

## Sheet #1

Lec. Date: December 24, 2020

Lec. Title: Anatomy, histology, and embryology of the pituitary gland

Written by: Ruba Akasheh

Edited by: Mira Sharayri

If you come by any mistake (whether it be spelling, grammatical or scientific) while browsing this sheet, kindly report it to the **Academic team Facebook account**.

## دعاء لأخيـنا رشيد الهواملة

اللَّهُمَّ، اغْفِرْ لَهُ وَارْحَمْهُ، وَاعْفُ عَنْهُ وَعَافِهِ، وَأَكْرِمْ نُزُلَهُ، وَوَسِّعْ  
مُدْخَلَهُ، وَاعْسِلْهُ بِمَاءٍ وَثَلَجٍ وَبَرْدٍ، وَنَقِّهِ مِنَ الْخَطَايَا كَمَا يُنْقَى الثُّوبُ  
الْأَبْيَضُ مِنَ الدَّنَسِ، وَأَبْدِلْهُ دَارًا خَيْرًا مِنْ دَارِهِ، وَأَهْلًا خَيْرًا مِنْ أَهْلِهِ،  
وَزَوْجًا خَيْرًا مِنْ زَوْجِهِ، وَقِهِ فِتْنَةَ الْقَبْرِ وَعَذَابَ النَّارِ

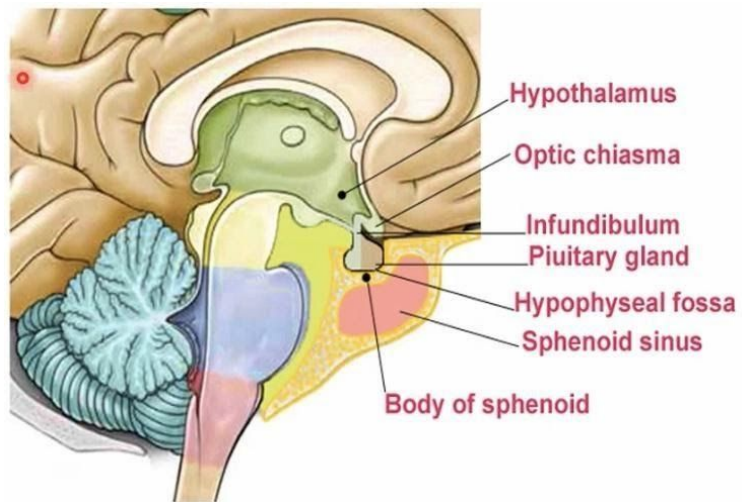
The **nervous** and **endocrine** systems act together to **coordinate** functions of all body systems. But the method of control of the two systems are very **different**.

\*The nervous system directly stimulates endocrine glands to release hormones, which is referred to as **neural stimuli**.

Because **hormones** act at a distance from the site of their release, they enter the circulatory system to be transported to the target organs. \*When the nervous system is activated, neurotransmitters are released. \*When the endocrine system is activated, hormones are released.

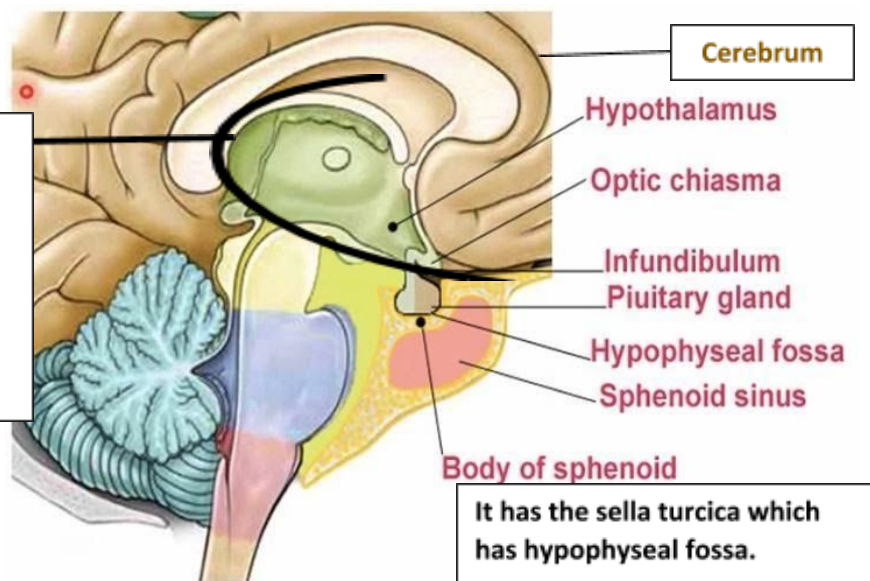
Furthermore, the cells in most endocrine tissues and organs are arranged into cords and clusters and are surrounded by an extensive capillary network that allows for more efficient transport of hormones.

