



ENDOCRINE BLOCK

LECTURE 2

Physiology of Hypothalamic-Pituitary Axis



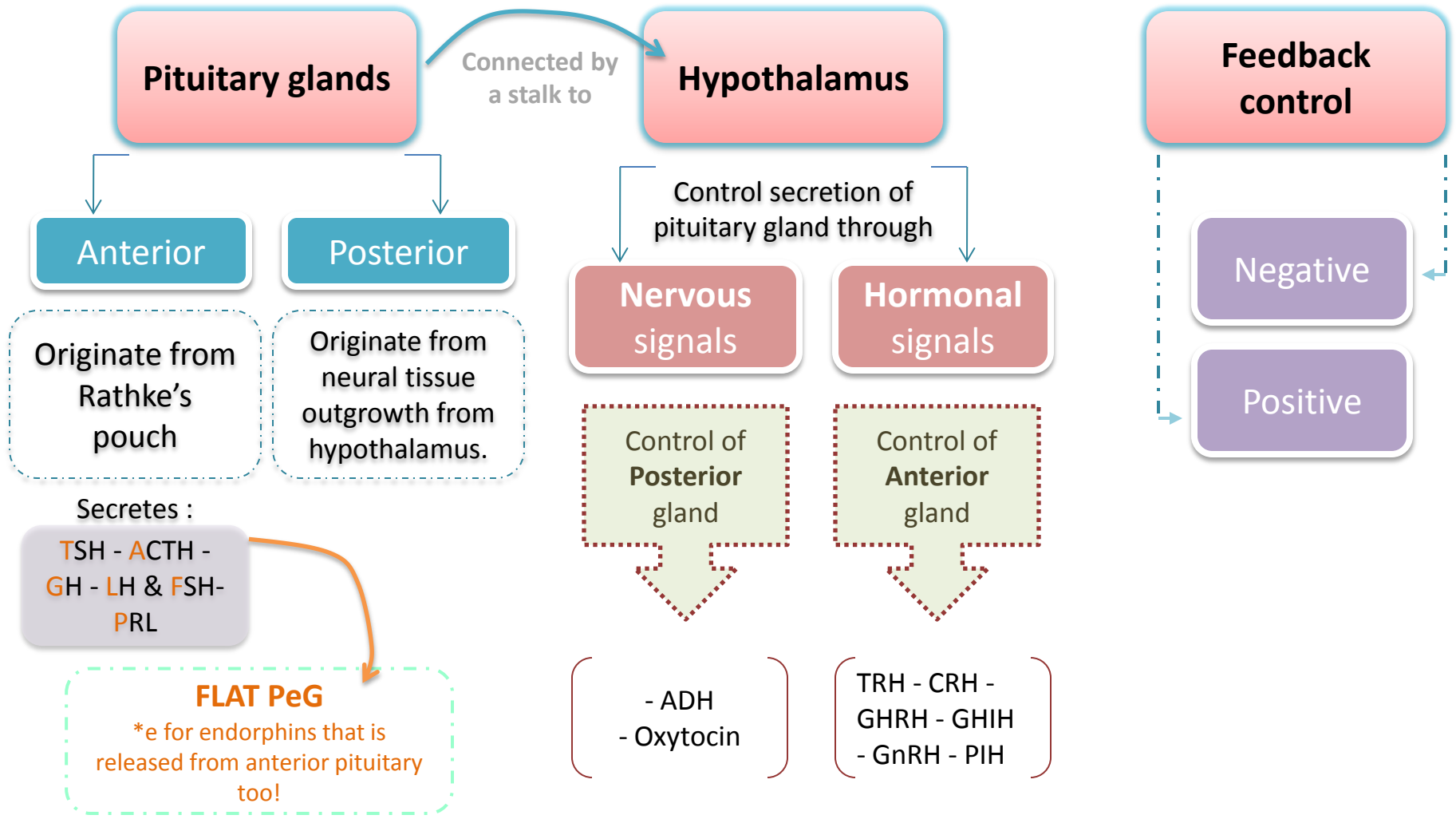
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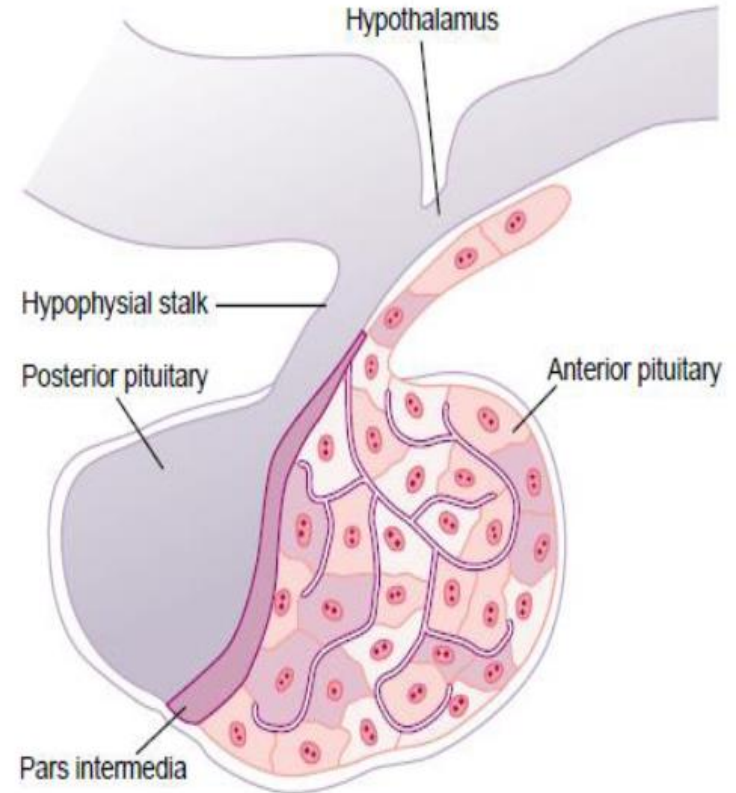
- **Pituitary gland** and its relation to hypothalamus.
 - **Anterior pituitary** cell types and hormones.
 - **Posterior pituitary** cell types and hormones.
- **Control of pituitary secretion** by hypothalamus
 - ✓ Hypothalamo-hypophysial portal system.
 - ✓ Hypothalamo-hypophysial tract.
- **Feedback mechanisms**
 - ✓ Positive feedback.
 - ✓ Negative feedback.





Pituitary gland and its relation to Hypothalamus

- The pituitary gland (the hypophysis), is a small gland about 1 cm in diameter and 0.5 to 1 g in weight. **Very small but it has many physiological functions!**
- It lies in the sella turcica, a bony cavity at the base of the skull.
- It is **connected to the hypothalamus** by the pituitary (or hypophysial) stalk.



Take a look!

What is the Pituitary Gland?



Hormones of the Anterior Pituitary Gland

There are two embryonic origins for the pituitary gland, so there are different cell types and different functions!

- Physiologically, the pituitary gland is divisible into two distinct portions (lobes):

Anterior (Adenohypophysis)

- **Embryonic origin:**

Anterior pituitary originates from **Rathke's pouch** (invagination of the pharyngeal epithelium). This explains the **epithelioid nature** of its cells. "secretory cells"

Posterior (Neurohypophysis)

- **Embryonic origin:**

Posterior pituitary originates from neural tissue outgrowth from **hypothalamus**. This explains the presence of large numbers of **glial-type cells** in this gland. "so these cells won't secrete any hormones, but stores them!"

- Between these is a small, the **pars intermedia**, which is almost absent in the human being but is much larger and functional in some lower animals.

- Almost all secretions by the pituitary is controlled by signals **from the hypothalamus**:

1

Nervous signals

Control posterior pituitary secretion.

