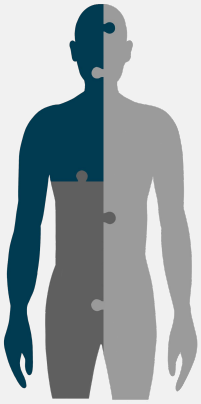
Physiology Team 439

MED439
KING SAUD UNIVERSITY

Revised & Approved

Bassam Alasmari
Rania Almutiri



Hypothalamo-Pituitary axis and regulatory mechanism

Objectives:

- Structure of pituitary gland:
  - ➢ Anterior pituitary cell types and hormones.
  - ➢ Posterior pituitary cell types and hormones.
- Hypothalamic control of pituitary gland:
  - ➢ Hypothalamo-hypophyseal portal system.
  - ➢ Hypothalamo-hypophyseal tract.
- Feedback mechanisms:
  - ➢ Positive feedback.
  - ➢ Negative feedback.

Color index:

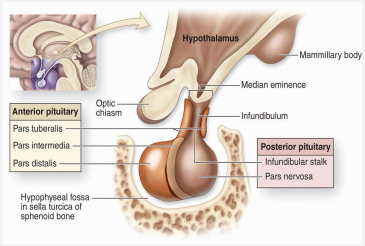
- Important.
- Girls slide only.
- Boys slide only.
- Dr's note.
- Extra information.

Editing File

Structure of Pituitary Gland

Pituitary gland (Hypophysis): is a 1cm gland that weigh 0.5-1g.

❖ **Pituitary gland consist of two lobes:**
- Anterior (Adenohypophysis) real gland
- Posterior (Neurohypophysis) related to hypothalamus
- Infundibulum connects the posterior lobe to hypothalamus

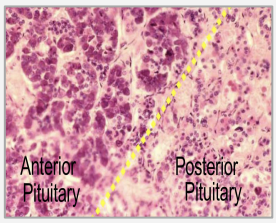


Relation to optic chiasm

Histology of Pituitary Gland*

❖ Anterior pituitary originates from Rathke's pouch (pharyngeal epithelium), which explains the epithelioid nature of its cells.

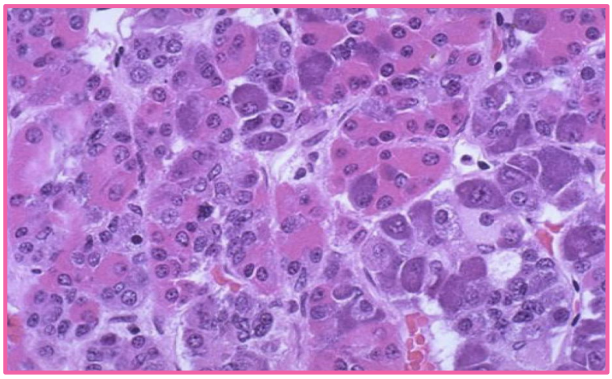
❖ Posterior pituitary originates from hypothalamus (neural tissue), which explains the cell type being (glial-type cells).



Anterior pituitary contains 5 cell types:

Anterior pituitary gland contains 5 cells which secrete 6 hormones, because 2 hormones are secreted from the same cell *(point no. 4).*
Female doctor: "no need to memorize the percentages"

1. **Somatotrops**
   GH 40%.
2. **Corticotrops**
   ACTH 20%
3. **Thyrotropes**
   TSH
4. **Gonadotropes**
   LH & FSH
5. **Lactotrops**
   PRL



Trops = Trophs all are correct.

Hypothalamus *

- Hypothalamus Composed of number of nerve cells.
- **Hypothalamic-Pituitary Axis:** coordinate Thyroid gland, adrenal gland & reproductive gland. It also controls growth, milk production and osmoregulation.