## Pituitary gland الغدة النخامية



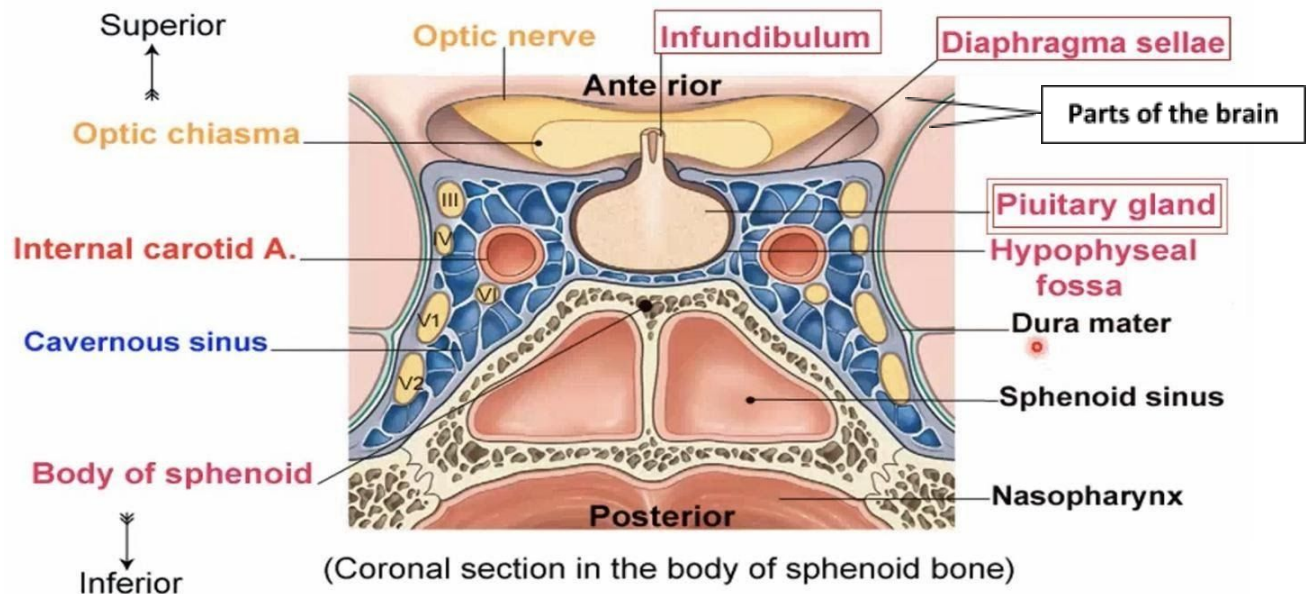
**Diencephalon** (the green area): is made up of four main components including the thalamus, and the hypothalamus.

In Arabic: الدماغ البيني



- A pea-shaped endocrine gland continuous with the hypothalamus through the infundibulum.
- Located within the hypophyseal fossa. (\*within the body of the sphenoid).
- Produce hormones that regulate growth, development, metabolism and homeostasis.

## Coronal section in the body of sphenoid bone



Brain is covered by 3 meninges:

1. Dura mater [forms dural venous sinuses around the brain to drain blood from it. They are valveless].
2. Arachnoid mater
3. Pia mater

## Relations of pituitary gland

Follow the figure above:

- Covered superiorly by the **diaphragma sellae** of **dura mater**.
- The diaphragma sellae is pierced centrally by an opening (aperture) for the **infundibulum**. (Which connects it to the hypothalamus).
- Diaphragma sellae separates the anterior superior aspect of the pituitary from the **optic chiasma**.

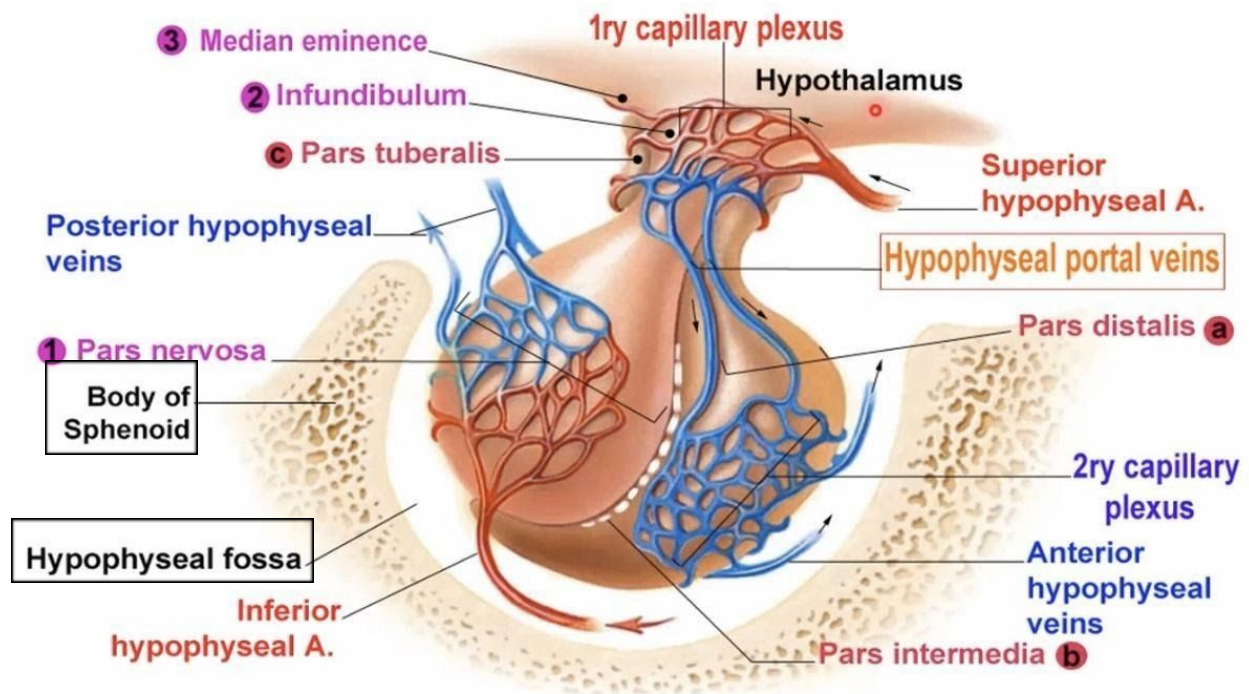
\*When the two optic nerves (right and left) pass through the optic foramen, they extend posteriorly and then cross at the **optic chiasma** (**decussation**: the action of crossing especially in the form of an X). They continue as optic tract.

