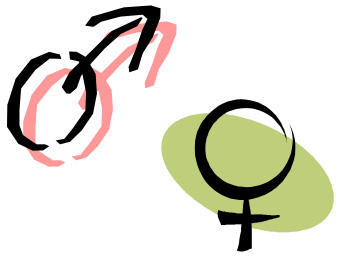
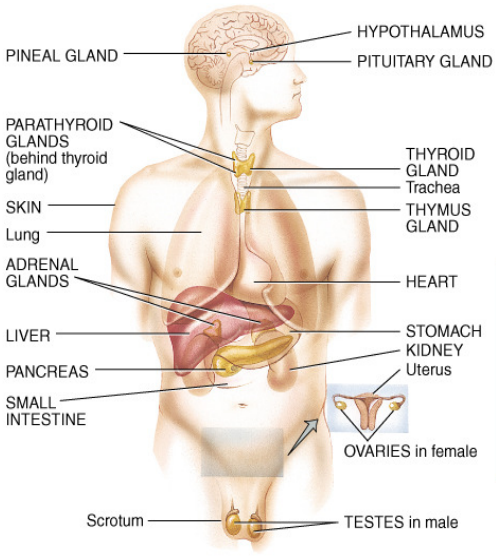
Bio& 242 A&P
Unit 4 / Lecture 1A



Introduction to the Endocrine System



FUNCTIONS OF HORMONES

1. Help regulate:
   - chemical composition and volume of internal environment (extracellular fluid)
   - metabolism and energy balance
   - biological clock (circadian rhythms)
   - contraction of smooth and cardiac muscle fibers
   - glandular secretions
   - some immune system activities.
2. Control growth and development.
3. Regulate operation of reproductive systems.

Patterns of Hormone Action

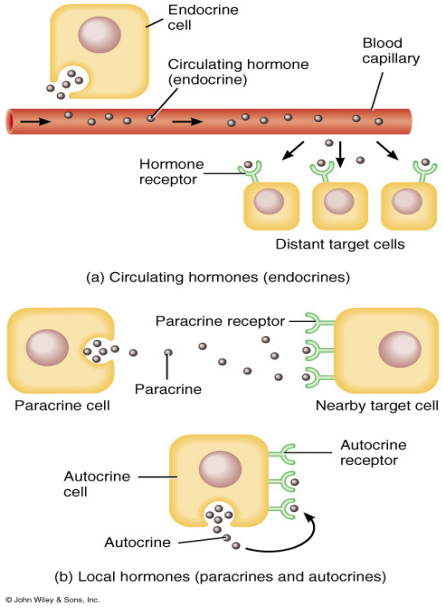
Target cells or tissue:

Specific cells affected by a hormone

Endocrine: circulated by blood to target cells

Paracrine: Hormones that affect neighboring cells

Autocrine: Hormones that act on the cells that secrete them



Mechanism of Action for lipid-soluble or steroid Endocrine hormones

Lipid-Soluble Hormones

Aldosterone

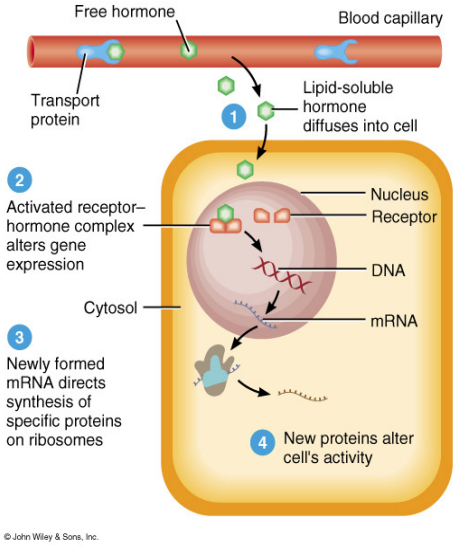
Calcitriol

Testosterone

Estrogen

Progesterone

T3 & T4



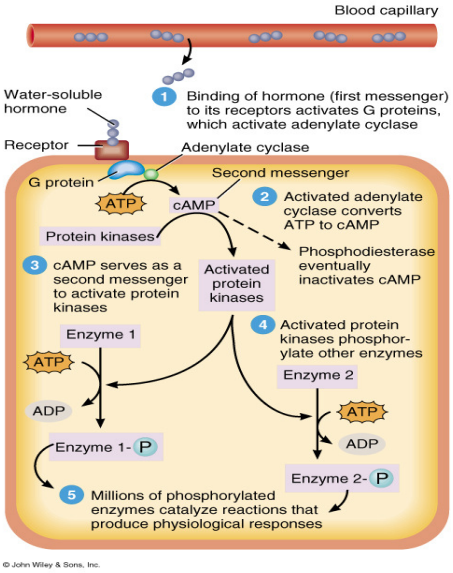
Mechanism of action for water-soluble Hormones

