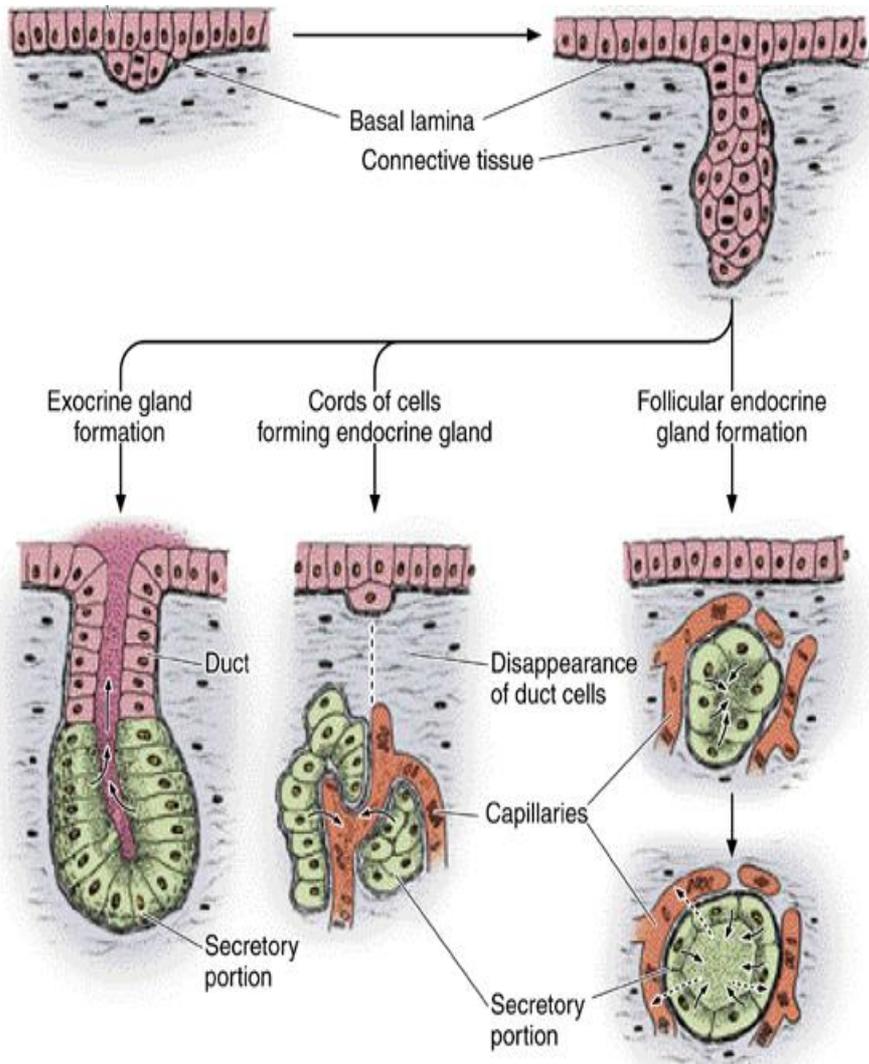


# Glands



## 1-Exocrine (has ducts): e.g.

Salivary glands,

Secrete saliva in the mouth cavity through ducts.

## 2-Endocrine (no ducts):

e.g. Thyroid ,pituitary glands.

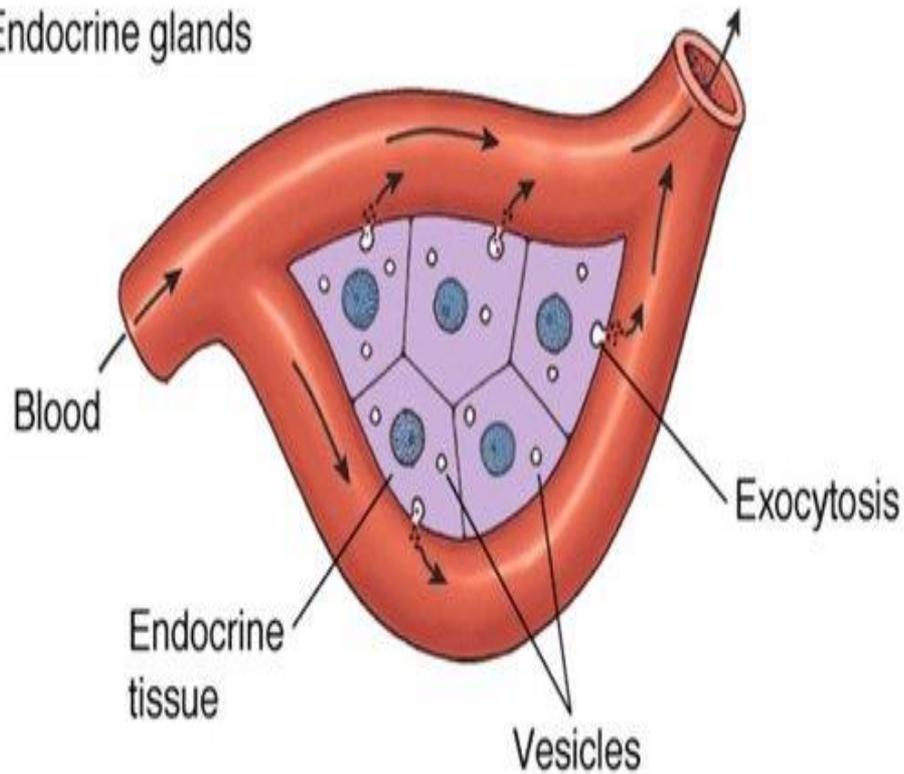
Secrete hormones directly into the blood.

## 3-Mexocrine: e.g. Pancreas

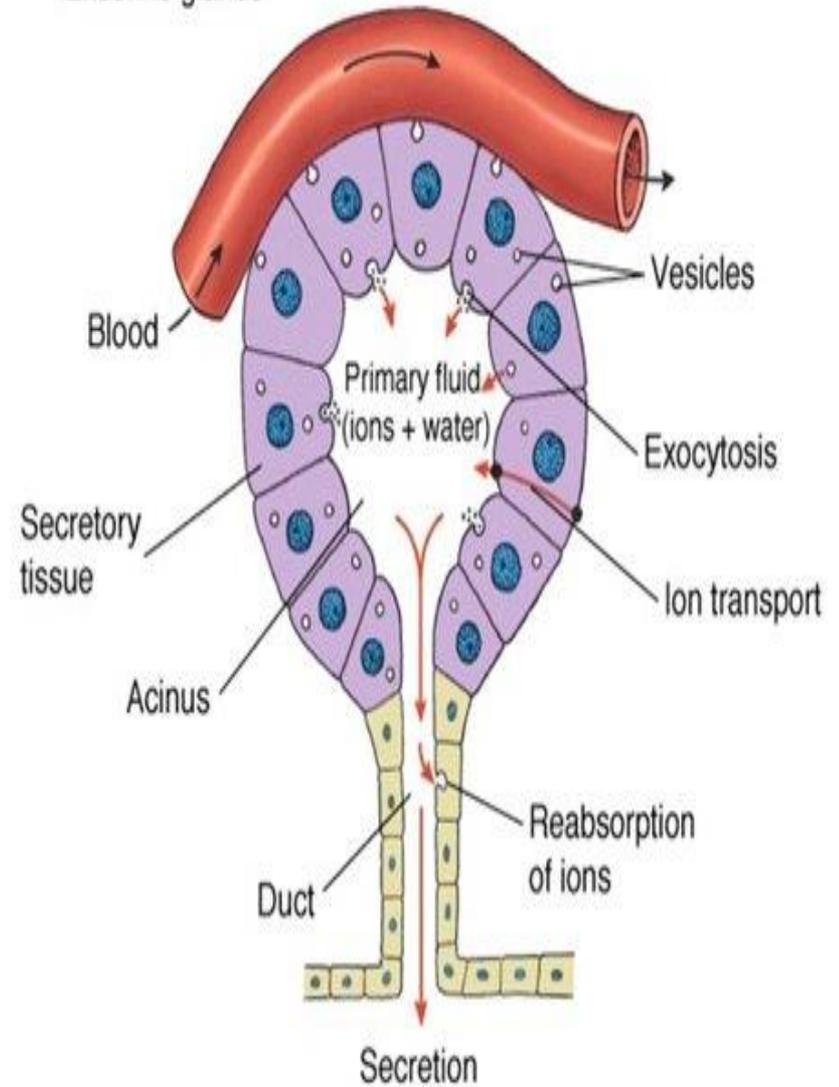
Secretes digestive enzymes in the intestine & insulin hormone to the blood

# Glands

Endocrine glands



Exocrine glands



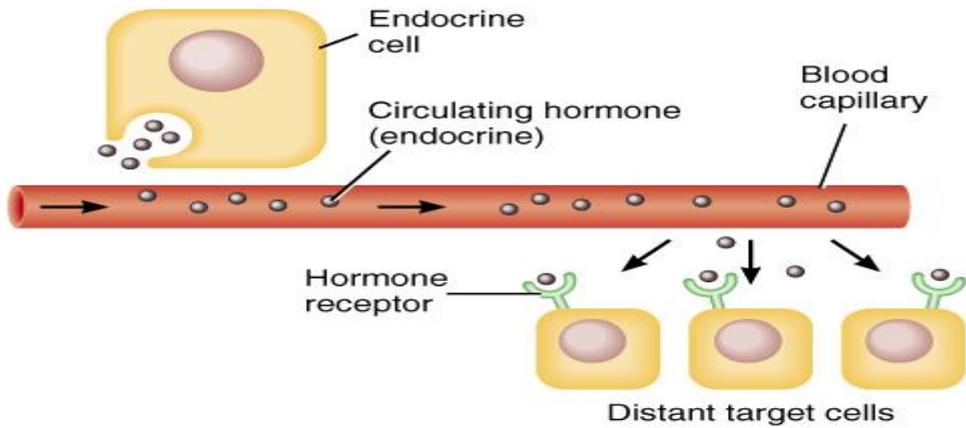
# Endocrine system

❑ The endocrine system is a control system of ductless glands that secrete hormones within specific organs.

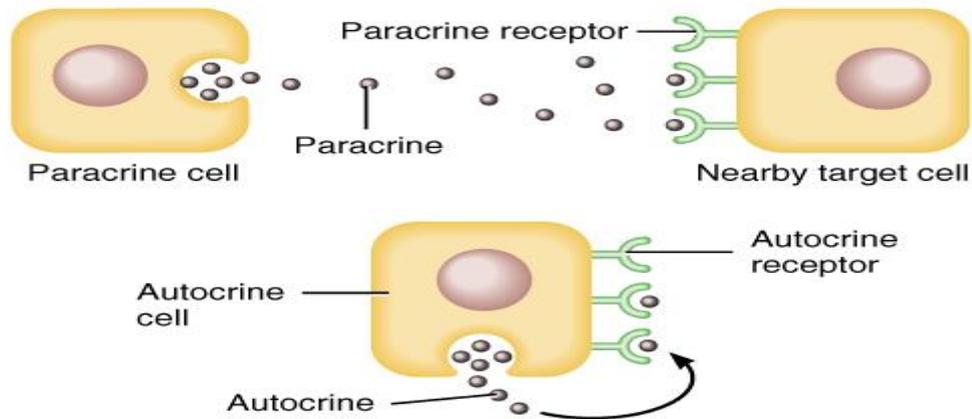
Hormones a small chemical act as "**messengers**," can enter the bloodstream and cause an action at **Target cells or tissue** (Specific cells affected by a hormone)

## Patterns of Hormone Action

- ❖ **Endocrine:** circulated by blood to distant target cells
- ❖ **Paracrine:** Hormones that affect neighboring cells
- ❖ **Autocrine:** Hormones that act on the cells that secrete them
- ❖ **Neuroendocrine**
- ❖ **Neurotransmitter**

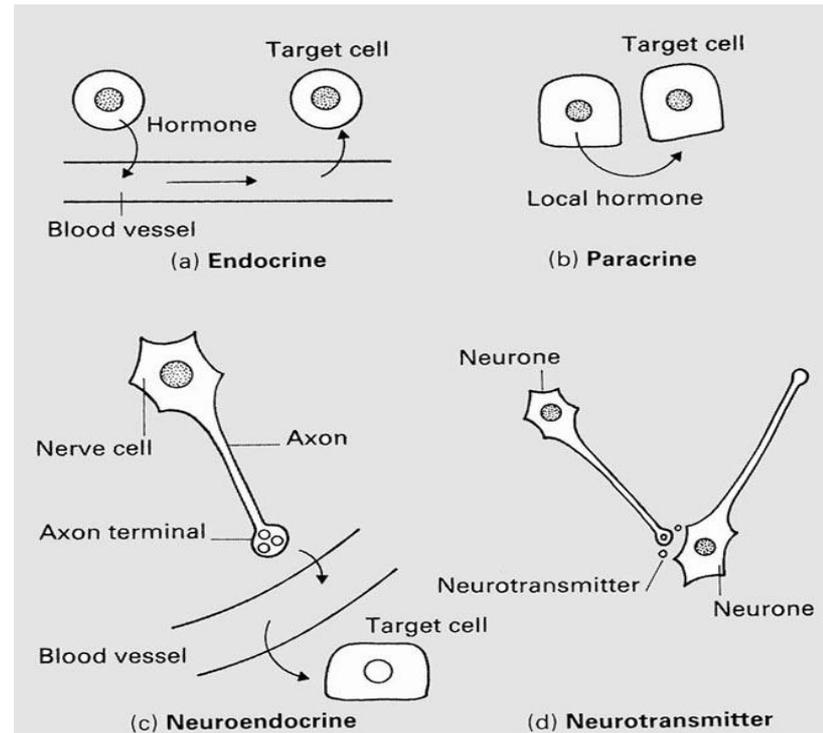


(a) Circulating hormones (endocrines)

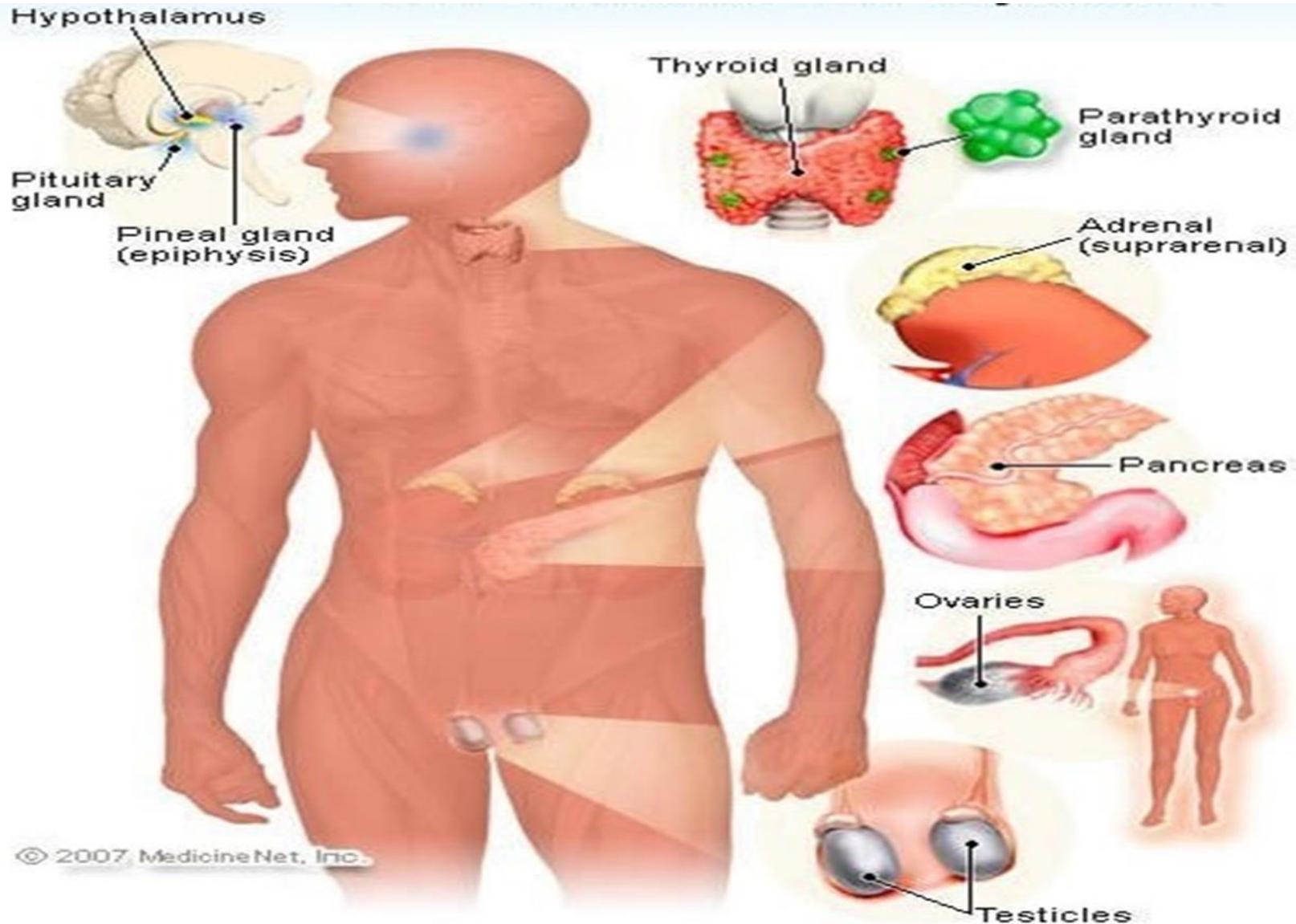


(b) Local hormones (paracrines and autocrines)

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# Endocrine glands



# Introduction to the Endocrine System

## The endocrine system

### ❖ Principle glands :

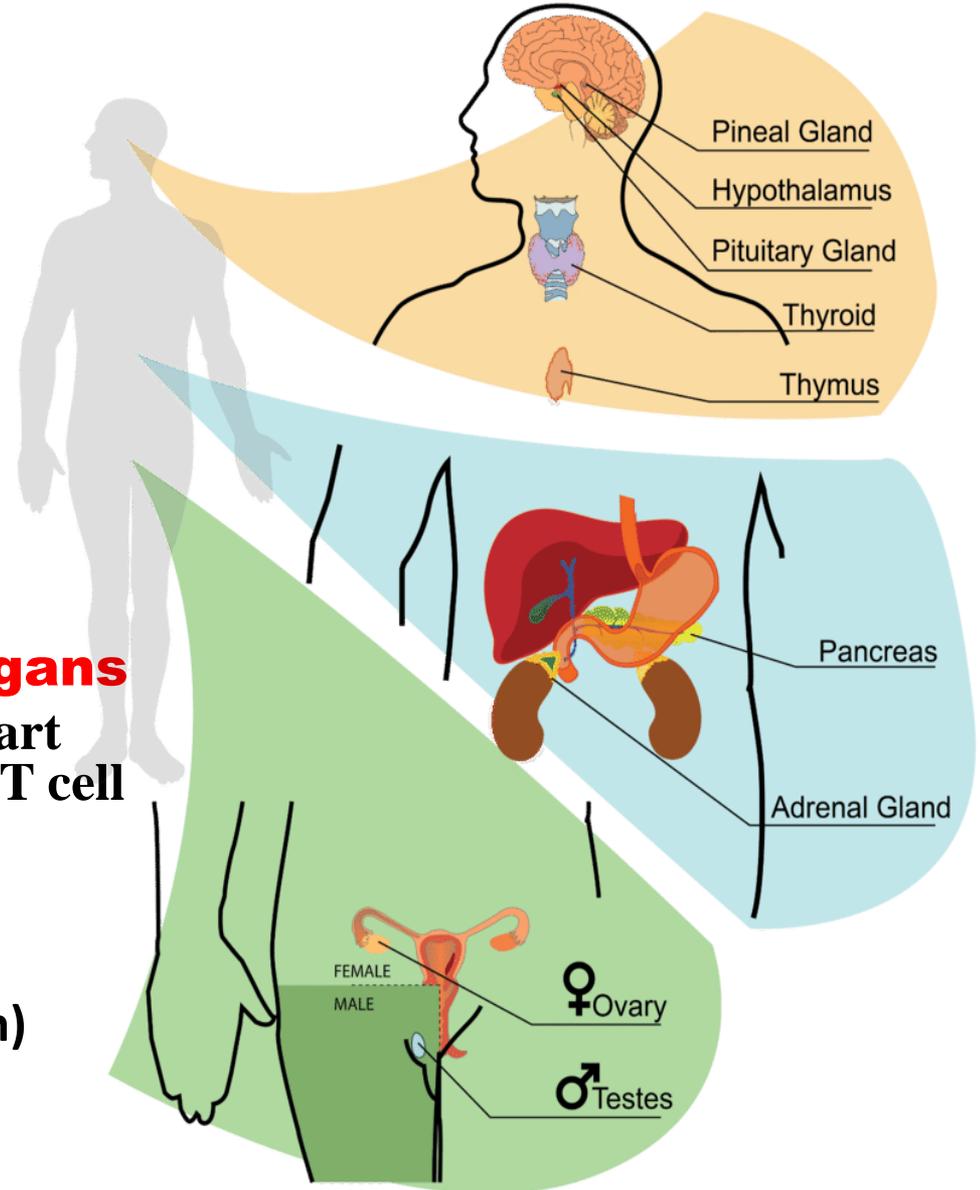
- Hypothalamus
- Pituitary gland
- Pineal body
- Thyroid gland & Parathyroid
- Suprarenal gland (adrenal )
- Pancreas
- Gonads (testis, ovary) + placenta

### ❖ Endocrine cells in other organs

Kidney (erythropoietin + renin) , heart (ANF) , Thymus (hormone stimulate T cell maturation) & adipose cells (leptin)

### ❖ Local Hormones

- GIT (Diffuse neuroendocrine system)
- Neurotransmitter (nerve ending)



# Basic structure of endocrine glands

## ❑ Stroma

- CT inside the gland
- CT capsule
- Loose tissue

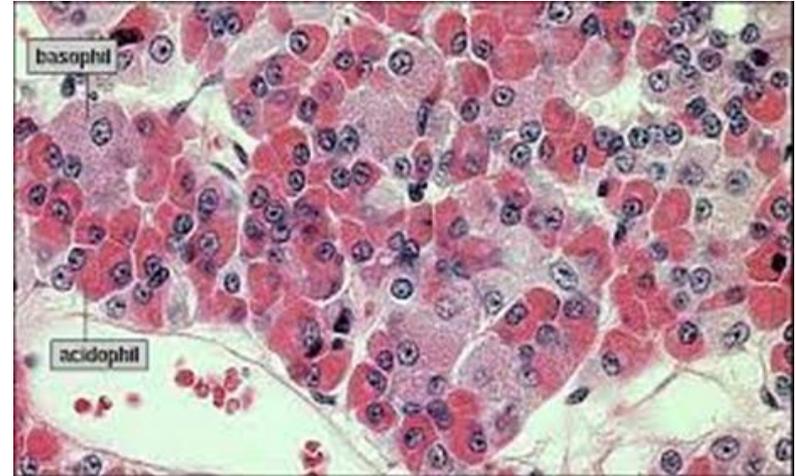
## ❑ Parenchyma= cells

- Cells
- Plexus of **blood vessels**

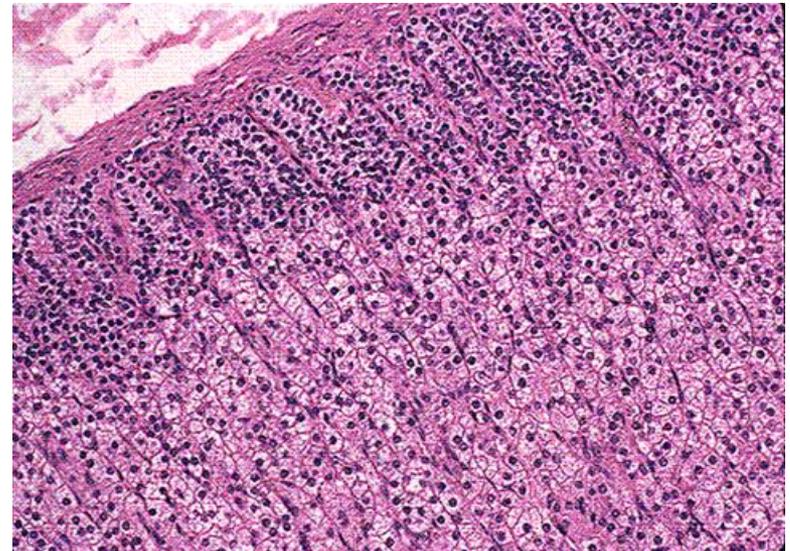
## Follicles



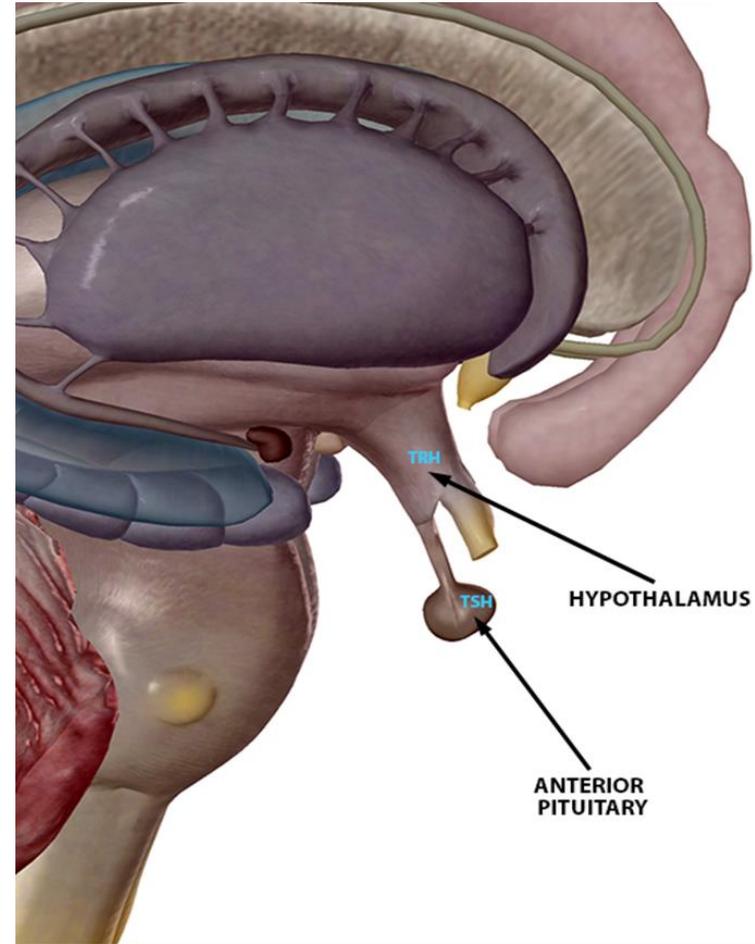
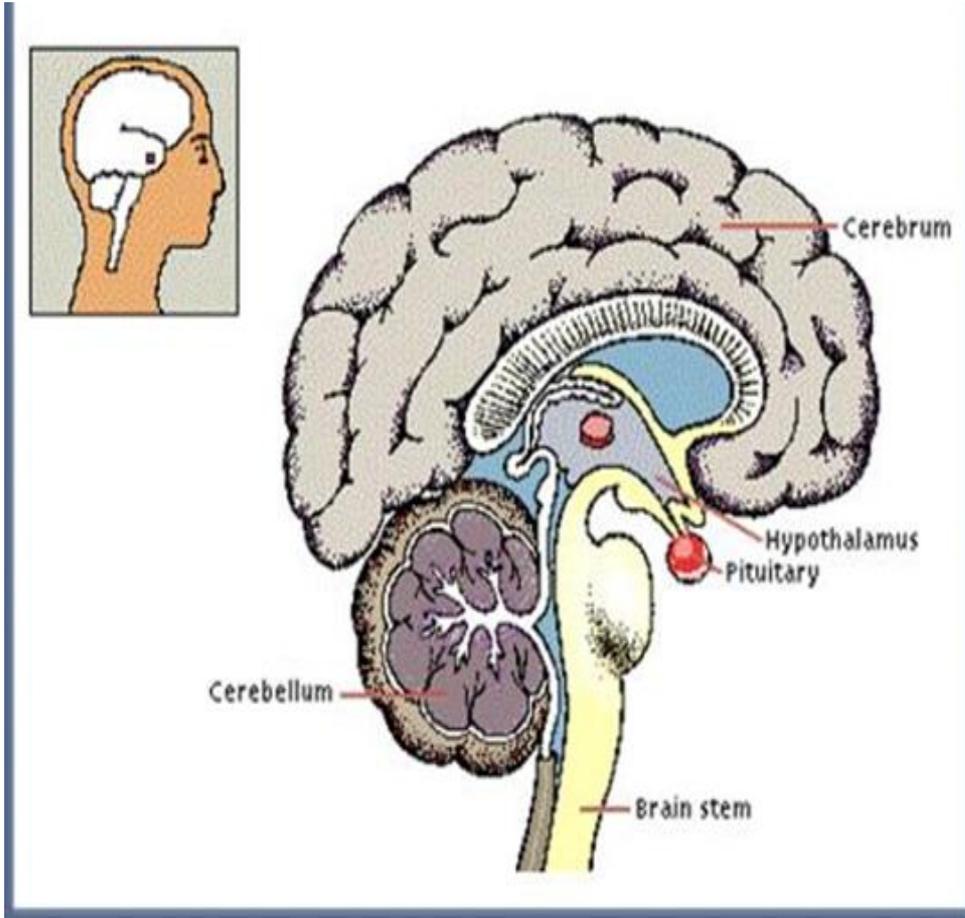
## Cords



