

# ANATOMY, PHYSIOLOGY & PATHOLOGY NOTES OF THE **ENDOCRINE** SYSTEM

## FOURTH EDITION

PRE-SUMMARIZED  
READY-TO-STUDY  
HIGH-YIELD NOTES

FOR THE TIME-POOR  
MEDICAL, PRE-MED,  
USMLE OR PA STUDENT



141 PAGES



## A Message From Our Team

Studying medicine or any health-related degree can be stressful; believe us, we know from experience! The human body is an incredibly complex organism, and finding a way to streamline your learning is crucial to succeeding in your exams and future profession. Our goal from the outset has been to create the greatest educational resource for the next generation of medical students, and to make them as affordable as possible.

In this fourth edition of our notes we have made a number of text corrections, formatting updates, and figure updates which we feel will enhance your study experience. We have also endeavoured to use only open-source images and/or provide attribution where possible.

**If you are new to us, here are a few things to help get the most out of your notes:**

- 1. Once saved, the notes are yours for life!** However, we strongly advise that you download and save the files immediately upon purchasing for permanent offline access.
- 2. Sharing notes is prohibited.** All files are share-protected and our system will automatically revoke access to and lock files if it detects a customer attempting to share or distribute our notes.
- 3. Your license permits you to do the following:**
  - a. You may download/save/view files on up to 2 simultaneous devices.
  - b. You may save the files to an external hard drive for backup purposes only.
  - c. You may print your notes to hard copy on any home printer/photocopier.
- 4. Once saved, you do not need to download the notes again.** You can simply transfer your file/s to your second personal device (eg: your iPad/tablet) without the need to re-download your files. If you wish to retire an old device, simply transfer your files to your new device, then delete the files from your old device.



## Table Of Contents:

**What's included:** Ready-to-study anatomy, physiology and pathology notes of the endocrine system presented in succinct, intuitive and richly illustrated downloadable PDF documents. Once downloaded, you may choose to either print and bind them, or make annotations digitally on your iPad or tablet PC.

### Anatomy & Physiology Notes:

- OVERVIEW OF THE ENDOCRINE SYSTEM
- THE HYPOTHALAMUS & PITUITARY GLAND
- THE PINEAL GLAND
- THE THYROID GLAND
- PARATHYROID GLANDS
- THE ADRENAL GLANDS
- THE 'ENDOCRINE' PANCREAS
- CALCIUM & PHOSPHATE HOMEOSTASIS
- FLUID & ELECTROLYTE HOMEOSTASIS
- ENDOCRINE REGULATION OF GROWTH
- PHYSIOLOGICAL RESPONSE TO STRESS
- REPRODUCTIVE ENDOCRINOLOGY

### Pathology Notes:

- GENERAL OVERVIEW OF ENDOCRINE DISORDERS
- THYROID DYSFUNCTION:
  - HYPOTHYROIDISM (INCL. HASHIMOTO'S DISEASE)
  - HYPERTHYROIDISM (INCL. GRAVE'S DISEASE)
  - DIAGNOSING THYROID DYSFUNCTION
  - NON-TOXIC GOITRES
  - THYROID NEOPLASMS
- GROWTH DYSFUNCTION:
  - GROWTH HORMONE DEFICIENCY (AKA. PITUITARY DWARFISM)
  - GIGANTISM/ACROMEGALY
- ADH DISORDERS:
  - DIABETES INSIPIDUS
  - SIADH
- ADRENAL CORTEX DYSFUNCTION:
  - ADDISON'S DISEASE
  - WATERHOUSE-FRIDERICHSEN SYNDROME
  - CONGENITAL ADRENAL HYPERPLASIA
  - CONN'S SYNDROME
  - CUSHING'S DISEASE/SYNDROME
- PHAEOCHROMOCYTOMA
- DIABETES
- CALCIUM & PHOSPHATE BALANCE DISORDERS:
  - PARATHYROID DISORDERS
- GONADAL DYSFUNCTION
- MULTIPLE ENDOCRINE NEOPLASIA SYNDROME

## OVERVIEW OF THE ENDOCRINE SYSTEM

## OVERVIEW OF THE ENDOCRINE SYSTEM

### Endocrinology:

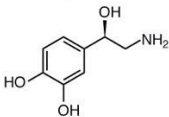
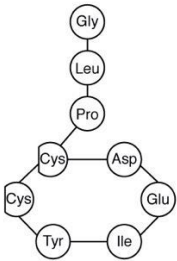
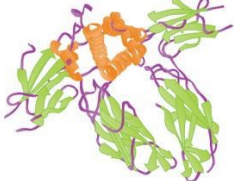
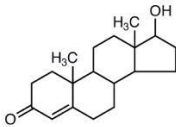
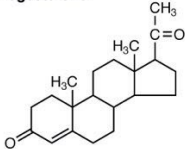
- **Endocrinology:** The scientific study of **Hormones (Chemical Messengers)** and the endocrine organs.
- Endocrine system is critical for **maintaining Homeostasis**

### What is a Hormone?

- Chemical signalling molecules secreted by endocrine glands into the extracellular fluids to exert an effect elsewhere in the body
- Hormones travel in blood or lymph throughout the body
- **BIOLOGICAL SPECIFICITY:** Hormones Interact with **specific receptors** of **specific cells** of **specific organs**.

### Hormones Are Either Steroidal or Non-Steroidal:

- **Steroids Hormones:**
  - Sex Hormones – Eg: Testosterone (Androgens), Oestrogens, Progestogens.
  - Adrenal Hormones – Eg: Glucocorticoids, Mineralocorticoids
  - (Derived from Cholesterol)
- **Non-Steroid Hormones:**
  - **Amino Acid Derivatives:**
    - Catecholamines (Eg: Adrenaline, Nor-Adrenaline & Dopamine) (Derived from Tyrosine)
    - Histamine (Derived from Histidine)
    - All Thyroid Hormones (Derived from Tyrosine)
  - **Proteins:**
    - All Pituitary Hormones
  - **Fatty-Acid Derivatives:**
    - Eg: Prostaglandins
    - Eg: Thromboxanes
  - **Purines:**
    - Eg: Adenosine
  - **Dissolved Gases:**
    - Eg: Nitric Oxide

Hormone Class	Components	Example(s)
<b>Amine Hormone</b>	Amino acids with modified groups (e.g. norepinephrine's carboxyl group is replaced with a benzene ring)	<b>Norepinephrine</b> 
<b>Peptide Hormone</b>	Short chains of linked amino acids	<b>Oxytocin</b> 
<b>Protein Hormone</b>	Long chains of linked amino acids	<b>Human Growth Hormone</b> 
<b>Steroid Hormones</b>	Derived from the lipid cholesterol	<div style="display: flex; justify-content: space-around;"> <div> <b>Testosterone</b>   </div> <div> <b>Progesterone</b>   </div> </div>

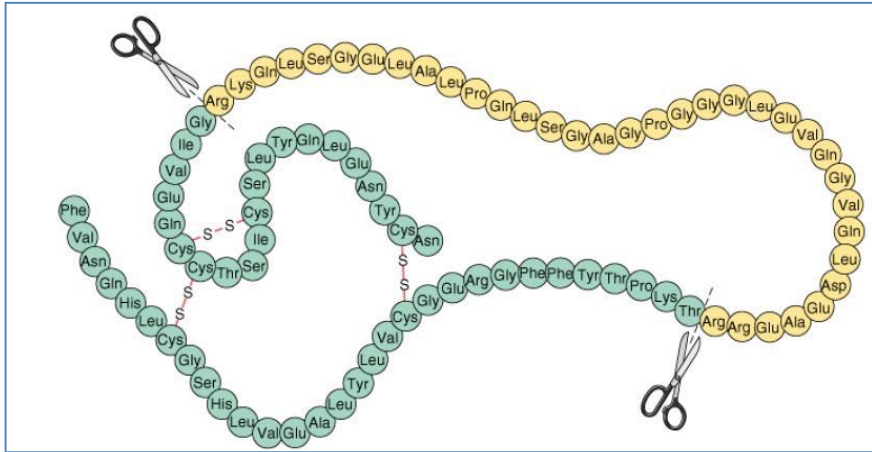
### Synthesis of Chemical Messengers:

- **Steroidogenesis:**

- All steroid hormones are derived from Cholesterol
- **There are 5 Families of Steroids, each with their main physiological member:**
  - Progestogens (Progesterone)
  - Androgens (Testosterone)
  - Mineralocorticoids (Aldosterone)
  - Glucocorticoids (Cortisol)
  - Oestrogens (Oestrogen)

- **Protein/Peptide Synthesis & Processing:**

- Synthesis of polypeptide hormones can be more complex than Transcription & Translation.
- Some Protein Hormones are initially synthesised as longer **Pre-Prohormones**
- These **Pre-Prohormones** are then cleaved, leaving **Prohormones**
- These **Prohormones** are then cleaved again, leaving active **Hormones**
  - Eg: Insulin:



### 'Reactive' Properties of Chemical Messengers:

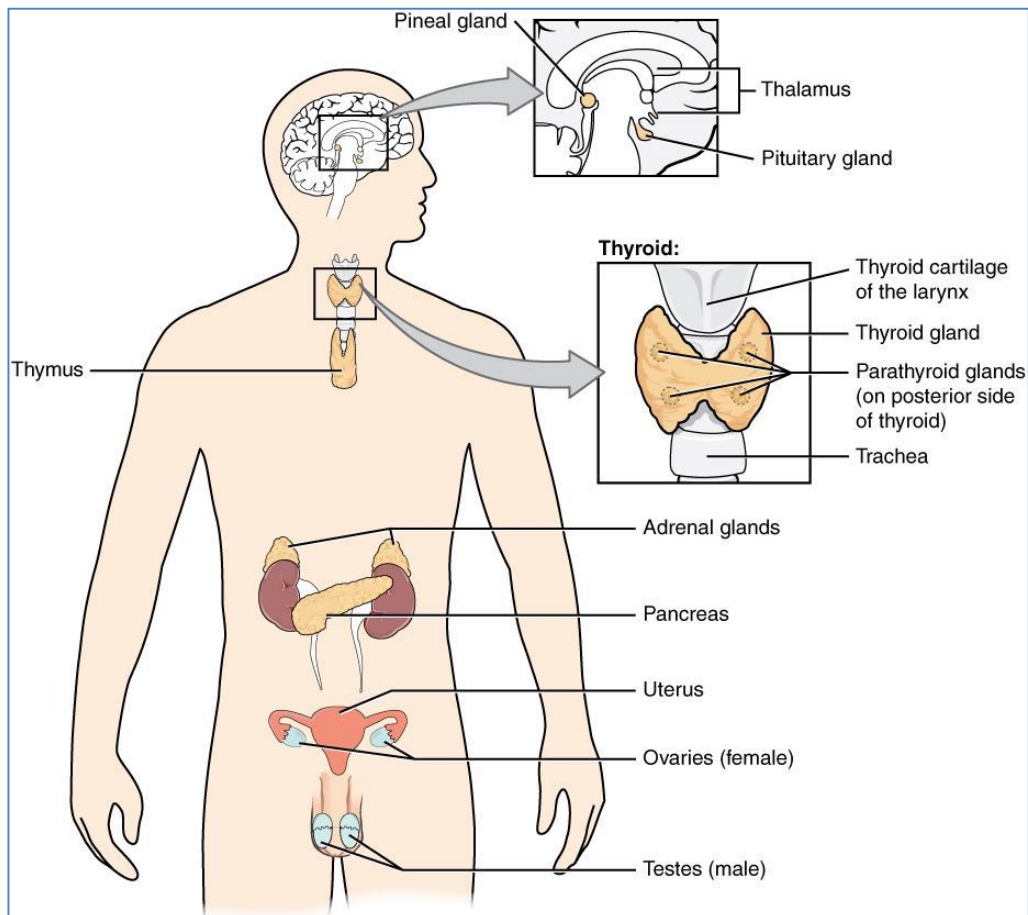
- **Biological Specificity:** Certain Chemical Messengers will only fit into certain receptors
- **Affinity:** The degree to which a chemical is attracted towards a receptor
- **Efficacy:** The degree of effectiveness of the binding of the messenger to the receptor
- **'Agonists':** Chemical Messengers with **High Affinity & High Efficacy**
- **'Antagonists':** Chemical Messengers with **High Affinity** but **Low Efficacy**  
**Note:** There are no Endogenous *Receptor*-Antagonists, Only Exogenous (Drugs)
- **Hormone Binding Proteins:** Proteins that inactivate hormones by binding to them, limiting Bioactivity
- **Epitope:** An Immunologically active binding site on a protein to which an antibody can attach

### Endocrine Glands:

- **Endocrine Glands** are **Ductless** and secrete by **Exocytosis** into the **Extracellular Fluid** → Diffuses into Blood

