

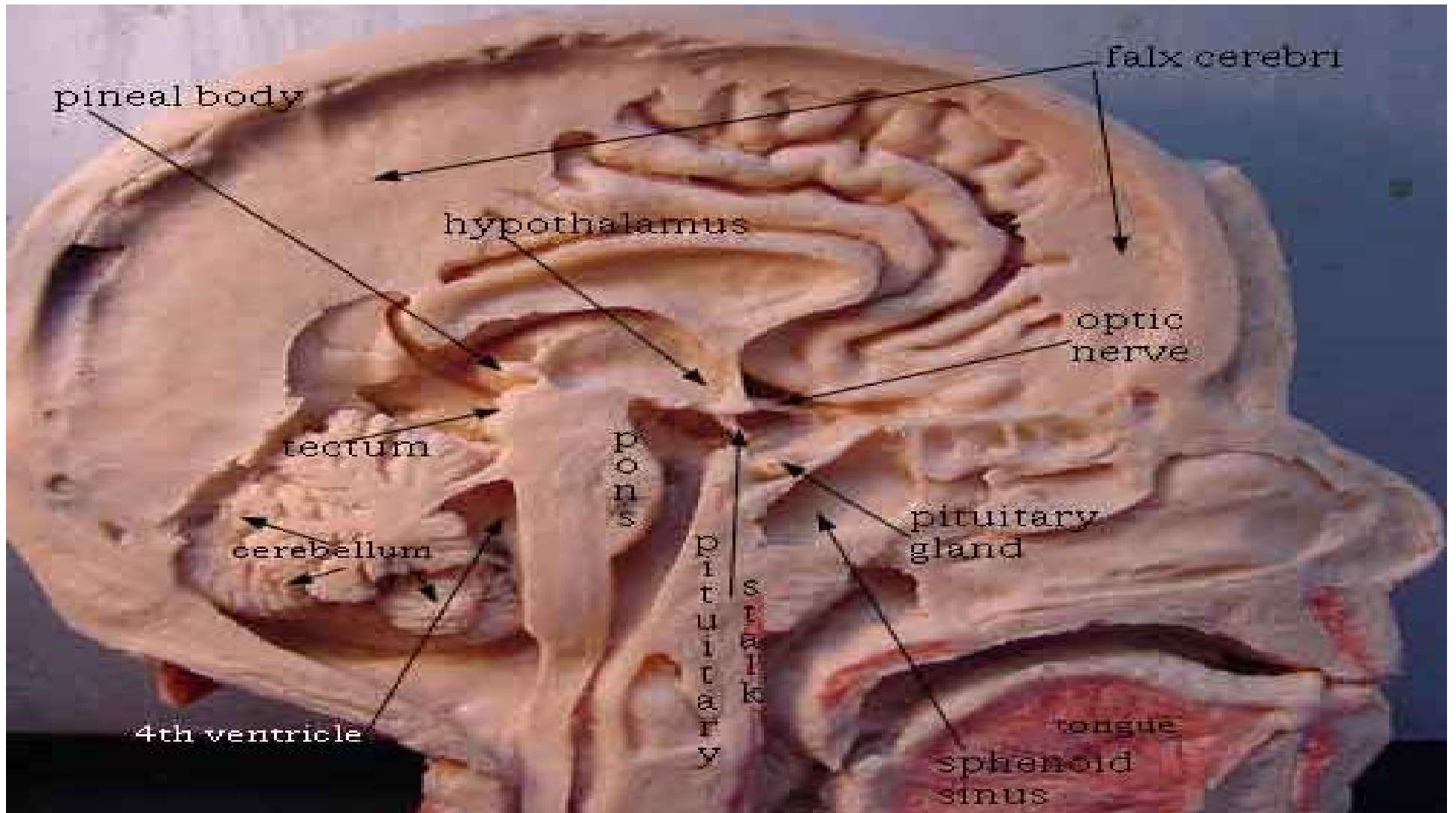
# NEUROENDOCRINOLOGY

Danil Hammoudi.MD

The hypothalamus and pituitary gland are key regulators of the hormone system.

Sensory and endocrine information is processed and integrated in the brain and hormone release is controlled by neuroendocrine secretion in the posterior pituitary lobe.

In addition, other hypothalamic neurons secrete releasing (RH) or release-inhibiting hormones (RIH) into the portal blood system that control hormone release from specific endocrine cells in the anterior pituitary lobe.





# HYPOTHALAMUS

# Hypothalamus

Below the thalamus, it caps the brainstem and forms the inferolateral walls of the third ventricle

**Mammillary bodies** - small, paired nuclei bulging anteriorly from the hypothalamus - relay stations for olfactory pathways

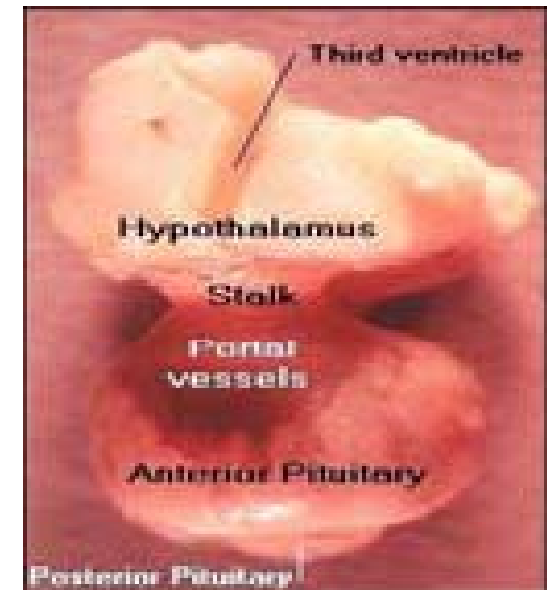
**Infundibulum** – stalk of the hypothalamus connecting to the pituitary gland

Main visceral control center of the body, important to overall body homeostasis



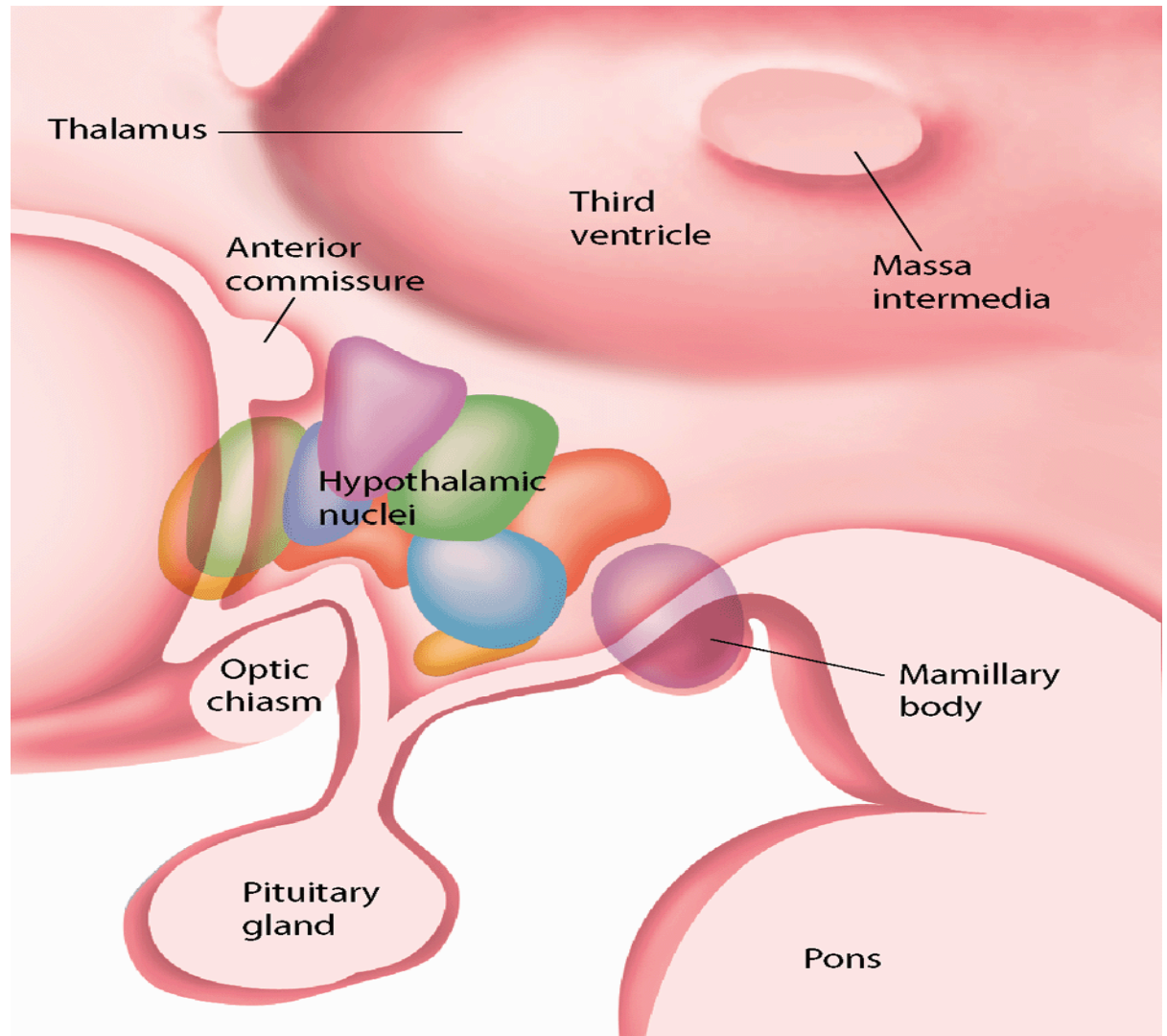
- Functions:
  - Autonomic regulatory center
- Influences HR, BP, resp. rate, GI motility, pupillary diameter.
- Can you hold your breath until you die?
  - Emotional response
- Involved in fear, loathing, pleasure
- Drive center: sex, hunger
  - Regulation of body temperature
  - Regulation of food intake
- Contains a satiety center
  - Regulation of water balance and thirst
  - Regulation of sleep/wake cycles
  - Hormonal control
- Releases hormones that influence hormonal secretion from the anterior pituitary gland.

