

# NEUROENDOCRINE SYSTEM

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# NEUROENDOCRINE SYSTEM

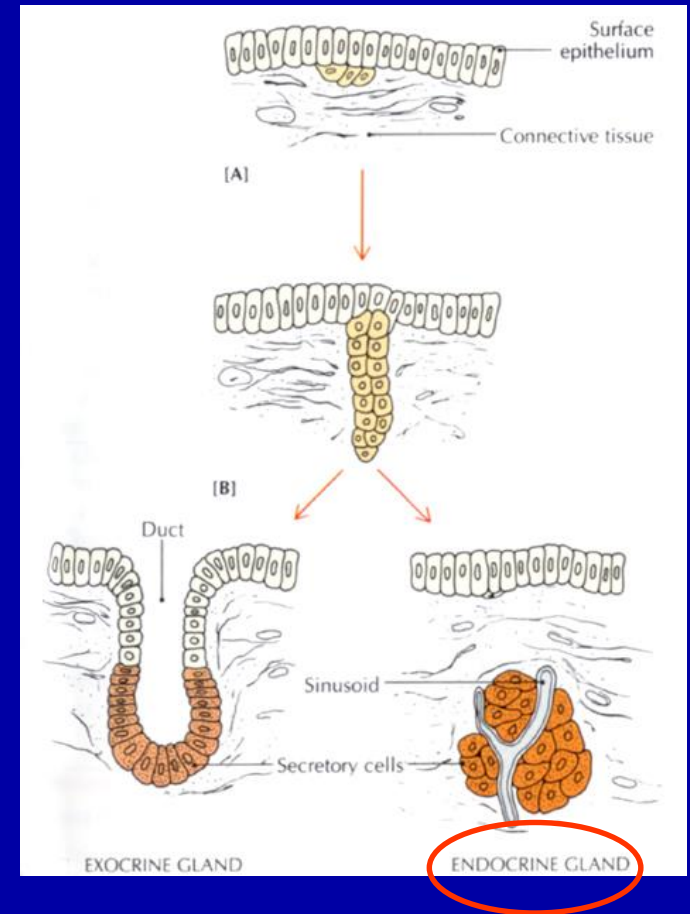
## Regulation:

- *neural* : nervous system and
- *chemical* (hormonal)

**Hormones:** are secreted by epithelial cells  
(endocrine glands)

BUT

neurons are also producing hormone-like substances called  
*neurosecretum*



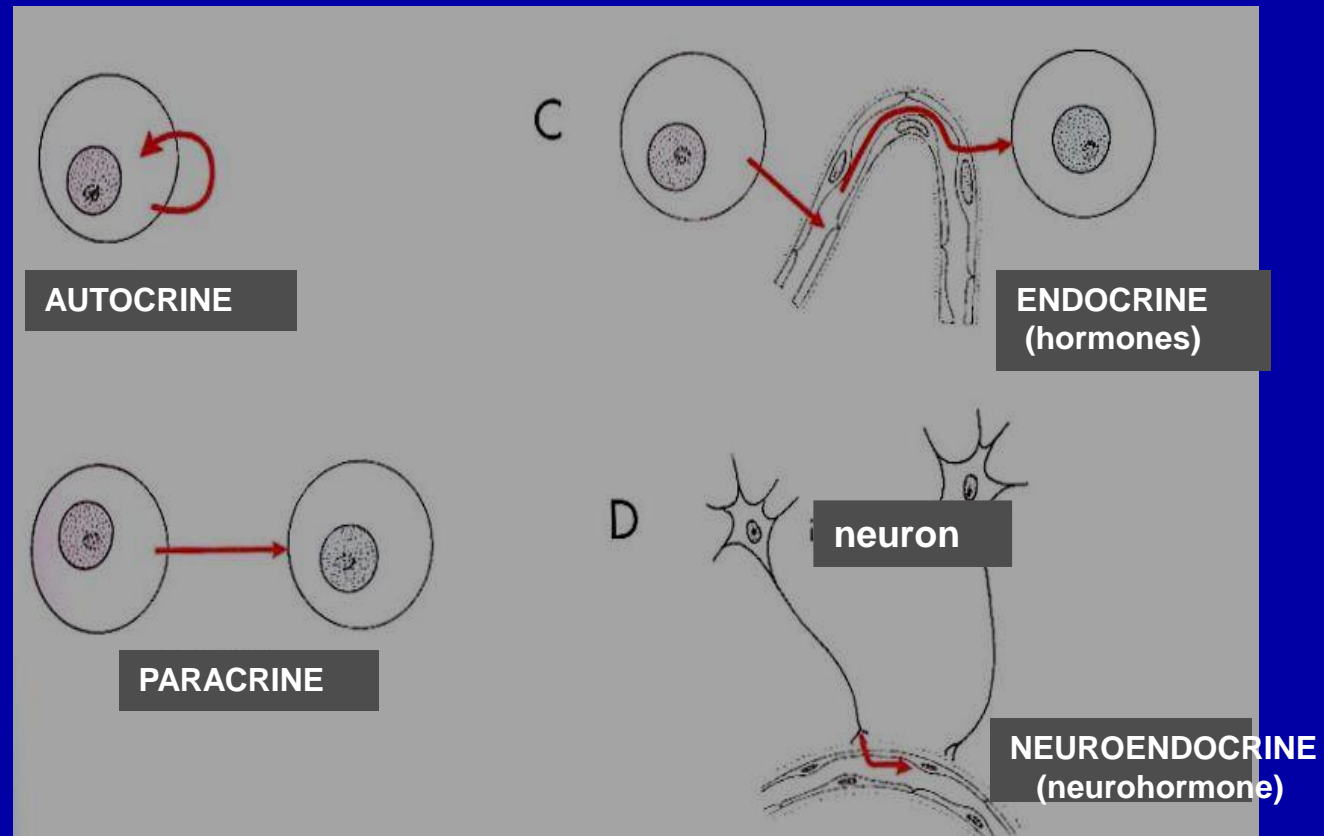
# MECHANISM OF SIGNAL TRANSMISSION

*Autocrine* regulation:  
the released *hormone*  
acts on the hormone  
producing cell itself

*Paracrine*: *hormone*  
acts on the  
neighbouring cell

*Endocrine*: *hormone*  
is released into the  
blood

*Neuroendocrine*:  
*neurosecretum* is  
released into the  
blood

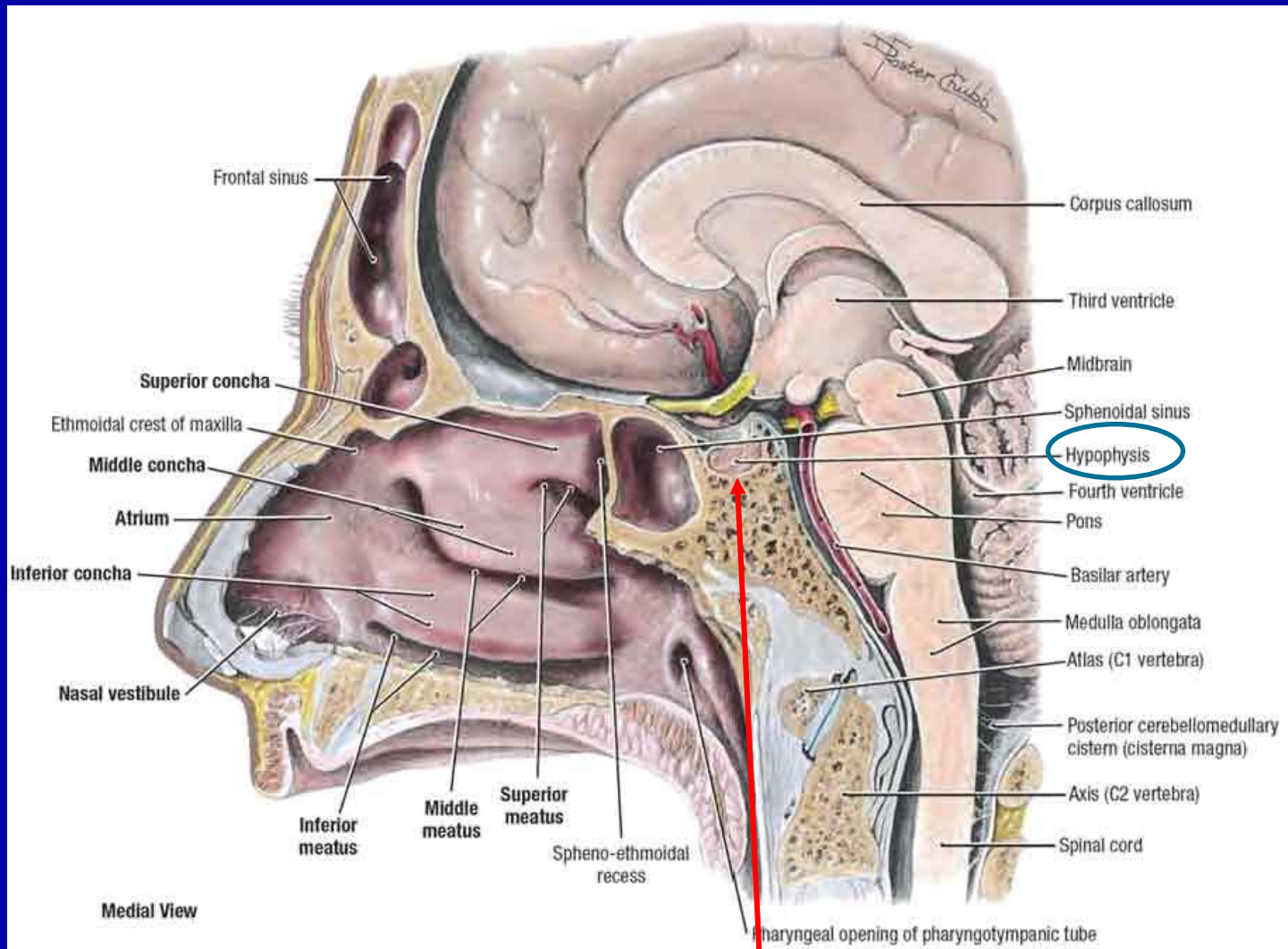


**ACCORDING TO THE PLACE OF EFFECT OF SECRETION**

# DIENCEPHALON

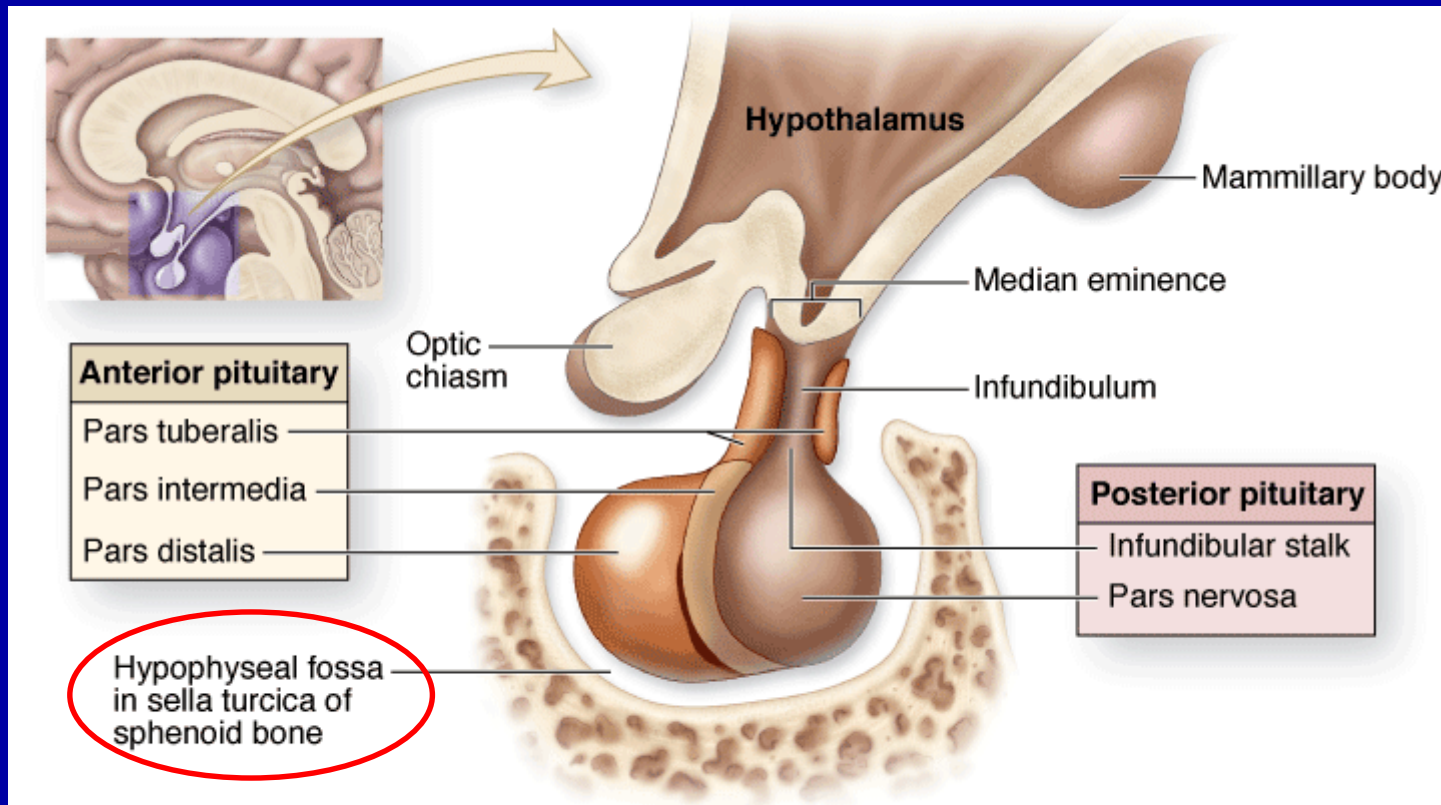


UPPER BRAIN STEM = DIENCEPHALON: hypothalamo/hypophyseal system



sella turcica/hypophyseal fossa

# Hypothalamo-hypophyseal system



Source: Mescher AL: *Junqueira's Basic Histology: Text and Atlas, 12th Edition*: <http://www.accessmedicine.com>