### Classical Endocrine Glands:

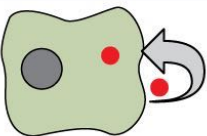
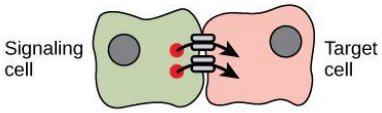
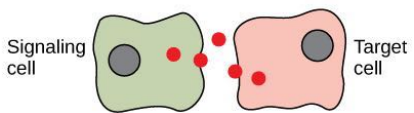
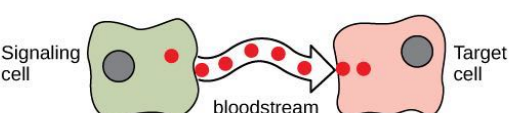
- Hypothalamus
- Pituitary gland
- Pineal gland
- Thyroid gland
- Parathyroid glands (dorsal aspect of thyroid gland)
- Thymus
- Adrenal glands
- Pancreas (has exocrine parts for digestion) (endocrine part secretes insulin)
- Gonads: Testes/Ovaries (also exocrine)



OpenStax College, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0>>, via Wikimedia Commons

### Long or Short-Range Signalling?

- **Endocrine:** Some signals are “broadcasted” throughout the entire body via bloodstream. → **Hormones** (produced by endocrine cells) [TV]
- **Autocrine:** Signals that affect only cells of the same cell type as the emitting cell. [doctor conference]
- **Paracrine:** Signals (aka local mediators) that act on cells in the vicinity of the emitting cell but on different cell types than the emitting cell. [Lecture]

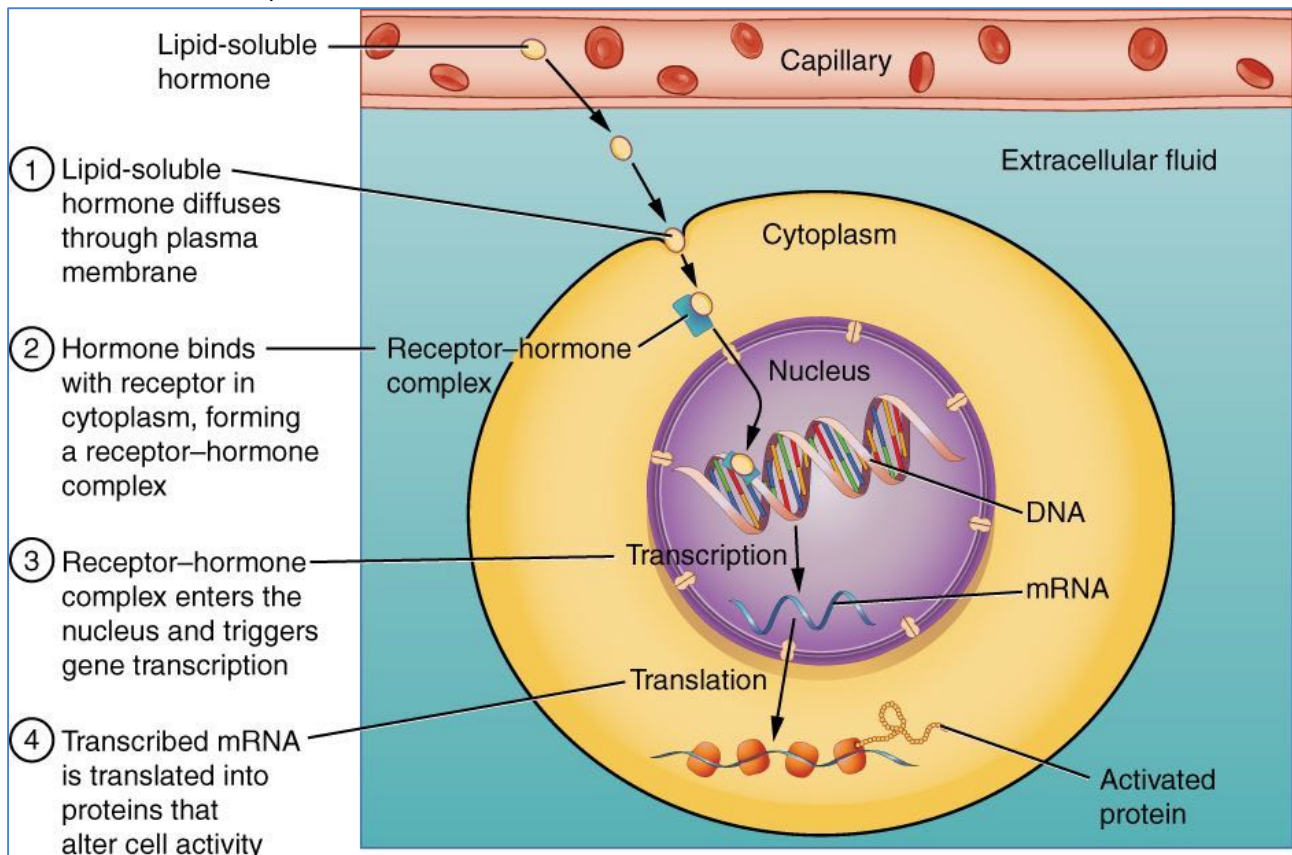
Forms of Chemical Signaling	
Autocrine	A cell targets itself.
	
Signaling across gap junctions	A cell targets a cell connected by gap junctions.
	
Paracrine	A cell targets a nearby cell.
	
Endocrine	A cell targets a distant cell through the bloodstream.
	

CNX OpenStax, CC BY 4.0 <<https://creativecommons.org/licenses/by/4.0>>, via Wikimedia Commons

## 2 Main Receptor Types: (Intracellular & Membrane-bound Receptors)

### • Intracellular Receptors:

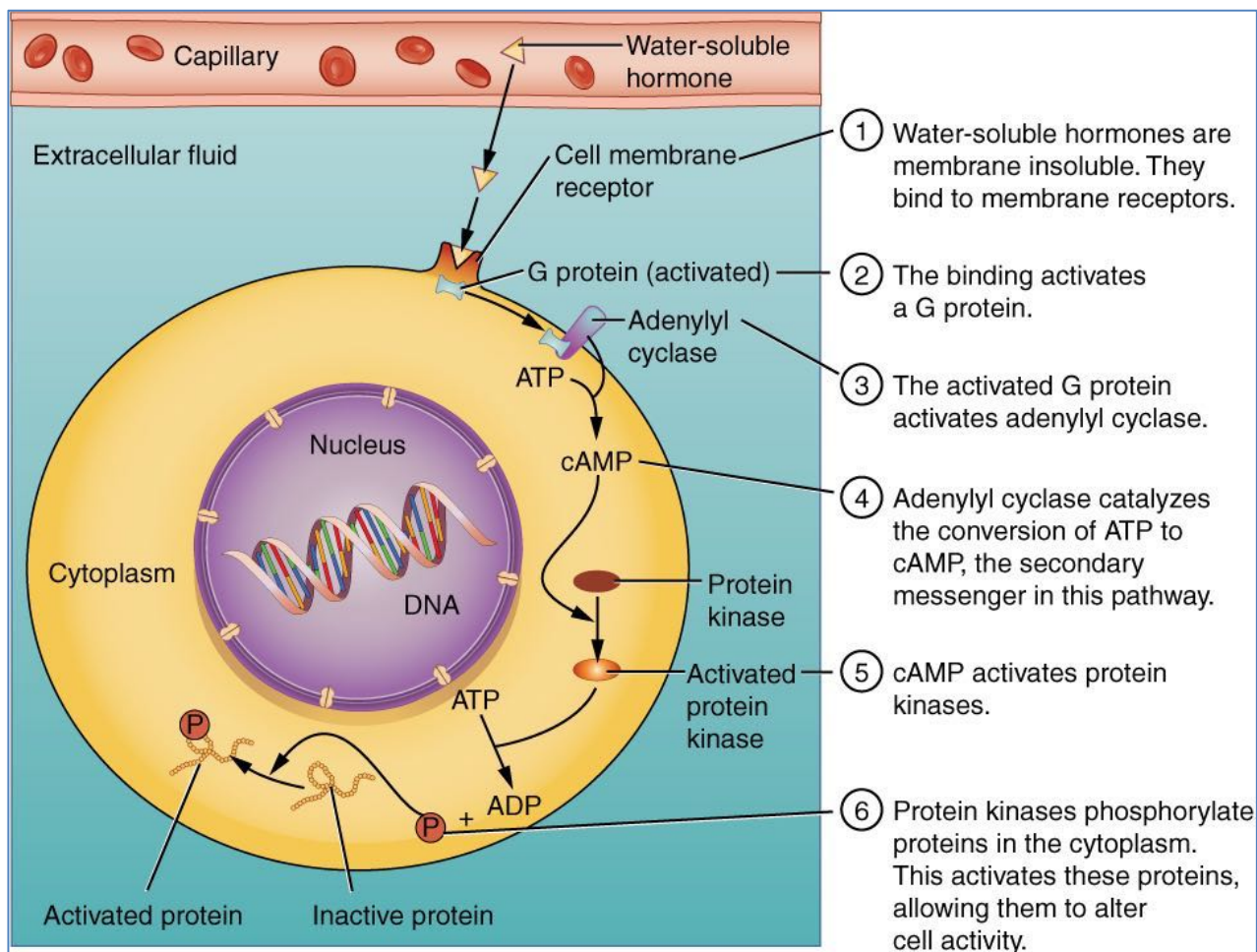
- Lipid-soluble hormones (steroid/thyroid hormones) & even gasses (nitric oxide-blood vessel dilation)
  - **Steroid hormones** bind to receptor proteins in the cytosol or the nucleus that regulate gene expression.



OpenStax College, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0/>>, via Wikimedia Commons

### • Plasma-Membrane-Bound-Receptors:

- Most signal molecules can't cross the plasma membrane of the target cell.
- Most intracellular signalling proteins act as **molecular switches** activated by either **phosphorylation** OR **GTP-Binding** (swapping a GDP for a GTP)
- **3 Types:**
  - **Ion-Channel-Linked Receptors**
    - Resulting signal is a flow of ions across the membrane – produces an electric current.
  - **Enzyme-Linked Receptors**
    - When activated – act as enzymes or are associated with enzymes inside the cell.
  - **G-Protein-Linked Receptors (more common)**
    - Binds to a class of membrane-bound **GTP-Binding-protein (G-Protein)** → becomes activated and released to migrate across the membrane, initiating a cascade of other effects.
    - Some G-Proteins directly regulate ion channels in the plasma membrane.
    - Other G-Proteins activate membrane-bound enzymes. Eg: **adenylyl-cyclase** → increases the [**second messenger (cyclic-AMP)**] → activates an intracellular **signalling protein** (eg: A protein kinase) OR turns on **genes via activated Protein Kinase 'A' (PKA)**.



OpenStax College, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0>>, via Wikimedia Commons

## Tissue Responsiveness:

### - Receptor Downregulation:

- Where a **decreased receptor density** in the membrane decreases the responsiveness of that cell to that receptor's stimuli.
- This is achieved **by Internalising** the **receptor-ligand complex**, dissociating the ligand, and recycling the receptor back to the surface.

### - Receptor Desensitisation:

- Where a **change in receptor structure** decreases the responsiveness of that cell to that receptor's stimuli.
- Why? To prevent multiple, rapid stimulations.