## Cords



# Pituitary gland

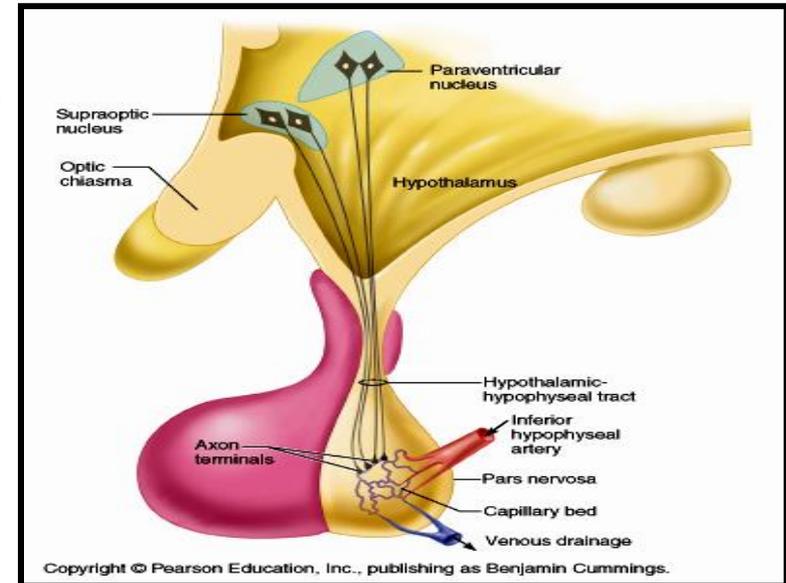
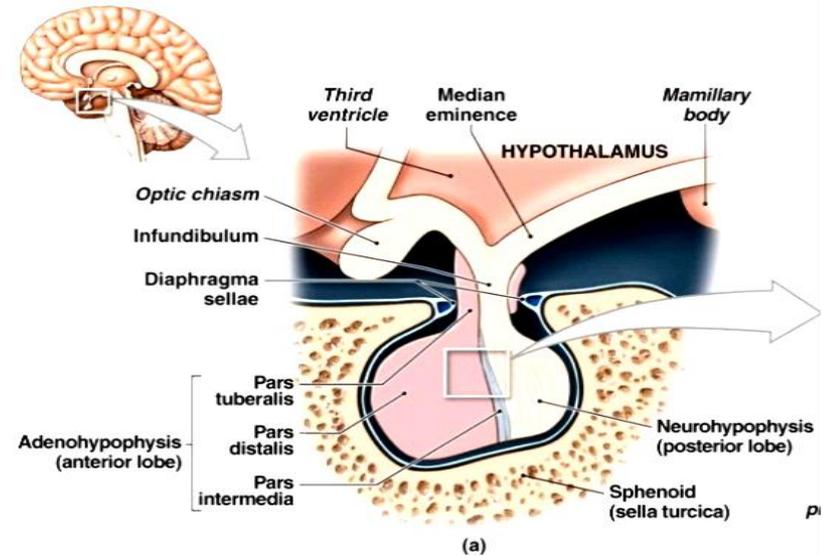


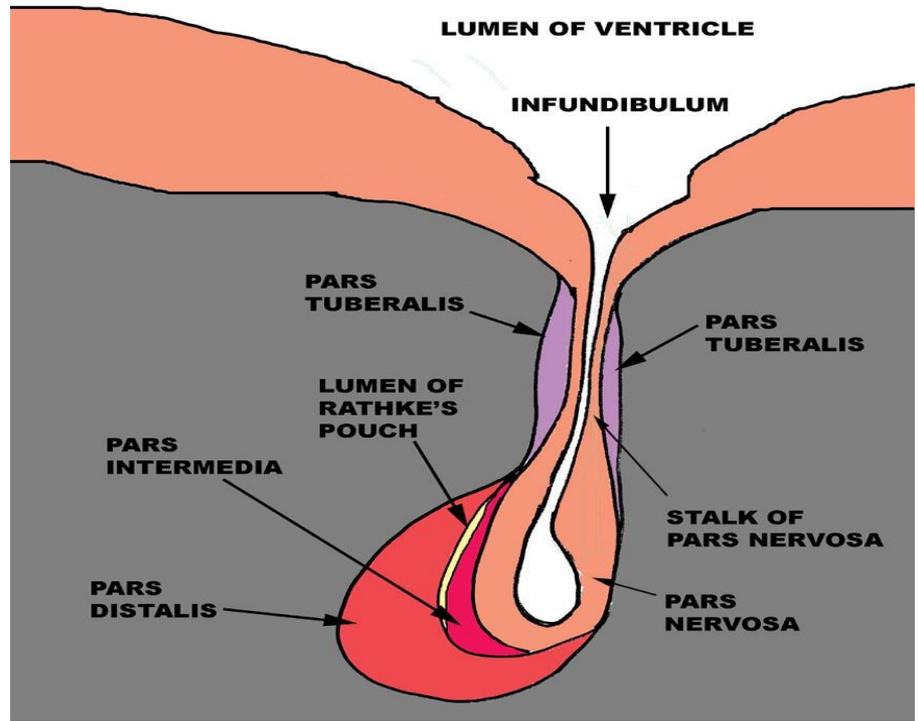
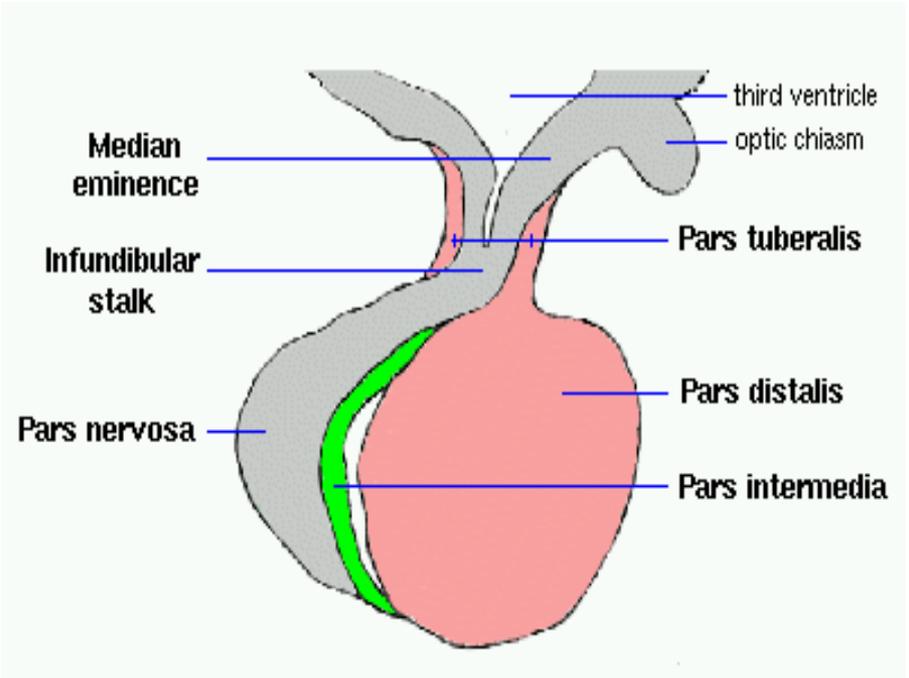
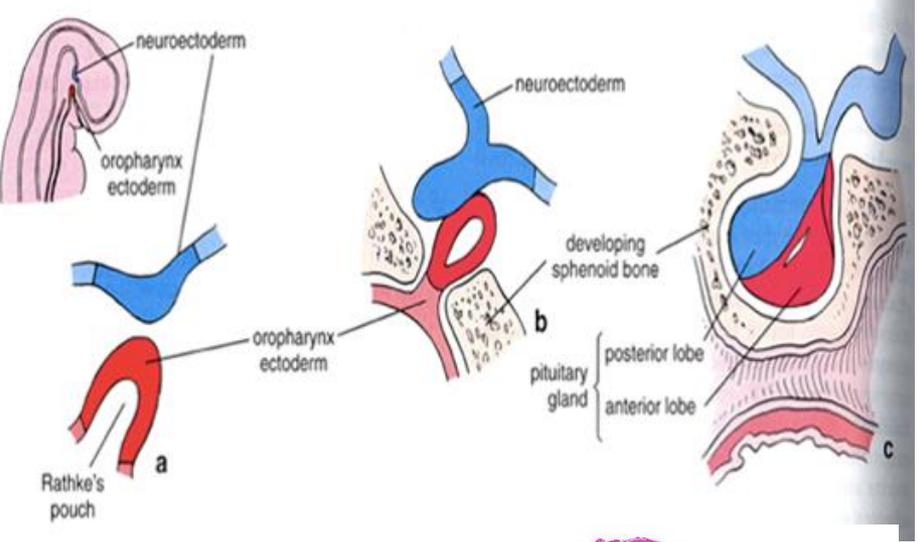
# Pituitary gland

- ❑ The pituitary gland (**hypophysis Cerebri**) is attached to the bottom of the hypothalamus by a slender stalk called the infundibulum.
  
- ❑ The pituitary gland consists of **two major regions**:
  - ❖ **Anterior** pituitary gland (anterior lobe or **adenohypophysis**)
  - ❖ **Posterior** pituitary gland (posterior lobe or **neurohypophysis**).
  
- The Anterior pituitary is involved in sending hormones that control all other hormones of the body so referred to as the **master gland** because it is the main place for everything that happens within the endocrine system.

# Pituitary gland (Hypophysis Cerebri)

- ❑ Lies in the **sella turcica** (bony cavity of sphenoid)
- ❑ Covered by **diaphragma sellae** (fold of dura mater)
- ❑ **Stroma**: surrounded by a **thin connective tissue** capsule/ loose connective tissue between the capsule and the periosteum.
- ❑ **Parenchyma**: it has a **dense plexus** of veins
  - ❖ **epithelial component**:  
adenohypophysis (anterior pituitary)
  - ❖ **neural component**:  
Neurohypophysis (posterior pituitary).





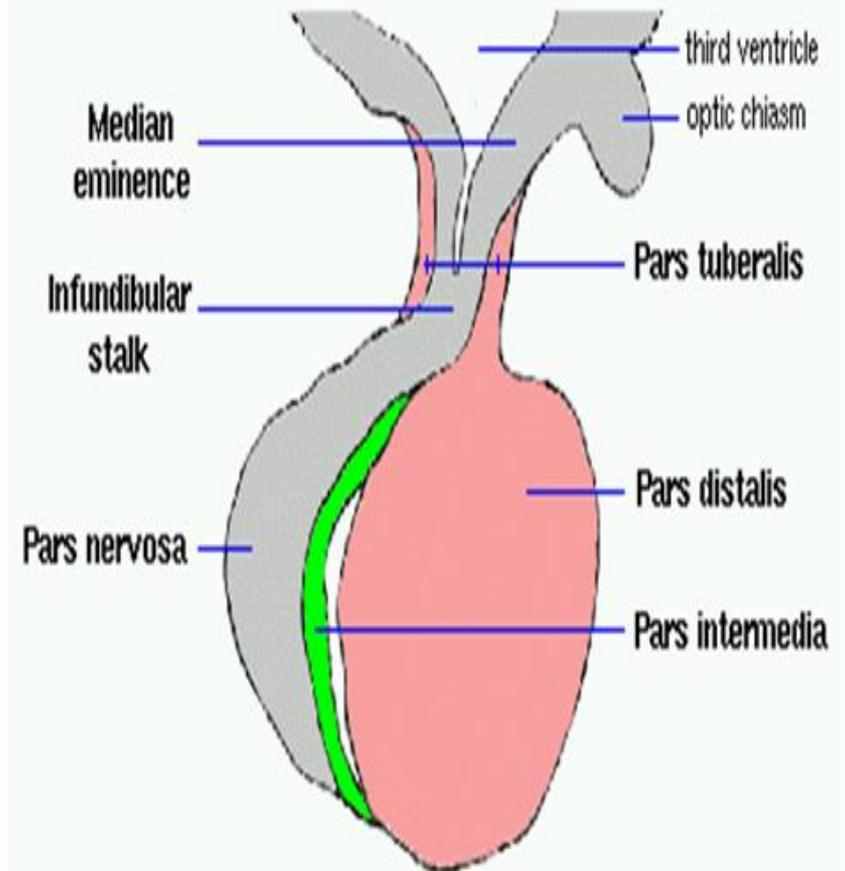
	<b>Adenohypophysis (glandular part)</b>	<b>Neurohypophysis (nervous part)</b>
<b>Derived from</b>	Oral ectoderm	Neural ectoderm 3 <sup>rd</sup> ventricle
	<b>pinched off (Rathke's pouch)</b>	Connected with the brain by <b>neural stalk (infundibulum)</b>
<b>Stain</b>	Dark	Pale
<b>Consist of</b>	Glandular epithelium in the form of irregular branching cords of cells	Nerve fibers

# Adenohypophysis

1. Pars Tuberalis

2- Pars Intermedia

3. Pars distalis



# Adenohypophysis

## 1. Pars Tuberalis

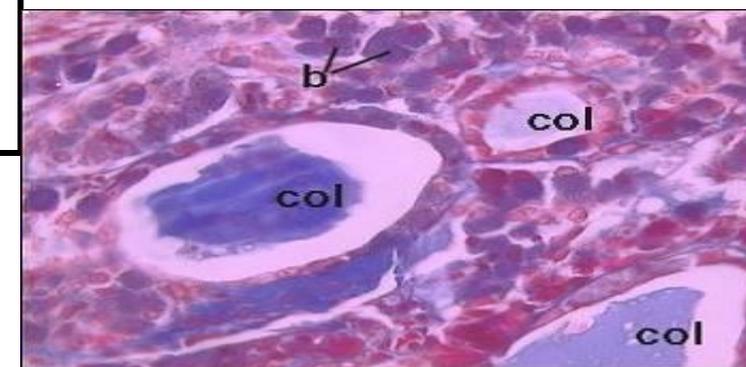
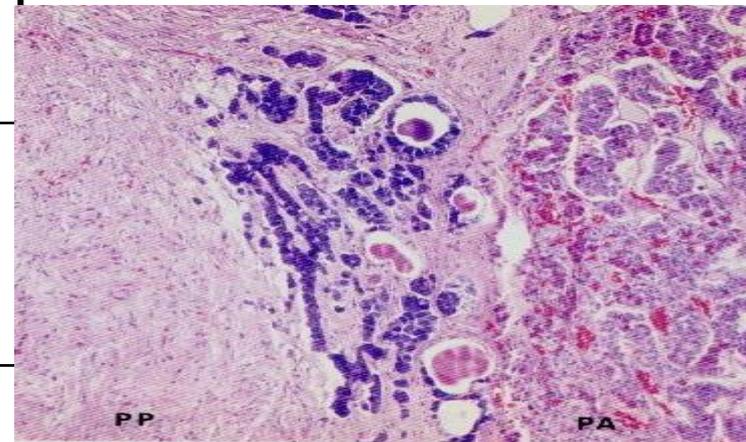
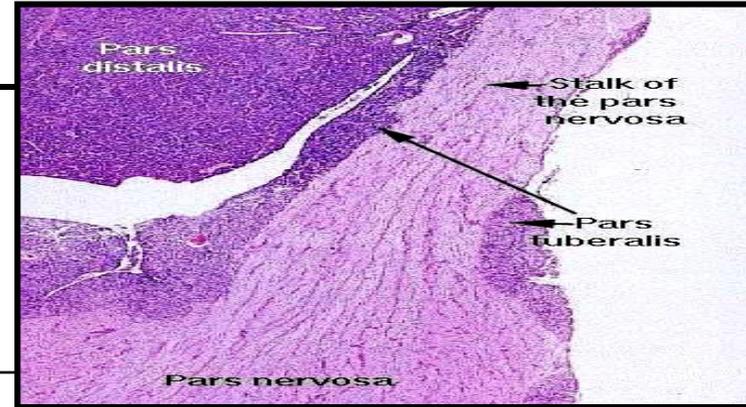
- **Highly vascular** region containing the veins of the **hypophyseal portal system** and wraps the **pituitary stalk (infundibulum)**.
- Principal cells of the pars tuberalis are **chromophobes**
- Stem cells or exhausted chromophils

## 2- Pars Intermedia

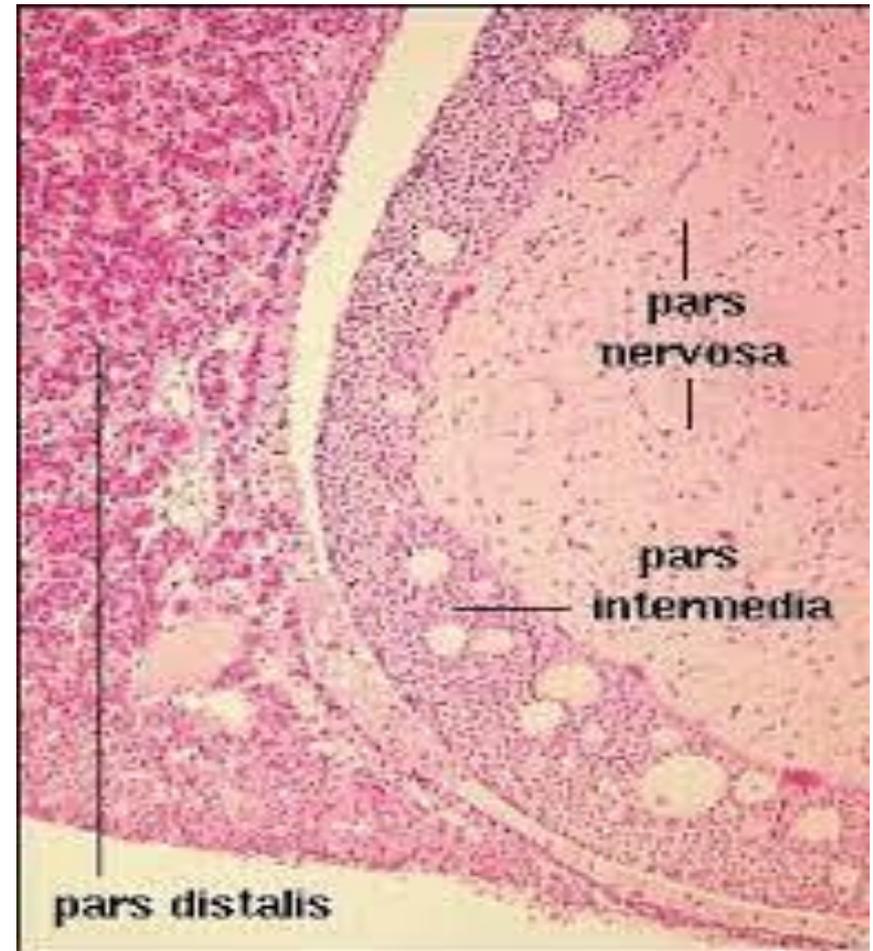
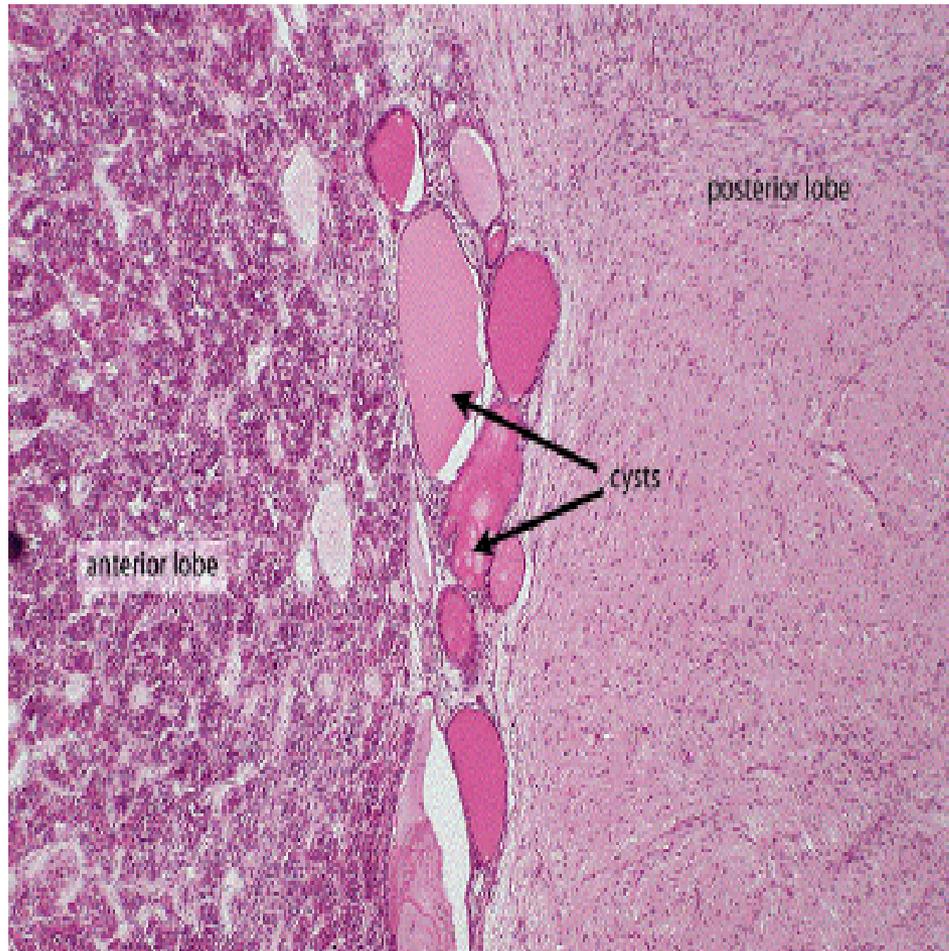
- In human/ **unclear function**
- contains **chromophobic** cells surrounding **colloid-filled cysts**
- In animals / the basophilic cells produce melanocyte stimulating hormone (**MSH**)

# 2- Pars intermedia

	In humans	In animals
<b>Development</b>	rudimentary	Well developed
<b>Arrangement Of Cells</b>	cords	Layers and cysts
<b>Function</b>	Non specific and unknown	MSH (melanocytes-stimulating hormone)



# Pars Intermedia



### 3- Pars distalis

➤ Stroma : CT capsule, reticular fibers.

➤ Parenchyma

❑ **Cells** cords of epithelial cells

+ fenestrated **sinusoids**

**staining characteristics** the cells are of two types :

I- **chromophobes 52%**

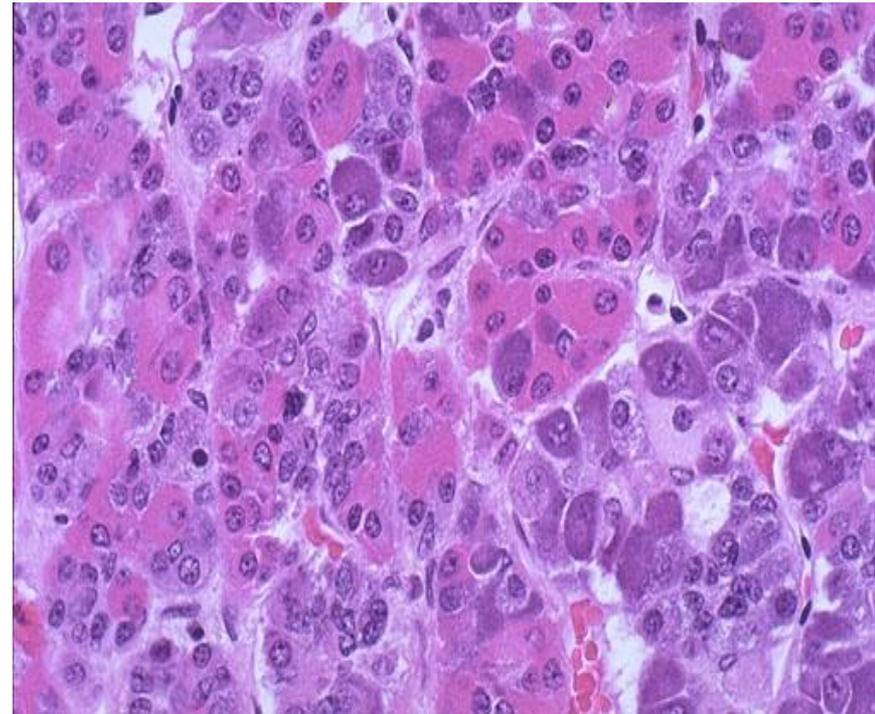
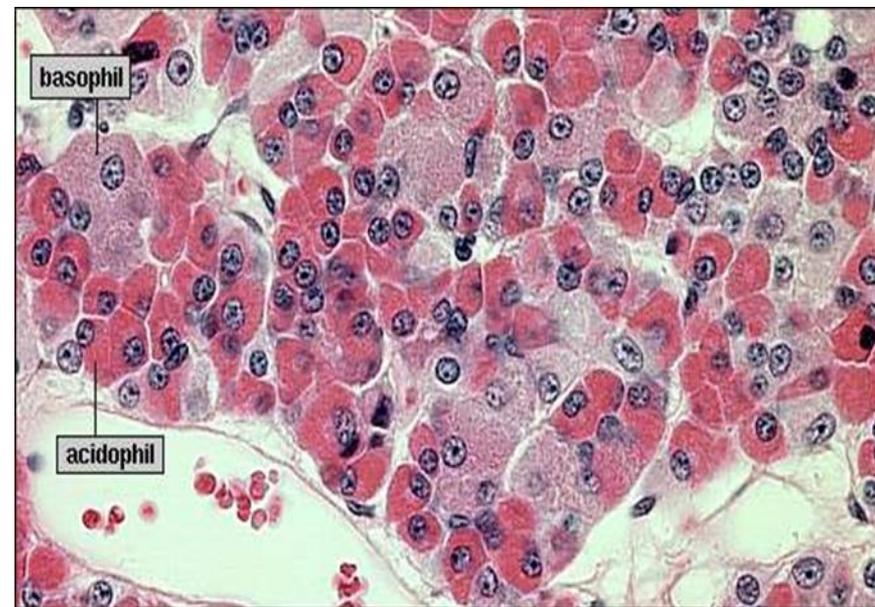
(which do **not stain intensely**).

