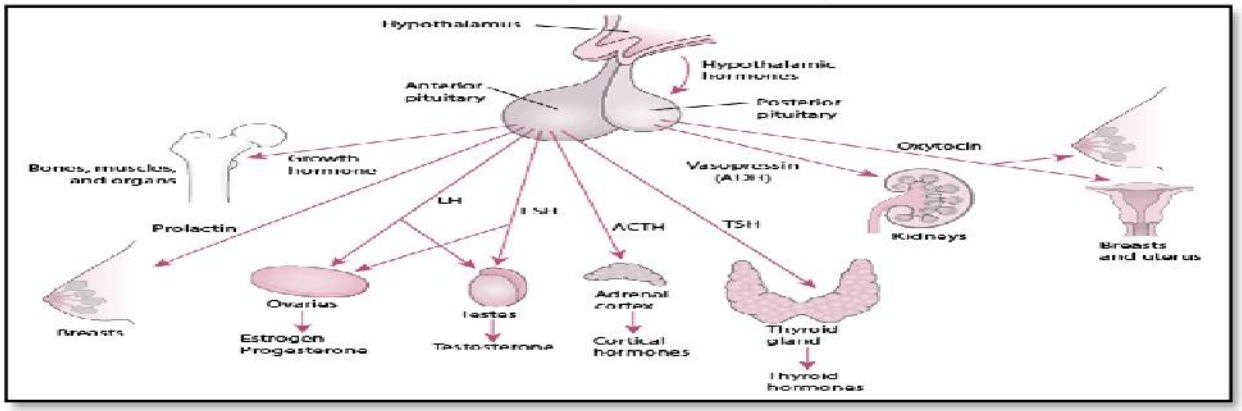


- ❖ The posterior pituitary (posterior lobe), also called the neurohypophysis.
- ❖ A third region of the pituitary gland called the pars intermedia.

FEEDBACK MECHANISM OF ENDOCRINE HORMONE SECRETION



- ❖ The neurosecretory cells synthesize the hypothalamic releasing and inhibiting hormones in their cell bodies and package the hormones inside vesicles, which reach the axon terminals by axonal transport.
- ❖ Nerve impulses [external stimuli] stimulate the vesicles to undergo exocytosis.
- ❖ The hormones then diffuse into the primary plexus of the hypophyseal portal system.
- ❖ The hypothalamic hormones flow with the blood through the portal veins and into the secondary plexus.
- ❖ Hypothalamic hormones then act on anterior pituitary cells.
- ❖ Hormones secreted by anterior pituitary cells pass into the secondary plexus capillaries, which drain into the anterior hypophyseal veins and out into the general circulation.
- ❖ Anterior pituitary hormones then travel to target tissues throughout the body.
- ❖ Those anterior pituitary hormones that act on other endocrine glands are called tropic hormones

