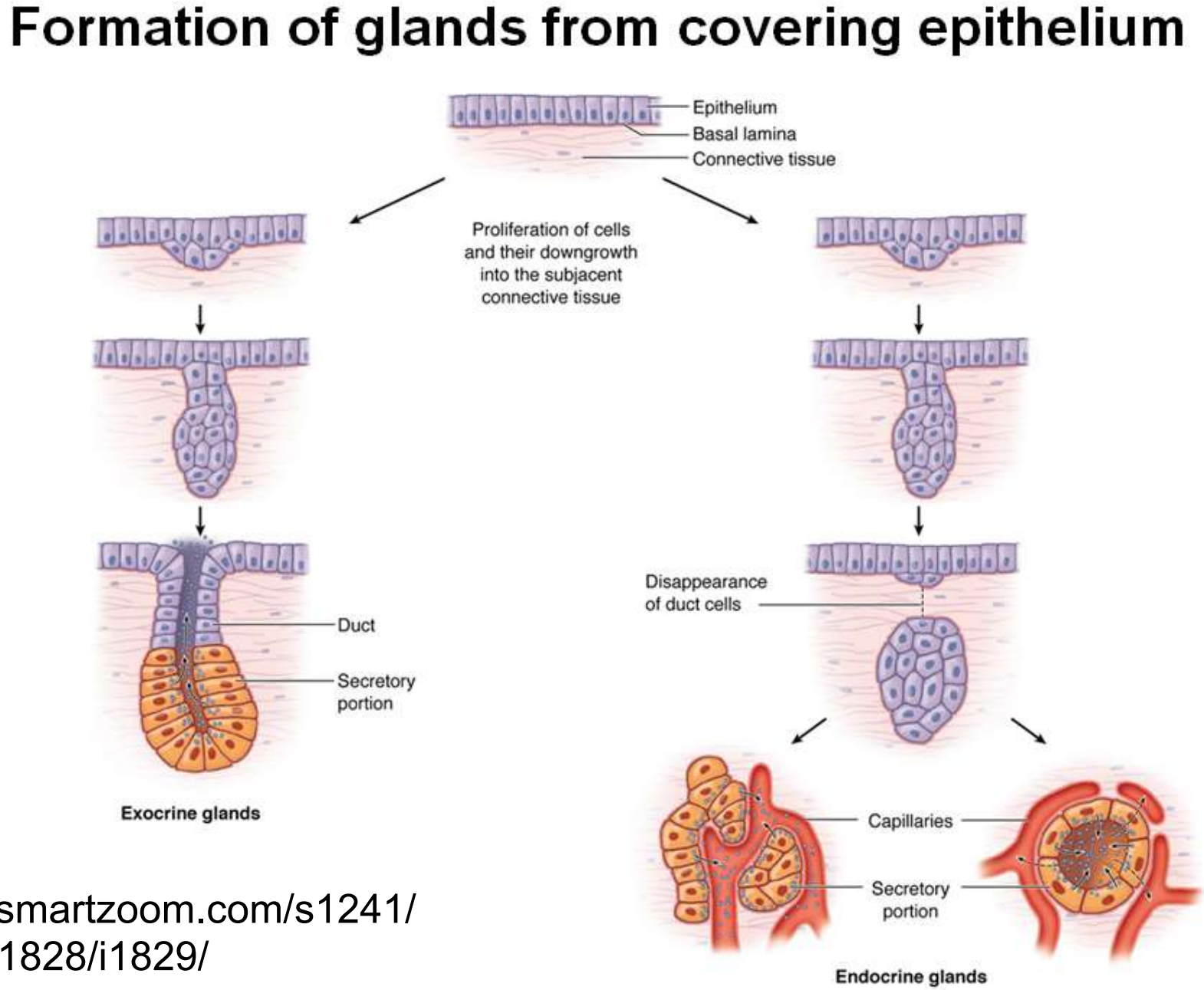
Endocrine Glands

Glands Genesis



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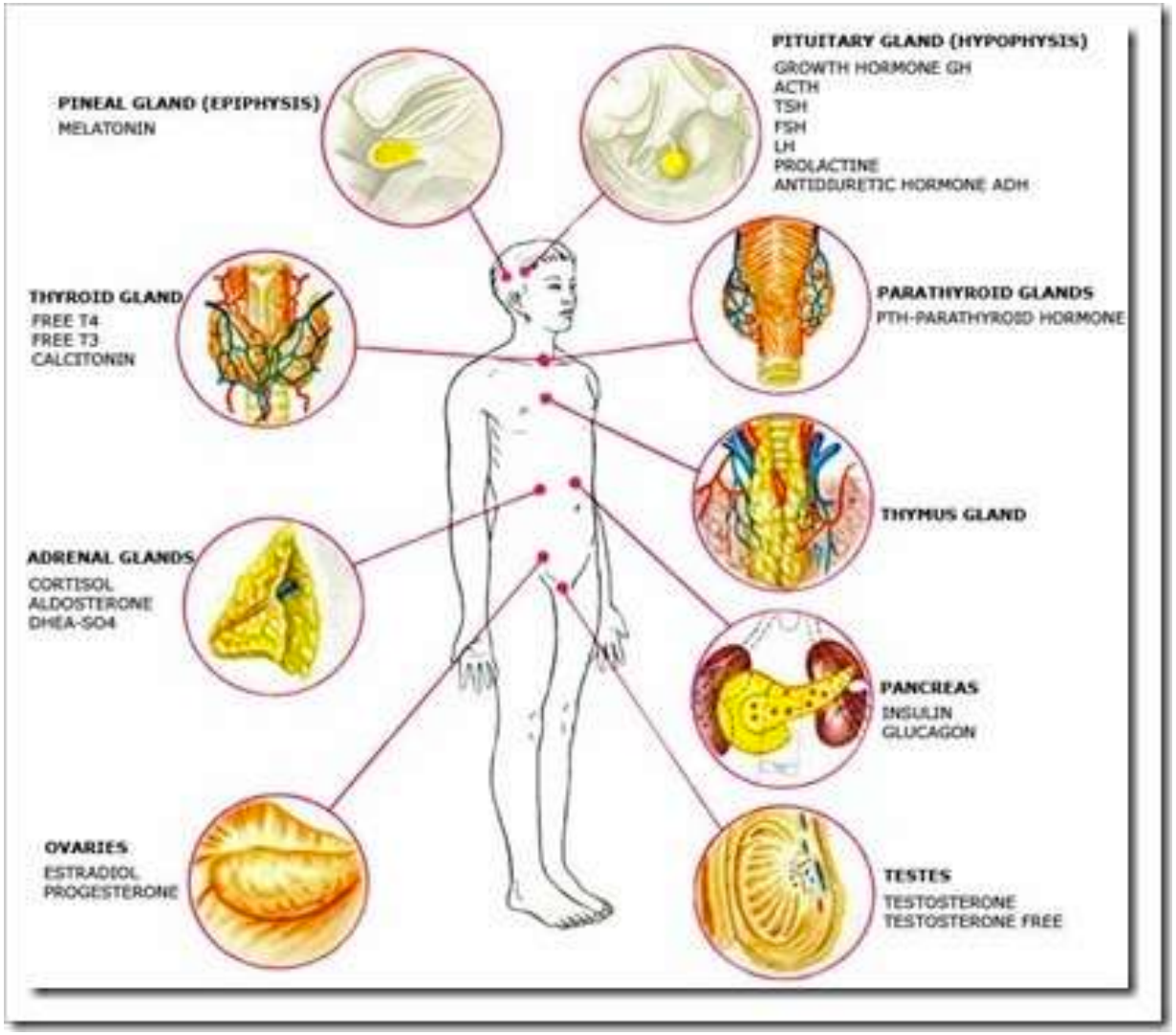
Endocrine Glands

Release their secretions, **hormones** into the blood or lymphatic vessels for distribution to target organs.



Endocrine Glands

- Lack of connection with the covering epithelium that generated them
- Endocrine glands do not have ducts. Their products (hormones) are secreted into the blood stream
- Highly vascularized - fenestrated capillaries

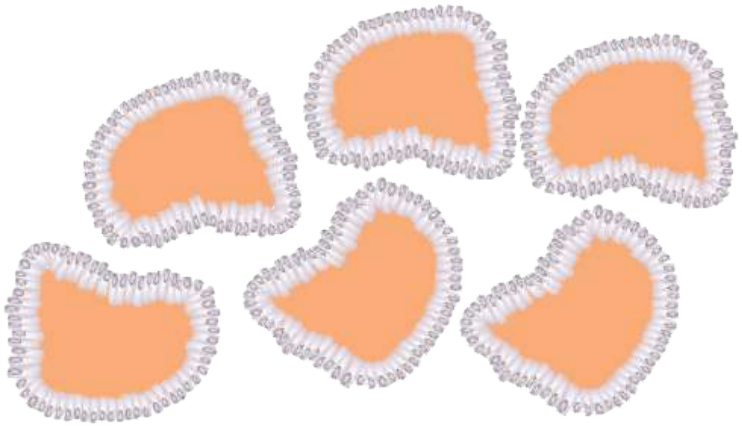
Secretory portion

Secretory cells of endocrine glands are organized either by **cords of cells** or **in follicles**

- In the cord type, the most common arrangement, cells form *anastomosing* cords around capillaries or blood vessels. The hormone is stored intracellularly and is released upon arrival of the signaling molecule or impulse.

- Follicle type of endocrine gland, secretory cells form follicles that surround a cavity that receive and store the secreted hormones.

Cord type



Follicle type

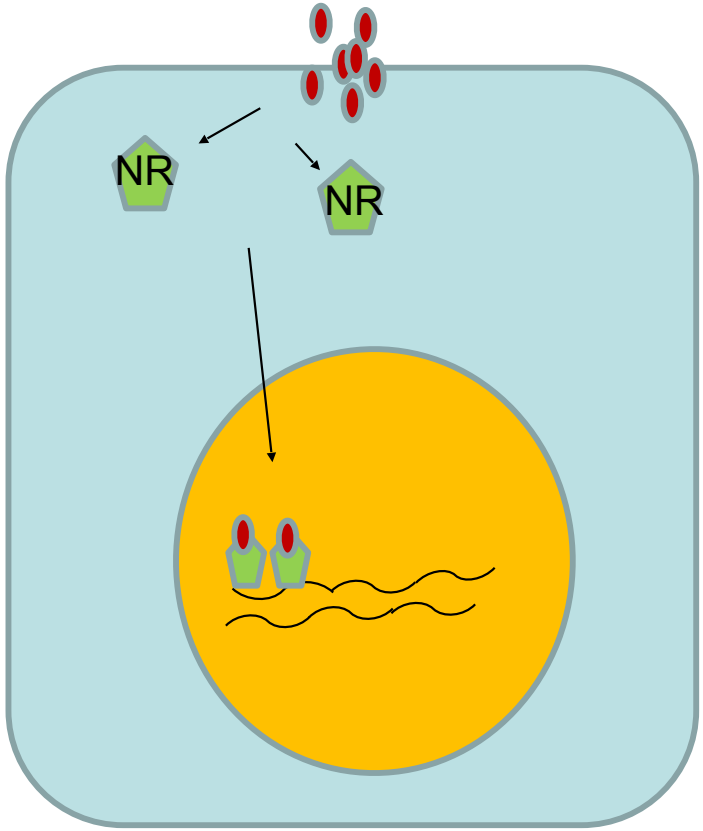
Hormones Classification

Chemical messengers that are produced by endocrine glands and delivered via blood stream to target cells or organs.

- Protein and polypeptides - water soluble, and amino-acid derivative (tyroxine, epinephrine)
- Steroid - lipid soluble (estrogen, progesteron, glucocorticoids)

Nuclear receptors

Steroid hormones are lipid soluble, penetrate the cell membrane barrier and bind cytoplasmic receptors. Upon binding, the hormone/receptor complexes (nuclear receptor) translocate to the nucleus for the gene transcription stimulation.



Polypeptides receptors

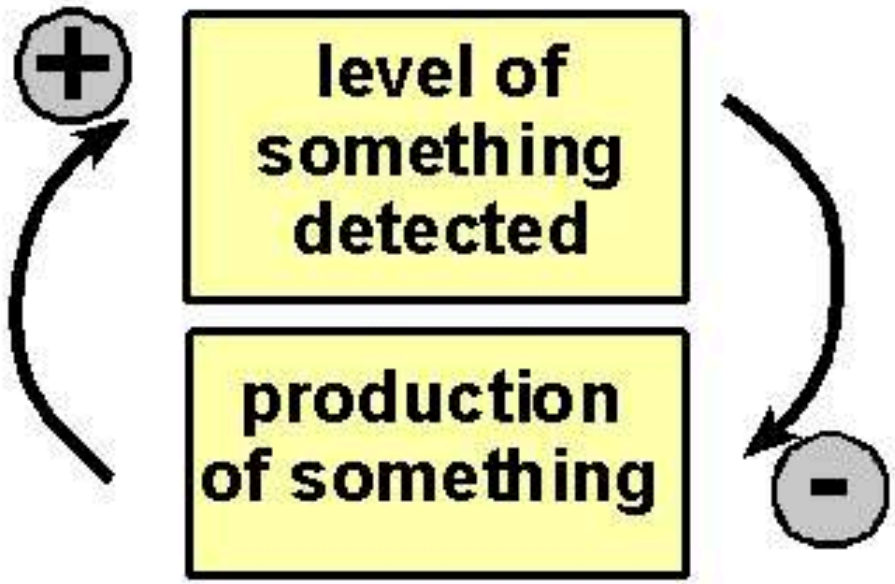
- Polypeptides hormones are **not able** to pass troughs the plasma membrane, thus the receptor/hormone complex occur on the external surface of the cells.

- To elicit a response, each receptor is coupled with protein kinases to phosphorylate downstream mediators and inducing a cascade of events culminating with the nuclear transcription factors phosphorylation and activation.

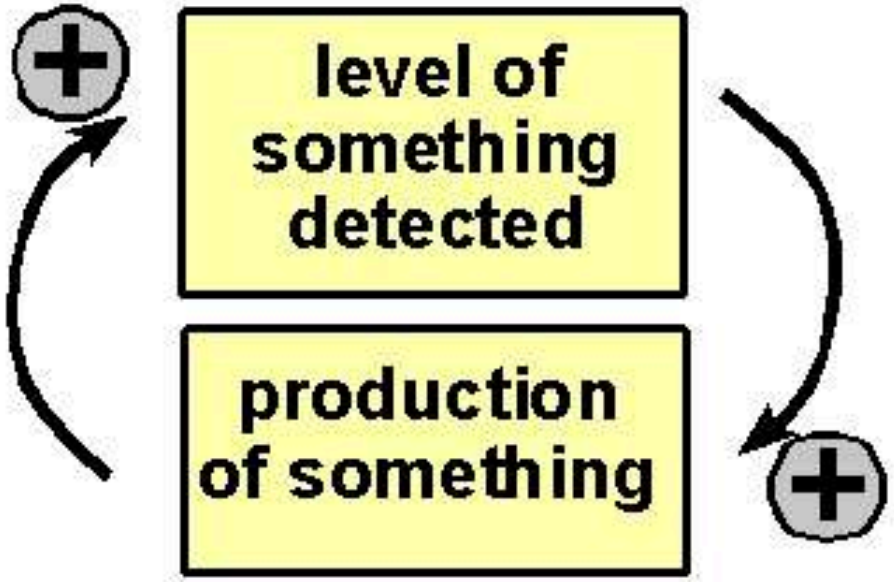
Protein and polypeptides - water soluble

- Usually bind a receptor on the external surface of the cell, but it needs a second messenger that will trigger signal transduction, in the cytoplasm.
- To elicit a response, each receptor is coupled with protein kinases to phosphorylate downstream mediators, and inducing a cascade of events culminating with the nuclear transcription factors phosphorylation and activation
- Some also interact with receptor inside the cells, in this case we refer to it as Intracrine activity

Feedback mechanisms



NEGATIVE FEEDBACK



POSITIVE FEEDBACK

ENDOCRINE GLANDS

The **endocrine system,** consisting of **ductless glands,** distinct clusters of cells within certain organs of the body, and **diffuse neuroendocrine cells,** regulates metabolic activities in certain organs and tissues of the body, thereby helping to reach homeostasis.

Endocrine system is based on chemical substances called **hormones,** which are released into the bloodstream to influence target cells both closer or in remote sites.

Pituitary Gland (Hypophysis)

Pituitary Gland is the master endocrine gland producing several hormones that are responsible for regulating growth, reproduction and metabolism.

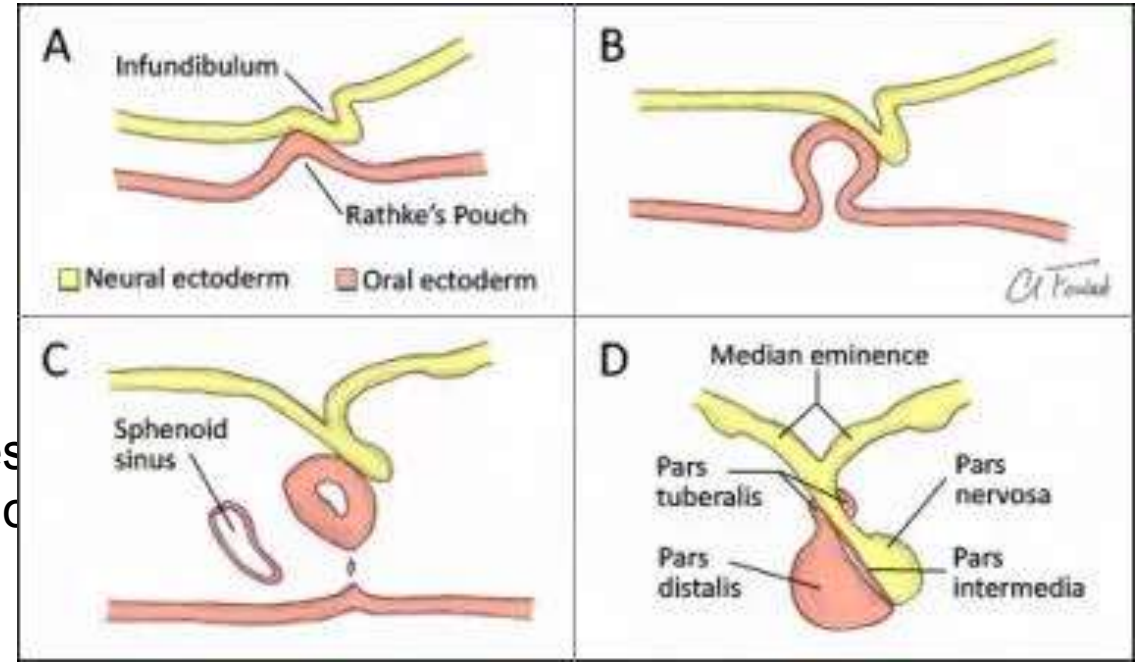
It is divided into:

- Adenohypophysis or anterior pituitary
- Neurohypophysis or posterior pituitary

Pituitary Gland (Hypophysis)

Adenohypophysis derived from the invagination of oral ectoderm (Rathke pouch), and it's controlled by BMP4 (bone morphogenic protein 4), FGF8 (fibroblast growth factor 8) and WNT5

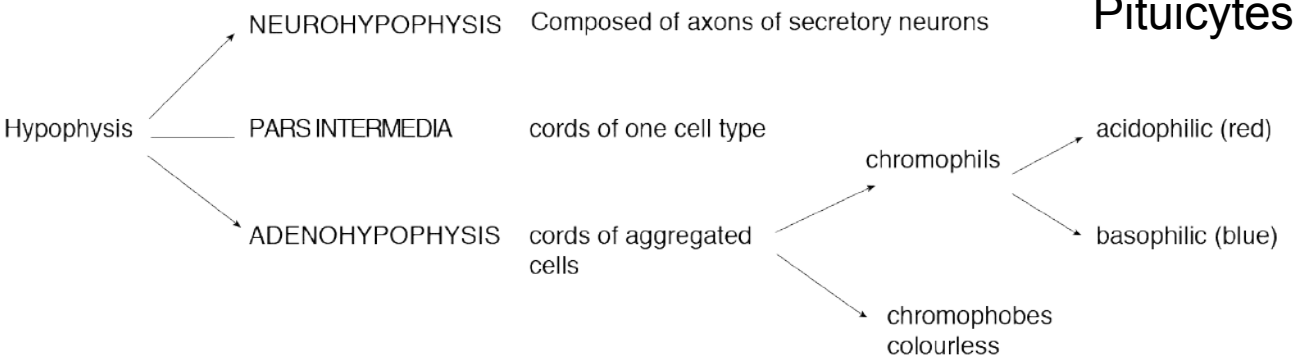
Neurohypophysis derives from the neural ectoderm



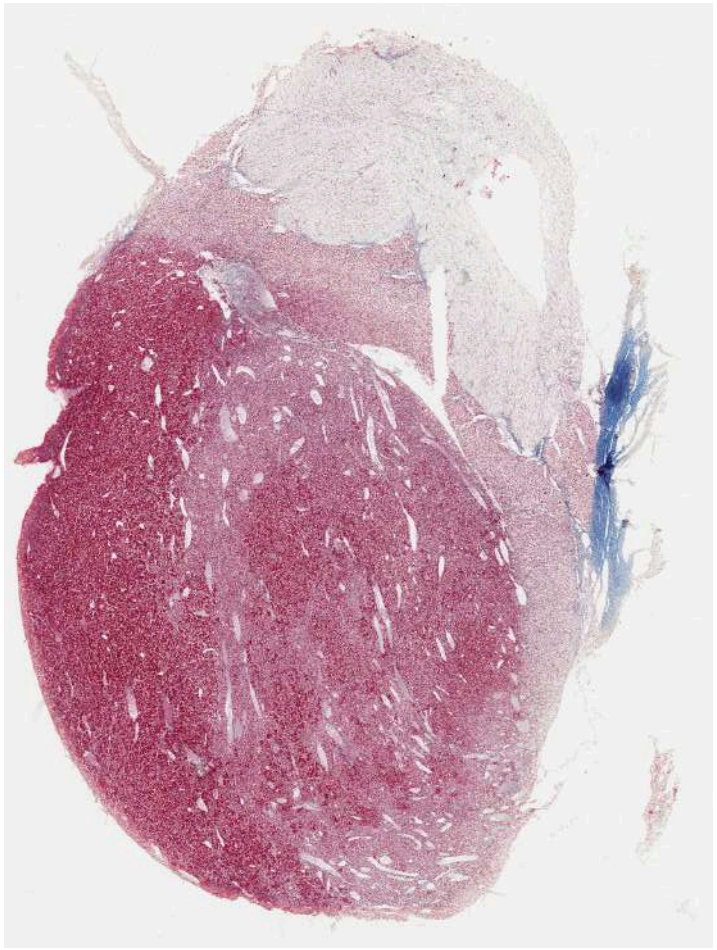
This gland measures increases to 1.2 cm in pregnant woman

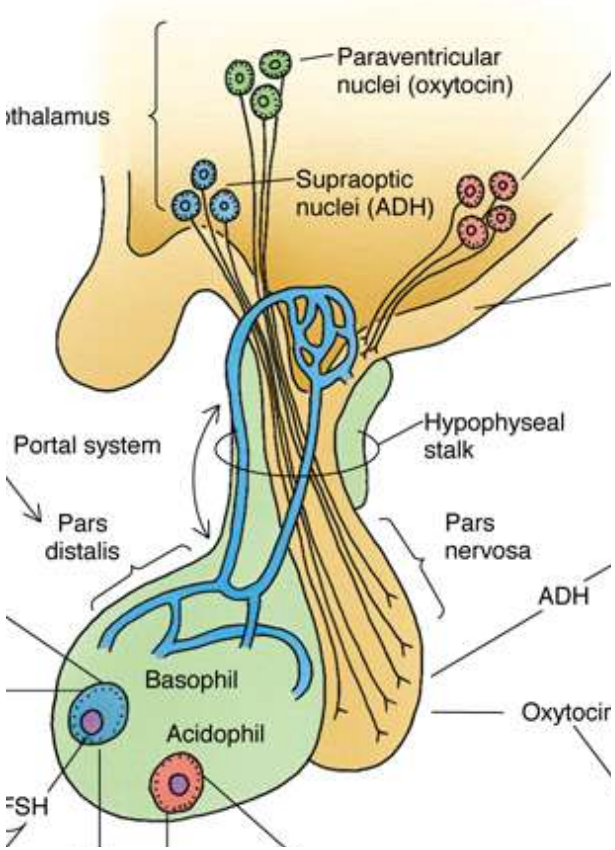
DISCRETE ENDOCRINE GLAND

Pituicytes (glia cells) and herring bodies



Hypothalamus





Pituitary Gland and hypothalamus

The pituitary gland is under the neural control of hypothalamus.