## Receptor Regulation

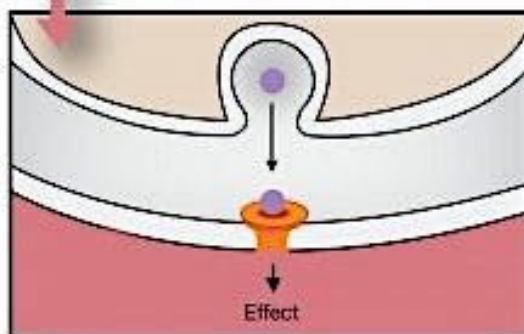
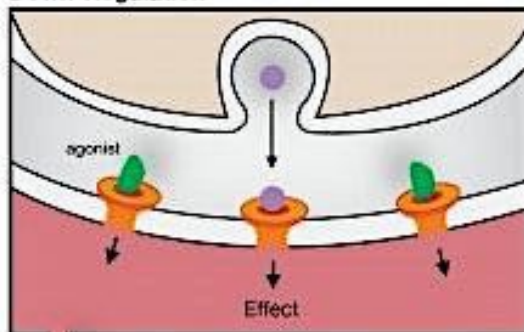
### Receptor Downregulation (Desensitization)

Sustained Agonist Activity  
↓  
Endocytosis  
↓  
Recycling or Degradation  
↓  
Synthesis of New Protein  
↓  
Incorporation into Membrane

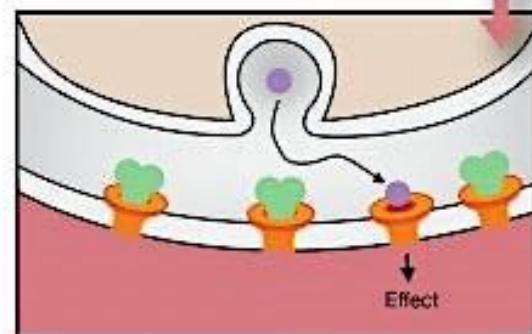
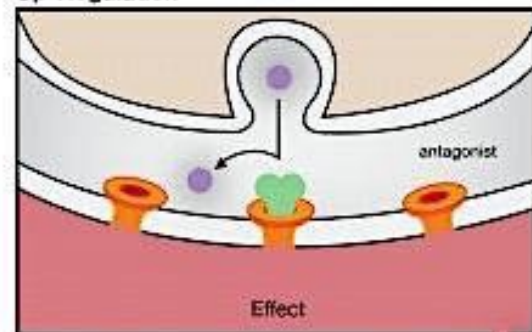
### Receptor Upregulation (Supersensitization)

Receptor Downregulation  
↓  
Increase total number of receptors  
↓  
Decrease down regulation  
↓  
Withdrawal of antagonist  
↓  
elevated number of receptors can  
produce exaggerated response

#### Down-Regulation



#### Up-Regulation



Source: Unattributable

## Regulation of Hormone Release:

### - 3 Mechanisms:

- **1- Humoral:**
  - Where the concentration of a solute in the blood (Eg: High Glucose/Low Calcium) is detected by a specific gland, stimulating hormone release (Eg: Insulin/Parathyroid Hormone)
- **2- Neural:**
  - Where the Nervous System Directly stimulates hormone release.
  - Eg: Sympathetic NS Activated → Stimulates Adrenal Medulla → Secretes Catecholamines.
- **3- Hormonal:**
  - Where one hormone stimulates the release of another hormone from a different cell.
  - Eg: The Hypothalamus secretes hormones → Stimulate Ant. Pituitary → Secretes Hormones.
  - Eg: The Ant. Pituitary secretes Hormones → Stimulate other organs to secrete hormones.

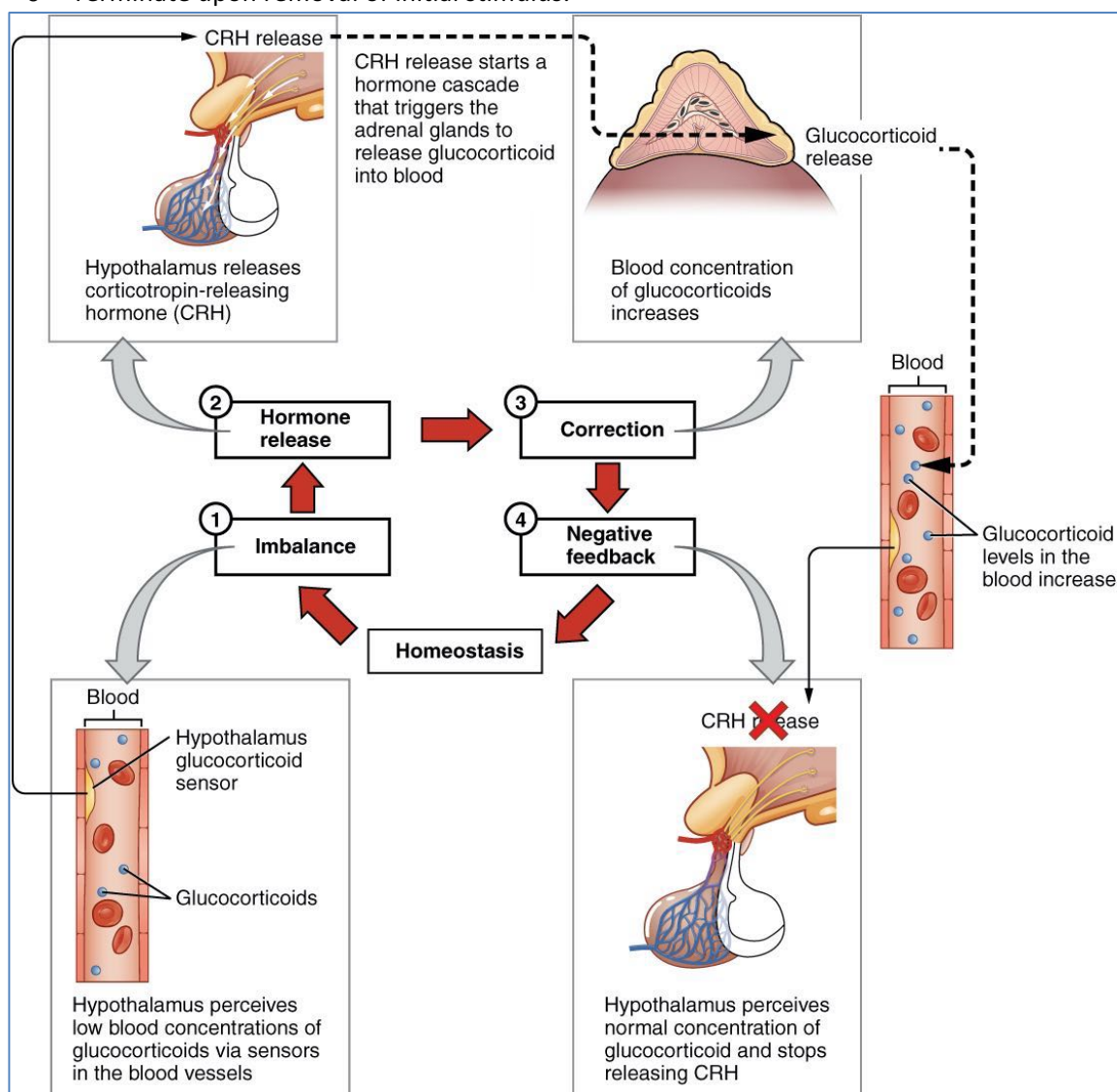
## FEEDBACK:

### • **Negative:**

- Most common
- Where the **Biological Response** causes a **Decreased Hormone Release**.
- Maintains levels around a stable intrinsic/pre-set level.
- Involved in homeostatic control.

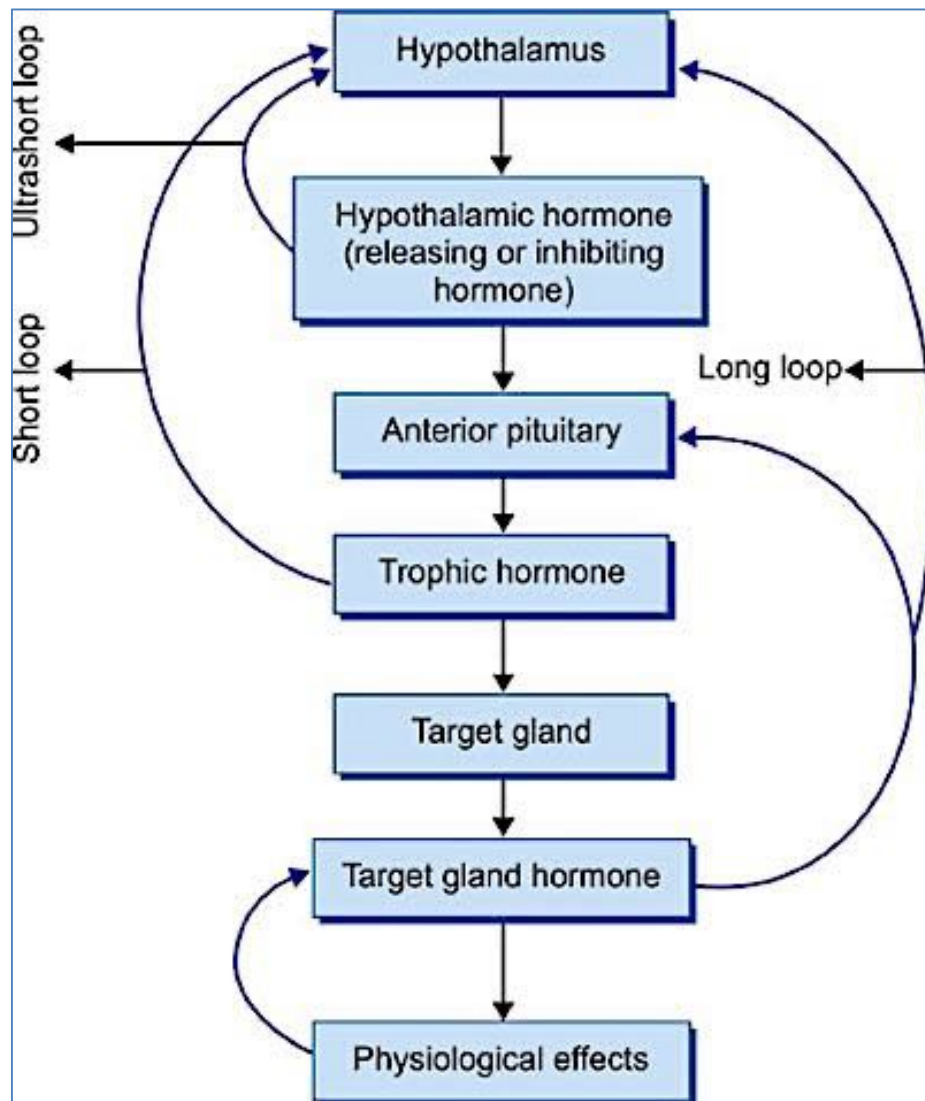
### • **Positive:**

- Uncommon (Lactation & Parturition)
- Where the **Biological Response** causes an **Increased Hormone Release**
- Are therefore Unstable mechanisms
- Terminate upon removal of initial stimulus.



### Levels of Feedback Loops:

- Feedback may occur at many different levels within an endocrine axis.
  - **Ultra-Short Loop:**
    - The secreted hormone feeds back to the same tissue that secreted it.
      - Eg: A Hypothalamic Hormone feeds back to the Hypothalamus.
  - **Short Loop:**
    - The secreted hormone feeds back to the tissue that stimulated its secretion.
      - Eg: The Hormone secreted by the Target Organ feeds back to the Pituitary.
      - Or. The Hormone secreted by the Pituitary feeds back to the Hypothalamus.
  - **Long Loop:**
    - The hormone secreted by the target organ feeds directly back to the Hypothalamus.



Source: Unattributable

### Major Hormones & Their Functions:

Endocrine gland	Associated hormones	Chemical class	Effect
Pituitary (anterior)	Growth hormone (GH)	Protein	Promotes growth of body tissues
Pituitary (anterior)	Prolactin (PRL)	Peptide	Promotes milk production
Pituitary (anterior)	Thyroid-stimulating hormone (TSH)	Glycoprotein	Stimulates thyroid hormone release
Pituitary (anterior)	Adrenocorticotrophic hormone (ACTH)	Peptide	Stimulates hormone release by adrenal cortex
Pituitary (anterior)	Follicle-stimulating hormone (FSH)	Glycoprotein	Stimulates gamete production
Pituitary (anterior)	Luteinizing hormone (LH)	Glycoprotein	Stimulates androgen production by gonads
Pituitary (posterior)	Antidiuretic hormone (ADH)	Peptide	Stimulates water reabsorption by kidneys
Pituitary (posterior)	Oxytocin	Peptide	Stimulates uterine contractions during childbirth
Thyroid	Thyroxine (T <sub>4</sub> ), triiodothyronine (T <sub>3</sub> )	Amine	Stimulate basal metabolic rate
Thyroid	Calcitonin	Peptide	Reduces blood Ca <sup>2+</sup> levels
Parathyroid	Parathyroid hormone (PTH)	Peptide	Increases blood Ca <sup>2+</sup> levels
Adrenal (cortex)	Aldosterone	Steroid	Increases blood Na <sup>+</sup> levels
Adrenal (cortex)	Cortisol, corticosterone, cortisone	Steroid	Increase blood glucose levels
Adrenal (medulla)	Epinephrine, norepinephrine	Amine	Stimulate fight-or-flight response
Pineal	Melatonin	Amine	Regulates sleep cycles
Pancreas	Insulin	Protein	Reduces blood glucose levels
Pancreas	Glucagon	Protein	Increases blood glucose levels
Testes	Testosterone	Steroid	Stimulates development of male secondary sex characteristics and sperm production
Ovaries	Oestrogens and progesterone	Steroid	Stimulate development of female secondary sex characteristics and prepare the body for childbirth