2

Hormonal signals

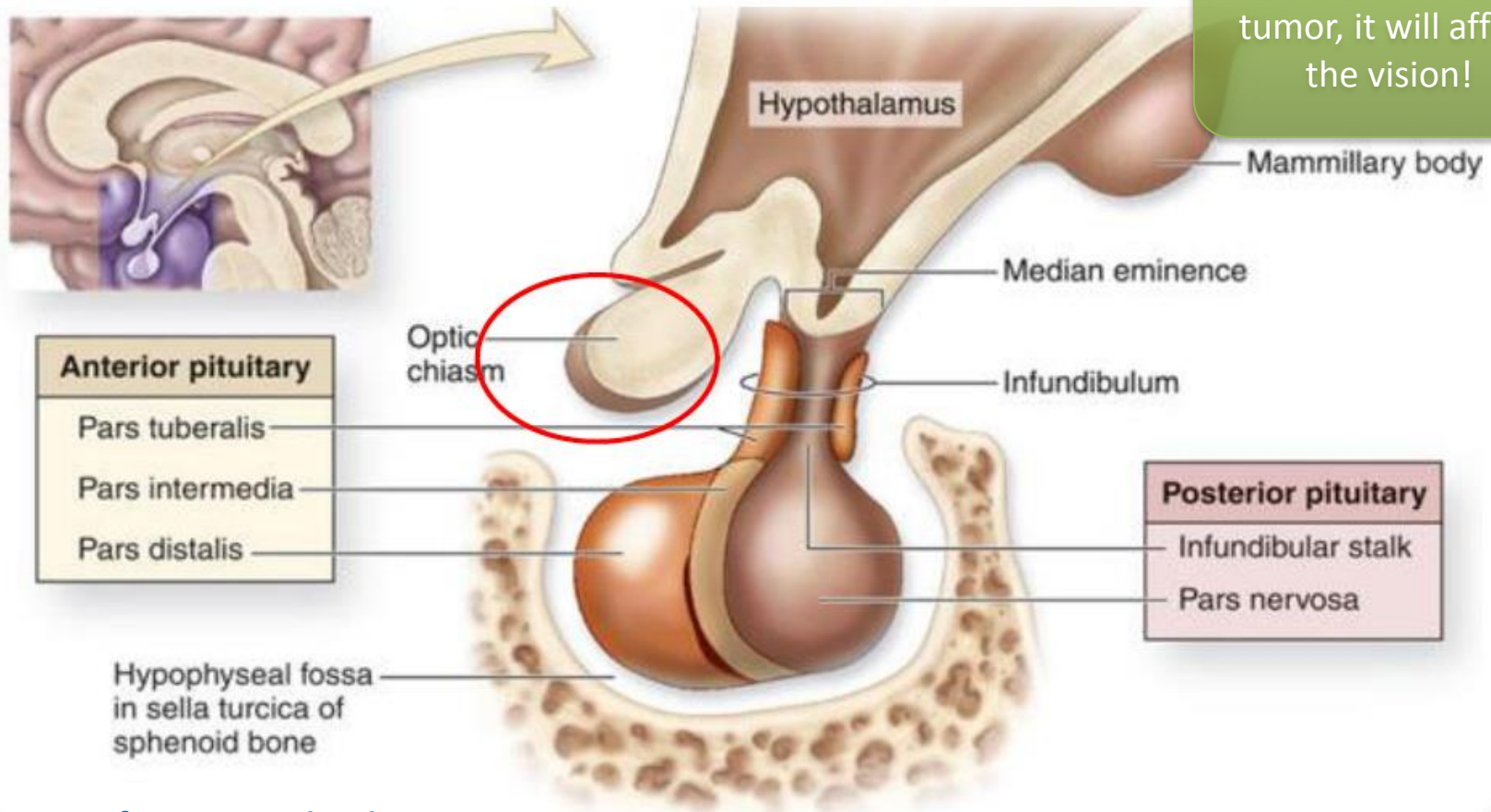
Control anterior pituitary secretion.

It means that the hormones that are secreted from the anterior pituitary are controlled by hormones from the hypothalamus!



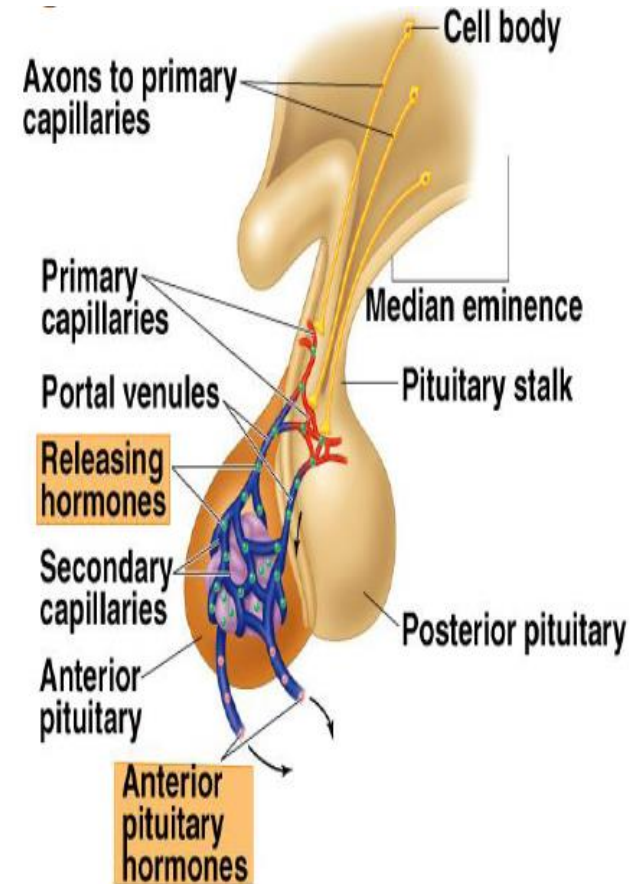
Structures of Pituitary gland (Relation to Optic Chiasm)

So if there's any tumor, it will affect the vision!

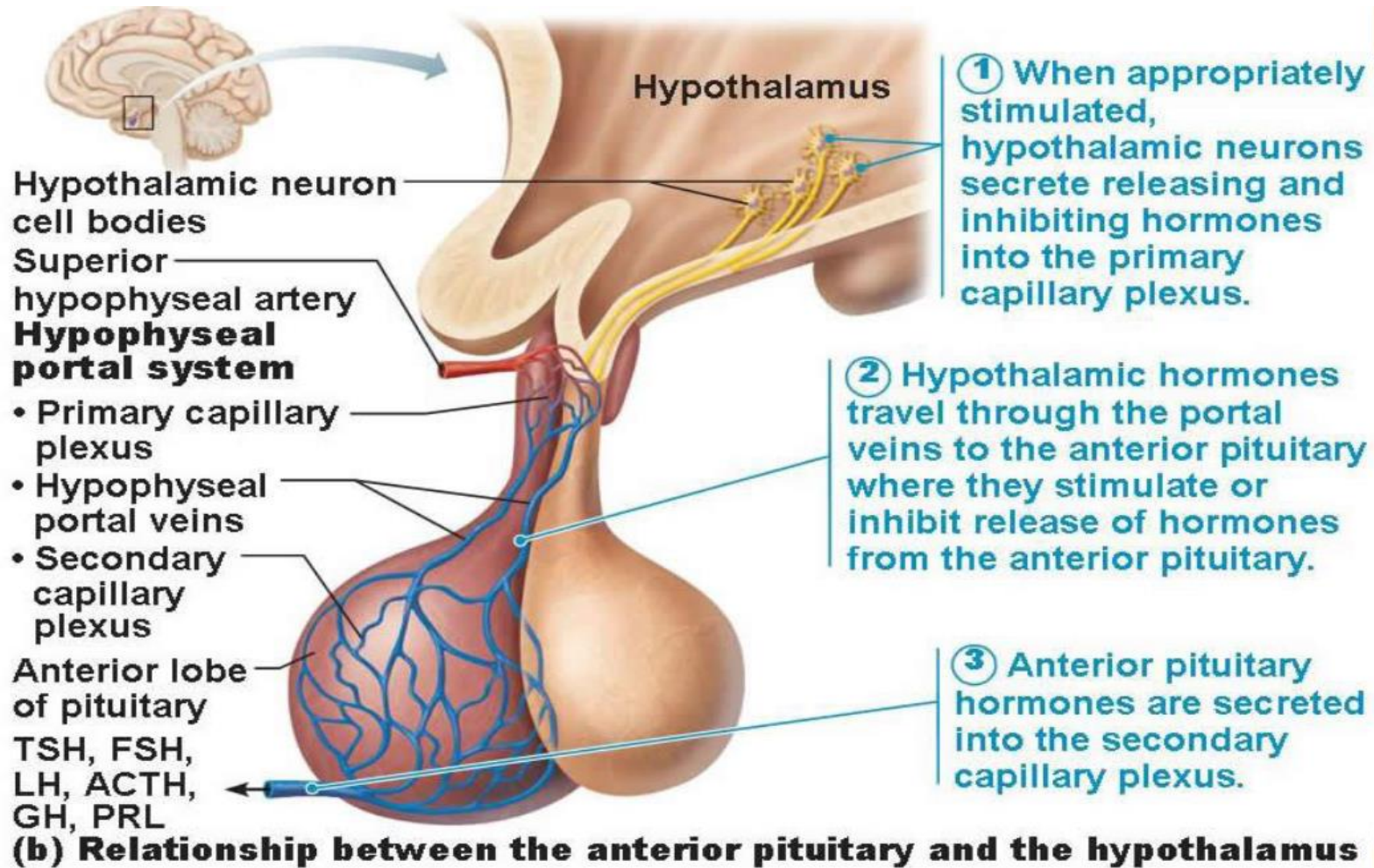


- **Structure of pituitary gland:**
anterior lobe, posterior lobe & infundibulum

- Secretion by the anterior pituitary is controlled by special neurons in the hypothalamus that synthesize and secrete releasing and hypothalamic inhibitory hormones (or factors). **The hypothalamus has neurons that secrete hormones which will stimulate or inhibit the anterior pituitary secretions!**
- Neurons send their nerve fibers to the (1) **median eminence** (the lowermost portion of the hypothalamus, which connects inferiorly with the pituitary stalk) and (2) **tuber cinereum**, an extension of hypothalamic tissue into the pituitary stalk.
- The function of endings of these hypothalamic fibers is to **secrete the hypothalamic releasing and inhibitory hormones into the tissue fluids.**
- These hormones are immediately absorbed into the **hypothalamic-hypophysial portal system** and carried directly to the sinuses of the anterior pituitary gland. **It means that hypothalamus is connected to the anterior pituitary by vascular connection.**