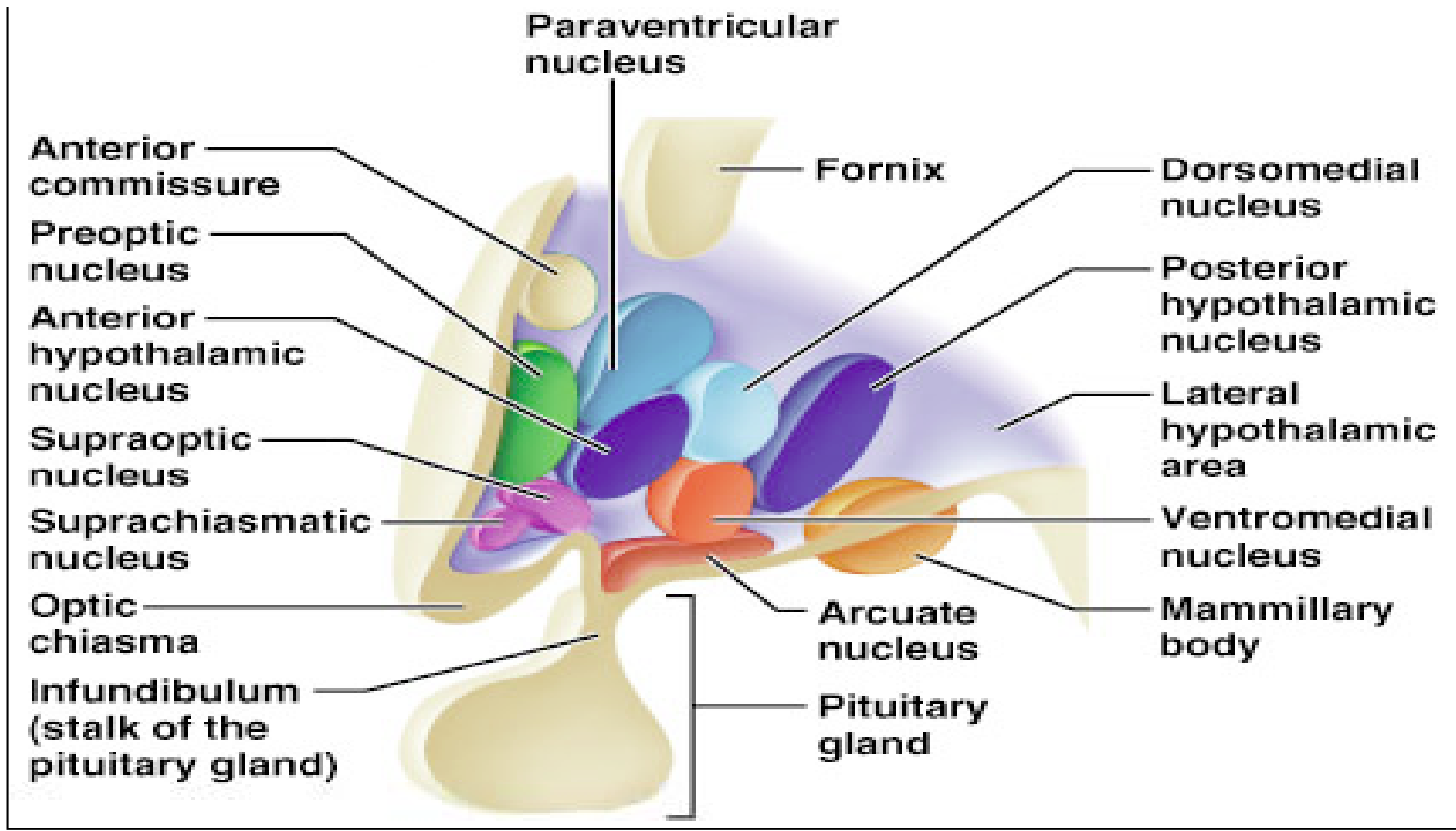
# Hypothalamus



# Hypothalamus

- *A group of nuclei critical for regulating homeostasis, the four Fs, and hormones*





## Hypothalamic Nuclei



# Hypothalamic Function

Regulates ANS by controlling activity of centers in brains stem and spinal cord

- Regulates blood pressure, rate and force of heartbeat, digestive tract motility, respiratory rate and depth, pupil size, and many other visceral activities
- Center for emotional response - involved in perception of pleasure, fear, rage
- Regulates body temperature – the body’s “thermostat”
- Regulates food intake - feelings of hunger and satiety
- Regulates sleep-wake cycle

# Endocrine Functions of the Hypothalamus

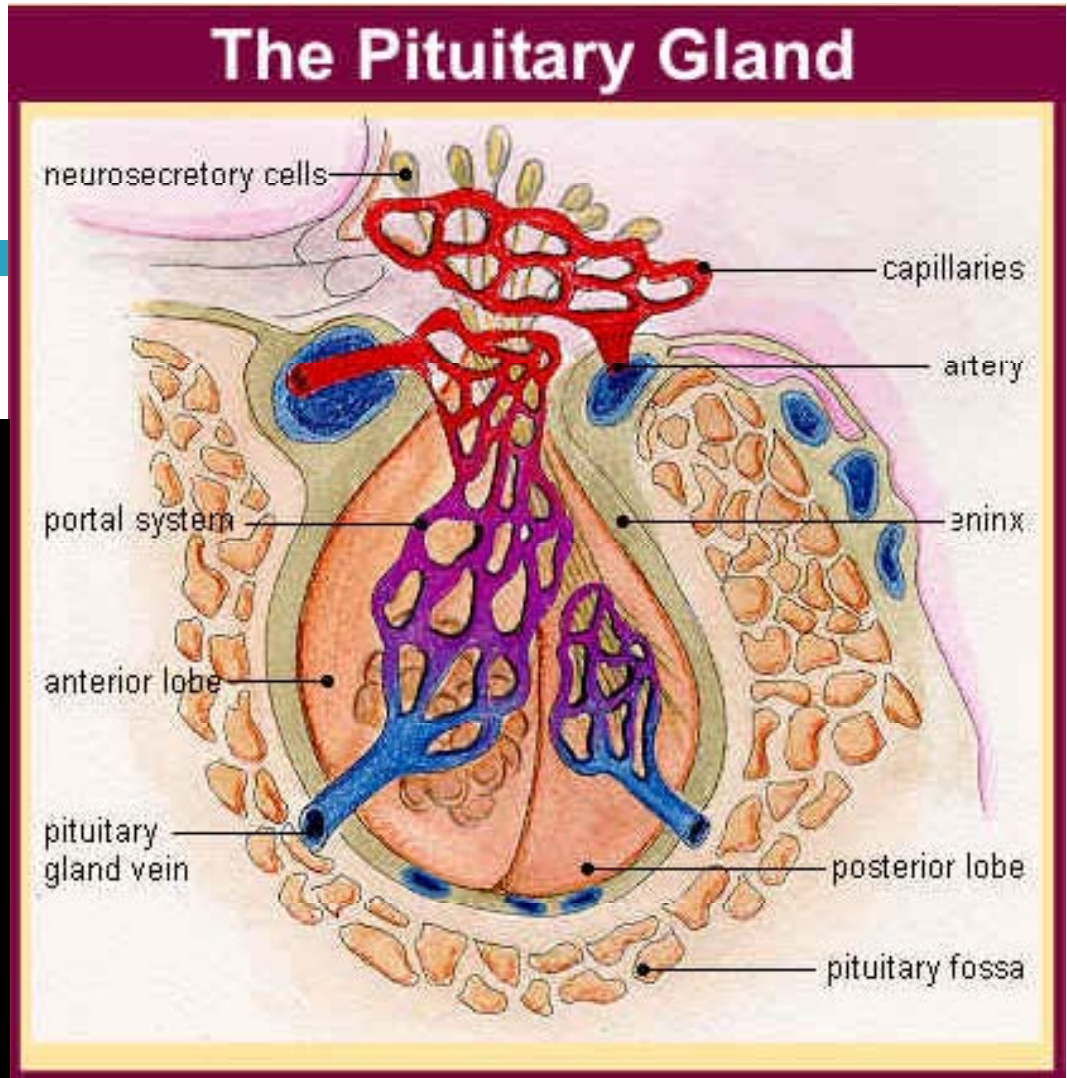
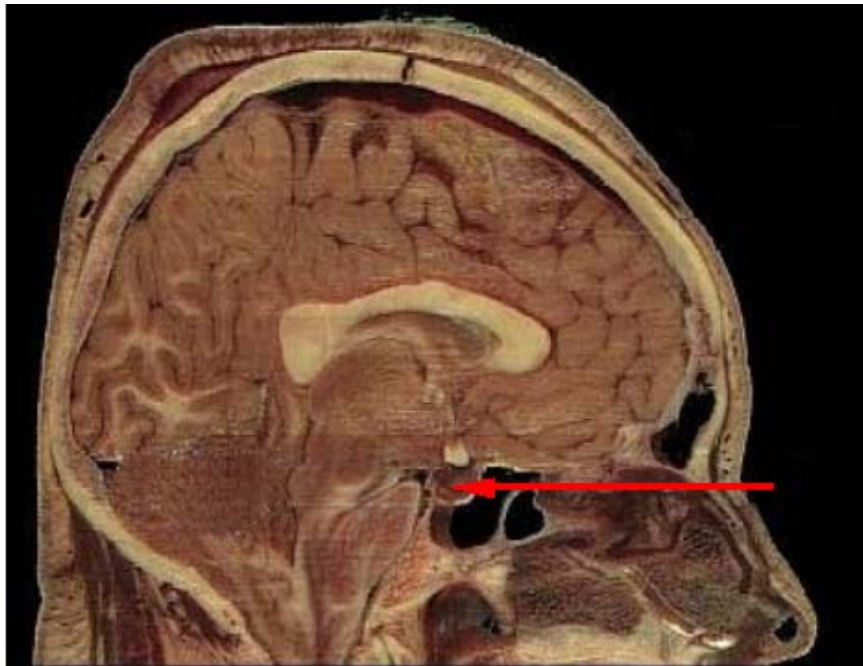
Releasing hormones control the secretion of hormones by the anterior pituitary