**A CLINICAL CASE:** If there's a tumor in the pituitary gland, what will be affected?

**Answer:** Optic chiasma is compressed. How did we know that?

- Symptoms and signs of the patient will be vision problems; *hemianopia*.
- The pituitary is bordered on both sides (laterally) by the **cavernous sinuses**: dural venous sinuses that are divided by septa into small 'caves' - from which it gets its name {If meningitis occurs, cavernous sinuses might be affected and pituitary gland as a consequence}.
- Below, lies the body **of the sphenoid**, containing the **sphenoid sinus**. (Above the nasopharynx).
- Posterior to Anterior structures:
  - nasopharynx > sphenoid sinus > hypophyseal fossa > pituitary gland > optic chiasm

Hypophysectomy (pituitary gland removal to treat pituitary tumors) used to be done by craniotomy anteriorly. Now, it's done trans-nasally, then enter anteriorly to the choana, to the body of sphenoid, sphenoid sinus, and reach the pituitary gland.



- Remember: The hypothalamus is part of the **Diencephalon**.
- The pituitary has two major parts: anterior lobe and posterior lobe.
- It is highly vascular.
- Blood supply:

- Superior hypophyseal artery (right & left)
- Inferior hypophyseal artery (right & left)

Branches from the internal carotid artery

- Venous drainage:
  - Dural venous sinuses
- Posterior lobe is connected to the hypothalamus.  
(The posterior pituitary is neural tissue) → عصبی
- Anterior lobe.  
(It is composed of glandular epithelium) → غددی



## Divisions of pituitary gland

- The pituitary has two major parts **adenohypophysis** (anterior lobe) and **neurohypophysis** (posterior lobe) which differ in their origin, structure and function.

"Adeno" = glandular.

Adenoma = A benign tumor that arises in or resembles glandular tissue.

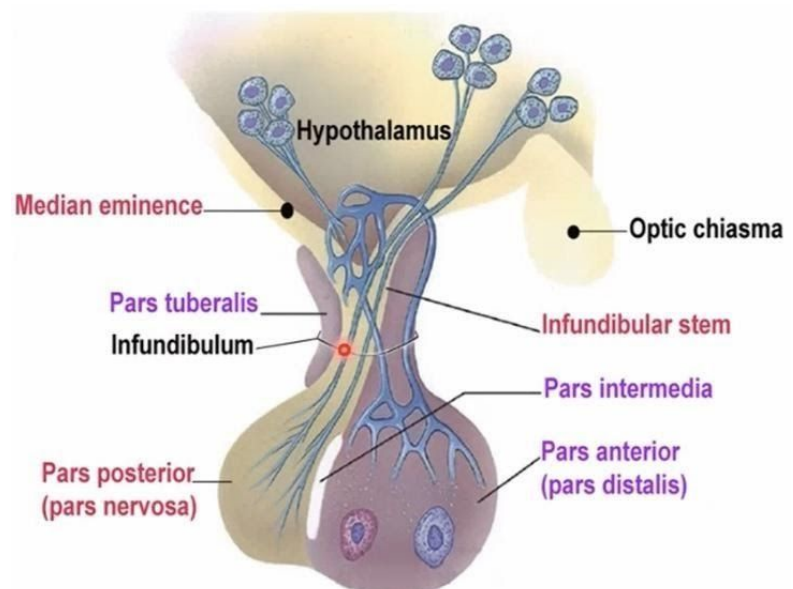
Hypophysis = below the thalamus

- A. The adenohypophysis** is an ectodermal derivative of the stomodeum (also called stomodeum; mouth to be/ is the precursor of the mouth).
- B. The neurohypophysis** is a downgrowth from the diencephalon connected with the hypothalamus.
- Both have ectodermal derivatives.
- Both lobes include parts of the infundibulum.
  - **Infundibular stem** is part of the neurohypophysis
  - **Pars tuberalis** is part of the adenohypophysis.

## Subdivisions of pituitary gland

- **Adenohypophysis** has three subdivisions:
  1. **Pars distalis** is the largest part of the hypophysis. (**Pars anterior**).
  2. **Pars tuberalis** surrounds the infundibular stem.
  3. **Pars intermedia** is a thin cell layer between the pars distalis and the neurohypophysis. It represents the remnant of the (Rathke) pouch that becomes rudimentary in humans.
- **Neurohypophysis**, has three parts:
  1. **Pars nervosa (Pars posterior)**
  2. **Infundibular stem**
  3. **Median eminence**; part of the hypothalamus.