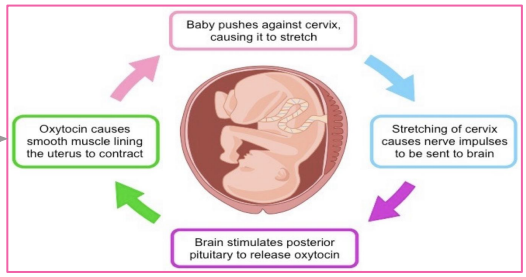
Feedback Mechanism

Positive Feedback Mechanism

*Release of hormone A stimulates the release of hormone B. Hormone B **stimulates** further release of hormone A. *Females slides only but it was mentioned by the boys doctor

Example

Doctors" explanation: Contraction -> stretch -> contraction -> stretch
This goes on until the baby is delivered or the uterus ruptures.
Oxytocin induces labor -> stimulates uterine contraction

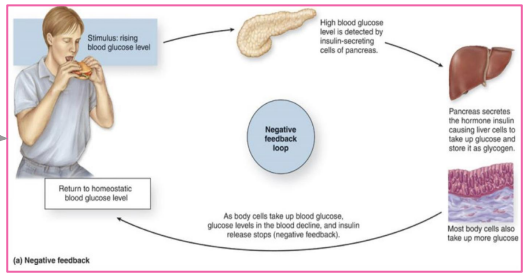


Negative Feedback Mechanism

*Release of hormone A stimulates the release of hormone B. Hormone B **inhibits** the release of hormone A. *Females slides only but it was mentioned by the boys doctor

Example

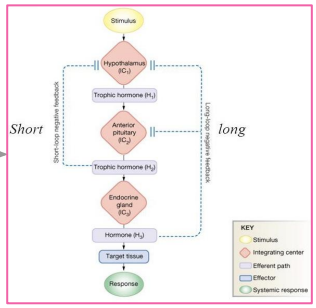
Doctors" explanation: After ingesting a meal, blood glucose level will rise (hyperglycemia) due to absorption of glucose. The pancreas will secrete insulin which will cause glucose utilization -> lowers glucose blood level.



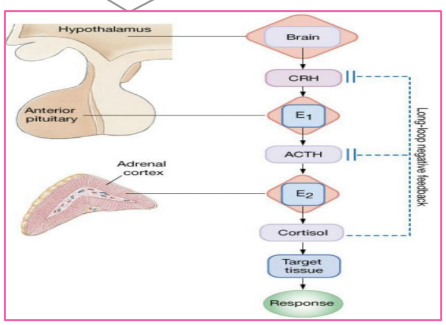
Negative feedback mechanism: Long and short loop reflexes

Example

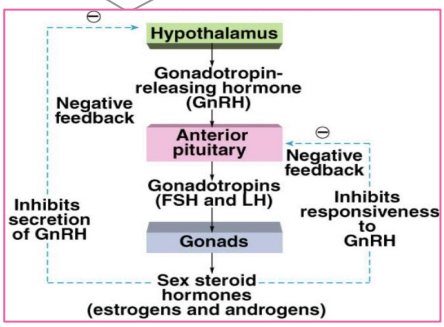
Doctors" explanation:
1.Long loop: Hormone secreted from target gland feedbacks on anterior pituitary and hypothalamus
2.Short loop: Hormone secreted from ant. Pituitary feedbacks on hypothalamus



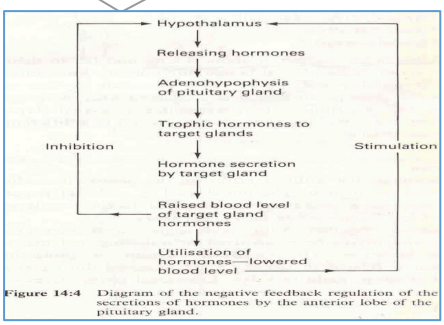
Negative feedback control mechanism of CORTISOL (skipped)



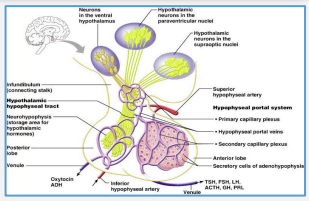
Negative feedback mechanism of sex steroid hormones (skipped)



Negative feedback mechanism



Hypothalamic control of Pituitary Gland



❖ **Hypothalamic control of pituitary gland:**
- Hypothalamo-hypophyseal portal system/ portal vessels/circulation
- Hypothalamo-hypophyseal tract/ neural tract / neural axons

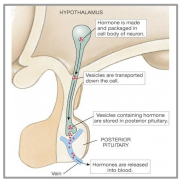
❖ **Almost all secretions by the pituitary are controlled by either:**
- Hormonal secretion of hypothalamus to the portal system to (Anterior pituitary).
- Nervous signals from hypothalamus to the neural tract to (Posterior pituitary).