- **Hypothalamus composed of number of nerve cells.**



Hypothalamic Hormones

Inhibitory Hormones

GHIH Growth hormone inhibiting hormone	also called Somatostatin . <u>Inhibits</u> release of GH .
PIH Prolactin inhibitory hormone	also known as Dopamine . <u>Inhibits</u> prolactin secretion

Releasing Hormones

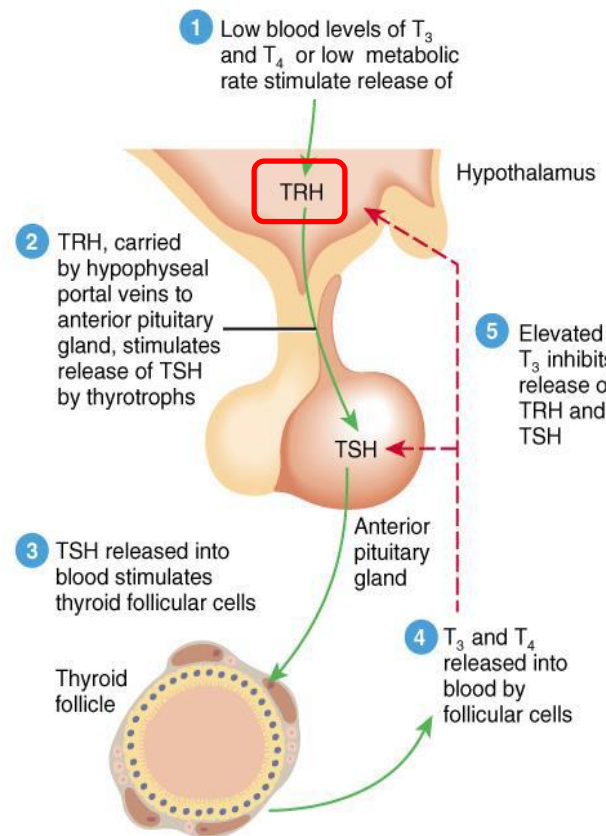
TRH Thyrotropin- releasing hormone	<i>Stimulates</i> release of thyroid stimulating hormone (TSH).
CRH Corticotropin- releasing hormone	<i>Stimulates</i> release of adrenocorticotropin hormone (ACTH).
GHRH Growth hormone releasing hormone	<i>Stimulates</i> release of growth hormone (GH).
GnRH Gonadotropin releasing hormone	<i>Stimulates</i> release of the 2 gonadotropic hormones: - Luteinizing (LH). - Follicle-stimulating hormone (FSH).

Hormones of anterior pituitary & its structures:

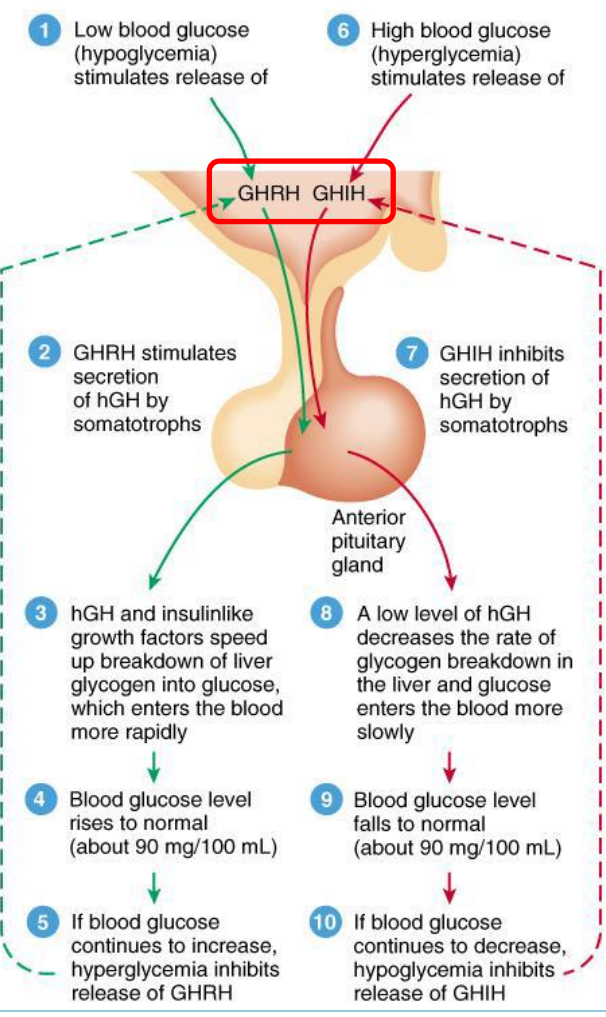
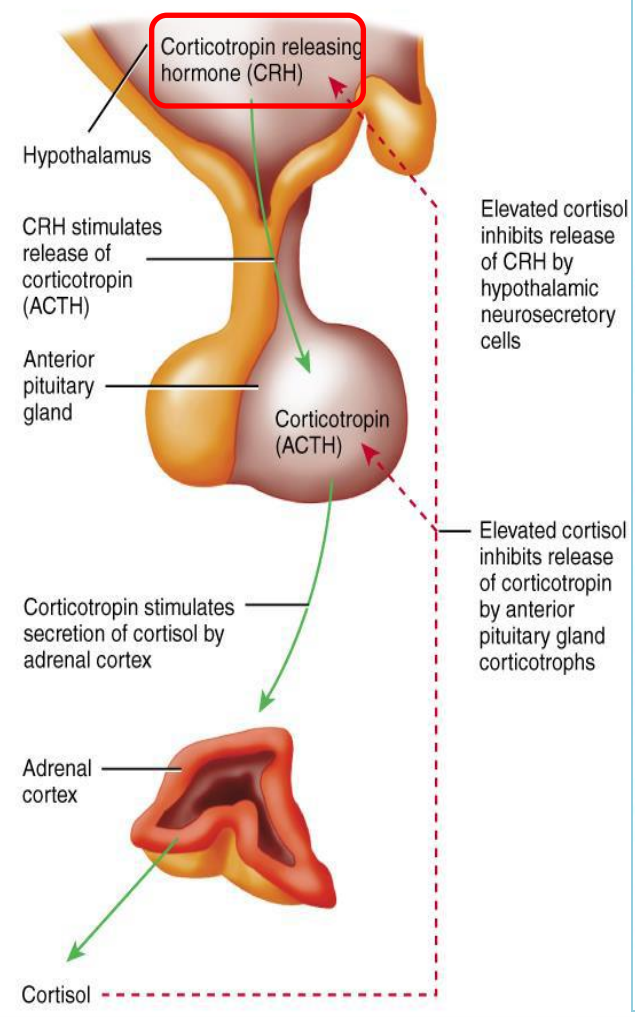
1. **TSH** (Thyrotropin): from **thyrotropes** cells.
2. **ACTH** (corticotropin): from **corticotropes** cells.
3. **GH** (Somatotropin): from **somatotropes** cells.
4. **LH & FSH** (Gonadotropic\Gonadotropin): from **Gonadotropes** cells.
5. **Prolactin** (PRL): from **lactotropes** cells.