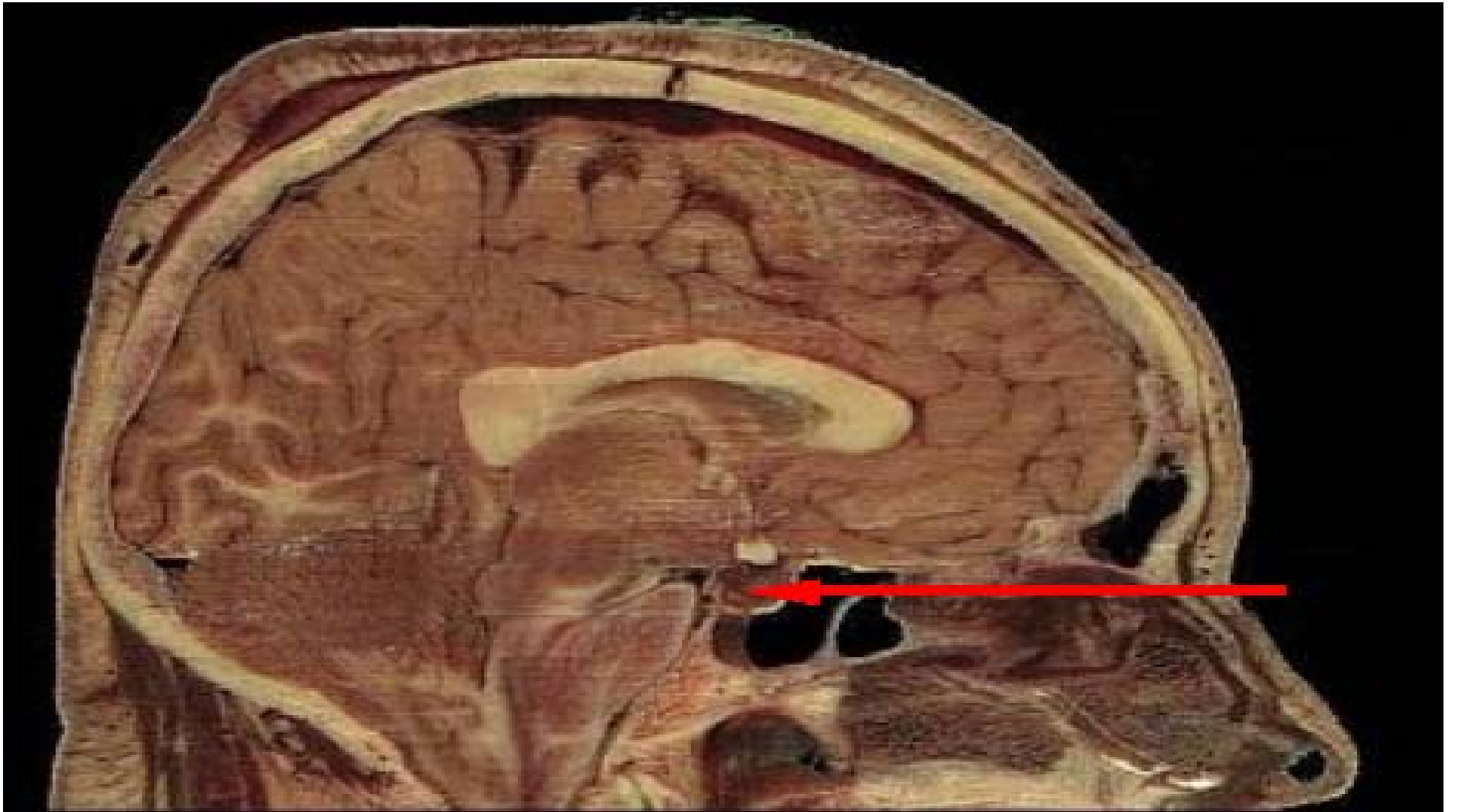
Stimulates ADH release from the posterior pituitary

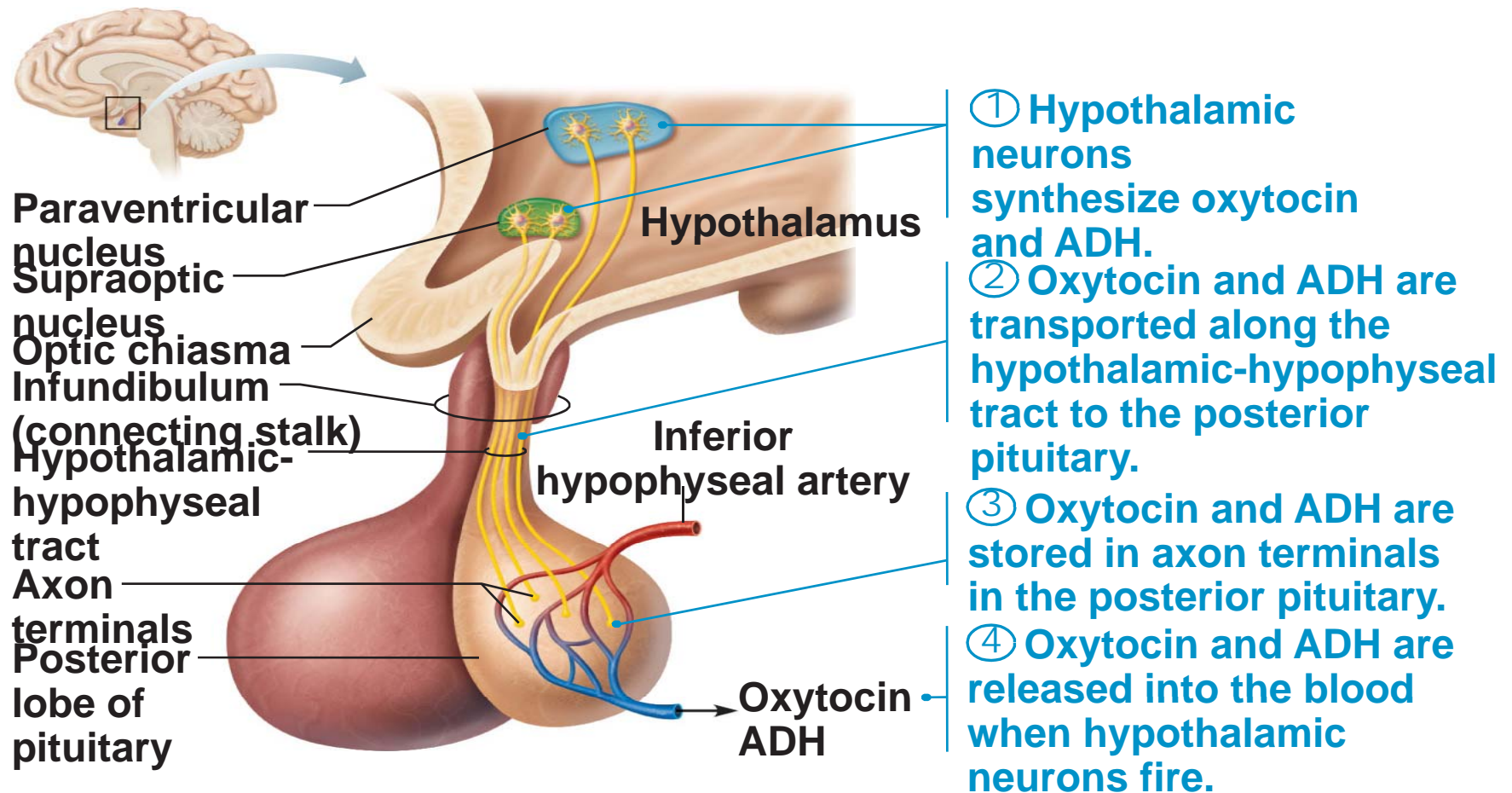
Anti-diuretic hormone- causes kidneys to retain water

<u>Secreted hormone</u>	<u>Abbrevi</u>	<u>Effect</u>
<b>Thyrotropin-releasing hormone</b> (Prolactin-releasing hormone)	TRH, TRF, or PRH	Stimulate thyroid-stimulating hormone (TSH) release from anterior pituitary (primarily) Stimulate prolactin release from anterior pituitary
<b>Dopamine</b> (Prolactin-inhibiting hormone)	DA or PIH	Inhibit prolactin release from anterior pituitary
<b>Growth hormone-releasing hormone</b>	GHRH	Stimulate Growth hormone (GH) release from anterior pituitary
<b>Somatostatin</b> (growth hormone-inhibiting hormone)	SS, GHIH, or SRIF	Inhibit Growth hormone (GH) release from anterior pituitary Inhibit thyroid-stimulating hormone (TSH) release from anterior pituitary
<b>Gonadotropin-releasing hormone</b>	GnRH or LHRH	Stimulate follicle-stimulating hormone (FSH) release from anterior pituitary Stimulate luteinizing hormone (LH) release from anterior pituitary
<b>Corticotropin-releasing hormone</b>	CRH or CRF	Stimulate adrenocorticotrophic hormone (ACTH) release from anterior pituitary
<b>Oxytocin</b>		Uterine contraction Lactation (letdown reflex)
<b>Vasopressin</b> (antidiuretic hormone)	ADH or AVP	Increase in the permeability to water of the cells of distal tubule and collecting duct in the kidney and thus allows water reabsorption and excretion of concentrated urine