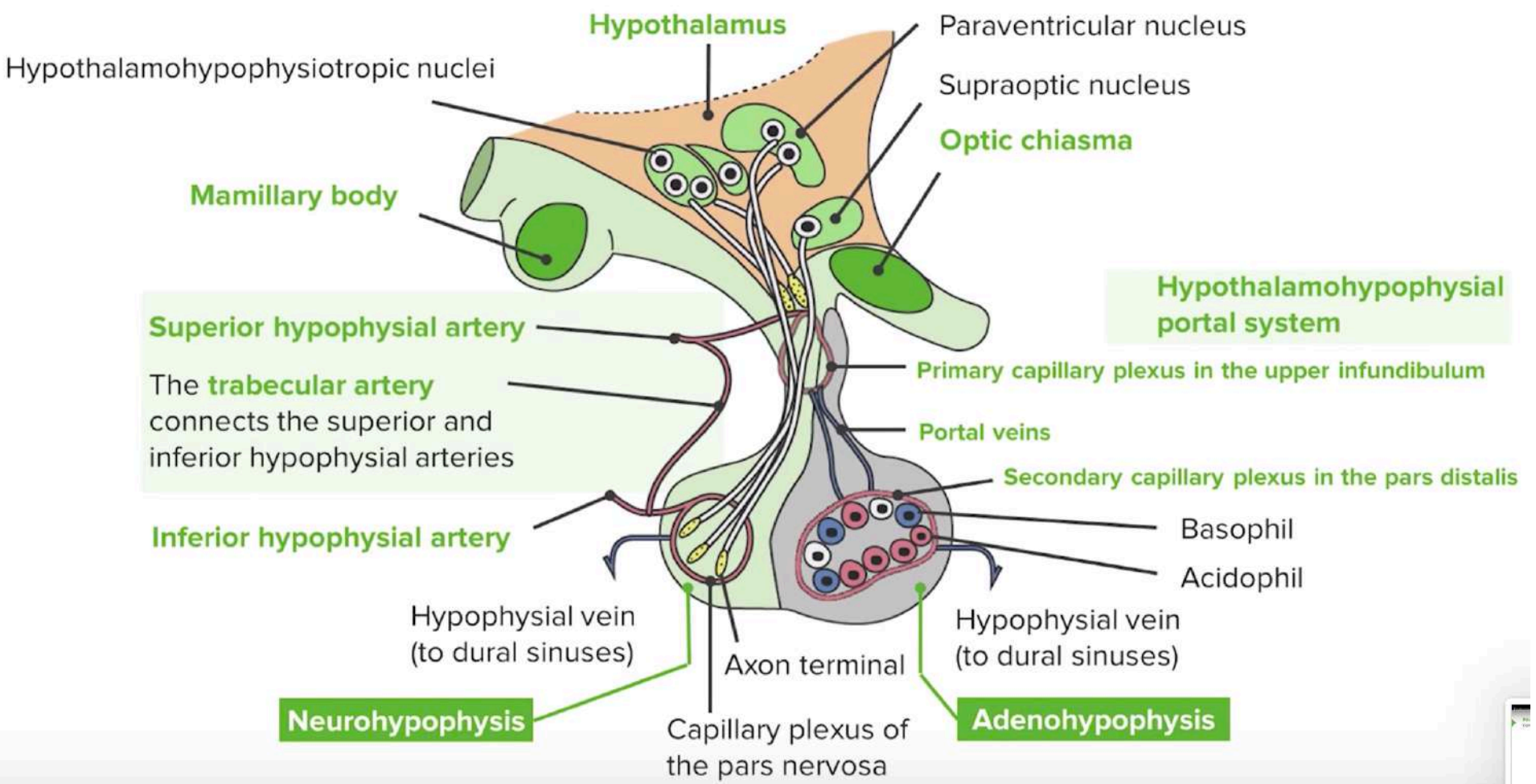
A group of neurons, with the soma located in the paraventricular and supraoptic nuclei of the hypothalamus, have the axon projections into the neurohypophysis.

These axons also release hypothalamic secretory hormones (releasing or inhibiting hormones), into the vascular supply of the capillary beds of the anterior pituitary

Pituitary Gland and hypothalamus

Pituitary gland (hypophysis)

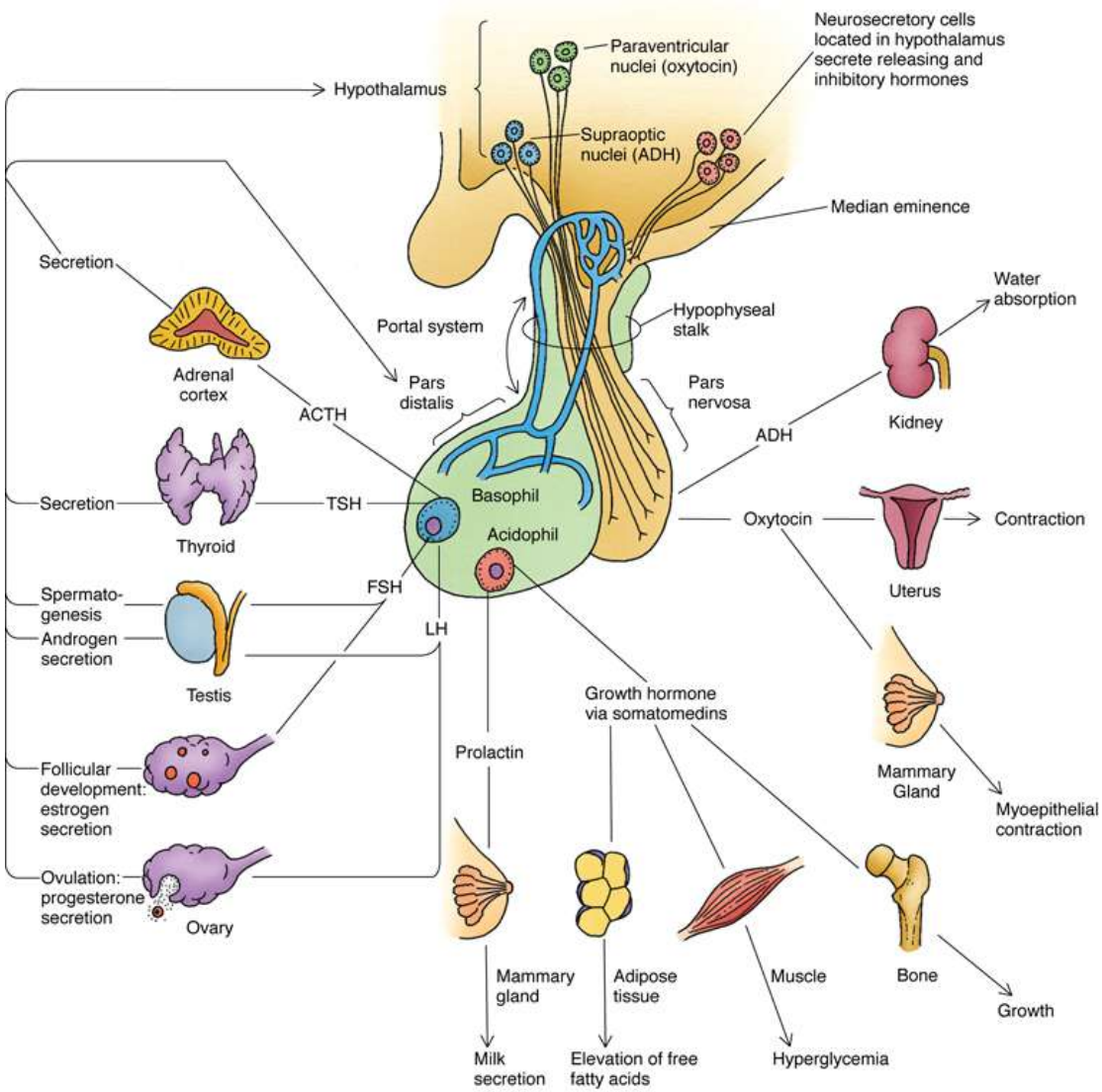
Consists of glandular (epithelial tissues) and neurosecretory tissue



Feed - Forward secretion from Hypothalamus

- TRH (Thyroid-stimulating hormone) - releasing hormone
- CRH (Corticotropin-stimulating hormone) releasing hormone
- SRH (Somatotropin-stimulating hormone) releasing of the growth hormone
- GnRH (Gonadotropin releasing hormone) both LH and FSH
- PRH (Prolactin releasing hormone) - stimulate prolactin
- PIF (Prolactin inhibitory factor): inhibit prolactin

Pituitary and its Targets

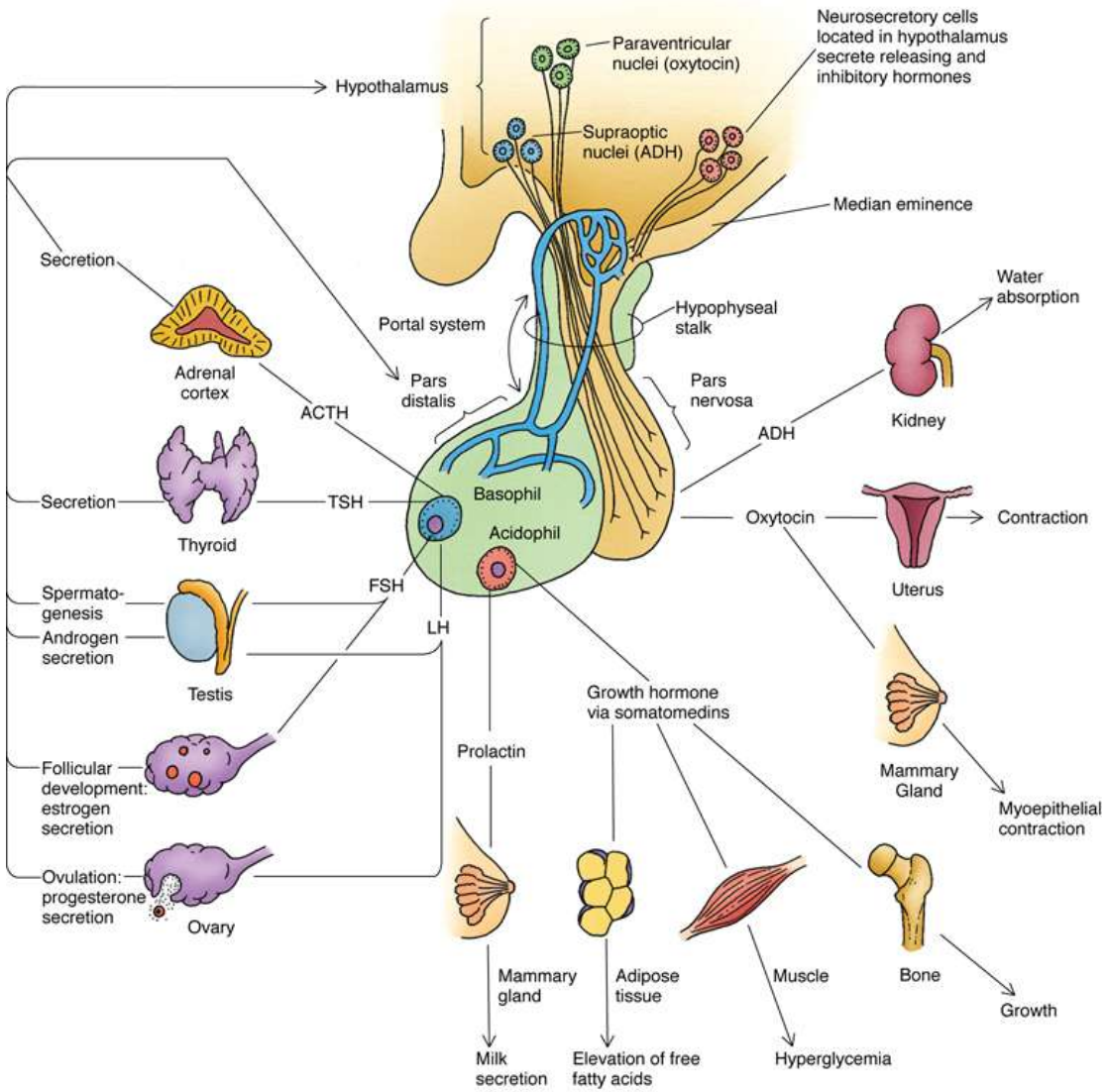


The pituitary gland and its target organs. ACTH, adrenocorticotropic hormone; ADH, antidiuretic hormone; FSH, follicle-stimulating hormone; LH, luteinizing hormone; TSH, thyroid-stimulating hormone.

The **pituitary gland** is connected to the brain by neural pathways; it also has a rich vascular apparatus from vessels that supply the brain, allowing the coordination of the two systems in maintaining a physiological balance.

Indeed, secretion of nearly all the hormones produced by the pituitary gland is controlled by either hormonal or nerve signals from the hypothalamus.

Cells of the Pituitary Gland



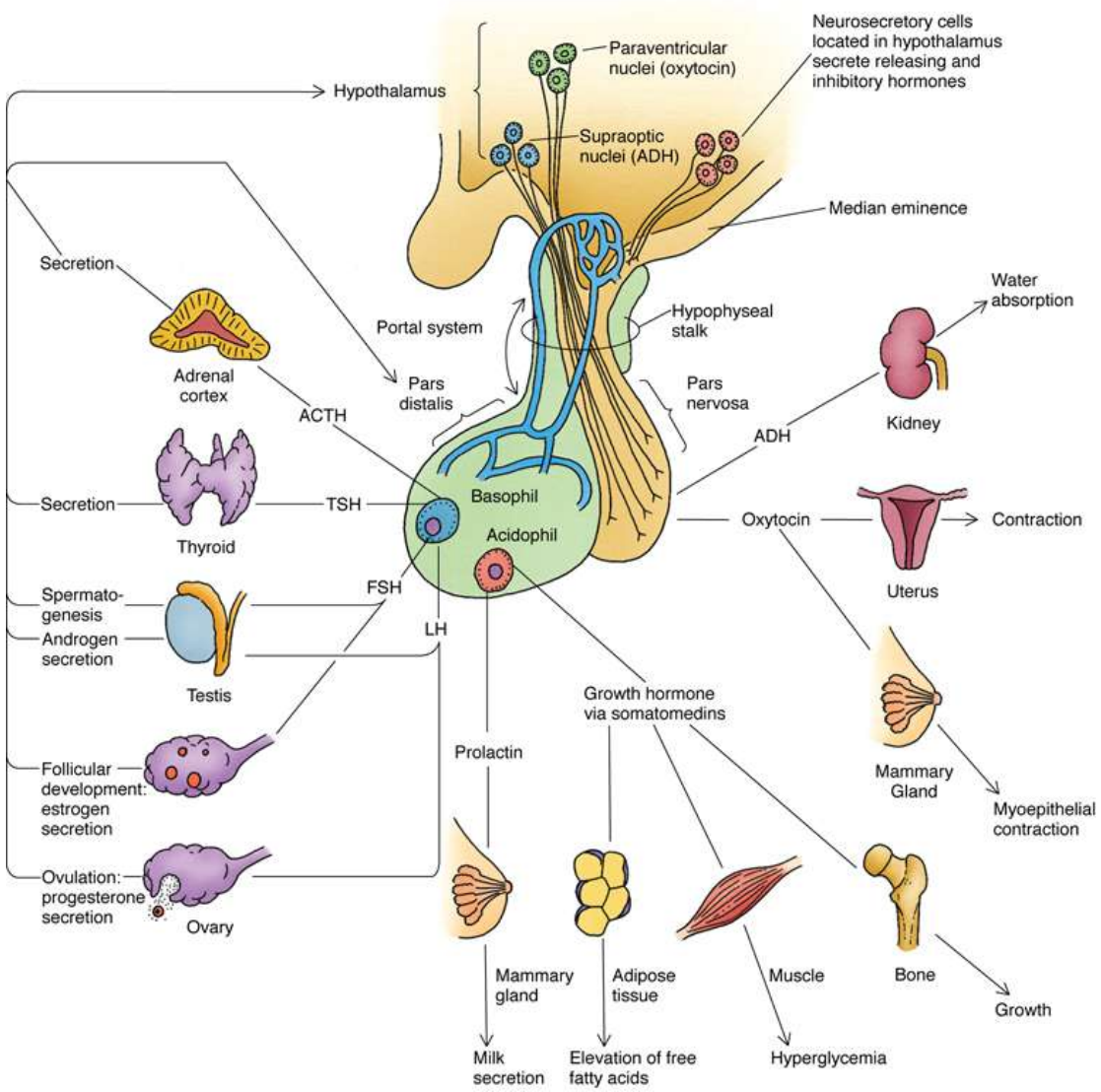
The pituitary gland and its target organs. ACTH, adrenocorticotropic hormone; ADH, antidiuretic hormone; FSH, follicle-stimulating hormone; LH, luteinizing hormone; TSH, thyroid-stimulating hormone.

The **pituitary gland** is divided into the **adenohypophysis** and the **neurohypophysis**.

The pars distalis of adenohypophysis has three types of cells, **acidophils** and **basophils** (together known as **chromophils**) and **chromophobes**.

The most abundant cells in the pars distalis are **acidophils,** possessing large, orange to red granules. There are two types of acidophils, somatotrophs and mammotrophs.

Cells of the Pituitary Gland



The pituitary gland and its target organs. ACTH, adrenocorticotropic hormone; ADH, antidiuretic hormone; FSH, follicle-stimulating hormone; LH, luteinizing hormone; TSH, thyroid-stimulating hormone.