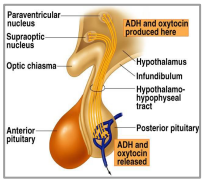
Control of Posterior Pituitary By Hypothalamus:

We'll start with the posterior because it's simpler and easier.

1 Connected by collection of nerve axons + supporting cells and secrete these hormones:

- Antidiuretic hormone (ADH) synthesized in the supraoptic nuclei.
- Oxytocin hormone synthesized in paraventricular nuclei.





2 Both of these hormones are transported in vesicles, released, and stored in posterior pituitary.

Control of Anterior Pituitary By Hypothalamus:*

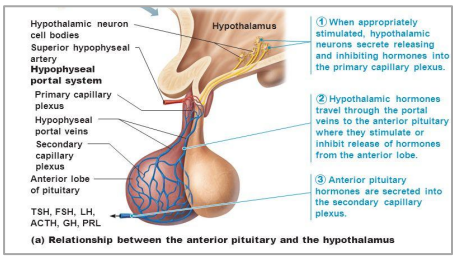
Explained by males doctor.

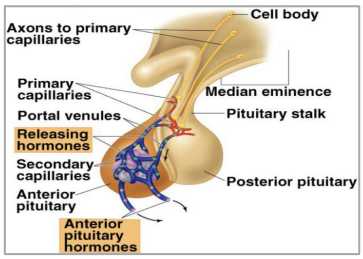
1 Anterior pituitary gland is connected to hypothalamus by portal system: "**hypothalamic-hypophyseal portal vessels**"

2 Special neurons in the hypothalamus synthesize and secrete the hypothalamic releasing and inhibitory hormones that control secretion of anterior pituitary. Both neural and endocrine control.

3 Neurons send their nerve fibers to the median eminence (extension of hypothalamic tissue into the pituitary stalk).

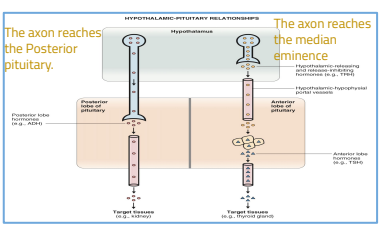
4 Hormones are secreted to the tissue fluids, absorbed into the hypothalamic-hypophyseal portal system and transported to the sinuses of the anterior pituitary.