Hypothalamic control of anterior pituitary



Key:
 TRH = Thyrotropin releasing hormone
 TSH = Thyroid-stimulating hormone
 T_3 = Triiodothyronine
 T_4 = Thyroxine (Tetraiodothyronine)



■ Slides

■ Important

■ Females' Notes

■ Explanation

■ Males' Notes

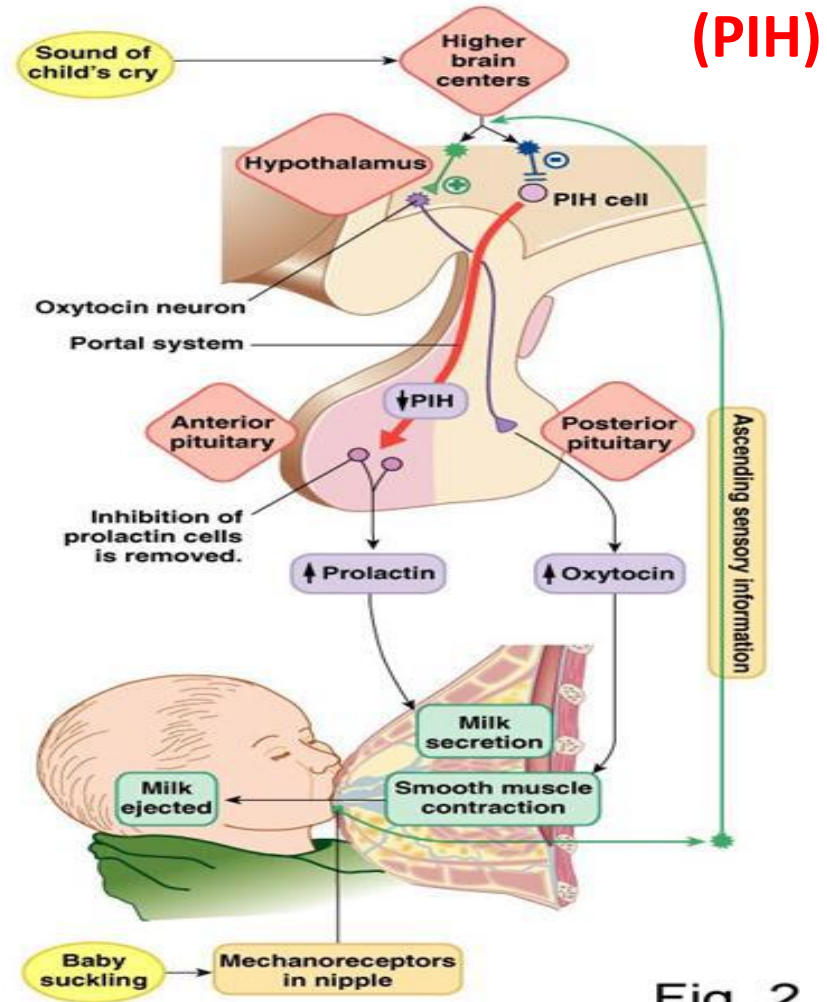
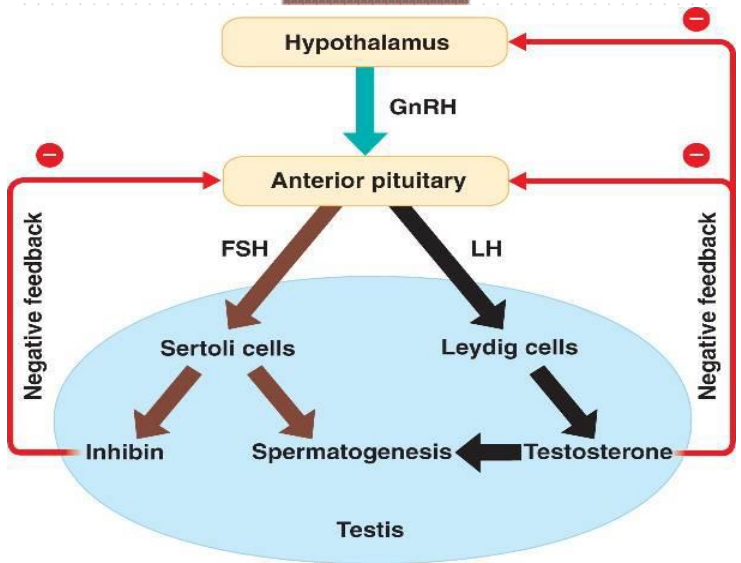
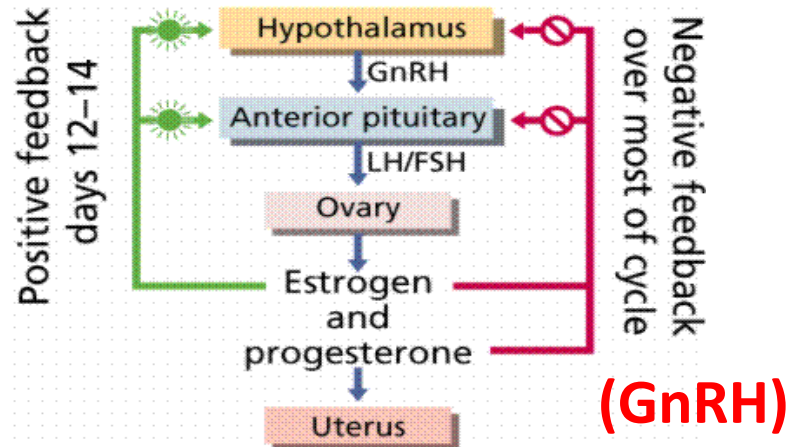
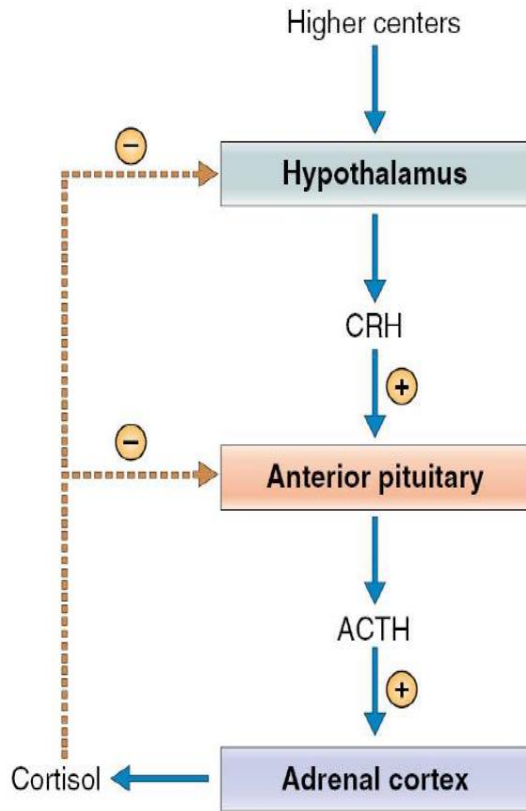
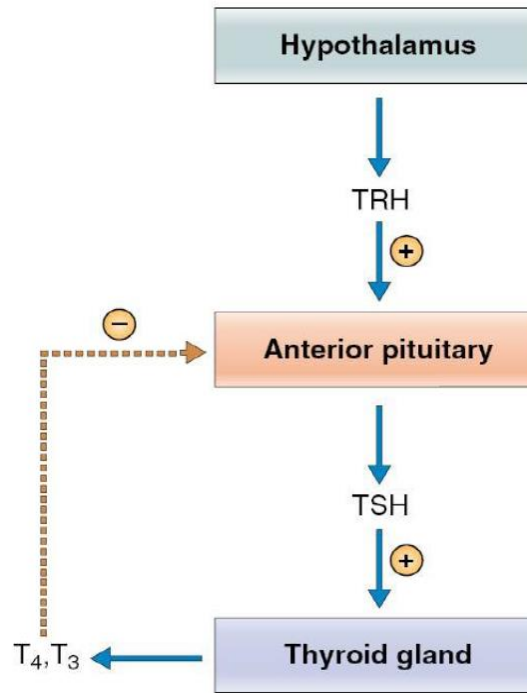