Pars means part



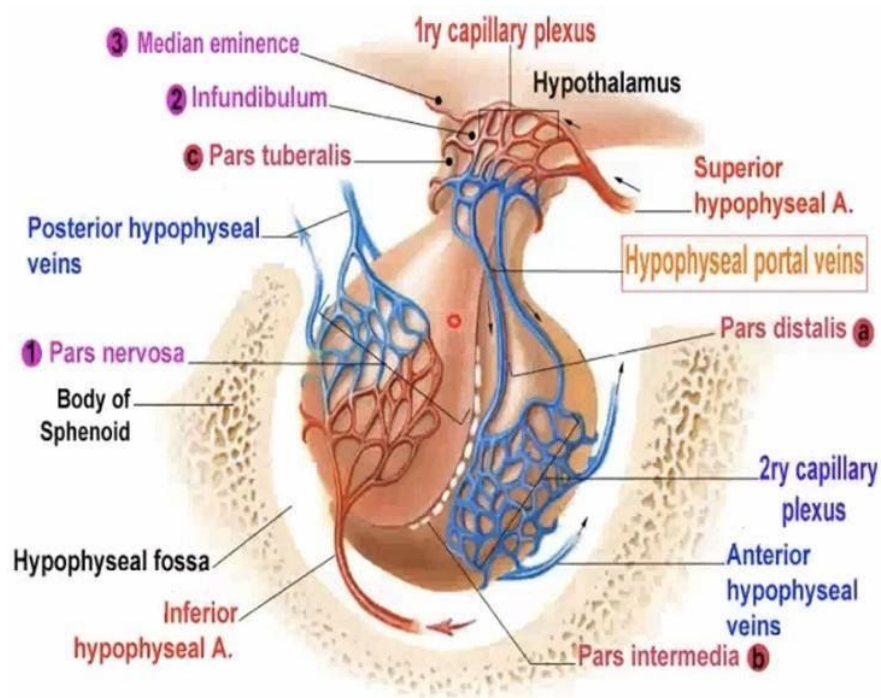
## Hypophyseal portal system

In our bodies, there are: systemic circulation and portal circulation.

The systemic circulation describes the blood that goes through the aorta and then descends down supplying every cell in the body. But when the veins return back, parts of the body are drained through systemic veins; superior vena cava (**SVC**) & inferior vena cava (**IVC**). However, blood that absorbs nutrients from the gastrointestinal tube (GI tube) should be filtered first by passing through the **portal vein** which goes to the liver where detoxification occurs in case of the presence of foreign bodies or toxins in order to be eliminated or destroyed. After that, it'll go to the systemic circulation.

Since the **adenohypophysis** does not develop from the neural tissue, its connection to the hypothalamus is only through a **rich vascular network**.

The ICA (internal carotid artery) supplies the pituitary gland by two sets of arteries: the superior and the inferior hypophyseal arteries.



The **superior arteries** supply the **median eminence** and the **infundibulum**.

The superior arteries divide into a 1ry plexus of fenestrated capillaries that supply the infundibulum and median eminence.

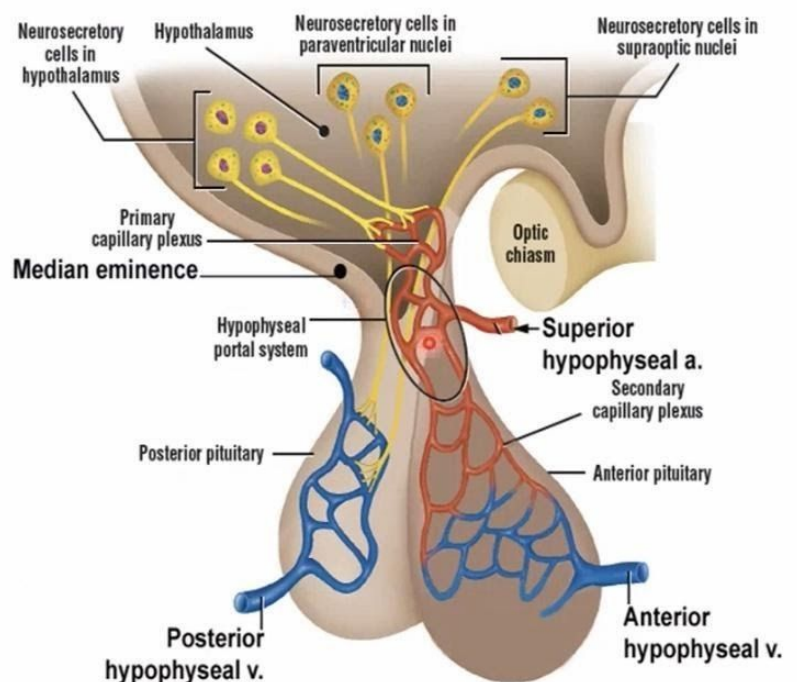
These capillaries then **rejoin** to form the portal veins that branch again as a large 2ry capillary plexus all over **pars distalis (pars anterior)** and drains into the **hypophyseal veins**, and finally to the dural venous sinuses.

❖ **To sum up all, follow the figure on the previous page:**

If we've got a hormone secreted by the hypothalamus, it will pass through the fenestrations of the 1ry capillaries → carried down to portal veins → to the 2ry capillary plexus → dural venous sinuses → systemic circulation → target cells.