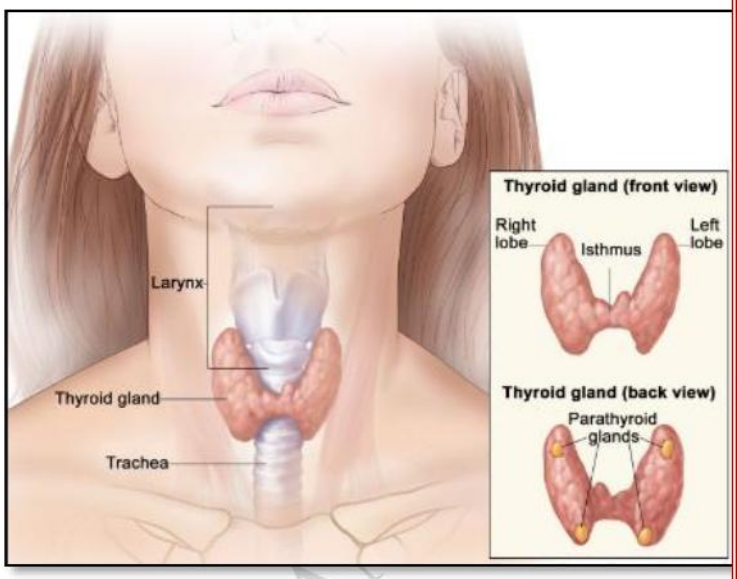


ENDOCRINE GLANDS AND THEIR SECRETIONS

Sr. No	Endocrine Gland	Hormone	Function
1	Anterior Pituitary Gland	Growth Hormone [Gh]	Promotes growth of cells
		Prolactin	Promotes breast-milk production
		Thyrotrophic Hormone [TSH]	Stimulating thyroid gland
		Follicle Stimulating Hormone [FSH]	Controls the production of eggs and sperm
		Luteinizing Hormone [LH]	Controls oestrogen and testosterone production as well as ovulation
	Intermediate	Melanocyte Stimulating Hormone [MSH]	Stimulates melanin in skin
	Posterior Pituitary Gland	Oxytocin	Helps with lactation, childbirth, and mother-child bonding
		Vasopressin	Promote the retention of water by the kidneys and increase blood pressure.
2	Thyroid Gland	Thyroid Hormone [T_3 & T_4]	Helps control several body functions, including the rate of metabolism and energy levels
3	Parathyroid Gland	Parathyroid Hormone [PTH]	Regulation of blood level of Calcium, Magnesium & Hypophosphate Controls calcium levels in bones and blood
4	Adrenal Gland	Adrenaline	Increases blood pressure, heart rate, and metabolism in reaction to stress
		Aldosterone	Controls the body's salt and water balance
		Cortisol	Plays a role in stress response
		Dehydroepiandrosterone Sulfate (DHEA-S)	Aids in production of body odor and growth of body hair during puberty
5	Pancreas	Glucagon	Helps increase levels of blood glucose (blood sugar)
		Insulin	Helps reduce your blood glucose levels
6	Pineal Gland	Melatonin	Controls sleep-wake cycles
7	Ovary	Progesterone	Helps prepare the body for pregnancy when an egg is fertilized
		Estrogen	Works to regulate the menstrual cycle, maintain pregnancy, and develop female sex characteristics; aids in sperm production
8	Ovary, Testes, Adrenal	Testosterone	Contributes to sex drive and body density in males and females as well as development of male sex characteristics

NOTE: Key to remember name of Pituitary hormones-------"GOAT FLAP"
GH, Oxytocin, ACTH, TSH, FSH, LH, ADH, Prolactin.