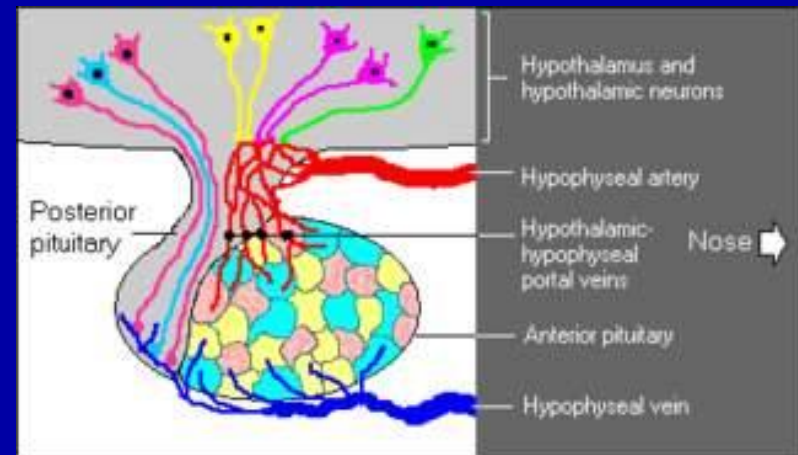
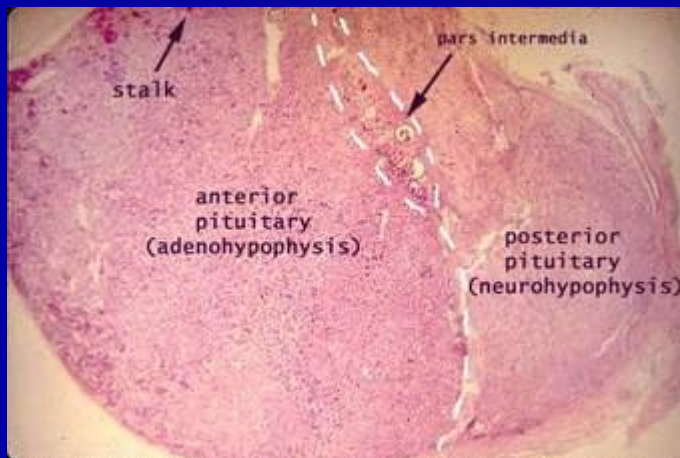
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# Hypothalamo-hypophyseal system

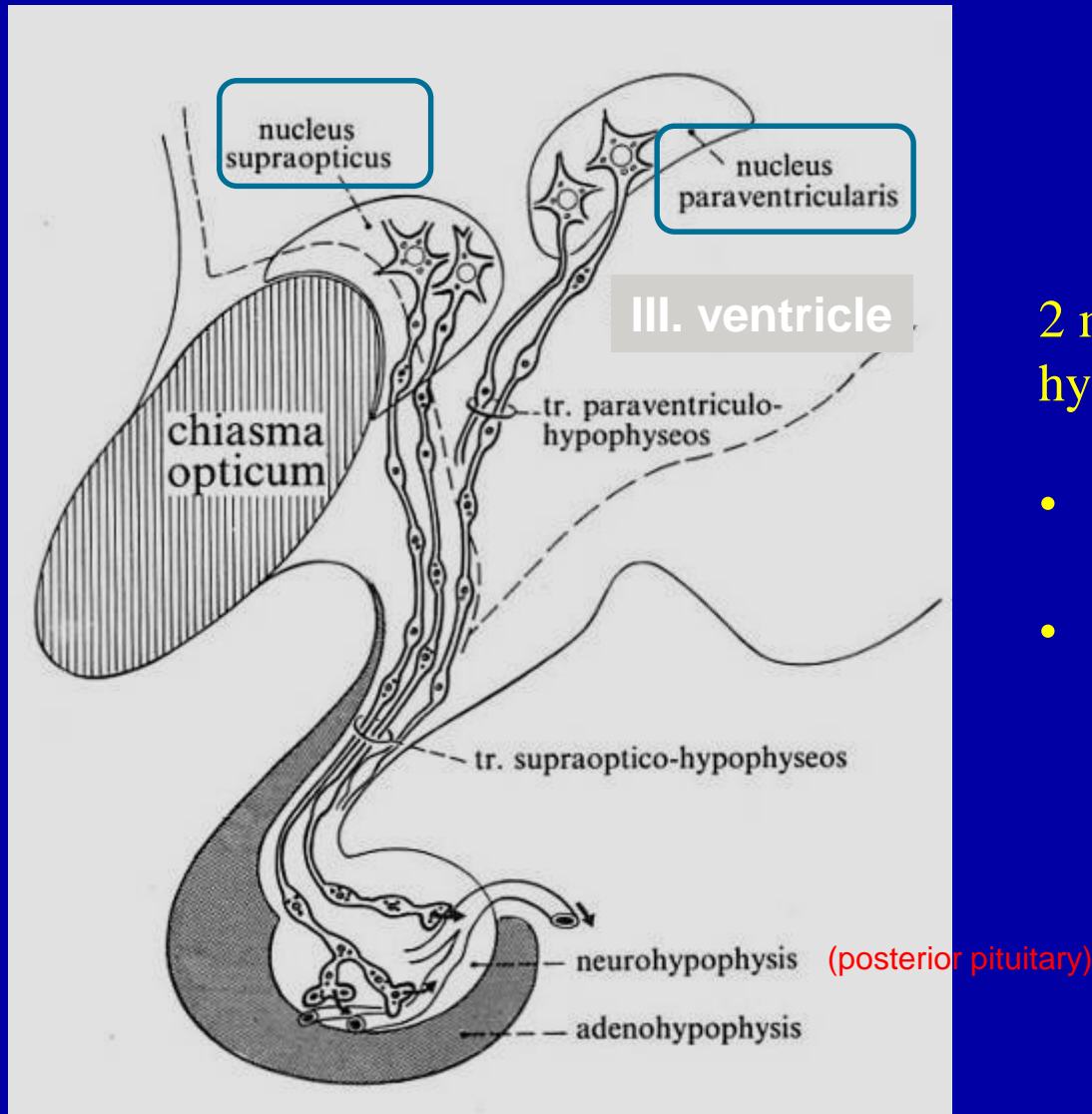
Posterior pituitary (neurohypophysis): is composed of axons of the neurons present in the hypothalamus called *magnocellular nuclei*:

1. *supraoptic* (above the optic chiasma and
  2. *paraventricular*: on the 2 sides of the 3rd ventricle
- +pituicytes: glial cells

Anterior pituitary: epithelial tissue developing from the roof of the primitive oral cavity: so called *Rathke pouch*



# SUPRAOPTICO-PARAVENTRICULO-HYPOPHYSEAL MAGNOCELLULAR SYSTEM

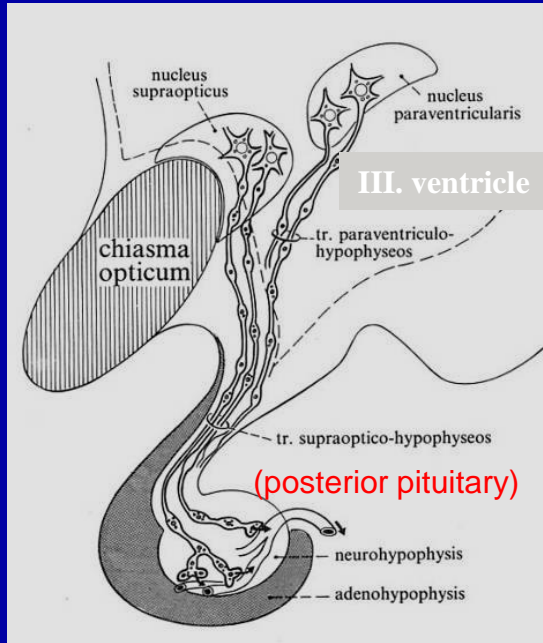


2 magnocellular hypothalamic nuclei:

- supraoptic
- paraventricular

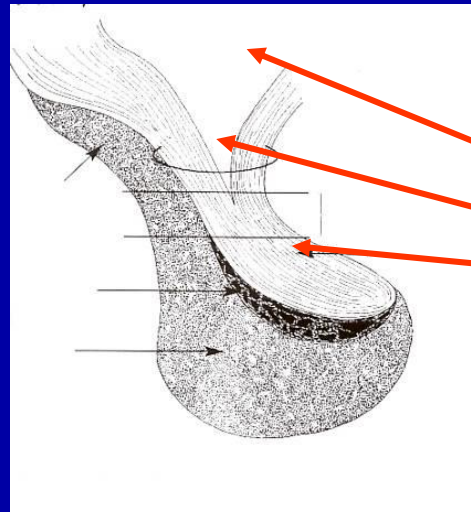


# SUPRAOPTICO-PARAVENTRICULO-HYPOPHYSEAL MAGNOCELLULAR SYSTEM



2 magnocellular hypothalamic nuclei:

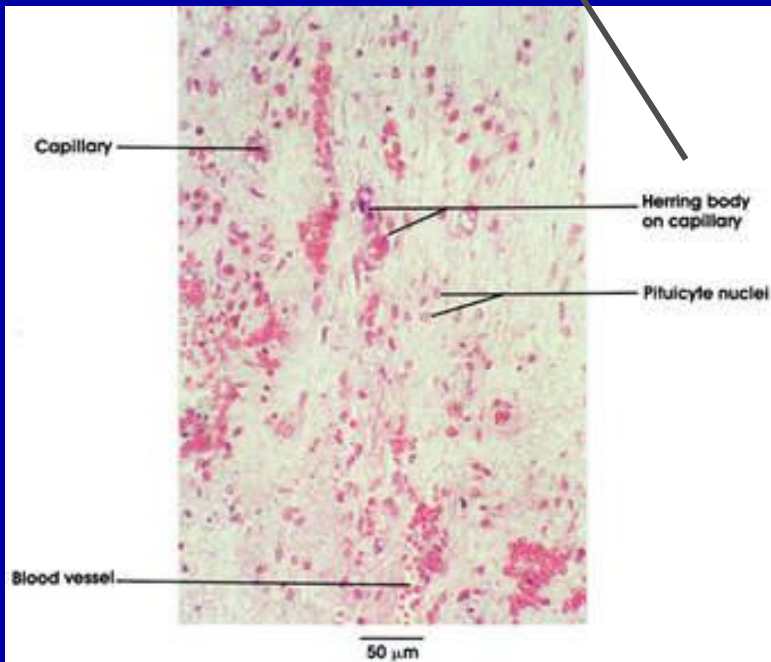
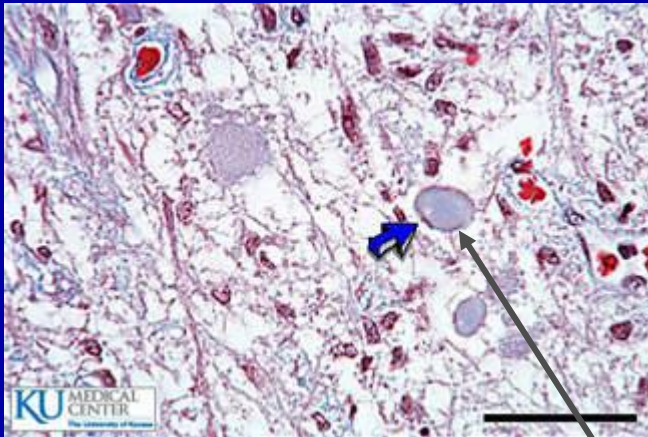
- supraoptic
- paraventricular



**NEUROHYPOPHYSIS: 3 parts**

- MEDIAN EMINENCE
- INFUNDIBULAR STEM
- INFUNDIBULAR PROCESS

# Histology of the posterior pituitary



*Nervous tissue: pituicytes (glial cells)+axon termini  
blood capillaries*

*Neurosecretums are produced by the neurons of the magnocellular cells (nuclei) of the hypothalamus. They are transported through the axons (in form of neurophysis) terminating in the posterior pituitary and stored there until they need.*

*These axons are surrounded by capillaries*

*Axon terminals +capillaries are making a special structure called Hering body*

# FUNCTION OF POSTERIOR PITUITARY HORMONES

## OXYTOCIN

Contraction of uterine smooth muscle (delivery)

Contraction of the mammary smooth muscle  
(milk ejection)

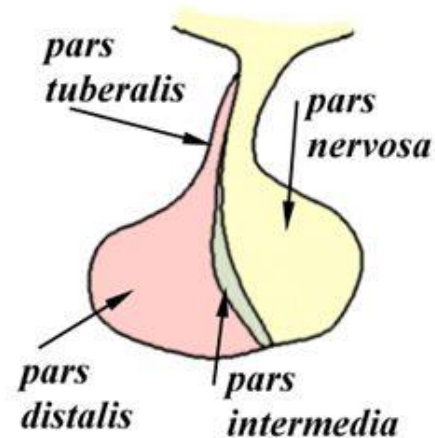
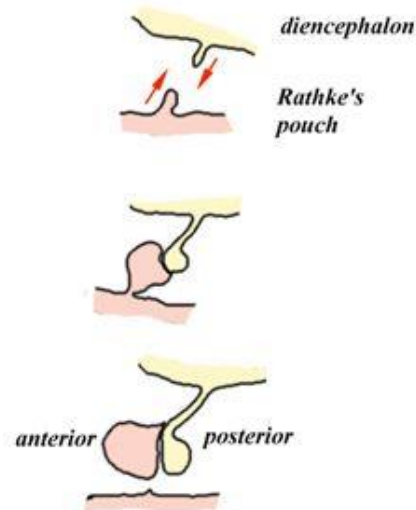
## VASOPRESSIN (antidiuretic hormone, ADH)

Vasoconstrictor, enhances the blood pressure

Water absorption in the collecting tubules of kidney

# Histogenesis

- Anterior pituitary (adenohypophysis)
  - Arises from invagination of Rathke's pouch
  - Residual small cystic epithelial lined remnants are common at interface with posterior pituitary
- Posterior pituitary (neurohypophysis)
  - Composed of nerve fibers (arising in hypothalamic nuclei), axon terminals and stromal cells