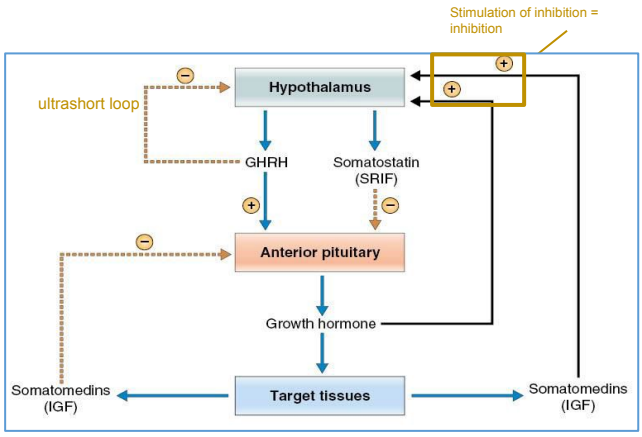
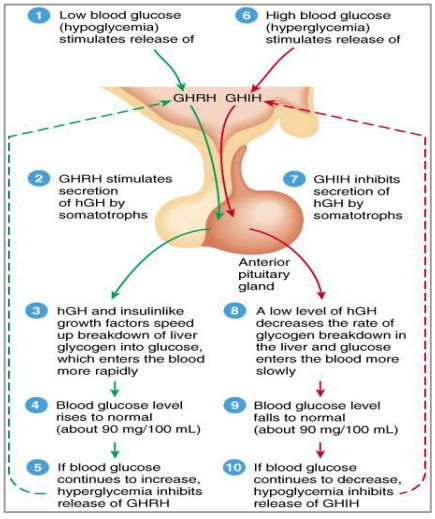
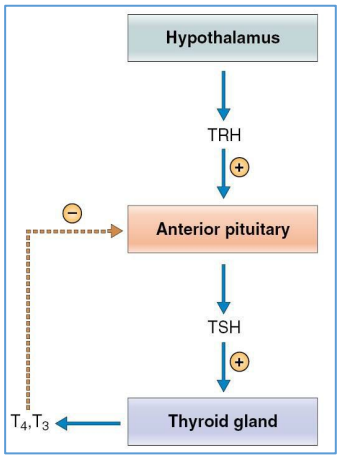
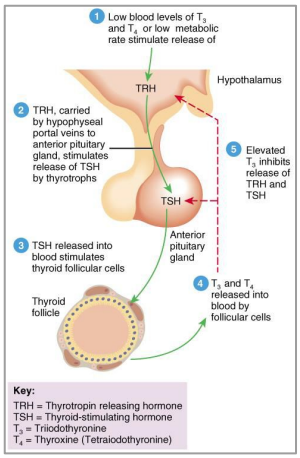


Whats the difference between the anterior and the posterior pituitary? مذكور الكلام من قبل الدكاترة بأجزاء متفرقة فجمعناه هنا

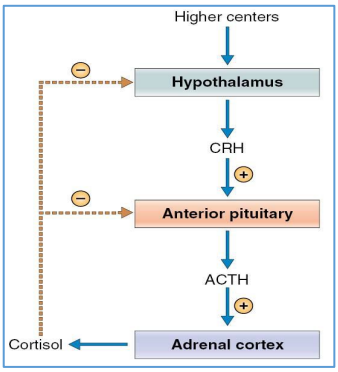
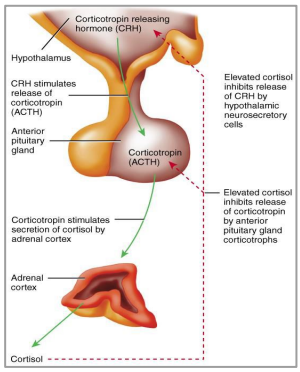
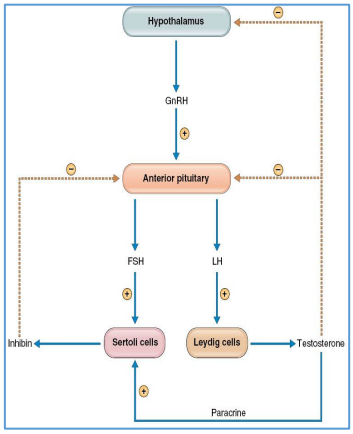
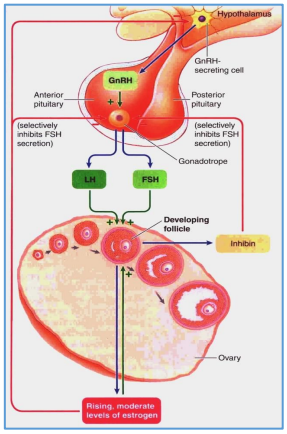
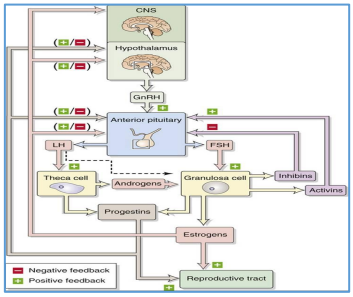
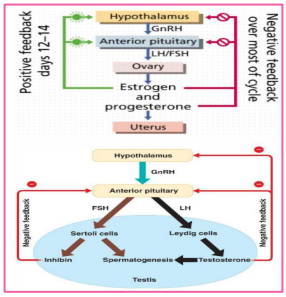
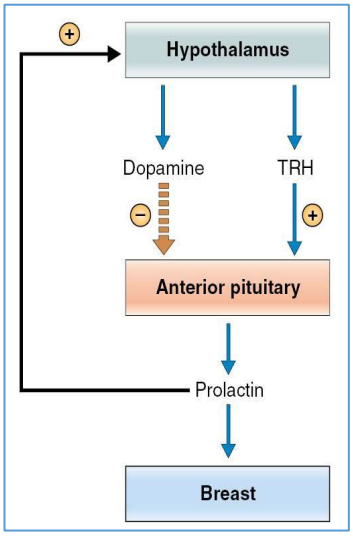
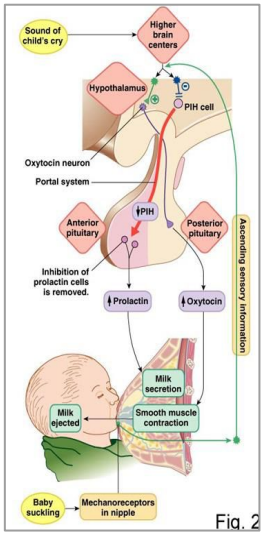
1. Both structures secrete hormones, and those secretions are controlled by the hypothalamus, however;
   a. The hormones of the Post. Pituitary are synthesized in the hypothalamus.
   b. The hormones of the Ant. Pituitary are synthesized in the Ant. Pituitary.
2. **The relationship between:**
   a. Hypothalamus and Posterior pituitary= straight-forward Neuronal (important)
   b. Hypothalamus and Anterior pituitary= Both Neuronal and Endocrine
3. *The image >*