# PITUITARY GLAND







(a) Relationship between the posterior pituitary and the hypothalamus. **Figure 16.5a**

# Pituitary-Hypothalamic Relationships

- Anterior Lobe:
  - ▣ Originates as an out-pocketing of the oral mucosa
  - ▣ Hypophyseal portal system
    - Primary capillary plexus
    - Hypophyseal portal veins
    - Secondary capillary plexus
- Carries releasing and inhibiting hormones to the anterior pituitary to regulate hormone secretion

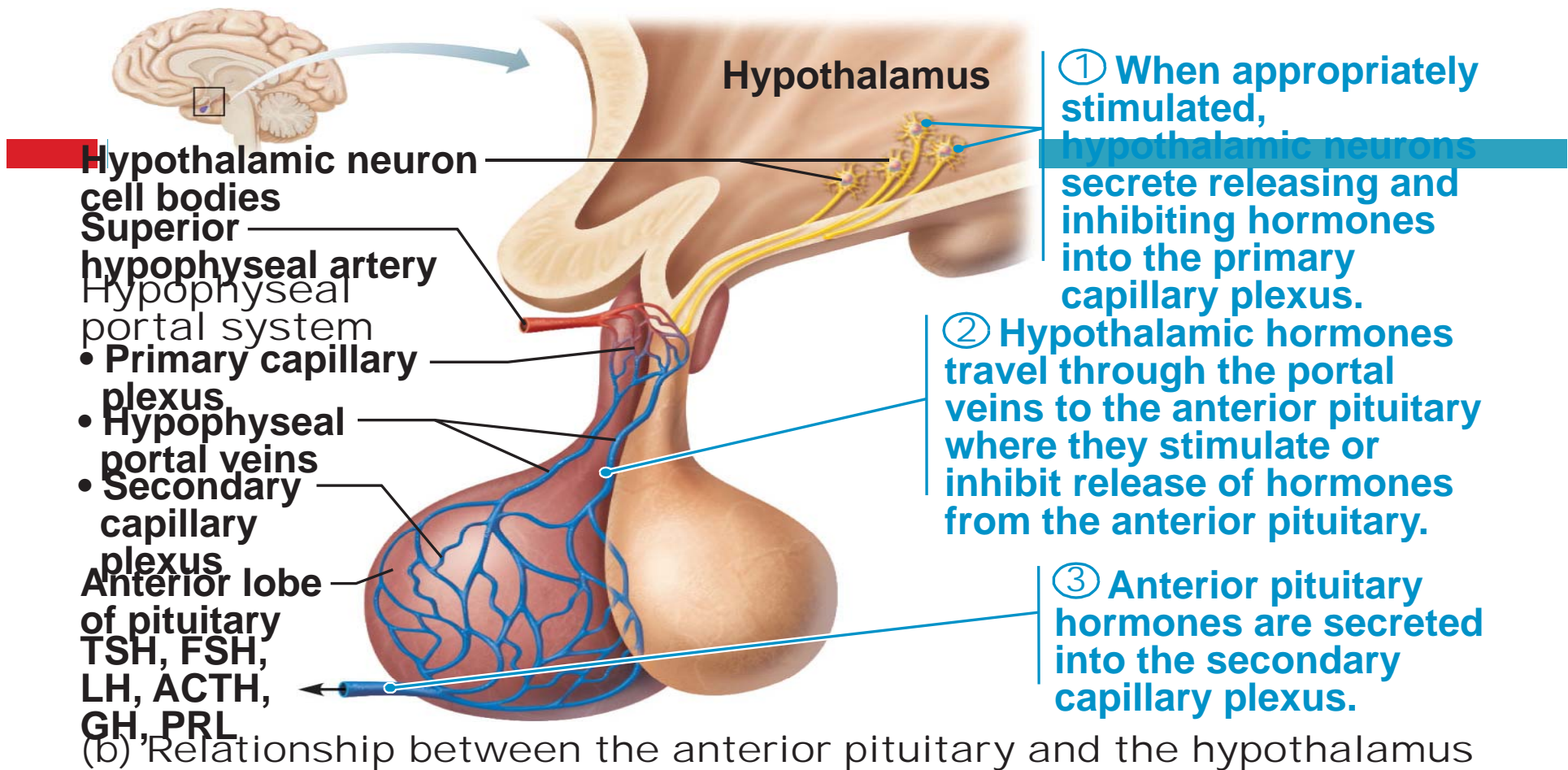
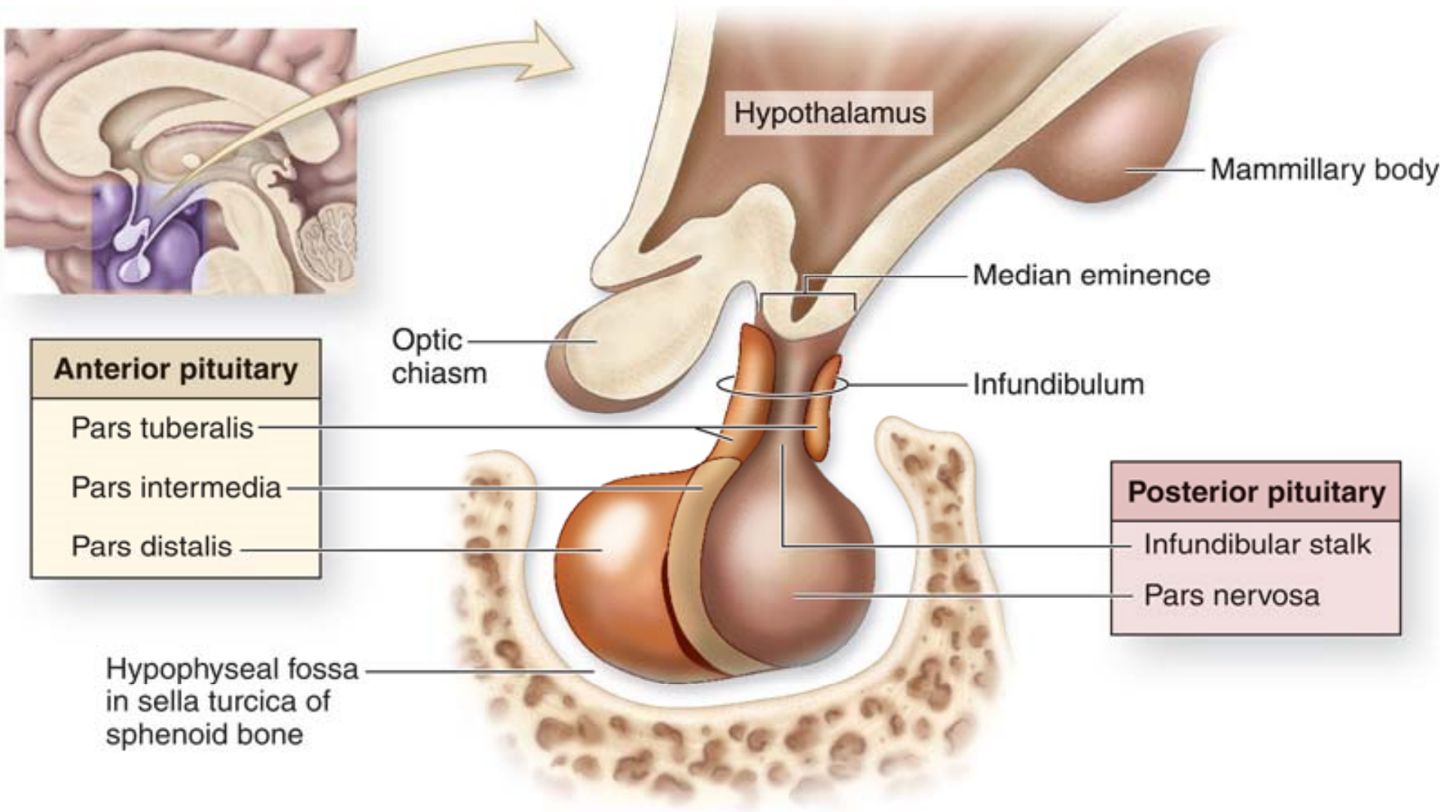
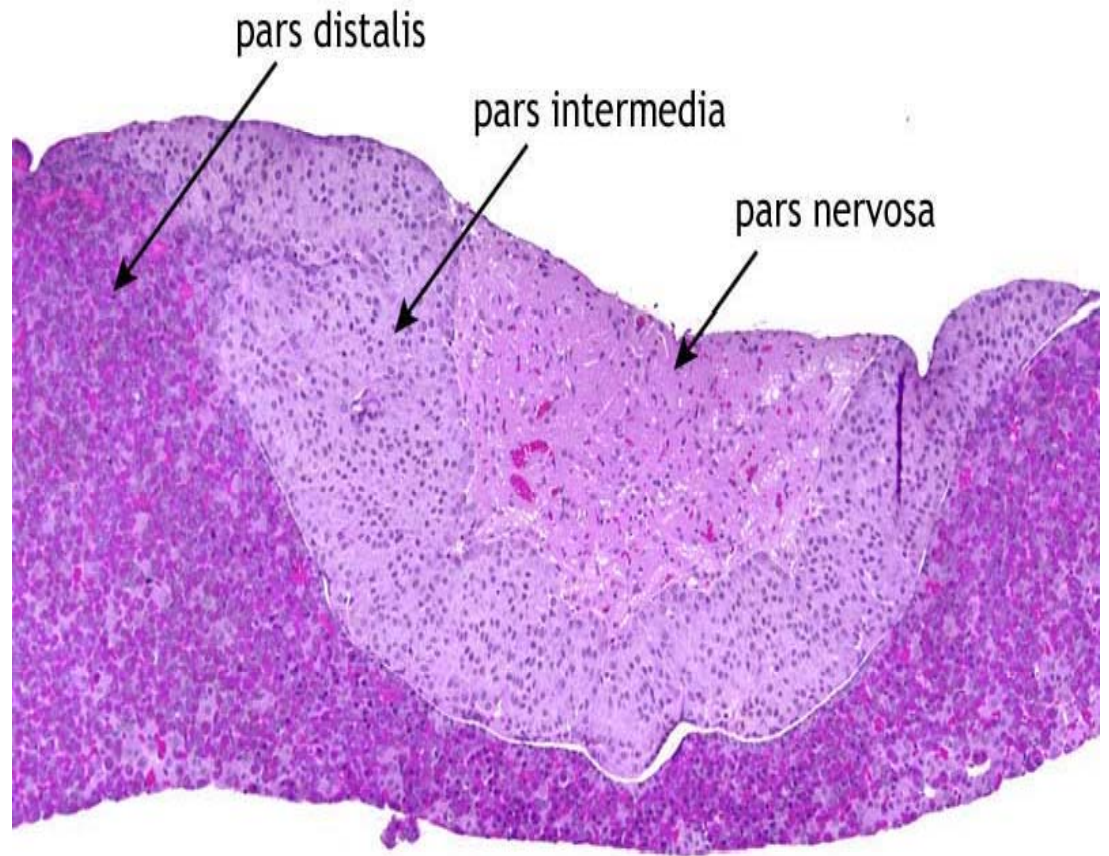
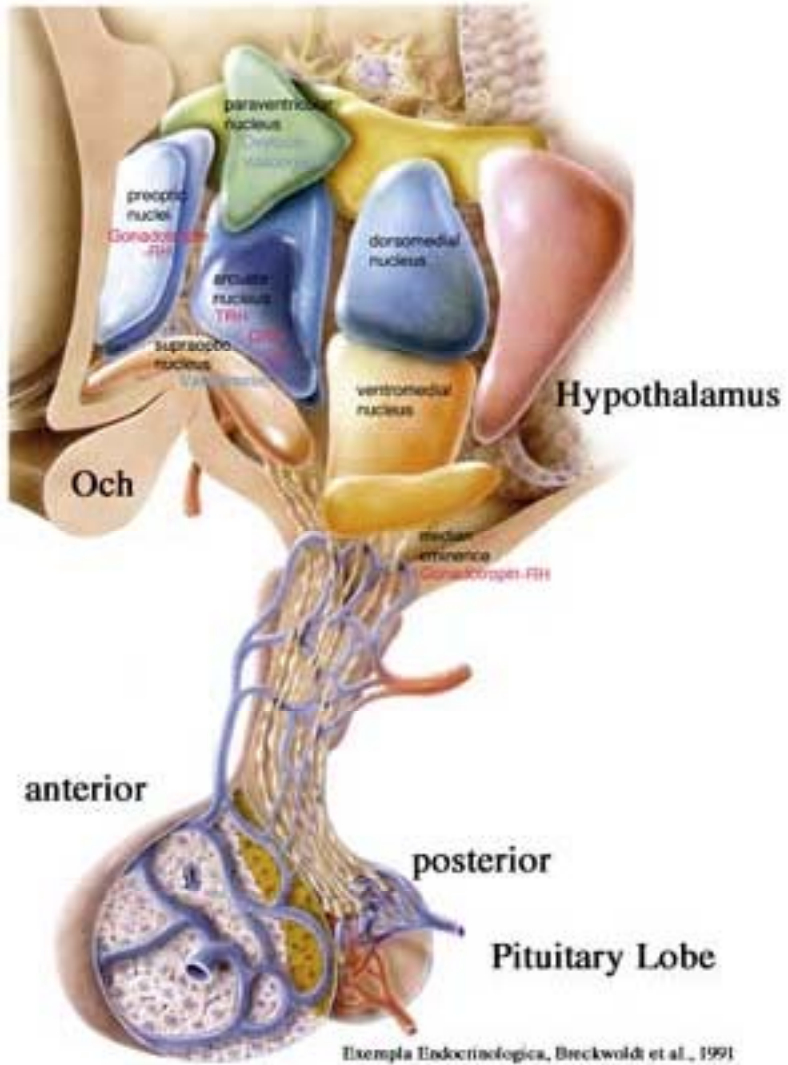