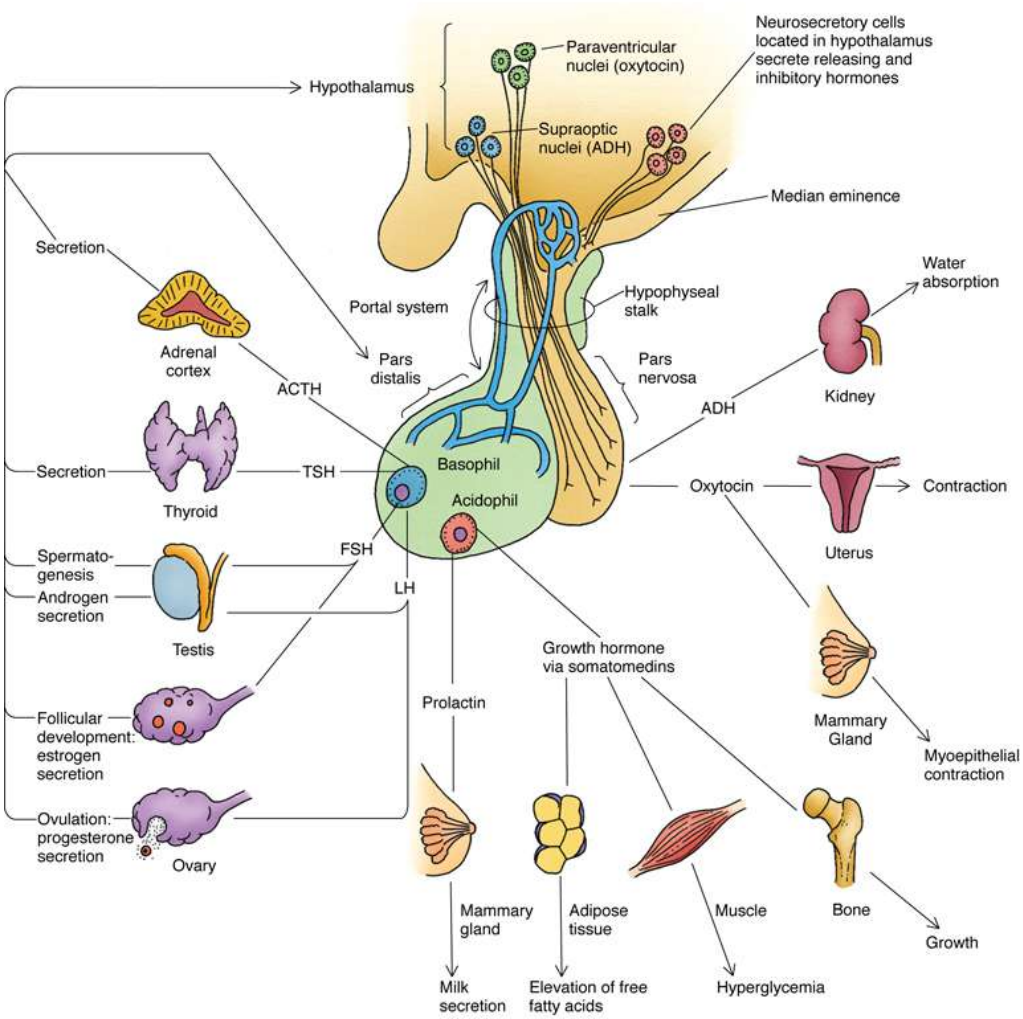
Somatotrophs secrete **somatotropin (growth hormone);**

they are stimulated by **SRH** and inhibited by **somatostatin.**

Somatotropin has a generalized effect of increasing cellular metabolic rates. This hormone also induces liver cells to produce **insulin-like growth factors I and II** which stimulate the mitotic rates of epiphyseal plate chondrocytes and thus promote elongation of long bones

Mammotrophs release the hormone **prolactin,** which promotes mammary gland development during pregnancy as well as lactation after birth.

Cells of the Pituitary Gland- **Basophils cells**



Basophils stain blue with basic dyes and are usually located at the periphery of the pars distalis.

Corticotrophs, which are scattered, round to ovoid cells, each with an eccentric nucleus and relatively few organelles. Their secretory granules are 250 to 400 nm in diameter. Corticotrophs secrete **proopiomelanocortin (POMC)**, a large protein that is cleaved to produce **adrenocorticotropic hormone (ACTH)** and **lipotropic hormone (LPH)**. Further cleavage of ACTH forms **melanocyte-stimulating hormone (MSH)** whereas cleavage of LPH forms **β-endorphin**.

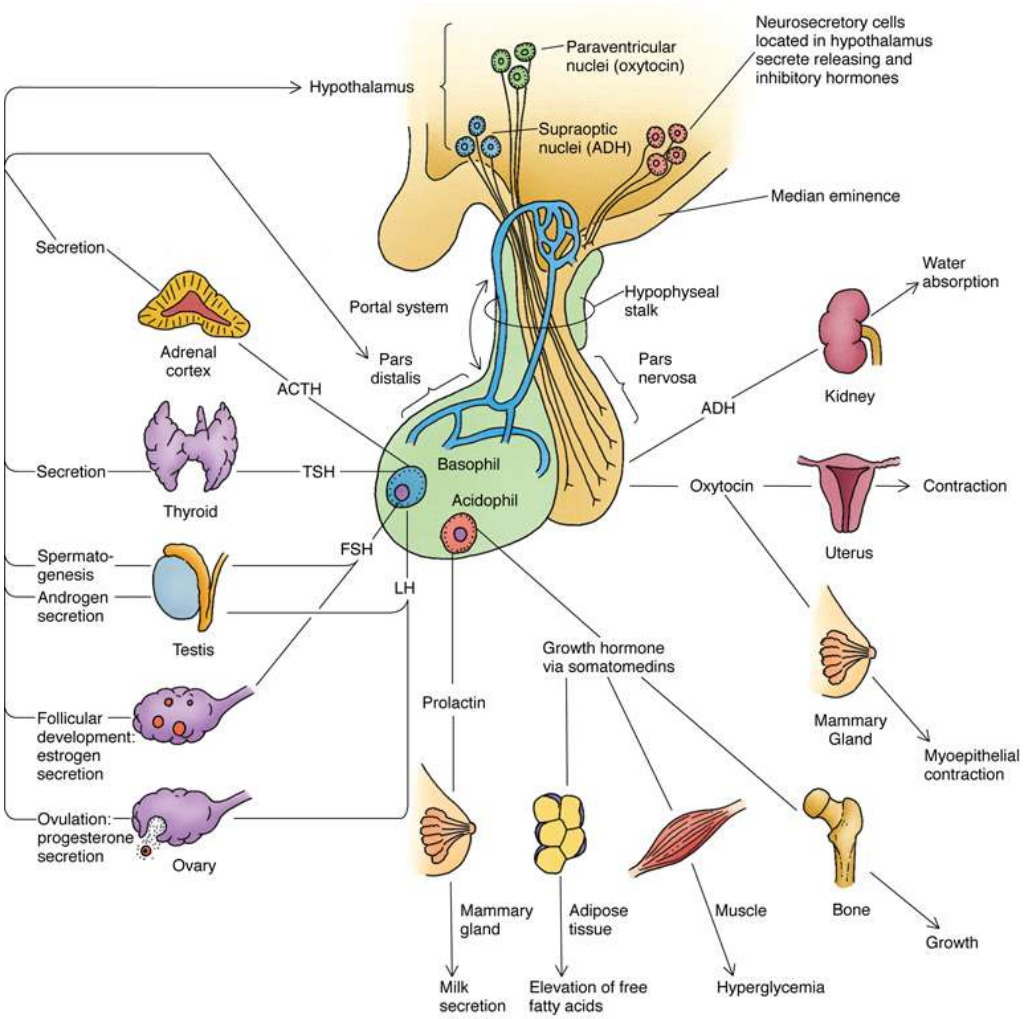
ACTH acts on the adrenal gland cortex, prompting the release of glucocorticoids by cells of the zona fasciculata.

MSH acts on melanocytes of the skin to produce melanin.

LPH induces lipolysis and the synthesis of steroids; it also prompts melanocytes to manufacture melanin pigments.

TSH and FSH/LH

Cells of the Pituitary Gland



TSH and FSH/LH

Basophils:

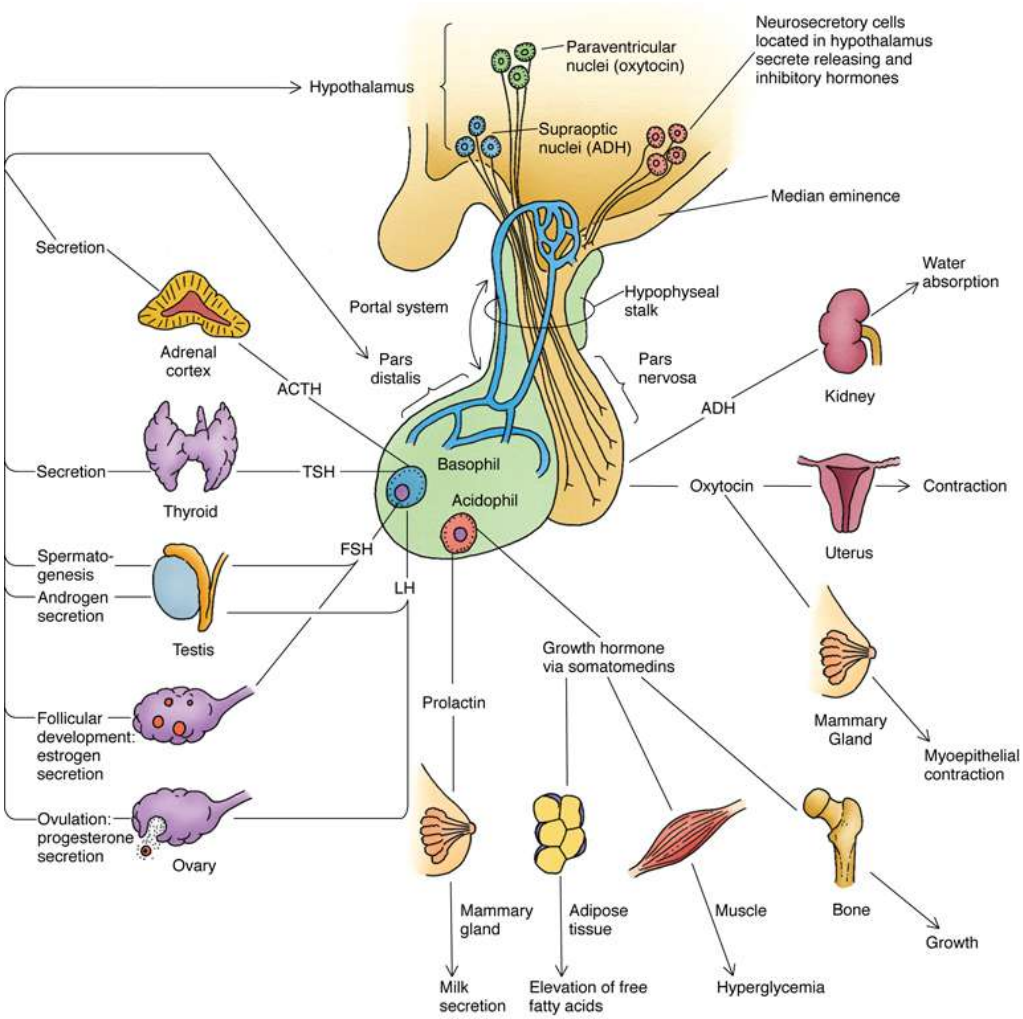
Thyrotrophs are deeply embedded within cords of the parenchymal cells.

These cells can be distinguished by their small secretory granules (150 nm in diameter), which contain **TSH**, also known as ***thyrotropin***. Secretion is stimulated by **TRH** and inhibited by the presence of thyroxine (T_4) and triiodothyronine (T_3) (thyroid hormones) in the blood.

TSH functions in prompting the follicular cells of the thyroid gland to release thyroxine and triiodothyronine.

Thyrotrophs are approximately 5% of the chromophil population and reside mostly in the anteromedial region of the adenohypophysis.

Cells of the Pituitary Gland



TSH and FSH/LH

Basophils:

Gonadotrophs are round cells that have well-developed Golgi complexes and abundant RER and mitochondria.

Secretory granules diameter: from 300 to 400 nm.

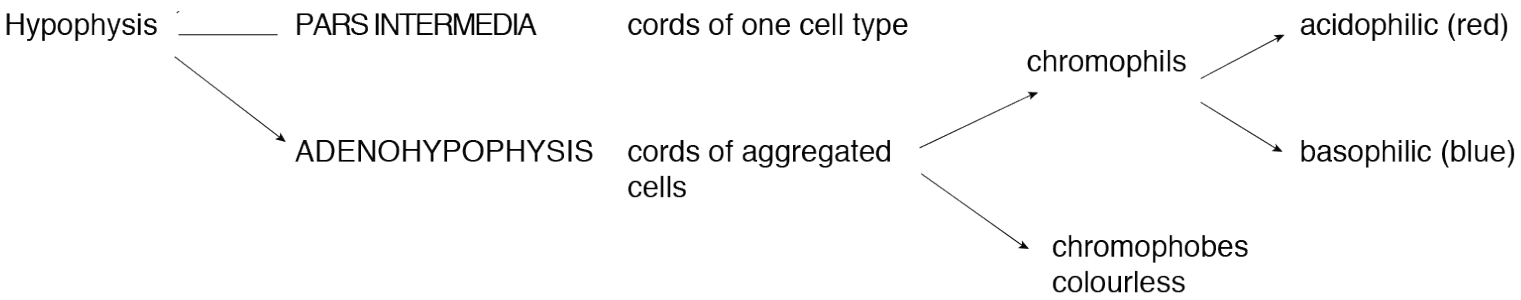
Gonadotrophs secrete **FSH** and **LH that** stimulates steroid hormone production in interstitial cells of the testes.

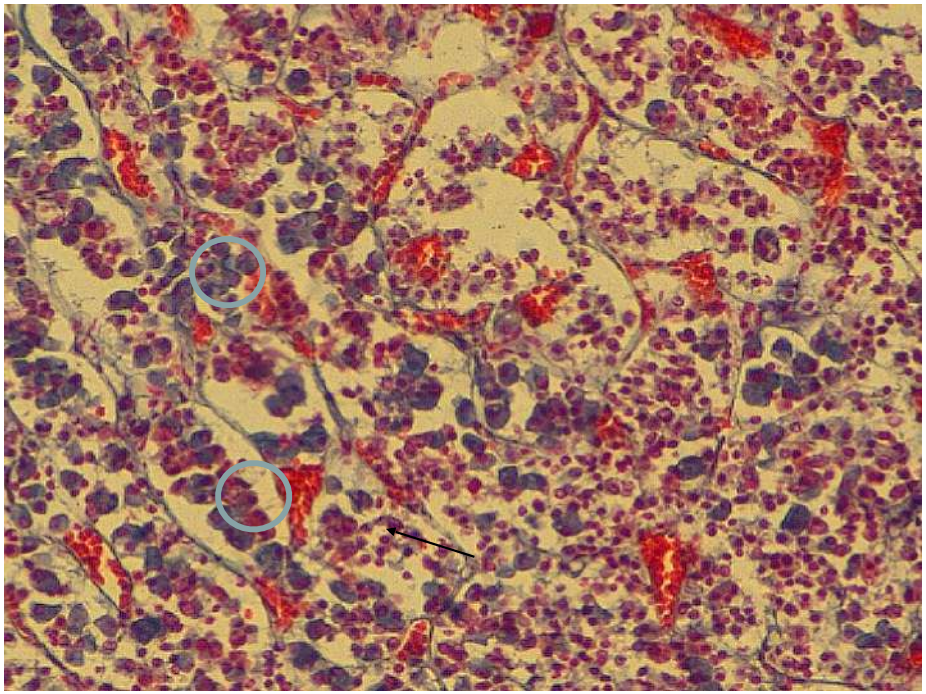
It remains unclear whether there are two subpopulations of gonadotrophs, one secreting FSH and the other LH, or whether both hormones are produced by one cell in different phases of the secretory cycle.

Secretion is stimulated by **gonadotropin releasing hormone (GnRH)** as well as by the hormone **leptin** and is inhibited by various hormones that are produced by the ovaries and testes.

Gonadotrophs comprise approximately 10% of the chromophil population and are distributed rather homogeneously throughout the adenohypophysis.

DISCRETE ENDOCRINE GLAND





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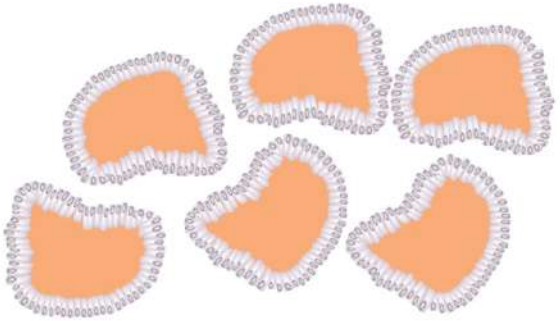
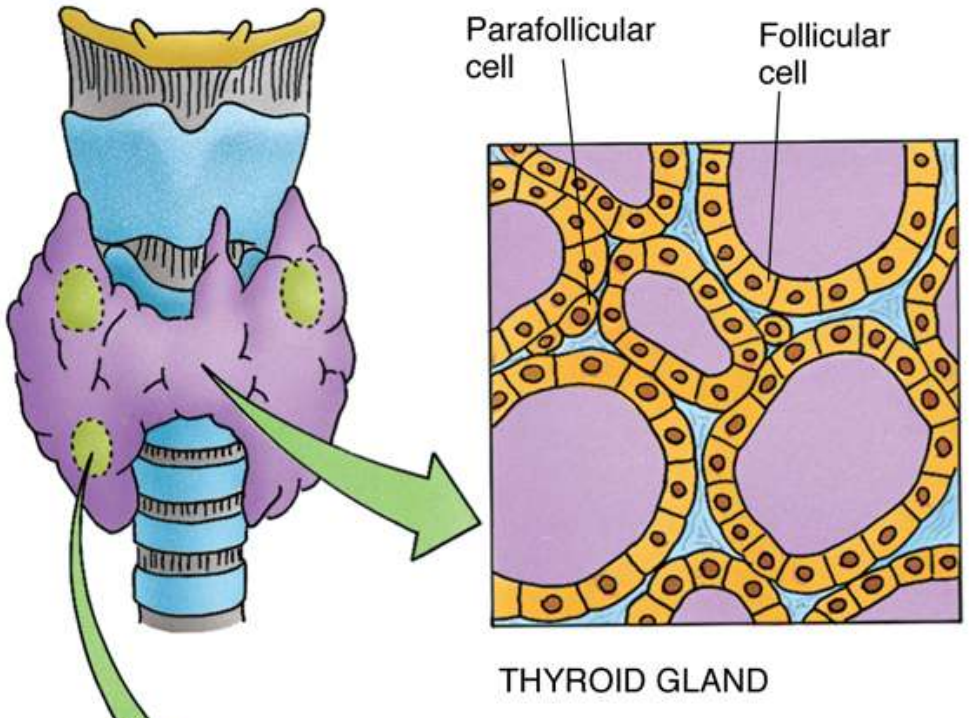
Thyroid Follicles that consist of a simple epithelial spheres, whose lumen contains colloid



Parathyroid cords of cells surrounded by a capsule of connective tissue

Thyroid Gland



The thyroid and parathyroid glands.

The thyroid is a gland composed of a right lobe and a left lobe, which are connected by an isthmus.

The whole gland is surrounded by a capsule of collagenous connective tissue and embedded within the capsule in the posterior of the gland, are the parathyroid glands.

The thyroid produces two hormones:

T3 known as thyroixin

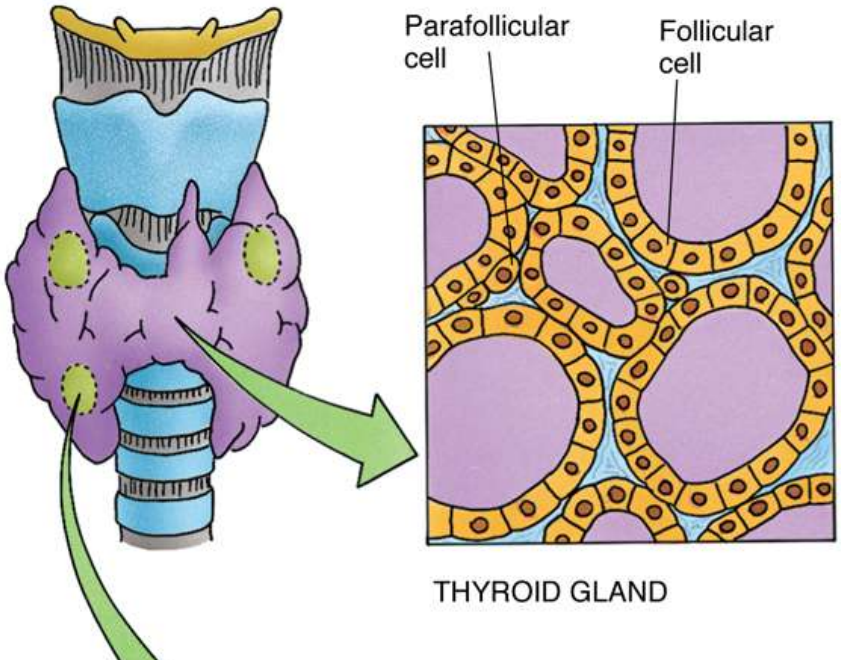
T4 known as triiodothyronine.

Their release is controlled by the adenopituitary glands, from the specialized cells **basophils**, that produce TSH: Thyroid stimulating hormone.

T3 and T4 stimulate the rate of metabolism.

Calcitonin is also produced by the thyroid and aids in decreasing the blood calcium level, thus facilitating the storage of calcium in bones.