2. **chromophils 48%**

(having **densly** stained cytoplasmic **granules**)

❑ **basophils 11%** (darkly pink stained)

❑ **acidophils 37%** (eosinophilic or reddish stained)

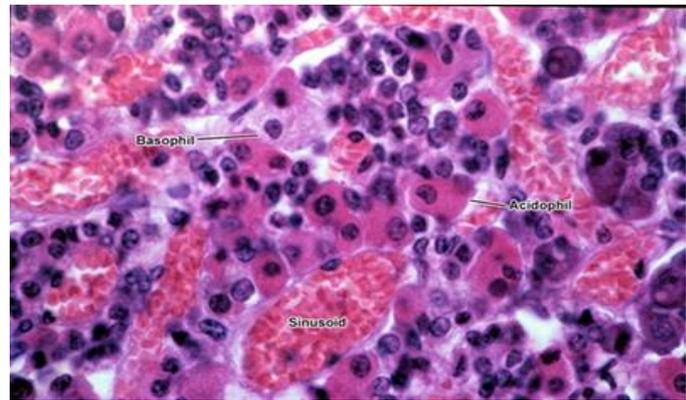
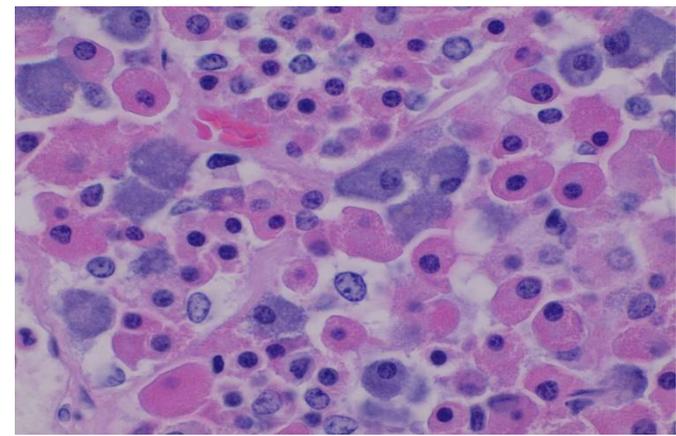
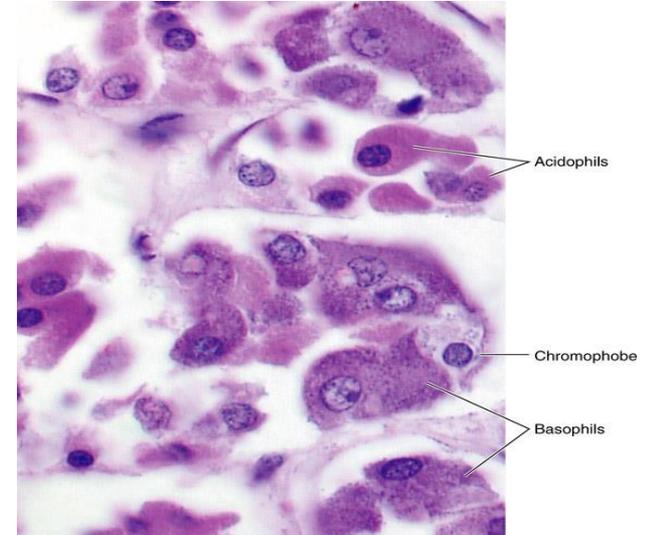


# Cells of pars distalis

## Chromophils

## Chromophobes

Function	Endocrine cells	Stem cells or exhausted chromophils
Affinity for stain	Great	Weak
Size & shape	Large , polyhedral	Small, rounded
Percentage	48% 11% <b>basophils</b> 37% <b>acidophils</b>	52%



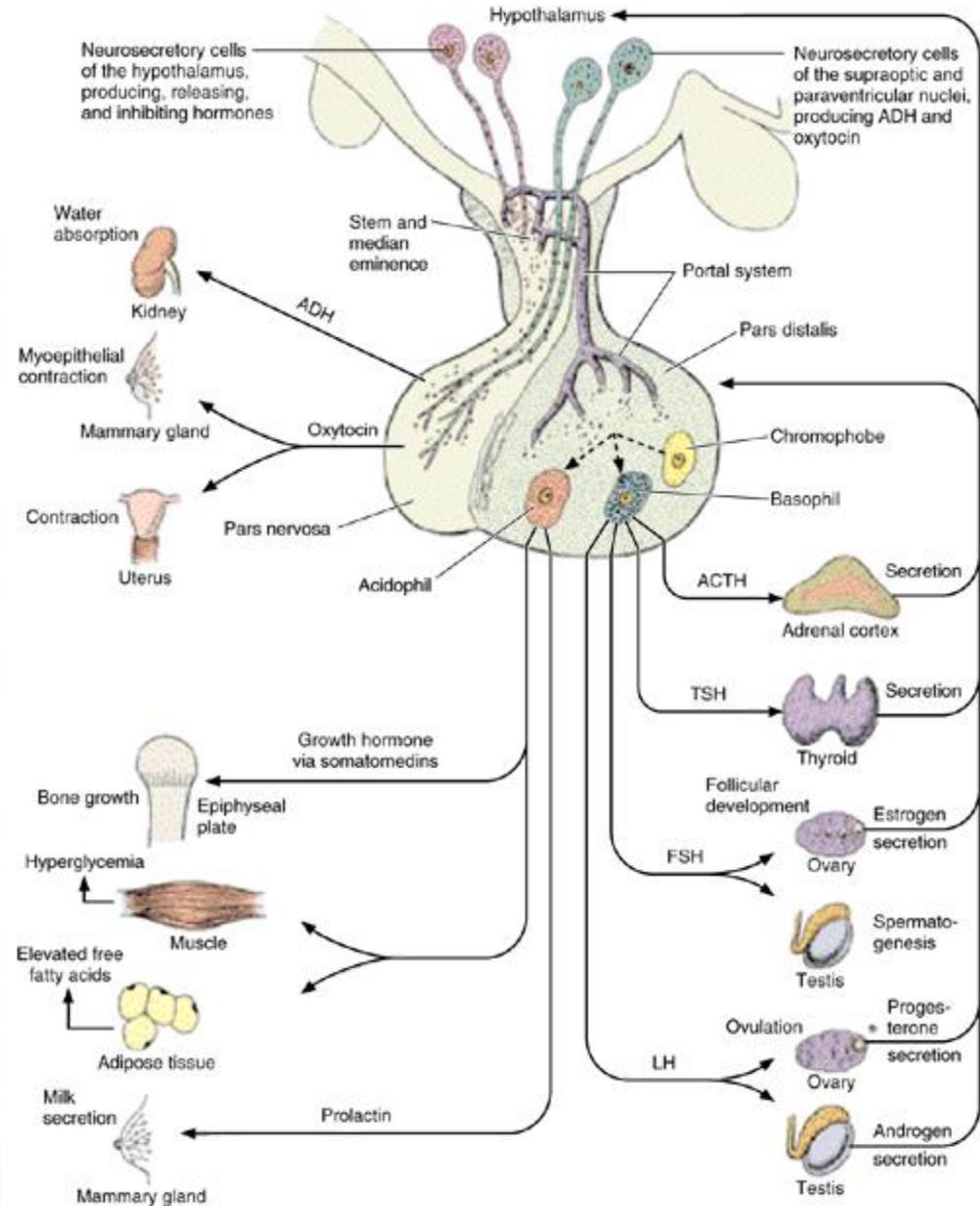
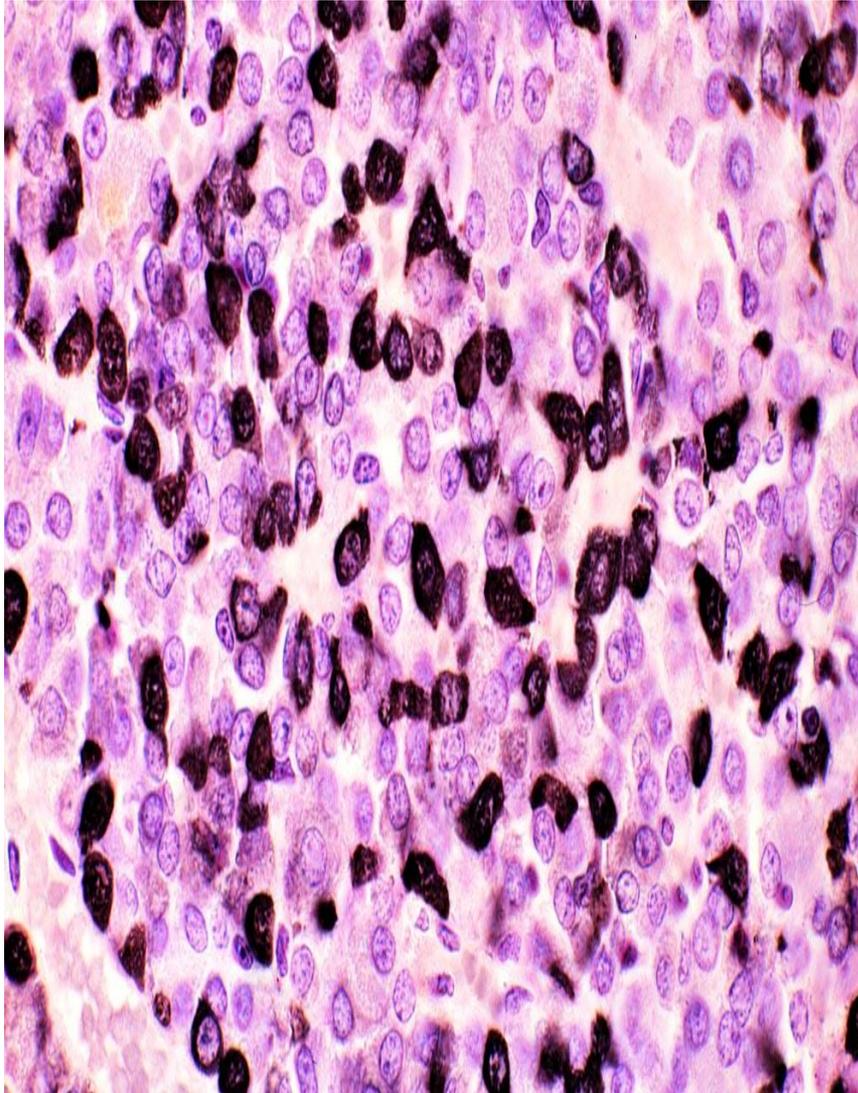
## Identification of the cells

- Routine stains
- Special stain
- Immuno-histochemistry
- Transmission electron microscope

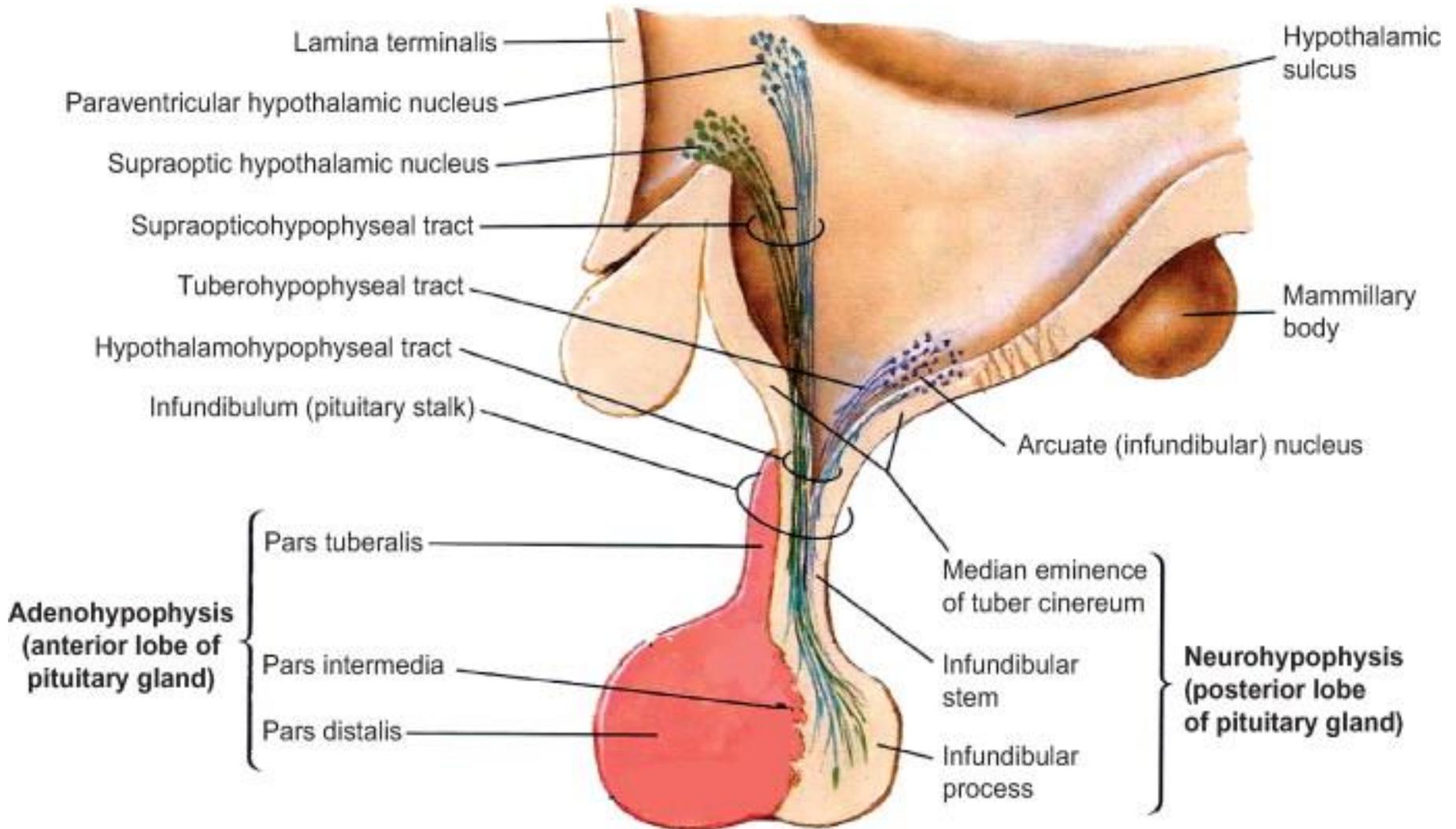
# Adenohypophysis hormones

Cells	%	Function	
<b>Chromophobes</b>	<b>52%</b>	degranulated cell, under-development cell (They are now thought to represent acidophil and basophilic cells in inactive or recently <b>degranulated</b> stage)	
<b>Basophils</b>	gonadotropic cells	<b>11%</b>	<b>FSH</b> <b>LH</b>
	thyrotrophic cells		<b>TSH</b>
	corticotroph cells		<b>ACTH</b>
<b>Acidophils</b>	somatotrop cells	<b>37%</b>	<b>GH</b> or somatotropic hormone (STH)
	mammotroph cells		<b>Prolactin</b> (PR) or lactogenic hormone (LTH)
	 <b>crinophagy</b>		Large in lactation & small in males & non pregnant

# Immunohistochemical localization of growth hormone



# Neurohypophysis



# Neurohypophysis (Pars nervosa)

## Two parts

**Infundibulum**, a slender stalk of nerve tissue that suspends the pituitary gland from the base of the brain **pituitary stalk**

**The Pars Nervosa**, is connected directly with the Hypothalamus of the brain by axons

## components

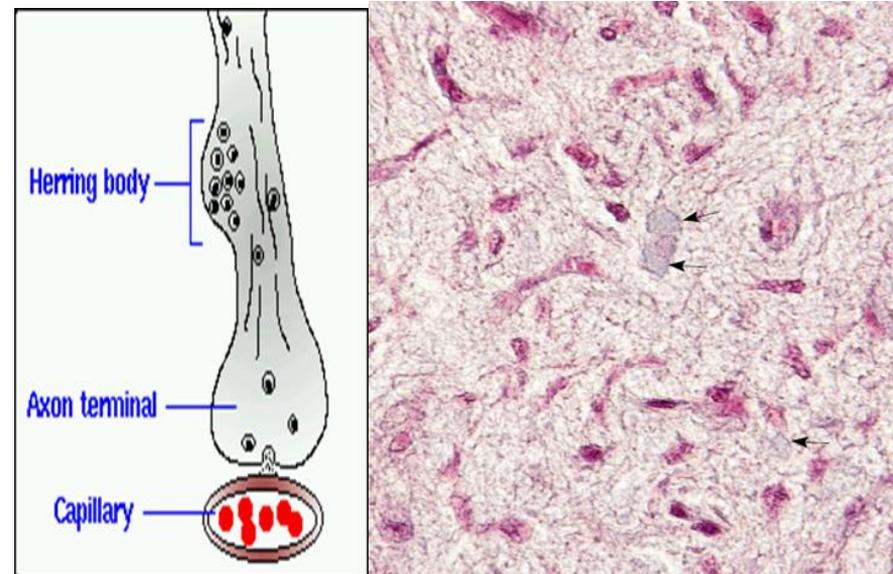
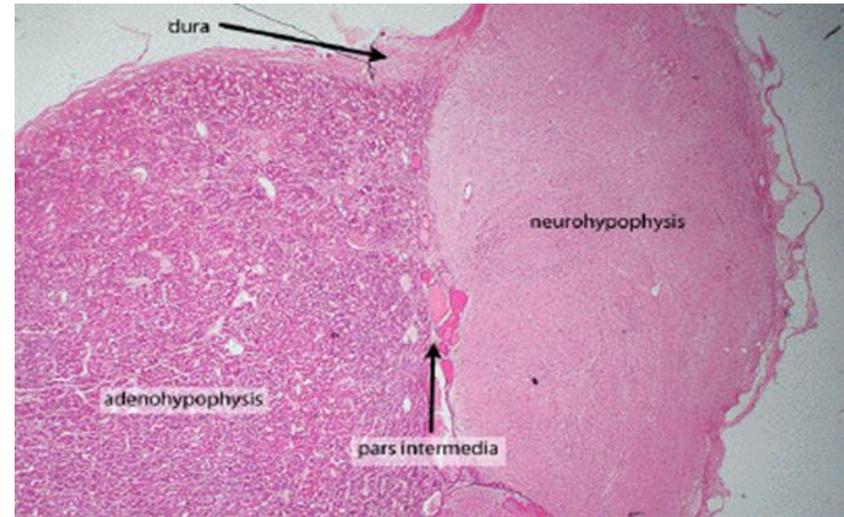
### 1- unmyelinated axons:

- of neurosecretory cells present in **supraoptic** and **paraventricular** nuclei of hypothalamus
- Transmit secretion through **hypothalamo-hypophyseal tract**.

2- **Herring bodies**: homogeneous red bodies stored in dilated terminal ends of these axons

3- **Pituicytes**: modified branched glial cells having supportive, nutritive and insulating function.

4- **Rich blood capillary plexus**



## ❑ Neurosecretory cells = supraoptic & paraventricular nuclei

forms **Herring bodies** i.e. a dilatation of the axon near the terminals/ contain either

❖ **Oxytocin** stimulate contraction of

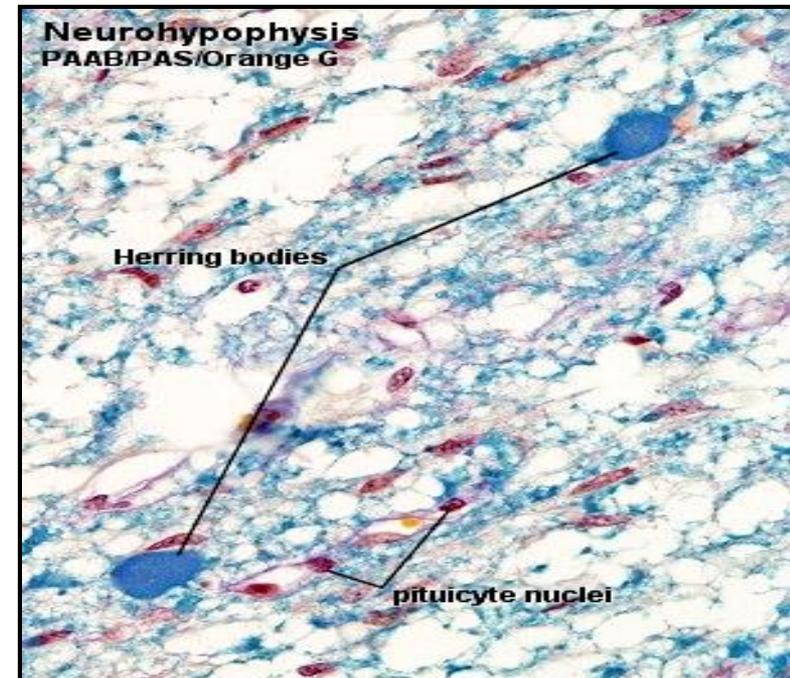
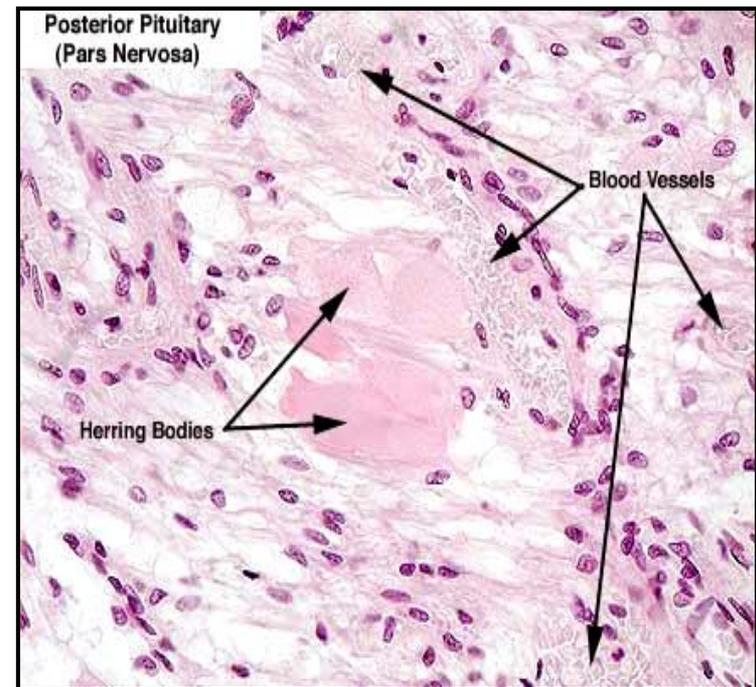
1. Smooth muscle of uterus
2. Myoepithelial cells of mammary glands

❖ **Antidiuretic hormone** (ADH) (vasopressin) increasing reabsorption of water in renal tubule and causing the constriction of arterioles to increase blood pressure

❖ Contraction of smooth muscle of BVs → ↑ BP

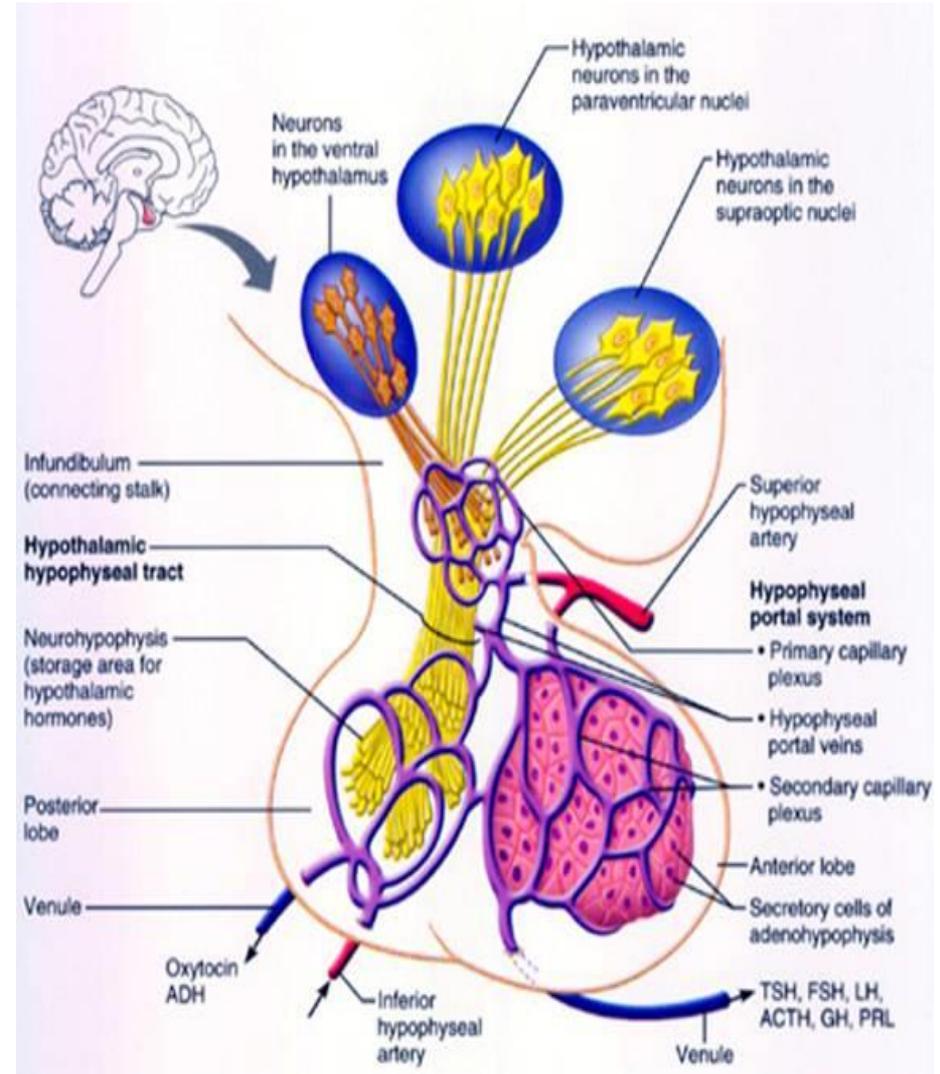
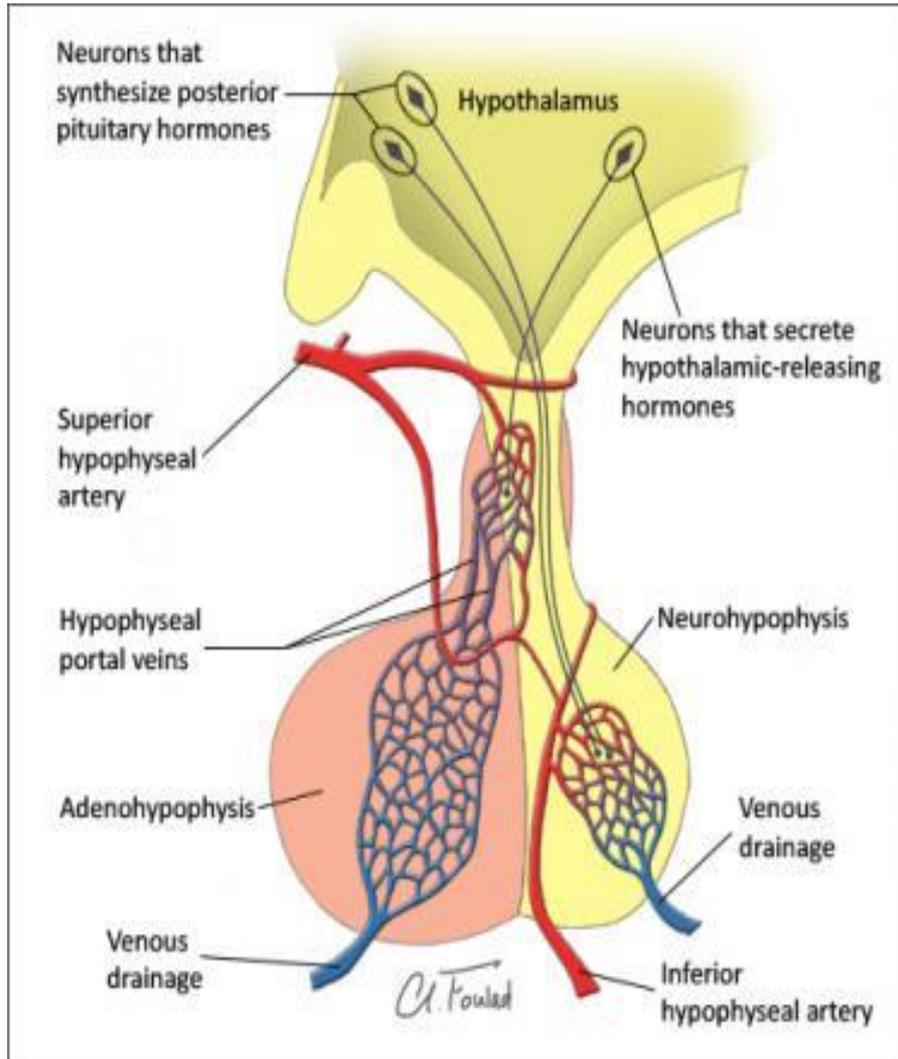
1. ↑ reabsorption of water from collecting tubules → hypertonic hypovolaemic urine  
(↓ ADH → **diabetes insipidus**)