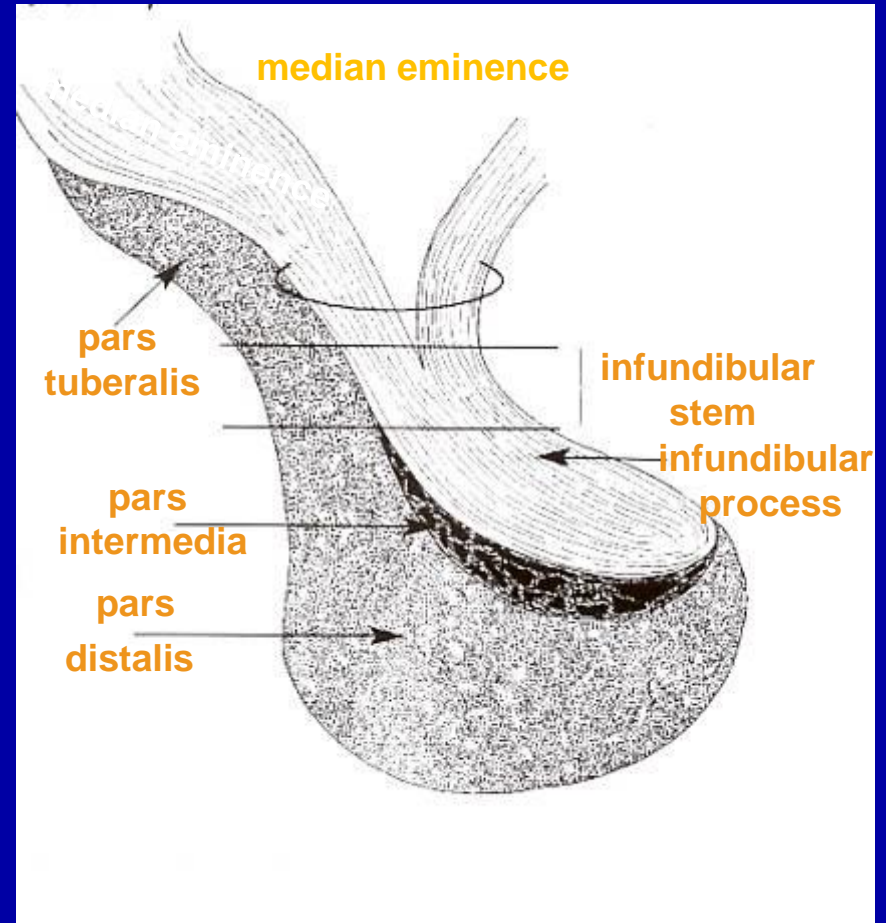
# Anterior pituitary

## ADENOHYPOPHYSIS

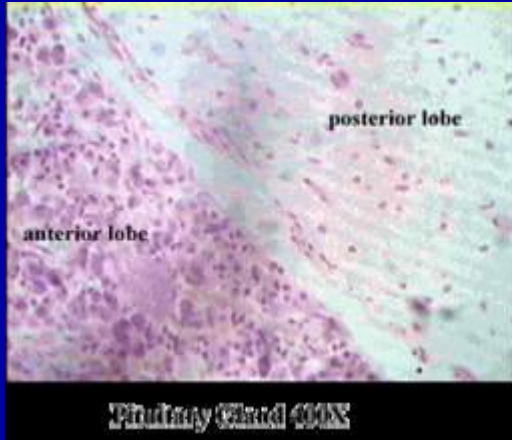
1. PARS TUBERALIS
2. PARS INTERMEDIA (INTERMEDIATE LOBE)
3. PARS DISTALIS (ANTERIOR LOBE)

## NEUROHYPOPHYSIS

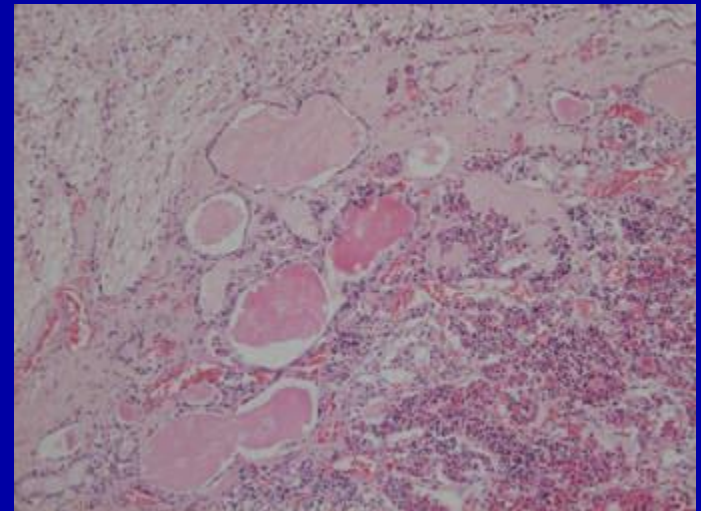
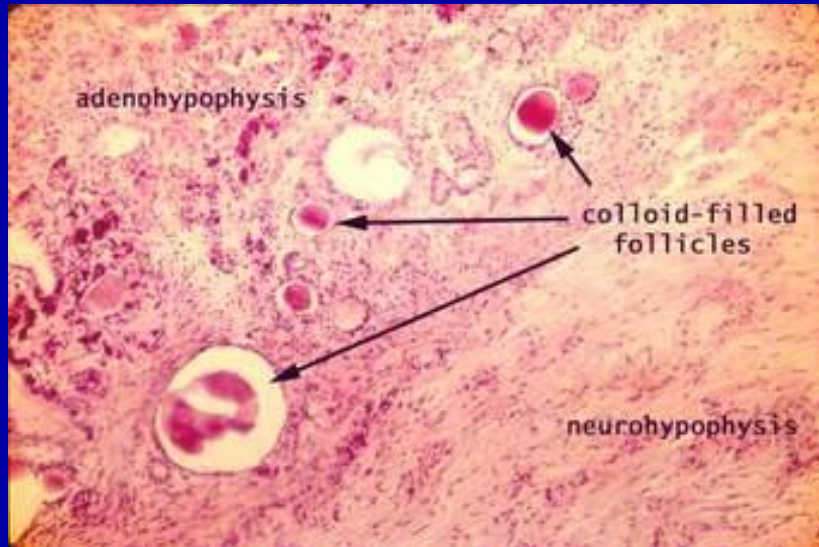
4. MEDIAN EMINENCE
5. INFUNDIBULAR STEM
6. INFUNDIBULAR PROCESS



# Histological structure of the intermediate lobe of the adenohypophysis



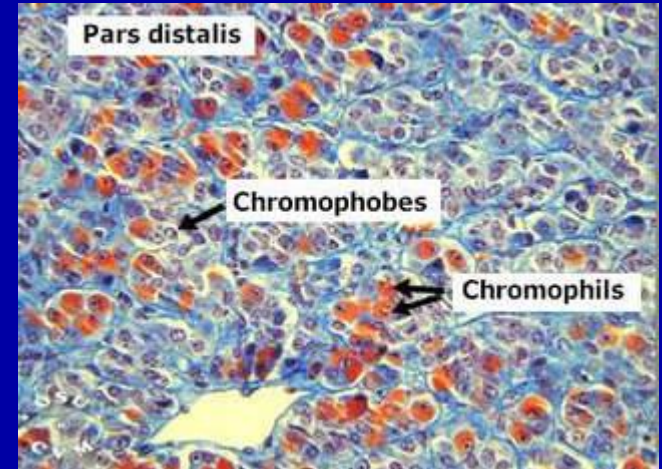
*Intermediate lobe: has follicles (remnants of the Rathke pouch) filled in by colloid + basophil cells*



# Histological structures of the adenohypophysis: distal part

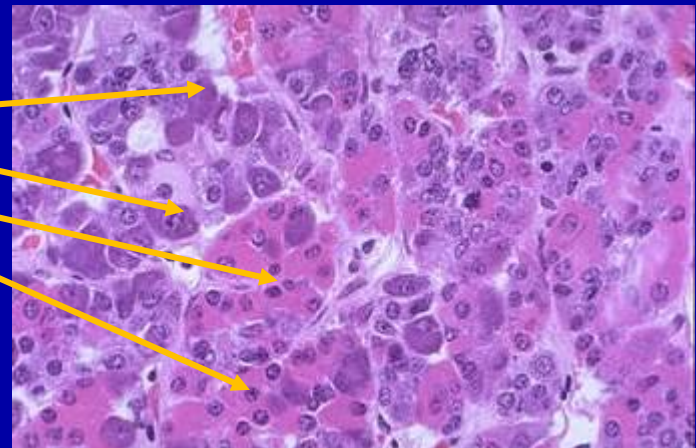
The distal part of the adenohypophysis is composed of 2 cell populations:

1. *chromophob* (cells that can not be stained) and
2. *chromophyl* cells



chromophyl cell can be stained by

- basic dye: *basophylic* cells or
- acidic dye: *acidophylic* cells



# HORMONES OF THE ANTERIOR LOBE

Trop hormones:  
stimulatory  
the target organ is another endocrine gland

STH (somatotrop hormone) = GH (growth hormone)

TSH (thyroid stimulating hormone)

ACTH (adrenocorticotrop hormone)

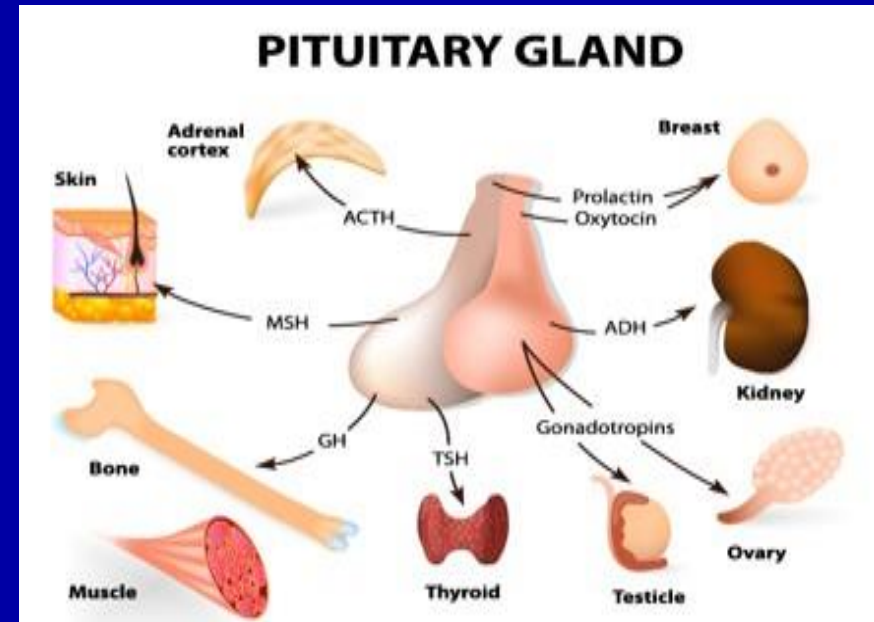
Gonadotrop hormones:

FSH (follicle stimulating hormone)

LH (luteinizing hormone)

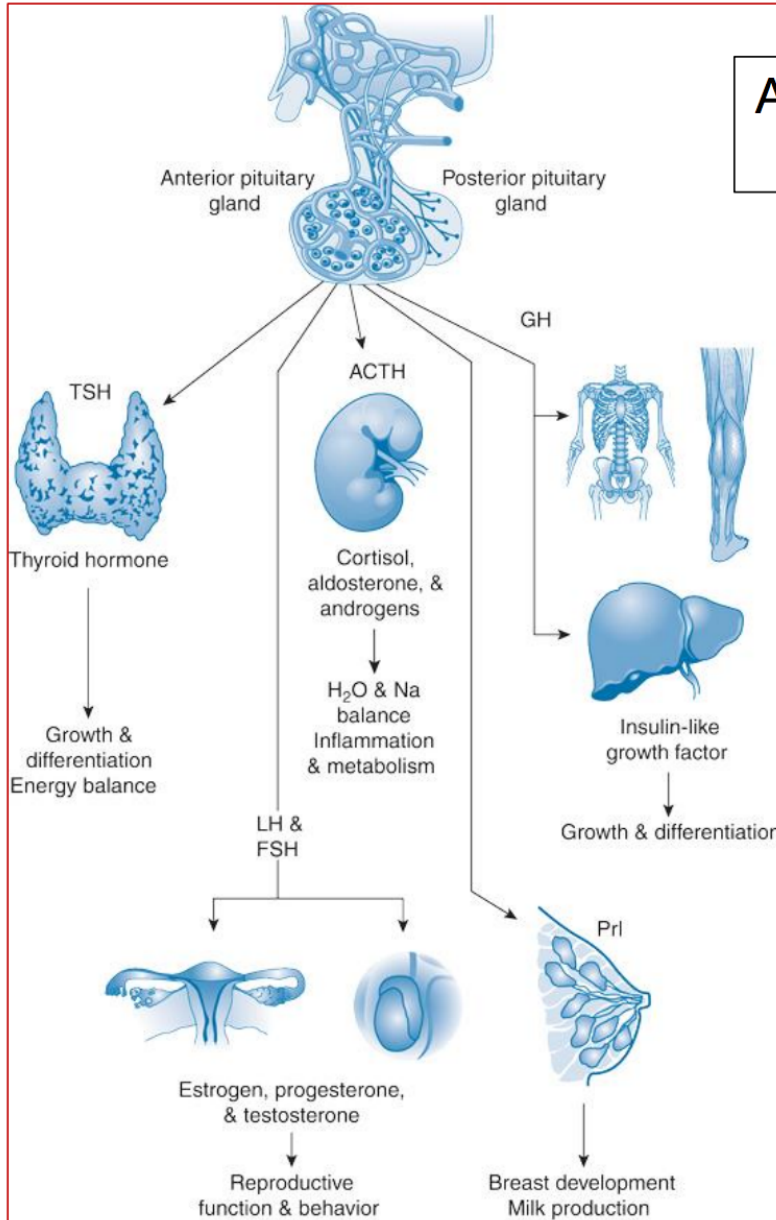
LTH (luteotrop hormone, prolactin)

MSH (melanocyte stimultaing hormon): p. intermedia



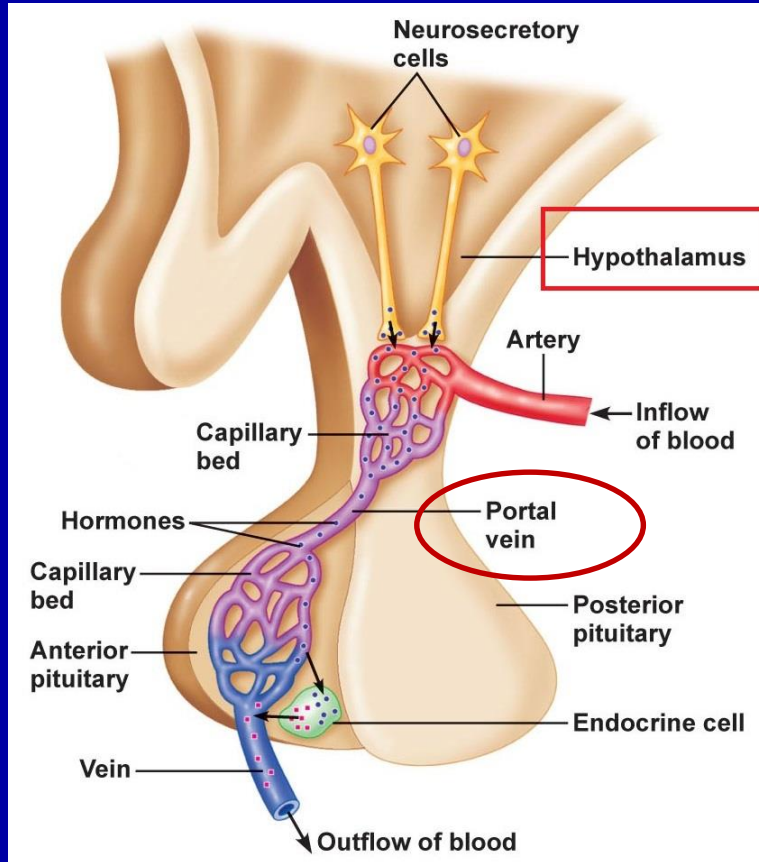


## Anterior pituitary hormones, target organs, and summary of their physiologic effects



- **TSH** stimulates the thyroid gland to produce and release thyroid hormones that regulate growth and energy balance.
- **LH and FSH** stimulate gonadal production of sex steroids, which mediate reproductive function and behavior.
- **ACTH** stimulates the adrenal glands to produce steroids, which regulate hydromineral balance, inflammation and metabolism.
- **PRL** stimulates breast development and milk production.
- **GH** exerts direct effects on tissue growth and indirect effects through the production of insulin-like growth factor-1, which mediates some of the growth effects of GH.

