

Endocrine Physiology Fall 2020

Lecture 2

Pituitary Hormones and Their Control by the Hypothalamus

Zuheir A Hasan

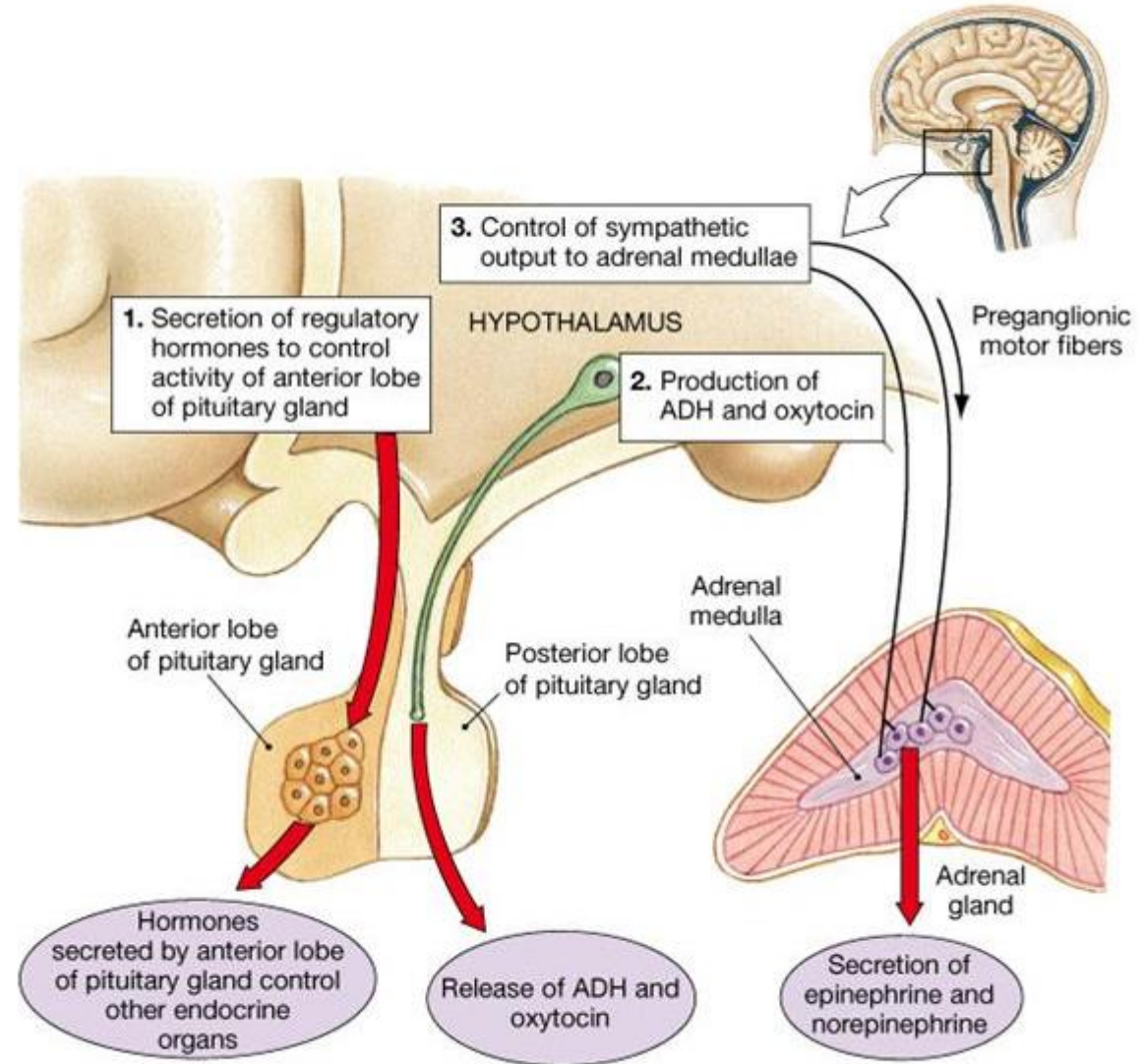
Professor of Physiology

College of Medicine