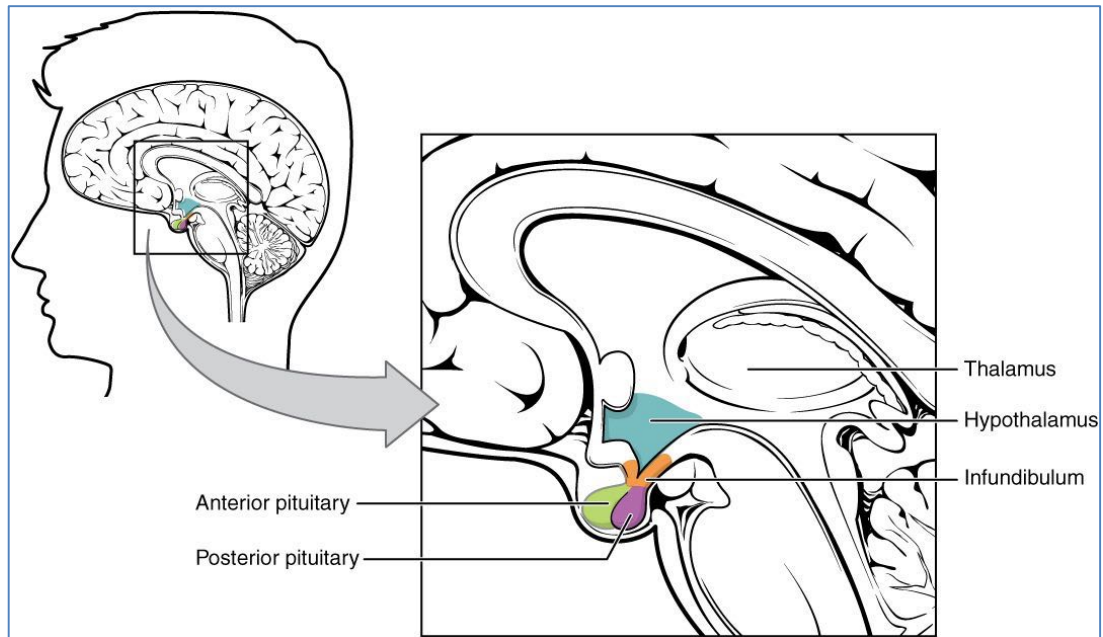
## **THE HYPOTHALAMUS & PITUITARY GLAND**

## THE HYPOTHALAMUS & PITUITARY GLAND

### The Hypothalamus:

#### - Location:

- In the diencephalon @ base of the brain, just below the thalamus.
- 'Hypo'-Thalamus = Below the Thalamus



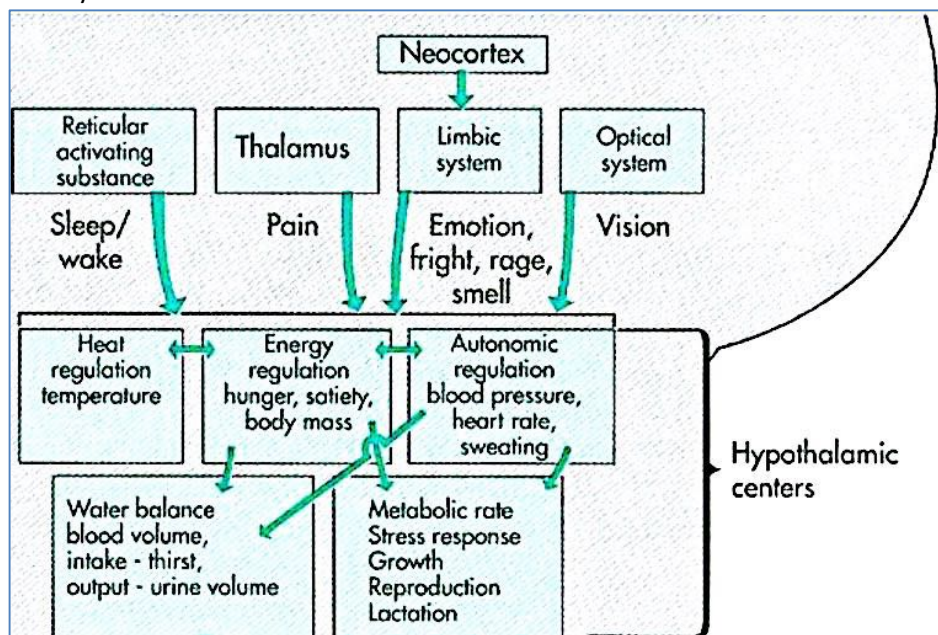
OpenStax College, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0/>>, via Wikimedia Commons

#### - Functions:

- The Hypothalamus receives information from multiple higher brain centres, integrates it, decides on a response, and orders the pituitary to secrete specific hormones to elicit the response.
  - Ie: Links the nervous system to the endocrine system via the pituitary gland.
- Controls body temperature, hunger, thirst, fatigue, anger, and cycles. Synthesizes & secretes **neurohormones** (hypothalamic-releasing hormones) which stimulate or inhibit the secretion of pituitary hormones.

#### - Inputs:

- RAS (Reticular Activating System/Substance) – Regulates drowsiness by releasing Serotonin.
- Thalamus – Plays a role in Pain Perception
- Neocortex & Limbic System – Emotional Centre
- Optical System – Vision

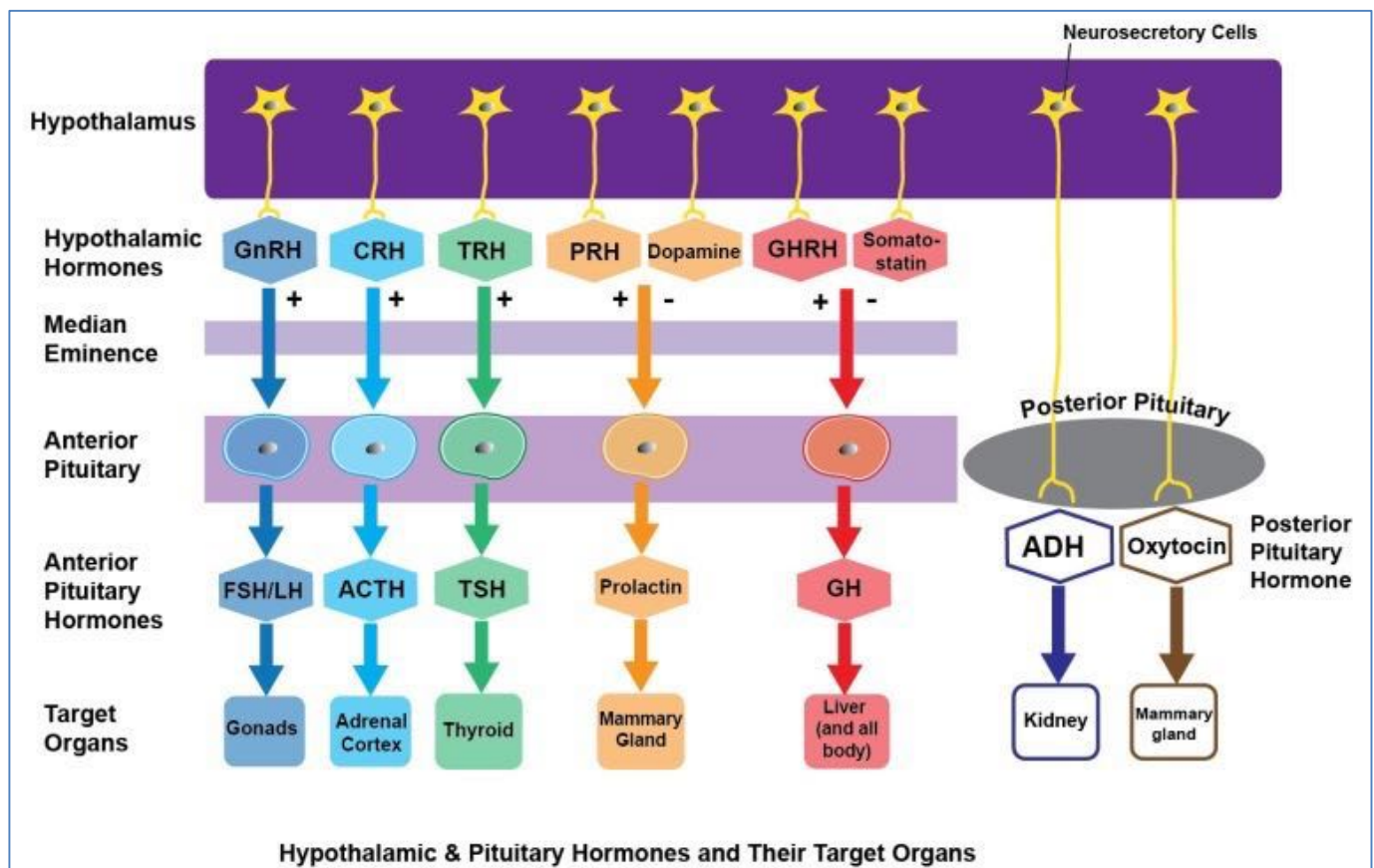


Source: Unattributable

- **Outputs:**
  - o Anterior Pituitary
  - o Posterior Pituitary
  - o Brain-Stem (Autonomic NS)

- **Hypothalamic Regulatory Hormones:**

Abbreviation	Full Name	Stimulated/Inhibited Hormone
GHRH	Growth-Hormone Releasing Hormone	Stimulates Release of Growth Hormone
SS	Somatostatin	Inhibits Release of Growth Hormone & TSH
TRH	Thyrotropin Releasing Hormone	Stimulates Release of TSH & Prolactin
PRH	Prolactin Releasing Hormone	Stimulates Release of Prolactin
GnRH	Gonadotropin Releasing Hormone	Stimulates Release of Gonadotropins; FSH & LH
CRH	Corticotrophin Releasing Hormone	Stimulates Release of ACTH
PIH	Prolactin Inhibiting Hormone	Inhibits Release of Prolactin



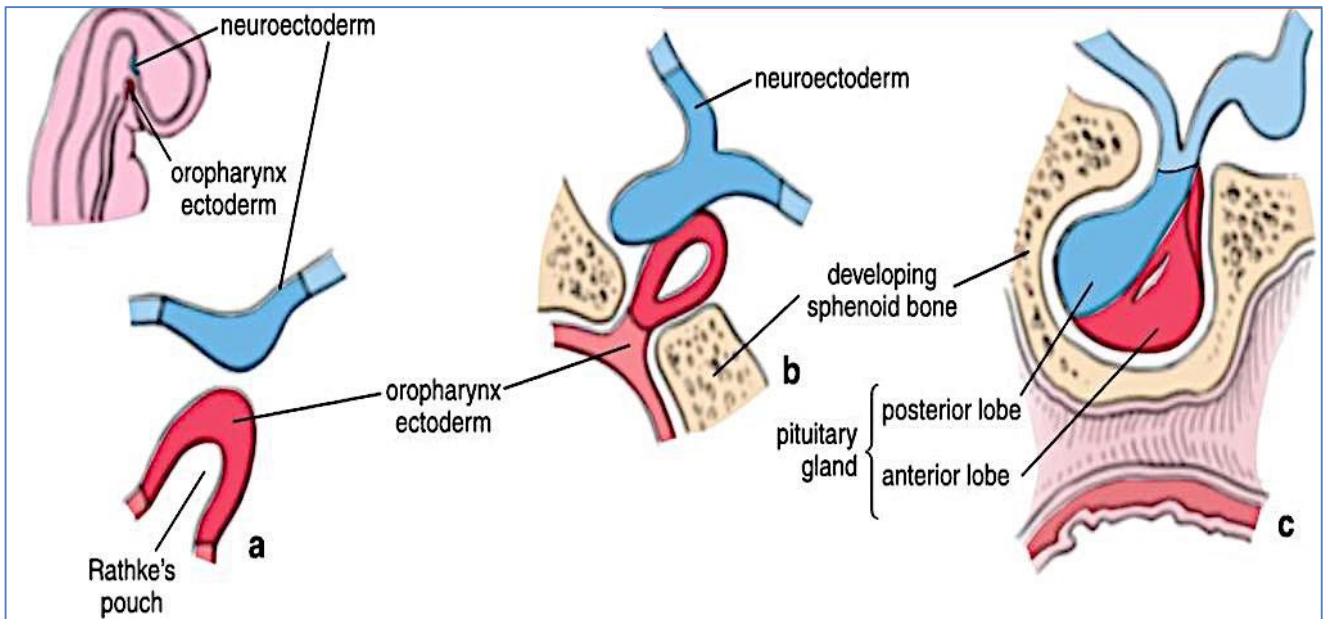
<https://www.ncbi.nlm.nih.gov/books/NBK551529/figure/article-692.image.f1/>

**The Pituitary Gland:**

- **Location:**
  - o Just Anterior to Pons of the Brainstem
  - o Just Posterior to the Optic Chiasma
  - o Just Inferior to the Hypothalamus
  - o Connects superiorly to the hypothalamus (above it) via the **Infundibulum**
- **Function:**
  - o Secretes at least 9 hormones.
  - o Function is controlled by hypothalamus (which secretes releasing/inhibiting hormones)