Fig. 2

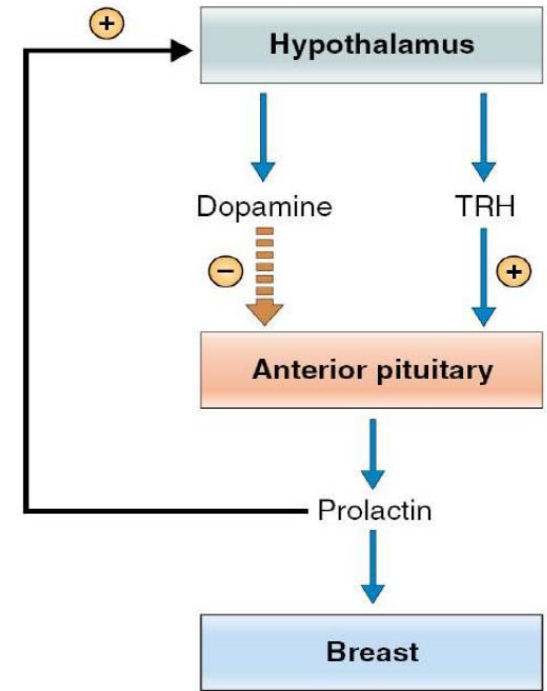
CRH



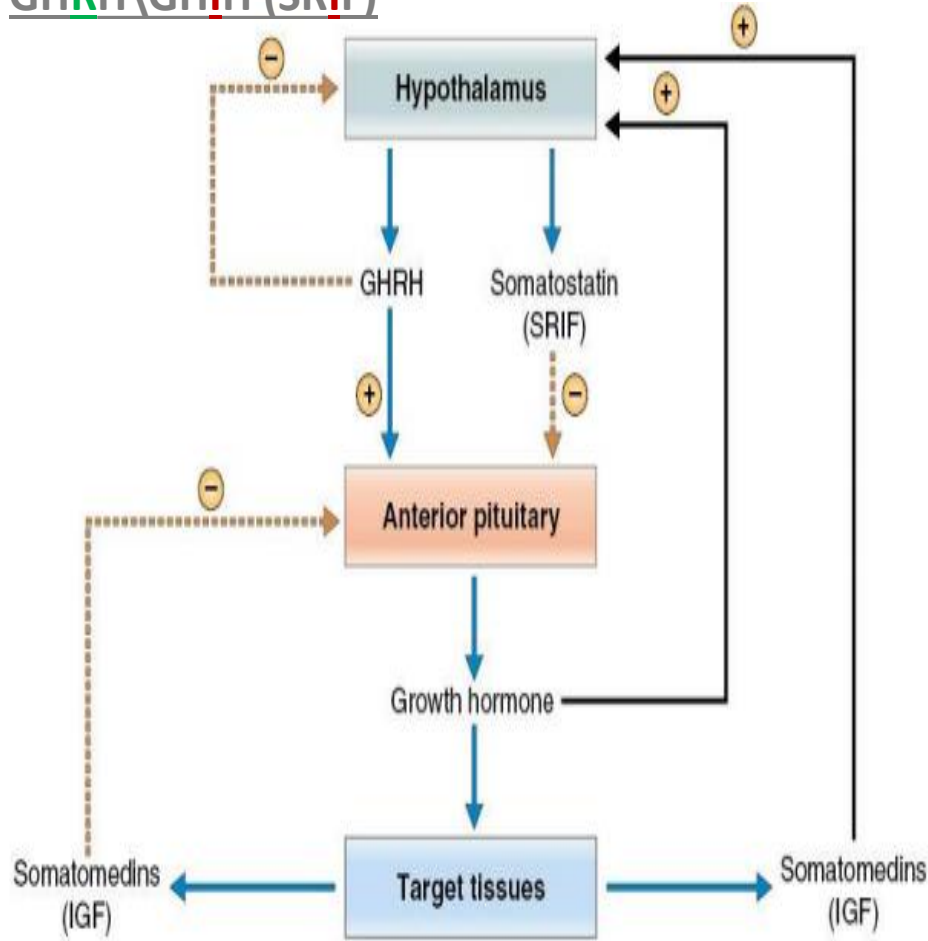
TRH



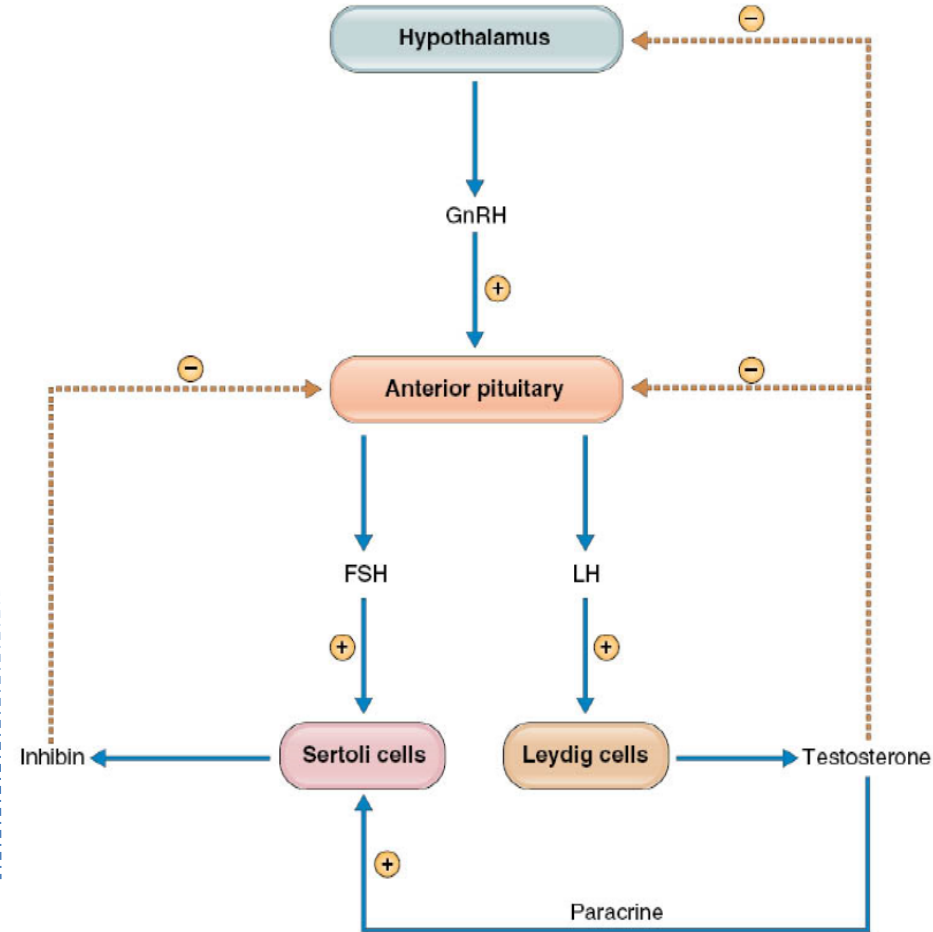
PIH



GHRH\GHIH (SRIF)



GnRH



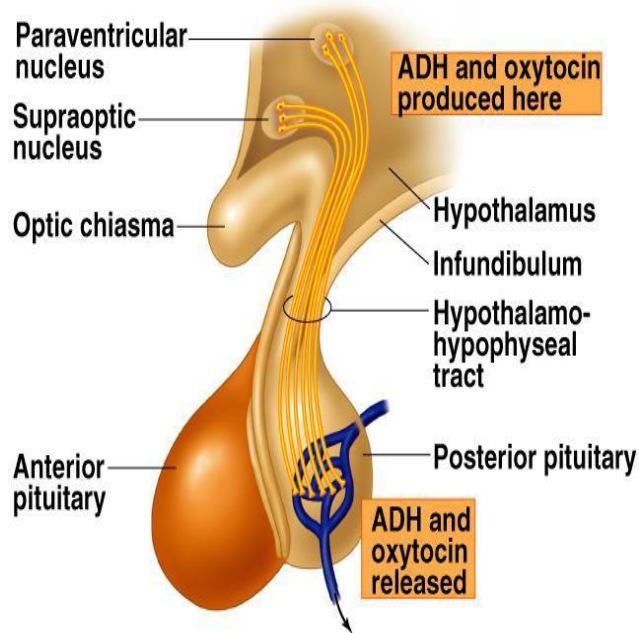
Hypothalamic control of posterior pituitary

* Next slide contains a great summary for some of these information, go through it (it is very helpful) =p

- The posterior pituitary gland is composed mainly of glial-like cells called **Pituicytes**. “ not secretory , just a supporting cells “
- The pituicytes **do not secrete hormones**; they act as a **supporting** structure for terminal nerve fibers and endings from nerve tracts that originate in the supraoptic and paraventricular nuclei of **the hypothalamus**.