# Regulation of the anterior pituitary: through the blood vessels: portal system



## *Parvocellular nuclei of the hypothalamus*

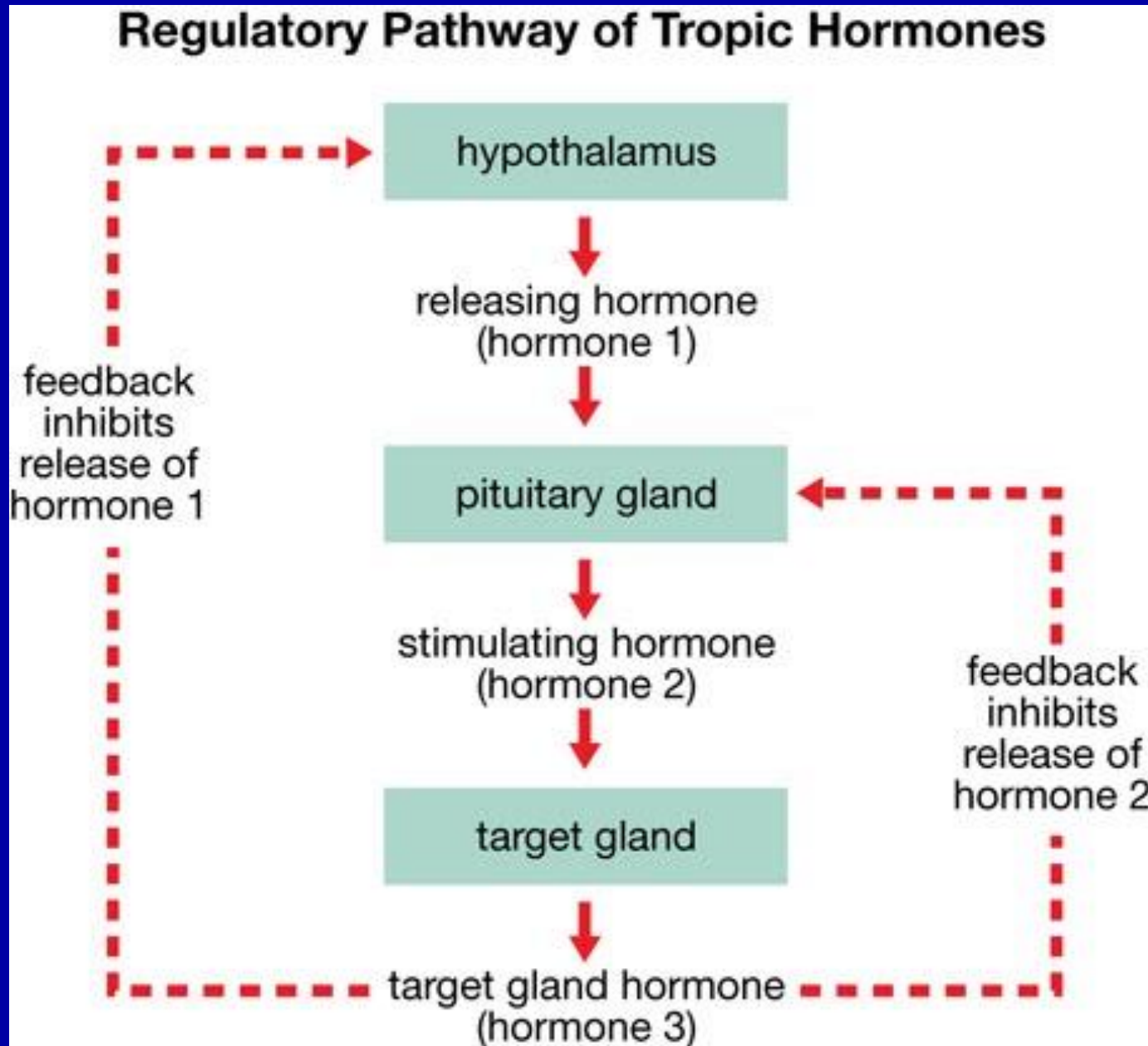
### RELEASING HORMONES

LHRH (luteinizing hormone-releasing hormone)  
TRH (thyrotrop hormone-releasing hormone)  
CRH (corticotrop hormone-releasing hormone)  
GRH (growth hormone-releasing hormone)

### INHIBITING HORMONES

Somatostatin (growth hormone-inhibiting hormone)  
Dopamine (prolactin-inhibiting hormone)

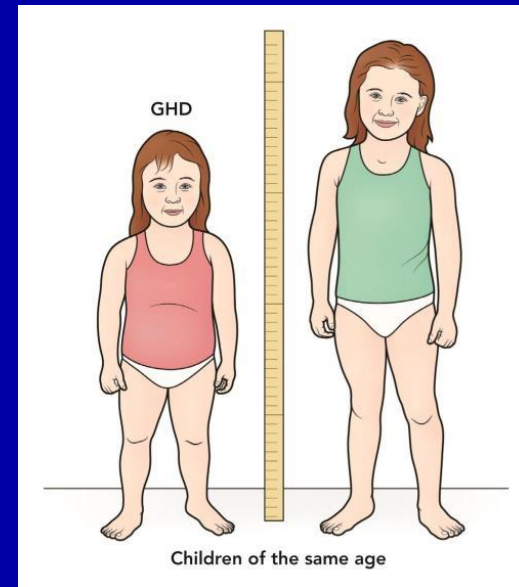
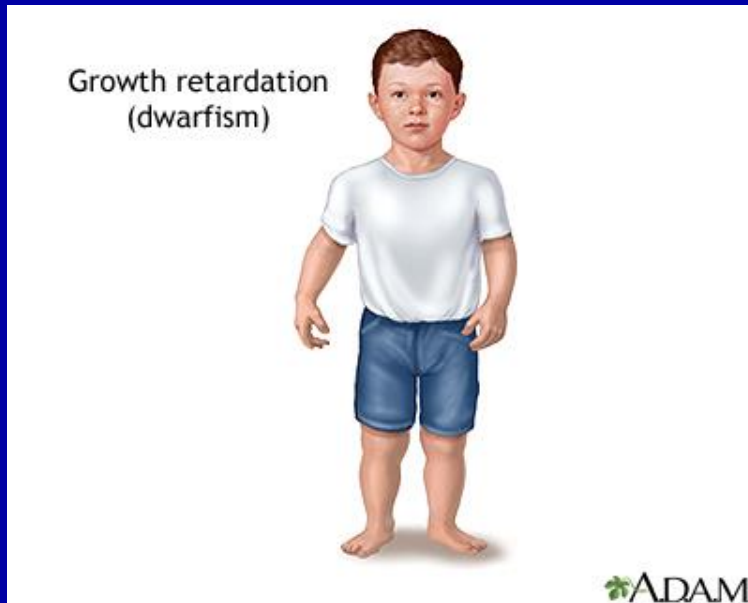
# NEGATIVE FEED-BACK MECHANISM



# STH: growth hormon

- acts on all cells of the body
- stimulates the liver to produce and secrete insulin-like growth factor
- results in body growth

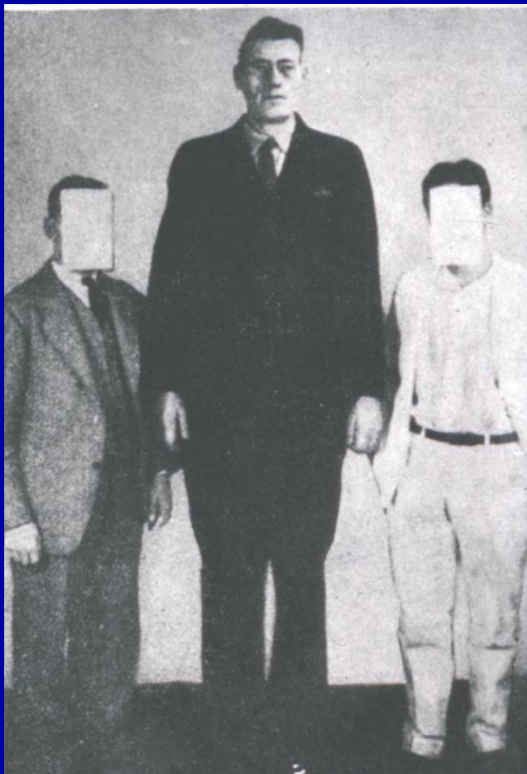
In the **absence** of GH during development



# Growth hormon, STH, somatotrop hormon

*overproduction*

## GIGANTISM

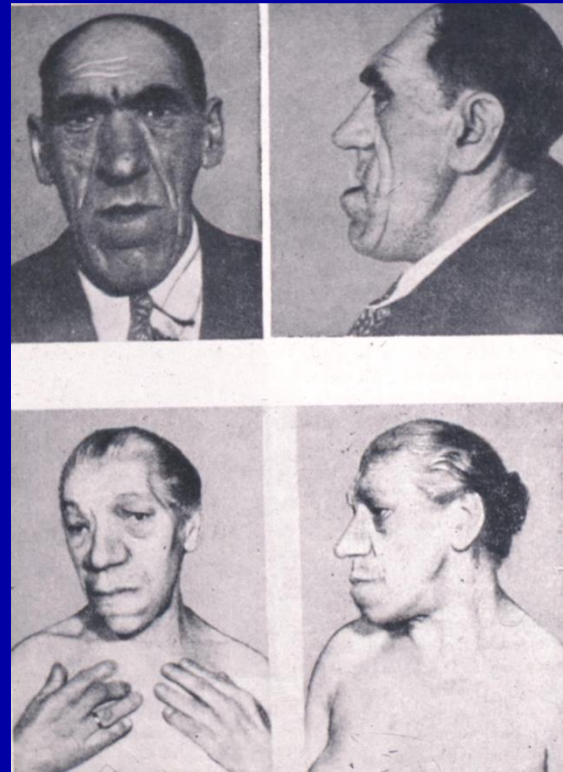


normal

giant

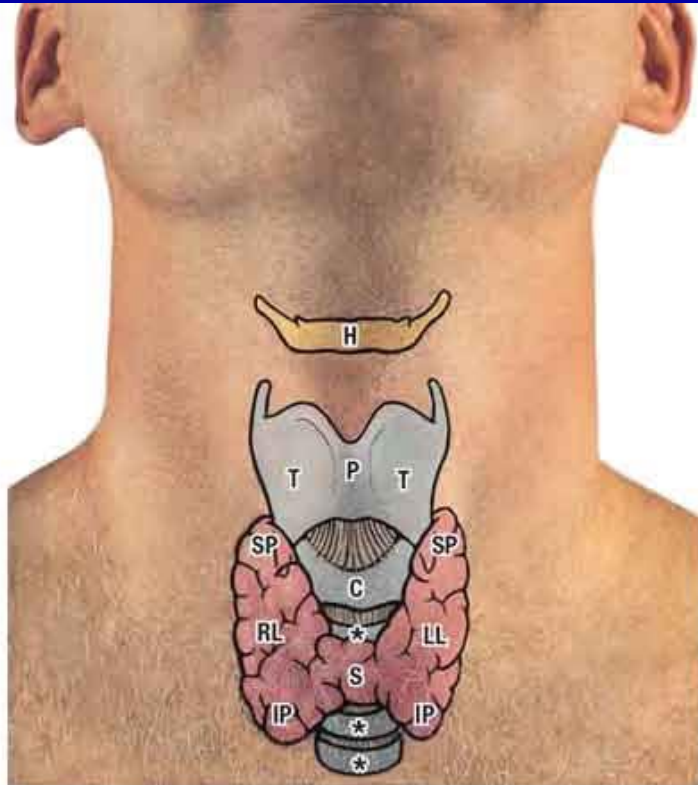
normal

## ACROMEGLALY



In adult

# TSH: Thyroid gland



Anterior View

C	Cricoid cartilage	RL	Right lobe of thyroid gland
H	Hyoid	S	Isthmus
IP	Inferior pole of thyroid gland	SP	Superior pole of thyroid gland
LL	Left lobe of thyroid gland	T	Thyroid cartilage
P	Laryngeal prominence	*	Tracheal rings



# HISTOLOGY OF THE THYROID GLAND

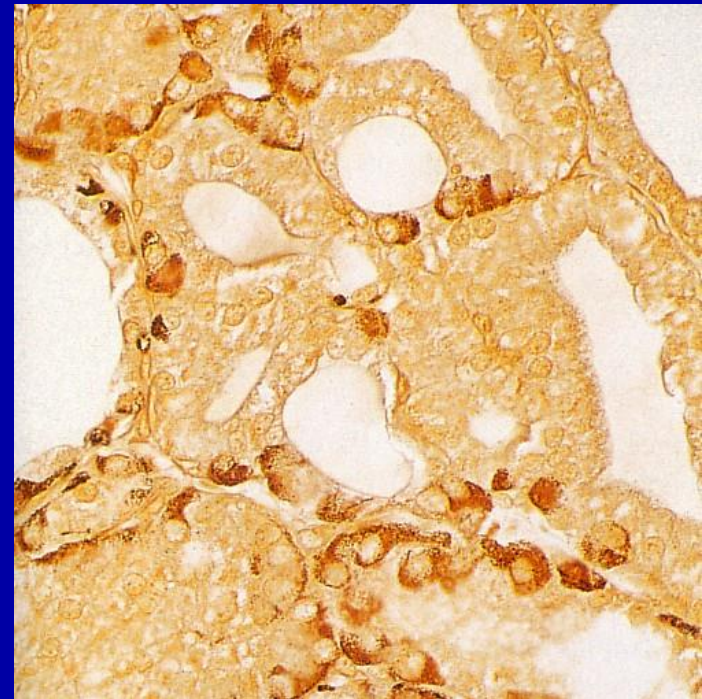
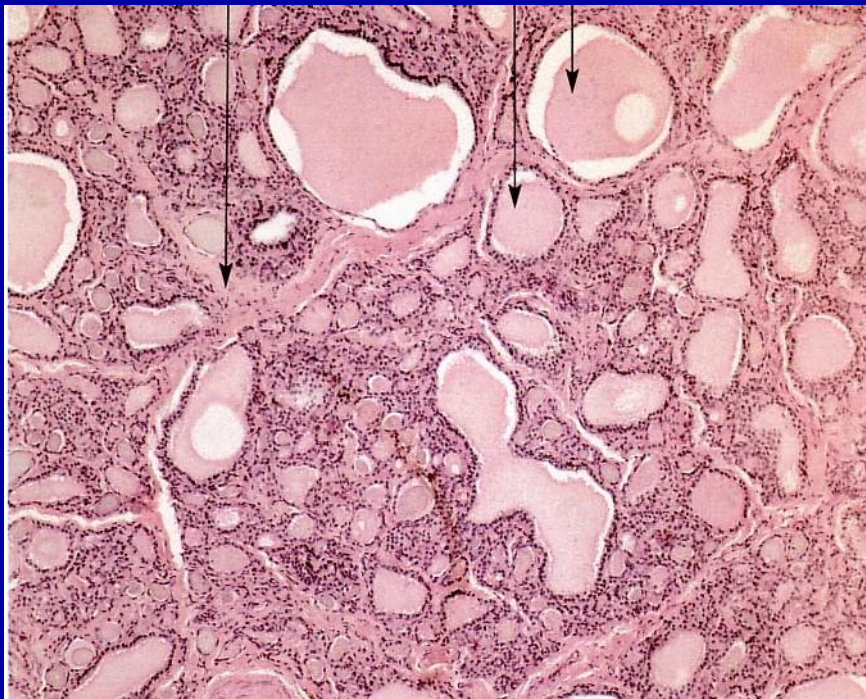
*Thyroid gland*: is composed of follicles, lined by simple cuboidal or tall columnar epithelial cells, called *follicular cells* (depending of the functional activity)