### Embryology of the Pituitary Gland:

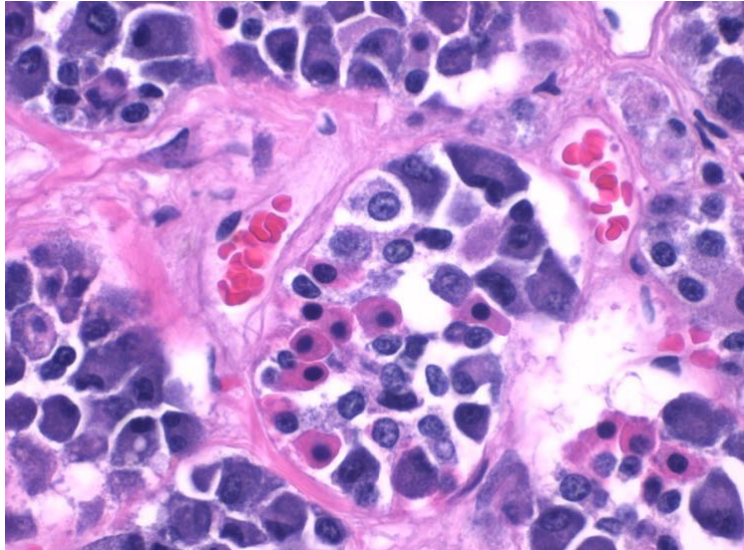
- **Q:** Why is the Anterior Pituitary **Endocrine**, but the Posterior Pituitary **Neuronal**?
- **A:** Because they have different embryonic origins.
  - **Anterior Pituitary:**
    - Arises from an upward out-pouching of the **Oral-Ectoderm** from the roof of the oral cavity called **Rathke's Pouch**. This pouch pinches off from the oral cavity and is later separated by the sphenoid bone.
    - Consists of **Epithelial/Glandular Tissue**, & therefore **Manufactures & Secretes Hormones**.
  - **Posterior Pituitary:**
    - Originates from a downward out-pouching of **Neuro-Ectoderm** from the brain in the floor of the 3<sup>rd</sup> ventricle.
    - Consists of **Neural Tissue**, & therefore **Secretes Neurohormones**.



Source: Unattributable

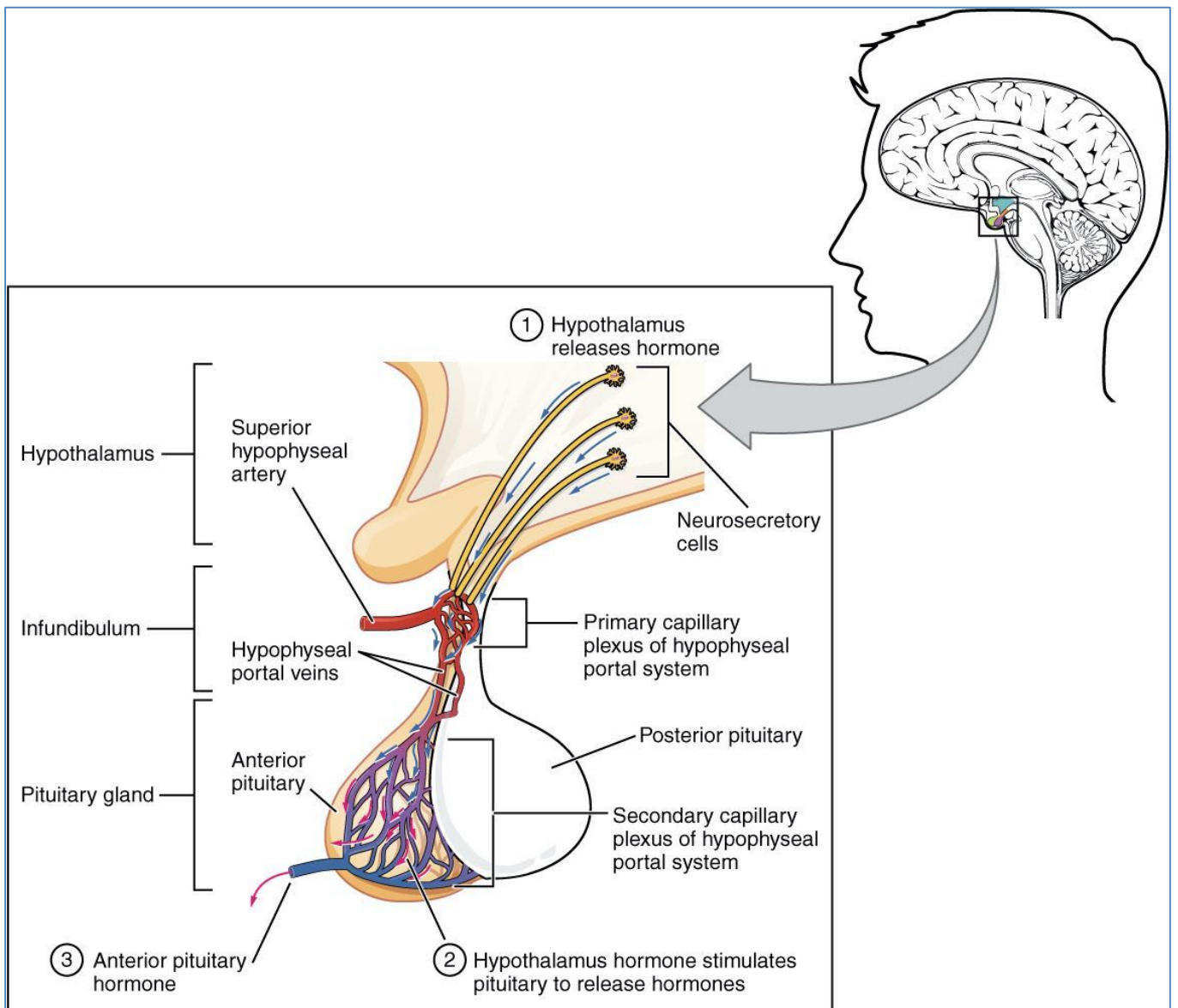
### Anterior Pituitary: (Adenohypophysis)

- Glandular Tissue (adeno = gland)
- **Responsible for Producing:**
  - o **TSH** (Thyroid Stimulating Hormone)
  - o **FSH/LH** (Follicle Stimulating Hormone; Luteinizing Hormone)
  - o **PRL** (Prolactin)
  - o **ACTH** (Adreno CorticoTropic Hormone)
  - o **GH** (Growth Hormone)
- **Different Cell Types in the Anterior Pituitary Secrete Specific Hormones:**
  - o **Gonadotrophs:** FSH & LH
  - o **Corticotrophs:** ACTH (Adreno-Cortico-Tropic Hormone)
  - o **Thyrotrophs:** TSH
  - o **Mammotrophs:** Prolactin
  - o **Somatotrophs:** Growth Hormone & Somatotropin
- **Histology – Glandular structure:**
  - o Clusters of acini surrounded by blood vessels
  - o Acini - mosaics of different cells:
    - (acidophils – red, basophils – dark blue, chromophobes - colourless)
    - Note: Pituitary Tumours may be from any of the 3 cells
  - o **PLENTY of blood vessels (neither arteries or veins; but 'Portal Vessels' – ie: Blood comes *only* from the hypothalamus → carries the hypothalamic hormones.)**



Mikael Häggström, M.D, CC0, via Wikimedia Commons

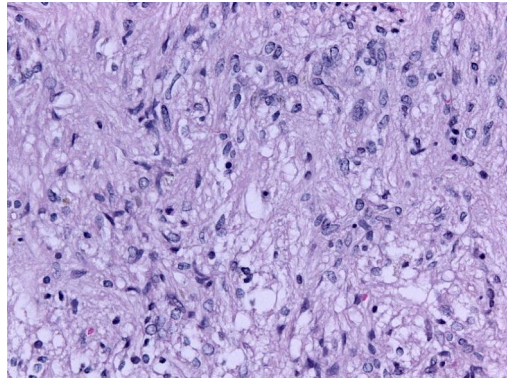
- **Blood Supply:**
  - o Arterial blood enters via **Hypophyseal Branches** of the **Internal Carotid Arteries**.
- **Venous Drainage:**
  - o Venous blood leaves via **venules** which drain into the **Dural Sinuses**.



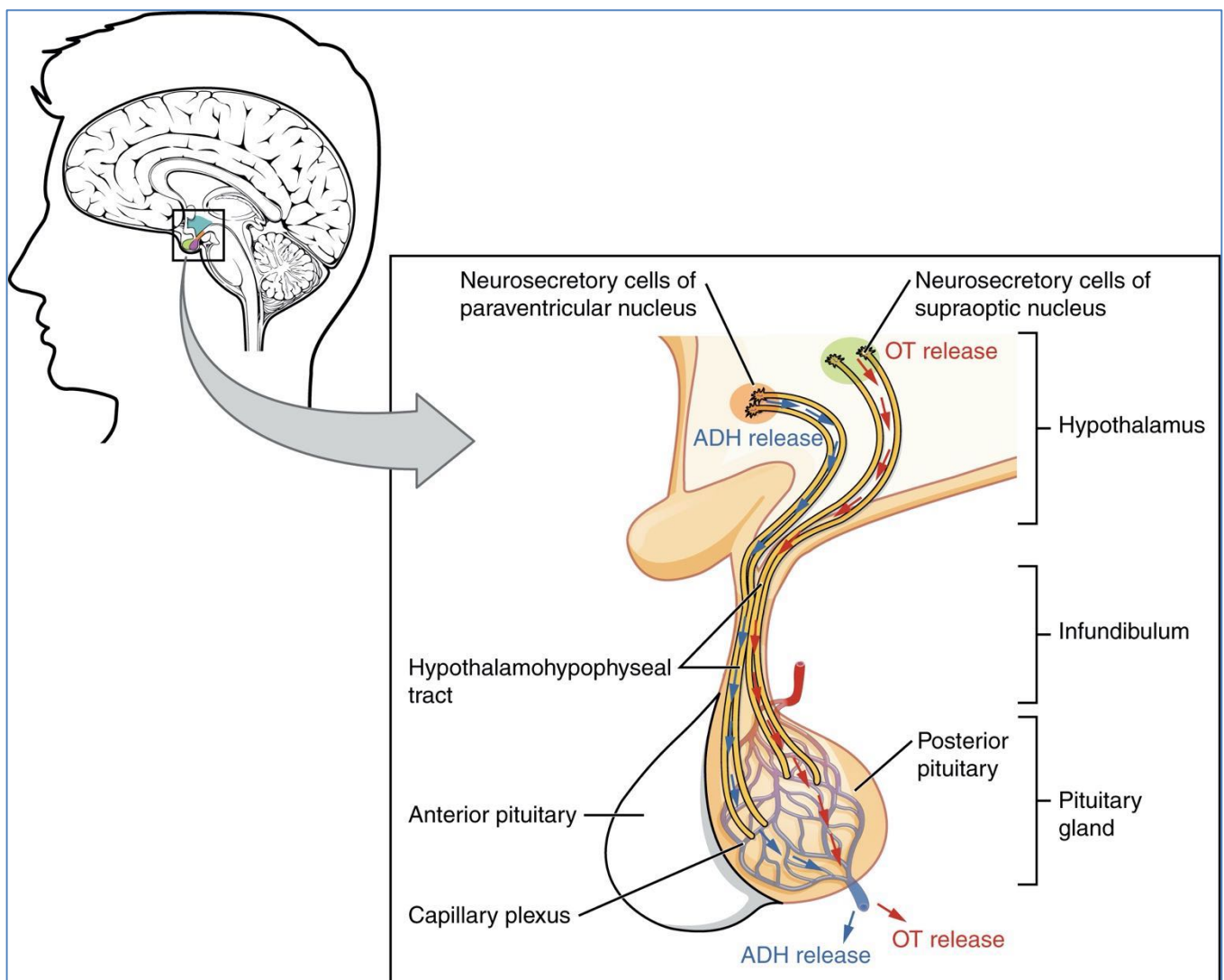
OpenStax College, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0/>>, via Wikimedia Commons

### Posterior Pituitary: (Neurohypophysis)

- Made of **Nervous Tissue**
- Is essentially an **Extension of the Hypothalamus**
- **Supraoptic & Paraventricular Nuclei** in the hypothalamus synthesize Oxytocin & ADH → Transport them to their axon terminals in the **Posterior Pituitary**.
  - Hormones released as needed via exocytosis in Post-Pituitary
    - ADH
    - Oxytocin
- **Histology – Just like normal brain tissue. (Neural Origin)**
  - Note: NO neurones, but plenty of axons.
  - Many supporting cells (Astrocytes, oligodendrocytes)
  - **Plus Blood Vessels (neither arteries or veins; but 'Portal Vessels' – i.e: Blood comes *only* from the hypothalamus → carries the hypothalamic hormones.)**