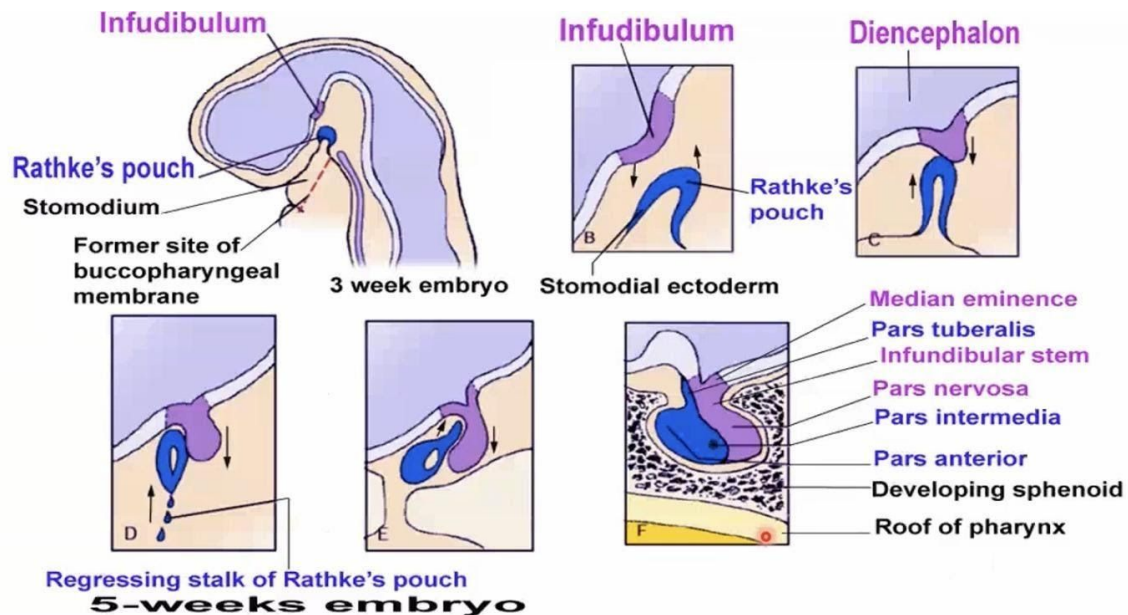
These vessels make up the **hypothalamic-hypophyseal portal system** that has great importance because it carries hormones **from** the median eminence the short distance **to** the adenohypophysis (pars distalis) where they either stimulate or inhibit hormone release by the endocrine cells there.

The **inferior arteries** mainly supply **neurohypophysis**.