- *follicular cells* are secreting *thyroxin* (regulating the cell metabolism)
- the lumen of the follicles contains colloidal material (stored inactiv hormone, *thyroglobulin*)
- in between the follicles: *parafollicular cells*: secreting calcitonin (regulating the blood  $\text{Ca}^{2+}$  level)

# HISTOLOGY OF THE THYROID GLAND

sinus

colloid in follicles

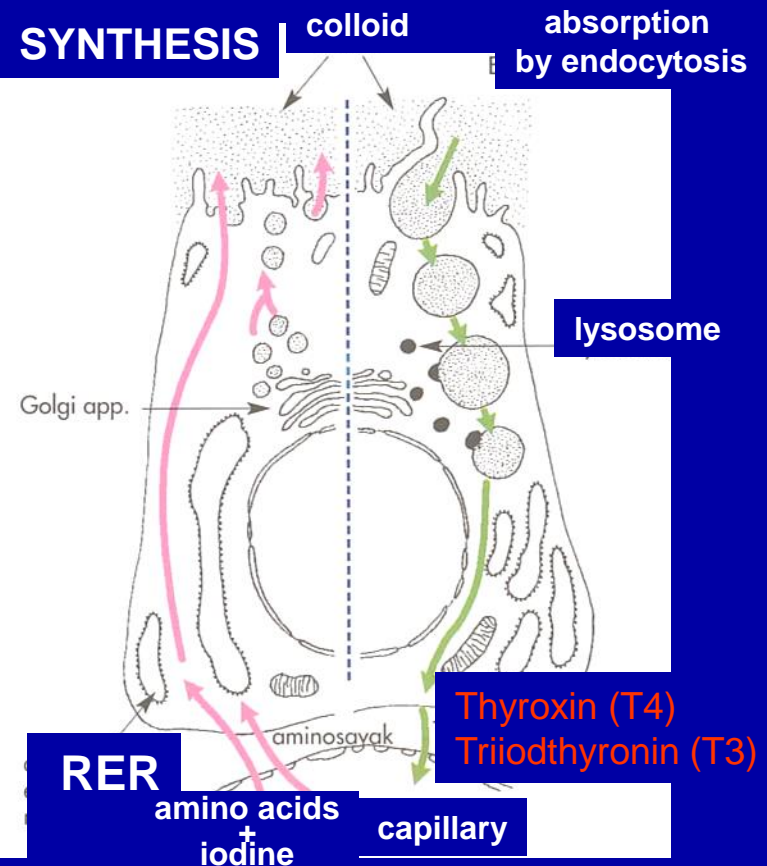
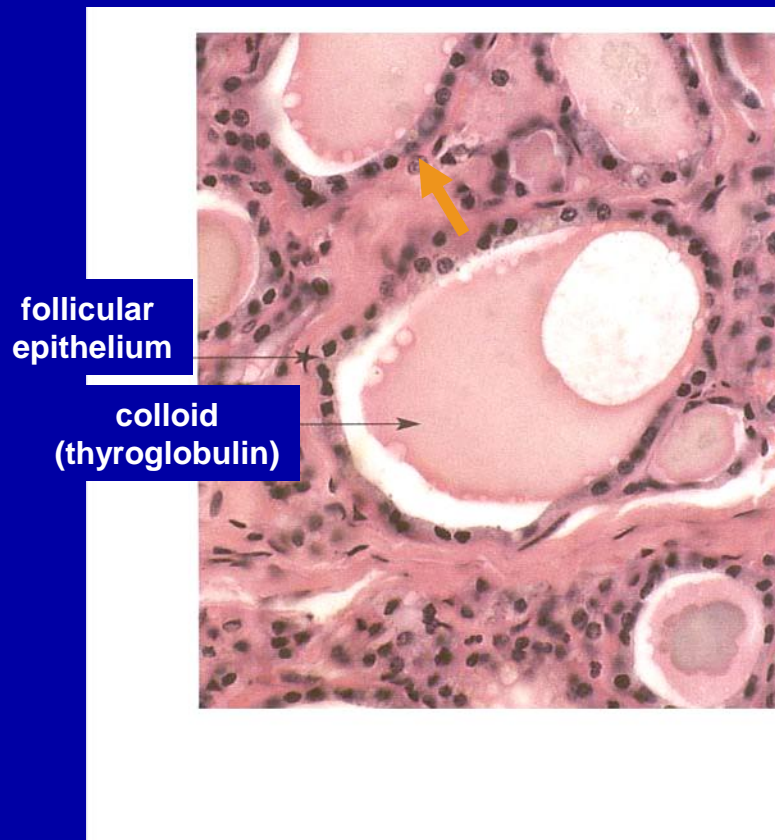


hematoxylin-eosin staining  
*thyroxin* production

immunostaining for *calcitonin* in C-cells  
(depresses the calcium level of the blood)



# MECHANISM OF THYROID HORMONE PRODUCTION



# Thyroid hormon (thyroxin):

*increases the metabolic rate*  
*has morphogenic effect*

absence of thyroxin during fetal life



**CRETENISM**



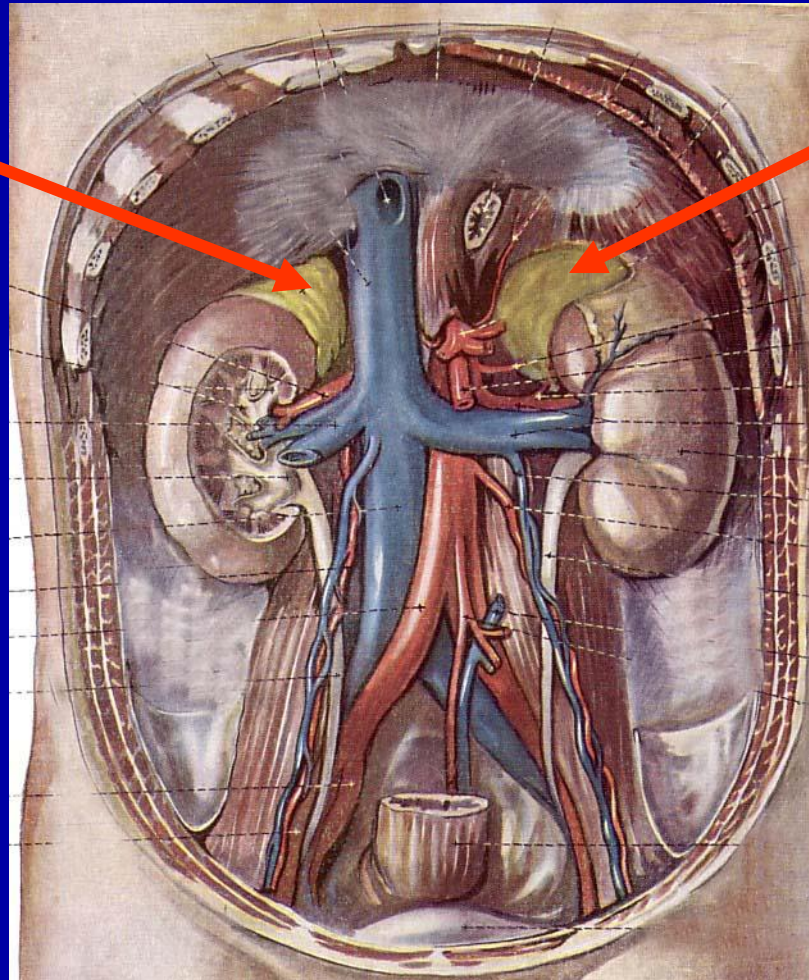
overproduction of thyroxin in adult



**BASEDOW-DISEASE**



# ADRENAL GLANDS



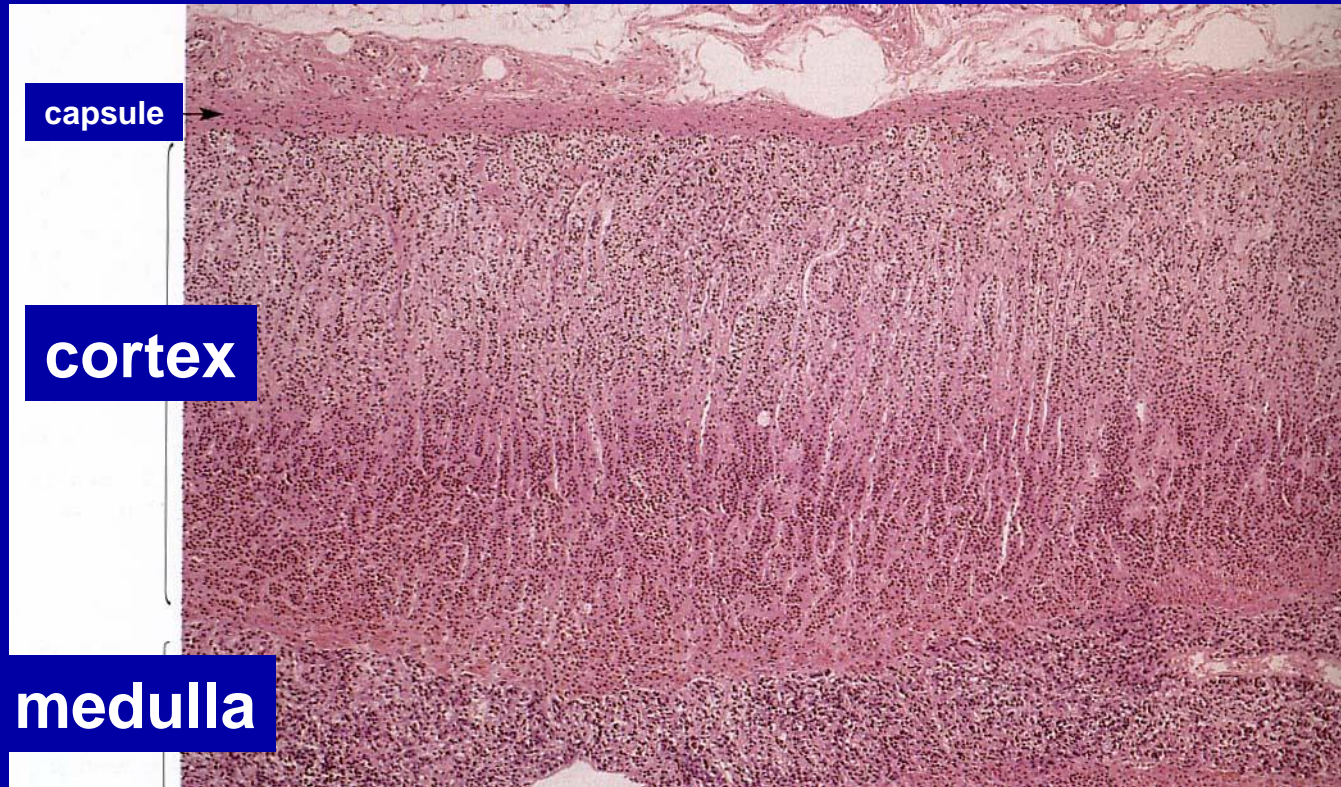
at the upper pole of the kidney, inside of the adipose capsule of the kidney

It has:  
cortex and  
medulla

*Cortex:* under the effect of the hypothalamo-hypophyseal system

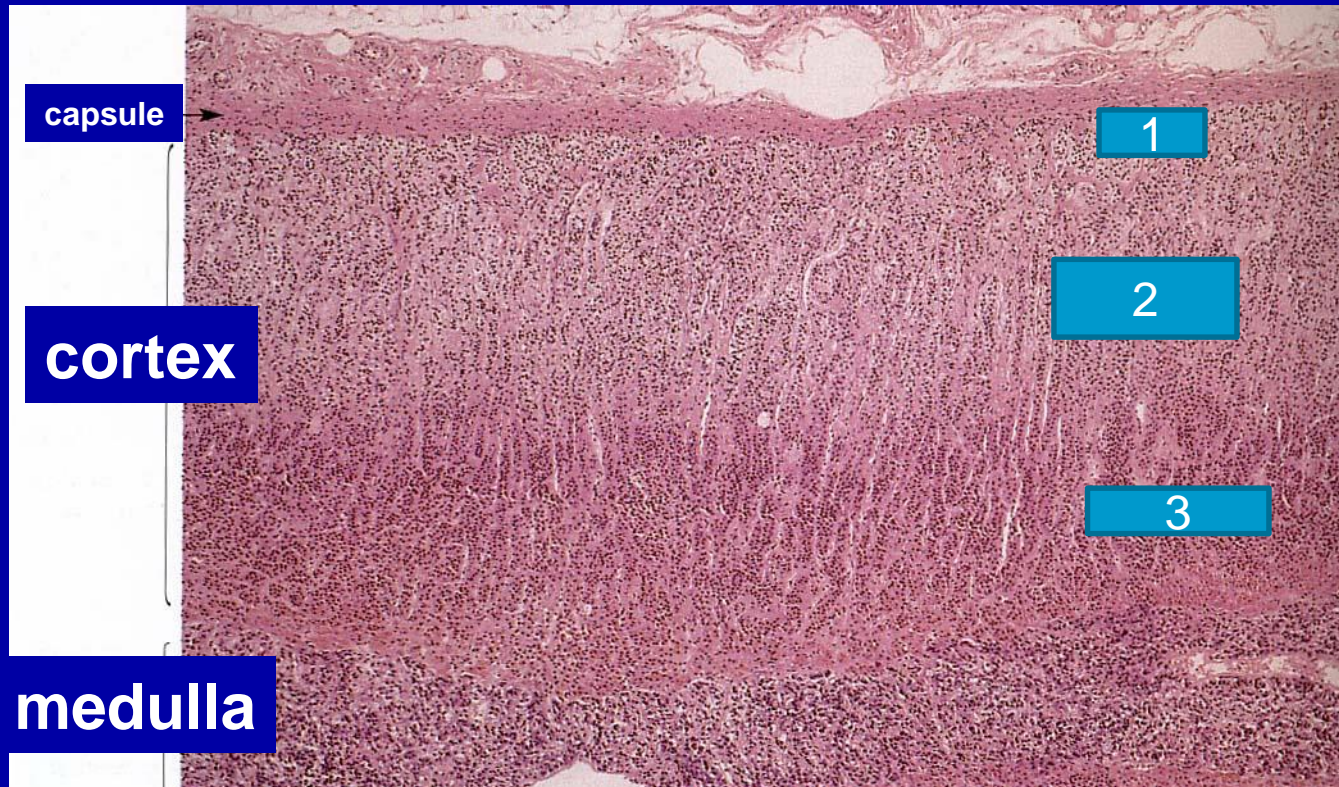
*Medulla:* is part of the sympathetic nervous system