❑ **Pituicyt** is a **glial cell** of the posterior pituitary. They are similar to the **astrocytes** / glial cells of the CNS. irregular with **processes** / cytoplasm contain pigment granules / function: provides **metabolic support** of nerve fibres

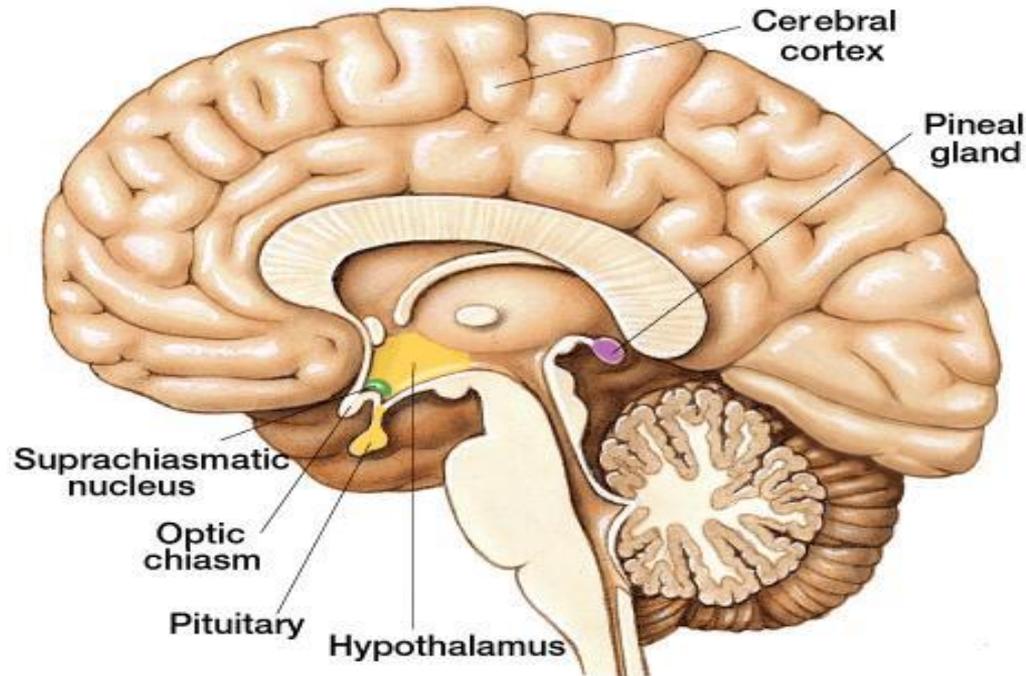


# Blood supply of pituitary gland

Releasing and inhibiting hormones  
Pass to hypophyseal portal system to pars distalis



# Pineal body (Epiphysis cerebri)



- ❑ It is embedded in between the cerebellum and cerebrum.
- ❑ The shape is flattened stalk like structure hence it is called epiphysis.
- ❑ The name is derived from its **pinecone** like structure.
- ❑ known as ‘third eye’ as this gland receives its stimuli through vision

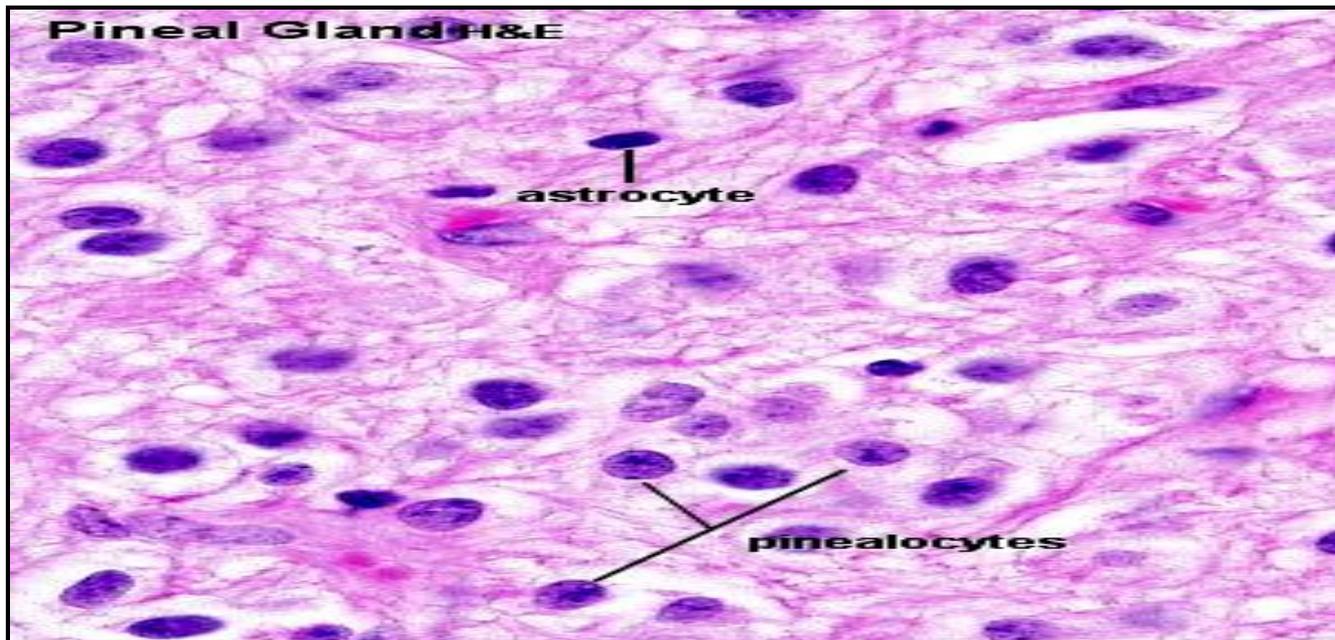
# Pineal gland

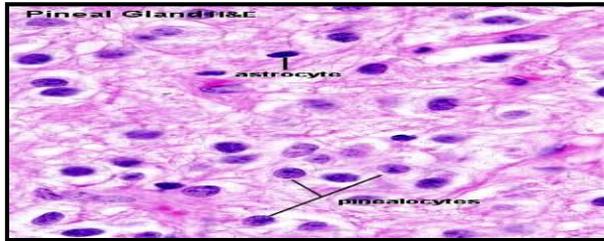
❑ **Stroma:** pia mater → septa ( BVs & unmyelinated nerve fibers

❑ **Parenchyma:** Two types of cells are present:

1. **glial cells (astrocytes 5%)** with **small dark nuclei**

2. **pinealocytes (95%),** are **large** and **lightly** stained have larger, lighter and round nuclei secrete **melatonin**





	<b>Pinealocytes</b>	<b>Astrocytes (neuroglia)</b>
<b>Nuclei</b>	large irregular	elongated and denser
<b>Cytoplasm</b>	pale basophilic	
<b>Function</b>	Melatonin secretion	Supportive & nutritive

**Function :** Pineal gland controls the sex drive, hunger, thirst and the biological clock which determines the body's normal aging process.

1. It is a neurosecretory cell the gland secretes melatonin.
  2. It controls sleepiness and wakefulness.
- **melatonin** - is involved in **daily cycles** or **circadian rhythms**. Levels are **high at night** as we grow sleepy & **low at day** light as we awake. The pineal body is directly **light sensitive**;

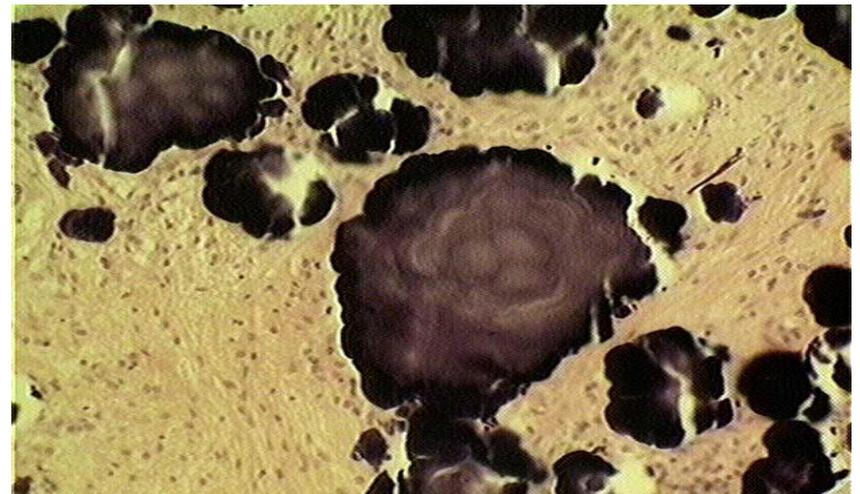
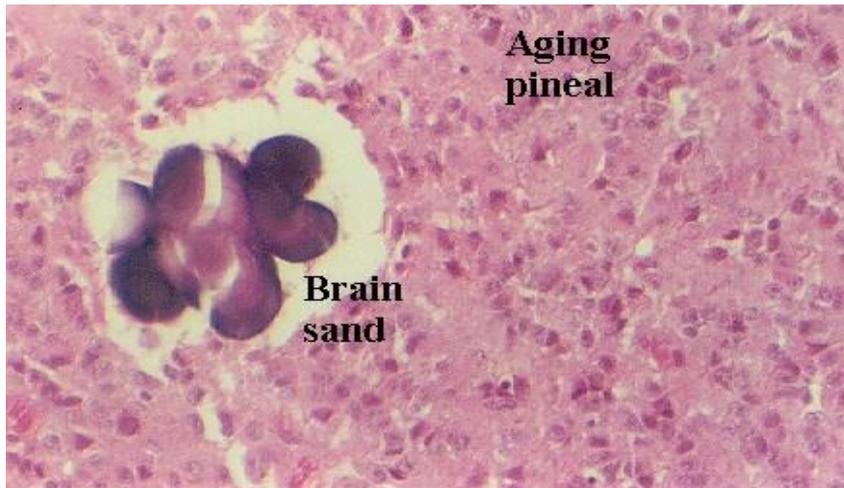
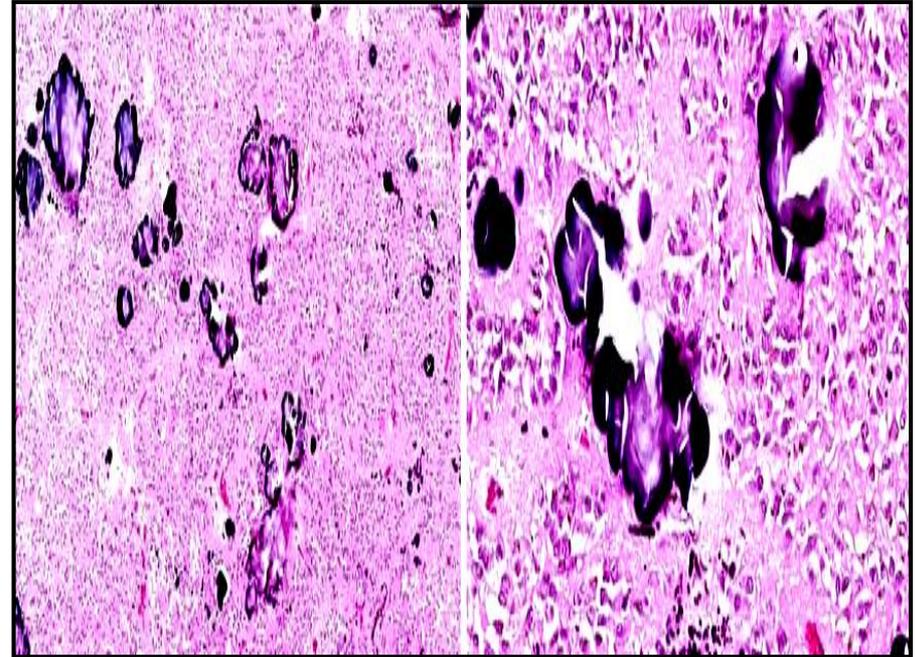
# Pineal body with aging

☐ → Fibrosis

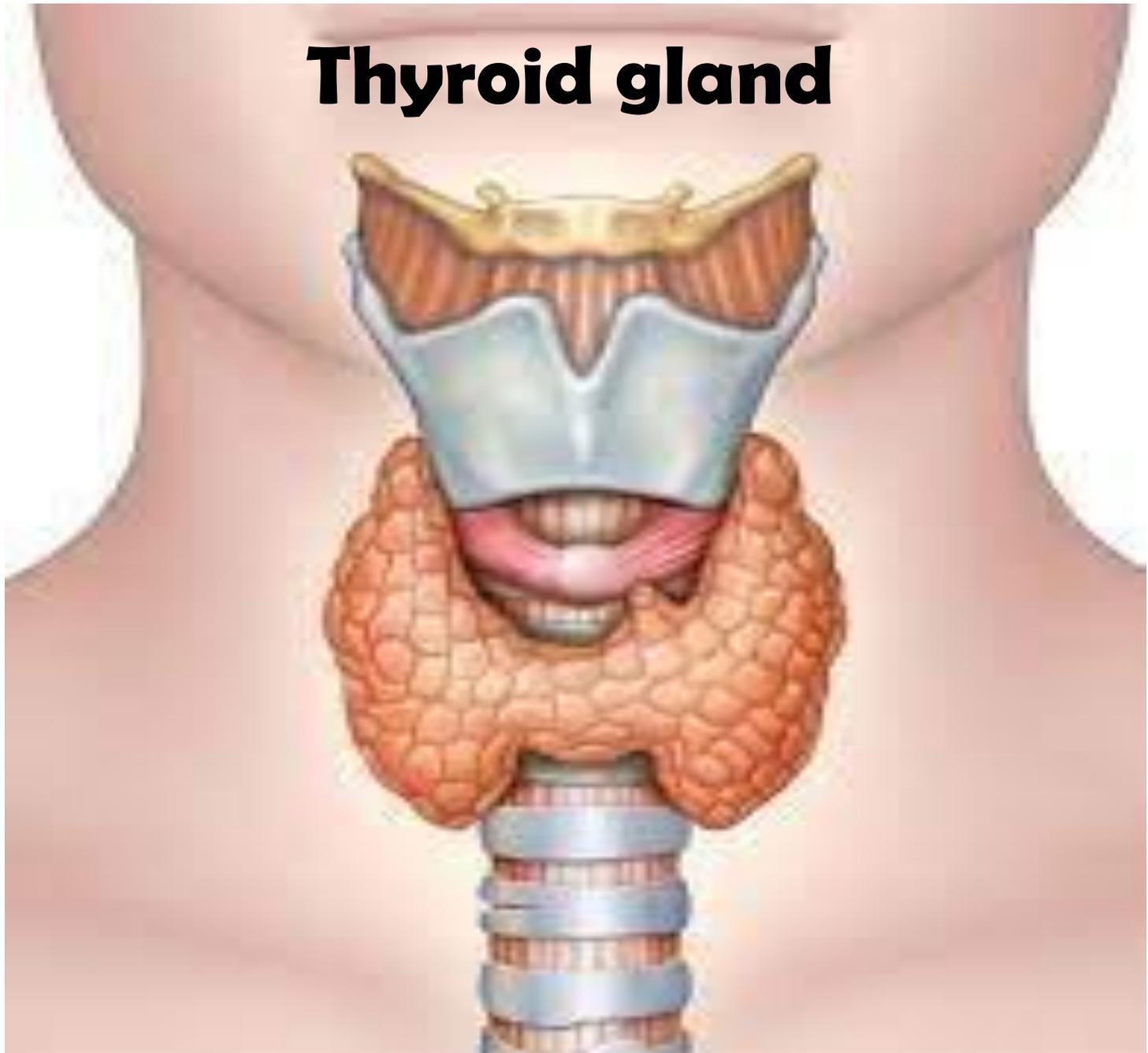
☐ Calcification = formation of calcified bodies = (brain sand)

**Brain Sand**, (areas of **calcification**) that are easily seen with the microscope.

These are **not a degenerative** change



# Thyroid gland



# Thyroid gland

## Structure

### ❑ Stroma

Thyroid gland is covered by

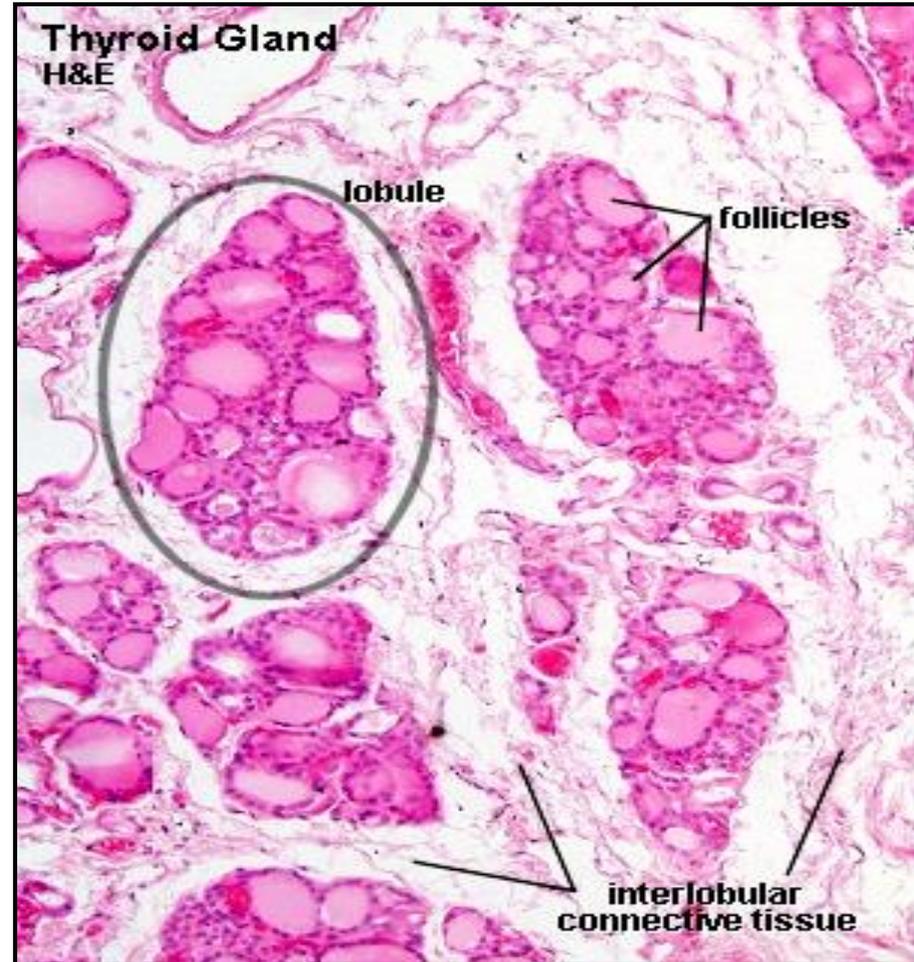
➤ double capsule

Outer: deep cervical fascia

Inner: true CT capsule

➤ incomplete septa

➤ reticular fibers



# □ Parenchyma

**lobules** surrounded by interlobular **connective tissue**

each lobule is composed of a number of :

Follicles + Blood vessels

- **Follicles** the **structural and functional** building block of the thyroid gland **spherical** in shape
- separated by scant **interfollicular connective tissue**.



**Thyroid capillary beds SEM**

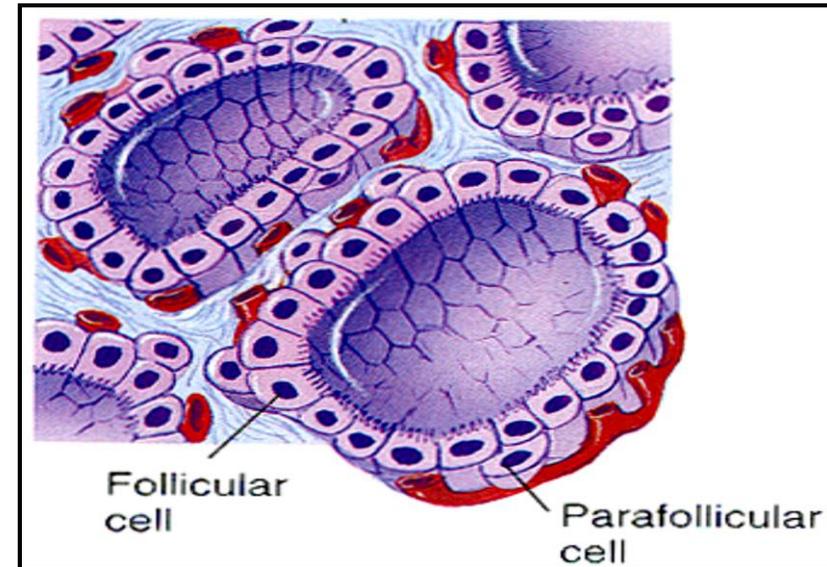
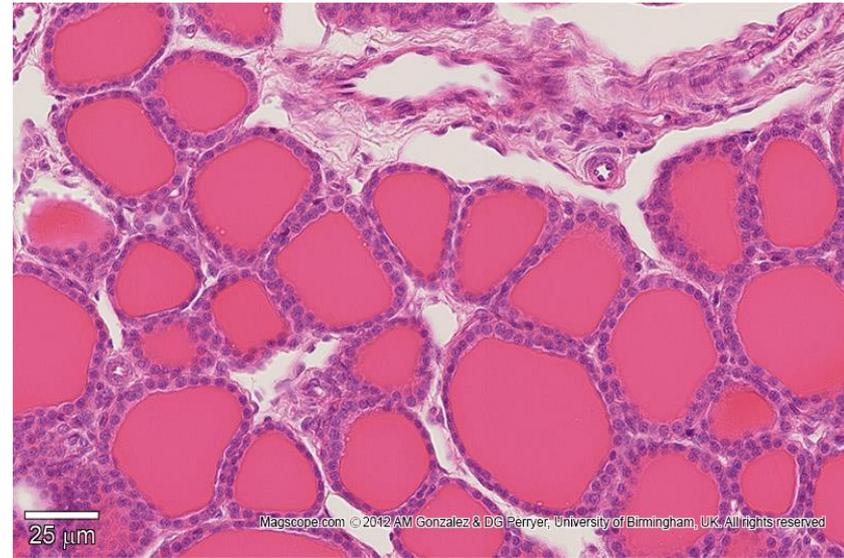
# Cells of thyroid follicles

- ❑ **Follicular cells:** a simple cuboidal epithelium
- ❑ **Parafollicular cells** (or "C cells")  
parafollicular cells are **scattered among** follicular cells and in **spaces** between the spherical follicles, they secrete **calcitonin**. – **large, pale stain** and **few** in number

★ No direct contact with the follicular **lumen**. They are **always** situated within the **basement membrane**, which surrounds the entire follicle

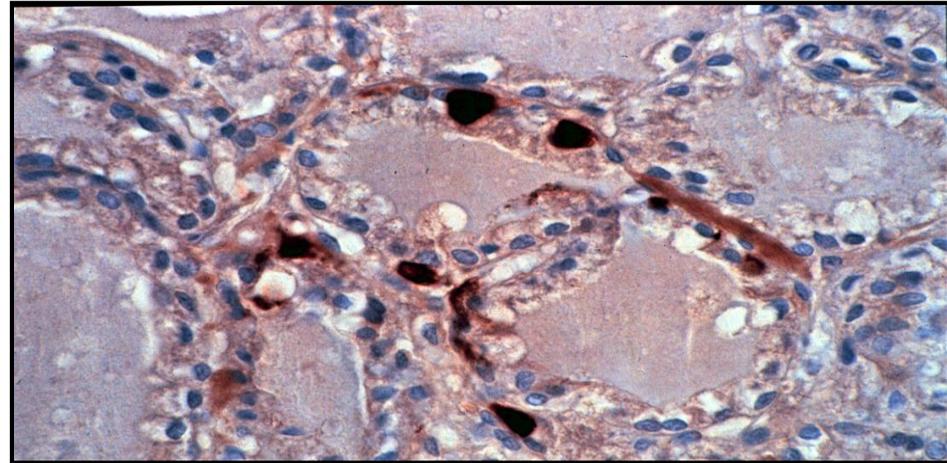
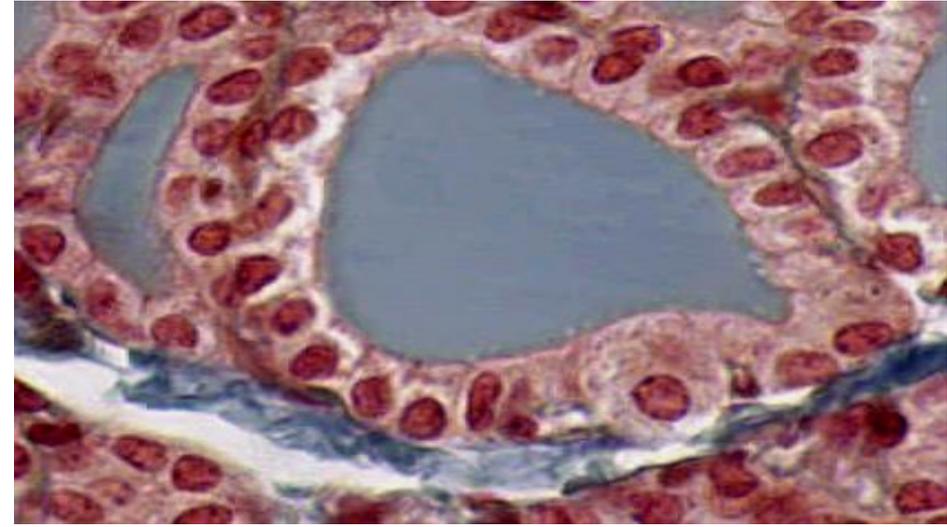
## ❑ Interfollicular cells