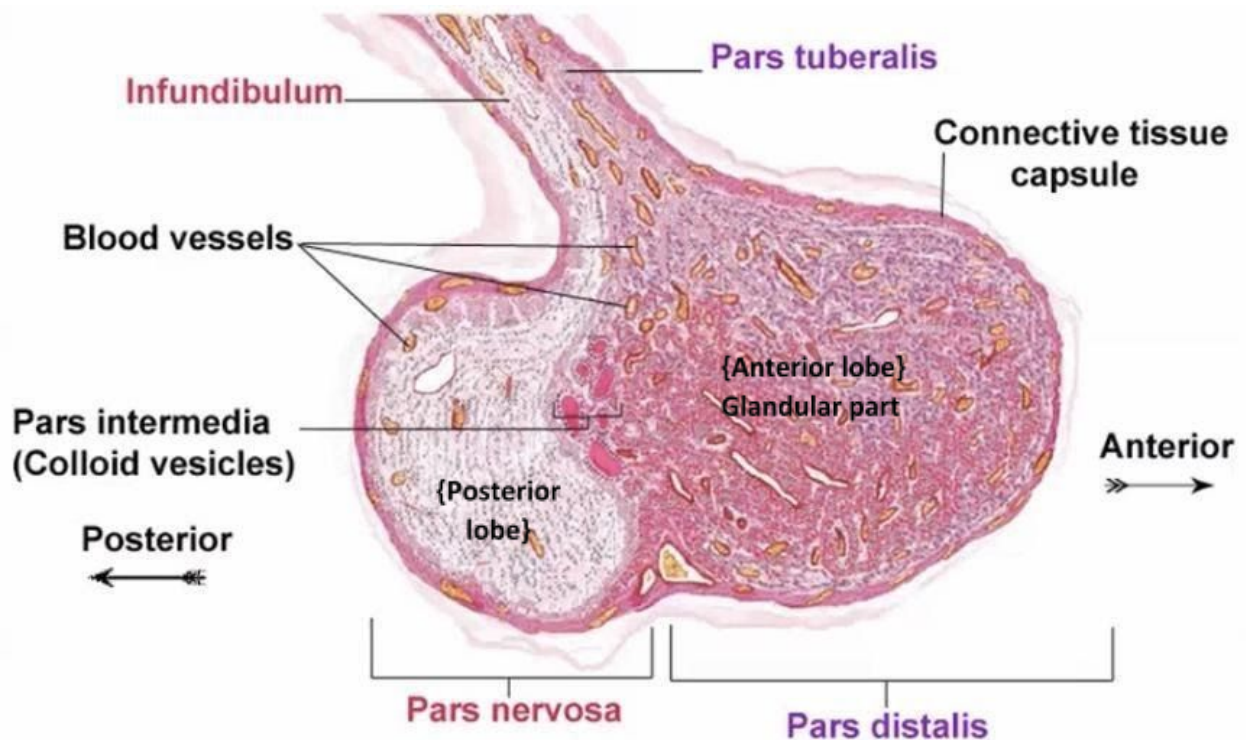
## Development of pituitary gland



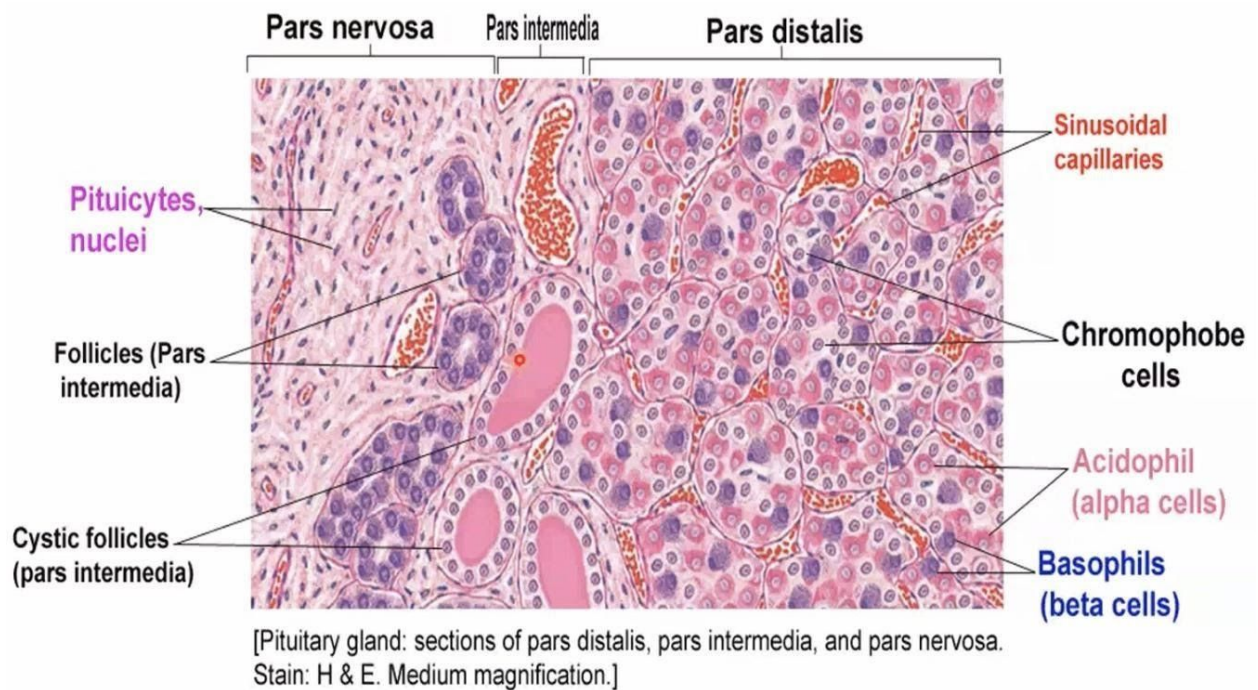
- Develops from two **ectodermal** sources.
- During the **3<sup>rd</sup> week**, **Rathke's pouch** develops as a dorsal upgrowth from the ectoderm of the roof of the stomodeum (primitive mouth).
- **At the same time**, the neural infundibulum develops as a ventral downgrowth from the floor of the diencephalon.
- By **5<sup>th</sup> week**, the **glandular pouch elongates**, loses its connection with the stomodeum and forms a separate sac that contacts the neural infundibulum.
- Pituitary develops from **stomodeum** forms the **adenohypophysis** that divides into:
  - **Pars anterior.**
  - **Pars tuberalis.**
  - **Pars intermedia.**
- Pituitary from the **hypothalamus** forms the **neurohypophysis** that divides into:
  - **Pars nervosa.**
  - **Median eminence.**
  - **Infundibular stem.**

Components of the pituitary gland reflect their embryology

## Pituitary gland, sagittal section. Stain: H&E. Low magnification



- Pars distalis and pars nervosa are surrounded by a connective tissue capsule.
- The adenohypophysis is highly vascular. (\*it has many BVs and sinuses).
- Consists of epithelial cells of varying size and shape.
- They are arranged in cords and separated by thin-walled vascular sinusoids supported by a delicate reticular connective tissue.
- The pars nervosa consists primarily of unmyelinated axons and supporting pituicytes.