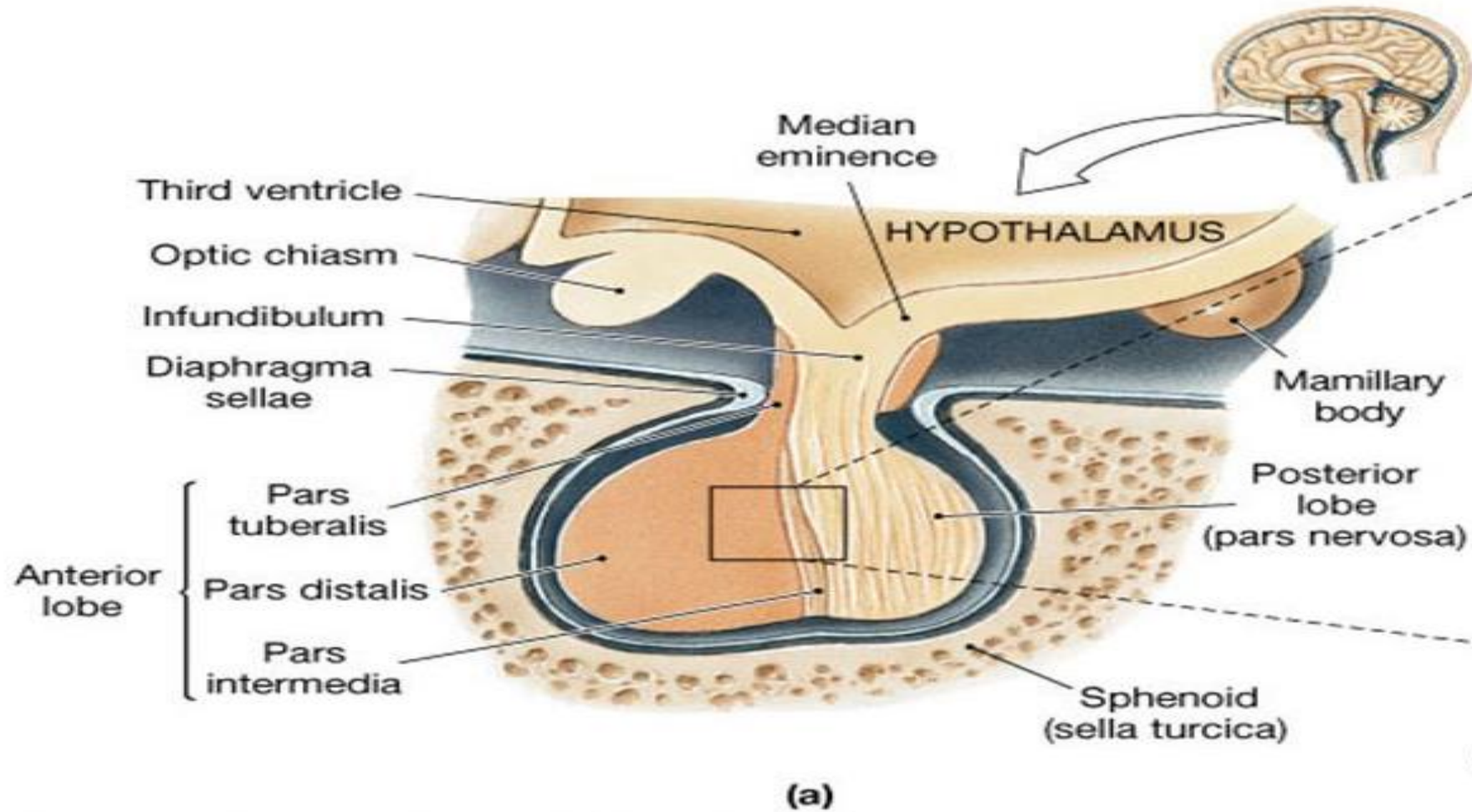
HU



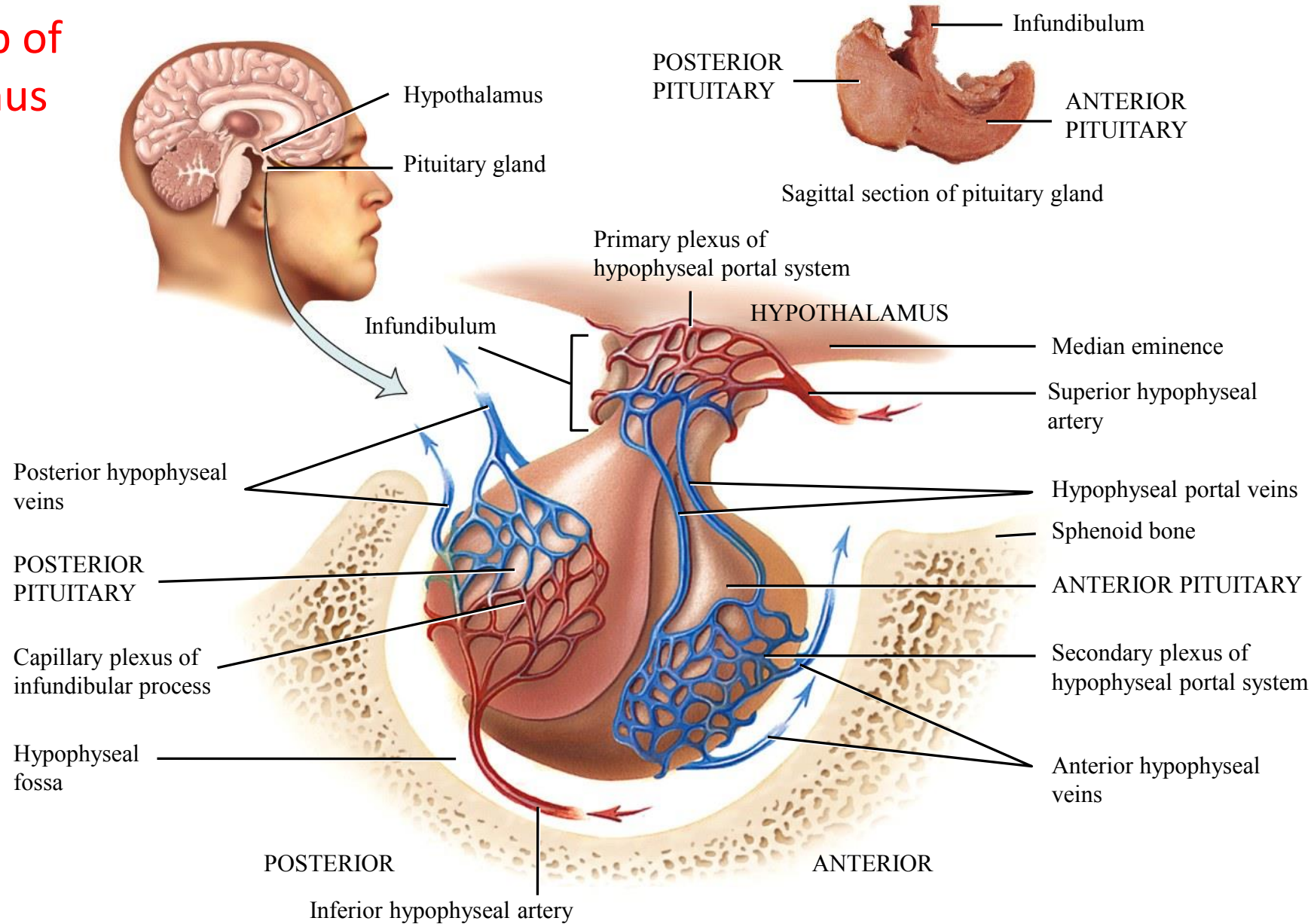
Endocrine control by hypothalamus



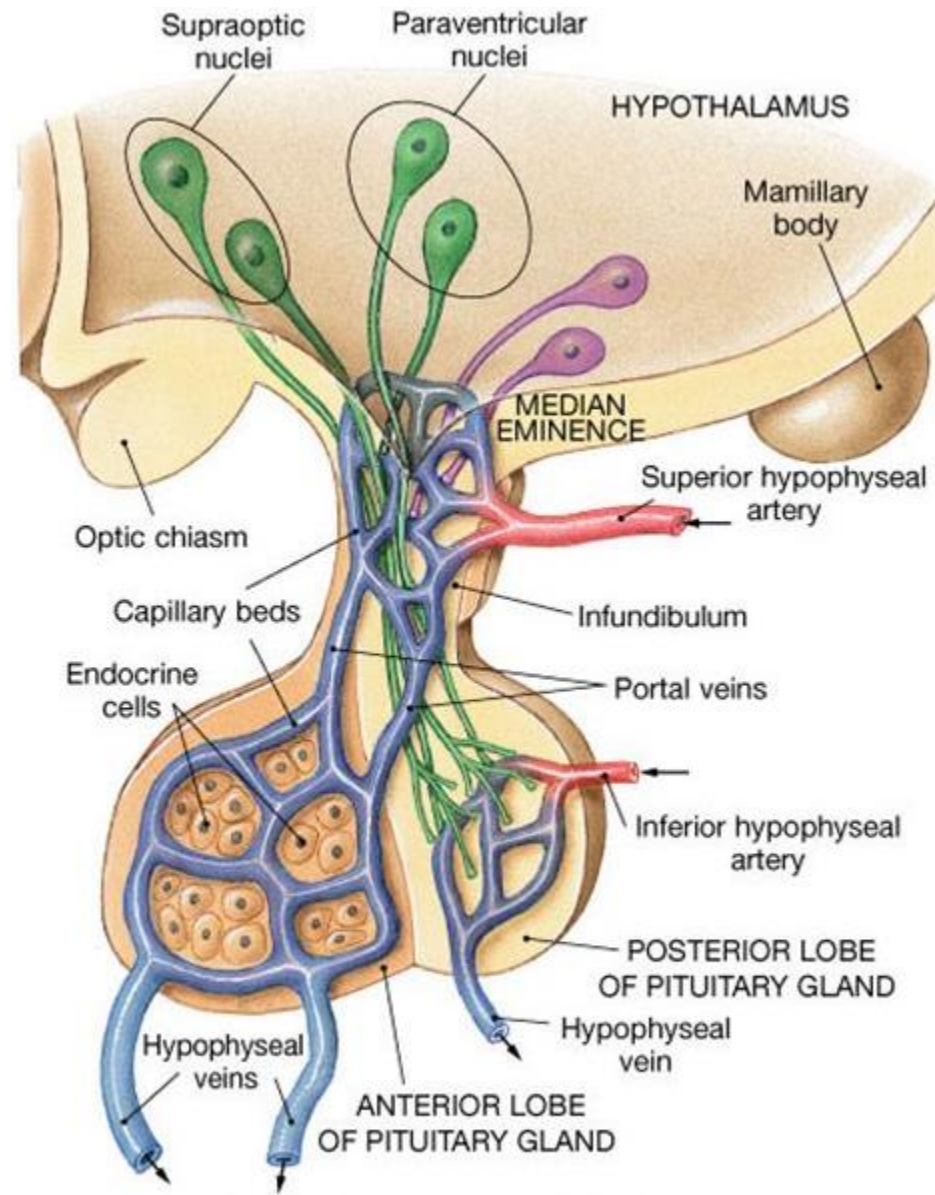
Anterior pituitary gland



Relationship of hypothalamus to pituitary gland