Figure 16.5b



- The pituitary gland (or hypophysis) is attached to the inferior surface of the brain by an extension of the nervous tissue of the **tuber cinereum /eminentia mediana of the hypothalamus, the infundibulum.**
- The pituitary gland is located in the sella turica, the hypophyseal fossa of the sphenoid bone.
- Macroscopically, the pituitary gland can be divided into **neurohypophysis**, which includes :
  - all neuroectodermal hypophyseal derivatives,
  - adenohypophysis, which includes all ectodermal hypophyseal derivatives.



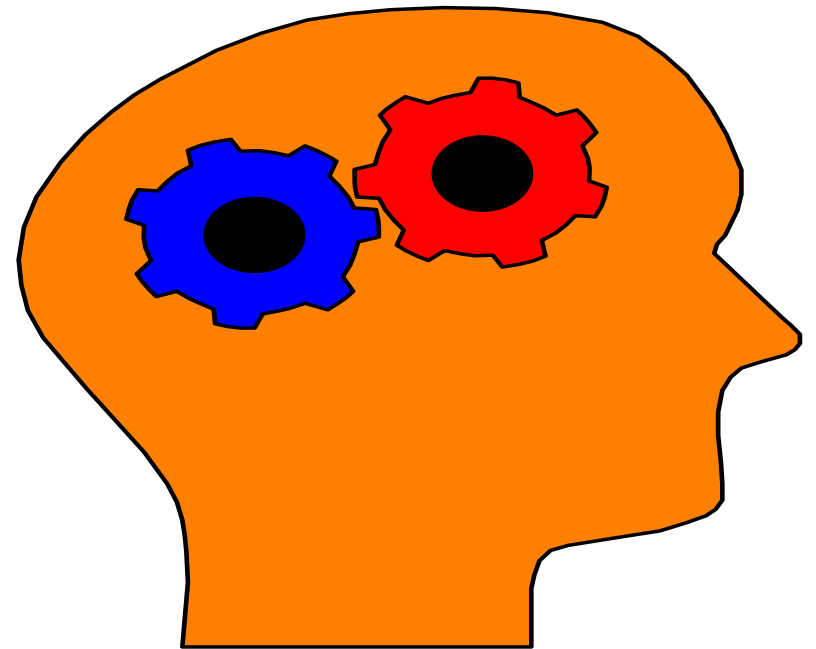


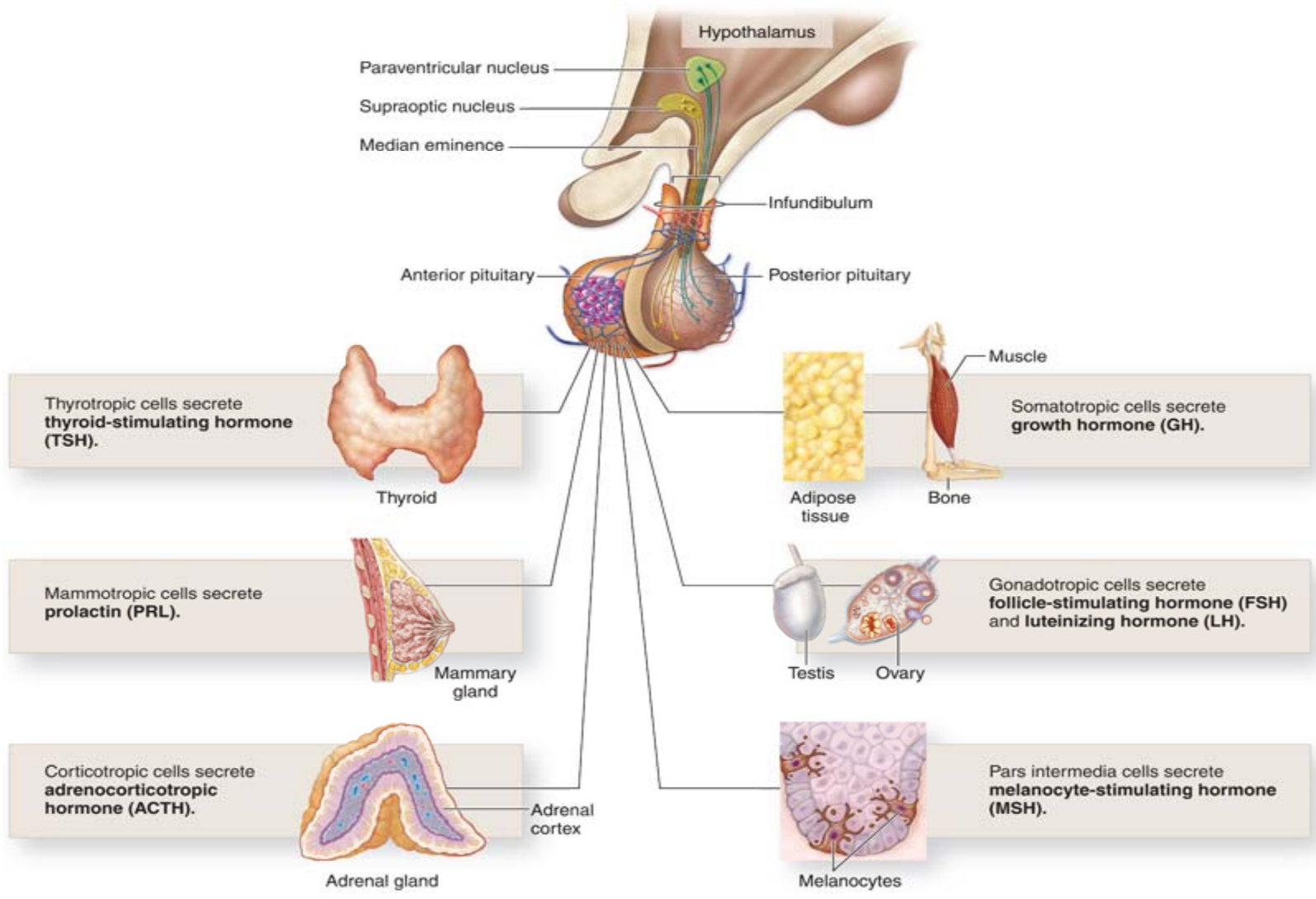
**Table 20.3****Pituitary Gland Hormones**