Remember

The connection between :
*Hypothalamus + **Anterior lobe**
is = **Vascular connection**
*Hypothalamus + **posterior lobe**
= **neural connection !**



- These tracts pass to the neurohypophysis (**posterior lobe**) through the **pituitary stalk**.
- The nerve endings lie on the surfaces of capillaries, where they secrete two posterior pituitary hormones:
 1. **Antidiuretic hormone (ADH), vasopressin**
 2. **Oxytocin**
(they transmitted along the nerve tract from hypothalamus “the supraoptic and paraventricular nuclei “ to posterior pituitary gland to be **STORAGE**)
- Magnocellular neurons “in paraventricular and supraoptic nuclei secrete oxytocin and vasopressin **directly** into capillaries in the posterior lobe

Hypothalamic control of posterior pituitary

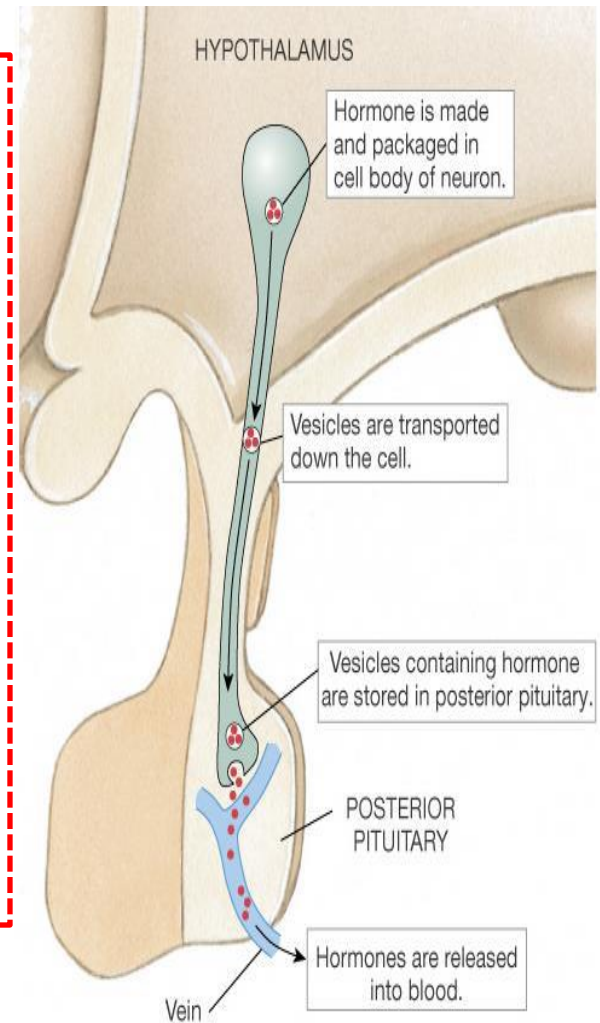
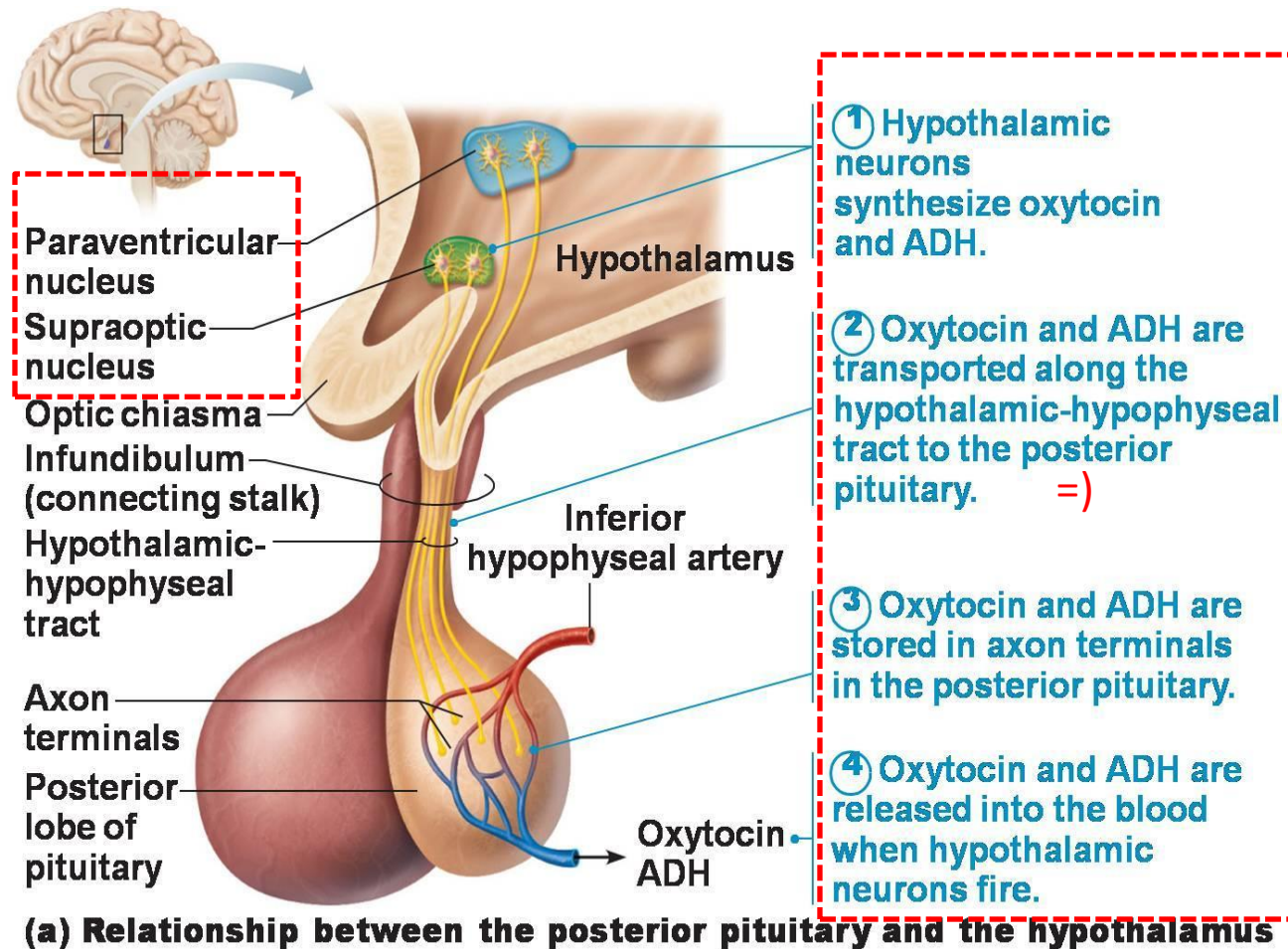


Figure 1

■ Slides

■ Important

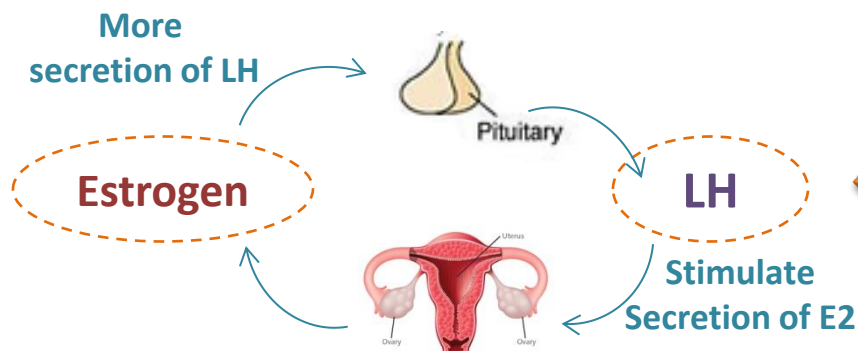
■ Females' Notes

■ Explanation

■ Males' Notes

1 > Negative feedback The dominant

- After a stimulus causes release of the hormone, conditions or products resulting from its action tend to suppress its further release **to prevent oversecretion of the hormone**. This is controlled by **the degree of activity of the target tissue**. “ that means it’s depend on the sensitivity or affinity of the receptor , **NOT** the level of hormone “