Hypothalamic Releasing and Inhibiting Hormones of Anterior Pituitary

Hormones	Information	Images
Growth hormone releasing hormone (GHRH)	GHRH Stimulates release of Growth Hormone. GHIH inhibit release of Growth Hormone. GHIH is also called somatostatin. a tip for the next lecture 😉 *Top image:* Hypothalamus will secrete GHRH that will act on Anterior pituitary to stimulate secretion of GH. GH will reach bloodstream and reach target tissue to cause its effect. A byproduct of GH is called somatomedin. Majority of GH acts by somatomedin (indirect), and the rest acts direct. 1- GHRH inhibits its own secretion from the hypothalamus via an ultrashort loop feedback 2- Somatomedins inhibit secretion of GH by ant. pituitary. 3- Both GH & somatomedin stimulate secretion of somatostatin by the hypothalamus. The overall effect is inhibitory (negative feedback) because somatostatin inhibits GH secretion.	
Growth hormone inhibiting hormone (GHIH)	*Bottom image:* Females doctor: just go through it. Males doctor: Hypoglycemia stimulates the release of GH. GH causes gluconeogenesis -> high level of glucose in circulation. In contrast, hyperglycemia leads to decreased secretion of GH. You know why there is this connection? The part of the hypothalamus that causes secretion of GHRH is the same area of the hypothalamus that is sensitive to blood glucose concentration.	
Thyrotropin releasing hormone (TRH)	Stimulates the release of Thyroid Stimulating Hormone (TSH). It will be secreted by hypothalamus and act on thyrotrophs of anterior pituitary gland to cause secretion of TSH. TSH then acts on thyroid gland to stimulate secretion of T3 and T4 (thyroid hormones). T3 and T4 inhibit secretion of TSH (-ve feedback)	 