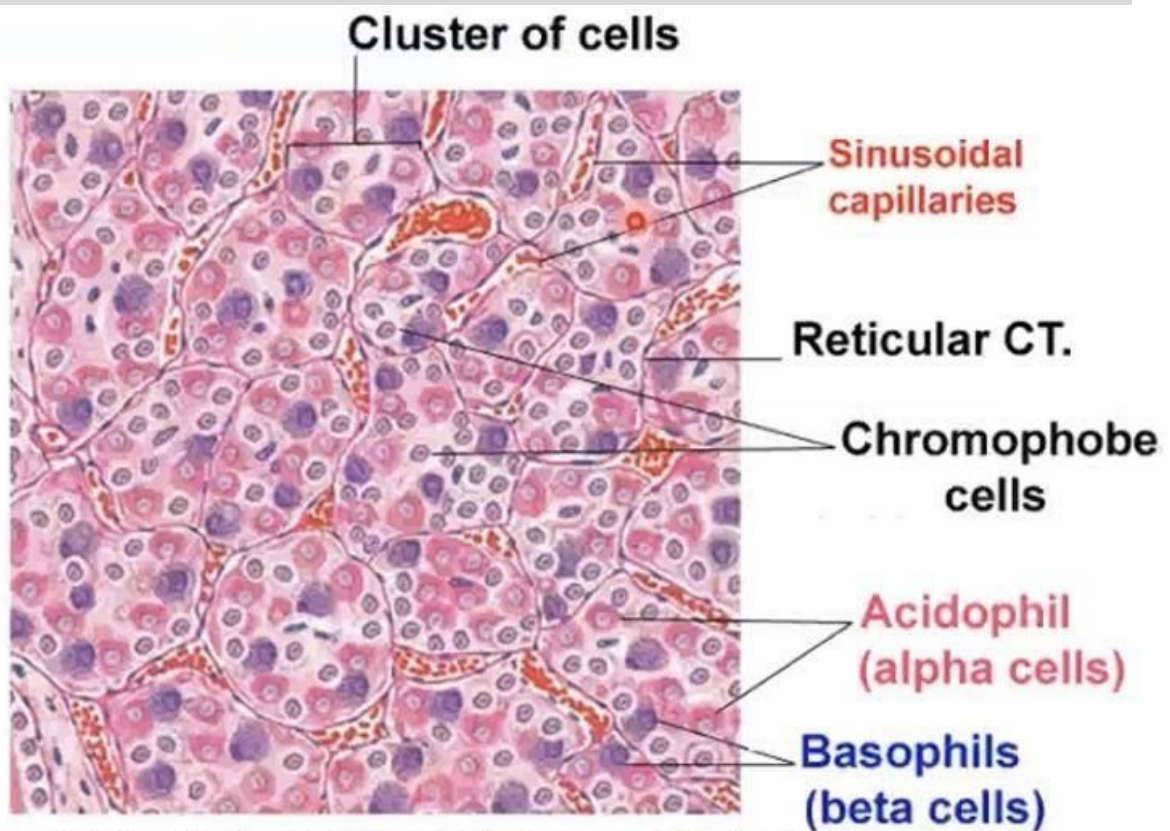
**Notice:** As you can see above, pars distalis (to the right), most of it are cells arranged in clusters/ clumps/ groups covered by a thin CT capsule. In between, there are many BVs [sinusoids].

Cells inside massed can be distinguished by their affinity for stain;

1. **Chromophobe cells:** are pale cells (not stained) but their nuclei are blue in color. They sometimes form groups within the adenohypophysis. Moreover, their cytoplasm doesn't contain granules (agranular), so they can't pick the stain.
2. **Acidophils (alpha cells):** their cytoplasm is stained red and pink.
3. **Basophils (beta cells):** blue in color.