Hypothalamic Hypophysial portal system and hypothalamic hypophysial tract



Hypothalamic Hypophysial portal system

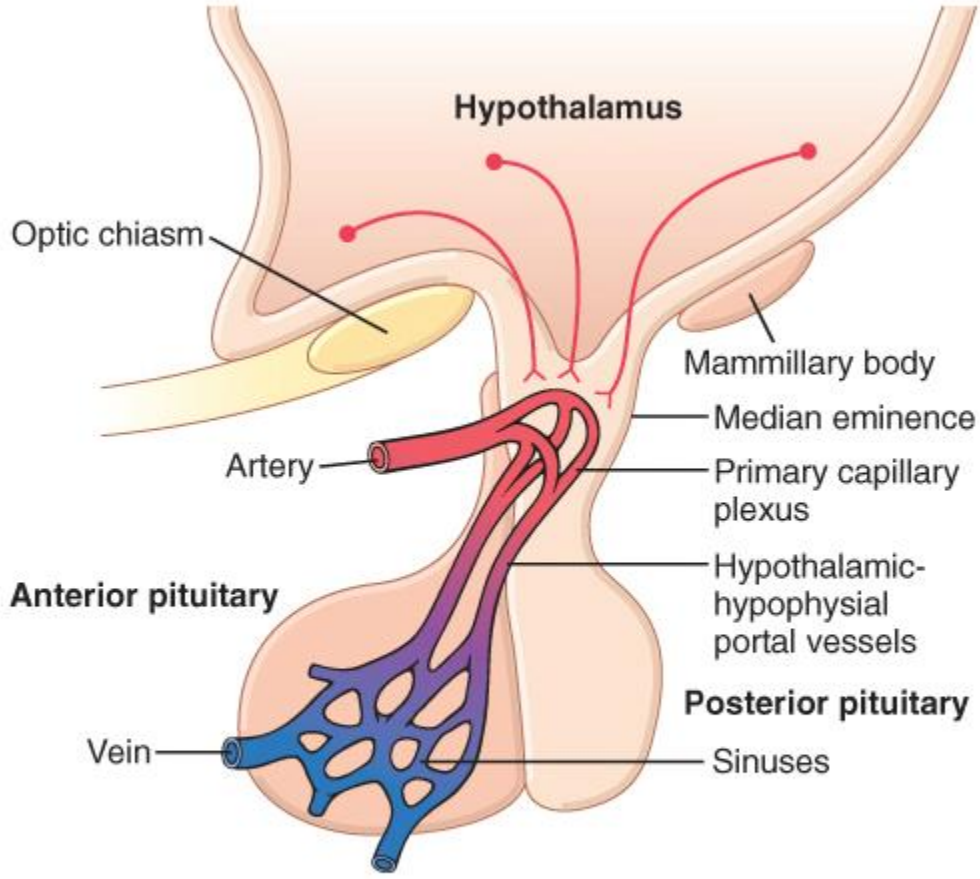
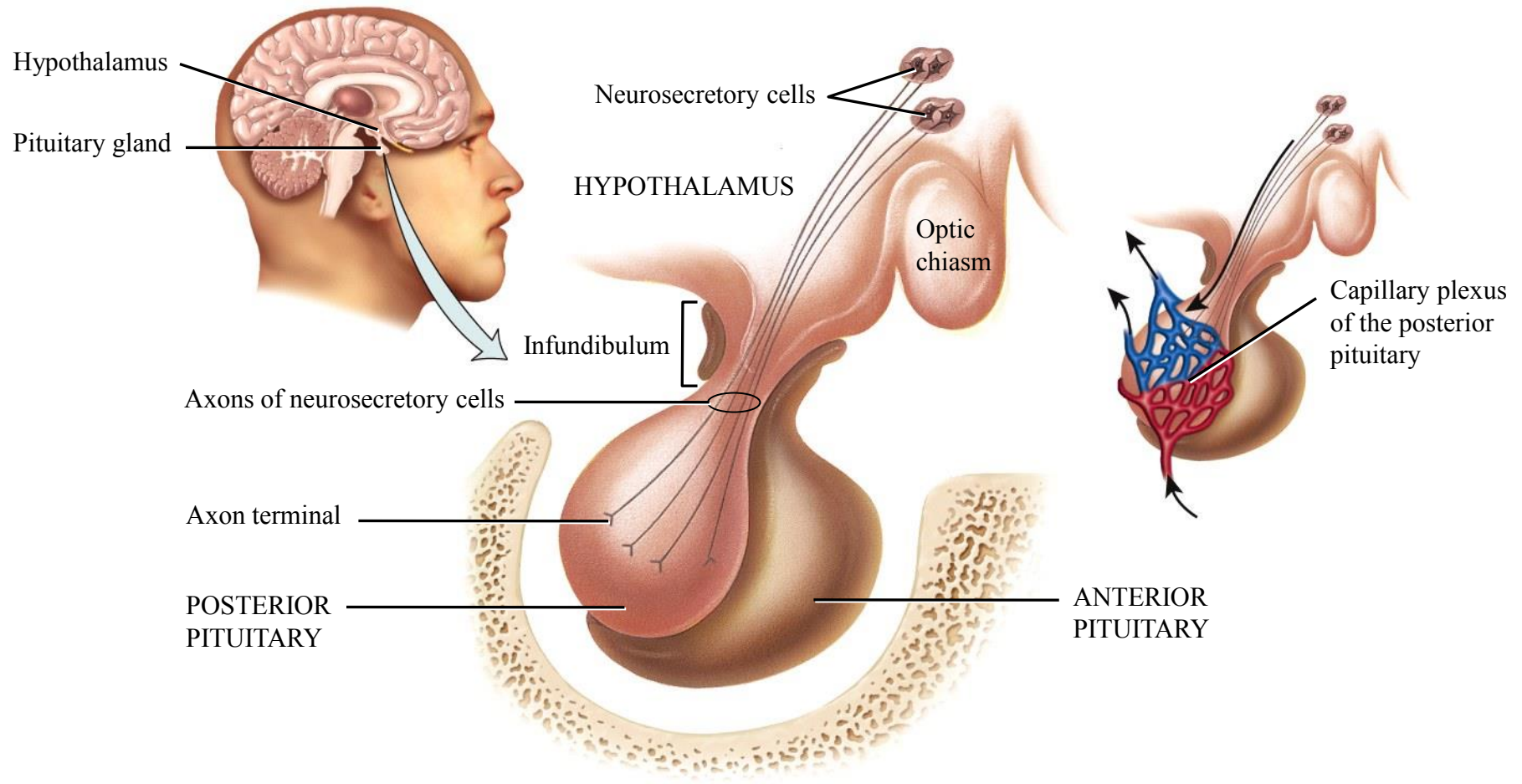