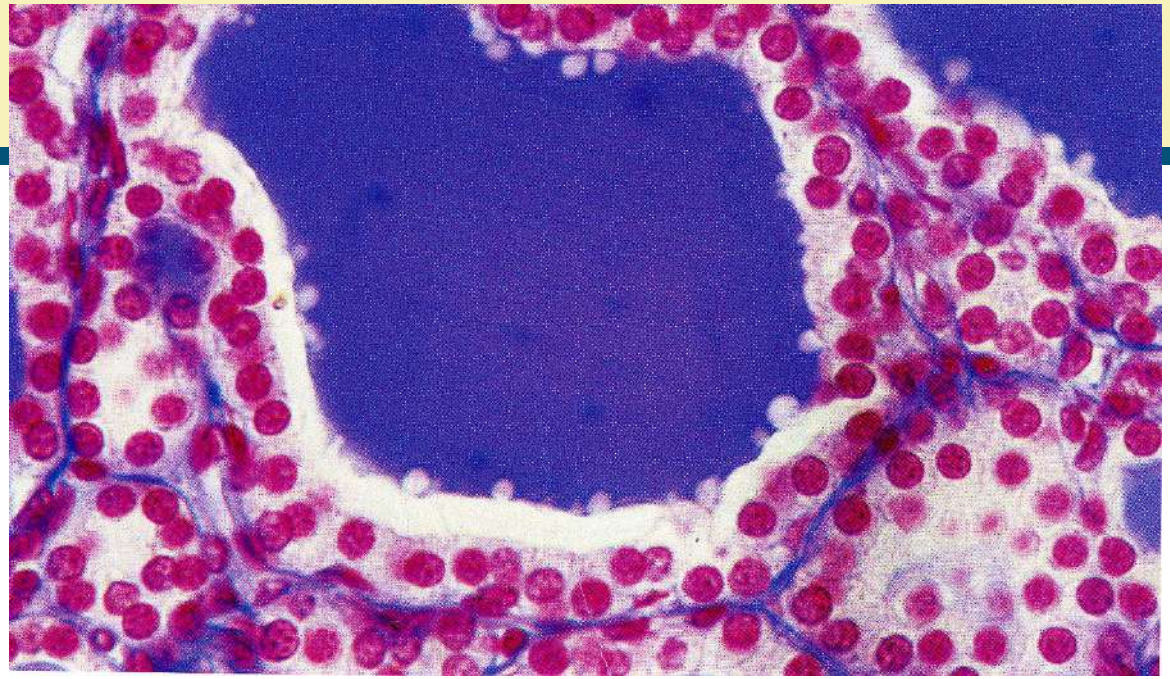
Thyroid Gland - cellular organization



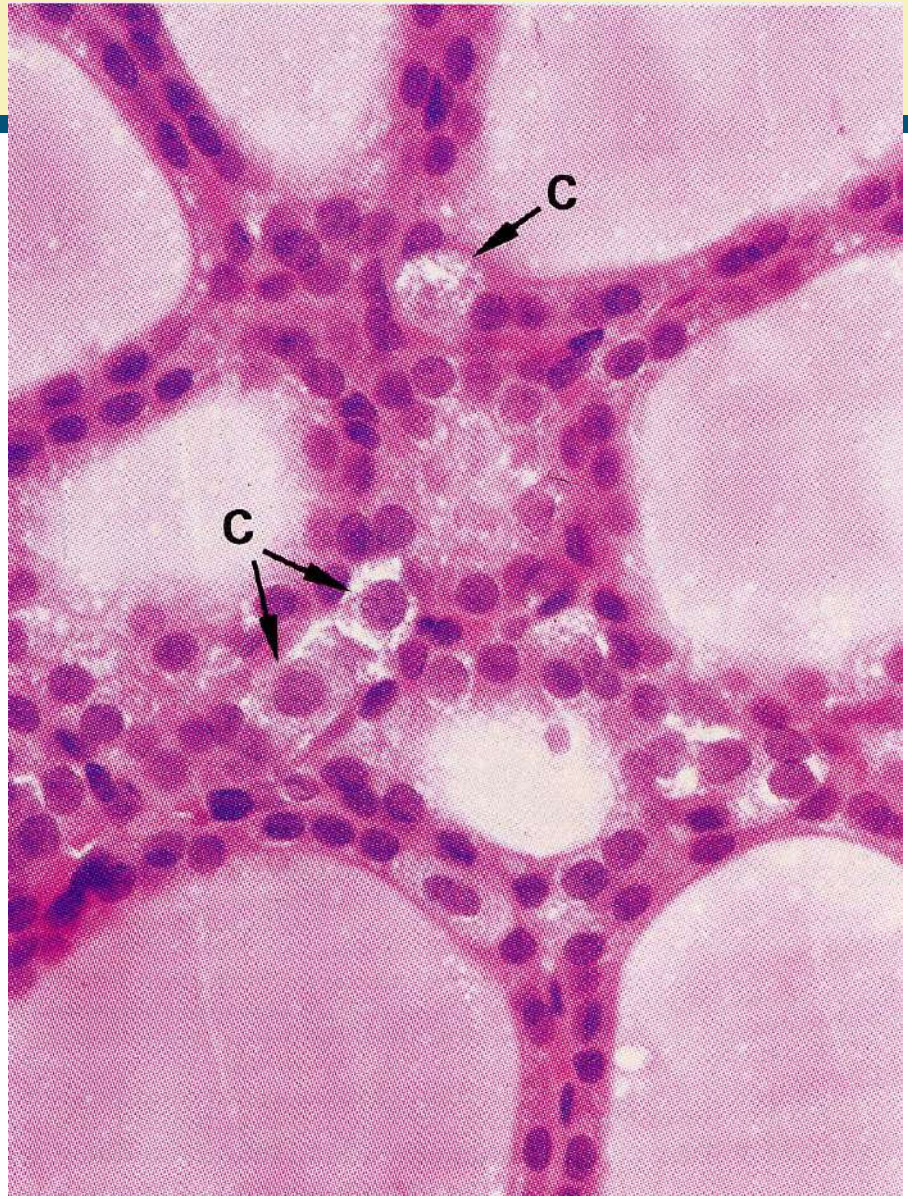
The thyroid and parathyroid glands.

The thyroid gland stores its secretory substances in the lumen of **follicles,** ranging from 0.2 to 0.9 mm in diameter, are composed of a simple cuboidal epithelium (composed of **follicular cells** and occasional **parafollicular cells**) surrounding a central colloid-filled lumen.

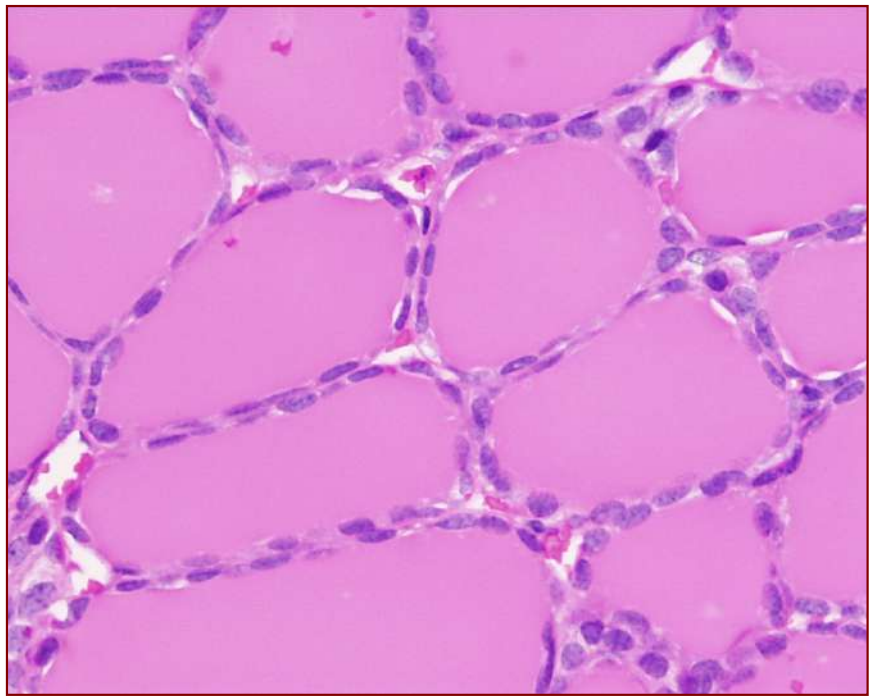
Each follicle can store several weeks' supply of hormone within the **colloid.** The hormones $\mathbf{T_4}$ and $\mathbf{T_3}$ are bound to **thyroglobulin** a large secretory glycoprotein. When the hormones are to be released, the hormone-bound thyroglobulin is endocytosed by the follicular cells and the hormones are cleaved from it by lysosomal proteases.



Activated thyroid



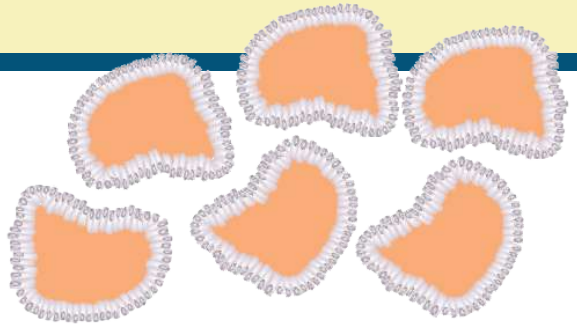
Parafollicular cells –C cells

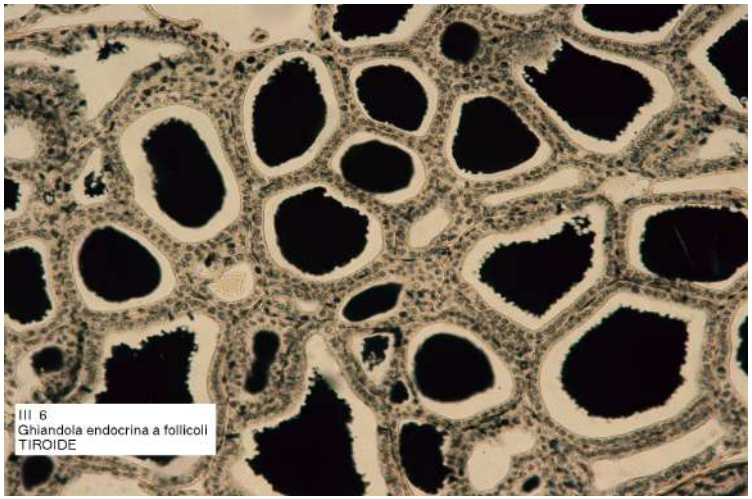


Resting Thyroid

Follicular cells or principal cells

Thyroid Follicles that consist of a simple epithelial spheres, whose lumen contains colloid

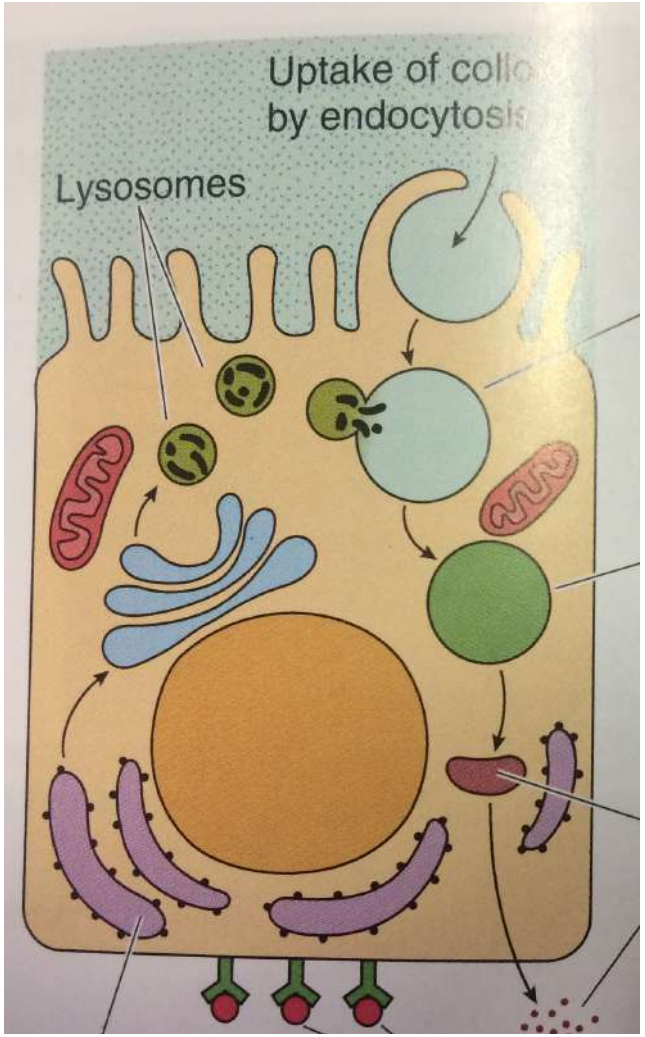




Might be also squamous, with round nuclei and basophilic cytoplasm.

Apically located lysosomes and several microvilli that extend into the colloid.

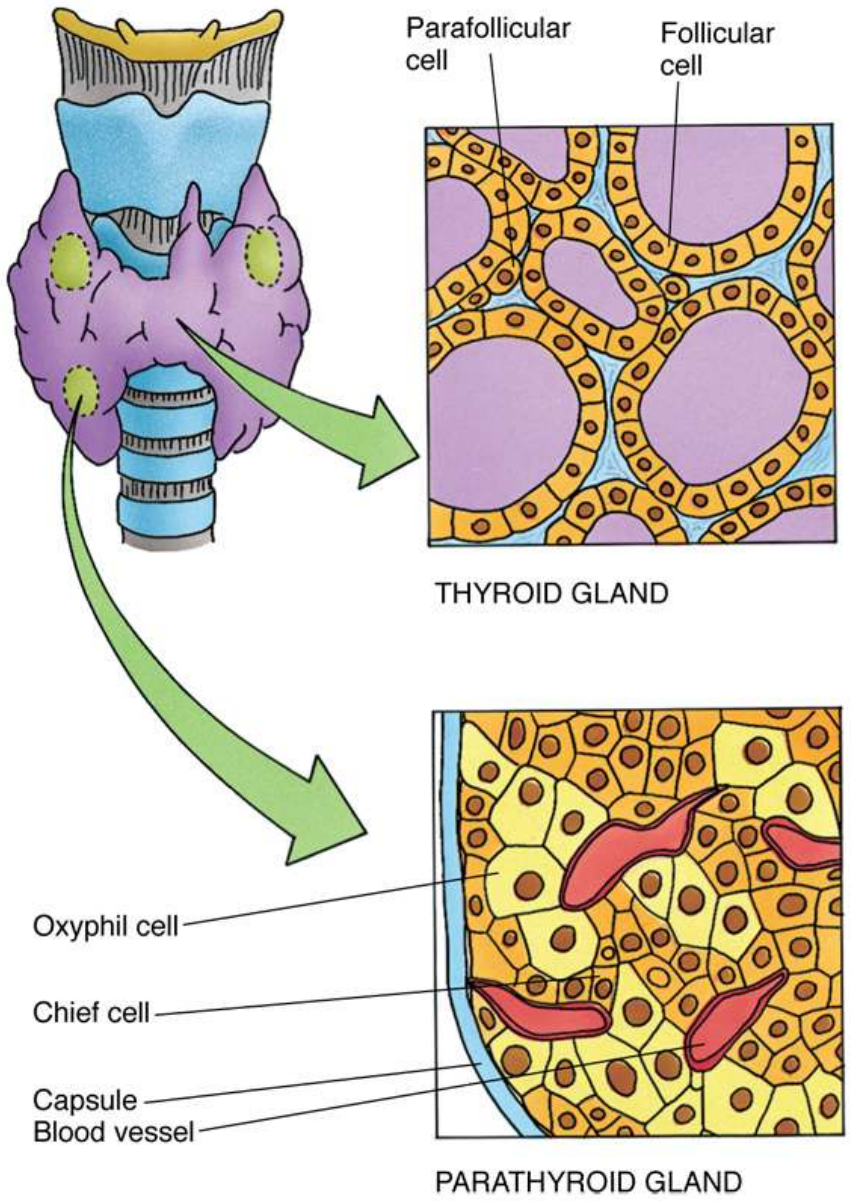
Upon TSH binding to the membrane receptor, cells change phenotype and develop filopodia at the apical membrane, endocytosis aliquot of colloid.
T3 and T4 are released at the basal membrane into the blood vessels.



T3 high affinity and 1 day half-life

T4 90% of the released hormone and 6 days half-life

Thyroid Gland- cellular organization



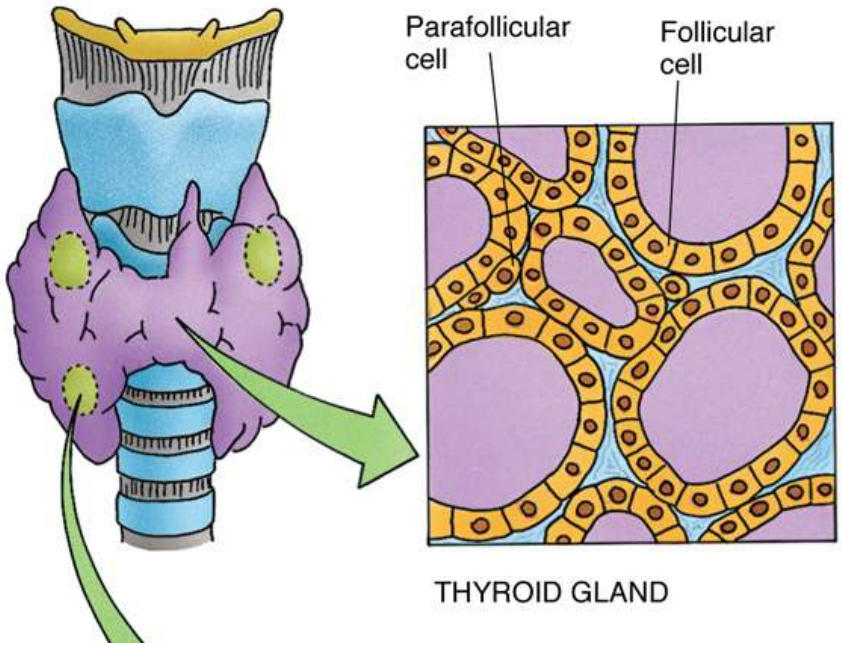
The thyroid and parathyroid glands.

Connective tissue septa derived from the capsule invade the parenchyma and provide a conduit for blood vessels, lymphatic vessels, and nerve fibers.

Connective tissue elements, composed mostly of reticular fibers and housing a rich capillary plexus, surround each follicle but are separated from the **follicular** and **parafollicular** cells by a thin **basal lamina.**

Iodide is essential for the synthesis of the thyroid hormones (T3 and T4); iodination of tyrosine residues occurs in the follicles at the colloid-follicular cell interface.

Thyroid Gland - cellular organization



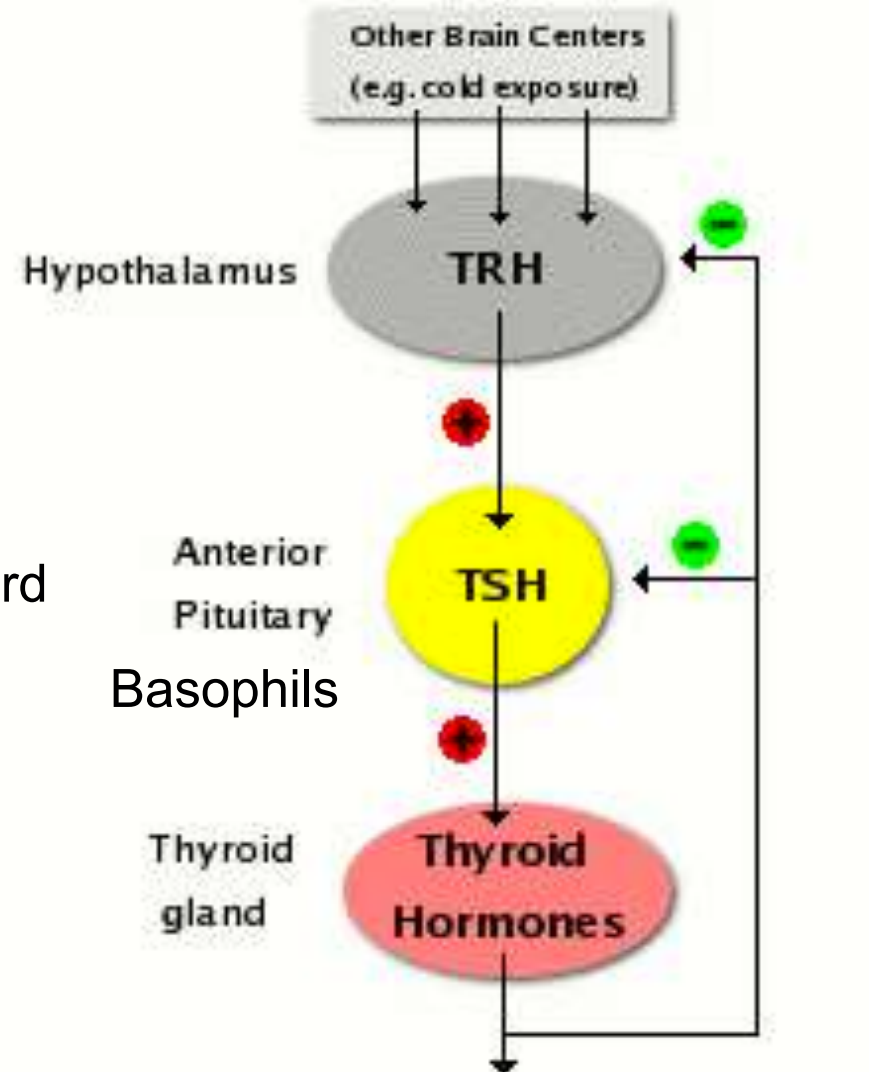
Parafollicular cells (Clear cells or C-cells) are 2-3 times larger than follicular cells and are very rare.

Just 0.1% of the thyroid epithelial cells

They make **calcitonin,** a peptide hormone that **inhibits bone resorption** by osteoclasts, thereby lowering calcium concentrations in blood.

The thyroid and parathyroid glands.