Hypothalamic Releasing and Inhibiting Hormones of Anterior Pituitary

Hormones	Information	Images
Corticotropin releasing hormone (CRH)	Stimulates the release of Adrenocorticotropic Hormone (ACTH). CRH will act on corticotrophs of anterior pituitary gland to secrete ACTH which will work on adrenal cortex and cause secretion of adrenocortical hormones. This will feedback on hypothalamus and Ant pituitary to inhibit further release of hormone.	 
Gonadotropin releasing hormone (GnRH)	Stimulates the release of two gonadotropic hormones: ❖ Luteinizing hormone (LH). ❖ Follicle-stimulating hormone (FSH). GnRH is secreted by the hypothalamus and acts on gonadotrophs of the anterior pituitary gland can cause secretion of LH and FSH that will work on gonads (ovary/testicles). Males Dr: It will be studied in details next block, just appreciate the fact that the target tissue of FSH and LH is the Gonads.	   
Prolactin inhibitory hormone (PIH)	Also called Dopamine. Inhibit the secretion of Prolactin. There are two regulatory pathways from hypothalamus:1) inhibitory via dopamine and 2)stimulatory via TRH. In persons who are not pregnant or lactating, prolactin secretion is **tonically** inhibited by dopamine (PIF) from the hypothalamus. The inhibitory effect of dopamine dominates and overrides the stimulatory effect of TRH. الدوبامين تاثيره قوي جدا فـ لما يكون موجود ماراح يعطينا برولاكتين لانه ضاغط على ال lactotrophs ومسوي inhibition. مجرد مايروح الدوبماين راح يصير فيه stimulation و راح تزداد عندنا كمية البرولاكتين بكثرة . main stimulus of prolactin secretion is limitation of dopamine تاثيره اقوى compared to TRH	 

Clinical Application*

*Was in 438 females slides, but a similar concept was mentioned by this years doctor.

What will happen if pituitary gland is removed from its normal position and transplanted to other part of the body?/ "cut"?

A) Release of all hormones will stop.
B) Release of some hormones will decrease to very low levels.
C) Release of some hormones will increase.

Answer: both the B and C answer are correct. All Ant. Pituitary hormones will not be released except for Prolactin, because the PIF will not be released (no inhibition leads to stimulation), and thus it'll increase.

Summaries

From the slides

Table 9–2 Summary of Endocrine Glands and Actions of Hormones

Gland of Origin	Hormones*	Chemical Classification†	Major Actions
Hypothalamus	Thyrotropin-releasing hormone (TRH)	Peptide	Stimulates secretion of TSH and prolactin
	Corticotropin-releasing hormone (CRH)	Peptide	Stimulates secretion of ACTH
	Gonadotropin-releasing hormone (GnRH)	Peptide	Stimulates secretion of LH and FSH
	Somatostatin or somatotropin release–inhibiting hormone (SRIF)	Peptide	Inhibits secretion of growth hormone
	Dopamine or prolactin-inhibiting factor (PIF)	Amine	Inhibits secretion of prolactin
	Growth hormone–releasing hormone (GHRH)	Peptide	Stimulates secretion of growth hormone

Summary of Anterior Pituitary Hormones:

From the slides, Just read it and be familiar with the hormones. They will be discussed in details in the next lectures.

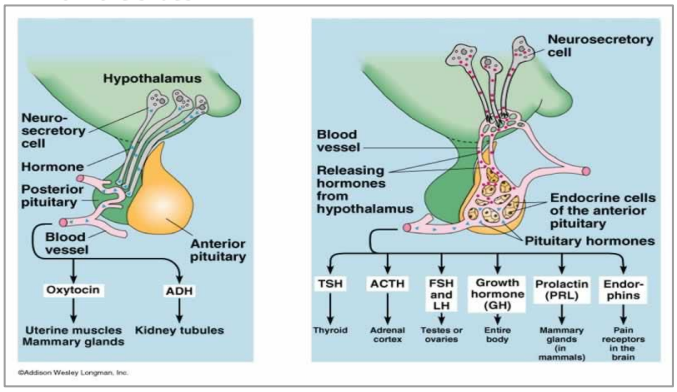
Table 11.6 | Anterior Pituitary Hormones