Figure 76-4. Hypothalamic-hypophysial portal system.

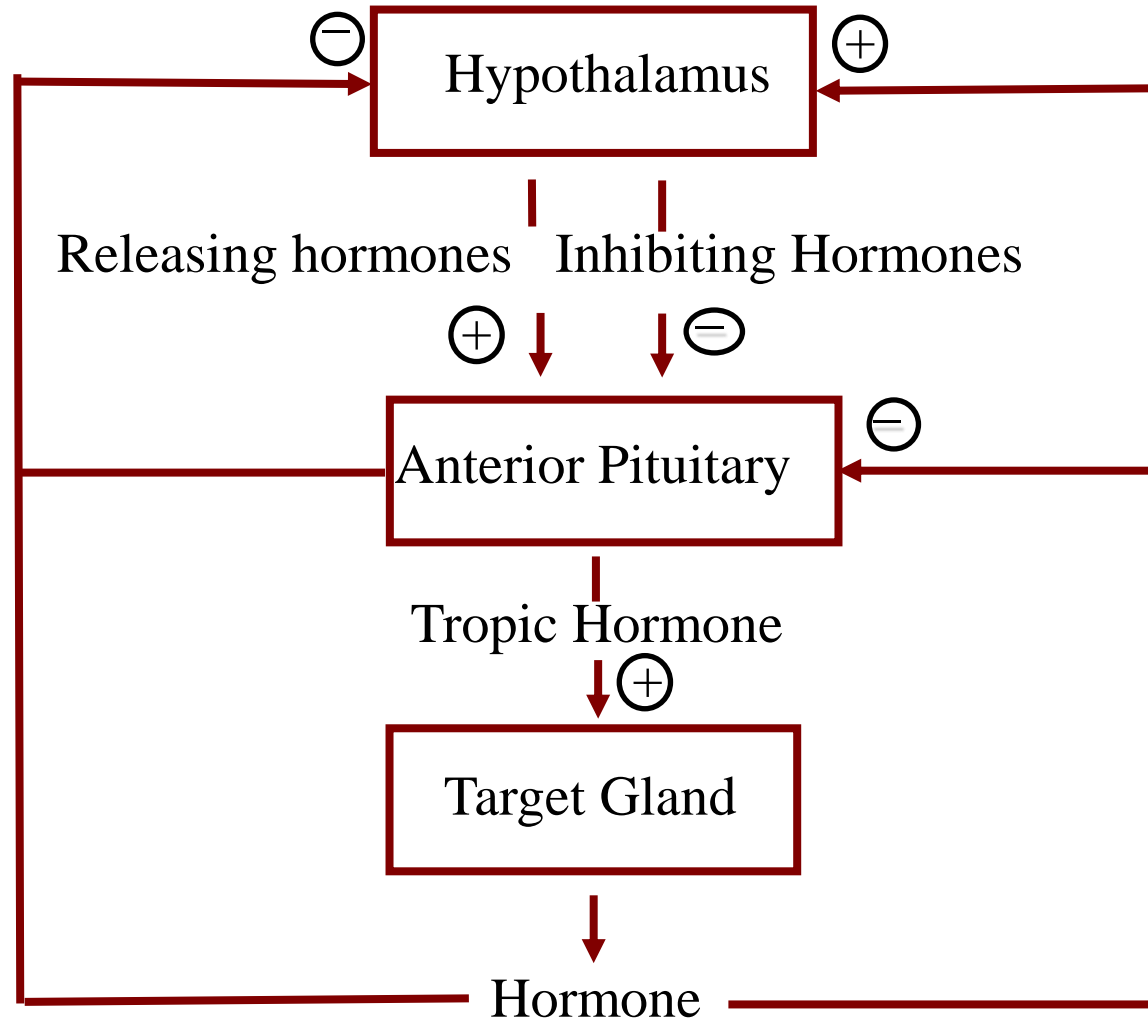




Copyright © John Wiley & Sons, Inc. All rights reserved.