Hormone	Target Cells	Effects of Hormone
<b>HORMONES OF THE ANTERIOR PITUITARY</b>		
Adrenocorticotrophic hormone (ACTH)	Adrenal cortex	Stimulates production of corticosteroid hormones
Follicle-stimulating hormone (FSH)	Female: Ovaries Male: Testes	Female: Stimulates growth of ovarian follicles Male: Stimulates sperm production
Luteinizing hormone (LH)	Female: Ovaries Male: Testes	Female: Stimulates ovulation, estrogen and progesterone synthesis in ovary Male: Stimulates androgen synthesis in testes
Thyroid-stimulating hormone (TSH)	Thyroid gland	Stimulates thyroid hormone synthesis and secretion
Prolactin (PRL)	Female: Mammary glands Male: Not known	Female: Stimulates milk production in mammary glands Male: May play a role in the sensitivity of the testes interstitial cells to LH
Growth hormone (GH)	Almost every cell in the body	Increased growth and metabolism in target cells; synthesis of somatomedin in the liver to stimulate growth at epiphyseal plate
Melanocyte-stimulating hormone (MSH)	Melanocytes	Stimulates synthesis of melanin and dispersion of melanin granules in epidermal cells
<b>HORMONES STORED IN THE POSTERIOR PITUITARY</b>		
Antidiuretic hormone (ADH) (also called vasopressin)	Kidney Smooth muscle in arteriole walls	Stimulates reabsorption of water from urine in kidneys Stimulates vasoconstriction in arterioles of body, thereby raising blood pressure
Oxytocin (OT)	Female: Uterus, mammary glands Male: Smooth muscle of male reproductive tract	Female: Stimulates smooth muscle contraction in uterine wall; stimulates milk ejection from mammary glands Male: Stimulates contraction of smooth muscle of male reproductive tract

# Pituitary or Master Gland

- posterior lobe
  - ▣ neurohypophysis
- anterior lobe
  - ▣ adenohypophysis





# Anterior Lobe

- growth hormone → GH somatotropin
- thyroid-stimulating hormone → TSH
- lactogenic hormone --→ Prolactin
- adrenocorticotropic hormone --→ ACTH
- follicle-stimulating hormone --→ FSH
- luteinizing hormone --→ LH

# Posterior Lobe

- antidiuretic hormone = ADH
  - ▣ decrease ADH causes increase urine output
  - ▣ increase ADH causes decrease urine output
  
- oxytocin
  - ▣ stimulates contraction of pregnant uterus, labor, and childbirth
  - ▣ stimulates milk secretion



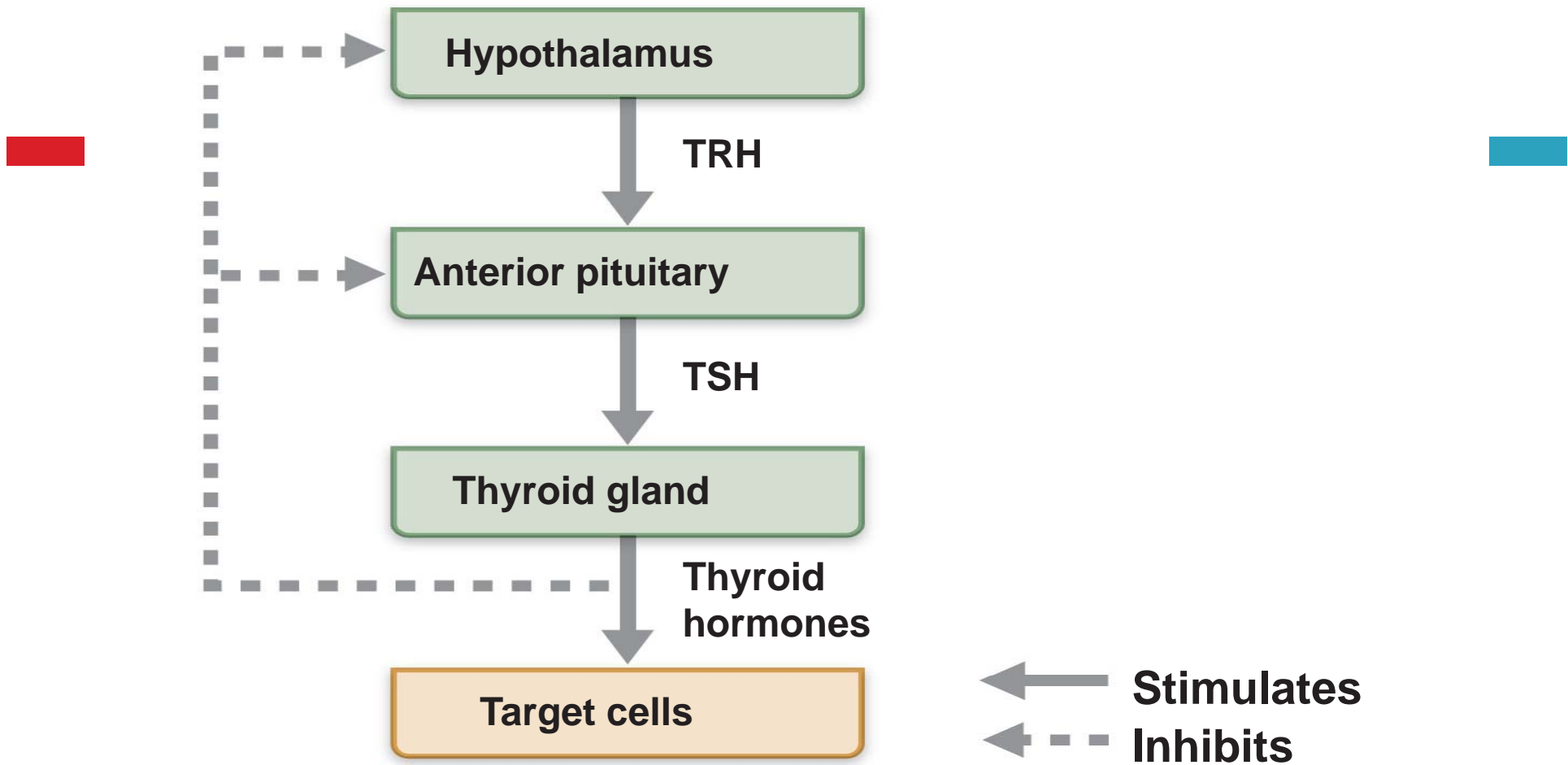
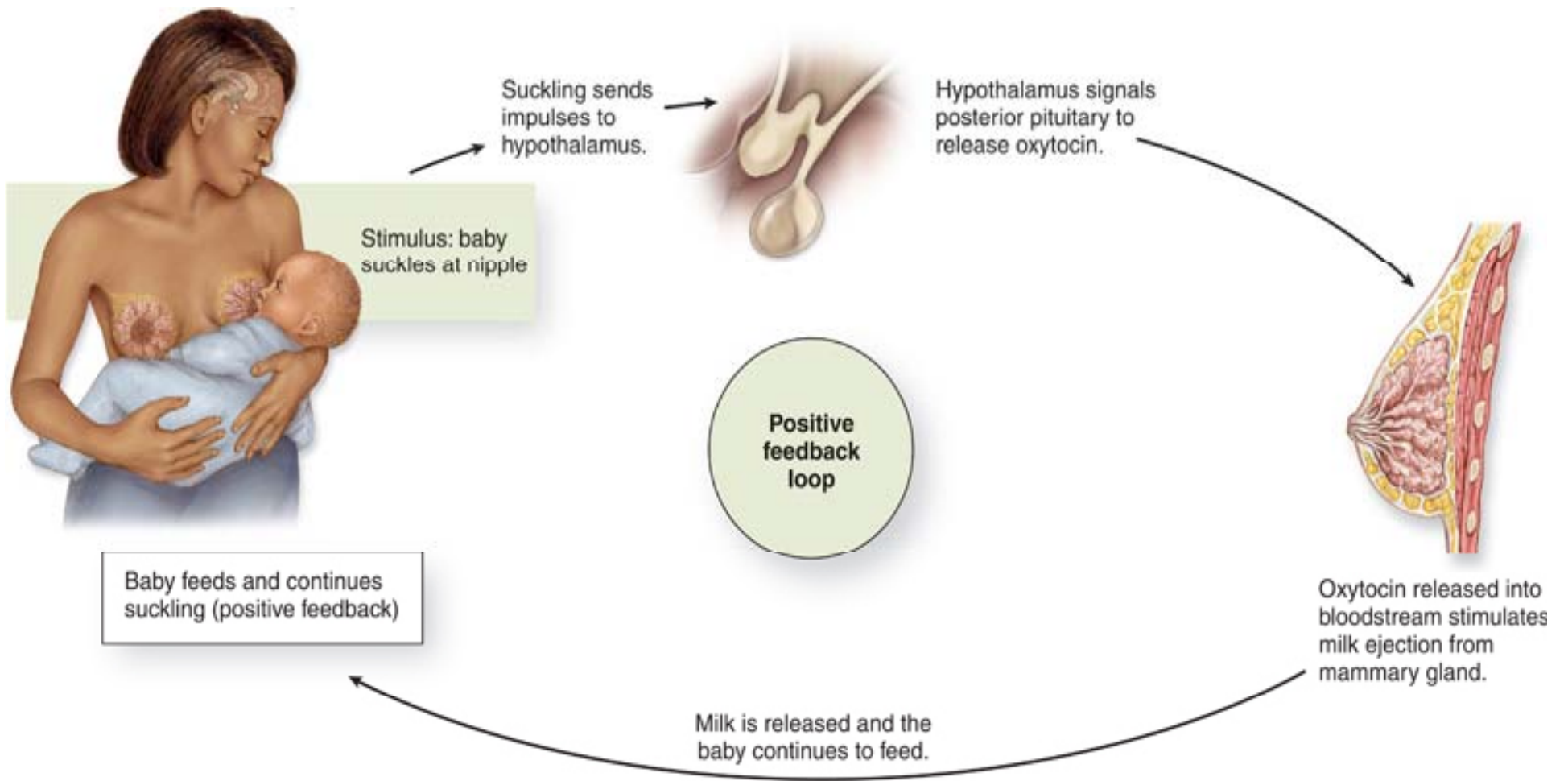
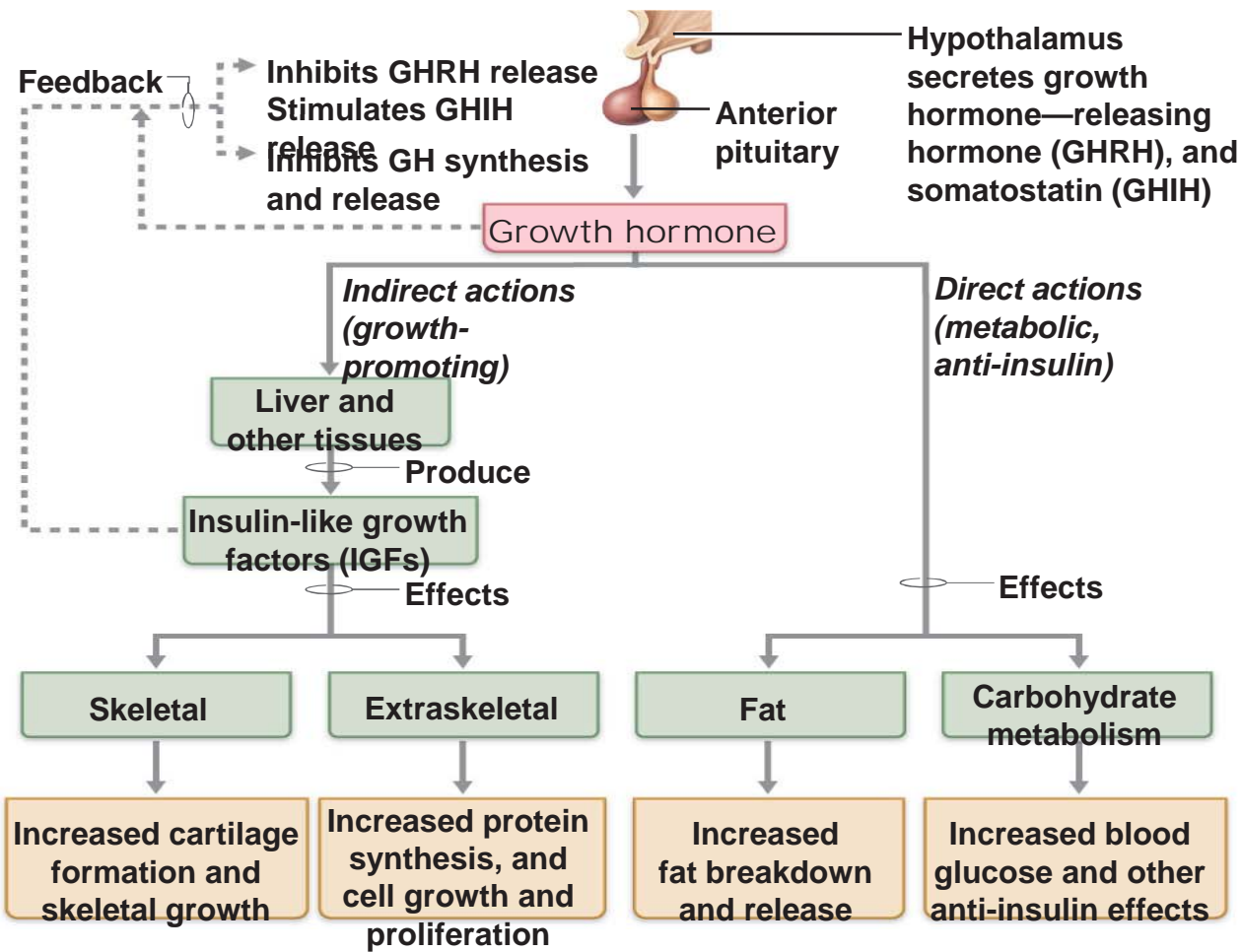