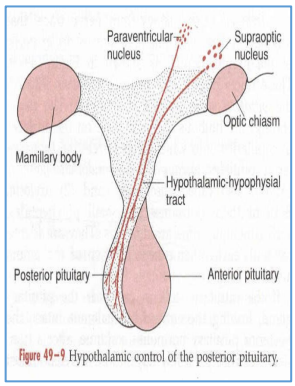
Hormone	Target Tissue	Principal Actions	Regulation of Secretion
ACTH (adrenocorticotropic hormone)	Adrenal cortex	Stimulates secretion of glucocorticoids	Stimulated by CRH (corticotropin-releasing hormone); inhibited by glucocorticoids
TSH (thyroid-stimulating hormone)	Thyroid gland	Stimulates secretion of thyroid hormones	Stimulated by TRH (thyrotropin-releasing hormone); inhibited by thyroid hormones
GH (growth hormone)	Most tissue	Promotes protein synthesis and growth; lipolysis and increased blood glucose	Inhibited by somatostatin; stimulated by growth hormone-releasing hormone
FSH (follicle-stimulating hormone)	Gonads	Promotes gamete production and stimulates estrogen production in females	Stimulated by GnRH (gonadotropin-releasing hormone); inhibited by sex steroids and inhibin
PRL (prolactin)	Mammary glands and other sex accessory organs	Promotes milk production in lactating females; additional actions in other organs	Inhibited by PIH (prolactin-inhibiting hormone)
LH (luteinizing hormone)	Gonads	Stimulates sex hormone secretion; ovulation and corpus luteum formation in females; stimulates testosterone secretion in males	Stimulated by GnRH; inhibited by sex steroids

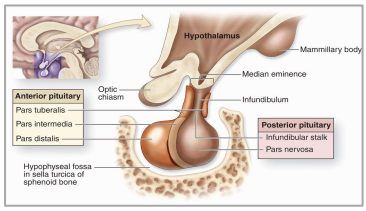
Summary of Hypothalamic Control of Pituitary Gland:

Click here for a summary of the Ant. Pituitary done by Asma Alamri and Shaden Alobaid!