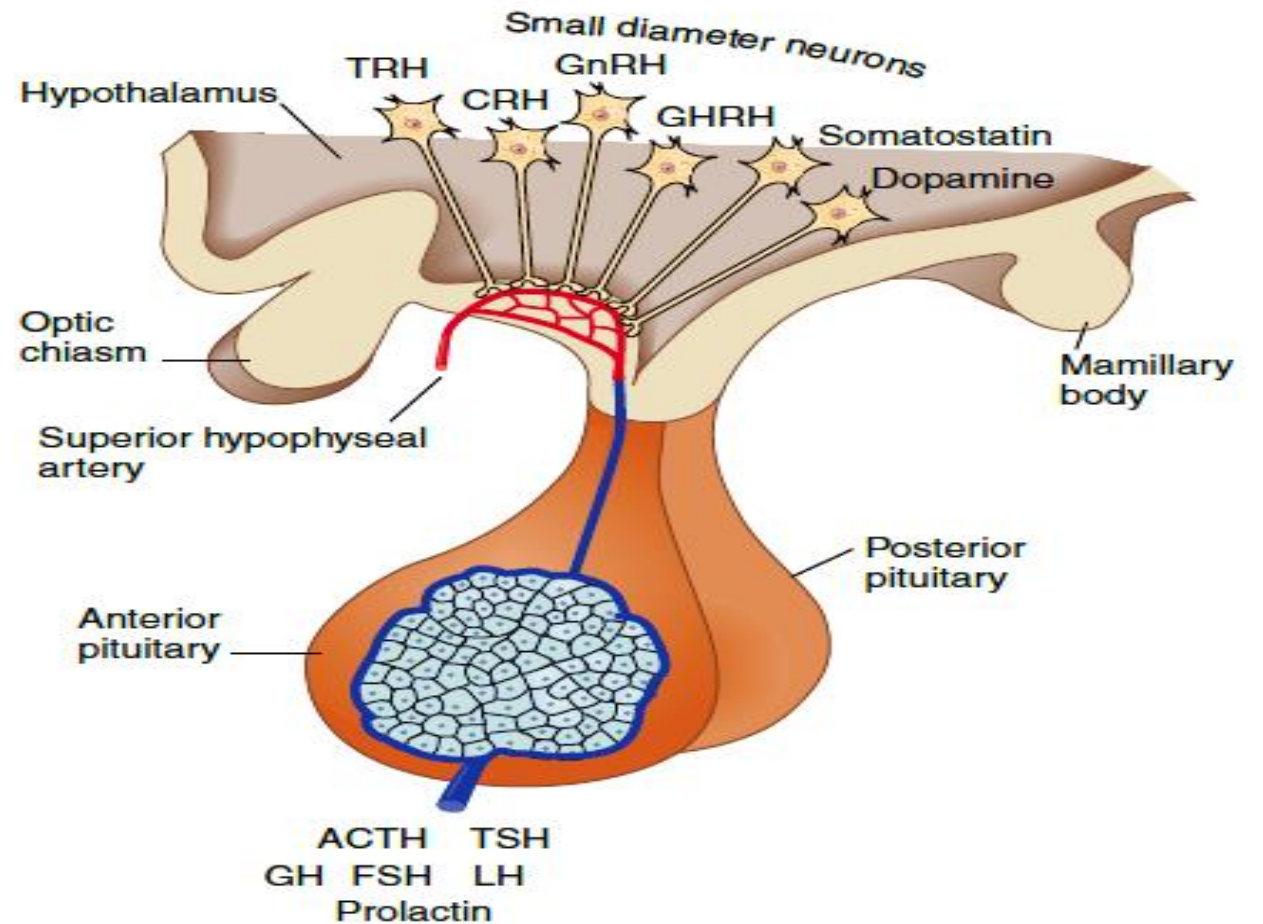


Hypothalamohypophyseal –Target Gland Axis



Hypothalamic and anterior pituitary hormone Hormones

- TRH
- GnRH
- CRH
- GHRH
- Somatostatin
- Dopamine



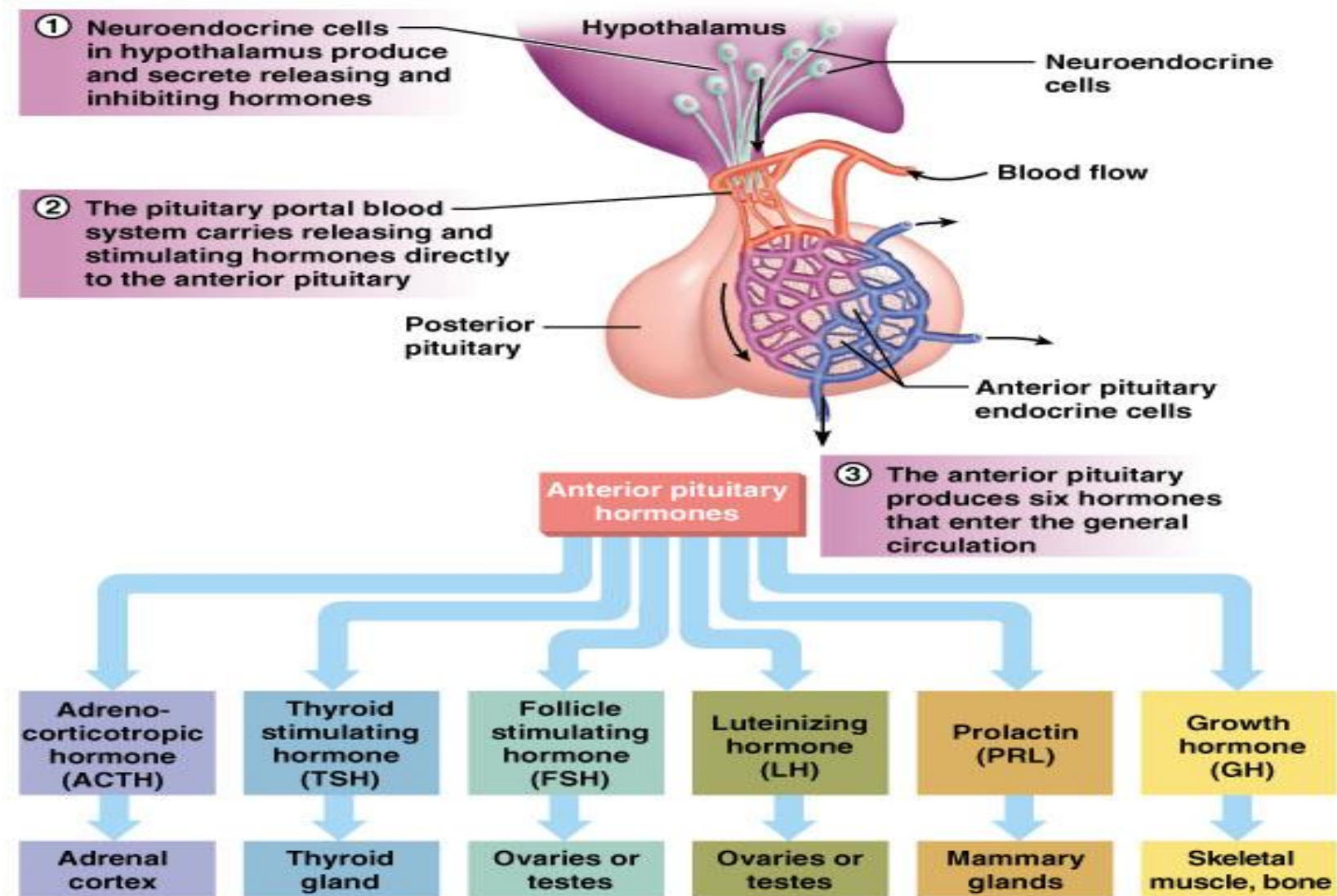
Summary

Effect of Each Hypothalamic Hormone on Anterior Pituitary

Hypothalamus		Pituitary Target	Secretion
TRH	+	Thyrotrophs (10%)	TSH
CRH	+	Corticotrophs (10–25%)	ACTH
GnRH*	+	Gonadotrophs (10–15%)	LH, FSH
GHRH**	+	Somatotrophs (50%)	GH
SST	-		
Dopamine***	-	Lactotrophs (10–15%)	Prolactin
TRH (elevated)	+		



Anterior pituitary hormones

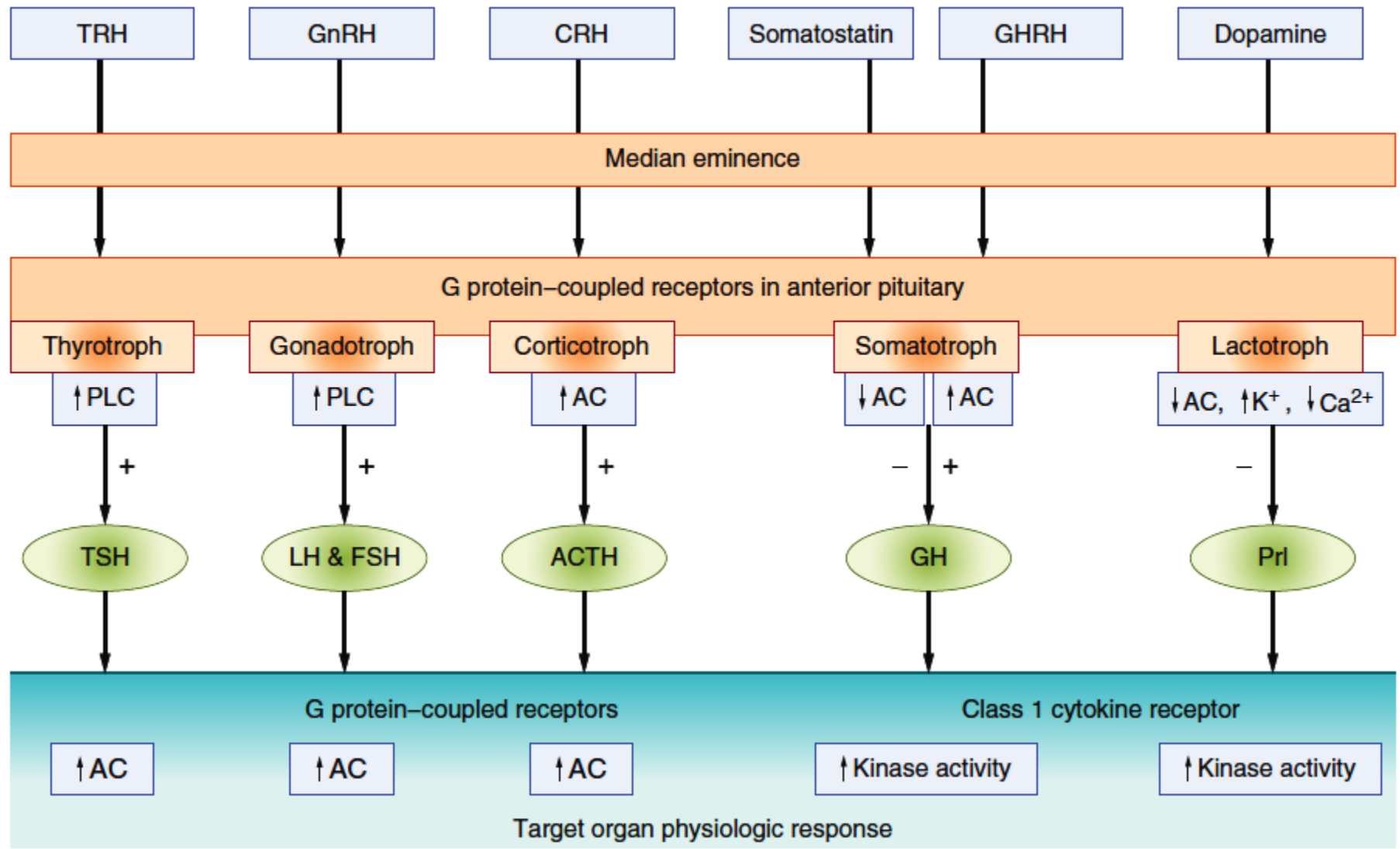


Hypophysiotropic Hormones

Hormone	Predominant hypothalamic localization	Structure	Actions on Anterior Pituitary
Thyrotropin-releasing hormone (TRH)	Paraventricular	Peptide consisting of 3 amino acids	Stimulates secretion of TSH by thyrotropes; stimulates expression of genes for α and β subunits of TSH thyrotropes; stimulates synthesis of PRL by lactotropes
Gonadotropin-releasing hormone (GnRH)	Arcuate	Single chain of 10 amino acids	Stimulates secretion of FSH and LH by gonadotropes
Corticotropin-releasing hormone (CRH)	Paraventricular	Single chain of 41 amino acids	Stimulates secretion of ACTH by corticotropes; stimulates expression of gene for POMC in corticotropes
Growth hormone-releasing hormone (GHRH)	Arcuate	Single chain of 44 amino acids	Stimulates secretion of GH by somatotropes; stimulates expression of gene for GH in somatotropes
Growth hormone-inhibiting hormone (somatostatin)	Anterior periventricular	Single chain of 14 amino acids	Inhibits secretion of GH by somatotropes
Prolactin-inhibiting hormone (PIH)	Arcuate	Dopamine	Inhibits biosynthesis and secretion of PRL by lactotropes