Jensflorian, CC BY-SA 3.0 <<https://creativecommons.org/licenses/by-sa/3.0>>, via Wikimedia Commons



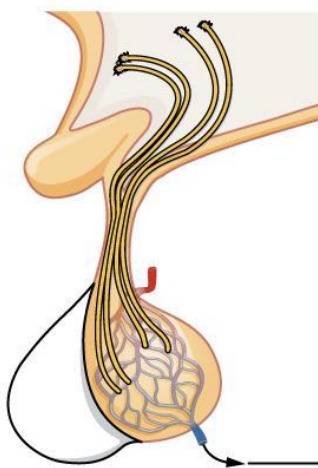
OpenStax College, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0>>, via Wikimedia Commons

**Pituitary Hormones:**

<b>Pituitary lobe</b>	<b>Associated hormones</b>	<b>Chemical class</b>	<b>Effect</b>
Anterior	Growth hormone (GH)	Protein	Promotes growth of body tissues
Anterior	Prolactin (PRL)	Peptide	Promotes milk production from mammary glands
Anterior	Thyroid-stimulating hormone (TSH)	Glycoprotein	Stimulates thyroid hormone release from thyroid
Anterior	Adrenocorticotrophic hormone (ACTH)	Peptide	Stimulates hormone release by adrenal cortex
Anterior	Follicle-stimulating hormone (FSH)	Glycoprotein	Stimulates gamete production in gonads
Anterior	Luteinizing hormone (LH)	Glycoprotein	Stimulates androgen production by gonads
Posterior	Antidiuretic hormone (ADH)	Peptide	Stimulates water reabsorption by kidneys
Posterior	Oxytocin	Peptide	Stimulates uterine contractions during childbirth
Intermediate zone	Melanocyte-stimulating hormone	Peptide	Stimulates melanin formation in melanocytes

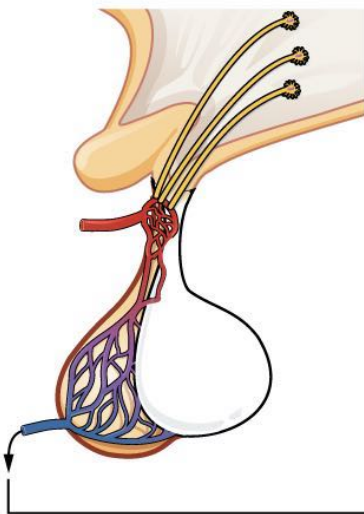
OpenStax College, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0>>, via Wikimedia Commons

### Posterior Pituitary Hormones



Releasing hormone (hypothalamus)	Pituitary hormone	Target	Effects
ADH	Stores ADH	Kidneys, sweat glands, circulatory system	Water balance
-	OT	Female reproductive system	Triggers uterine contractions during childbirth

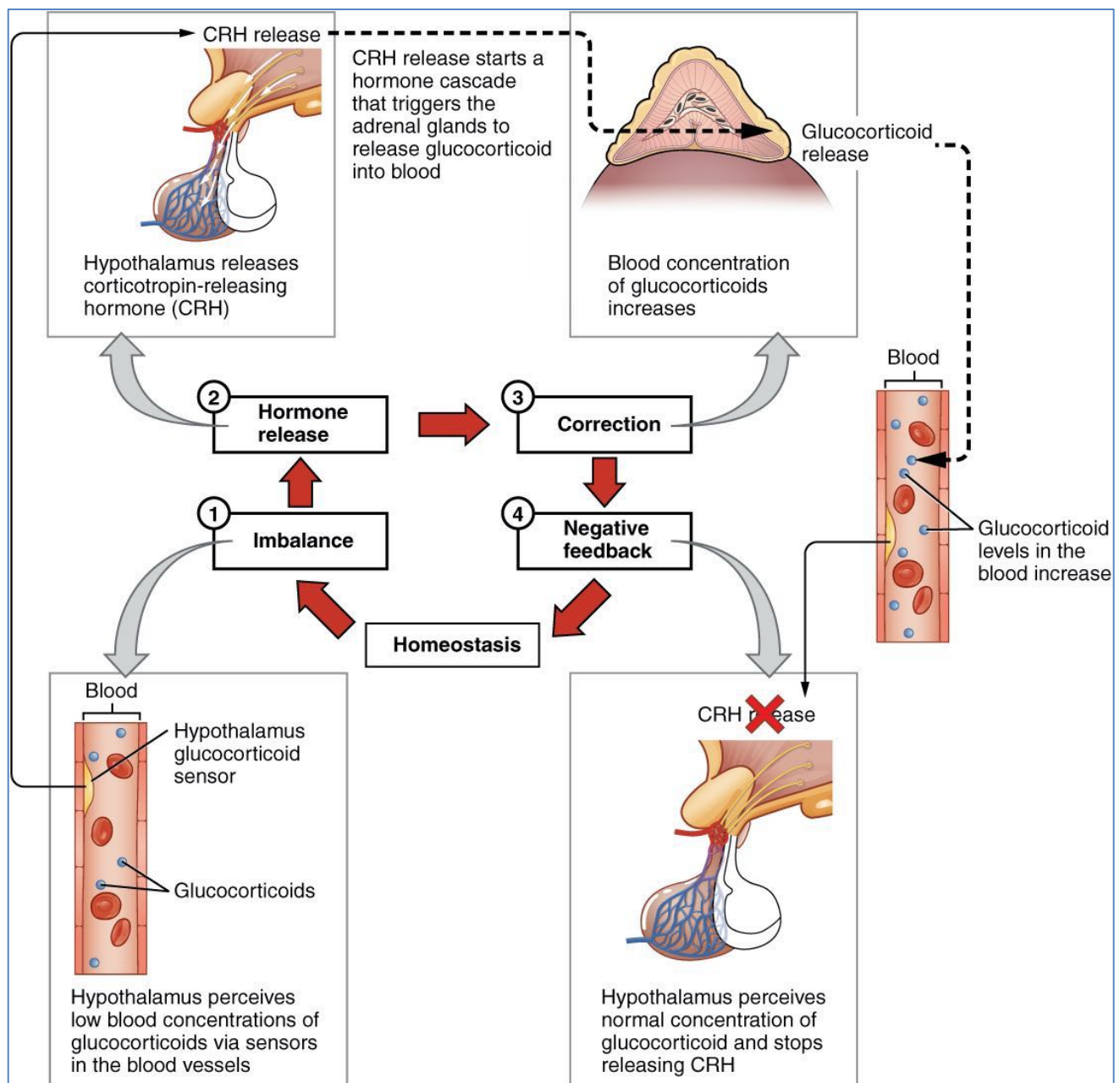
### Anterior Pituitary Hormones



Releasing hormone (hypothalamus)	Pituitary hormone	Target	Effects
GnRH	LH	Reproductive system	Stimulates production of sex hormones by gonads
GnRH	FSH	Reproductive system	Stimulates production of sperm and eggs
TRH	TSH	Thyroid gland	Stimulates the release of thyroid hormone (TH). TH regulates metabolism.
PRH (inhibited by PIH)	PRL	Mammary glands	Promotes milk production
GHRH (inhibited by GHIH)	GH	Liver, bone, muscles	Induces targets to produce insulin-like growth factors (IGF). IGFs stimulate body growth and a higher metabolic rate.
CRH	ACTH	Adrenal glands	Induces targets to produce glucocorticoids, which regulate metabolism and the stress response

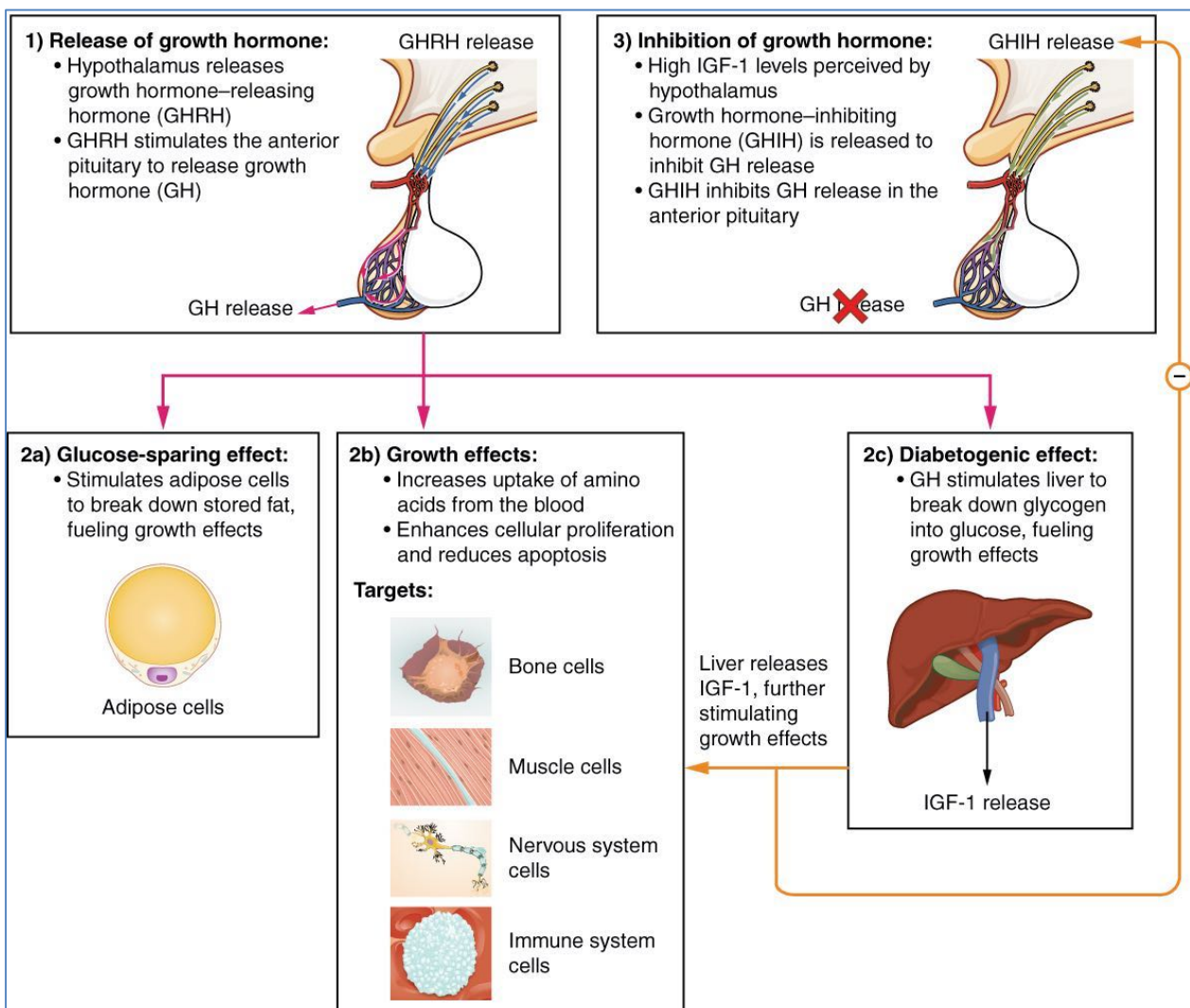
## ACTH – Adrenocorticotrophic Hormone:

- **Secreted By:**
  - Corticotrophs in the Anterior Pituitary
- **Primary Action:**
  - Stimulates adrenocortical cells in the **Zona Fasciculata** of the **Adrenal Cortex** to secrete **Glucocorticoids**.
    - To reduce inflammation
    - To increase blood glucose levels
    - To increase lipolysis & proteolysis
- **Release is Stimulated By:**
  - Corticotrophin Releasing Hormone (CRH)
  - CRH is secreted by the Hypothalamus in response to:
    - Stress
    - Low blood glucose
    - Low glucocorticoid levels
    - Increased Sympathetic Activity
    - Normal Diurnal Rhythm
- **Release is Regulated By:**
  - Negative feedback loop between Hypothalamus-Pituitary-Adrenal glands