Thyroid Hormones T3 and T4 and negative feedback control



Feed-forward

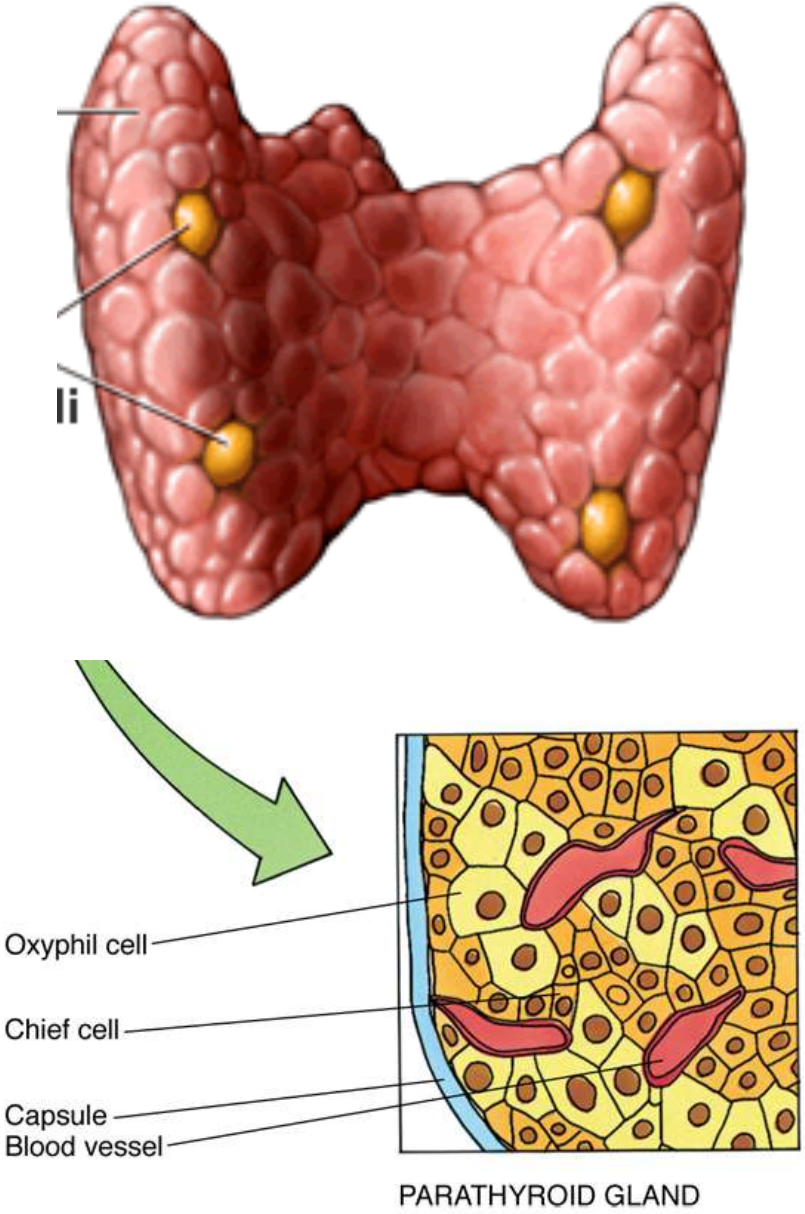
Negative feed-back

overactive thyroid

[3] Tireotropina (TSH) **0.21** < *microU/mL* 0.25 - 4.50

Metodica: CLIA

Parathyroid Gland



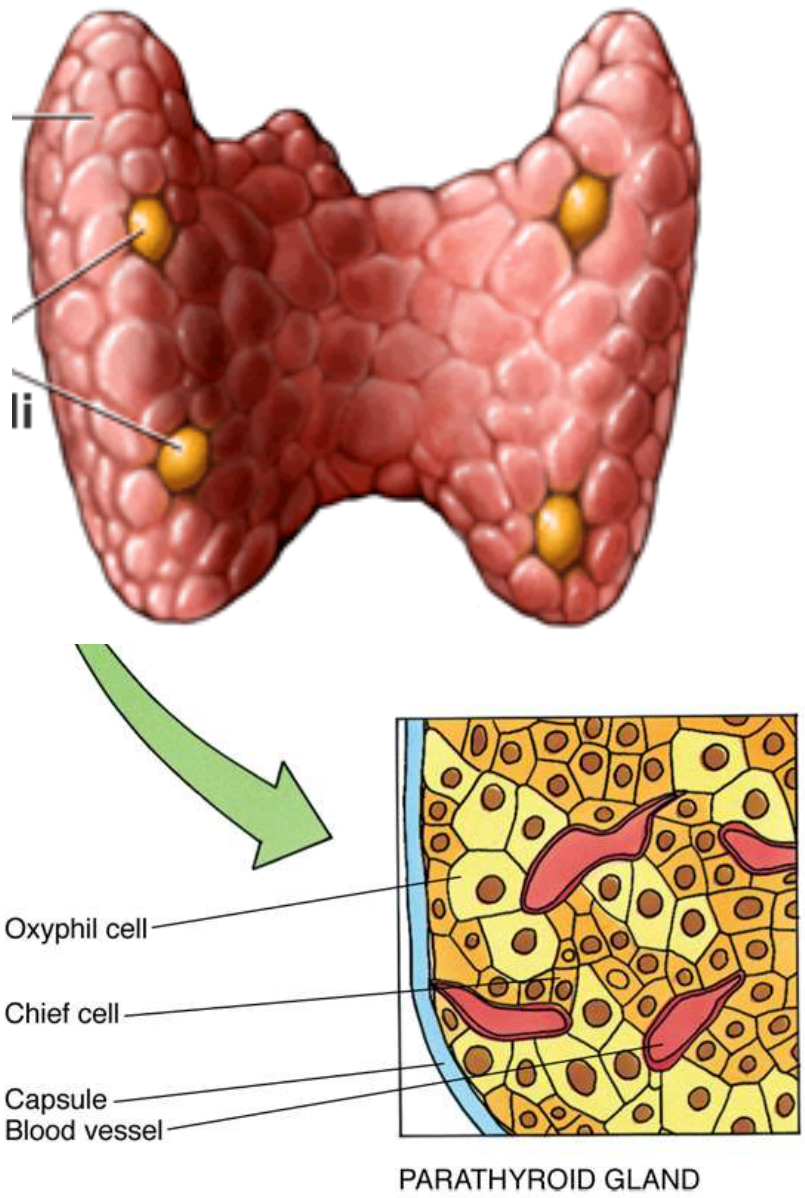
The thyroid and parathyroid glands.

The **parathyroid glands,** usually four in number, are located on the posterior surface of the thyroid gland; each gland is enveloped in its own thin, collagenous connective tissue capsule.

The major functional parenchymal cells of the parathyroid glands are the slightly eosinophilic-staining **chief cells** which house **PTH** containing secretory granules.

PTH acts on bone, kidneys, and the intestines in maintaining the optimal calcium concentrations in blood and interstitial tissue fluid.

Parathyroid Gland



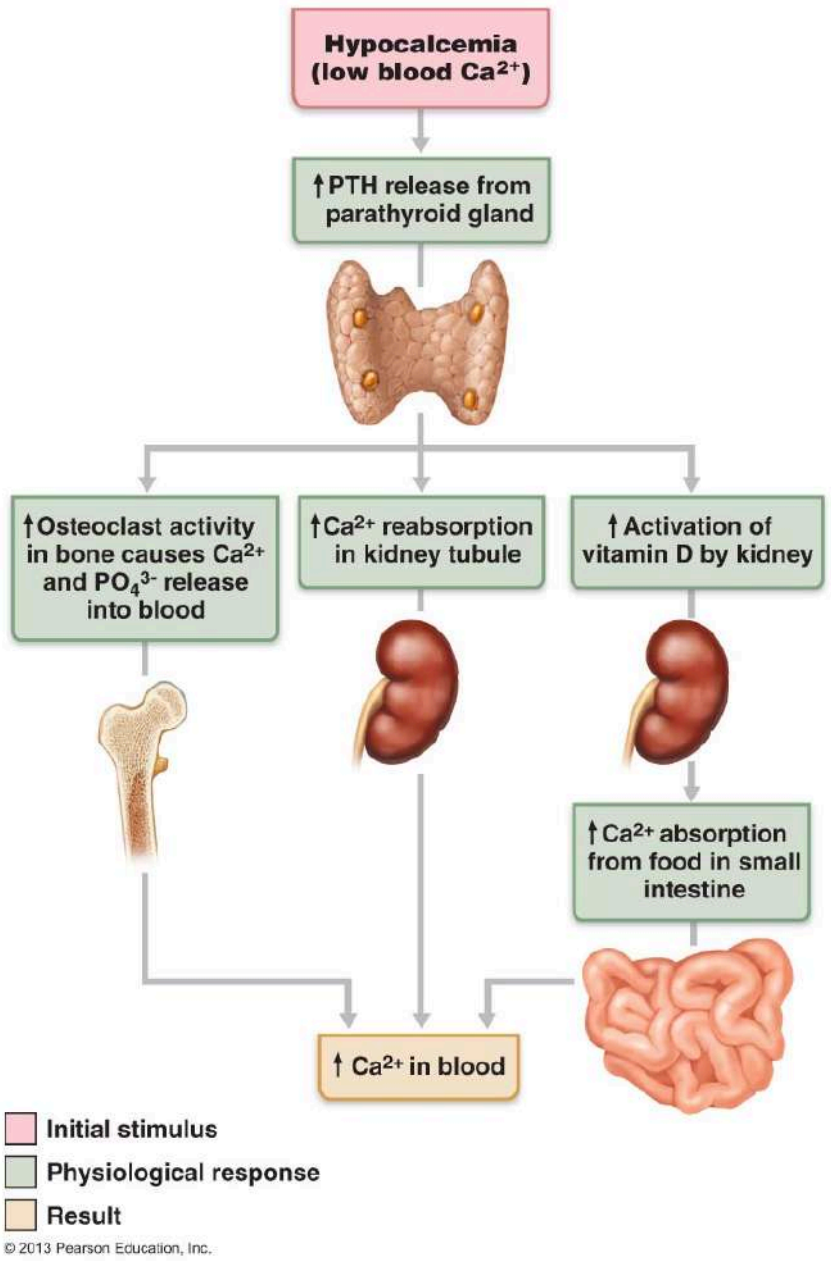
The thyroid and parathyroid glands.

The second cell type located in the parathyroid glands is the **oxyphil cell.**

Its function is unknown, although it is believed that oxyphil cells and a third cell, described as an **intermediate cell,** probably represent inactive phases of chief cells.

Are deeply stained with eosin.

Physiological effect of parathyroid hormone



It maintains the Ca^{2+} homeostasis

8.5 to 10.5 mg/dl

It acts on bone, kidney and intestine, leading to an increased Calcium ions concentration.

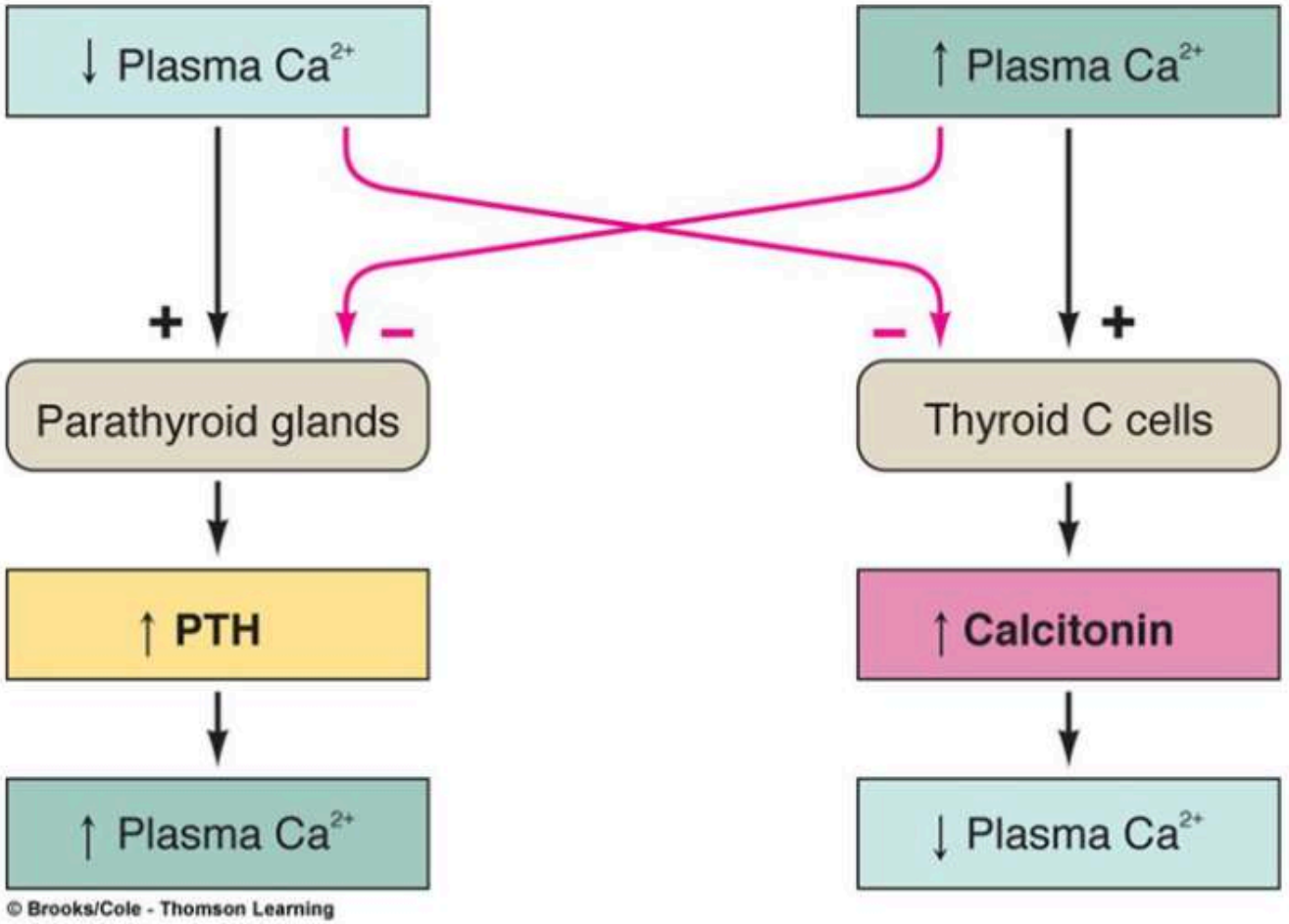
Low calcium level induces the chief-cells to produce and release PTH.

In bone PTH binds to receptor on osteoblast to increase the secretion of osteoclast-stimulating factor. This factor induces bone to release calcium ions into the blood.

In the kidney, PTH prevents loss of calcium in the urine and the proximal tubes cells produce calcitriol (active Vit.D)

Vit.D is necessary for the intestinal uptake of calcium from the intestinal mucosa.

Negative-feedback Loops Controlling Parathyroid Hormone (PTH) and Calcitonin Secretion



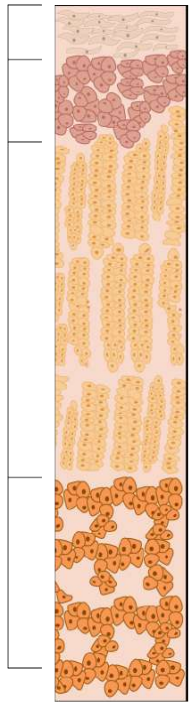
https://unibo.smartzoom.com/s1241/course1776/f1815/i1819/

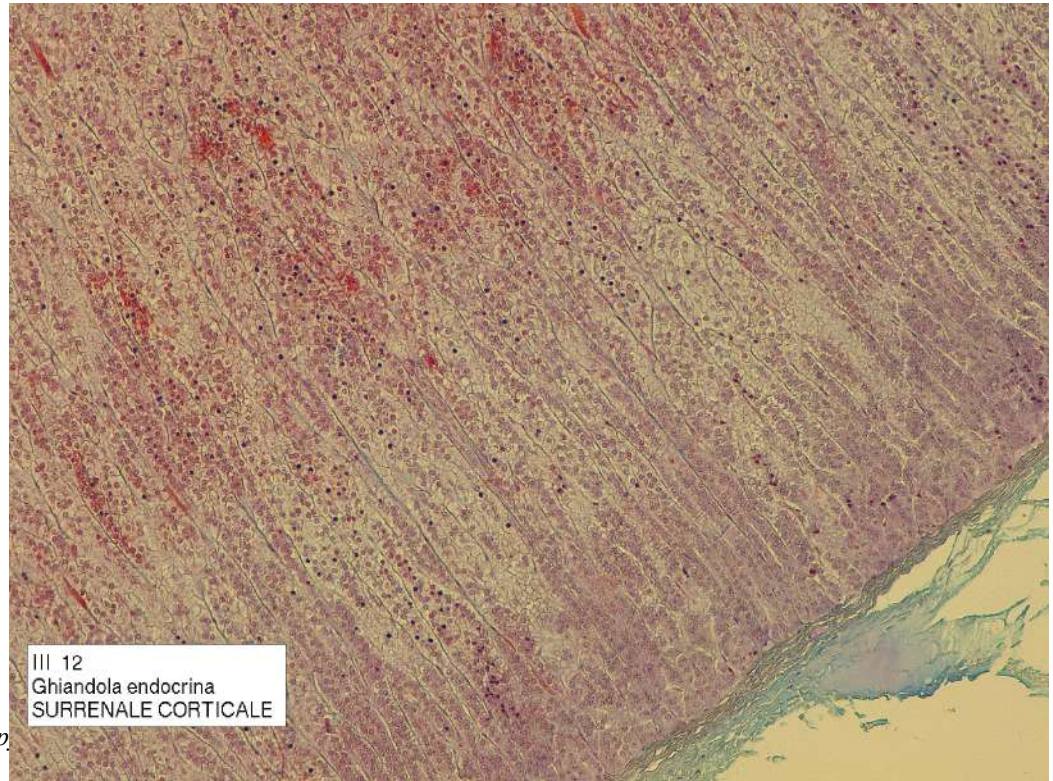
http://www.histologyguide.com/slideview/MH-151-thyroid/13-slide-1.html

DISCRETE ENDOCRINE GLAND - ADRENAL GLAND

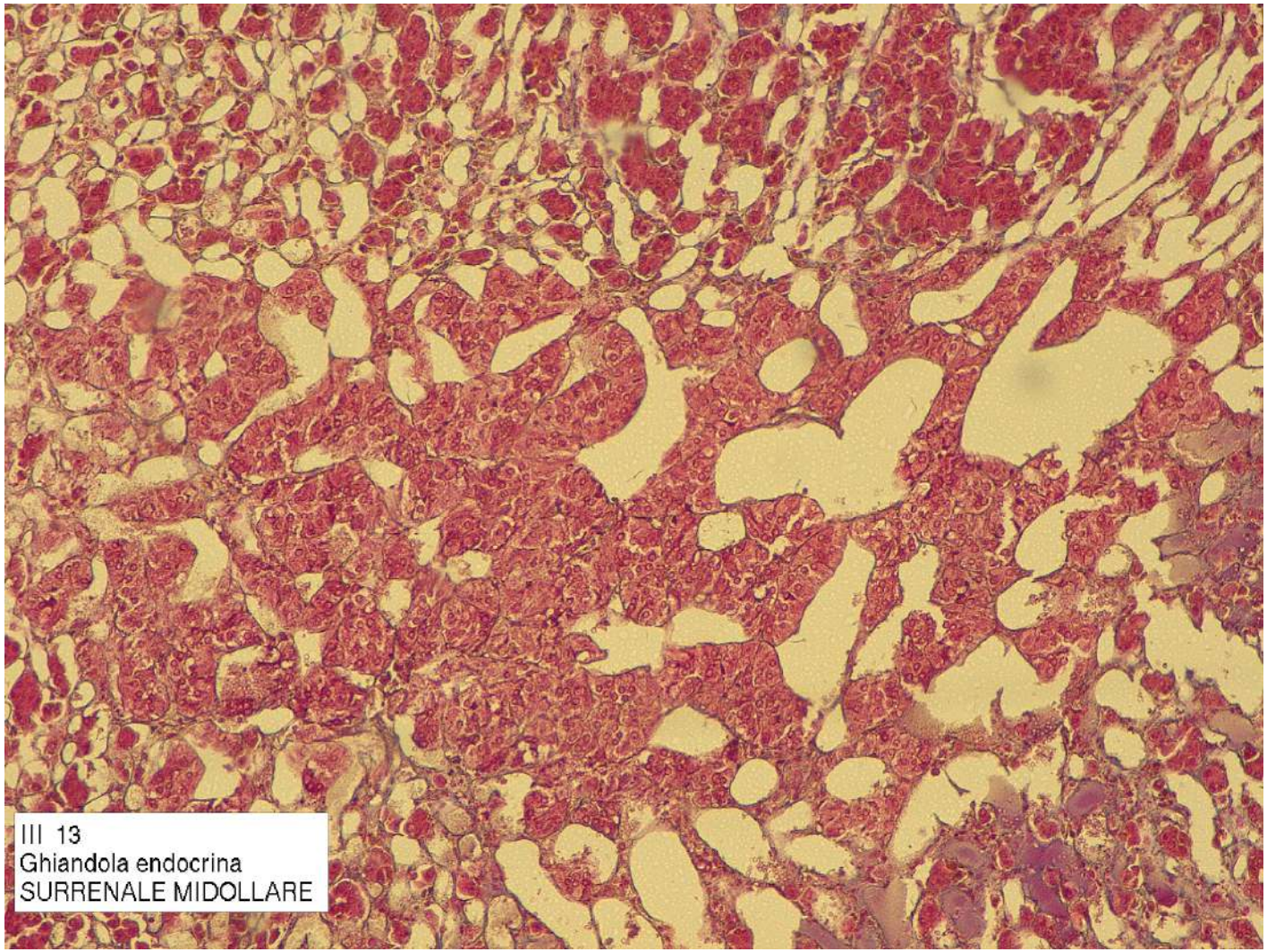
Adrenal Glands

- Capsule of dense collagenous connective tissue
- Adrenal Cortex
  - Zona Glomerulosa (columnar cells closely packed)
  - Zona Fasciculata (straight cords, one or two cells thick)
  - Zona Reticularis (irregular cords that form an anastomosing network)
- Adrenal Medulla
  - Polyhedral parenchymal cells arranged in cords and supported by a reticular fiber network