Hypothalamic Peptides

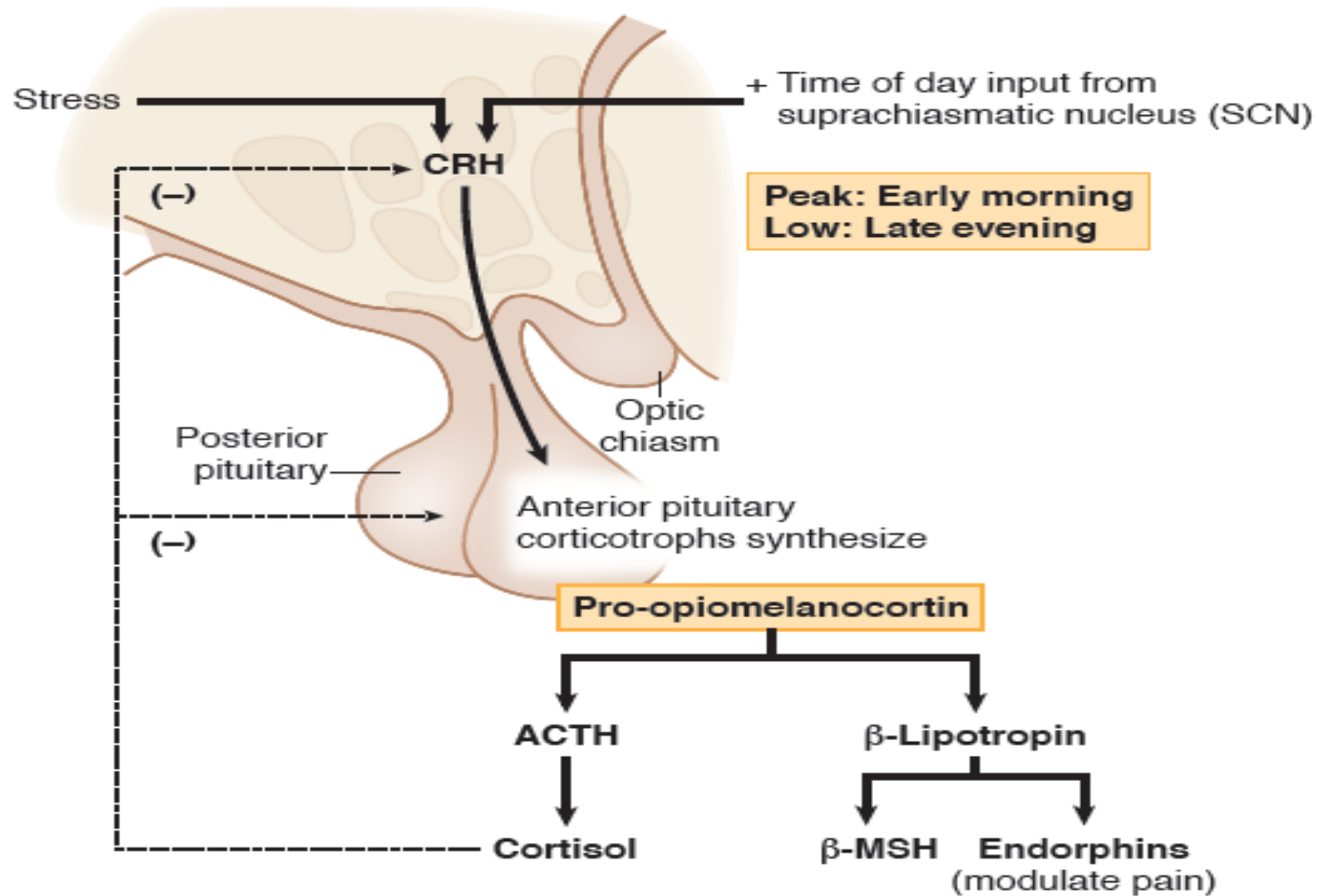


Adenohypophyseal Cells & Hormones

Cell	Hormone	Chemistry	Physiologic Actions
Corticotropes	Adrenocorticotrophic hormone (corticotropin; ACTH)	Single chain of 39 amino acids	Stimulates production of glucocorticoids and androgens by the adrenal cortex; maintains size of zona fasciculata and zona reticularis of cortex
Thyrotropes	Thyroid-stimulating hormone (thyrotropin; TSH)	Glycoprotein having two subunits, α (89 amino acids) and β (112 amino acids)	Stimulates production of thyroid hormones, T4 and T3, by thyroid follicular cells; maintains size of follicular cells
Gonadotropes	Follicle-stimulating hormone (FSH)	Glycoprotein having two subunits, α (89aa) and β (115aa)	Stimulates development of ovarian follicles; regulates spermatogenesis in the testis
Gonadotropes	Lutenizing hormone (LH)	Glycoprotein having two subunits, α (89aa) and β (115aa)	Causes ovulation and formation of corpus luteum in the ovary; stimulates production of estrogen and progesterone by the ovary; stimulates testosterone production by the testis
Mammotropes, Lactotropes	Prolactin (PRL)	Single chain of 198 amino acids	Essential for milk production by lactating mammary gland
Somatotropes	Growth hormone (somatotropin; GH)	Single chain of 191 amino acids	Stimulates postnatal body growth; stimulates secretion of IGF-1; stimulates triglyceride lipolysis; inhibits actions of insulin on carbohydrate and lipid metabolism