Superficial cut of the follicles



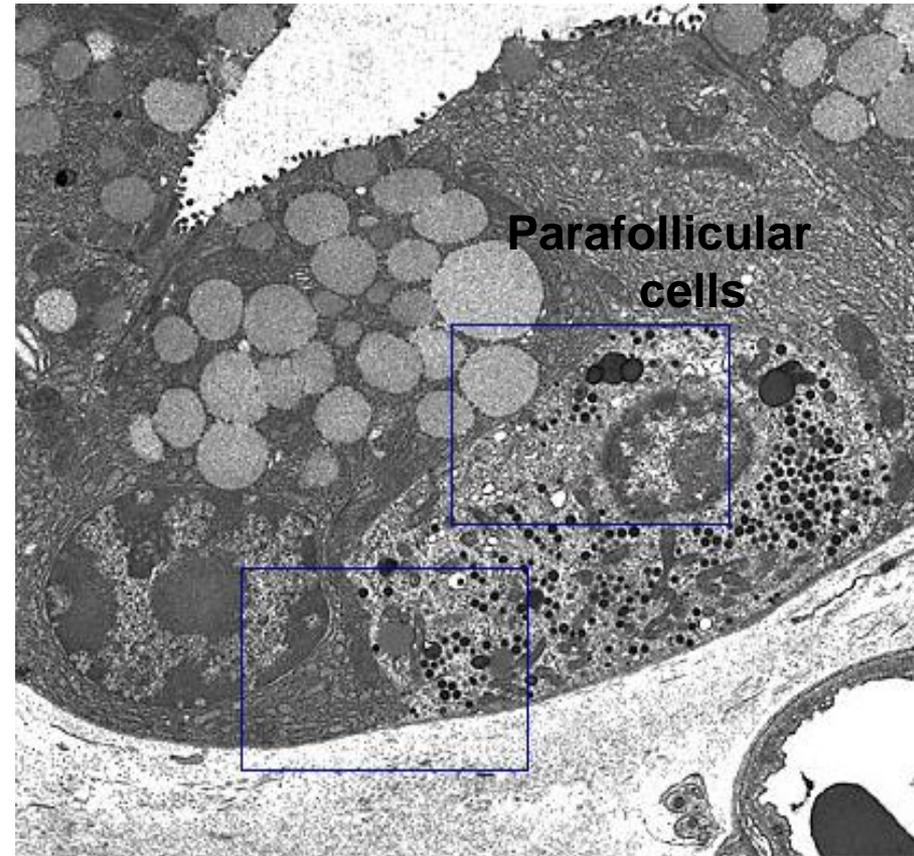
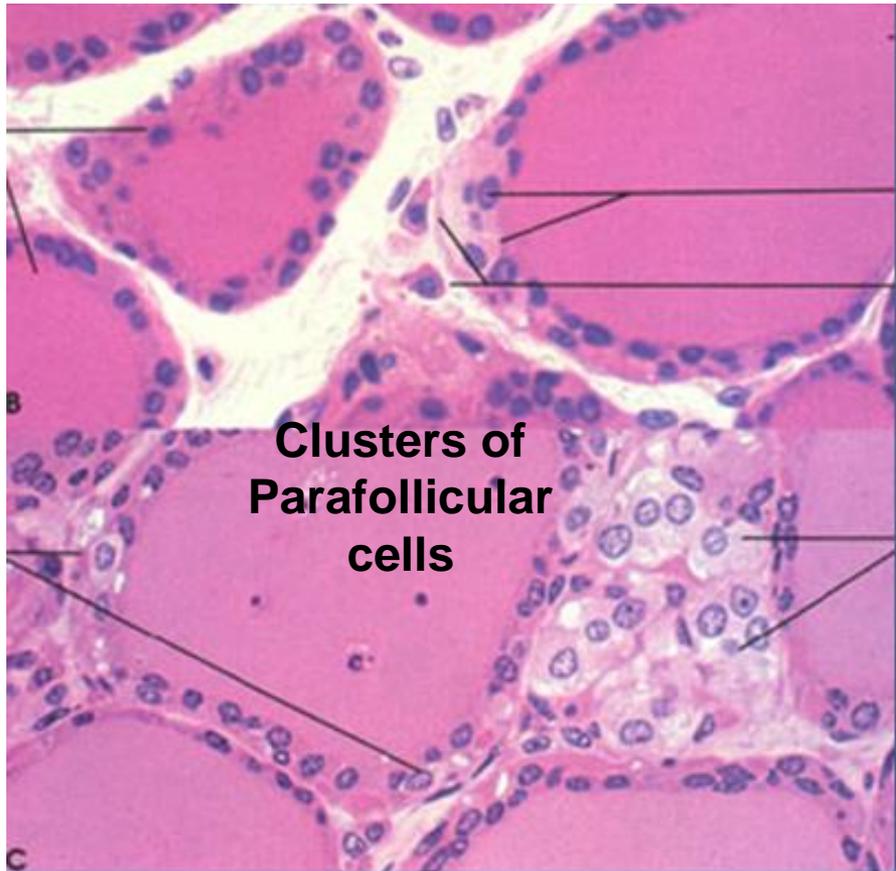
	<b>Follicular cells</b>	<b>Parafollicular cells</b>
<b>Size</b>	<b>smaller</b>	<b>larger</b>
<b>Number</b>	numerous	Few
<b>Extension</b>	<b>Reach the lumen</b>	<b>Do not</b>
<b>Stain</b>	basophilic	pale
<b>Secretion</b>	<ul style="list-style-type: none"> <li>•Stored extracellularly in the lumen</li> <li>•Secrete <b>T3 &amp;T4</b></li> </ul>	<ul style="list-style-type: none"> <li>•Stored intracellularly in small basal secretory granules</li> <li>•Secrete <b>calcitonin</b></li> </ul>
<b>Lysosomes &amp; phagosomes</b>	<b>abundant</b>	Few in number

# Parafollicular cells

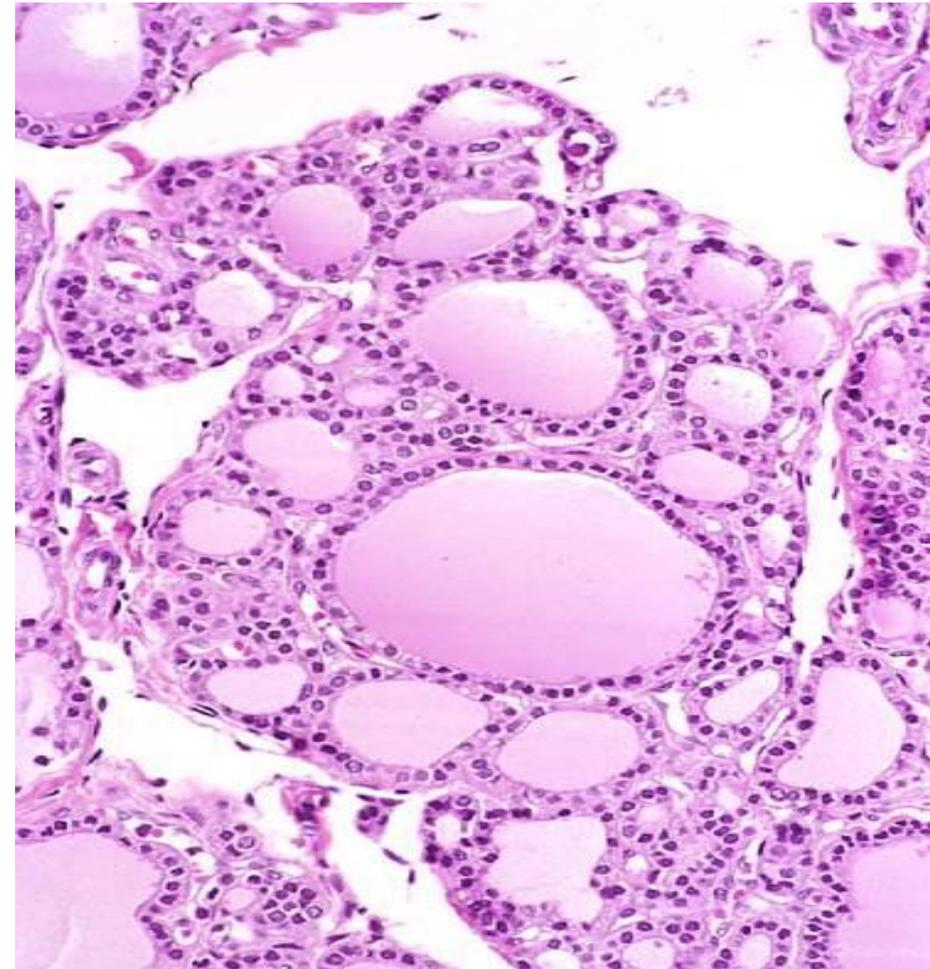
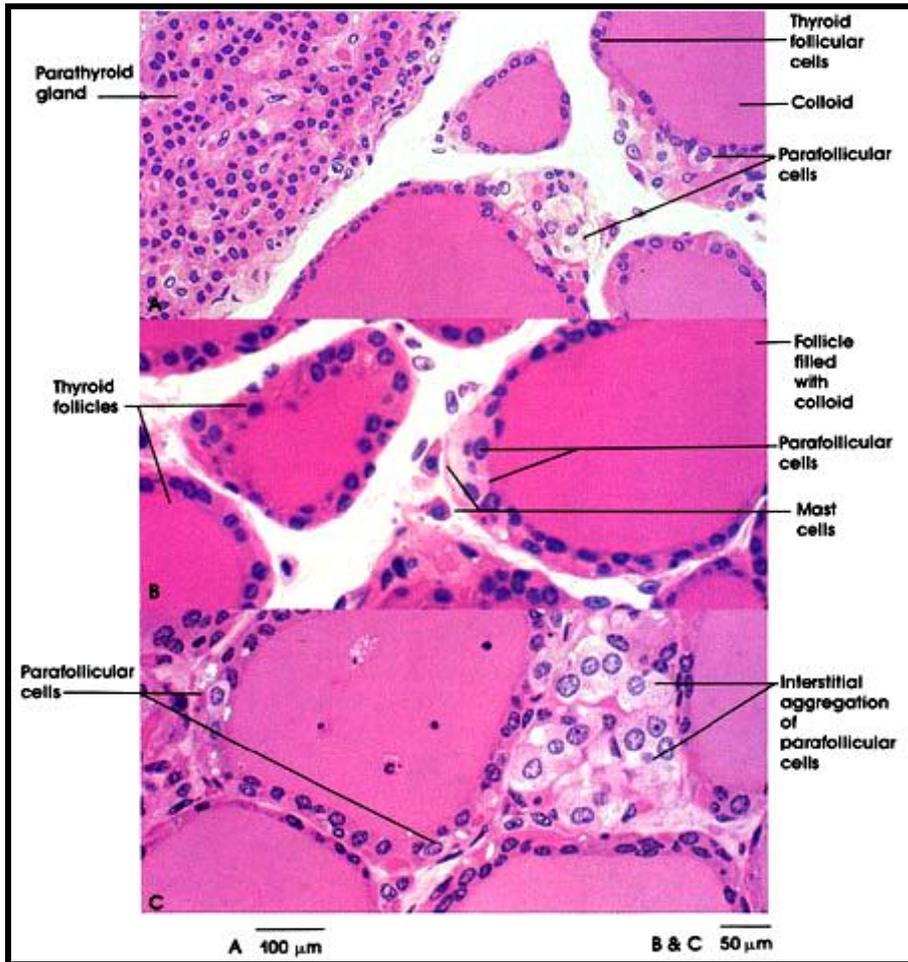


Immunocytochemical localization of calcitonin in C cells

# Parafollicular cells



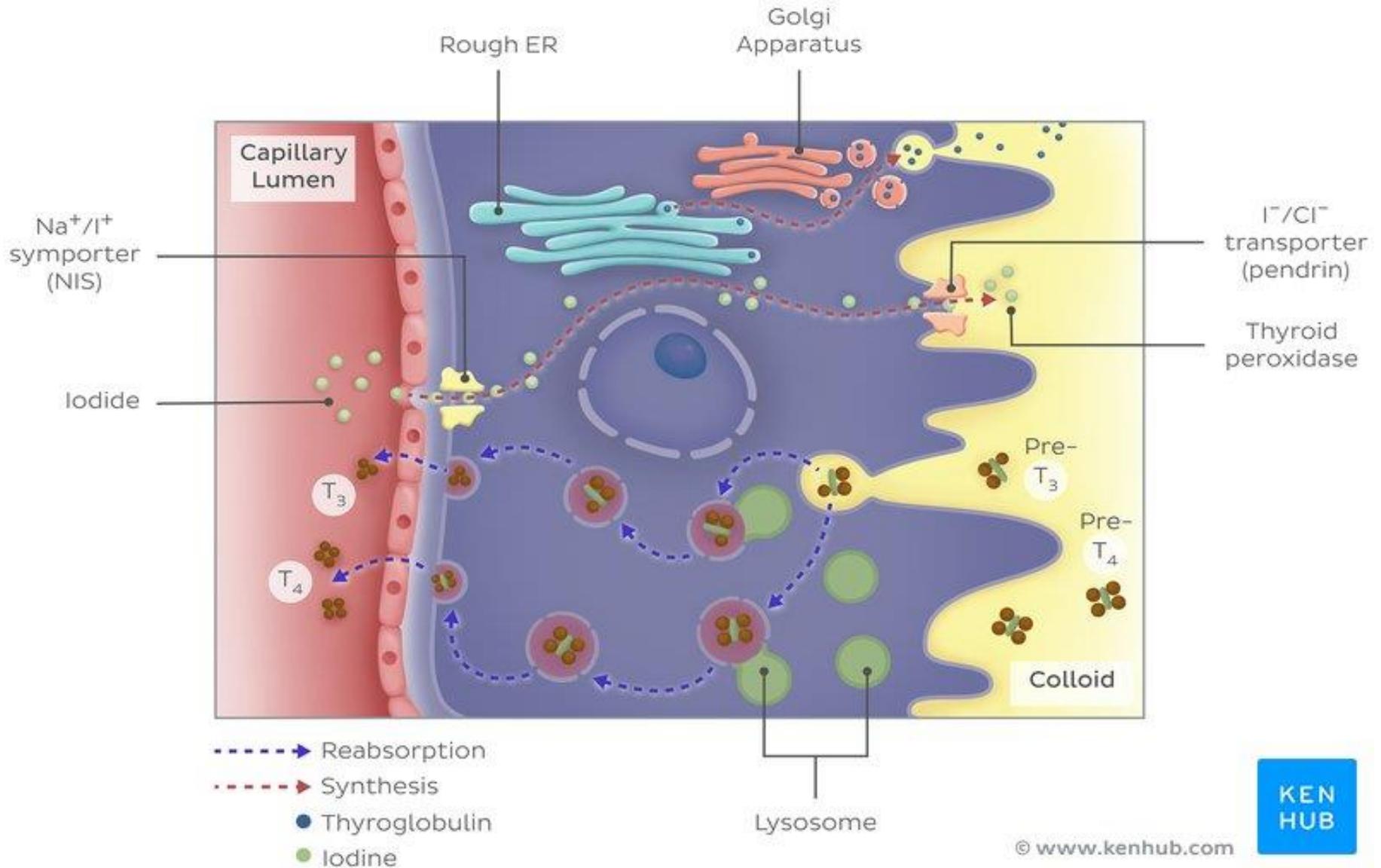
# Interfollicular cells



# Correlates EM structure of follicular cells to its function.

- **rER.** —————→ ● Synthesis of thyroglobulin.
- **Golgi apparatus** —————→ ● add carbohydrate and form the vesicles.
- **exocytotic vesicles** —————→ ● discharge Thyroglobulin into the lumen
  - Follicular cells trap the iodide and liberate it as iodine in the follicular lumen
- **Microvillous border** ● | Surface area
  - iodination takes place **extracellularly.**
- **endocytotic vesicles.** —————→ ● reabsorb thyroglobulin.
- **lysosomes.** —————→ ● hydrolyse thyroglobulin to thyroxine
  - ↓
  - thyroxine which is released into the fenestrated blood capillaries

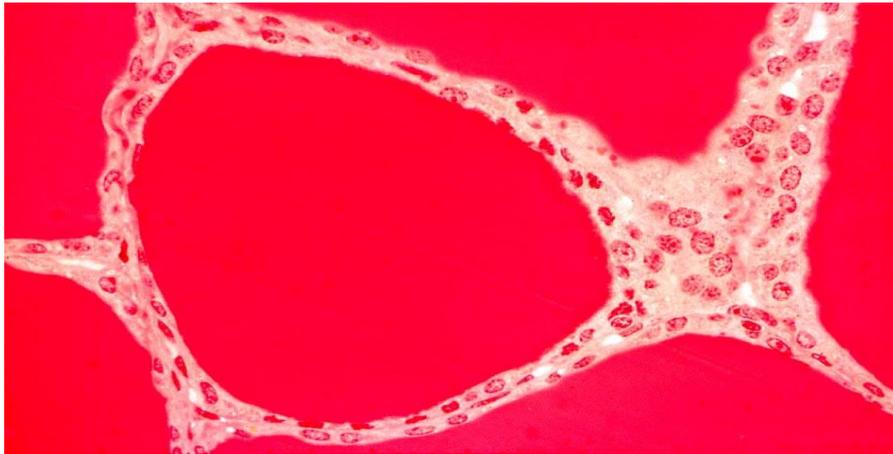
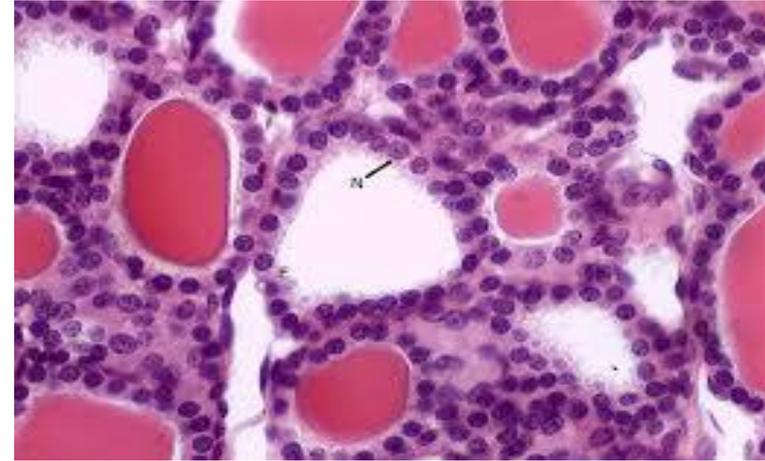
# Follicular cells synthesis of T3 & T4



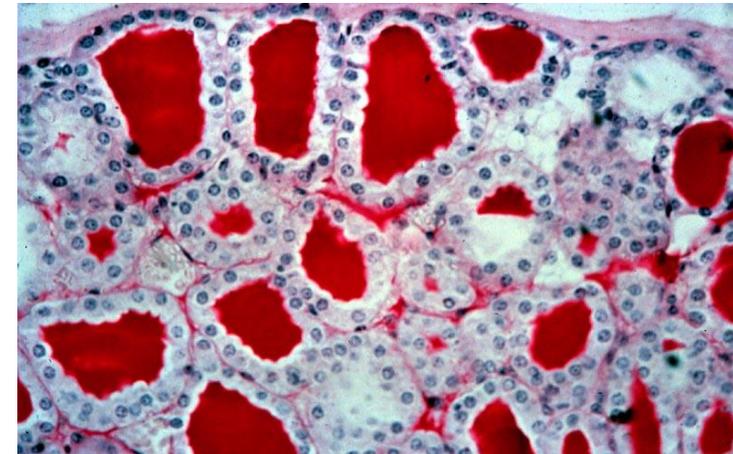
# Functional states of thyroid follicles

- (variable - depending on the functional state) not secreting T3/T4 (**inactive**), the epithelial cells range from low columnar to **cuboidal cells**. When **active**, the epithelial cells become tall **columnar cells**.

Normal



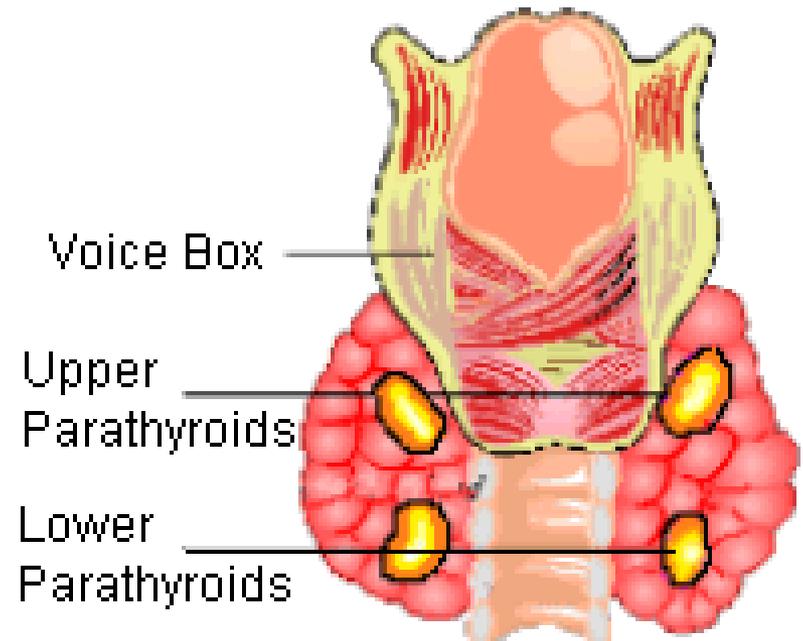
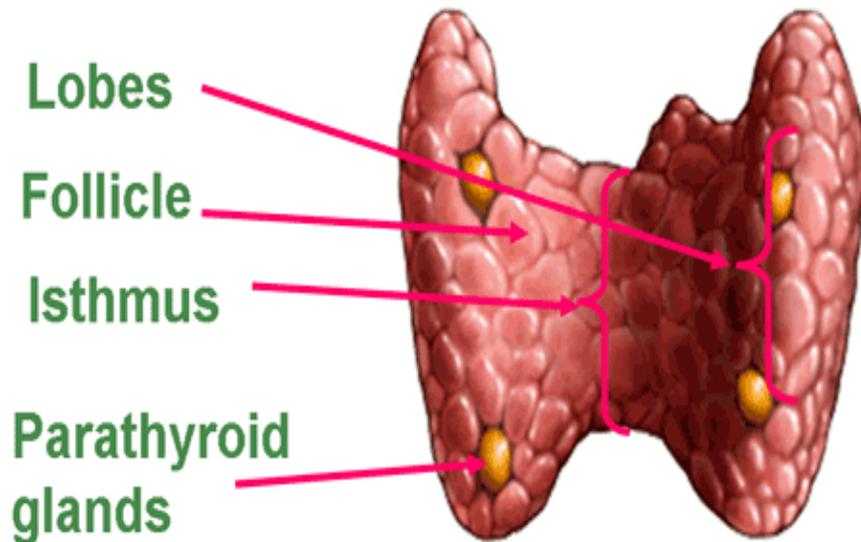
hypoactive



hyperactive

# Parathyroid gland

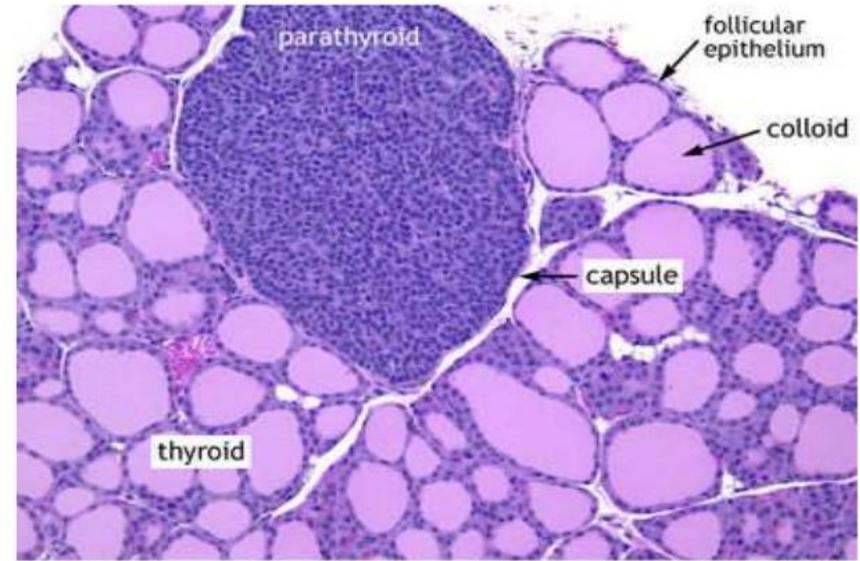
## THYROID



# Structure of parathyroid gland

## ❑ Stroma

Each parathyroid gland is surrounded by a thin **connective tissue capsule**, **delicate connective tissue septa**, a considerable number of **fat cells** infiltrate the gland

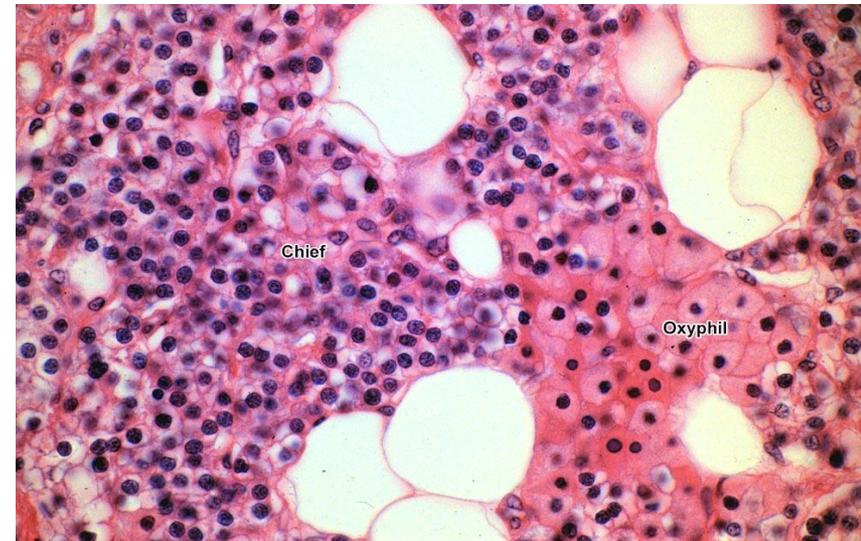


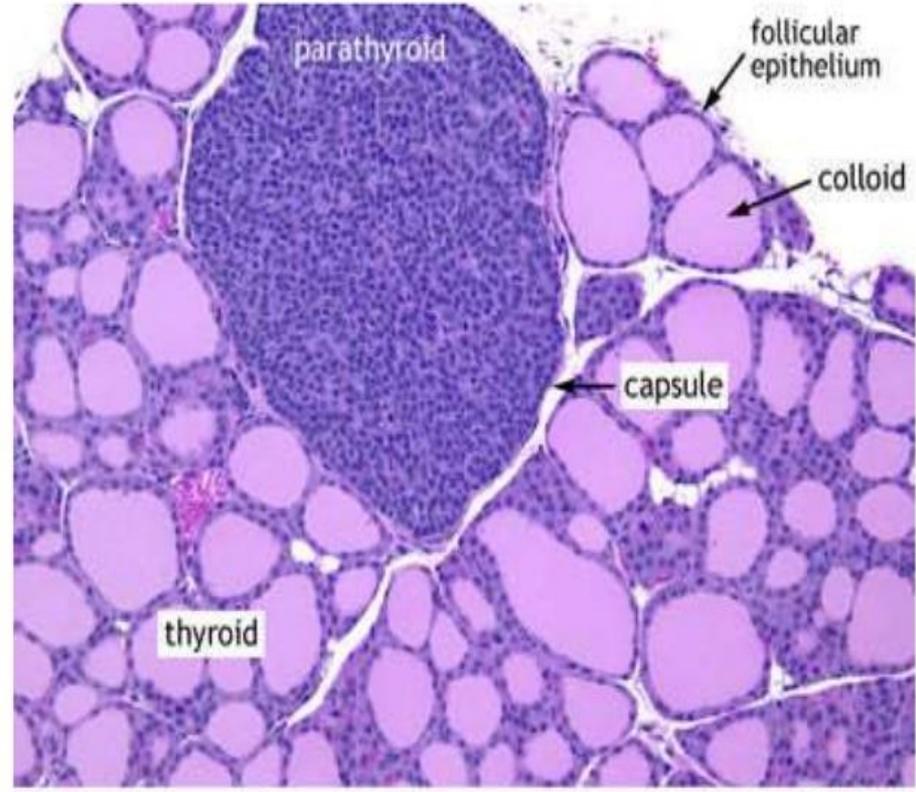
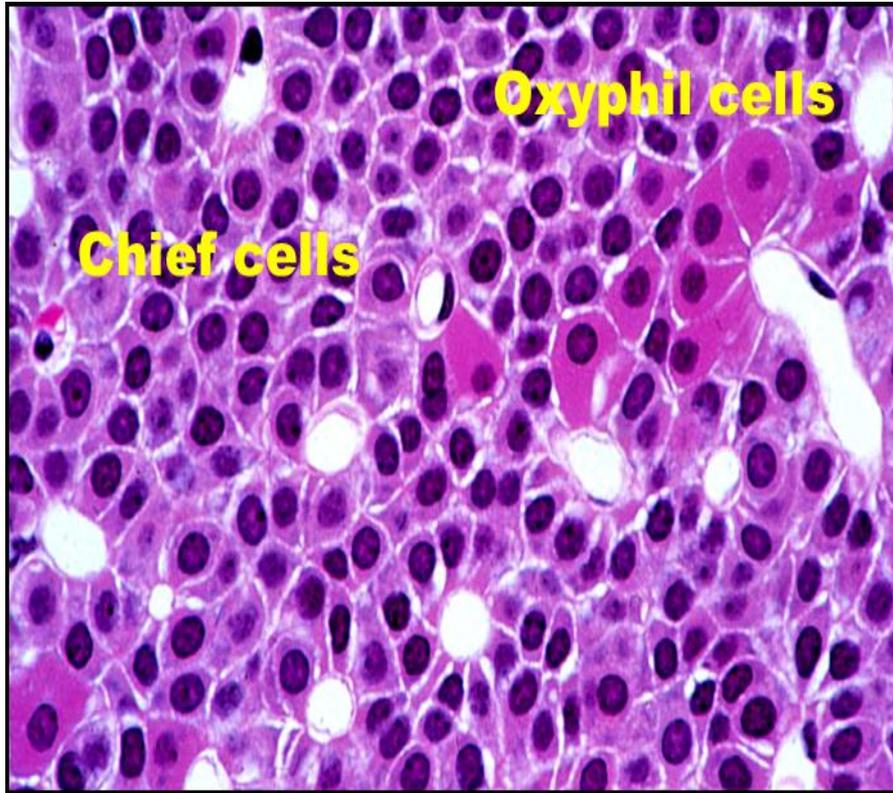
© Deltagen Inc.