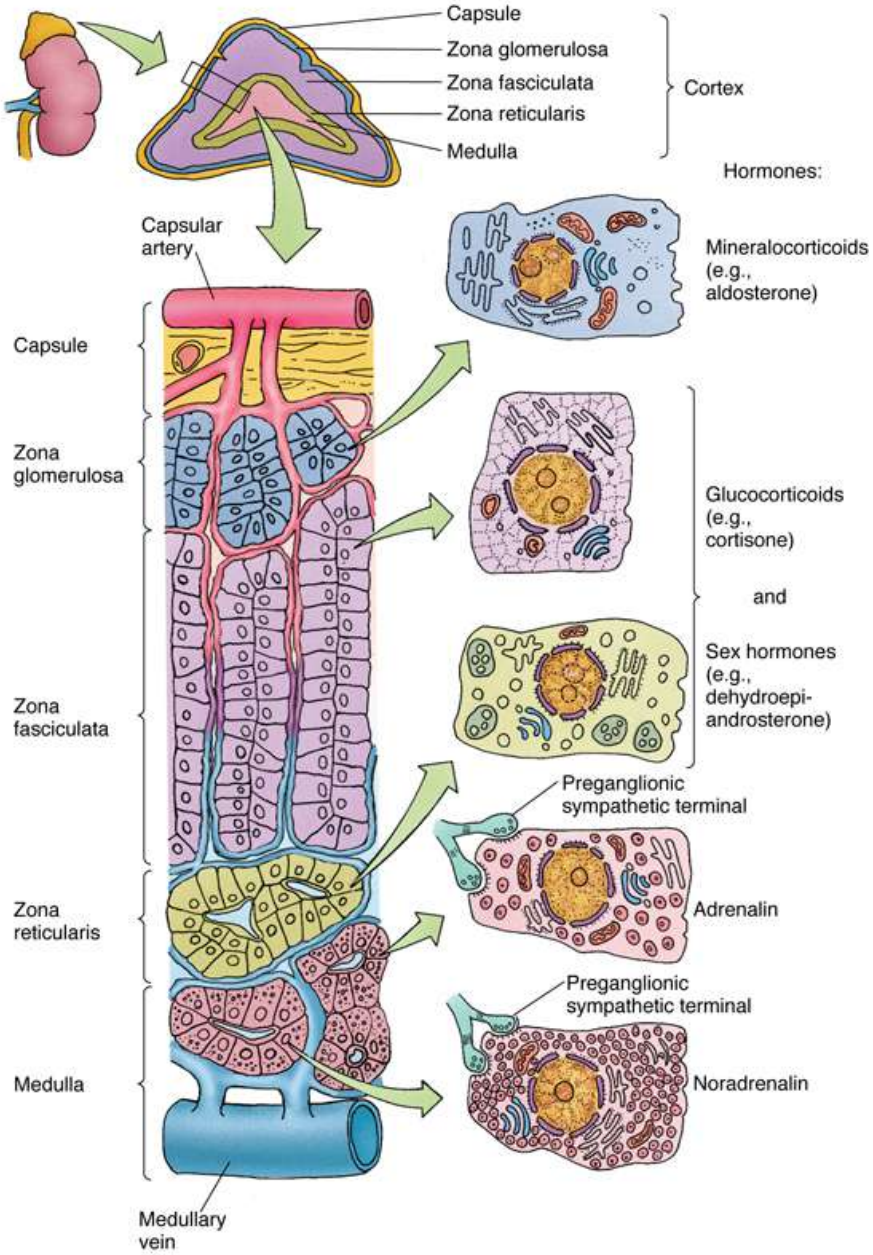




DISCRETE ENDOCRINE GLAND



Suprarenal Glands



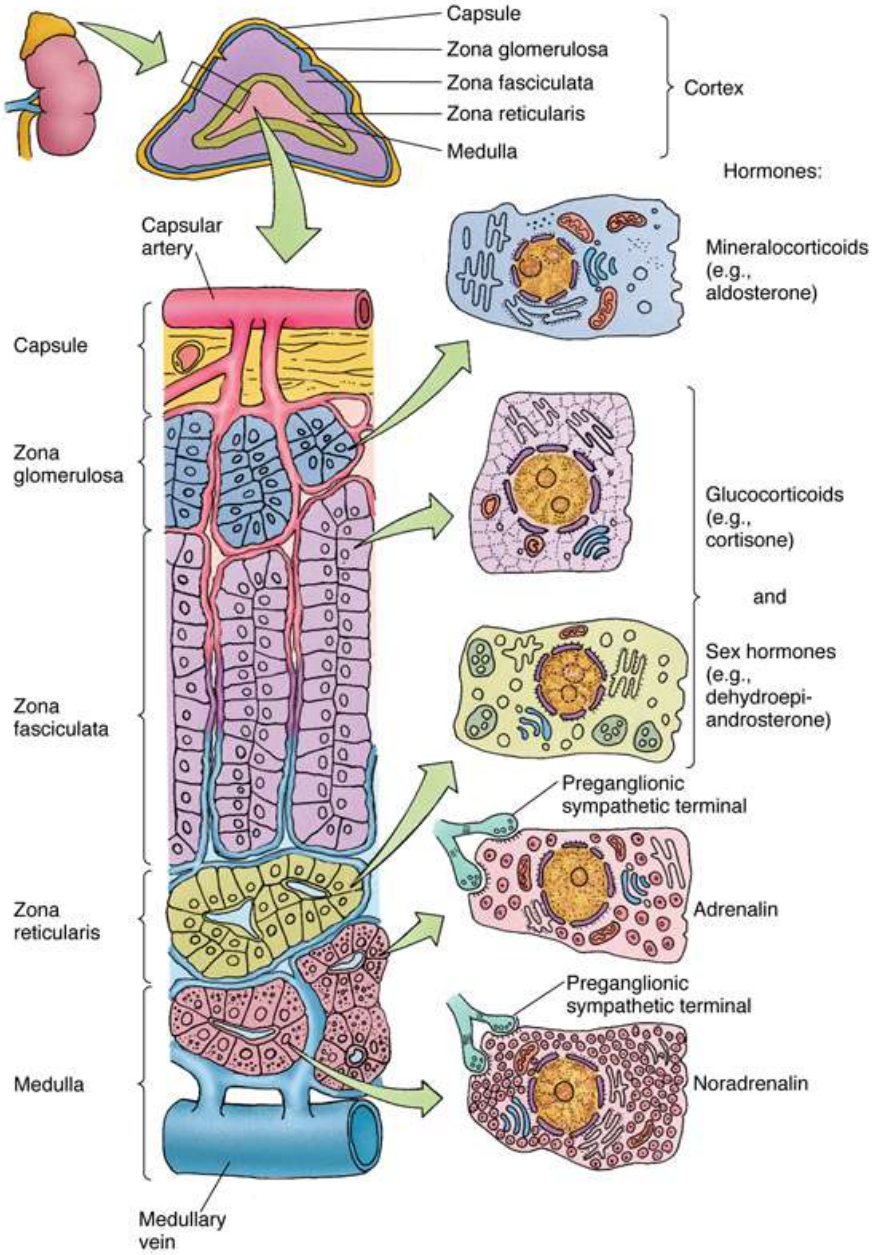
The suprarenal gland and its cell types.

The **suprarenal gland** is divided into two histologically and functionally different regions: an outer yellowish portion, called the **suprarenal cortex,** and a small, dark, inner portion called the **suprarenal medulla**.

Although both entities are endocrine in function, each develops from a different embryological origin and performs a different role.

The **suprarenal cortex** is divided into three concentric regions, the outermost zona glomerulosa, the middle (and largest) zona fasciculata, and the innermost zona reticularis.

Suprarenal Glands



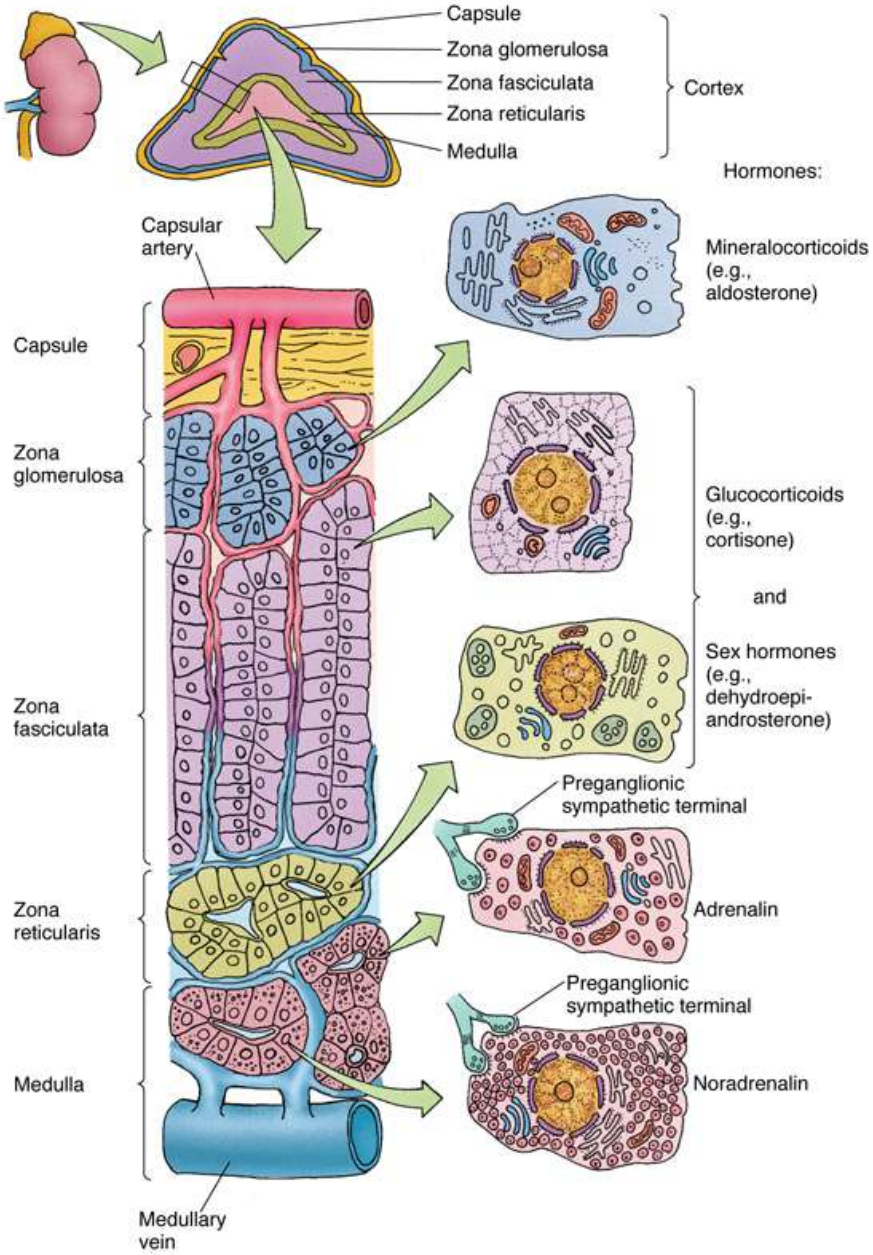
The suprarenal gland and its cell types.

The **zona glomerulosa**, when stimulated by angiotensin II and ACTH, synthesizes and releases the hormones aldosterone and deoxycorticosterone.

The **zona fasciculata,** whose cells are referred to as **spongiocytes,** when stimulated by ACTH, synthesize and release the hormones cortisol and corticosterone.

The **zona reticularis**, when stimulated by ACTH, synthesize and release dehydroepiandrosterone, androstenedione, and some glucocorticoids.

Suprarenal Glands

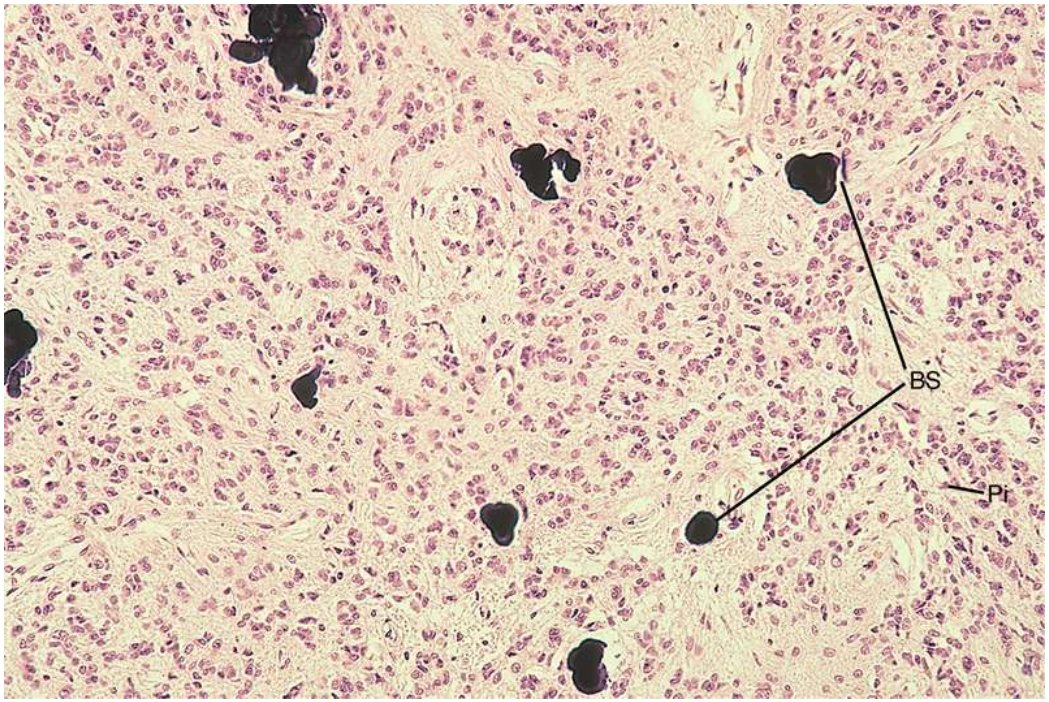


The suprarenal gland and its cell types.

The **suprarenal medulla** is functionally related to and regulated by the sympathetic nervous system.

Its parenchymal cells are known as **chromaffin cells** which are considered to be modified postganglionic sympathetic cell bodies. These chromaffin cells manufacture and release the neurotransmitter substances **epinephrine** and **norepinephrine** in response to preganglionic sympathetic splanchnic nerves.

Pineal Gland



Pineal gland (×132). The large, darkly staining structures are brain sand (BS) scattered among the pinealocytes (Pi). Neuroglial cells are present but difficult to distinguish at this magnification.

The **pineal gland** (**pineal body**) is an endocrine gland whose secretions are influenced by the light and dark periods of the day. The gland is covered by a capsule from which septa extend and divides the pineal gland into incomplete lobules. Blood vessels enter the gland via the connective tissue septa.

The parenchymal cells of the gland are composed primarily of **pinealocytes** and **interstitial cells**.

Melatonin and serotonin production

Circadian Rhythm

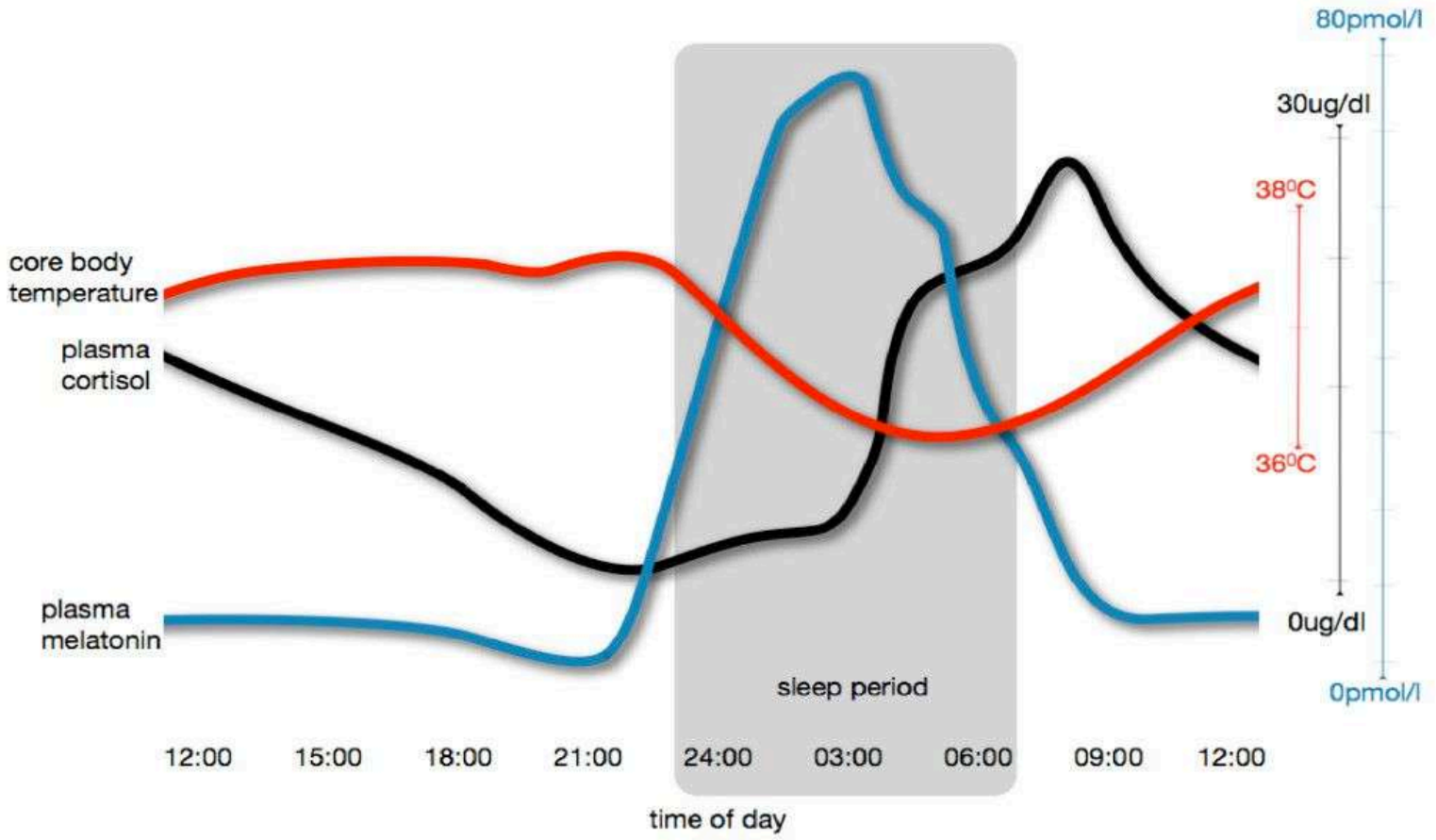
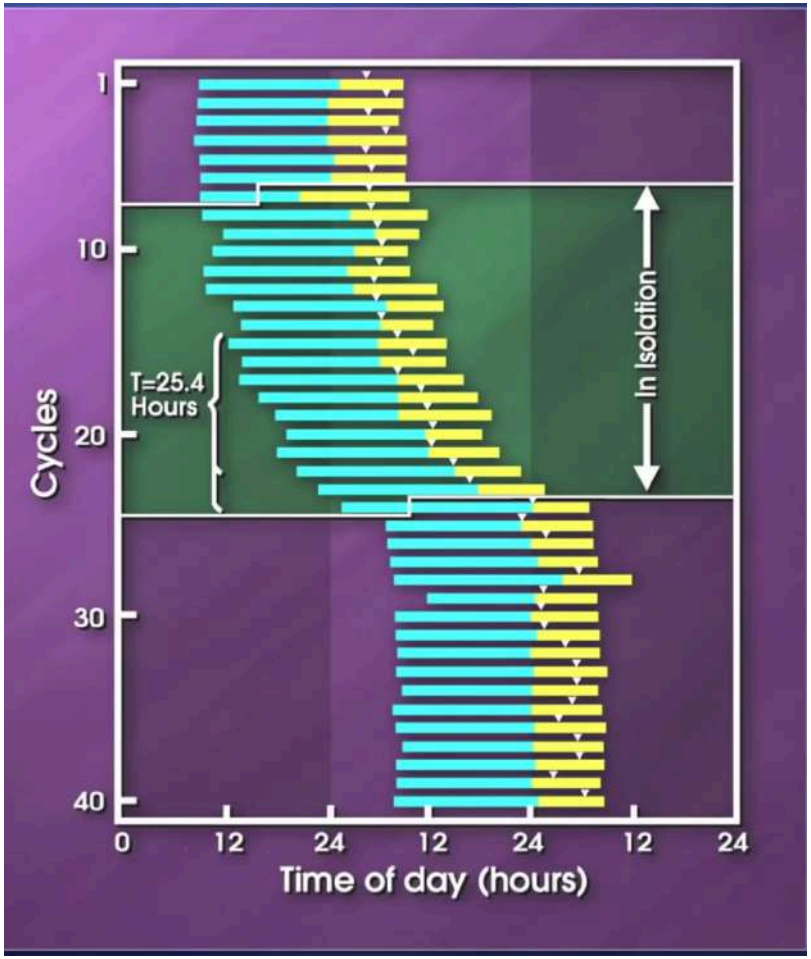


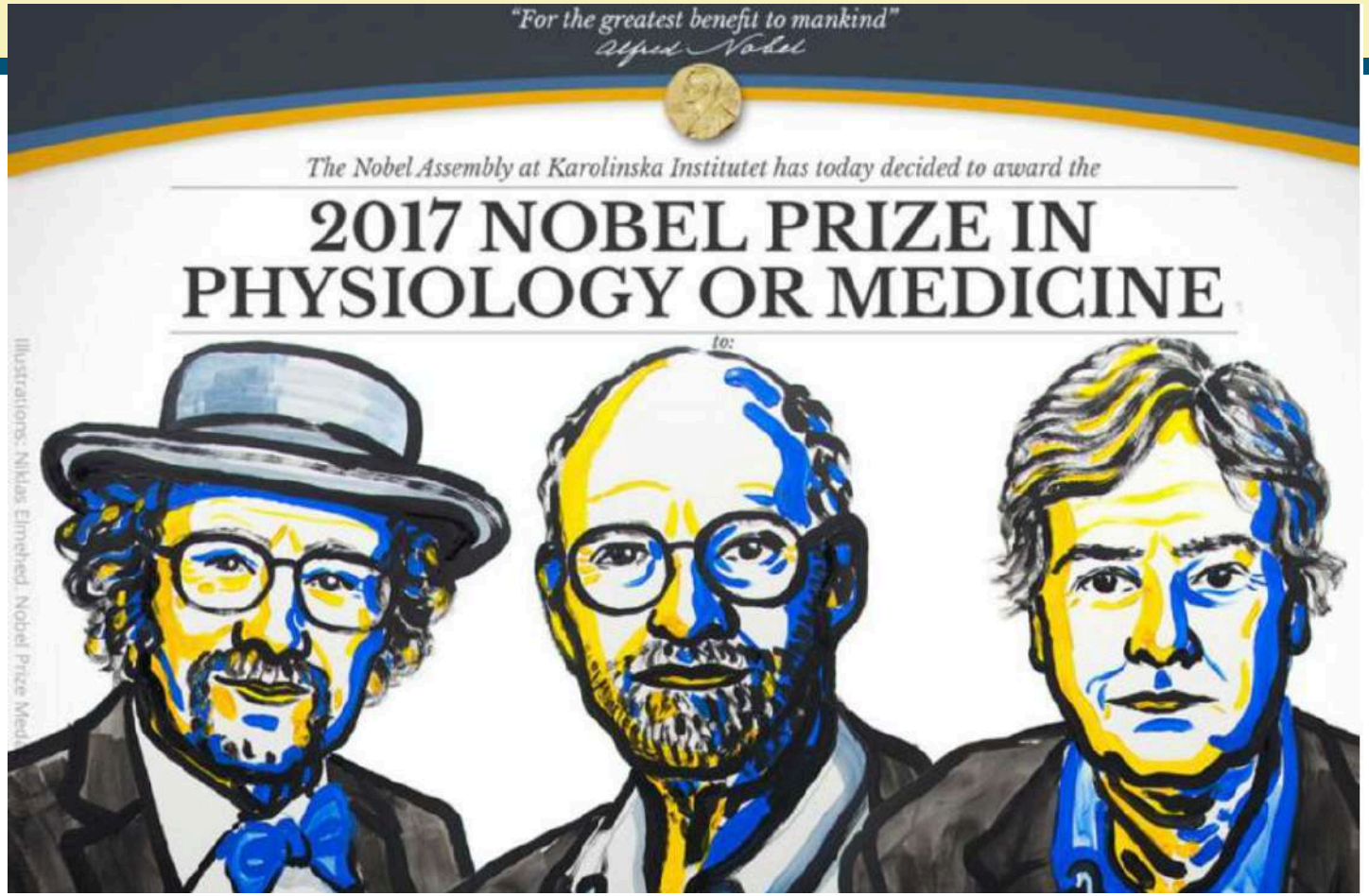
Figure 3: The normal synchronous relationships between sleep and daytime activity and varying levels of cortisol, melatonin and body temperature