# HISTOLOGY OF THE ADRENAL GLANDS



hematoxylin-eosin staining

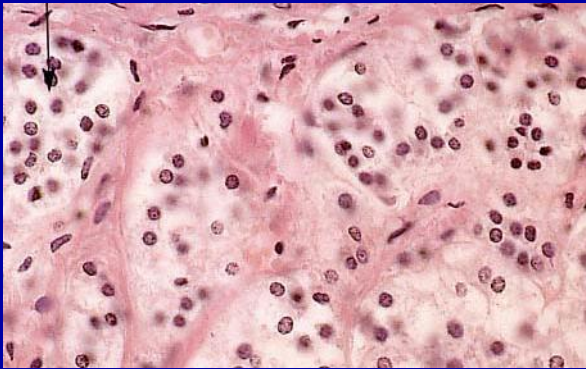
# HISTOLOGY OF THE ADRENAL GLANDS



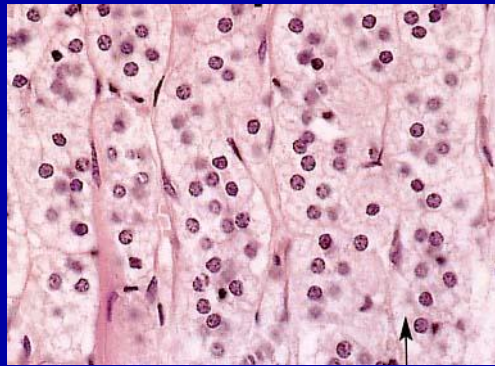
The cortex has 3 layers:

- 1.) zona glomerulosa
- 2.) zona fasciculata
- 3.) zona reticularis

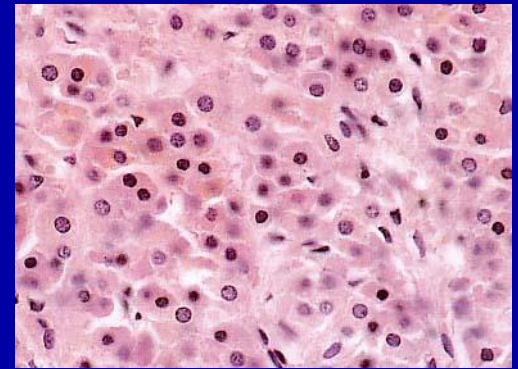
# Cortex of the adrenal gland



**Zona glomerulosa**  
mineralocorticoids



**Zona fasciculata**  
glucocorticoids



**Zona reticularis**  
sexual steroids

hematoxylin-eosin staining

# **FUNCTION OF ADRENAL HORMONES**

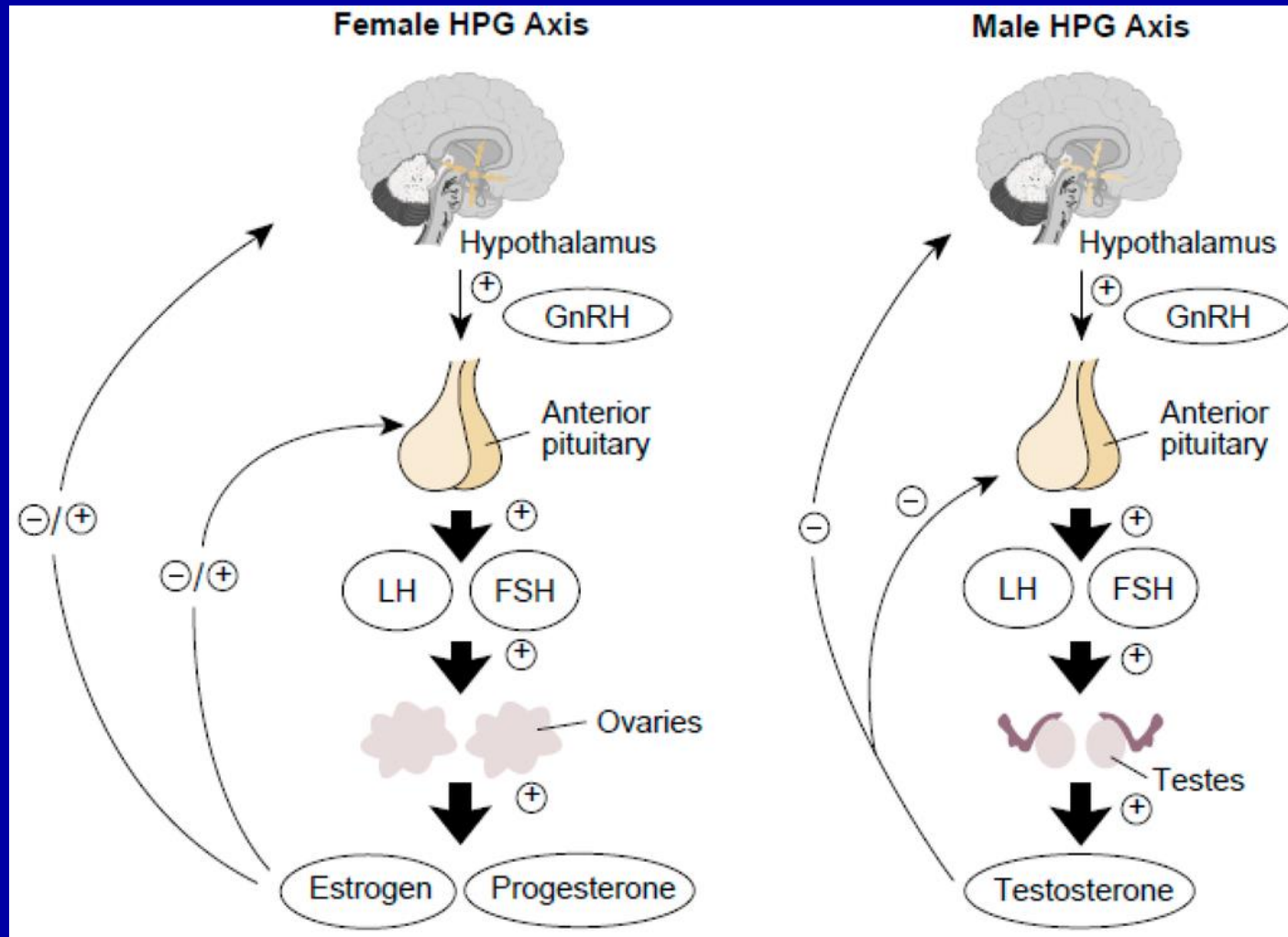
## **CORTEX**

**MINERALOCORTICIDS (aldosteron)**  
water and salt balance

**GLUCOCORTICIDS (cortisol, corticosterone)**  
carbohydrate metabolism  
enhancing the level of blood glucose

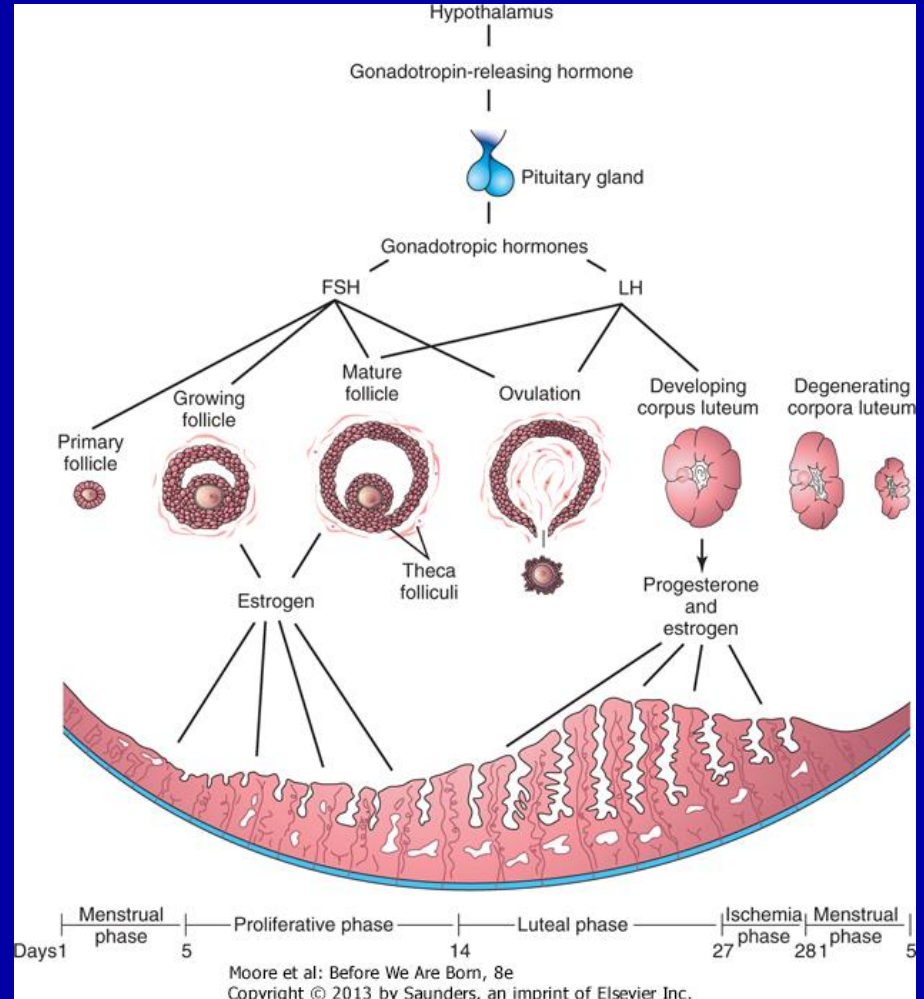
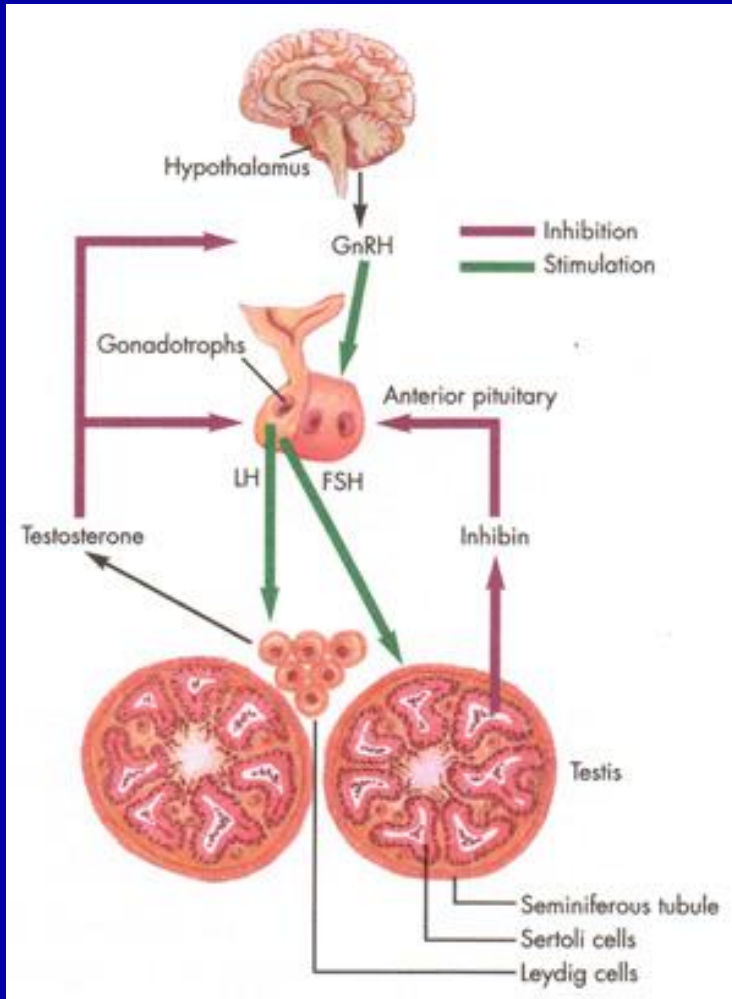
**SEXUAL STEROIDS**