## ❑ Parenchymal cells

Two types of cells arranged in anastomosing **corde**s surrounded by abundant **capillaries**

- ❖ Chief cells
- ❖ Oxyphil cells

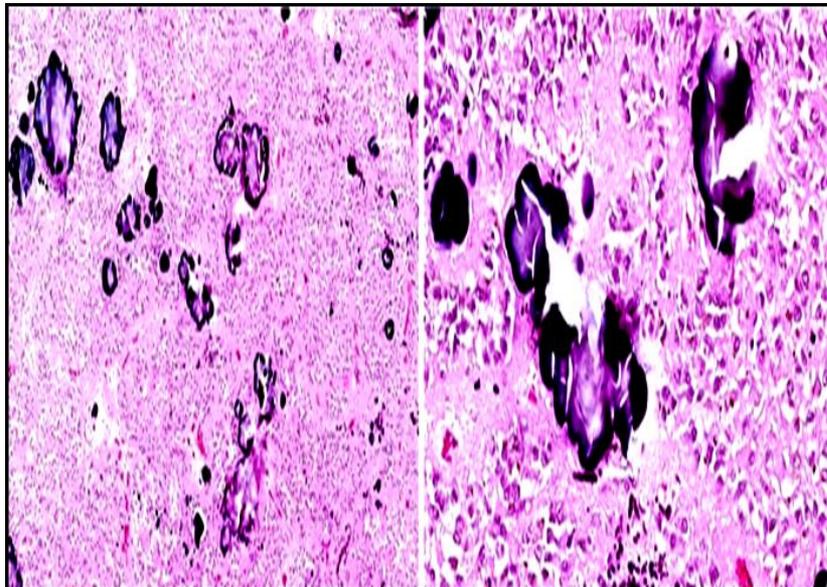
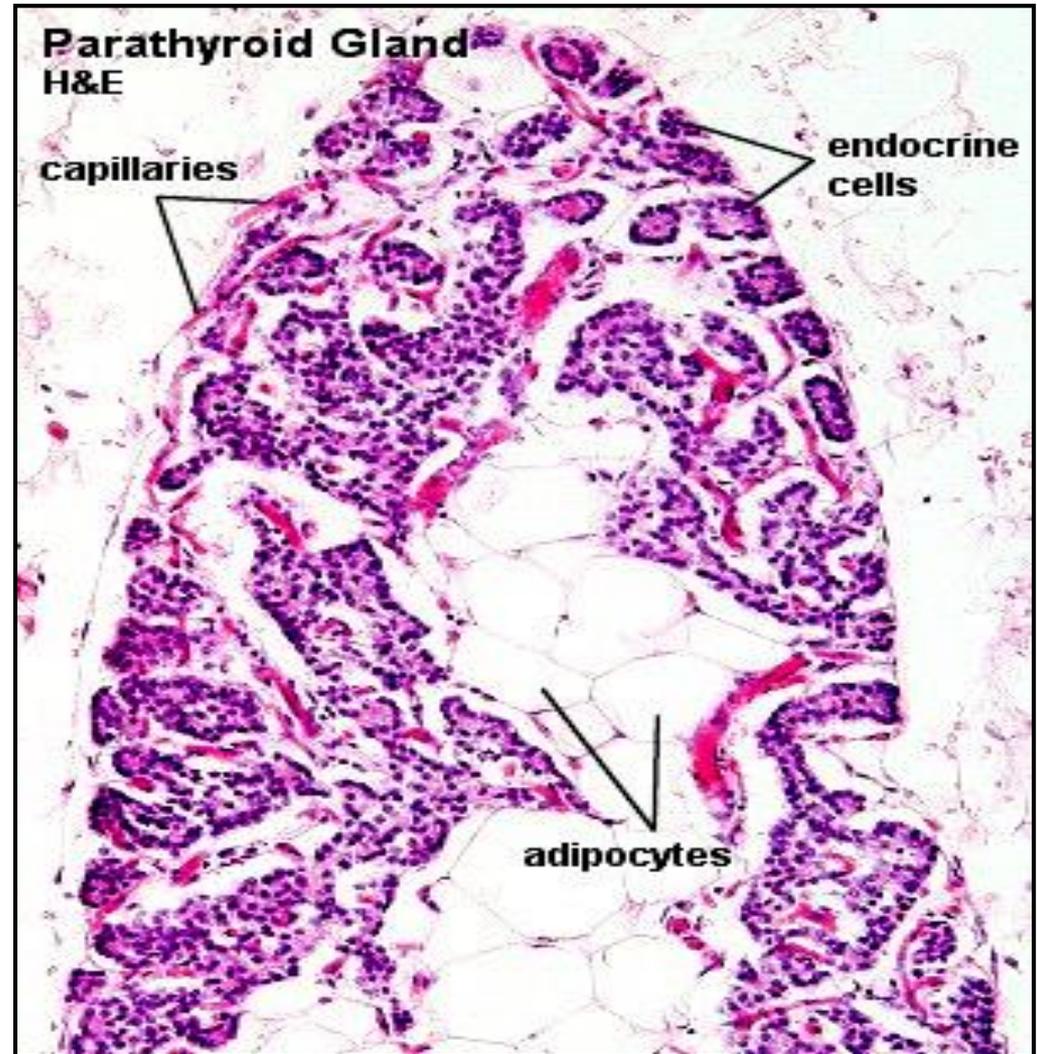




	<b>Chief cells (principal)</b>	<b>Oxyphil cells</b>
<b>size</b>	Small polygonal	Large polygonal
<b>number</b>	numerous	few
<b>Stain</b>	Faint acidophilic	Deep acidophilic
<b>nucleus</b>	Large vesicular	Small dense
<b>Function</b>	Parathyroid hormone (↑ Blood Ca level)	<b>unknown</b>

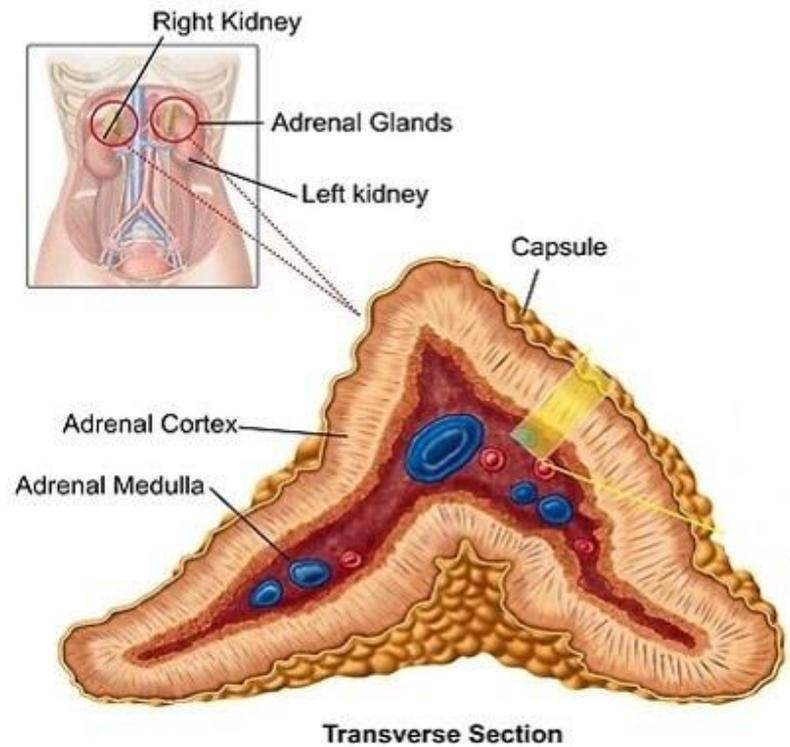
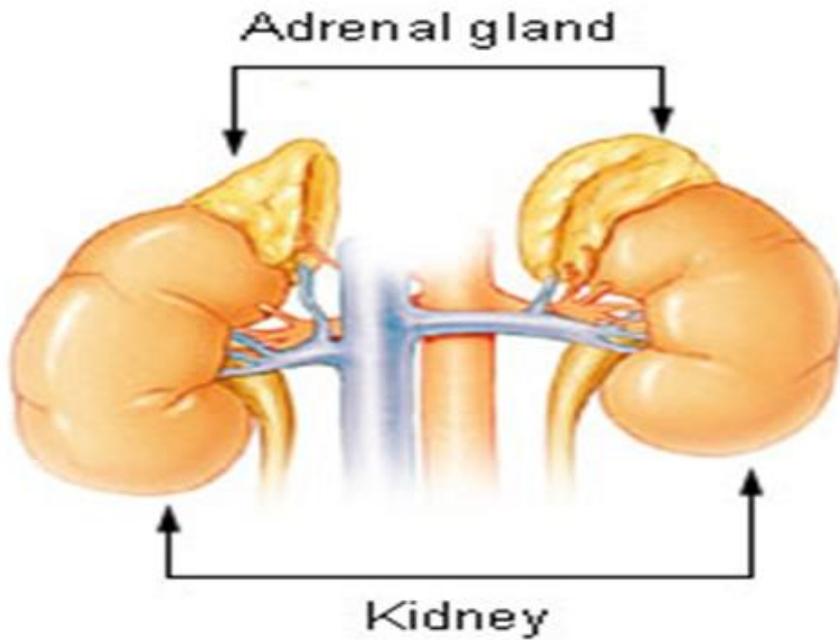
# Parathyroid gland in old people

- ❑ Increase number of fat cells
- ❑ Increase number of oxyphil cells



Pineal gland with in old age

# ADRENAL GLANDS or suprarenal gland

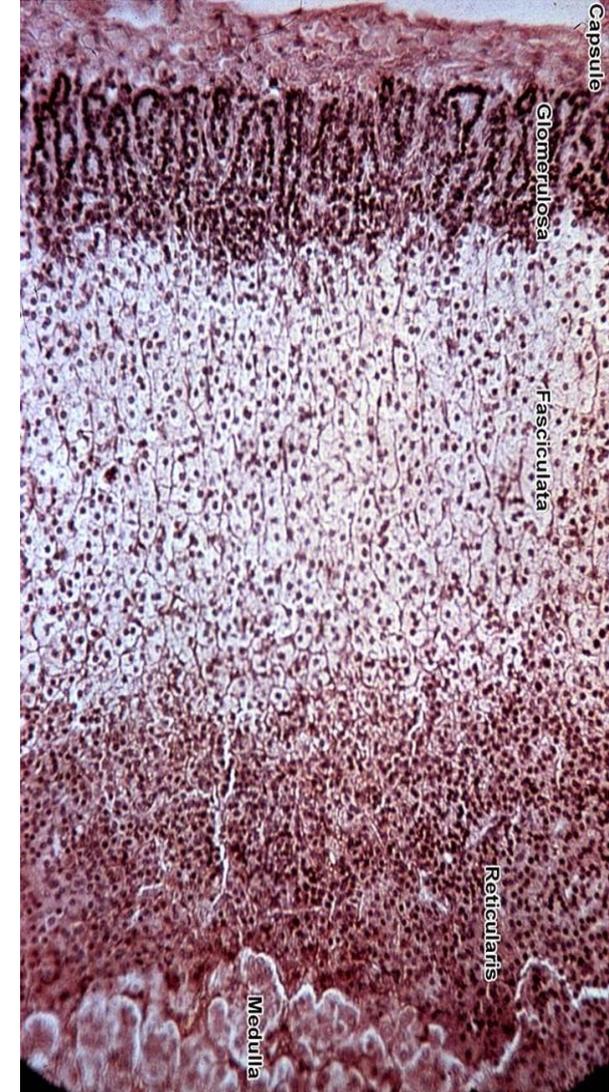
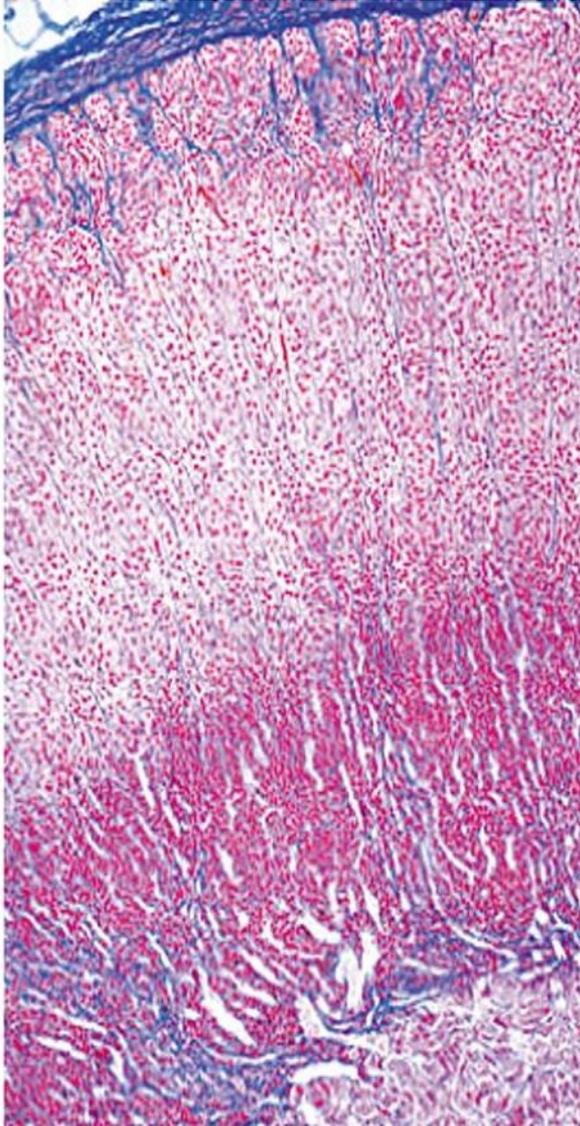


- **Stroma** : The **gland** is surrounded by a **thick connective tissue capsule**.
- Vessels and nerves reach the medulla by way of connective tissue **trabeculae** which extend from the capsule towards the medulla.
- **Parenchyma** : **consist of**
  - outer **cortex** (the main part)
  - inner **medulla** 10%



	<b>Cortex</b>	<b>Medulla</b>
<b>Colour</b>	<b>Yellow</b>	<b>Reddish-brown</b>
<b>Position</b>	<b>Peripheral</b>	<b>Central</b>
<b>Origin</b>	<b>Coelomic mesoderm (mesodermal)</b>	<b>Neural crest (ectodermal)</b>

# ADRENAL GLANDS or suprarenal gland



# Zones of the cortex

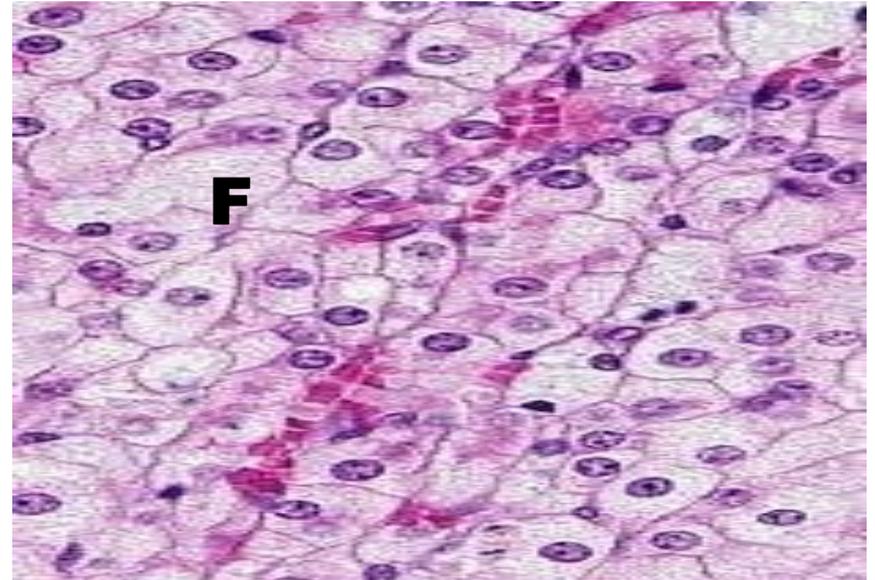
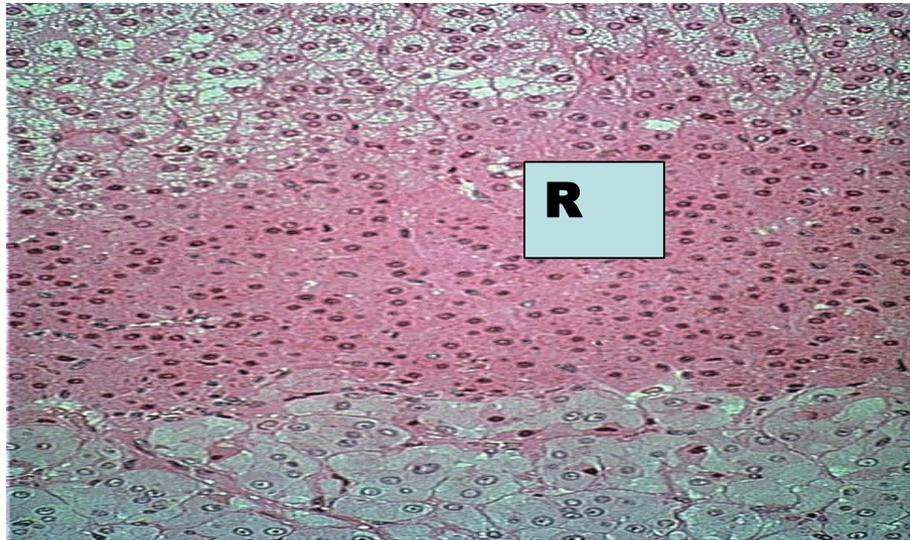
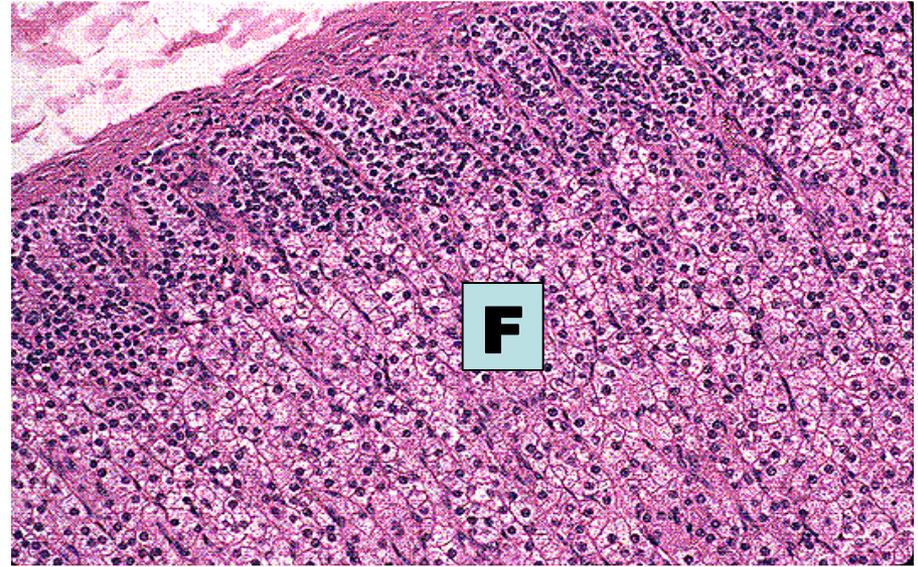
**1. zona glomerulosa (15%)** /small rounded cells groups (clusters) or curved columns. The smallest cells, their nuclei are dark and round, and the cytoplasm is light basophilic// not influenced by ACTH// mineralocorticoid

**2. zona fasciculata (65%)** consists of radially arranged cell cords separated by fenestrated sinusoid capillaries. The nucleus is light and typically located centrally. The cytoplasm is also light and often has a characteristic foamy or spongy appearance (lipid droplets) spongiocytes// glucocorticoids

**3. zona reticularis (7%).**

- **Outer cells:** like zona fasciculata but with fewer lipid droplets
- **Inner cells:** two types:
  1. **Dark cells:** pyknotic nuclei, excess lipofuscin pigment suggesting cellular degeneration.
  2. **Light cells:** pale with pale staining nuclei

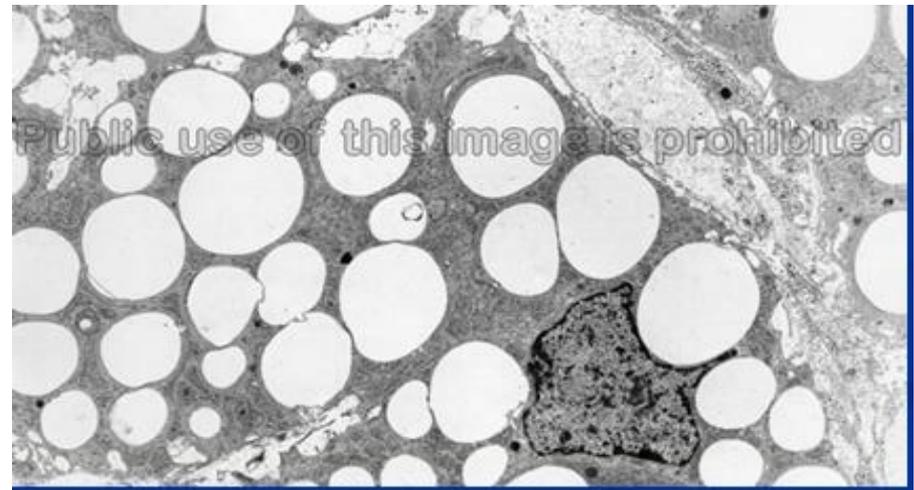
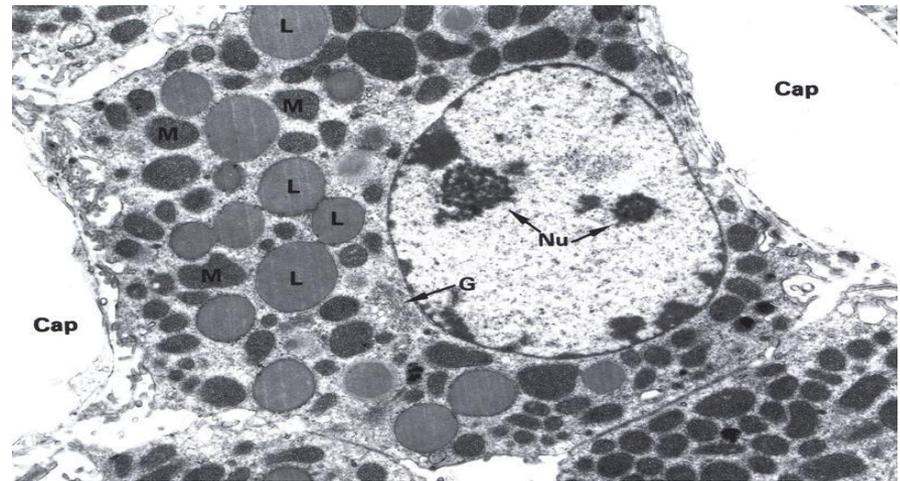
# Zones of the cortex



<b>Cortex</b>	<b>Z. Glomerulosa</b>	<b>Z. Fasciculata Spongiocytes</b>	<b>Z. Reticularis</b>
<b>% of volume</b>	15%	65%	7%
<b>Shape of cells</b>	Columnar or pyramidal cells	Polyhedral	Polyhedral
<b>Arrangement</b>	Closely packed rounded or arched clusters	Cords 1 or 2 cell thick	Anastomosing Irregular cords
<b>Cytoplasm (Acidophilic)</b>	Slightly vacuolated	Numerous vacuoles (spongiocytes)	less
<b>Lipid droplets</b>	few	numerous	less
<b>Function</b>	mineralocorticoids	glucocorticoids	<b>Sex hormones</b>

# Cells in adrenal cortex are **steroid secreting cells**

- Extensive smooth ER
- Mitochondria with tubular cristae
- Golgi apparatus
- Lipid droplets
- Spongiocytes in zona fasciculata (highly vacuolated cells due to lipid droplets)

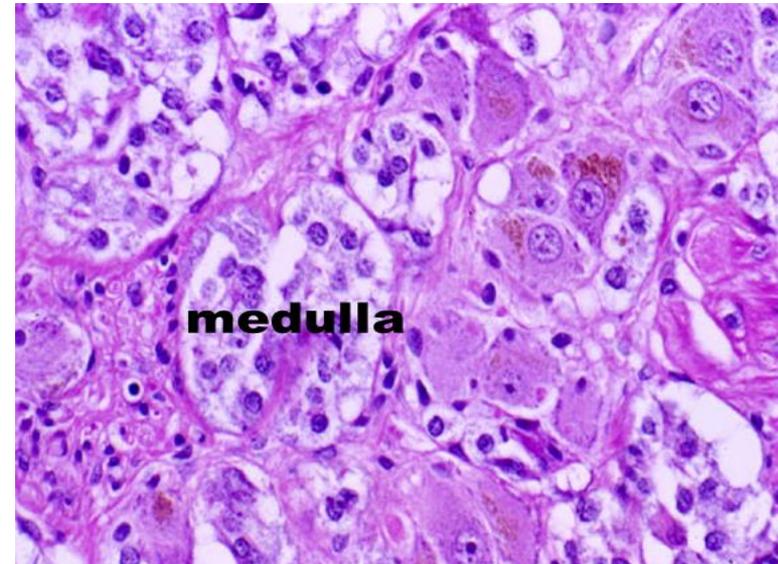
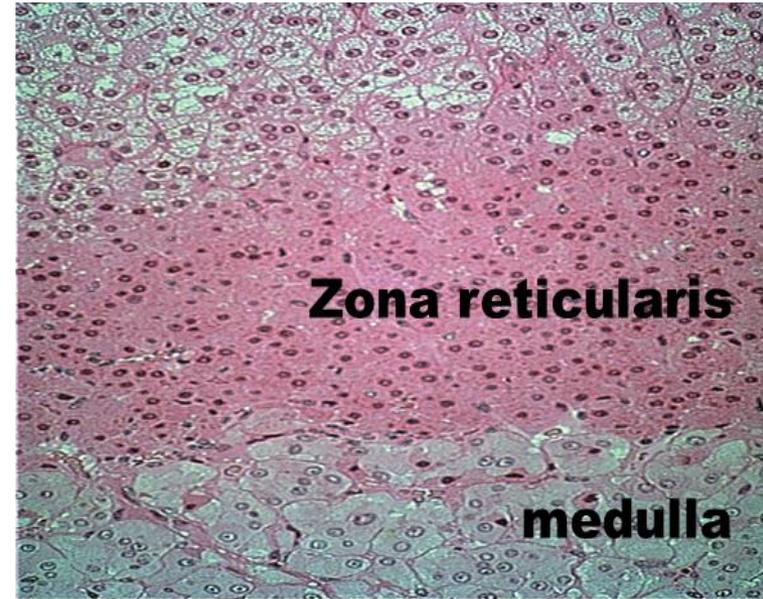


# Adrenal medulla

- not sharply **delimited** from the cortex.
- Cells are arranged in **strands or small clusters** with capillaries and venules, weakly **basophilic**.
- chromaffin cells**, granules of these cells can be stained with **potassium bichromate**.
- Catecholamines adrenaline and noradrenaline**
- Chromaffin cells are, like **ganglion cells** of the PNS, derived from **neural crest** cells.