Figure 16.7



**(b) Positive feedback**



- ← Increases, stimulates
- ← - - - Reduces, inhibits
- Initial stimulus
- Physiological response
- Result

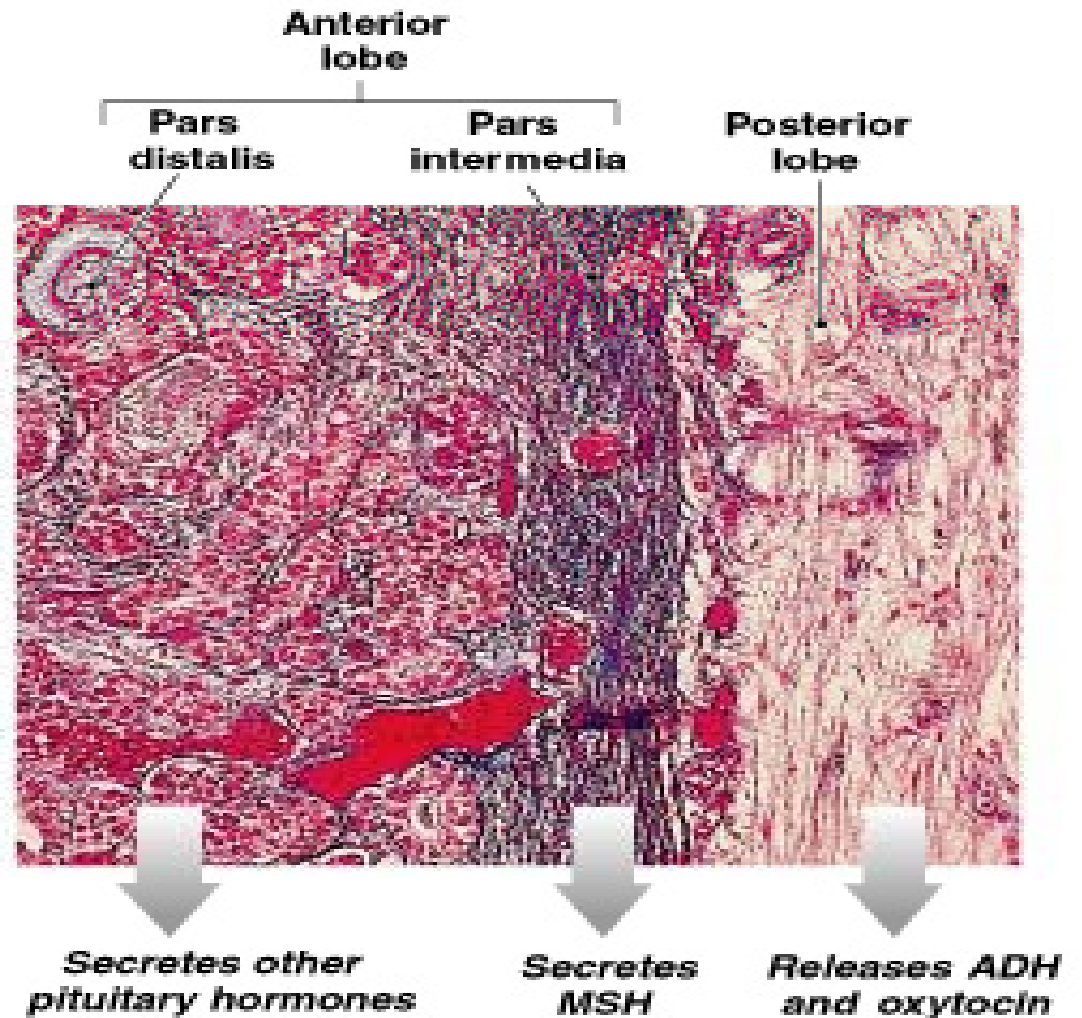
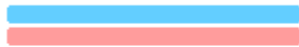
Figure 16.6

# Pituitary Pathology

- Growth Hormone GH
  - ▣ dwarfism - hyposecretion
  - ▣ gigantism, acromegaly - hypersecretion
- Thyroid Stimulating Hormone TSH
  - ▣ cretinism (infants) - hyposecretion
  - ▣ myxedema (adults) - hyposecretion
  - ▣ Toxic goiter (adults - hypersecretion
    - **exophthalmos**