THYROID GLAND

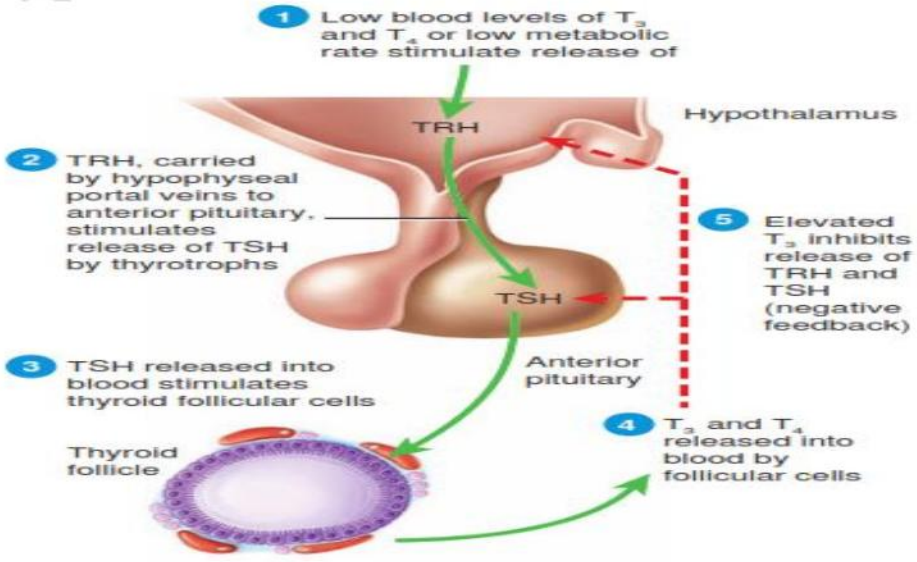


- The butterfly-shaped thyroid gland is located just inferior to the larynx (voice box).
- It is composed of right and left lateral lobes, one on either side of the trachea.
- The normal mass of the thyroid is about 30 g. It is highly vascularized and receives 80–120 mL of blood per minute.
- Microscopic spherical sacs called thyroid follicles make up most of the thyroid gland.
- The follicular cells produce two hormones: thyroxine which is also called tetraiodothyronine because it contains four atoms of iodine, and triiodothyronine, which contains three atoms of iodine.
- T3and T4 together are also known as thyroid hormones.
- A few cells called parafollicular
- cells or C cells lie between follicles. They produce the hormone calcitonin homeostasis, which helps regulate calcium.

Actions of Thyroid Hormones:

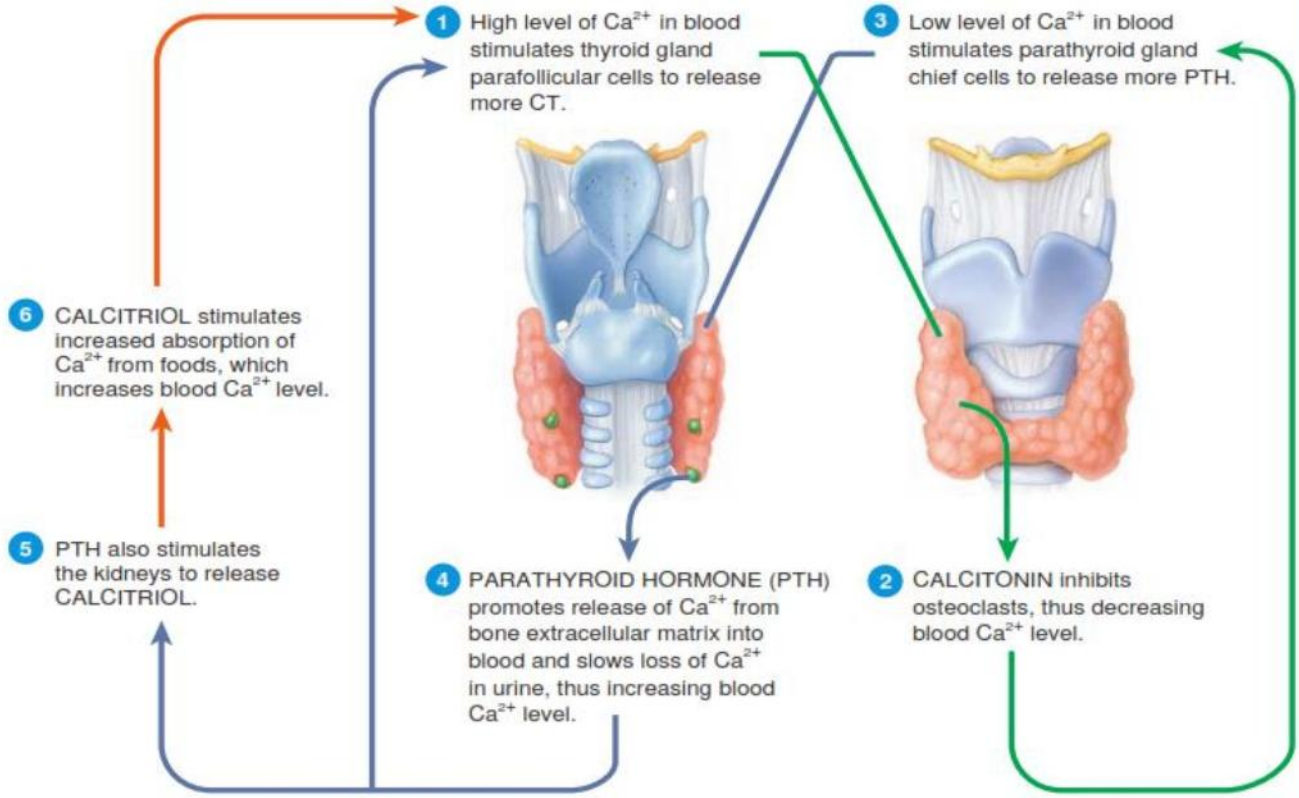
- Increase basal metabolic rate
- Stimulate protein synthesis
- Increase body temperature (calorigenic effect)
- Stimulate synthesis of Na/K+ ATPase
- Increase the use of glucose and fatty acids for ATP production
- Regulate development and growth of nervous tissue and bones
- Enhance some actions of catecholamines
- Stimulate lipolysis