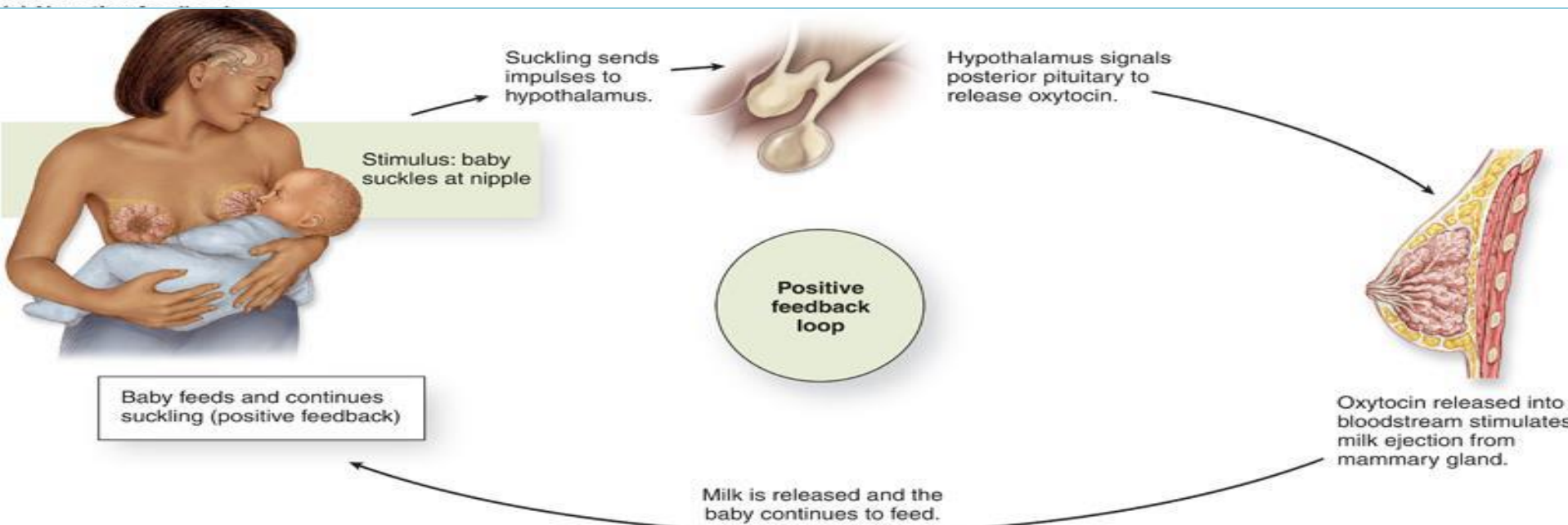
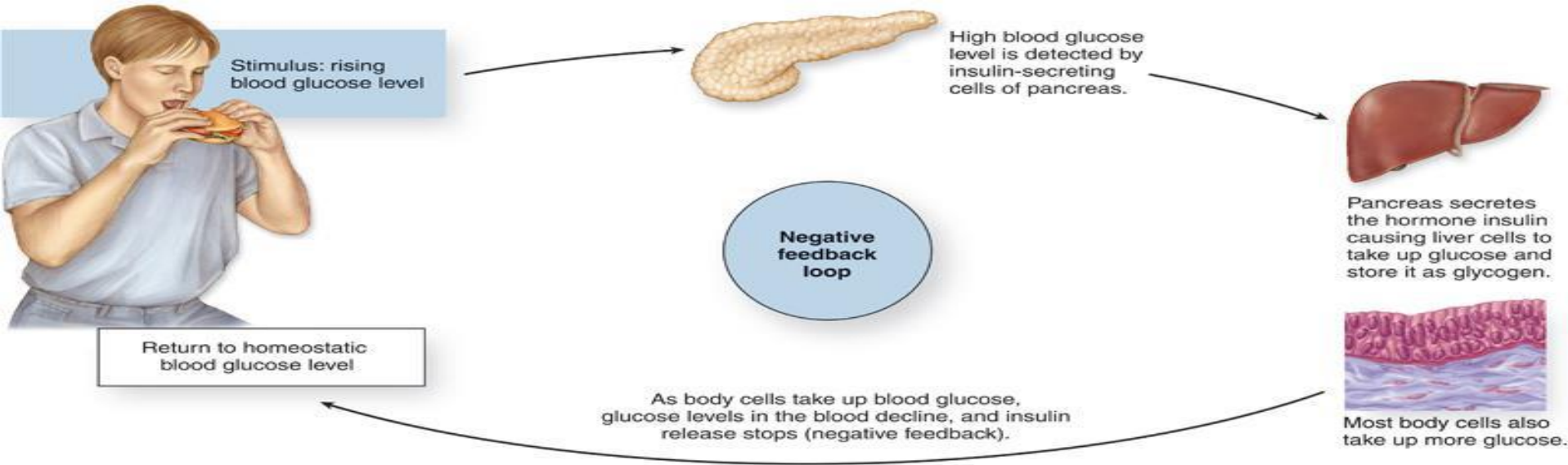
2 > Positive feedback

- It occurs when the biological action of the hormone causes additional secretion of the hormone.

Example: The LH surge “Luteinizing hormone level is suddenly increase just before ovulation “ occurs as a result of the **stimulatory effect of E2** “Estrogen hormone” on the anterior pituitary before ovulation.

The secreted LH then acts on the ovaries to stimulate secretion of E2, which in turn causes more secretion of LH. Eventually, LH reaches an appropriate concentration, and typical negative feedback control of hormone secretion is then exerted.

* see the next slide for more examples of these 2 types of feedback.

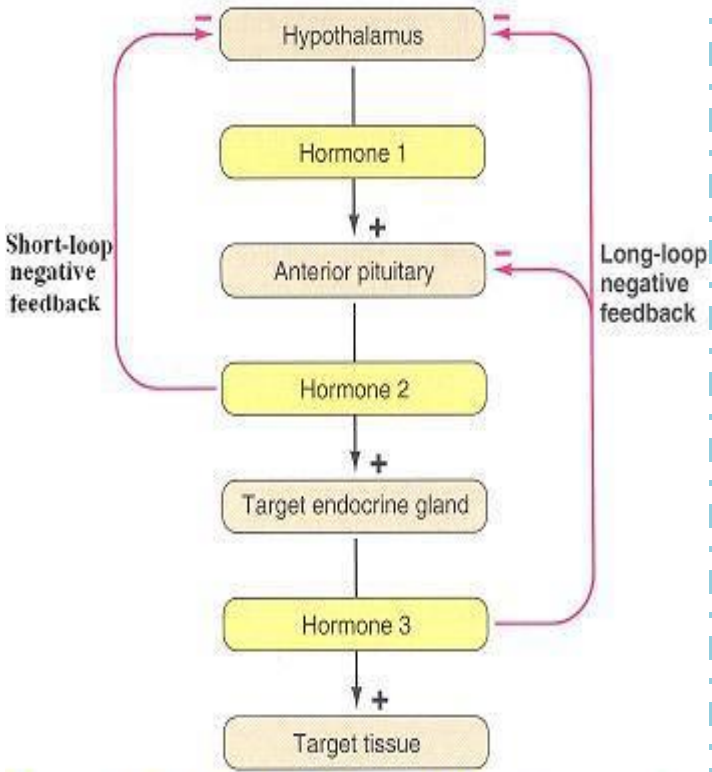


(b) Positive feedback



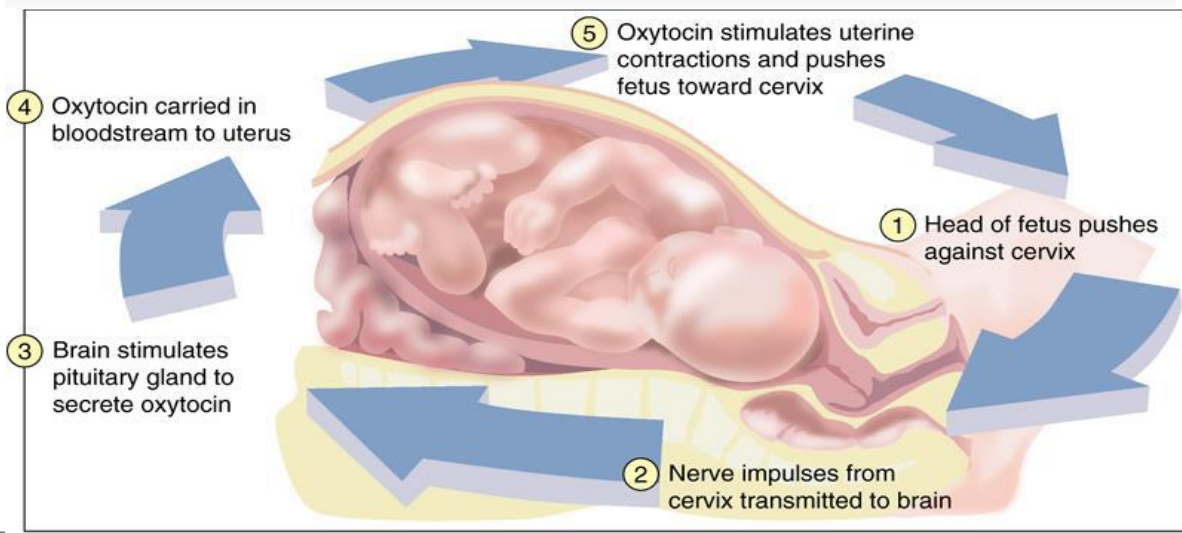
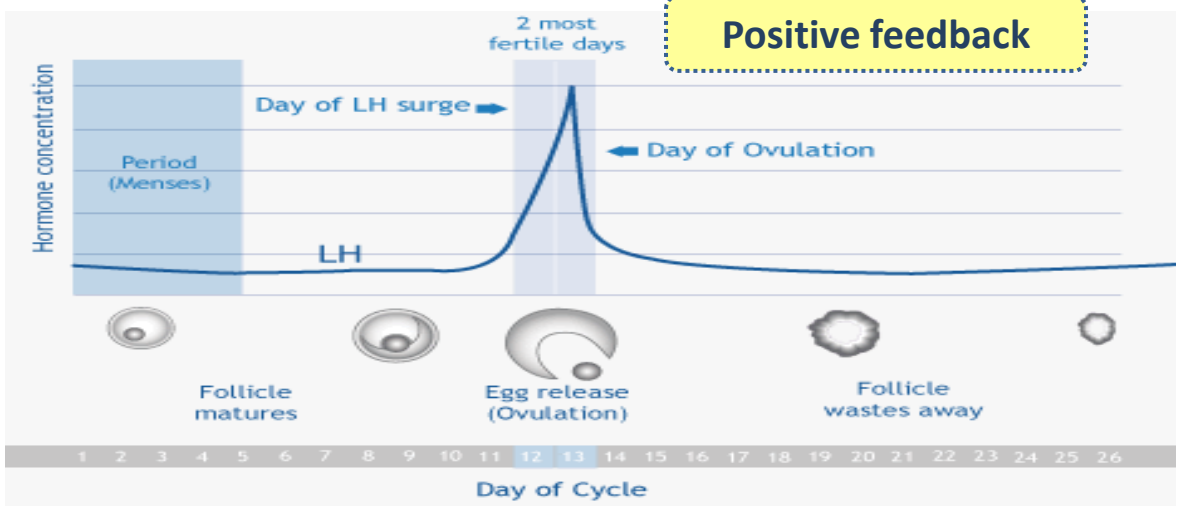
Feedback control of hormone secretion (E.G.)