Experiment that demonstrates the preservation of the circadian rhythm in the absence of light



J. Ashoff 1969, *A. Medicine*

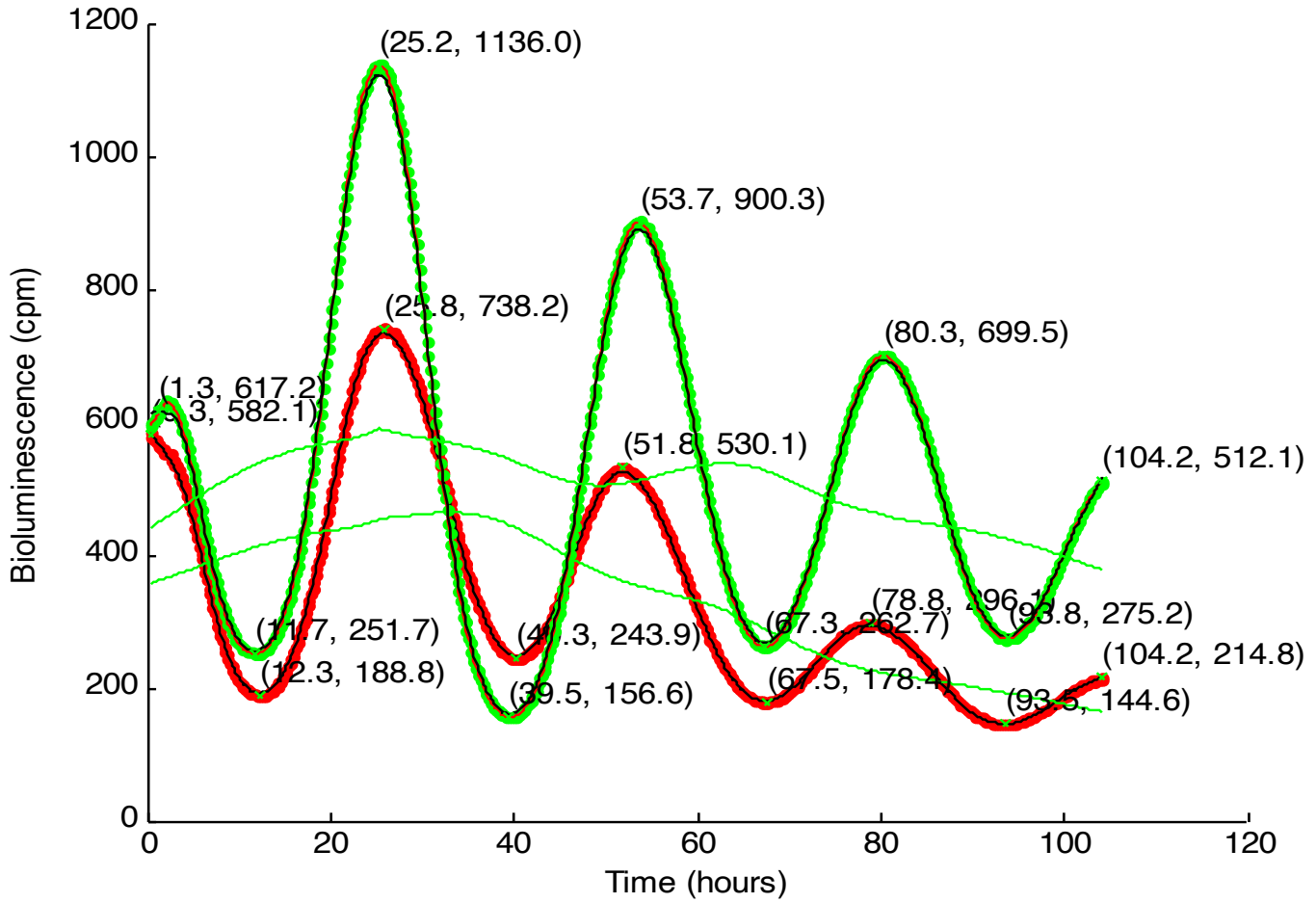
Max Plank experiment – 40 days –a student



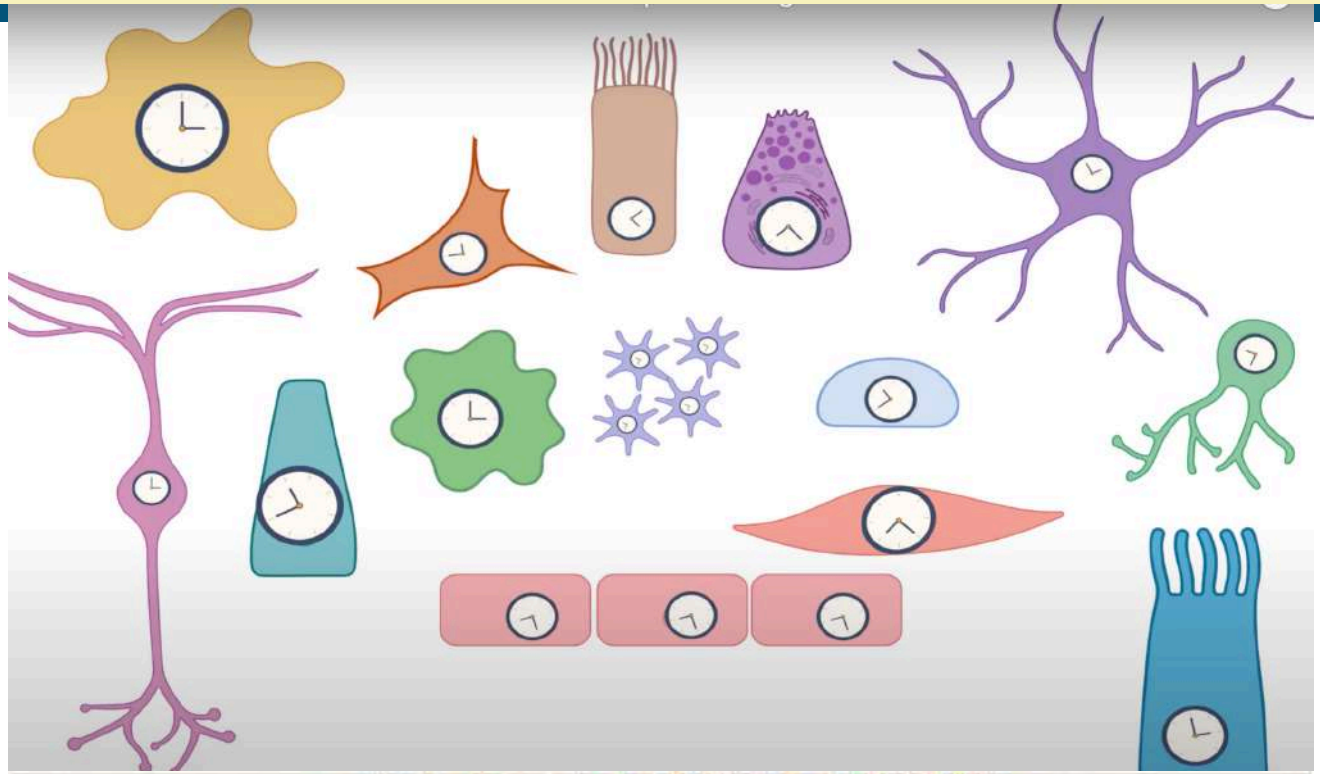
Jeffrey C. Hall, Michael Rosbash e Michael W.Young, Nobel for Medicine in 2017

A genetic screen for mutants that altered circadian behavioral rhythms

Oscillations of the clock genes are maintained in vitro, in fibroblasts isolated from healthy tissues

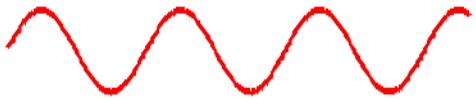


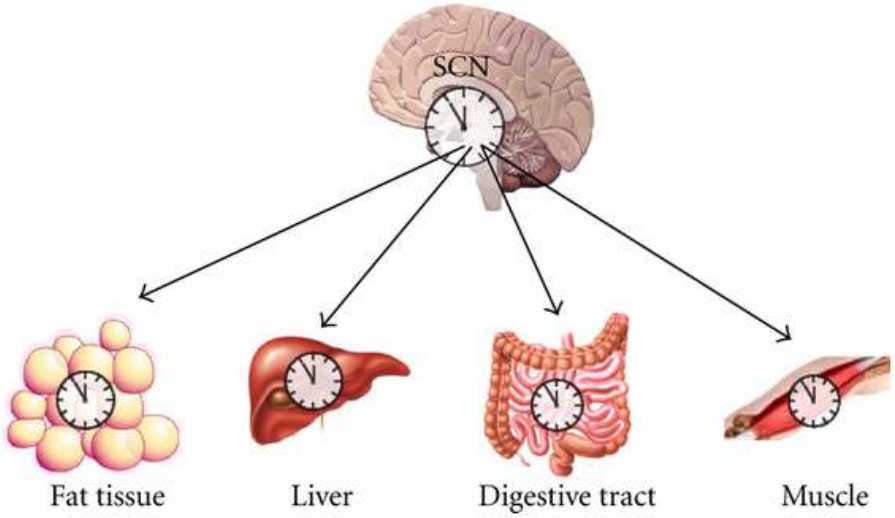
10-60% of the transcriptome is circadian regulated



Circulating levels of glucocorticoids show circadian rhythmicity with peak levels during the onset of activity. Indicating that the oscillation of glucocorticoid levels is truly a clock-regulated process.

and/or feeding time must be
freely circulating diffusible signals





Science

Current Issue First release papers

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Resetting of Circadian Time in Peripheral Tissues by Glucocorticoid Signaling

nature COMMUNICATIONS

ARTICLE

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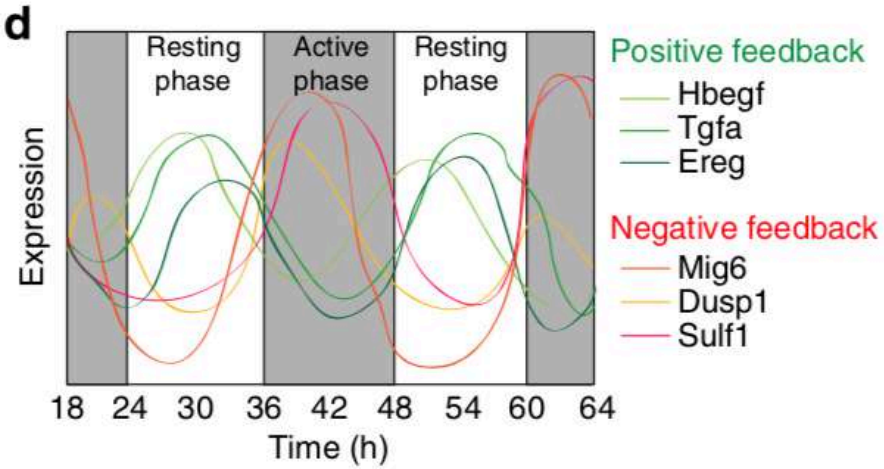
Diurnal suppression of EGFR signalling by glucocorticoids and implications for tumour progression and treatment

Mattia Lauriola[1,2], Yehoshua Enuka[1], Amit Zeisel[3,†], Gabriele D'Uva[1], Lee Roth[1], Michal Sharon-Sevilla[1], Moshit Lindzen[1], Kirti Sharma[4], Nava Nevo[1], Morris Feldman[1], Silvia Carvalho[1], Hadas Cohen-Dvashi[1,†], Merav Kedmi[1], Nir Ben-Chetrit[1], Alon Chen[5], Rossella Solmi[2], Stefan Wiemann[4], Fernando Schmitt[6,7,8], Eytan Domany[3] & Yosef Yarden[1]

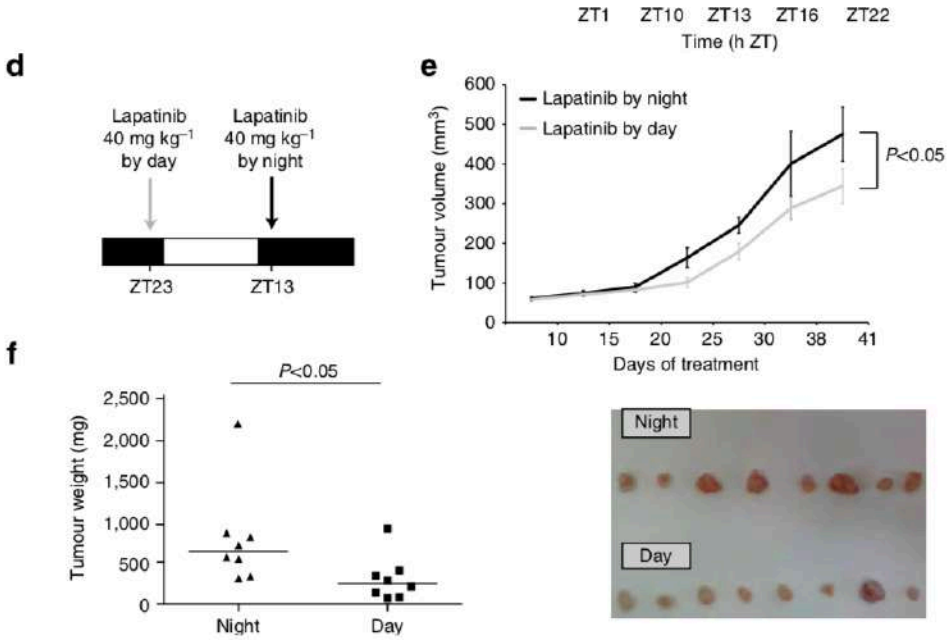


FEATURE

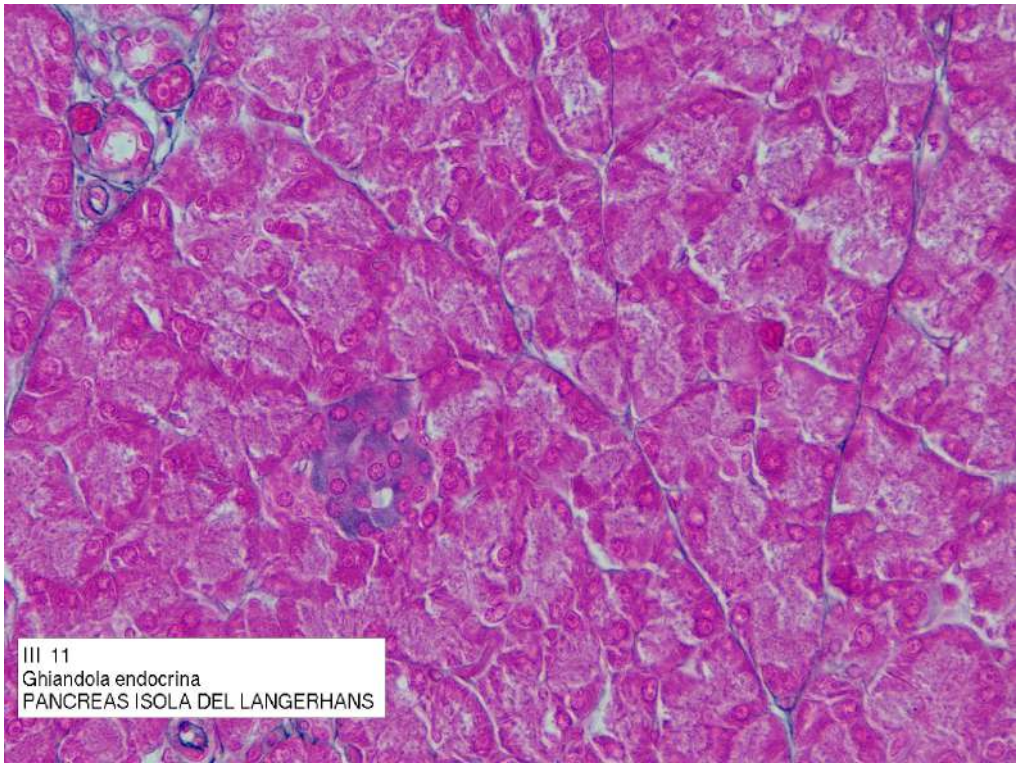
Chronotherapy: treating cancer at the right time

Oncologist Francis Lévi has been probing the potential of chronotherapy for 20 years, but momentum is now building as more researchers join his mission to prove that the time cancer drugs are given influences their efficacy and toxicity.

DARA MOHAMMADI



Islet of Langherans: rounded cluster of cells embedded within exocrine pancreatic tissue



Each islet is highly vascularized, composed by about 3000 cells. There are about 1-2 millions of islets distributed in a human pancreas.

Each islet is about 0.3 mm diameter and it's surrounded by reticular fibers.

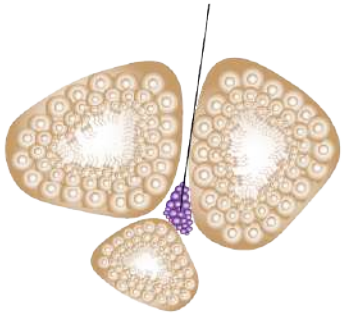
Islets of Langherans: 5 cell types

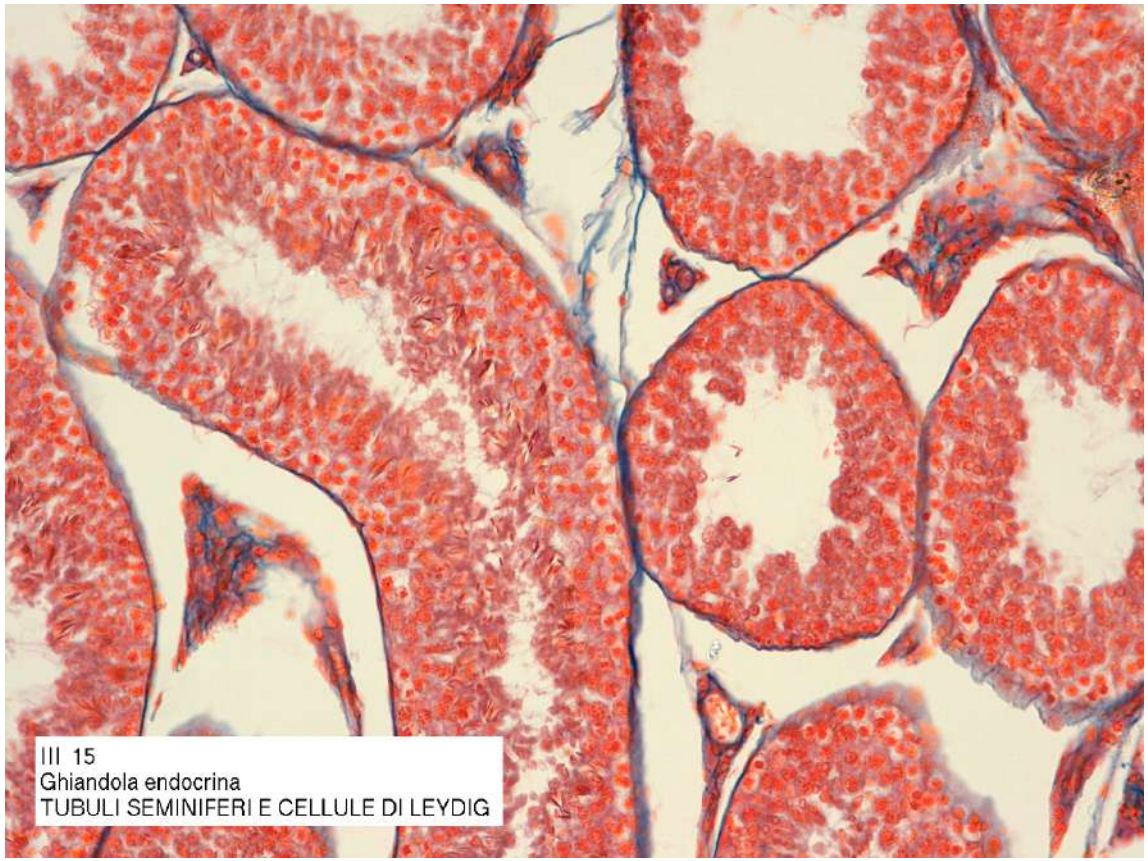
- **Beta cells**: Insulin production, to decrease glucose levels in the blood and amylin (inhibit gastric emptying and alpha cells)
- **Alpha cells**: Glucagon, to increase glucose levels
- **Delta**: somatostatin (to inhibit hormone release from endocrine and enzyme release from exocrine pancrease) and Vasoactive Intestinal peptide (VIP) regulates smooth muscle tonus, glycogenolysis
- **PP cells**: pancreatic polypeptide (exocrine secretion from pancreas)
- **G cells**: gastrin, stimulate HCl production in the stomach