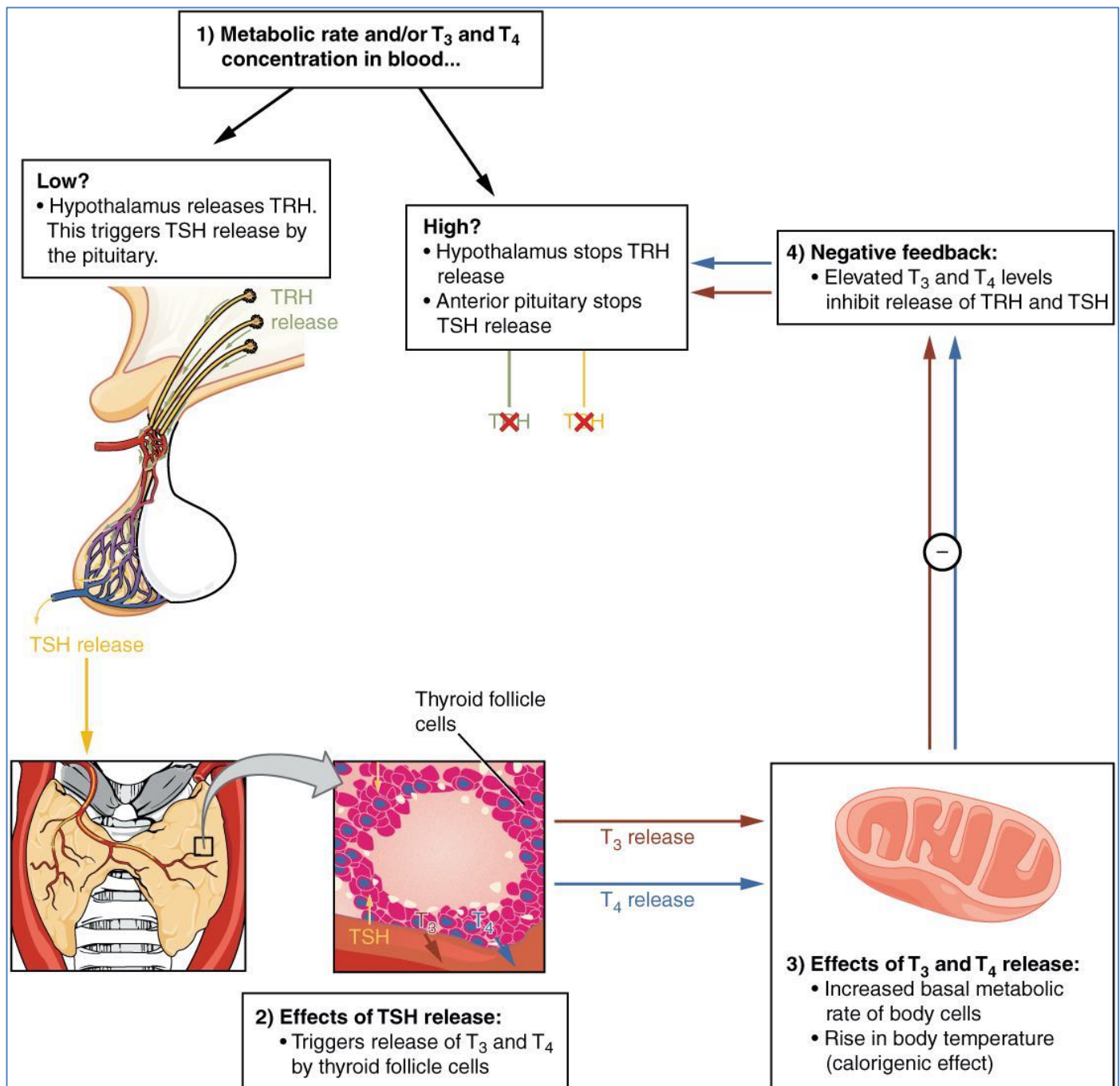
## GH – Growth Hormone:

- **Secreted By:**
  - Somatotrophs in the Anterior Pituitary
- **Primary Actions:**
  - **↑Proportion of LEAN BODY MASS:**
    - ↑Muscle Mass
    - ↓Adipose Tissue
  - **Stimulates cell metabolism, growth and division throughout the body**
    - Stimulates Protein Synthesis
    - Decreases Protein Breakdown
    - Stimulates Bone Osteoblast activity
  - **Also has anti-insulin-like effects:**
    - Stimulates Gluconeogenesis (Liver)
    - Stimulates Glycogenolysis (Liver)
    - Increases tissue insulin resistance
    - Stimulates Lipolysis (Adipose tissue)
  - **Indirect Actions (Via Somatomedins/IGF's):**
    - **Linear Bone Growth** (↑Collagen & Protein Synthesis)
    - **Tissue Growth** (↑Protein Synthesis & Gene Replication/Transcription)
- **Release is Stimulated By:**
  - Growth Hormone Releasing Hormone (GHRH)
  - GHRH is secreted by the Hypothalamus in a diurnal manner & in response to low GH levels
  - Also stimulated by Ghrelin from the stomach
- **Release is Regulated By:**
  - Negative feedback loop between Hypothalamus & Pituitary gland



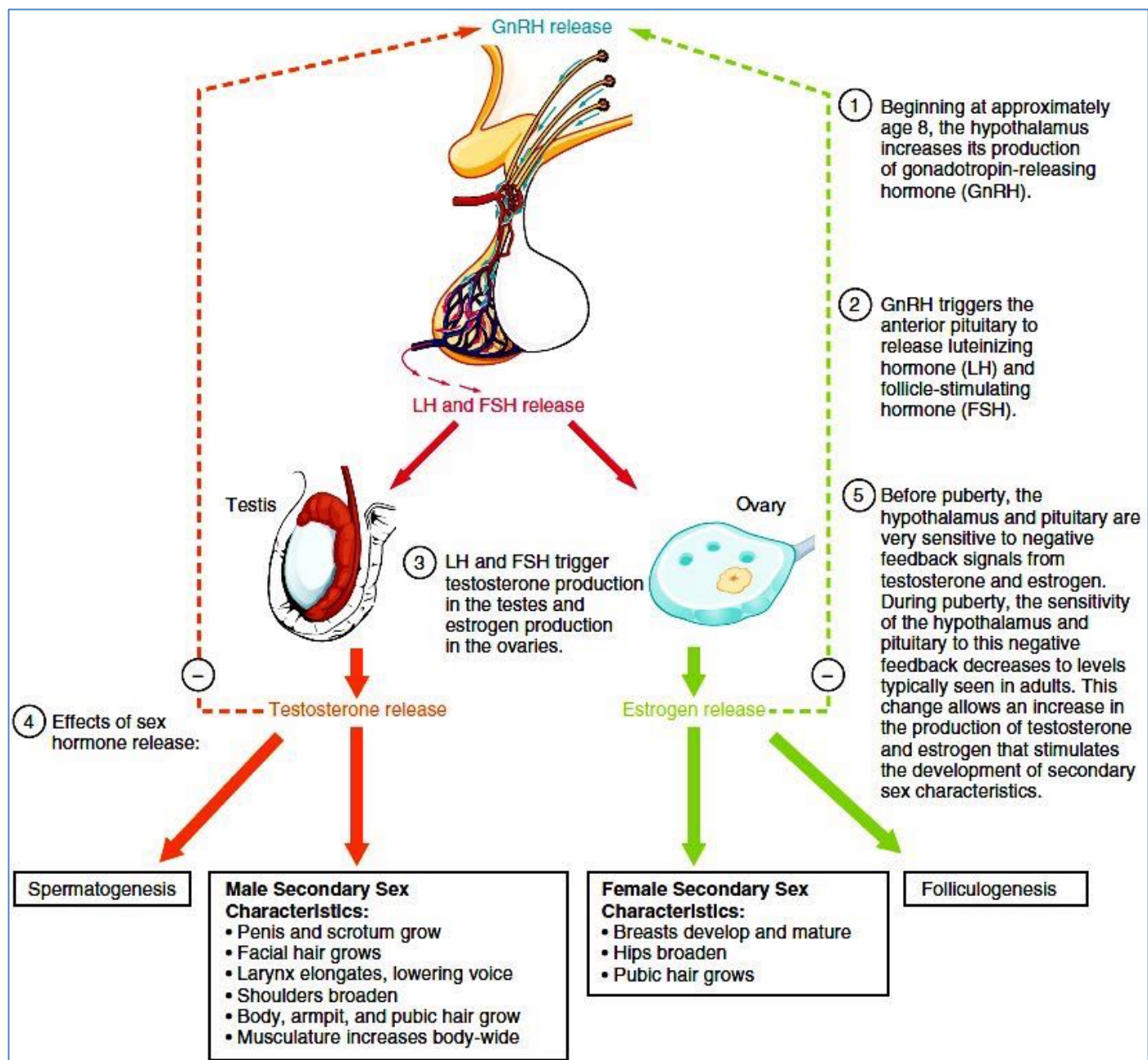
## TSH - Thyroid Stimulating Hormone:

- **Secreted By:**
  - o Thyrotrophs of the Anterior Pituitary
- **Primary Action:**
  - o Stimulates Thyroid Gland Growth
  - o Stimulates Thyroid Hormone Synthesis
  - o Stimulates Thyroid Hormone Release
- **Release is Stimulated By:**
  - o Thyrotropin-Releasing Hormone (TRH)
  - o TRH is secreted by the Hypothalamus in response to:
    - Low T<sub>3</sub>/T<sub>4</sub> Blood Levels
    - Decreased metabolism
    - Cold stress
    - High-energy-use situations
- **Release is Regulated By:**
  - o Negative feedback loop between Hypothalamus-Pituitary-Thyroid glands:



## FSH/LH – Follicle Stimulating Hormone & Luteinizing Hormone:

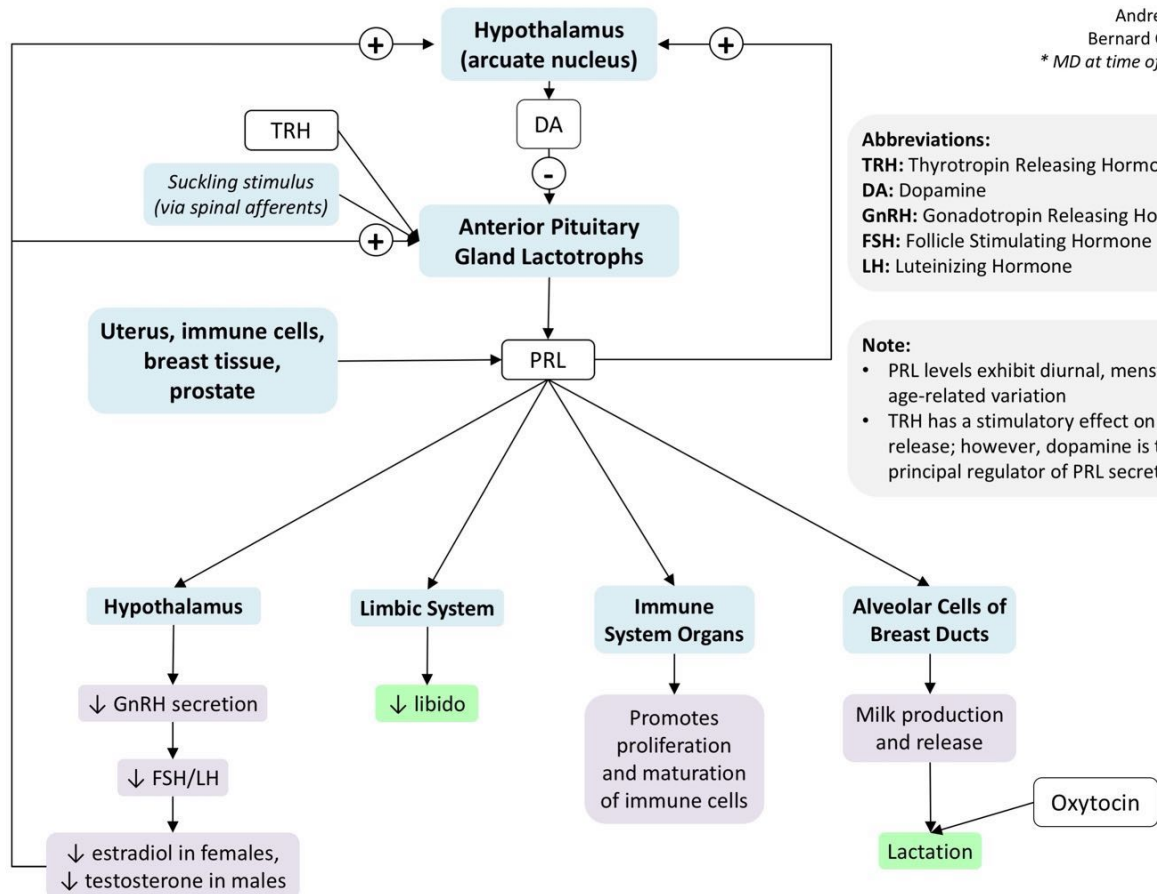
- **Secreted By:**
  - o Gonadotrophs of the Anterior Pituitary
- **Primary Action:**
  - o Important in Puberty → Development of Sexual Characteristics:
    - Primary Sex Characteristics (Genital Development)
    - Secondary Sex Characteristics (Eg: Pubic hair, voice changes, breast development)
  - o Important for Gamete Production
    - Males: LH → Leydig Cells → Produces Testosterone
    - Males: FSH → Sertoli Cells → Produce Sperm
    - Females: LH → Ovarian Follicles & Progesterone/Oestrogen Synthesis
    - Females: FSH → Recruits Ovarian Follicles early in menstrual cycle
- **Release is Stimulated By:**
  - o Gonadotropin-Releasing Hormone (GnRH)
- **Release is Regulated By:**
  - o Negative feedback loop between Hypothalamus, Anterior Pituitary & Gonads:



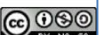
## PRL – Prolactin:

- **Secreted By:**
  - Lactotrophs in the Anterior Pituitary
- **Primary Action:**
  - Targets Breast Tissue:
    - → Stimulates growth of glandular breast tissue during pregnancy
    - → Stimulates Breast Milk Production after birth
- **Release is Stimulated By:**
  - Prolactin-Releasing Hormone (PRH)
- **Release is Regulated By:**
  - Complex feedback loop involving dopamine, suckling stimuli, and other sex hormones

## Feedback Loop: Prolactin (PRL)



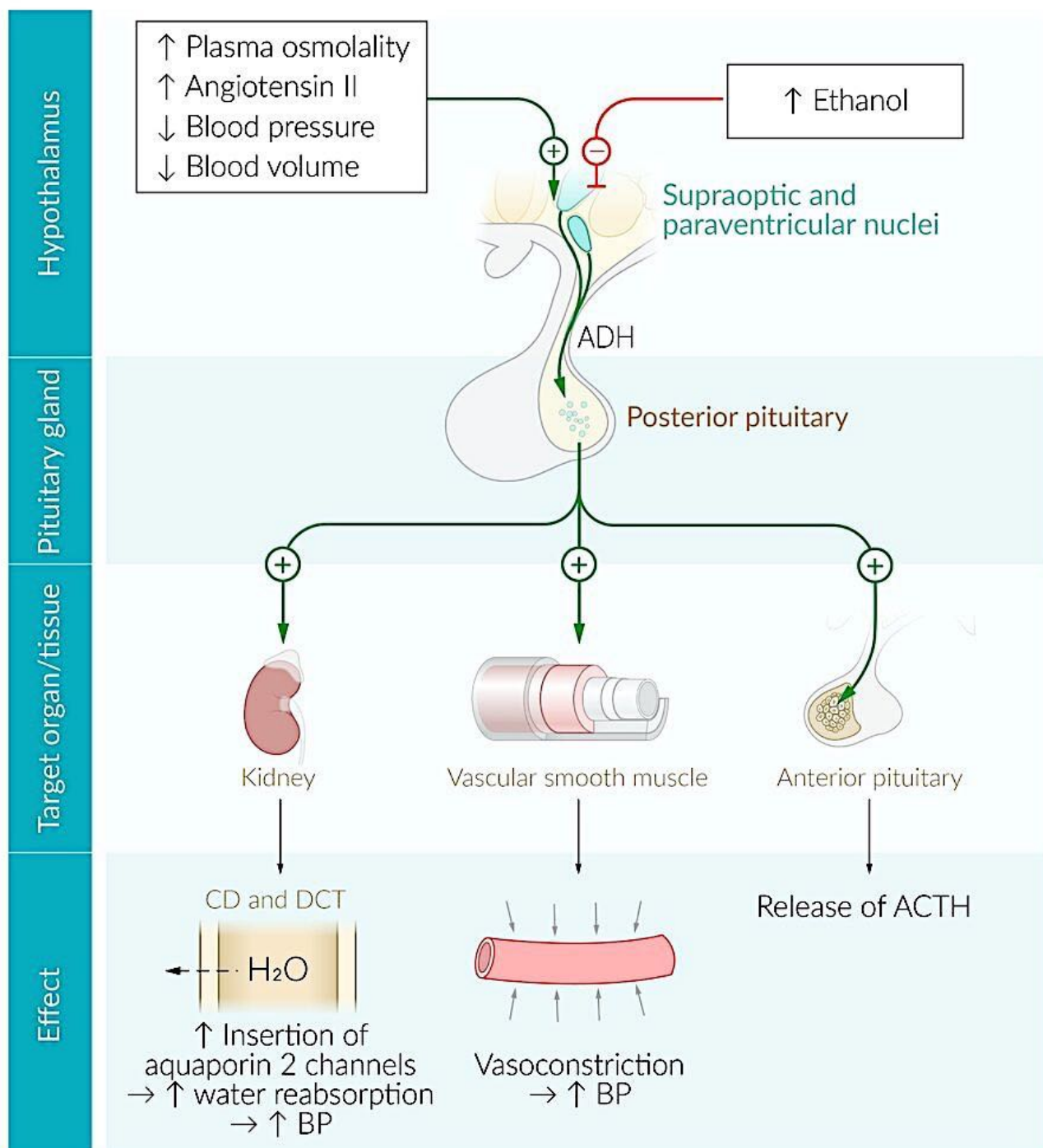
Legend: Pathophysiology Mechanism Sign/Symptom/Lab Finding Complications Published November 19, 2018 on [www.thecalgaryguide.com](http://www.thecalgaryguide.com)



<https://calgaryguide.ucalgary.ca/feedback-loop-prolactin-prl/>

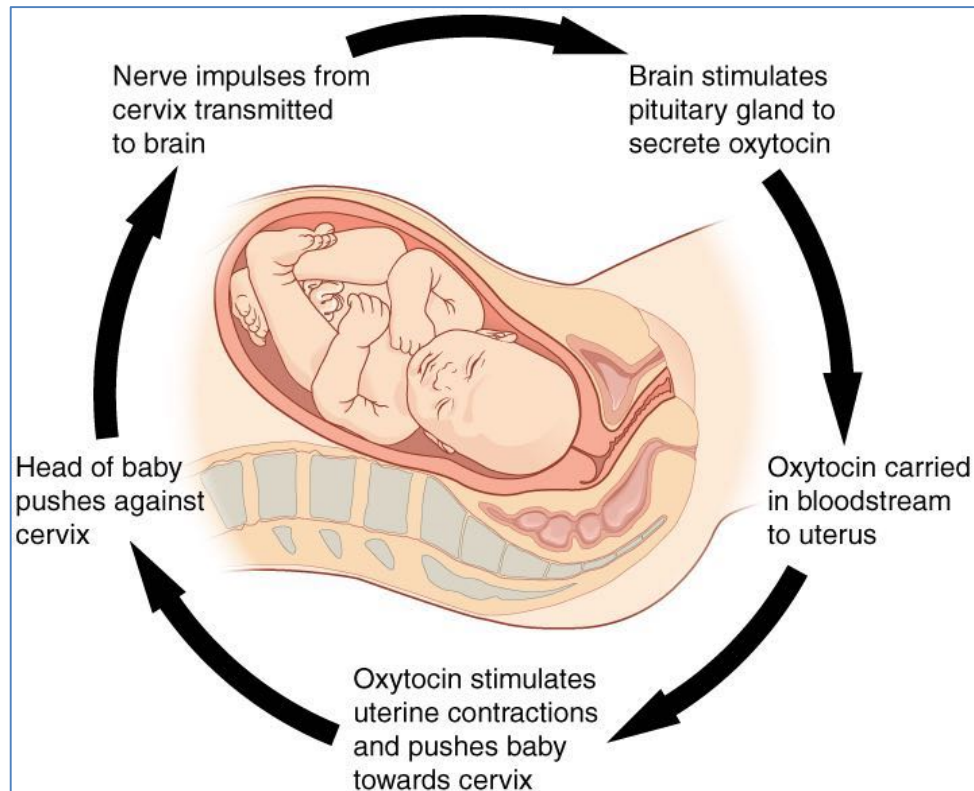
## ADH – Anti-Diuretic Hormone (AKA: “Vasopressin”):

- **Secreted By:**
  - Posterior Pituitary
- **Primary Action:**
  - Regulates Blood Pressure & Blood Volume
    - V1 Receptors → Arteriole Constriction → Increased Systemic Vascular Resistance
    - V2 Receptors → Increases water reabsorption in the Renal Collecting Ducts
- **Release is Stimulated By:**
  - Low blood volume
  - Increase of serum osmolality
  - Angiotensin-II
- **Release is Regulated By:**
  - Feedback mechanism between Plasma osmolality & Osmoreceptors in Hypothalamus, Total body water, and the Renin-Angiotensin System



### Oxytocin:

- **Secreted By:**
  - Posterior Pituitary
- **Primary Action:**
  - Progression of Labour
  - Let-Down Reflex in Breastfeeding
- **Release is Stimulated By:**
  - Baby Suckling (Breastfeeding)
  - Fetal head pushing against cervix (During Labour)
- **Release is Regulated By:**
  - Positive Feedback Mechanisms:
  - **Birth:**

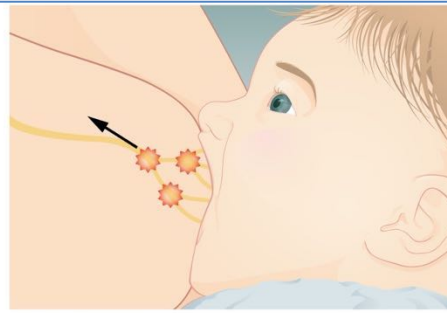


OpenStax, CC BY 4.0 <<https://creativecommons.org/licenses/by/4.0>>, via Wikimedia Commons

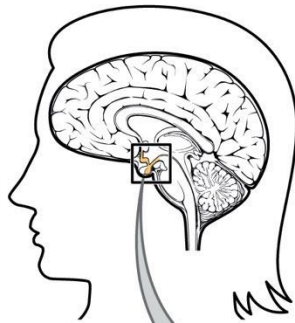
- **Breastfeeding:**

Increased milk production triggers increased suckling by infant (positive feedback loop).

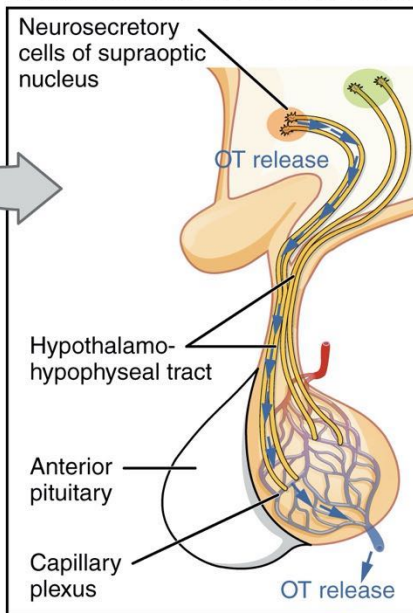
+



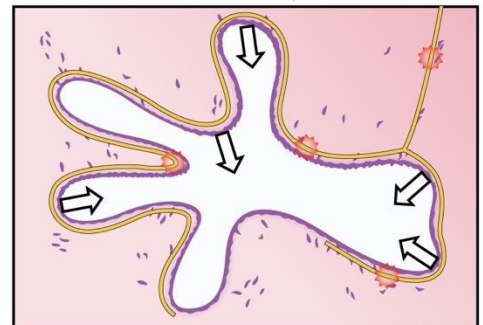
Suckling triggers sensory nerve impulses in the areola.



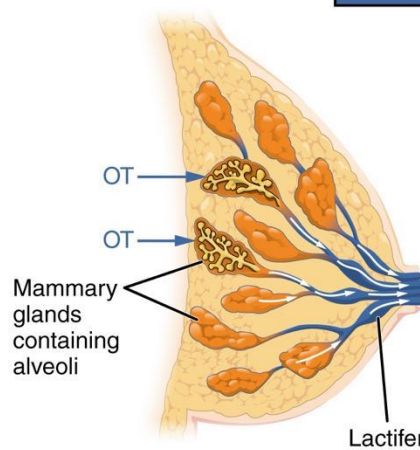
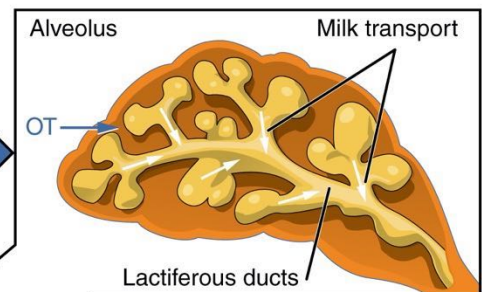
Brain receives sensory impulses from the areola and releases oxytocin (OT) from the hypothalamus and posterior pituitary.



Lactocytes in mammary alveoli produce milk in response to sensory nerve impulses.



Oxytocin (OT) triggers myoepithelial cells to squeeze milk from alveoli so it drains into lactiferous ducts.



Milk is pooled in lactiferous sinus before being discharged through nipple pores.

Lactiferous sinus

## End of Sample

Thankyou for previewing this **FREE** sample.  
For the rest of this subject, or to explore more of our range of  
amazing study notes, visit the link below:

>>> <https://mednotesstudent.com/product/all-21-notes-80-off-bundle/> <<<

**OR GET 80% OFF THIS SUBJECT IN THE BUNDLE DEAL HERE!**

**(Offer Ends Soon)**

# **MOST POPULAR**