Negative feedback



Negative feedback in hypothalamic-anterior pituitary control systems

Positive feedback



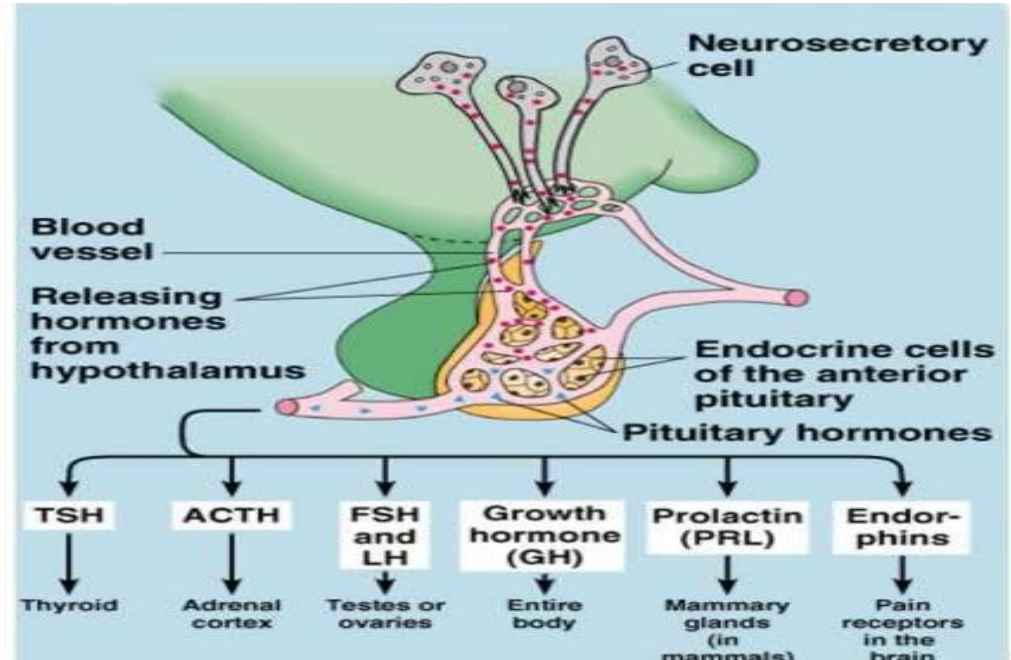
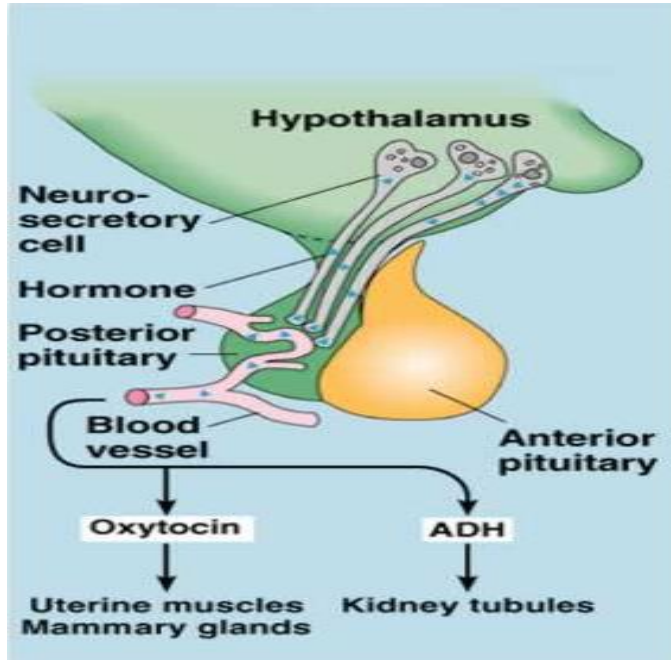


SUMMARY

- The pituitary gland (the hypophysis), is a small gland but it has many physiological functions.
- It lies in the **sella turcica**, a bony cavity at the base of the skull.
- It is connected to the hypothalamus by the **pituitary (or hypophysial) stalk**.
- Physiologically, the pituitary gland is divisible into two distinct portions (lobes):
 - Anterior (Adenohypophysis) Originate from **Rathke's pouch**.
 - Posterior (Neurohypophysis) Originate from neural tissue outgrowth from **hypothalamus**.
- Hypothalamus controls pituitary secretion by:
 - Hormonal signals, Control **anterior pituitary** secretion.
 - Nervous signals, Control **posterior pituitary** secretion.
- Hypothalamus is connected to the anterior pituitary by vascular connection (**hypothalamic-hypophysial portal system**).
- while it's connected to the posterior pituitary by neural connection (**hypothalamic-hypophysial tract**)
- **Relationship of the hypothalamus to the posterior pituitary:**
 - collection of nerve axons + supporting cells.
 - ADH (supraoptic nuclei) \ Oxytocin (paraventricular nuclei)
- **Relationship of the hypothalamus to the Anterior pituitary:**
 - collection of endocrine glands.



Summary of Hypothalamic Control of Pituitary Gland



- The feedback control of hormone secretion are two types :
 - **Negative feedback** (the dominant) : it's controlled by the degree of activity of the target tissue .
 - **Positive feedback** : It occurs when the biological action of the hormone causes additional secretion of the hormone.

1. The body's 'master gland' is the:

- A) Thyroid gland.
- B) Parathyroid gland.
- C) Pituitary gland.
- D) Pancreas.

2. Which of the following is not produced by the human anterior pituitary gland?

- A) Prolactin.
- B) Luteinizing hormone.
- C) Follicle-stimulating hormone.
- D) Oxytocin.

3. Releasing hormones are produced by:

- A) The hypothalamus.
- B) The anterior pituitary.
- C) The posterior pituitary.
- D) The ovaries and testes.

4. Releasing hormones directly affect:

- A) The hypothalamus.
- B) The anterior pituitary.
- C) The posterior pituitary.
- D) The ovaries and testes.

5. A suckling infant will stimulate the production of which hormone in a breast-feeding mother?

- A) Growth Hormone (GH)
- B) Follicle-Stimulating Hormone (FSH)
- C) Prolactin (PRL)
- D) Luteinizing Hormone (LH)

6. All of these hormones are neurohormones produced in the hypothalamus EXCEPT :

- A) GnRH
- B) PRH
- C) CRH
- D) FSH

1	C
2	D
3	A
4	B
5	C
6	D

[Check this link for more questions. \(From: Asma AlMohizea\)](#)

■ [Slides](#)

■ [Important](#)

■ [Females' Notes](#)

■ [Explanation](#)

■ [Males' Notes](#)

THE END

If there are any Problems or Suggestions,
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THANK YOU



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