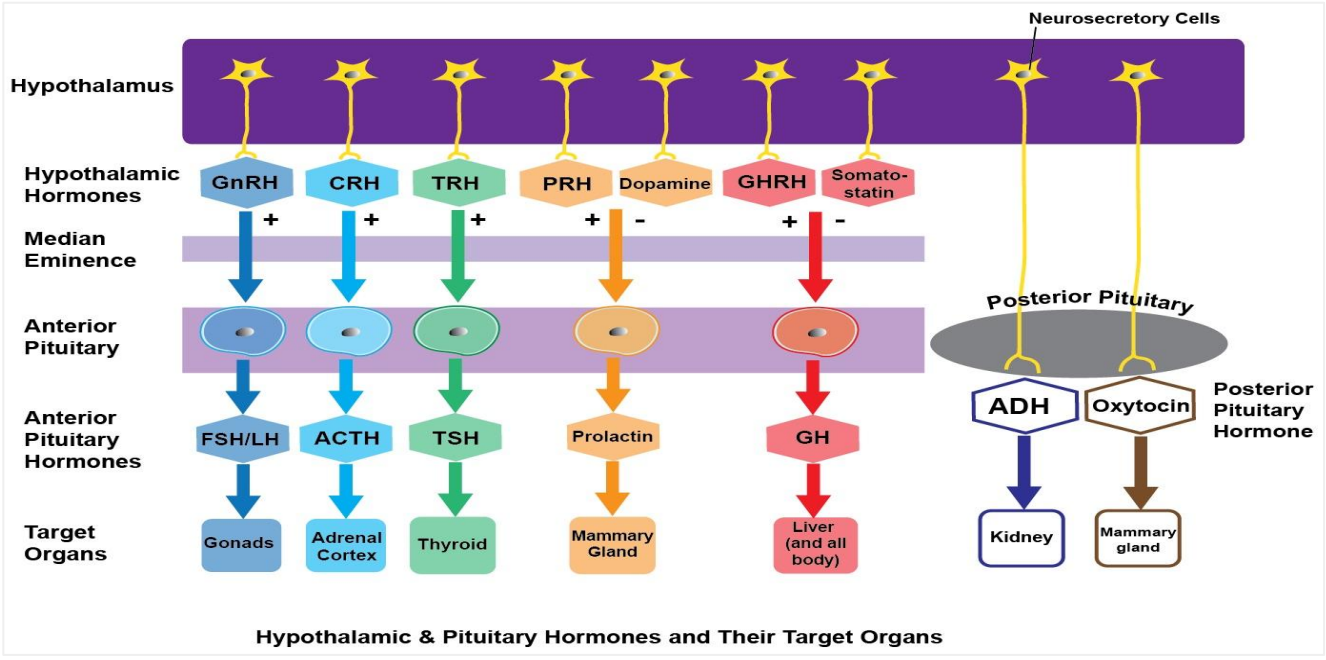
From the slides







Extra



Hypothalamic & Pituitary Hormones and Their Target Organs

الله يوفقن

person: tries to lose weight
endocrine system:

MCQ & SAQ:

Q1: Which one of the following hormones is released by Somatotrops?

A. TSH
B. GH
C. ACTH
D. FSH

Q2: Which of the following is secreted in the hypophyseal portal system?

A. CRH
B. Prolactin
C. Growth hormone
D. ACTH

Q3: Which one of the following cells produce Luteinizing Hormone?

A. Gonadotropes
B. Somatotrops
C. Lactotrops
D. Thyrotropes

Q4: What is Growth hormone releasing hormone (GHRH) effect on Growth hormone?

A. Increase Growth hormone
B. Decrease Growth hormone
C. Positive feedback on Growth hormone
D. Negative feedback on Growth hormone

Q5: Gonadotropin releasing hormone (GnRH) affect which of the following hormones?

A. Luteinizing hormone
B. Follicle-stimulating hormone
C. Prolactin hormone
D. A+B

Q6: Oxytocin hormone synthesis in?

A. Supraoptic nuclei
B. Supraventricular nuclei
C. Paraventricular nuclei
D. Chiasmal nuclei

answer key:
1: B
2: A
3: A
4: A
5: D
6: C

1- Mention 5 cells located in the Anterior pituitary gland?

2- What are the hormones synthesized from the anterior pituitary cells?

3- List 3 of the hypothalamic hormones and mention their function.

A1: 1-Somatotrops 2-Corticotrops 3-Thyrotropes 4-Gonadotropes 5-Lactotrops

A2: GH, ACTH, TSH, LH, FSH, PRL

A3:
Growth hormone releasing hormone (GHRH) Stimulates release of Growth Hormone.
Growth hormone inhibiting hormone (GHIH) inhibit release of Growth Hormone.
Thyrotropin releasing hormone (TRH) Stimulates the release of Thyroid Stimulating Hormone (TSH).
Corticotropin releasing hormone (CRH) Stimulates the release of Adrenocorticotropic Hormone (ACTH).
Gonadotropin releasing hormone (GnRH) Stimulates the release of Luteinizing hormone (LH) & Follicle-stimulating hormone (FSH).
Prolactin inhibitory hormone (PIH) Inhibit secretion of Prolactin.

Leaders:

- Samar Almohammedi
- **Aljoud Algazlan**
- Mohamed Alquhidan

Organizers:

- Sarah alqahtani
- Albandari Alanazi
- Renad alhomaidi
- **Asma Alamri**
- Hessah Alalyan

Note takers:

- Homoud algadheb
- Raghad albarrak
- **Abdulaziz Alrabiah**
- Shuaa khdary
- **Shaden alobaid**
- Duaa Alhumoudi

Revisers:

- **Abeer Awwad**

MEMBERS:

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- **Abdullah Alburikan**
- Abdulaziz Alkraida
- Mohammed alkathiri
- Ahmad Alkhayatt
- Omar Alhalabi
- Rakan aldohan
- Mohamed Akresh
- Bader Alrayea
- Saud Alhasani
- Yazeed Alghtani
- Abdulrhman Alsuhaibany
- Khalid alkublan
- Mayasem Alhazmi
- **Joud Alarifi**
- Muneerah Alsadhan
- Sarah Alqahtani
- Bushra Abdulaziz
- Yara Alasmari
- Budoor Almubarak
- Tarfa Alsharidi
- Sarah AlQuwayz
- Budoor Almubarak
- Sara Alharbi
- Leena almazyad
- Noura aldahash

Physiology439@gmail.com