REGULATION OF THYROID HORMONE



PARATHYRIOD GLAND

- Partially embedded in the posterior surface of the lateral lobes of the thyroid gland are several small, round masses of tissue called the parathyroid glands.
- Each has a mass of about 40 mg.
- Microscopically, the parathyroid glands contain two kinds of epithelial cells.
- The more numerous cells, called chief (principal) cells, produce parathyroid hormone PTH), also called parathormone.



ADRENAL GLANDS

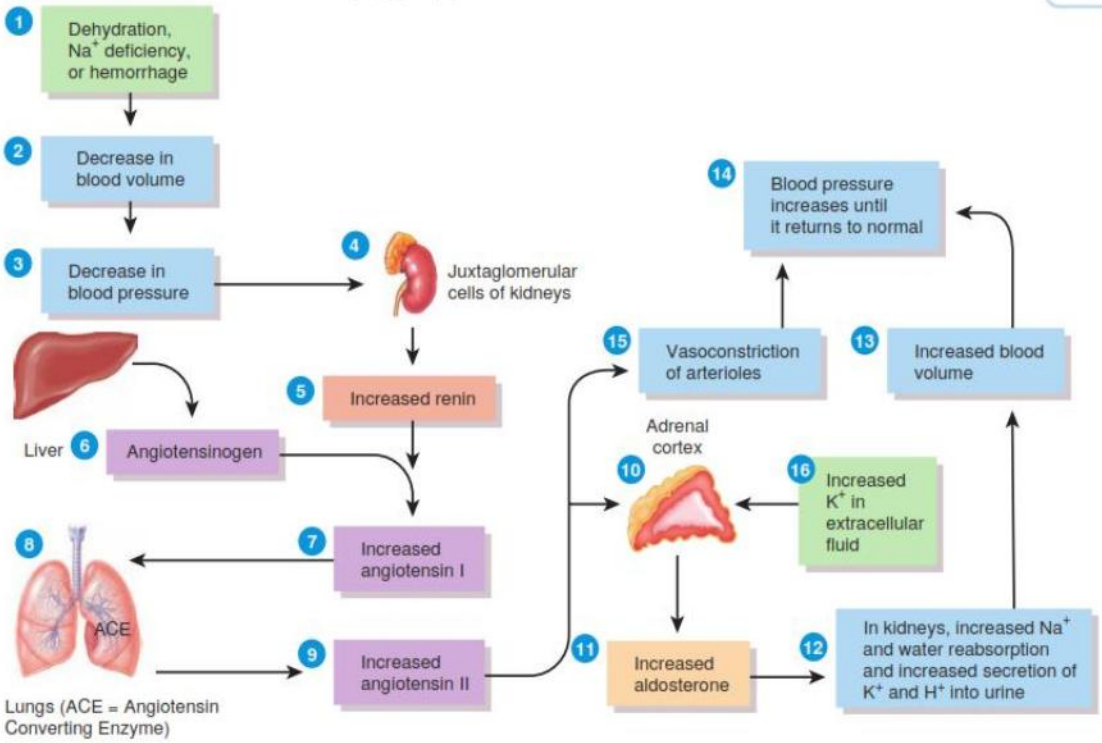
- The paired adrenal (suprarenal) glands, one of which lies superior to each kidney in the retroperitoneal space, have a flattened pyramidal shape.
- Each adrenal gland is 3–5 cm in height, 2–3 cm in width, and a little less than 1 cm thick, with a mass of 3.5–5 g.
- During embryonic development, the adrenal glands differentiate into two structurally and functionally distinct regions:
  1. A large, peripherally located adrenal cortex, comprising 80–90% of the gland, and
  2. A small, centrally located adrenal medulla
- A connective tissue capsule covers the gland.
- The adrenal glands, like the thyroid gland, are highly vascularized.
- The adrenal cortex produces steroid hormones that are essential for life.
- Complete loss of adrenocortical hormones leads to death due to dehydration and electrolyte imbalances in a few days to a week, unless hormone replacement therapy begins promptly.
- The adrenal medulla produces three catecholamine hormones—norepinephrine, epinephrine, and a small amount of dopamine.