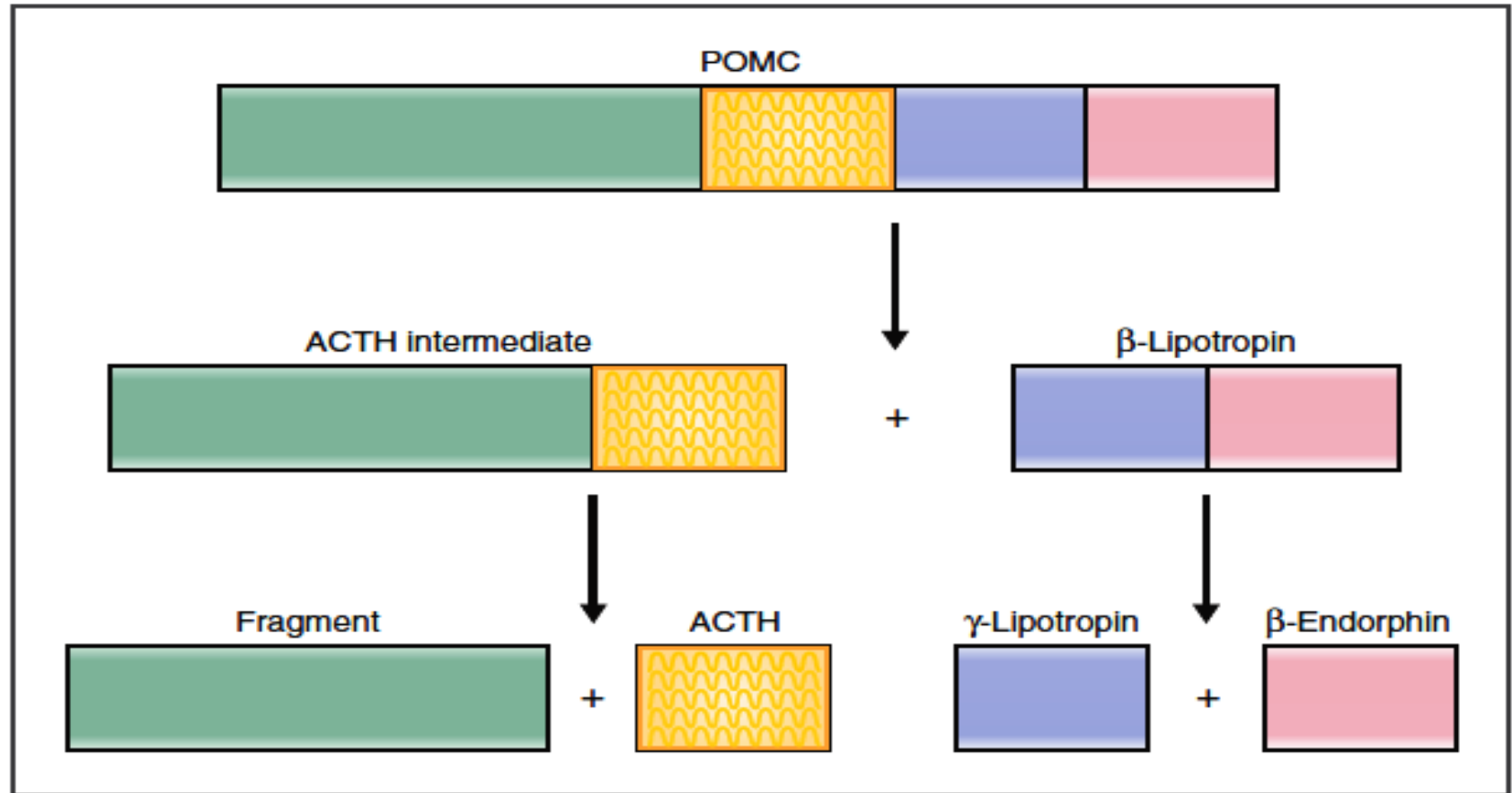


Proopiomelanocortin hormones



The hormones derived from pro-opiomelanocortin (POMC)

The anterior pituitary in humans produces mainly ACTH, γ -lipotropin, and β -endorphin.



The fragment contains γ -MSH; ACTH contains α -MSH; and γ -lipotropin contains β -MSH. ACTH, Adrenocorticotrophic hormone; MSH, melanocyte-stimulating hormone.



Proopiomelanocortin hormones

Melanocyte-stimulating Hormone (α -MSH)

- is produced by the proteolytic cleavage of POMC
- Mainly in the pars- intermedia of the pituitary gland (not well developed in man)
- Only small amounts of α -MSH are produced in the human pituitary under normal conditions.
- Melanocortin peptides exert their effects through MCR found in melanocytes, which are key components of the skin's pigmentary system
- Pigmentary changes in some human endocrine diseases are due to changes in circulating ACTH.
 - Abnormal pallor is a hallmark of hypopituitarism.
 - Hyperpigmentation occurs in patients with adrenal insufficiency



Melanocortin receptors (MCRs)

- Mediated the effects of POMC-derived peptides
- Including the skin, adrenal steroid hormone production, and thermoregulation
- MCR been implicated in feeding behavior and appetite regulation.



Proopiomelanocortin hormones

β -Endorphin

- the most abundant endogenous opioid peptide
- is another product of POMC processing in the pituitary
- The physiologic effects of this opioid peptide are mediated by binding to opiate receptors, multiple cell types in the brain as well as in peripheral tissues.
- The physiologic may include analgesia, behavioral effects, and neuromodulator functions



EVALUATION OF ANTERIOR PITUITARY FUNCTION

- Measurements of anterior pituitary hormone concentrations and of the respective target gland hormone levels are used to assess the functional status of the system.
- For example, paired measures of TSH and thyroid hormone, FSH and estradiol, and ACTH and cortisol are used to evaluate the integrity of the respective systems.
- In addition, stimulation and inhibition tests can be used to assess the functional status of the pituitary gland.
- These tests are based on the normal physiologic feedback mechanisms that control tropic hormone release.
- For example, administration of the amino acid arginine can be used to elicit an increase in GH release in patients with suspected GH deficiency.
- In contrast, suppression tests can be used to diagnose Cushing syndrome, a clinical state resulting from prolonged inappropriate exposure to excessive endogenous secretion of cortisol (Low dose Dexamethasone test)



Pituitary disorders : Hypersecretion

- pituitary adenoma , usually benign neoplasm (Prolactinomas are the most common)
- GH-secreting adenomas can be associated with **acromegaly** or bone and soft tissue overgrowth in adults and **gigantism** in children.
- ACTH-releasing adenomas are associated with excess cortisol production or **Cushing disease**
- Clinical presentation
 Central obesity, proximal myopathy ,hypertension, and hyperglycemia, skin pigmentation etc
- Gonadotroph pituitary adenomas are frequently inefficient in hormone production.
- Thyrotropin-secreting tumors are rare and are frequently large when diagnosed.



Hypopituitarism

- Can be congenital or acquired
 - A acquired can result from
 - Head trauma , surgery, penetrating injury,
 - **Craniopharyngioma** is a rare type of brain tumor derived from pituitary gland embryonic tissue that occurs most commonly in children, but also affects adults. It may present at any age, even in the prenatal and neonatal periods, but peak incidence rates are childhood-onset at 5–14 years and adult-onset at 50–74 years.
- Severe blood loss and **decreased** blood flow (ischemia) of the pituitary
- Ischemic damage to the pituitary gland or hypothalamic-pituitary stalk during the peripartum period Sheehan syndrome
- **Pan hypopituitarism in adults leads to**
 - Hypothyroidism
 - Adrenal insufficiency
 - hypogonadism (failure to resume normal menses in women)
 - Loss of lactation in lactating mothers
 - GH deficiency .
 - GH deficiency cause growth retardation leading to dwarfism in children and sexual immaturity before puberty