# Pituitary Histology

Development of the Hypophysis

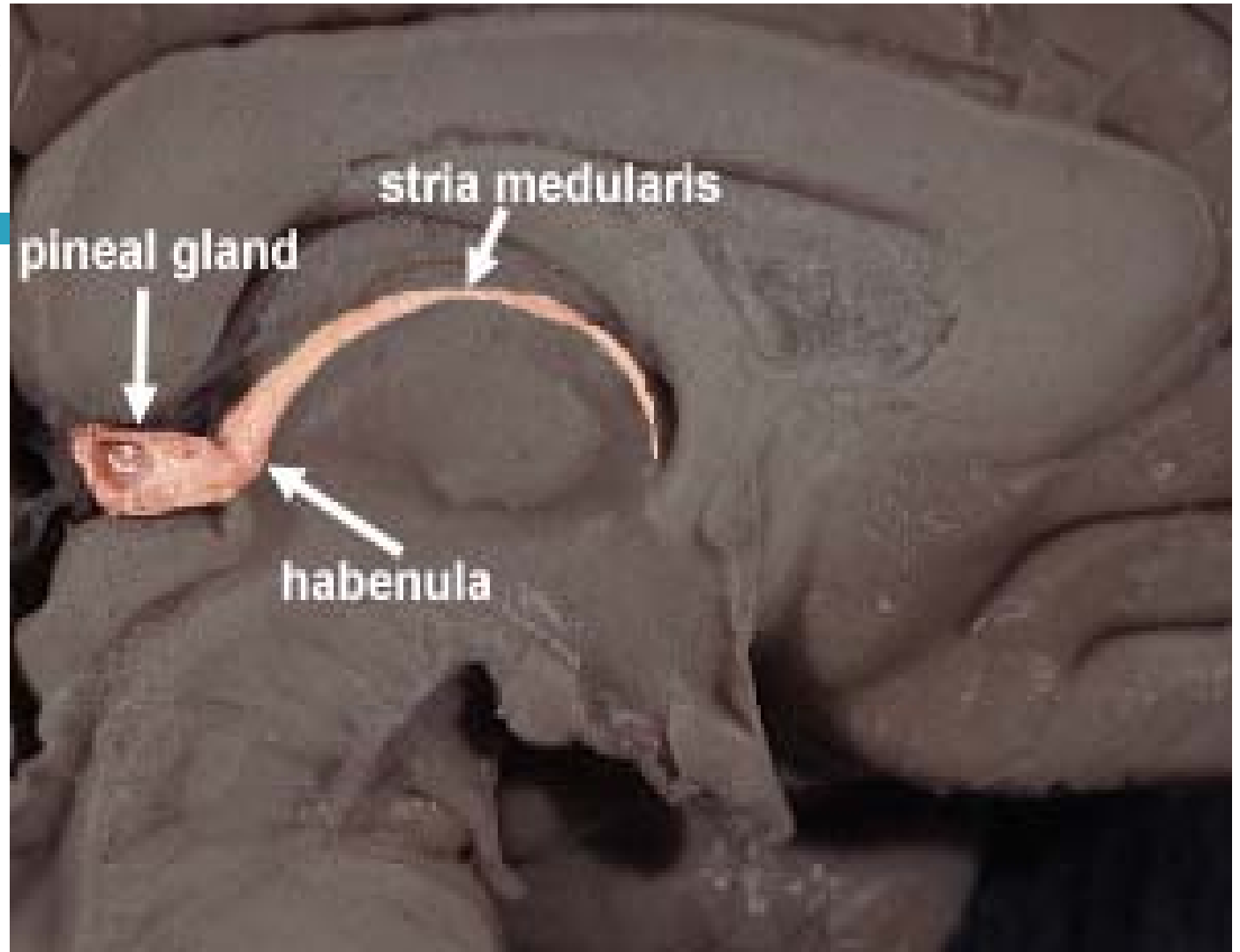


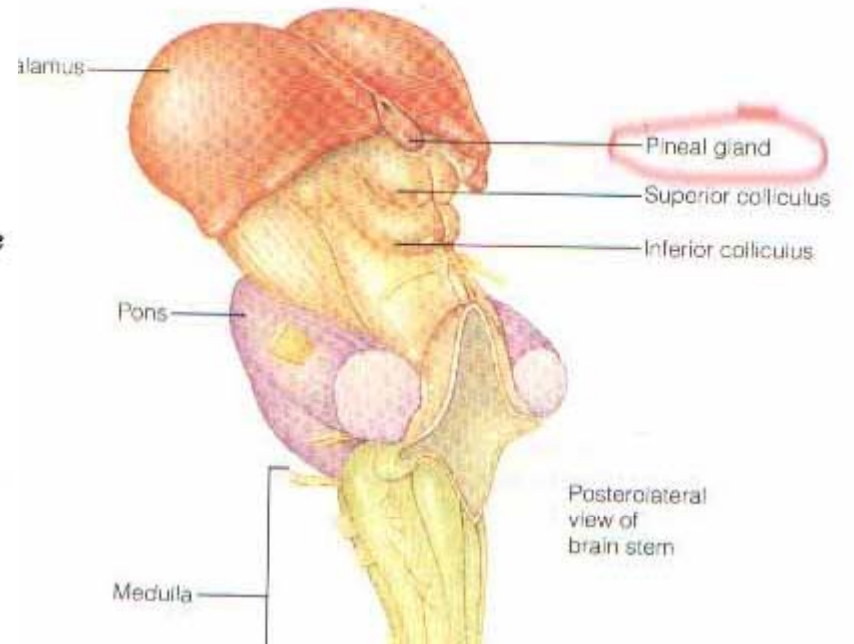
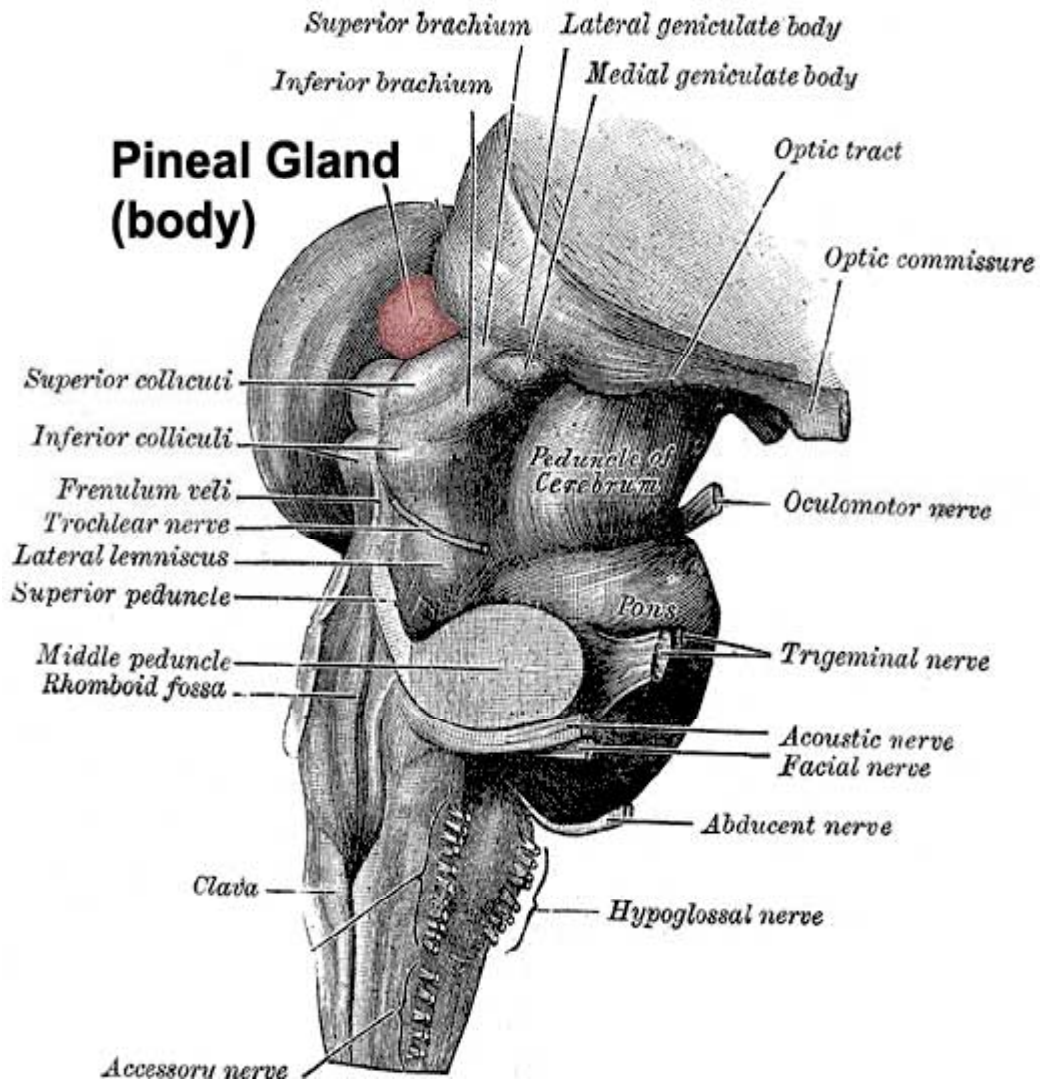


# Pineal Gland

# Epithalamus

- Above the thalamus
- Contains the pineal gland which releases melatonin (involved in sleep/wake cycle and mood).
- Contains a structure called the habenula – involved in food and water intake

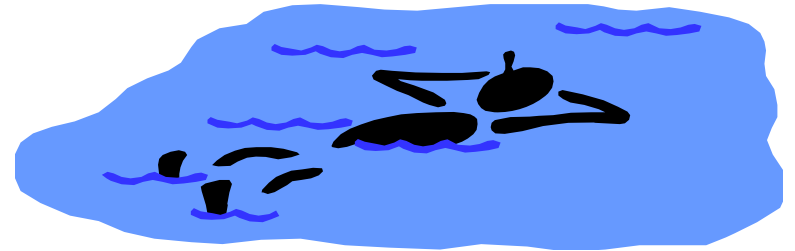




# PINEAL GLAND



# Pineal Gland



- **melatonin**-[N-acetyl-5-methoxytryptamine] may control biological cycles
  - regulation of the circadian rhythms
  - antioxidant with a particular role in the protection of nuclear and mitochondrial DNA.
- **inhibit ovarian activity**
- **Dreaming:** Some supplemental melatonin users report an increase in vivid dreaming. Extremely high doses of melatonin (50 mg) dramatically increased REM sleep time and dream activity in both people with and people without narcolepsy.
- **Autism** Individuals with autism spectrum disorders (ASD) may have lower than normal levels of melatonin
  
- **serotonin**-neurotransmitter, vasoconstrictor
  - stimulates smooth muscles and inhibits gastric secretion

**Pineal Gland H&E**