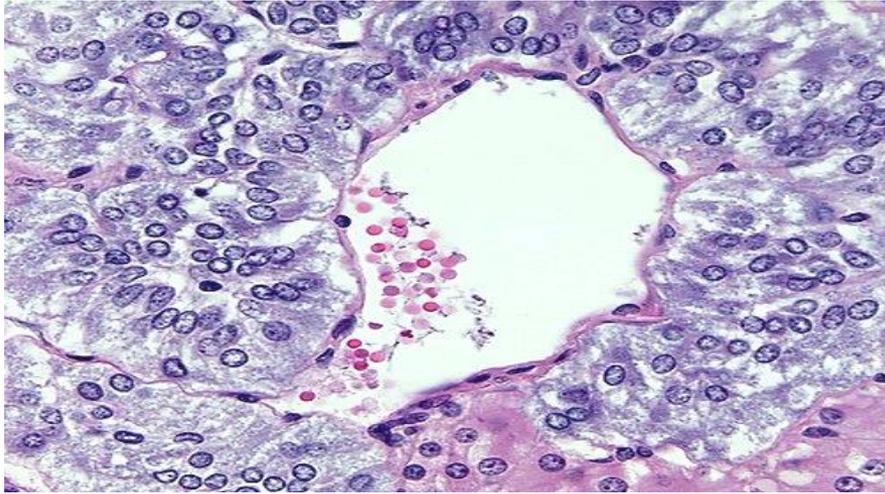
It includes **3** types of cells:

- 1- Chromaffin cells
- 2- Sympathetic ganglion cells
- 3- Lymphocyte like cells

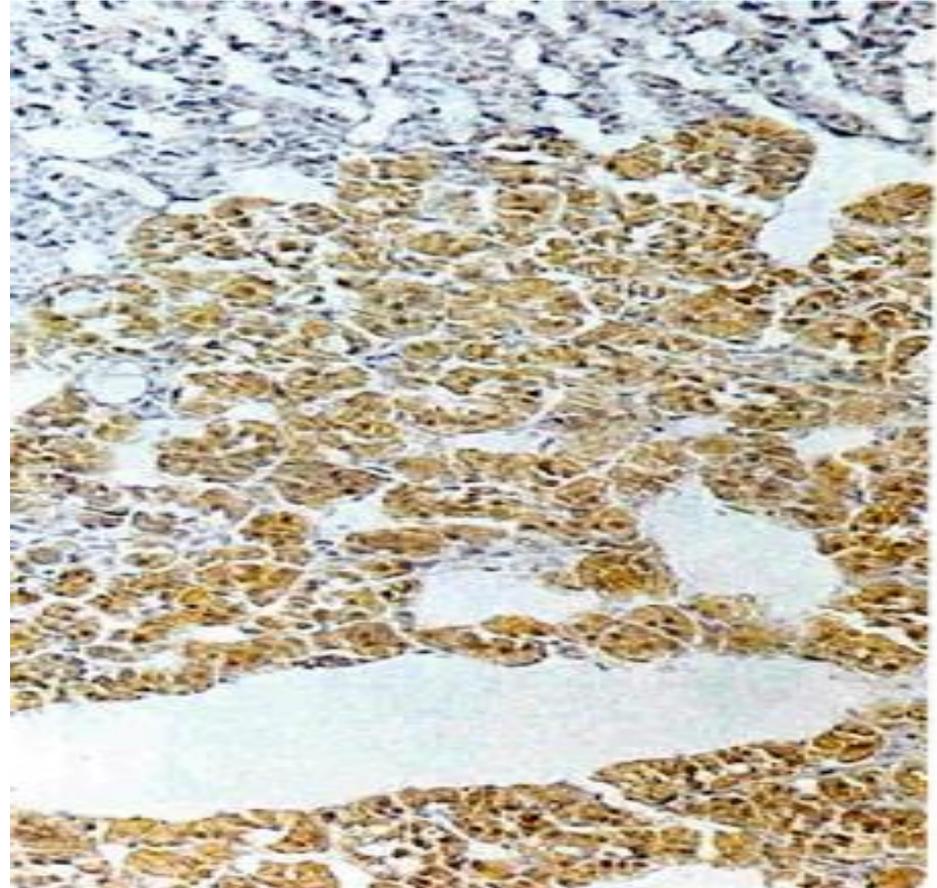


# Chromaffin cells

## epinephrine cells & nor epinephrine cells

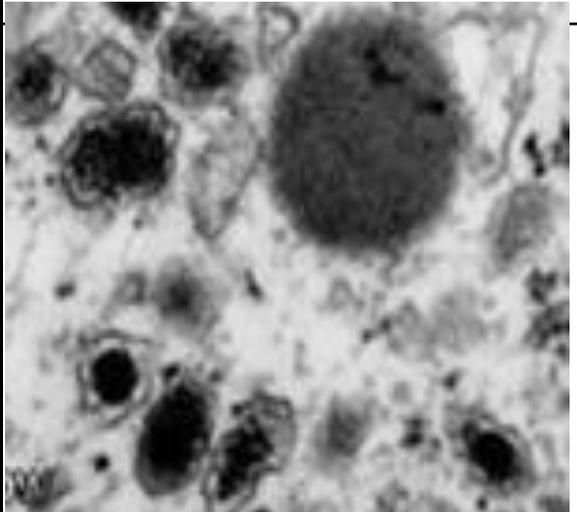


- LM:** large ovoid cells  
large spherical nuclei
- pale basophilic cytoplasm
  - arranged in rounded groups or short cords intimately related to BVs



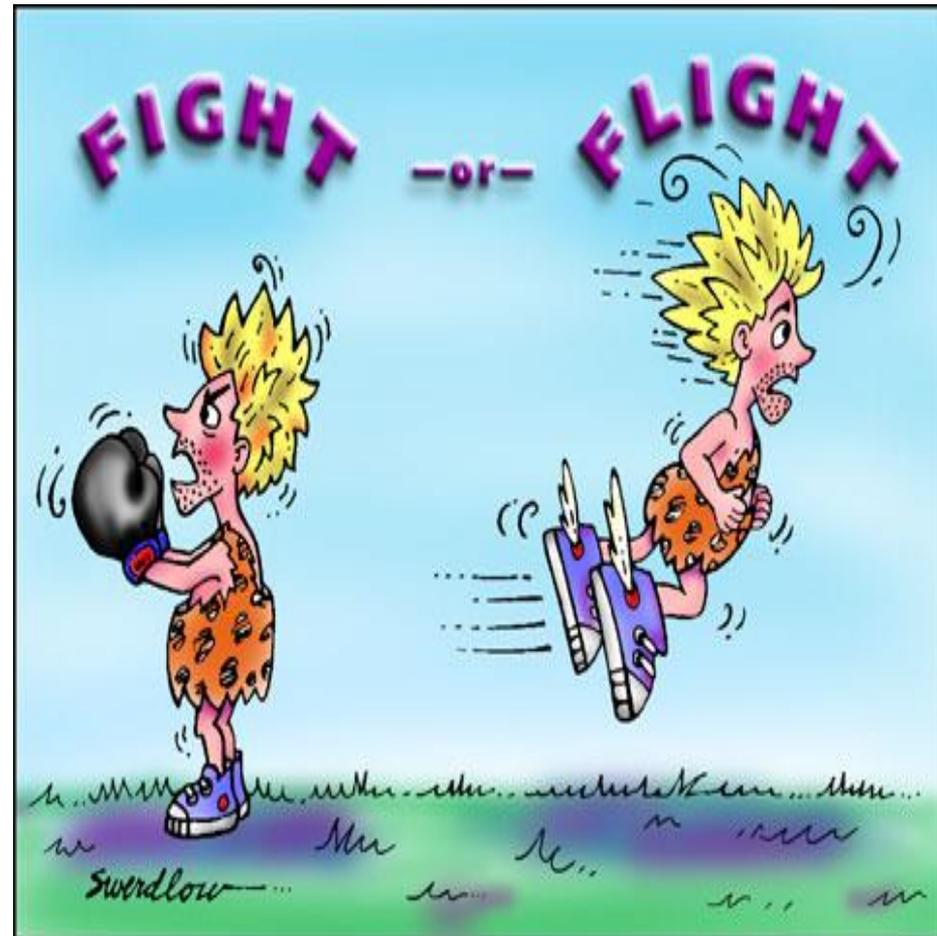
## Chromaffin reaction

# Granules of epinephrine & norepinephrine

<b>Granules in:</b>	Epinephrine-secreting cells	Norepinephrine-secreting cells
<b>Size</b>	Small	larger
<b>Contents</b>	Fill the granule	Do not
	<p><b>EM</b>            protein synthesizing cells:            rER            mitochondria            prominent Golgi            membrane-limited electron-dense granules of either epinephrine or norepinephrine</p>	

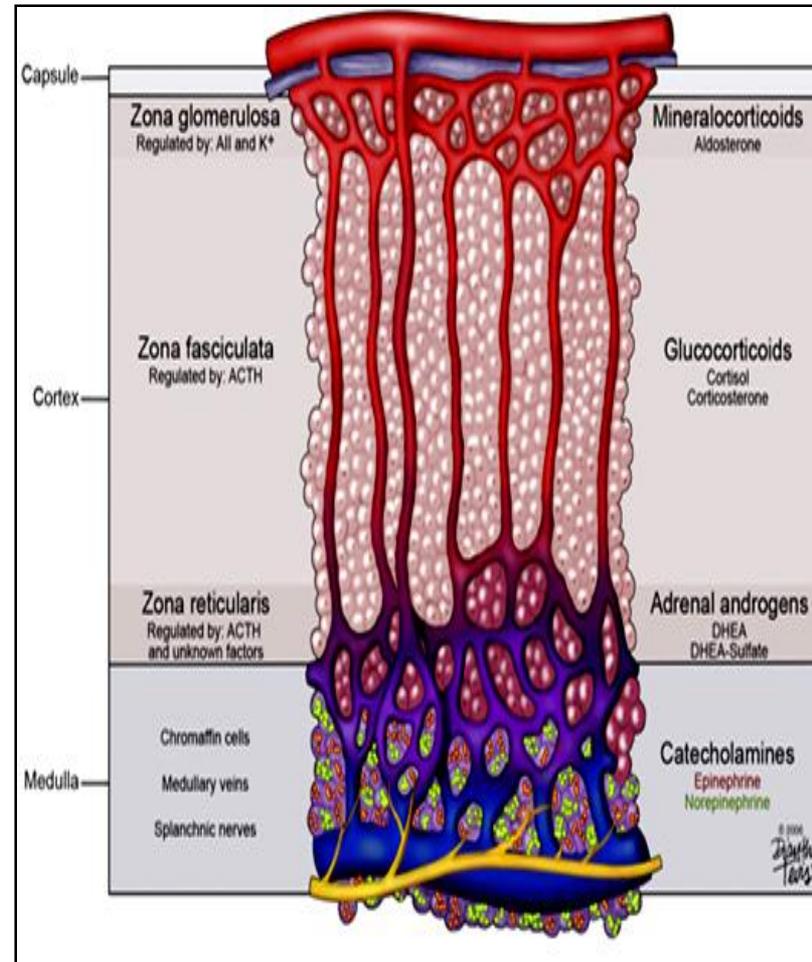
# Function of adrenal medulla

- epinephrine and norepinephrine → vasoconstriction, hypertension, ↑ heart rate & metabolic rate
- **Clinical hints of medulla**
  - Pheochromocytoma (tumour of chromaffin cells) → paroxysmal elevation of BP



# Blood supply of adrenal gland

- The adrenal glands are supplied by several arteries, these arteries can be divided into:
  - ❖ **Cortical arteries**, arteries that irrigate the capsule; branching into capillaries that irrigate the gland cells of the cortex and that eventually reach the medullary capillaries;
  - ❖ **medullary arteries**, which pass through the cortex and form an extensive capillary network in the medulla.
- The cells of the medulla are, thus, bathed with both arterial blood from the medullary arteries and venous blood originating from the capillaries of the cortex.
- Capillaries of the medulla, together with capillaries that supply the cortex, form the medullary veins, which join to constitute the **adrenal or suprarenal vein**

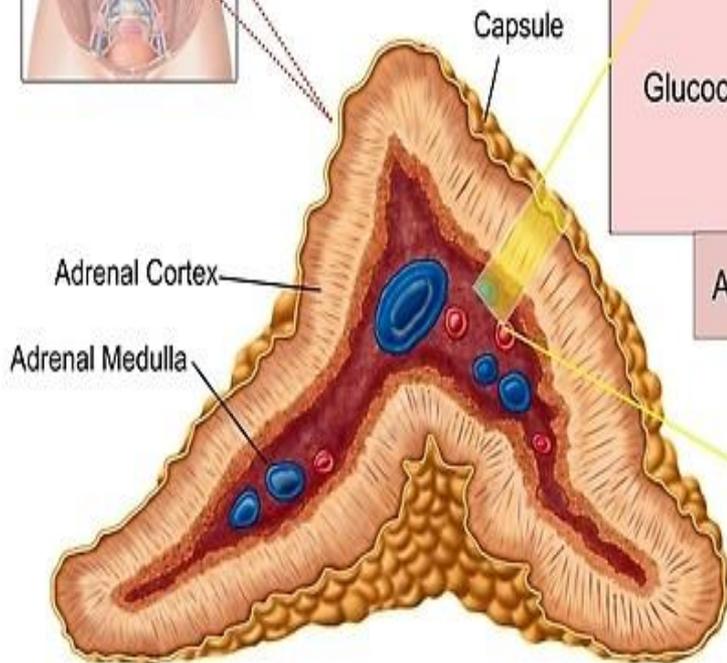
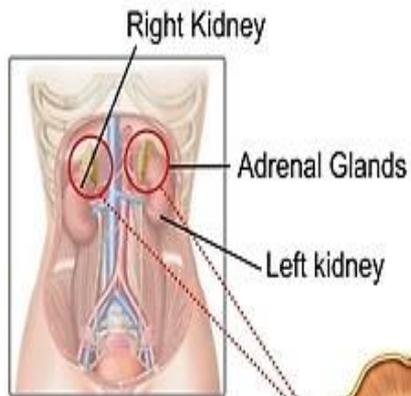


# Control of the Adrenal Cortex

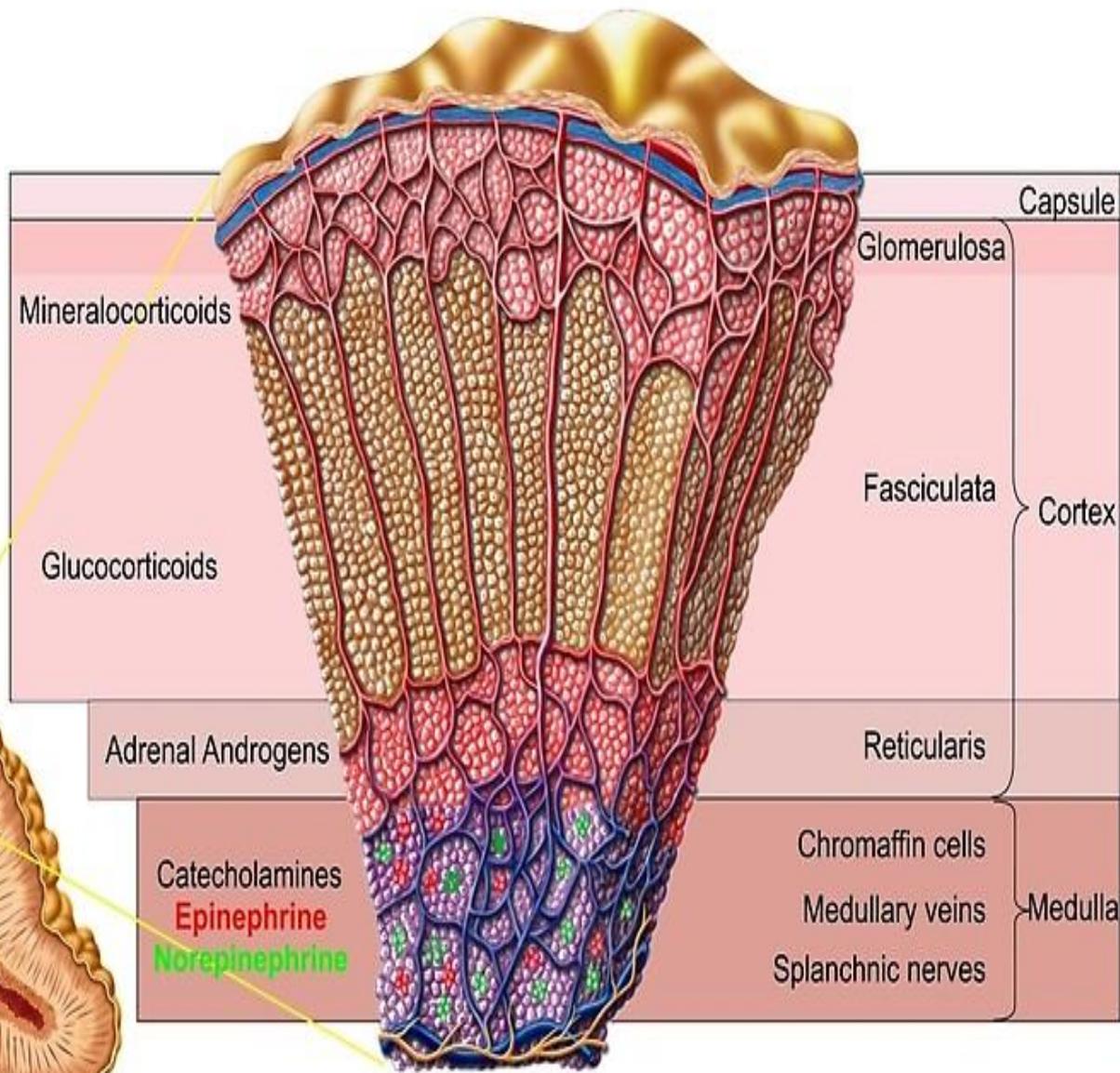
- The secretion of glucocorticoids is controlled initially through the release of corticotropin-releasing hormone in the median eminence, followed by secretion of (ACTH, corticotropin) by the pars distalis of the hypophysis
  - Free glucocorticoids may then inhibit ACTH secretion. The degree of pituitary inhibition is proportionate to the concentration of circulating glucocorticoids; inhibition is exerted at both the pituitary and hypothalamic levels
-  Aldosterone secretion is controlled primarily by renin-angiotensin and secondarily by ACTH.

## MEDICAL APPLICATION

- Because of the feedback mechanism of adrenal cortex control, patients who are treated with corticoids for long periods should never stop taking these hormones suddenly:
- secretion of ACTH in these patients is inhibited, and thus the cortex will not be induced to produce corticoids, causing a severe misbalance in the levels of sodium and potassium.



Transverse Section

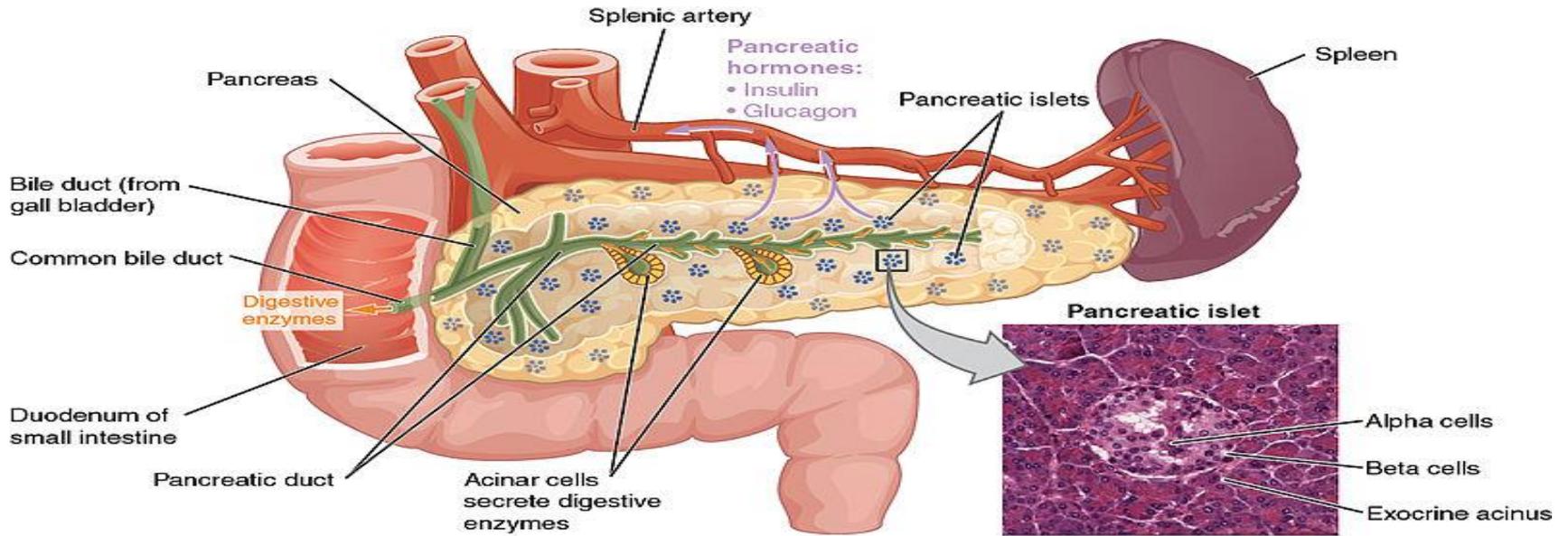


Microscopic Section

# Control of adrenal Medulla

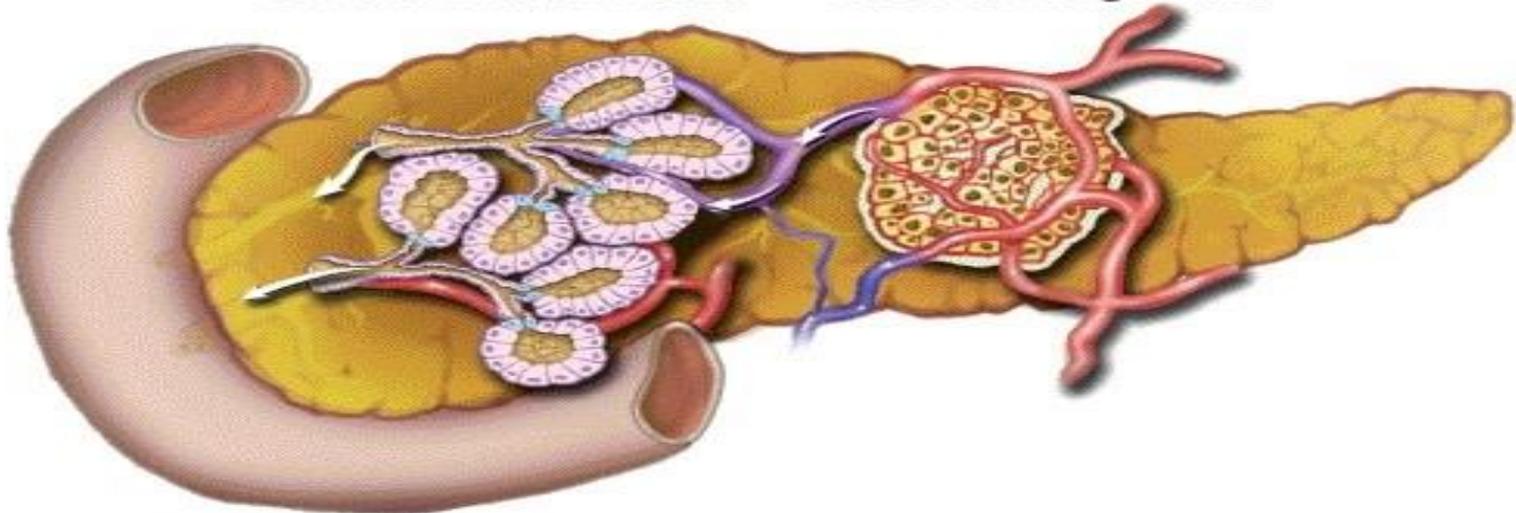
- The adrenal medullary cells are innervated by cholinergic endings of preganglionic sympathetic neurons.
- Epinephrine and norepinephrine are secreted in large quantities in response to intense emotional reactions, such as fright, that are part of an alarm reaction  
(the fight-or-flight response).
- Secretion of these substances is mediated by the preganglionic fibers that innervate medullary cells.
- **Glucocorticoids** produced in the cortex, which reach the medulla through capillaries that bathe cells of the cortex, constitute another mechanism of control.

# PANCREAS



**Exocrine  
Acinar and duct tissue**

**Endocrine  
Islets of Langerhans**



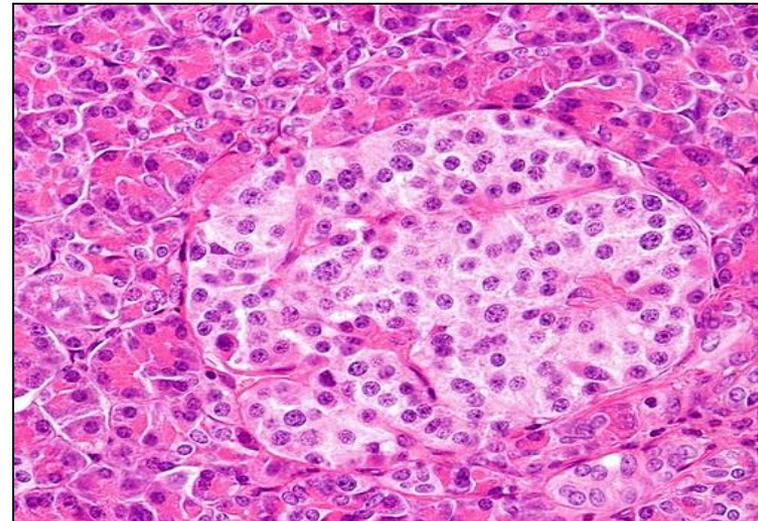
# PANCREAS

- ❑ Exocrine and endocrine gland.
- ❑ The exocrine part produces pancreatic juice.
- ❑ The endocrine part, ~1% , consists of the cells of the **islands of Langerhans**.

## Endocrine part: Islets of Langerhans

Masses of pale staining cells scattered between the pancreatic acini

- They are more in the **tail** than head of pancreas
- The cells are separated by fenestrated capillaries (highly vascularized)
- Cells of islets of Langerhans are Alpha, Beta, Delta, F (PP) cells



❑ **Structure** : of the islands of Langerhans.