# Gonadotropic hormones : FSH, LH acting on the gonads

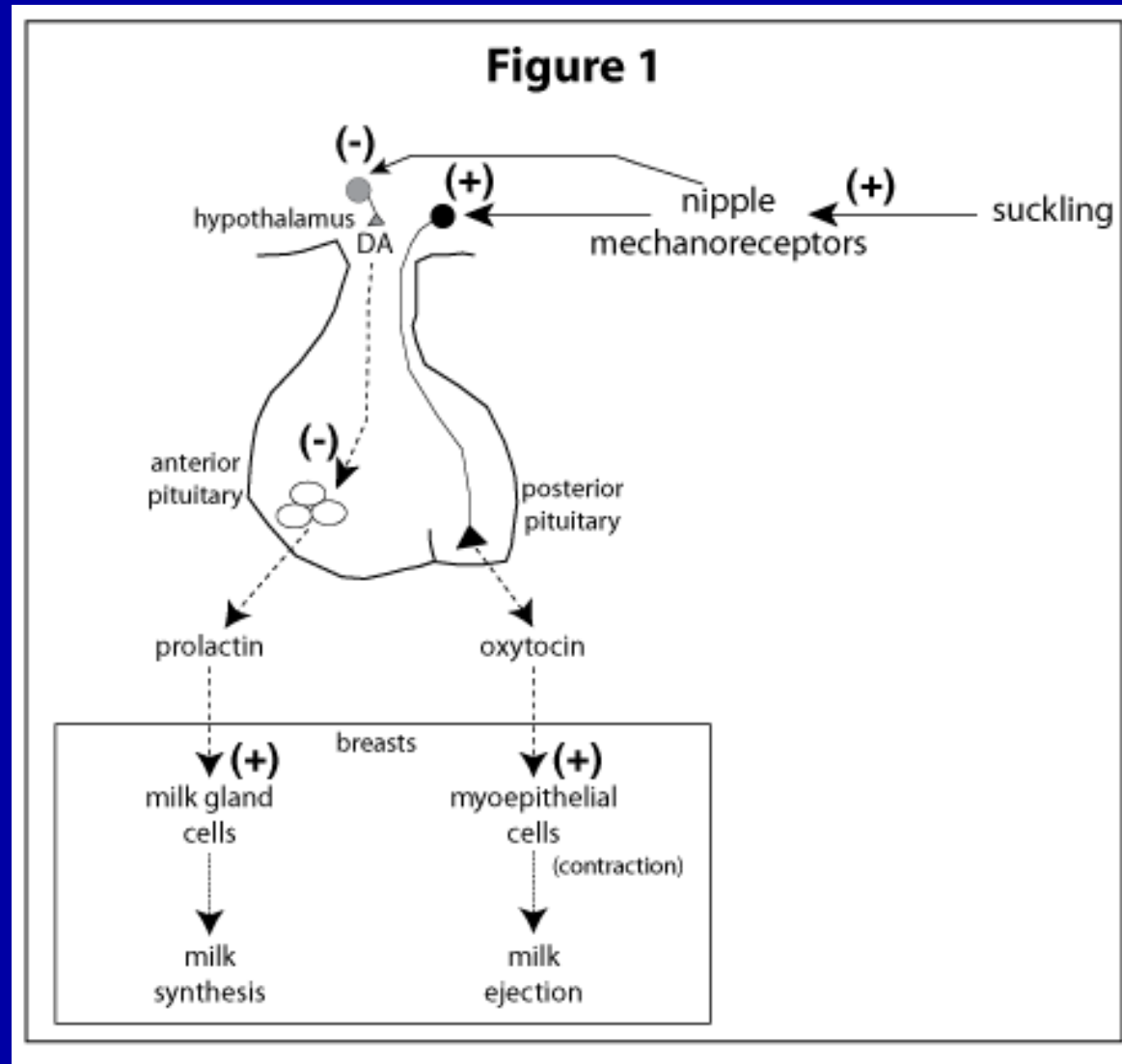




# The effect of the gonadotropic hormones



# Regulation of the milk production: the effect of LTH



# Pituitary-independent endocrine organs

**Adrenal medulla**

**Pineal body**

**Parathyroid gland**

**Islets of Langerhans**

**Placenta**

**Enteroendocrine cells**

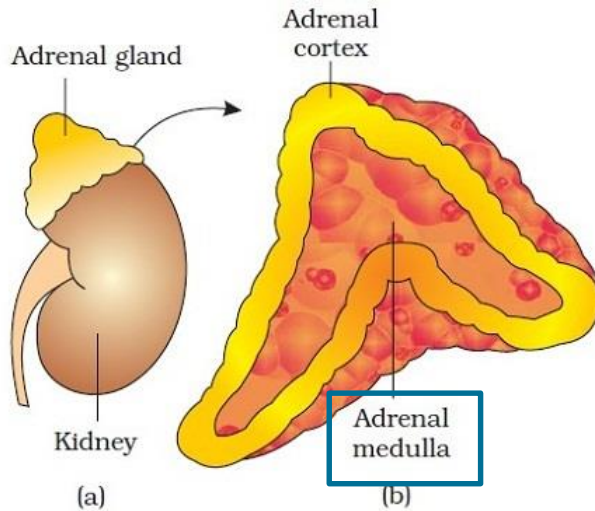
# Pituitary-independent endocrine organs

**Adrenal gland medulla: pituitary independent!!!**

**EPINEPHRIN, NOREPINEPHRIN**  
**involved in defense reaction to stress**

**works together with the sympathetic nervous system**

# ADRENAL MEDULLA

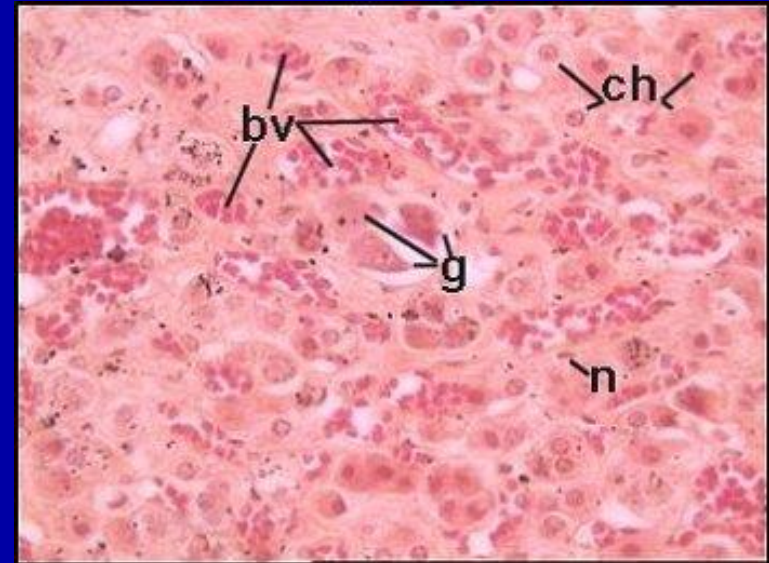
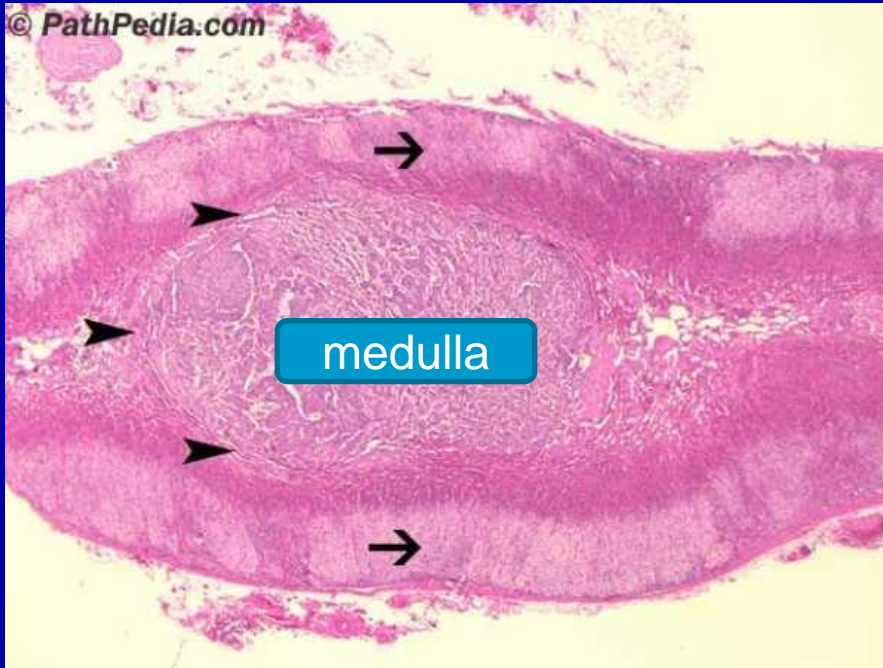


**Figure 4.** Diagrammatic representation of : (a) Adrenal gland on kidney  
(b) Section showing two parts of adrenal gland

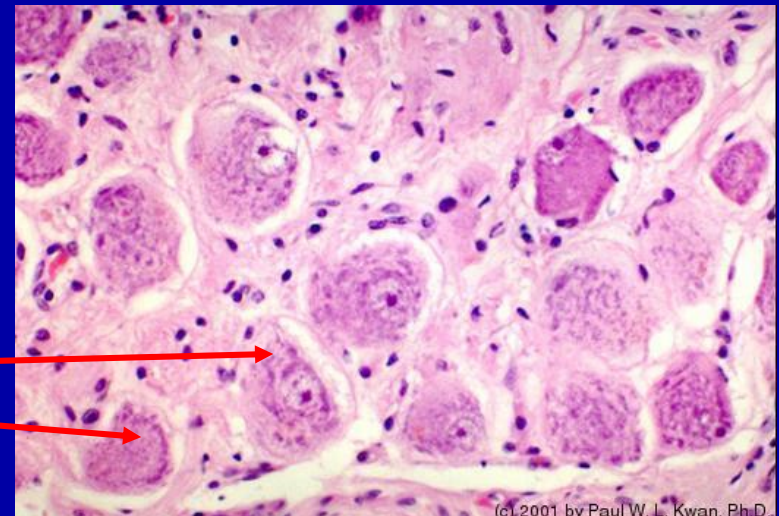
## Sympato-adrenal system

- venous sinusoids: muscular wall
- chromaffin cells: adrenalin, noradrenalin
- ganglion cells

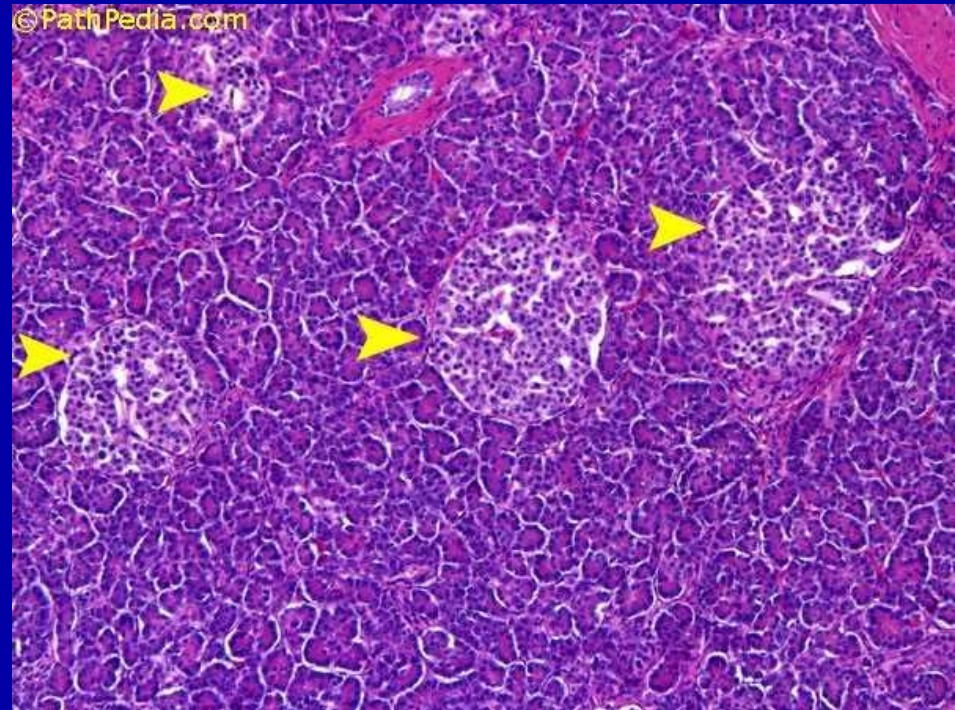
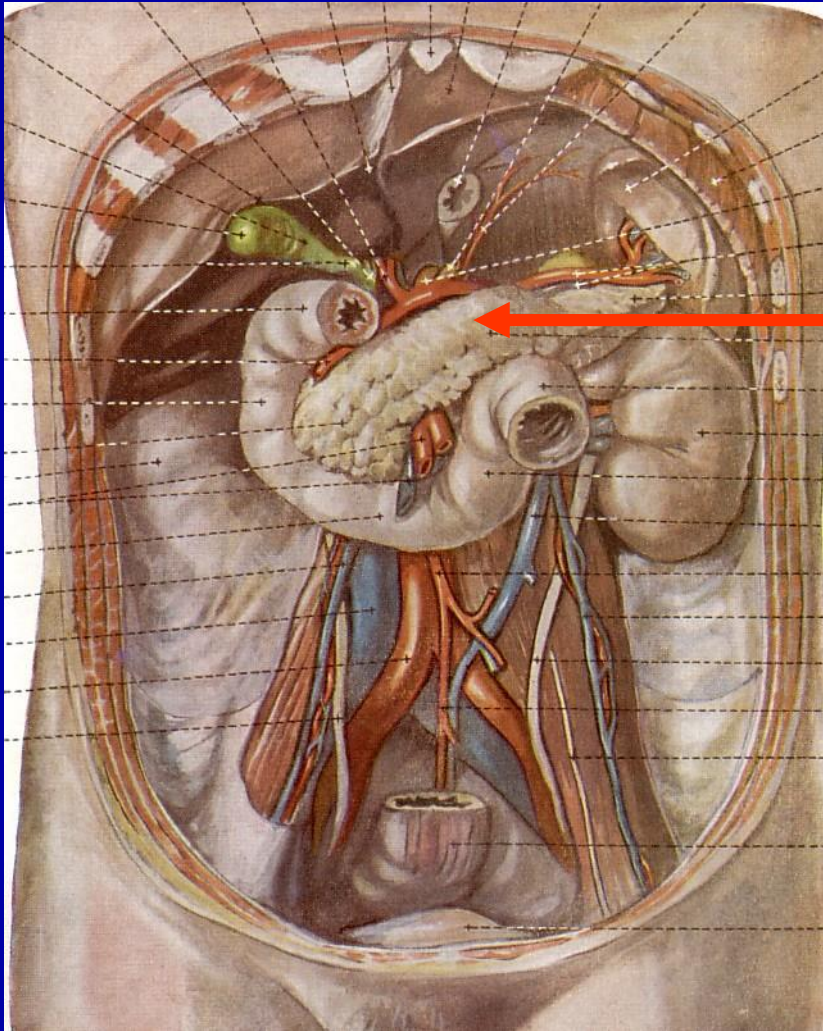
# Adrenal medulla



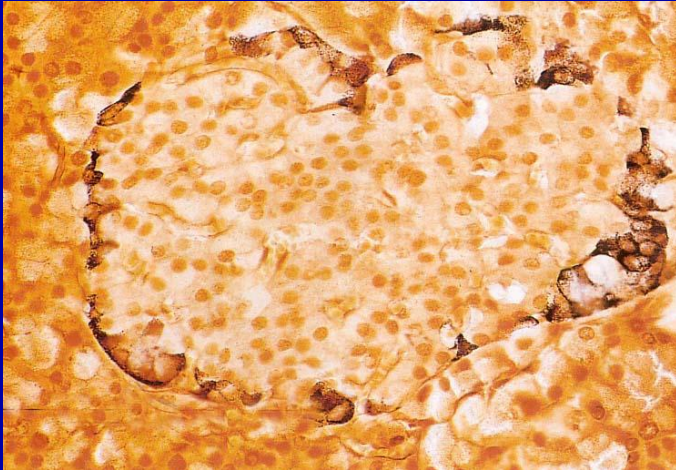
chromaffin cells (ch): adrenalin, noradrenalin  
ganglionic cells (g) (neurons)