Adrenal gland:

- Medulla: MEN –Medulla, Epinephrine, Norepinephrine.
- Cortex: has 3 layers: GFR- Glomerulosa, Fasiculata, Reticularis
- their hormones are: Make Good Sweets
- Mineralocorticoids, (aldosterone) , Glucocorticoids, (cortisol) , Sex hormone, (androgen) .
- All adrenal gland hormones together: "CANES"
- Cortisol, Aldosterone, Norepinephrine, Epinephrine, Sex hormone.

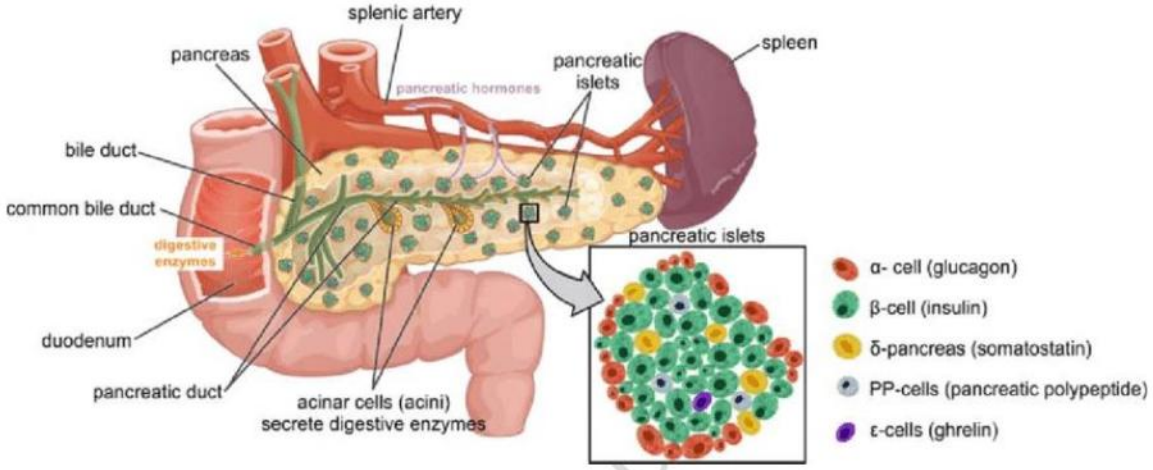
Aldosterone

- Regulation of aldosterone secretion by the renin–angiotensin–aldosterone (RAA) pathway.
- Aldosterone helps regulate blood volume, blood pressure, and levels of Na, K, and H in the blood.



PANCREAS

- The pancreas is both an endocrine gland and an exocrine gland.
- A flattened organ that measures about 1 2. 5–15 cm (4.5–6 in.) in length, the pancreas is located in the curve of the duodenum, the first part of the small intestine, and consists of a head, a body, and a tail.
- Roughly 99% of the cells of the pancreas are arranged in clusters called acini.
- The acini produce digestive enzymes, which flow into the gastrointestinal tract through a network of ducts.
- Scattered among the exocrine acini are 1–2 million tiny clusters of endocrine tissue called pancreatic islets or islets of Langerhans.
- Abundant capillaries serve both the exocrine and endocrine portions of the pancreas.