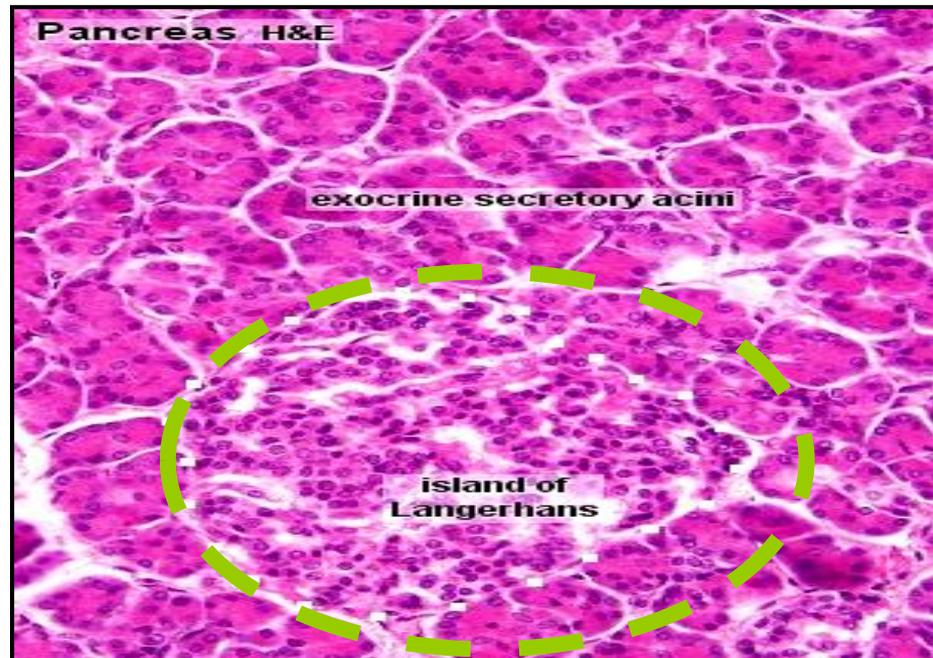
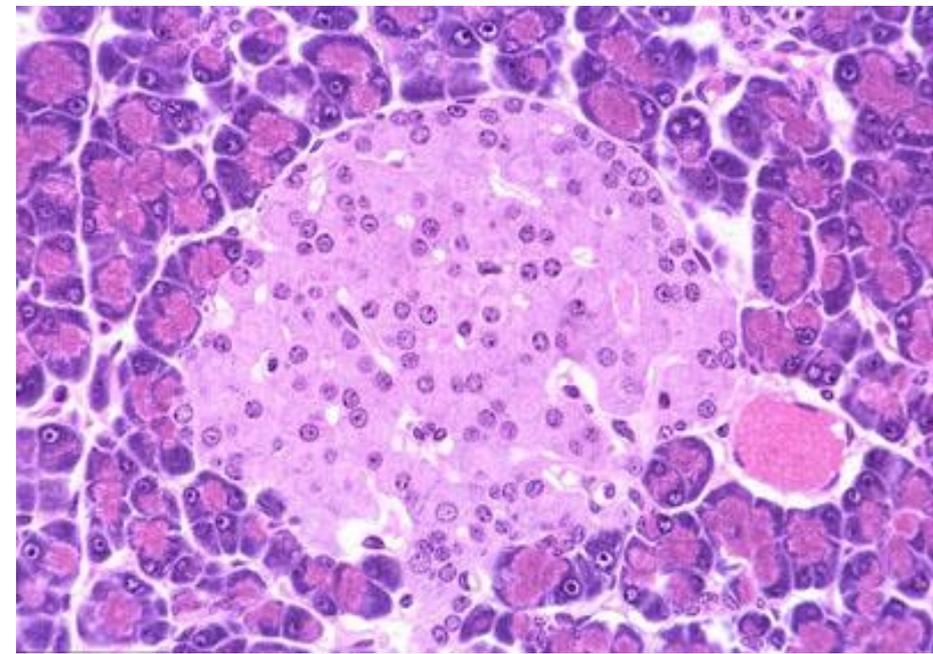
## **Stroma:**

Surrounded by **thin** capsule

## **Parenchyma**

cellular composition of the islands

- ❑ **70% beta-cells, insulin.** Insulin stimulates
- ❑ **20% alpha-cells, glucagon.**
- ❑ **5- 10 % delta-cells** which secrete somatostatin,
- ❑ **F- cells (PP)**



## Beta (B) cells (70%):

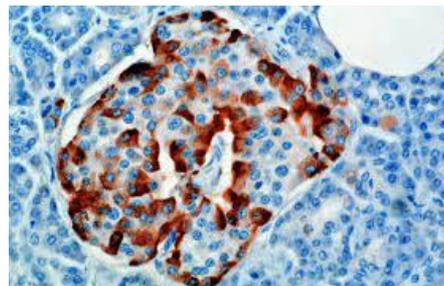
- Produce **insulin** which **lower** blood sugar
- Cells are **small** in size, **most numerous** cell type, **central** in location in islets
- Stain **blue**
- EM: appear in two functional stages active & resting
- When active synthesize insulin. When resting packed with granules storing insulin
- Cells divide at very slow rate

Beta cells

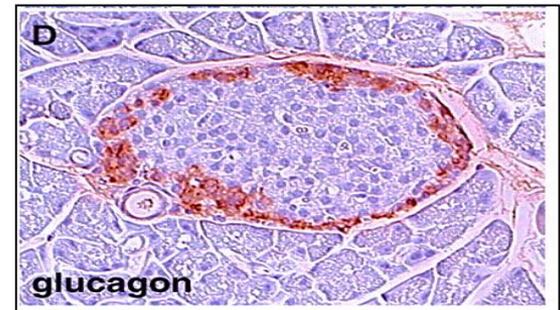


## Alpha (A) cells (20%):

- Produce **glucagon** which **increase** blood sugar
- Cells **larger** in size, **fewer** in number, **peripheral** location in Islets
- Stain **pink**



Alpha cells



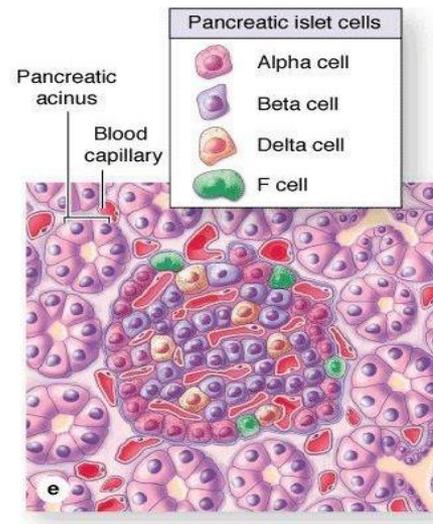
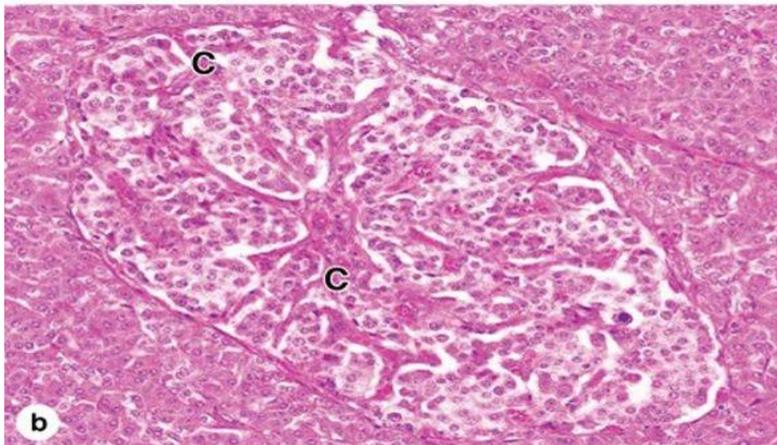
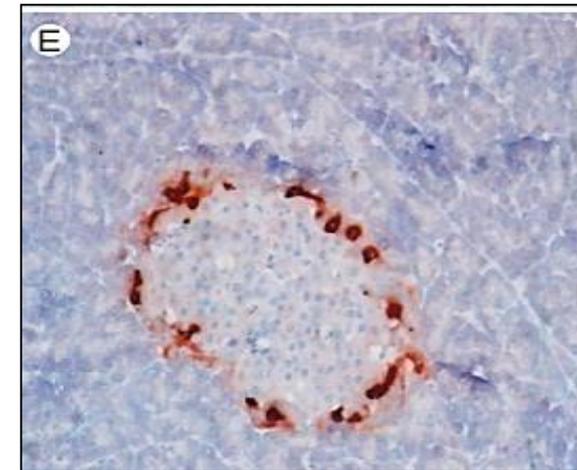
## Delta cells:

- Secret **somatostatin** ( growth inhibiting factor)
- Cells scattered at periphery and less abundant

## F (PP) cells:

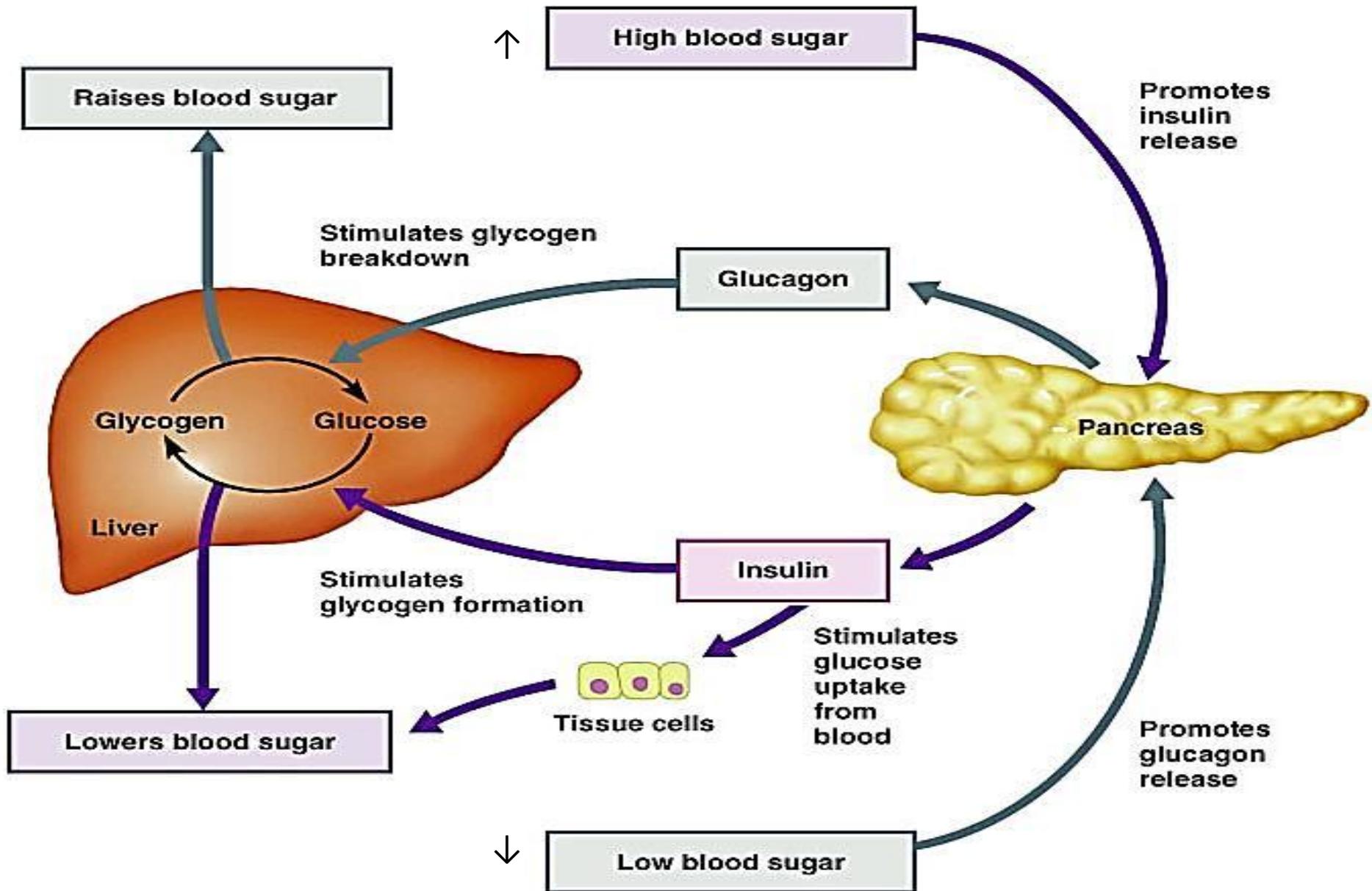
- Very few
- Secrete **pancreatic polypeptide h.**
- Regulate exocrine pancreas secretions

Delta cells

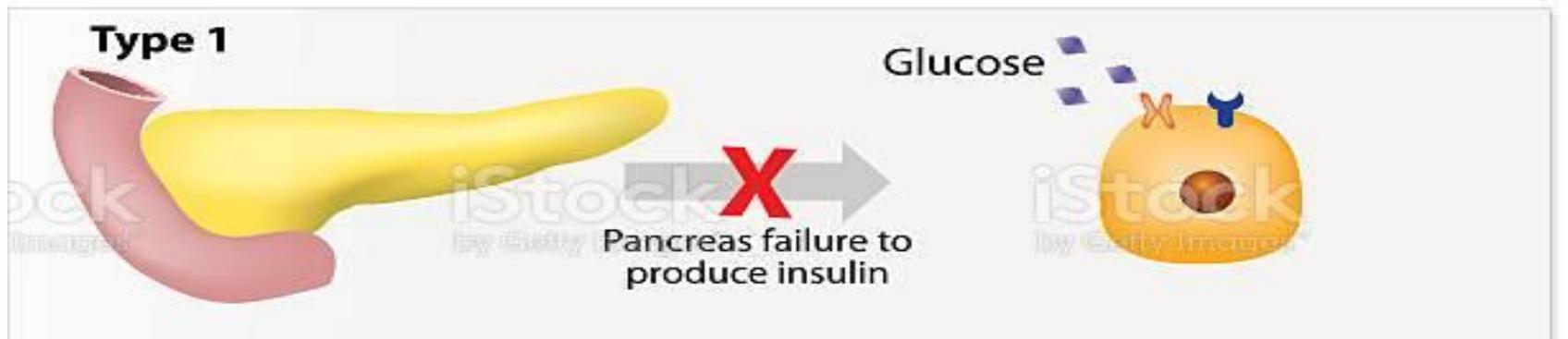


PP cells

# Regulation of blood glucose level



# DIABETES MELLITUS

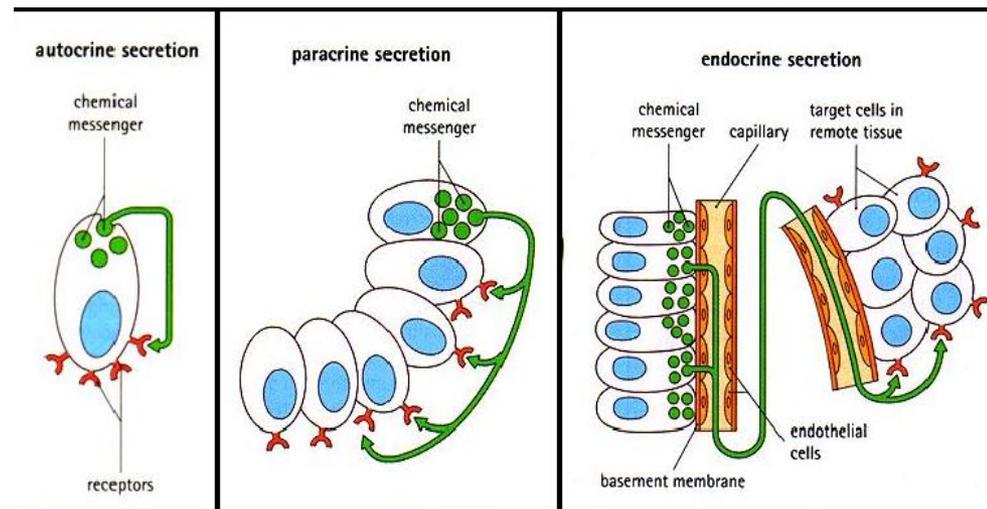


# Diffuse neuroendocrine system

- Apudocytes or **APUD cells**
- Classification according to staining activity
- 1. **Argentaffin cells:** ppt silver in absence of reducing agent
- 2. **Argyrophilic cells:** ppt silver in presence of reducing agent
- 3. **Chromaffin like cells:** bind K dichromate

## • Mode of action

1. **Endocrine** → target organ
2. **Paracrine** → surrounding tissue
3. **Autocrine** → themselves
4. **Neuroendocrine** → neurosecretion



# Distribution of APUD cells

- **GIT (enteroendocrine cells) :**

G cells            EC cells

ECL cells        D cells

S cells

- **Respiratory system**

Bronchial Kulchitsky cells

Small granule cells

Neuroepithelial bodies

among tracheobronchial  
epithelium.

- **Other sites**

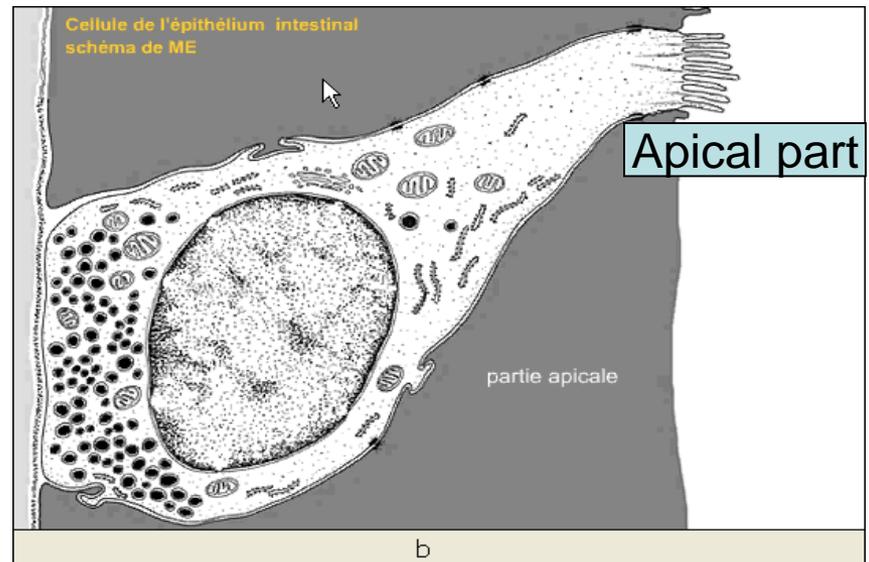
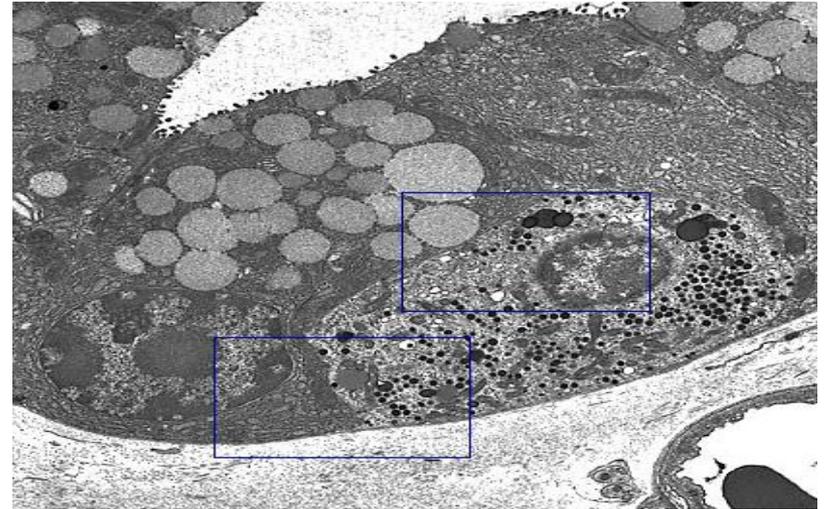
**1. Myocardium:** → cardiodilatins  
and atrial naturetic polypeptides

**2. Hypothalamus:** supraoptic  
and paraventricular nuclei →  
oxytocin and vasopressin

**3. Endocrine system:**  
pinealocytes,parafollicular cells,  
chief cells, cells of islets of  
Langerhans and some  
adenohypophyseal and adrenal  
medullary chromaffin cells

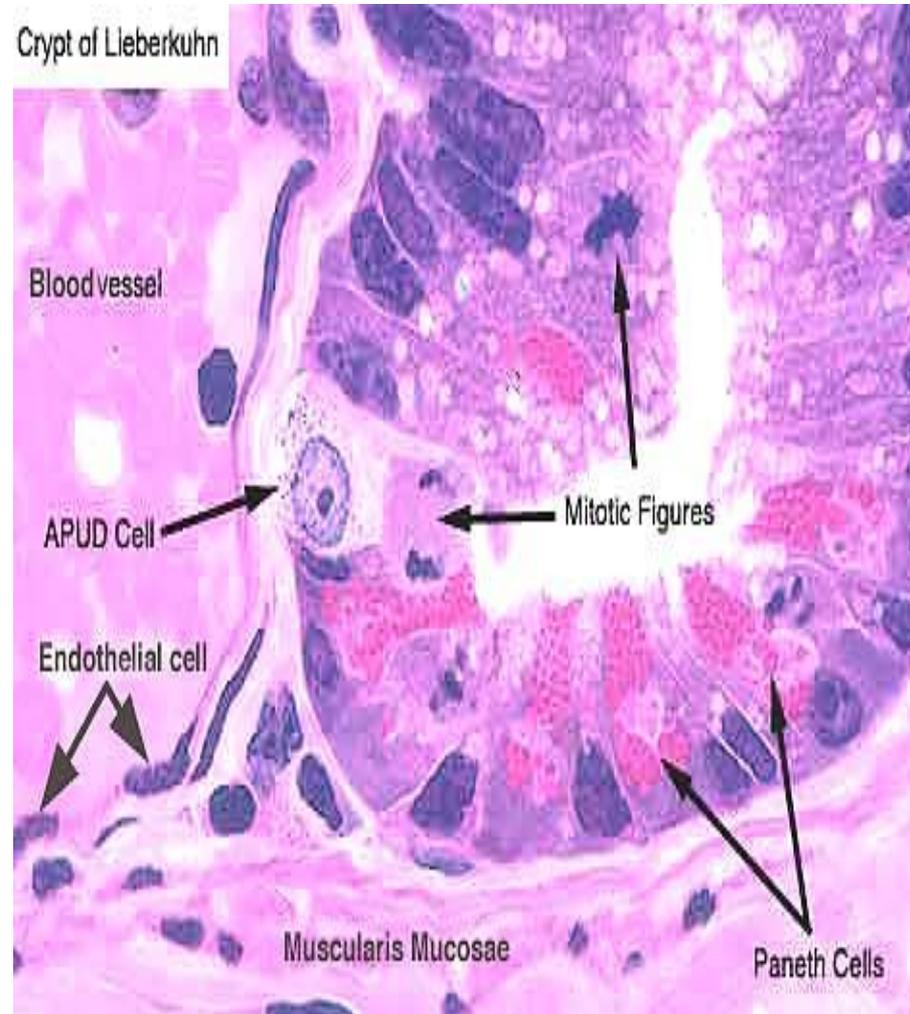
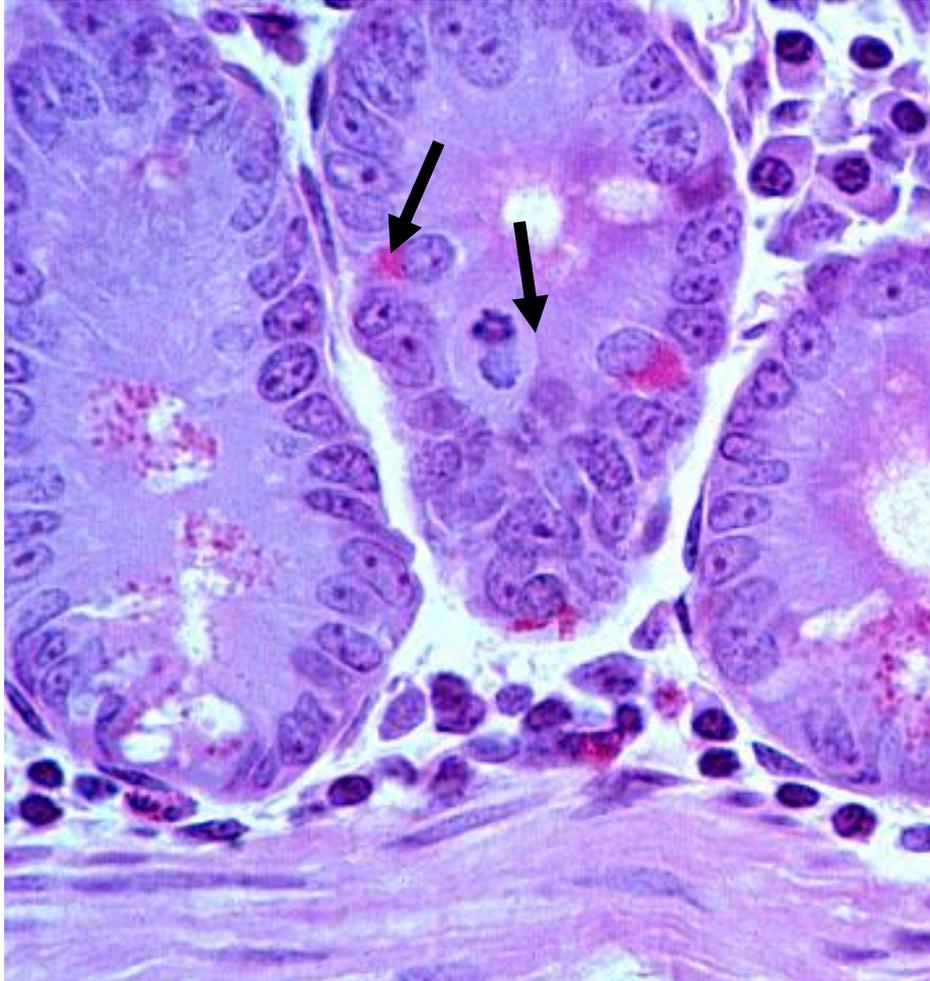
# Microscopic features

- **Two types:**
  1. **Open type**
  2. **Closed type**
- Electrolucent cytoplasm
- Few small secretory granules **at the base** or vascular pole
- Small **infranuclear** Golgi
- **Sparse** rER



APUD of small intestine

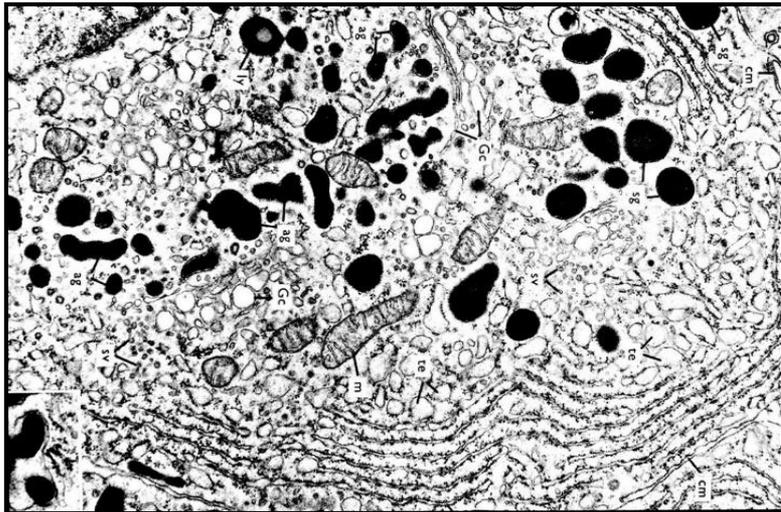
# Enteroendocrine cells



# General histological structures

## Protein , polypeptide & a.a secreting cells

- ❖ Active nucleus
- ❖ Basophilic cytoplasm
- ❖ Numerous ribosomes & **rER**
- ❖ Prominent golgi & numerous mitochondria
- ❖ Secretory granules



## Steroid secreting cells

- Active nucleus
- Acidophilic cytoplasm
- Numerous **sER**
- numerous mitochondria with tubular cristae
- Numerous lipid droplets