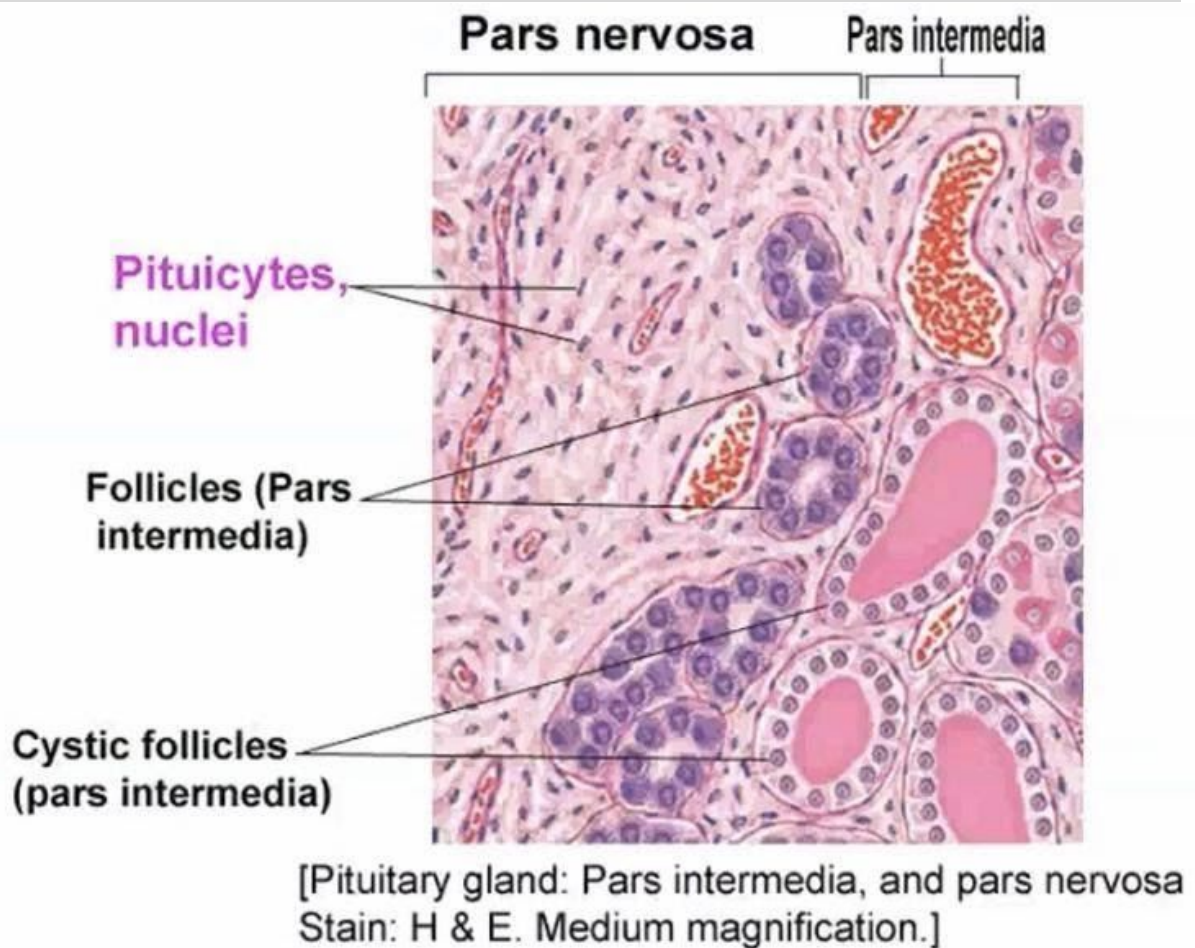
## Pars distalis, medium magnification



(Pars distalis, Stain: H & E. Medium magnification)

1. The cells are arranged in **clusters**.
2. **Numerous** capillaries, blood vessels and thin CT between the clusters.
  - Cell types can be identified with the **staining affinity** of their cytoplasmic granules.
  - **The chromophobes show** pale nuclei and pale cytoplasm, ill-defined outlines. [Seen in groups in this slide].
  - **The acidophils**; alpha cells, more numerous and contain red-staining cytoplasmic granules, blue nuclei.
  - **The basophils**; beta cells, less numerous and contain blue-staining granules in their cytoplasm.

## Microstructure of pars nervosa and intermedia



**Pars intermedia:** is found between pars distalis and pars nervosa and represents the residual lumen of the Rathke's pouch. Contains:

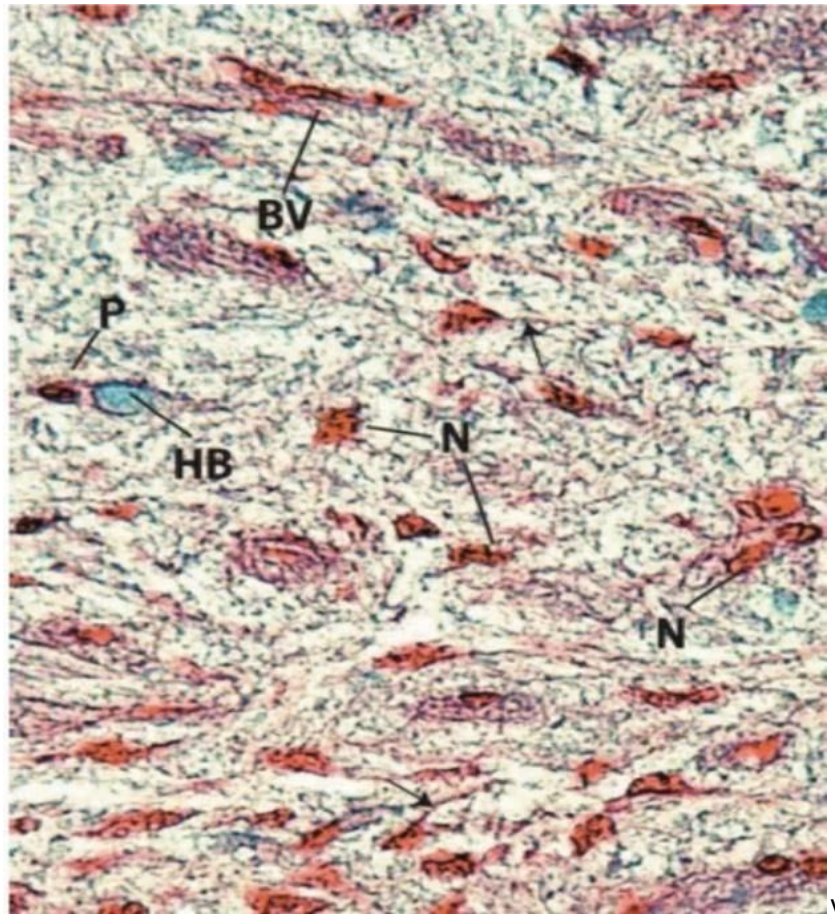
1. Follicles lined with **basophils**, frequently present in the pars intermedia.
2. Colloid-filled cystic follicles.

**Pars nervosa** contains:

1. Unmyelinated axons
2. Pituicytes are supportive (neuroglial) cells with oval nuclei.



### Pars nervosa. Paraffin section. X540



- Pars nervosa filled with, light-staining axons of secretory cells, whose cell bodies are located in the hypothalamus.
- The unmyelinated nerve fibers and processes of pituicytes make up the cellular network of pars nervosa.
- **Numerous oval red-staining nuclei (N)** of the pituicytes.
- The expanded terminal regions of the nerve fibers, which house neurosecretions, are known as **Herring bodies (HB)**.
- Blood vessels (BV) can be seen in pars nervosa.

**Happy New Year!**