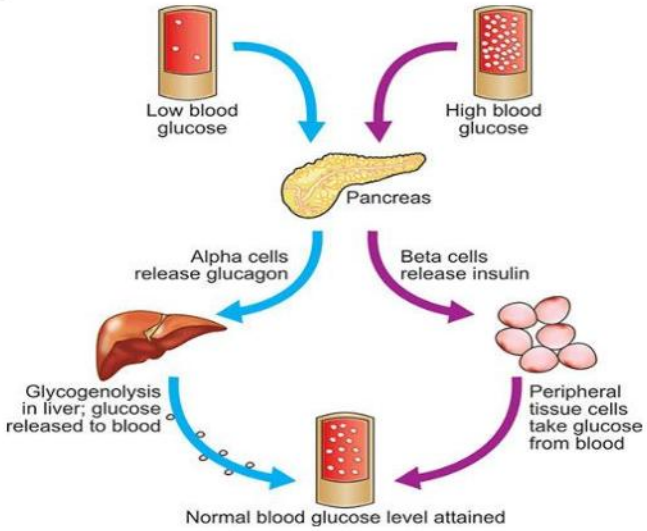


Cell Types in the Pancreatic Islets

Each pancreatic islet includes four types of hormone-secreting cells:

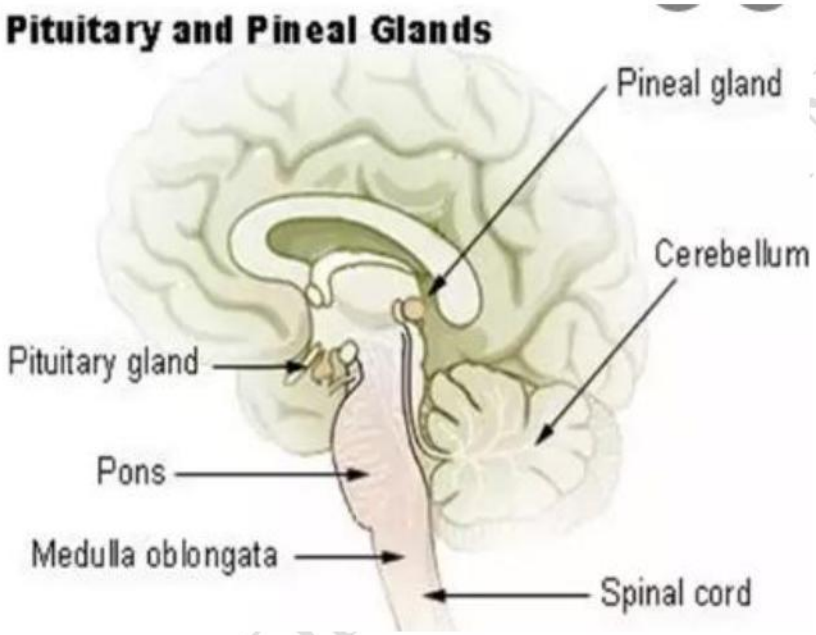
1. Alpha or A cells constitute about 17% of pancreatic islet cells and secrete glucagon.
2. Beta or B cells constitute about 70% of pancreatic islet cells and secrete insulin.
3. Delta or D cells constitute about 7% of pancreatic islet cells and secrete somatostatin.
4. F cells constitute the remainder of pancreatic islet cells and secrete pancreatic polypeptide.

Low blood glucose stimulates release of glucagon; high blood glucose stimulates secretion of insulin.



PINEAL GLAND

- The pineal gland is a small endocrine gland attached to the roof of the third ventricle of the brain at the midline.
- Part of the epithalamus, it is positioned between the two superior colliculi, has a mass of 0. 1–0.2 g, and is covered by a capsule formed by the pia mater.
- The gland consists of masses of neuroglia and secretory cells called pinealocytes.
- The pineal gland secretes melatonin, an amine hormone derived from serotonin.
- Melatonin appears to contribute to the setting of the body's biological clock and maintain sleep.



SIGNATURE OF TEACHER