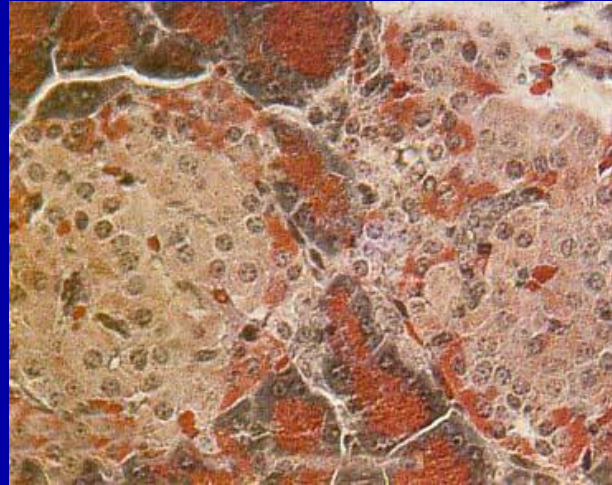
# PANCREAS: Langerhans islets



# LANGERHANS-ISLETS



Prepared by Mihály Petkó



Prepared by György Sétáló

***blood sugar level***

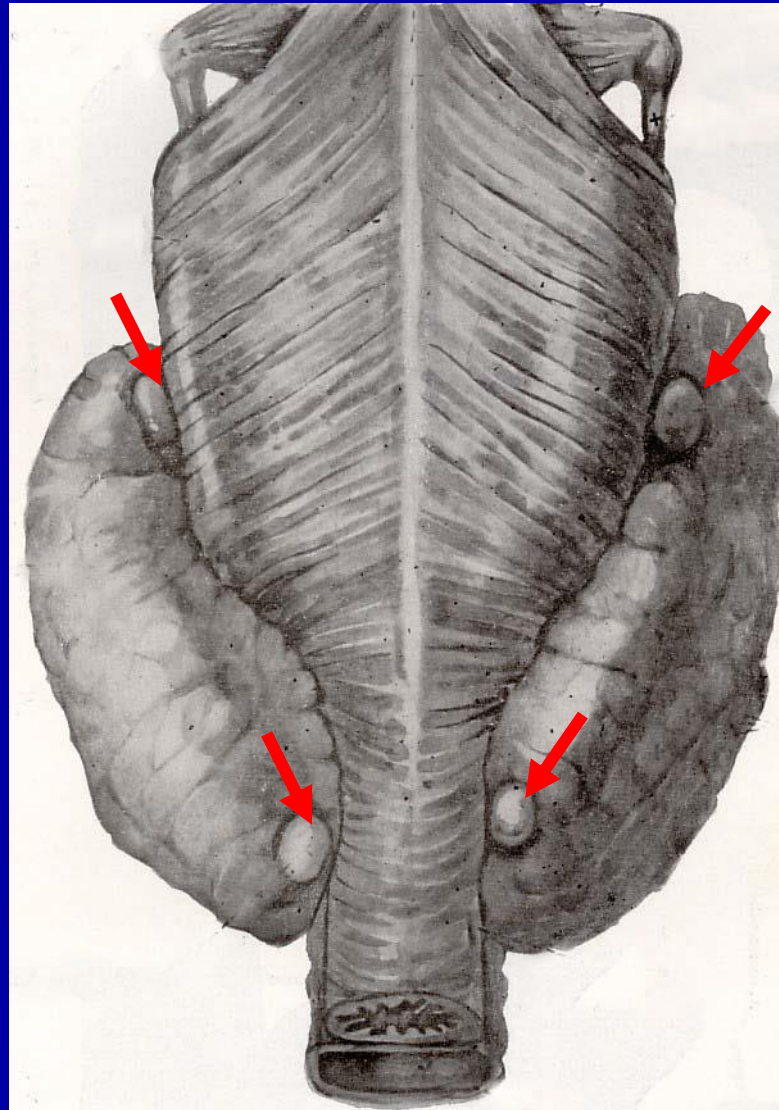


A ( $\alpha$ ) cells: glucagon: increases the blood sugar level

B ( $\beta$ ) cells: insulin: decreases the blood sugar level



# THE PARATHYROID GLANDS

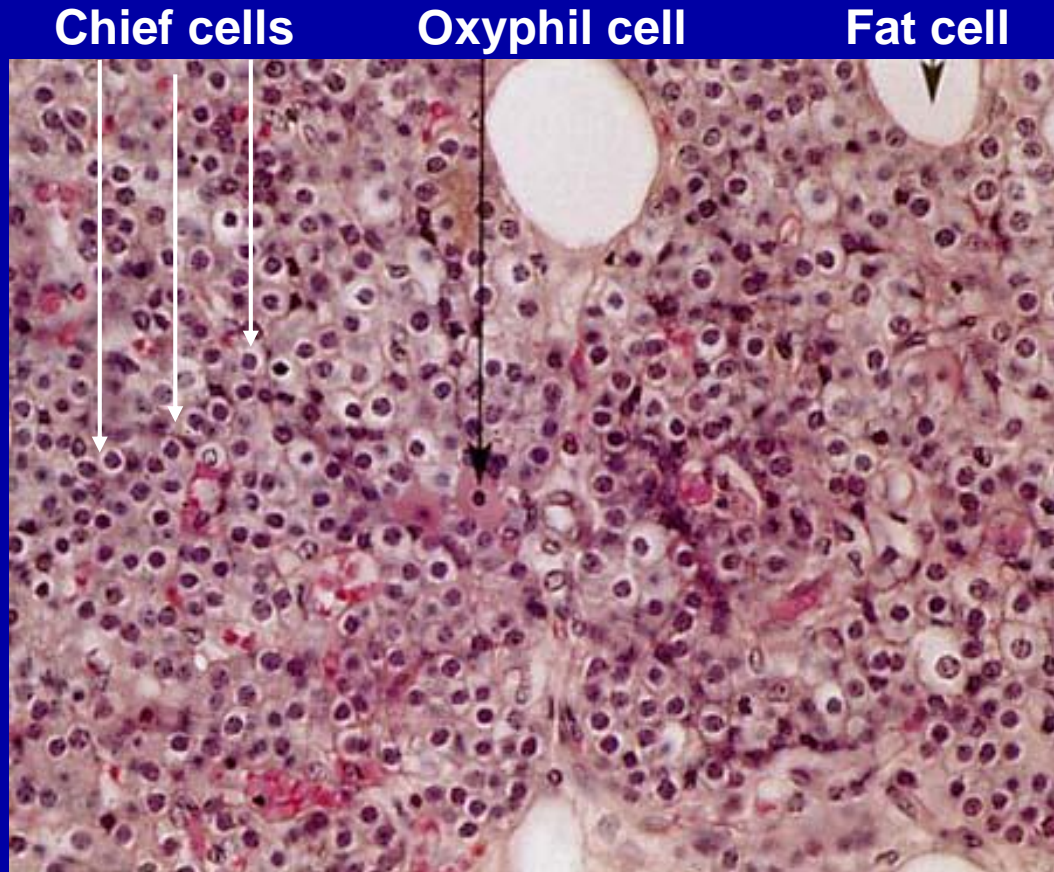


on the posterior parts of  
the thyroid glands: 4  
small islet

2 main cell populations:

- chief cells
- oxiphyl cells

# HISTOLOGY OF THE PARATHYROID GLANDS



hematoxylin-eosin staining

Chief cells produce parathormone  
(controls the concentration of calcium and phosphate ions of blood)

# THE PARATHYROID GLANDS

***Parat hormon:*** (parathyroid gland)

- increases the blood  $\text{Ca}^{2+}$  level (increased reabsorbtion at the large intestine+remove  $\text{Ca}^{2+}$  from the bone)
- decreases the blood phosphate level (preventing the phosphate reabsorbtion in the kidney)

***Calcitonin:*** (parafollicular cells of the thyroid gland)

- decreases the blood  $\text{Ca}^{2+}$  level
- Increases the blood phosphate level

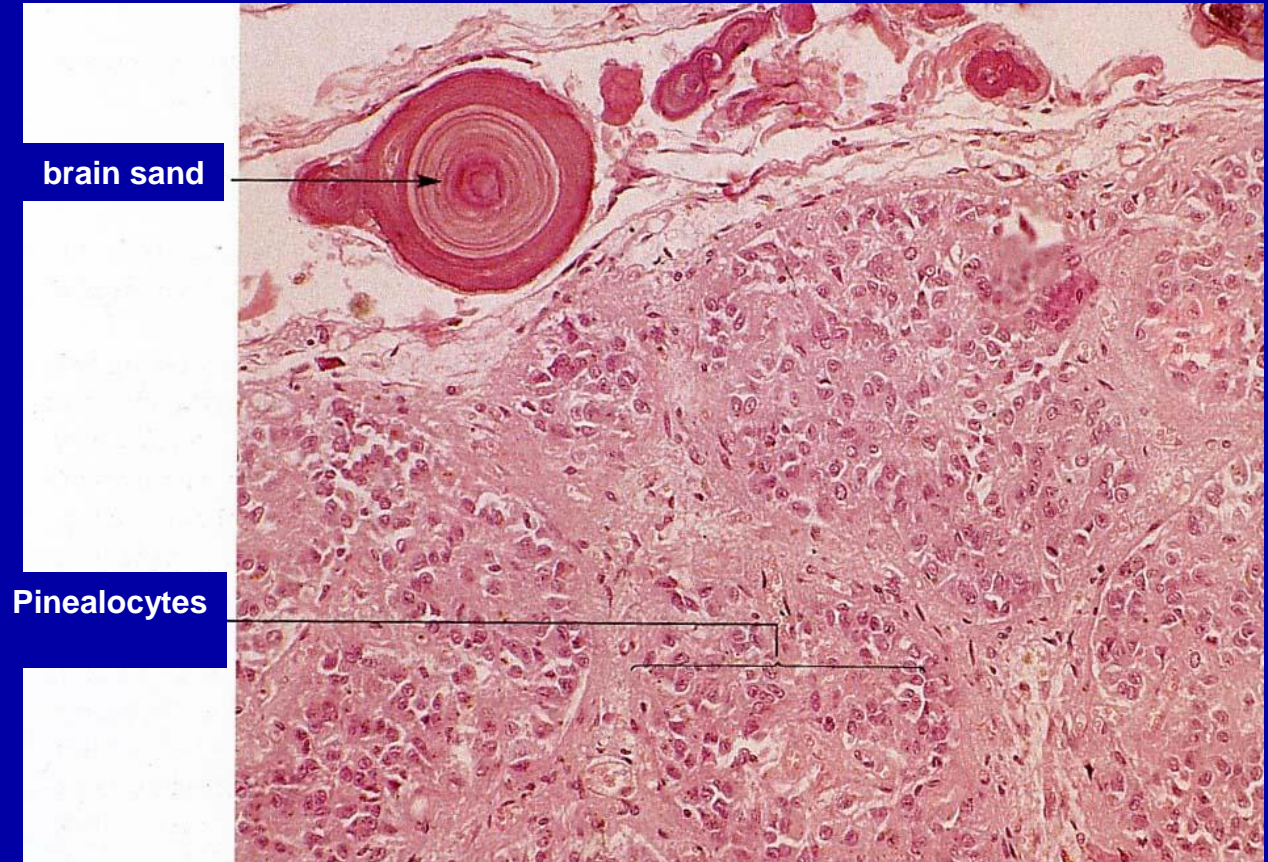
# PINEAL BODY: at the diencephalon

## LOCALIZATION



Melatonin, serotonin

## HISTOLOGY

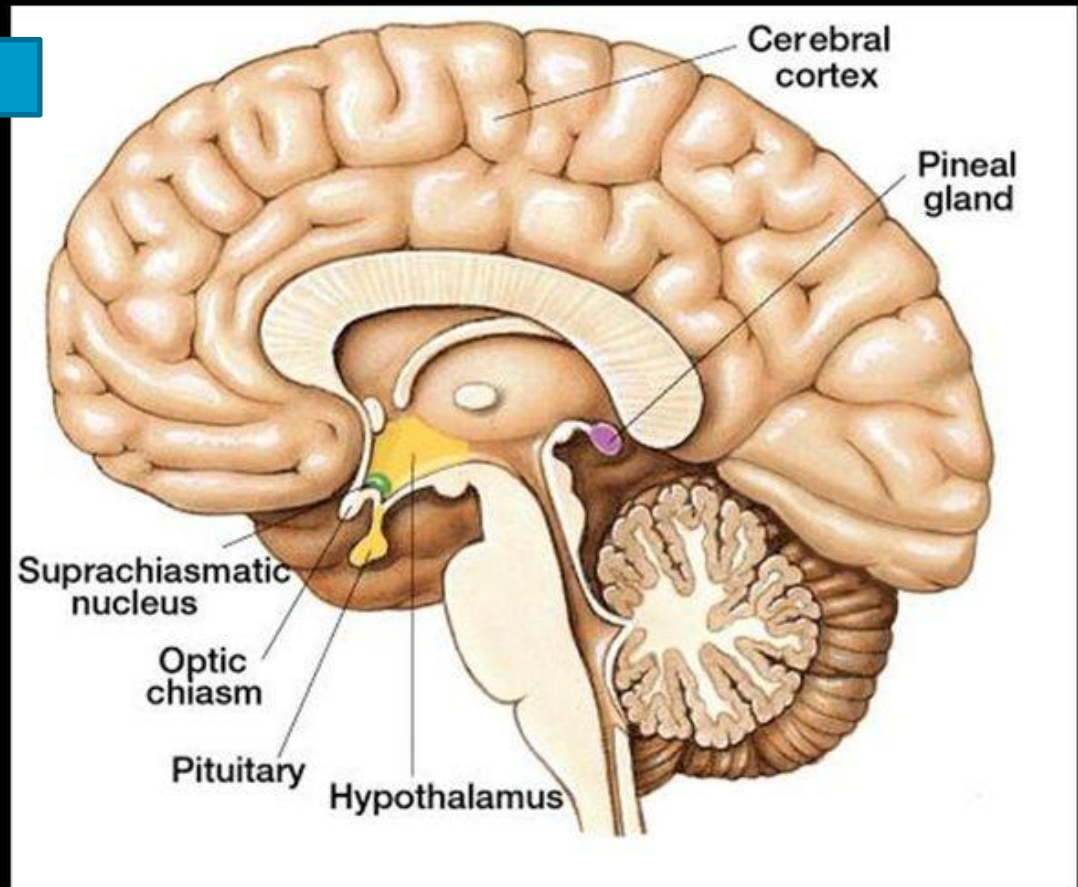


hematoxylin-eosin staining

# Pineal gland

## Pineal gland

- Functions: the pineal gland releases hormones that control circadian rhythm and regulate certain reproductive hormones.
- Hormones:
  - Melatonin
  - Serotonin



# References

Sobotta atlas  
Wikipedia