CLUSTER OF CELLS

Endocrine interstitial cells

- ♀ Interstitial cells between ovarian follicles
- ♂ Leydig cells, interstitial cells between the seminiferous tubules



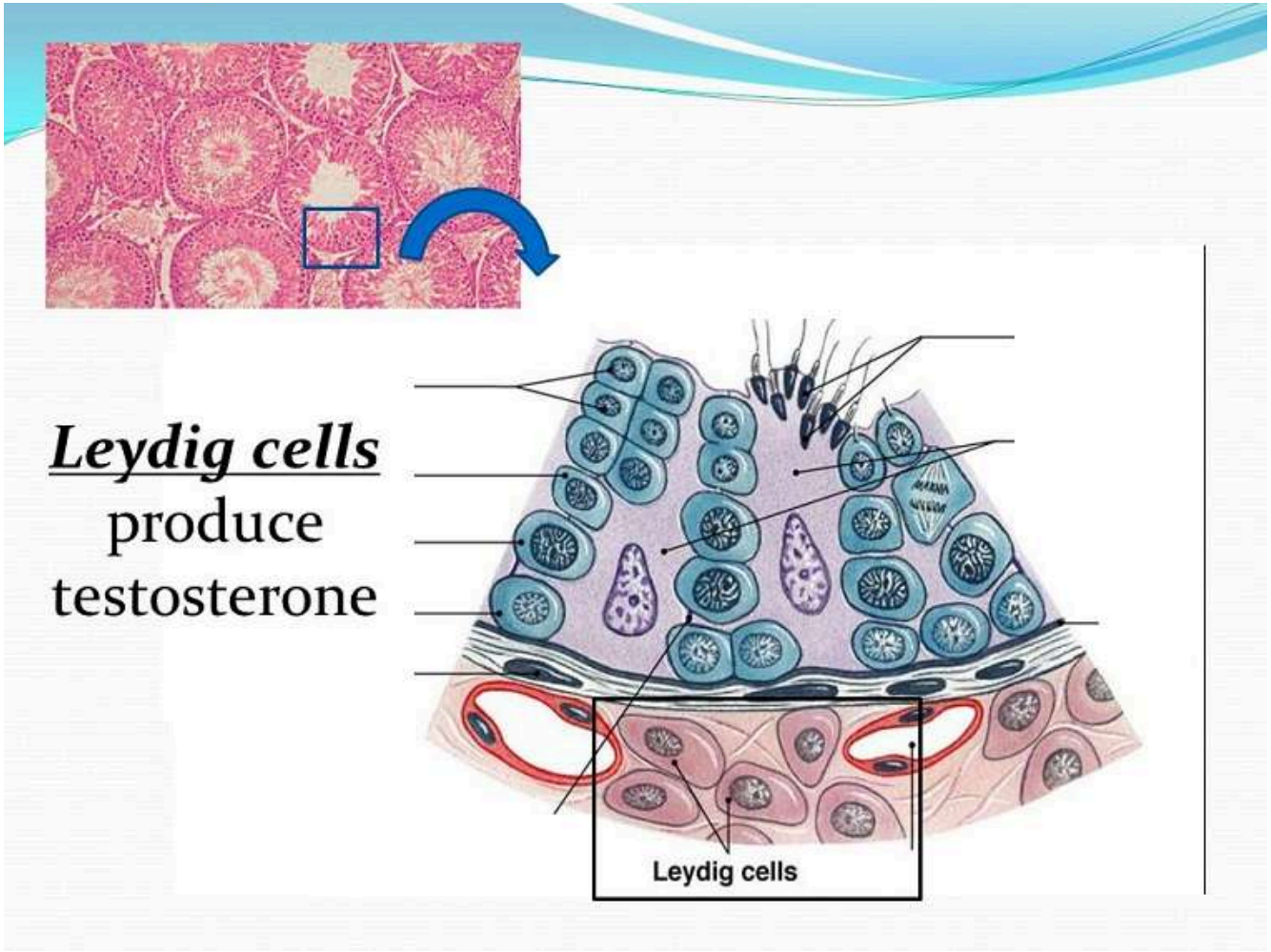


III 15
Ghiandola endocrina
TUBULI SEMINIFERI E CELLULE DI LEYDIG

Leydig cells

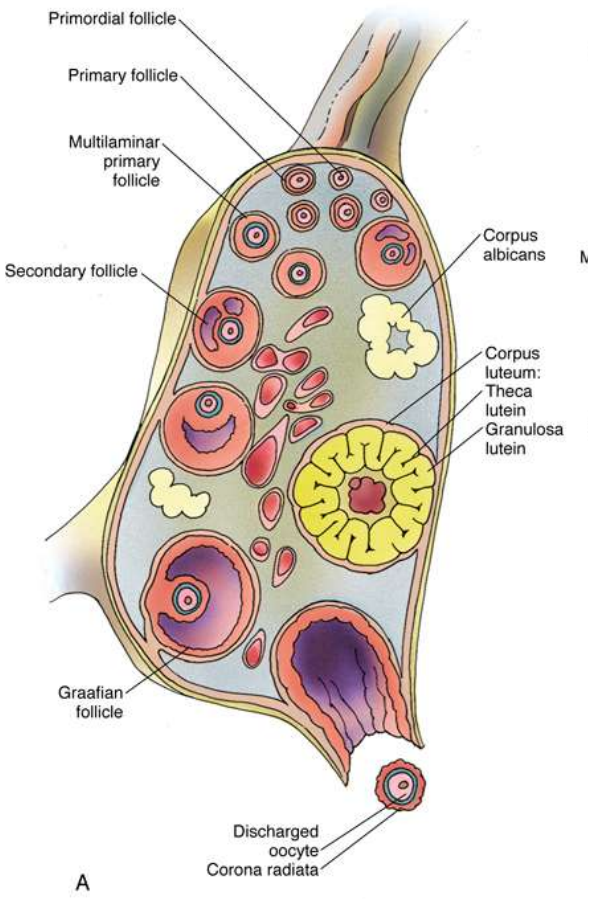
- Interstitial cells, dispersed into the loose connective tissue housing fibroblasts, mast cells.
- Leydig cells produce: Testosterone and INSL3 (insulin-like factor 3)
- Testosterone is responsible for spermatogenesis
- INSL3 is responsible for the descent of the testes into the scrotum in the fetal life

Leydig cells



Leydig cells have the receptor for LH (luteinizing hormone) that from the anterior pituitary gland, will stimulate the synthetic pathway responsible for the production of testosterone

Ovaries



Ovarian structure **(A)** and follicular development

https://unibo.smartzoom.com/s1241/course1776/f1815/i2437/

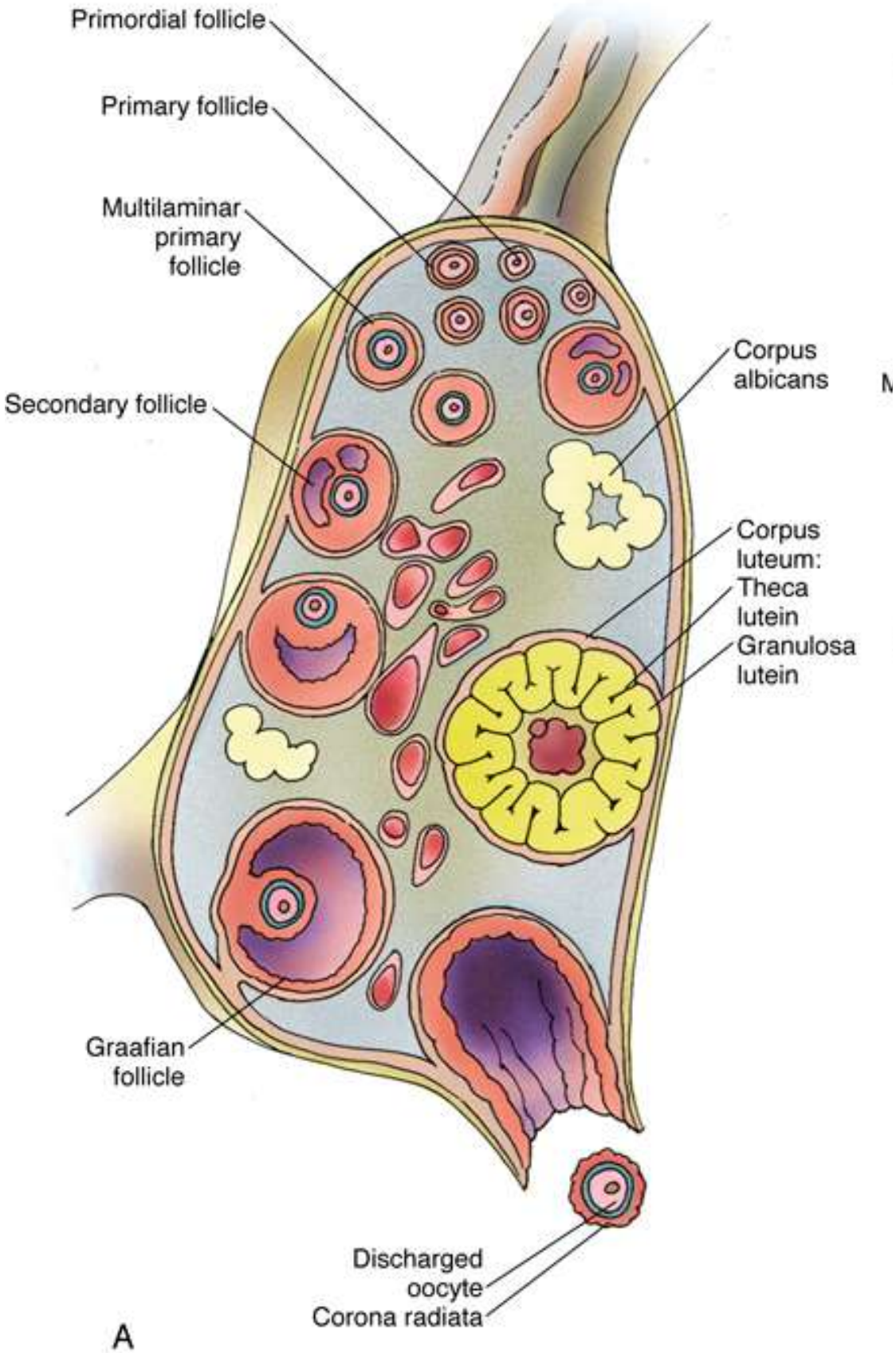
The paired **ovaries,** located within the pelvis, are almond-shaped bodies 3 cm long, 1.5 to 2 cm wide, and 1 cm thick.

The surface epithelium covering the ovaries, called the **germinal epithelium**.

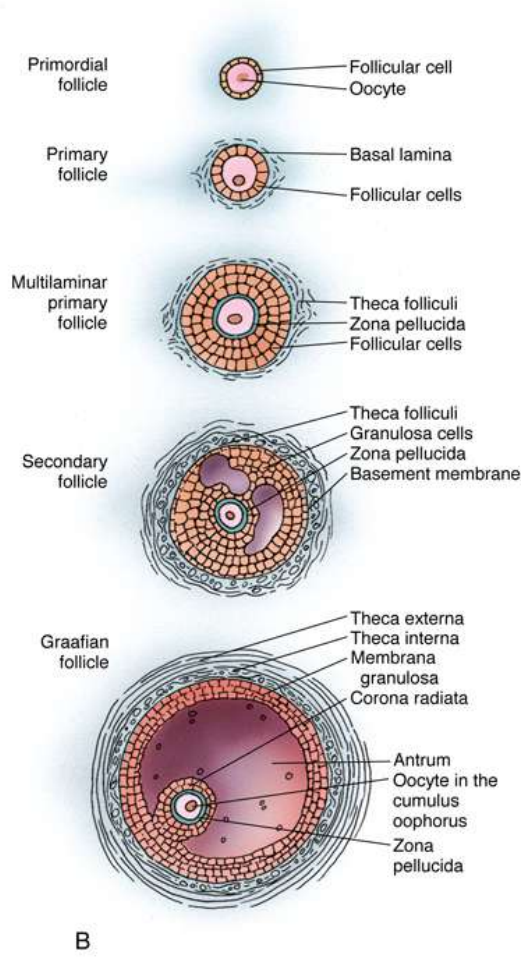
Each ovary is subdivided into the **cortex** and a **medulla.**

The **ovarian cortex** is composed of a connective tissue framework, the **stroma,** housing fibroblast-like **stromal cells** as well as **ovarian follicles** in various stages of development.

The **medulla** contains large blood vessels, lymph vessels, and nerve fibers embedded in a connective tissue stroma.



Ovarian Follicles - Follicular development usually culminates in the release of a **single oocyte** (ovulation).



Note the corpus luteum and corpus albicans. All the stages of follicular development, from the primordial follicle stage to the graafian follicle stage, are presented.

Before the onset of puberty, all the follicles of the ovarian **cortex** are in the **primordial follicle** stage. The pulsatile release of GnRH from the hypothalamus results in a similar, pulsatile, release of gonadotropins (follicle-stimulating hormone [FSH], and luteinizing hormone [LH])

Ovarian follicles: consist of a

- primary oocyte and its associated

- follicular cells.

4 differentiation stages of follicular development:

Primordial follicles,

unilaminar and

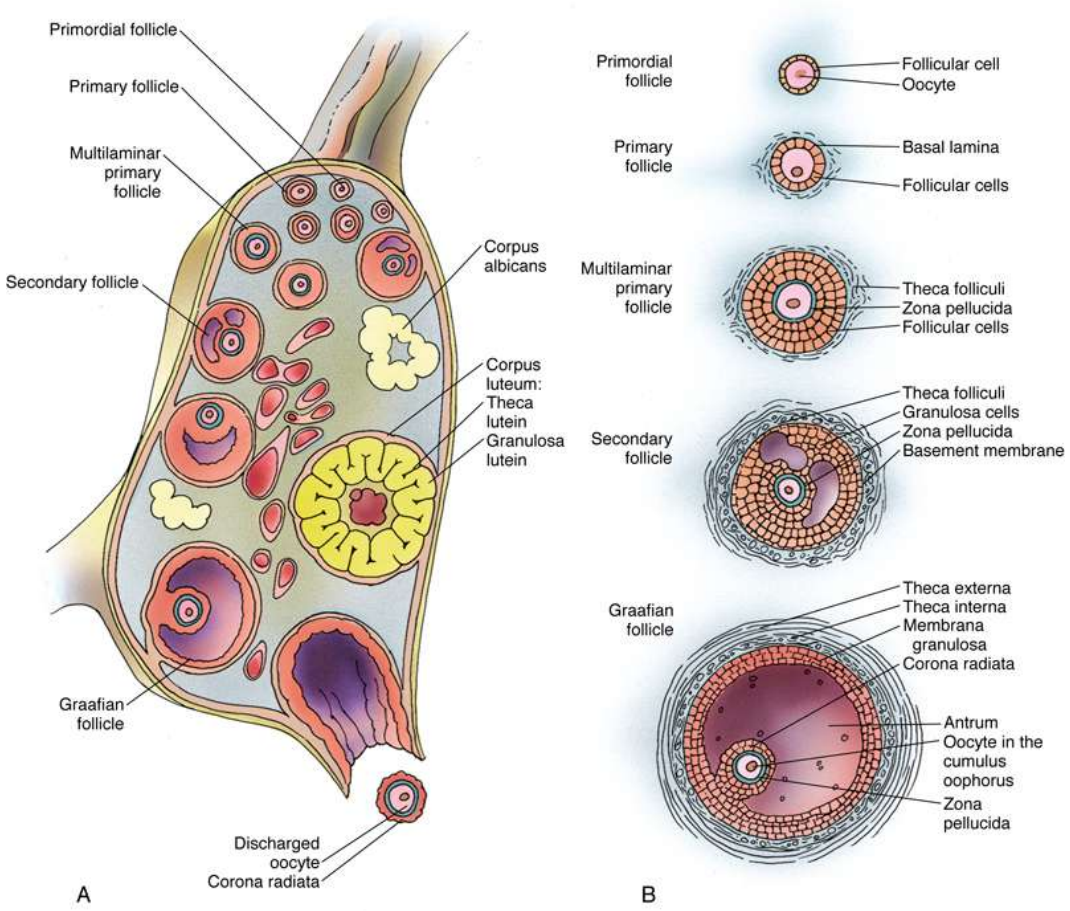
multilaminar primary follicles,

secondary (antral) **follicles**, and **Graafian** (mature) **follicles**.

The development of the primordial and primary follicles is independent of FSH; instead, the differentiation and proliferation of the follicular cells are triggered by a yet uncharacterized local factors secreted by cells of the ovary.

Secondary and later follicles, however, are under the influence of FSH. Follicular development usually culminates in the release of a single oocyte (ovulation).

Ovarian Follicles — Primary Follicles



Ovarian structure **(A)** and follicular development **(B).** Note the corpus luteum and corpus albicans. All the stages of follicular development, from the primordial follicle stage to the graafian follicle stage, are presented.

The **primary oocyte** grows to about 100 to 150 µm in diameter with an enlarged nucleus.

Follicular cells become cuboidal in shape, it is called a **unilaminar primary follicle.**

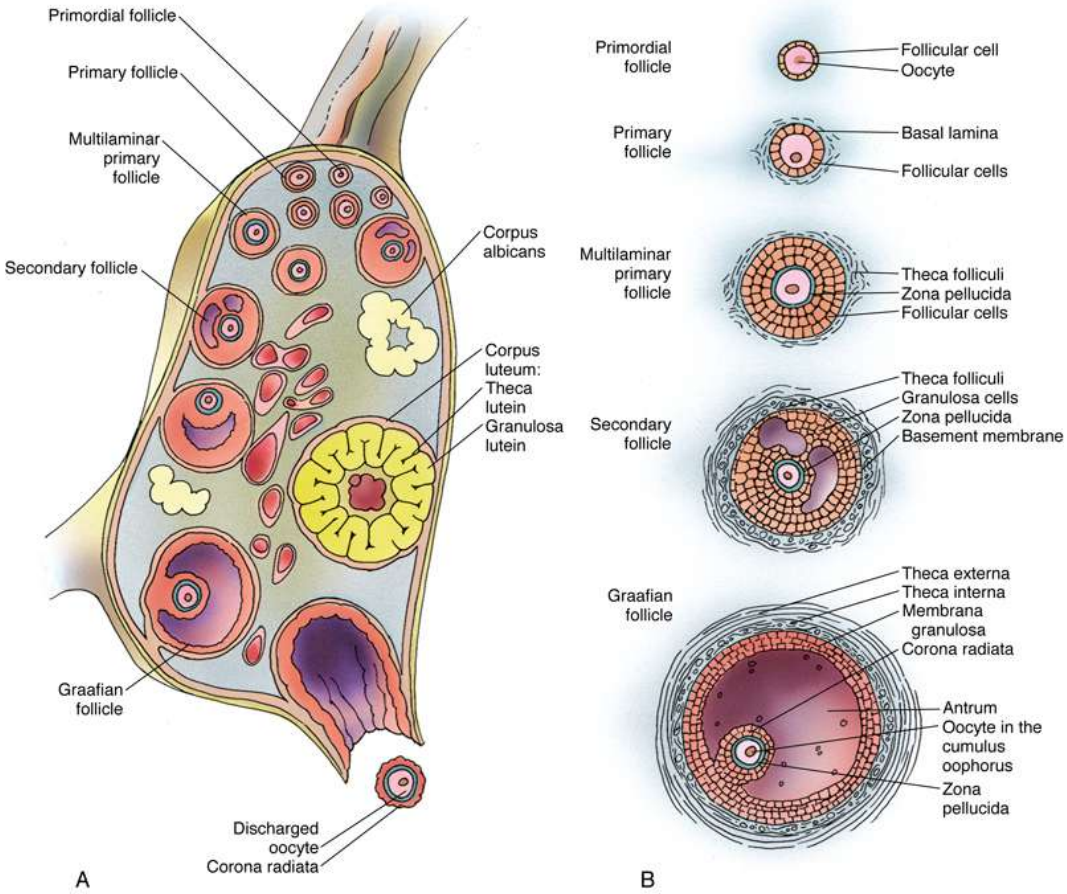
When the follicular cells proliferate and stratify, forming several layers of cells around the primary oocyte, the follicle is called a **multilaminar primary follicle,** and the follicular cells are more commonly referred to as **granulosa cells.**

The theca interna cells produce the male sex hormone **androstenedione,** which enters the granulosa cells, where it is converted by the enzyme **aromatase** into the estrogen **estradiol.**

During this stage, an amorphous substance (the **zona pellucida**) appears, separating the oocyte from the surrounding follicular cells.

Stromal cells form an inner **theca interna,** composed mostly of a richly vascularized cellular layer, and an outer **theca externa,** composed mostly of fibrous connective tissue.

Ovarian Follicles — Secondary Follicles



Ovarian structure **(A)** and follicular development **(B).** Note the corpus luteum and corpus albicans. All the stages of follicular development, from the primordial follicle stage to the graafian follicle stage, are presented.

Secondary follicles are similar to primary follicles except for the presence of accumulations of liquor folliculi among the granulosa cells.

Continued proliferation of the granulosa cells of the secondary follicle depends on **FSH** released by basophil cells of the anterior pituitary.

During Ovulation a surge in LH production from the basophil cells of the anterior pituitary will allow the discharge of the mature oocyte, which is ready for the fertilization.

The follicle will undergo atresia, and the granulosa cells will change to granulosa lutein and theca lutein: thus forming the corpus luteum, which will produce **Progesterone**

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