Catecholamines

- Epinephrine
- Norepinephrine

Peptides/Proteins

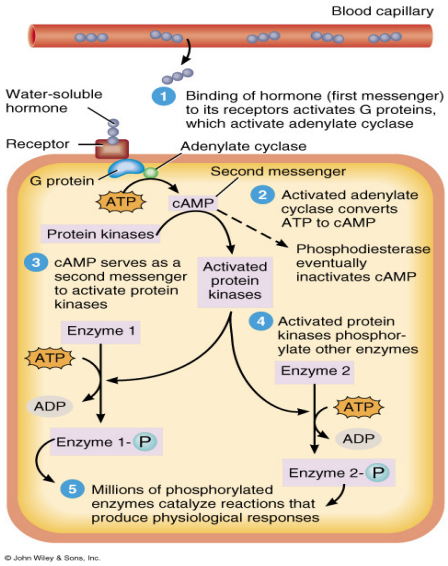
- All Hypothalamic releasing/inhibiting hormones
- Oxytocin
- ADH



Mechanism of action for water-soluble Hormones

Anterior Pituitary Hormones

- Human Growth hormone
- TSH
- ACTH
- FSH
- LH
- Prolactin
- MSH



Mechanism of action for water-soluble Hormones

Parathyroid Hormone

Parathyroid Hormone

Pancreas Hormones

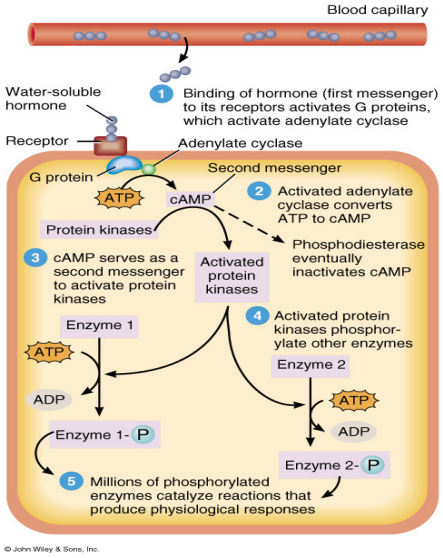
Insulin

Glucagon

Somatostatin

Pancreatic polypeptide

Calcitonin



Hormone Interactions

Down-regulation:

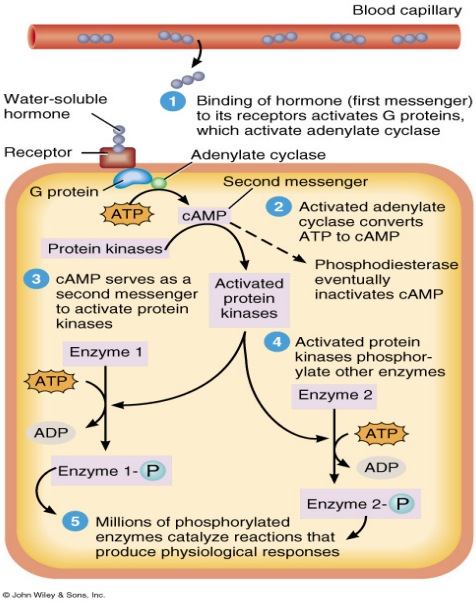
decrease in target cell receptors when excessive hormone is present

Up-regulation:

Increase in target cell receptors when there is a deficiency of hormone

Permissive Effect:

When the actions of a hormone on target cells requires a simultaneous or recent exposure to a second hormone



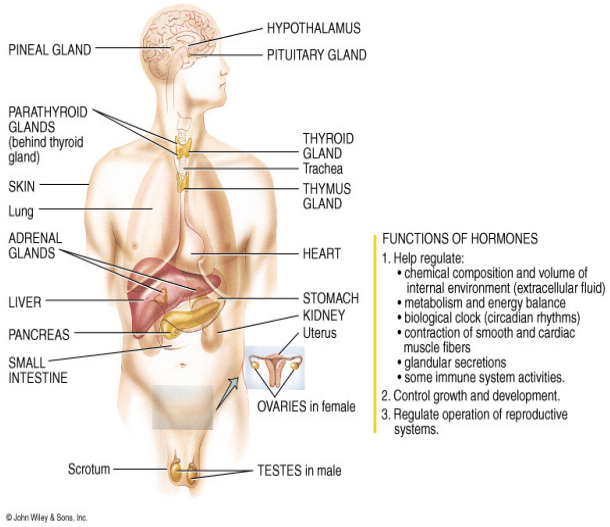
Hormone Interactions

Synergistic Effect:

Two hormones acting together have a greater or more extensive effect.

Antagonistic Effect:

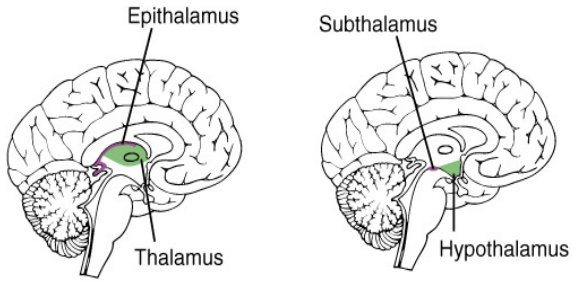
One hormone opposes the action of another hormone.



Action of the Hypothalamus as the "Master" Gland

- **Hypothalamus:**

  Controls the activity of the pituitary gland by releasing hormones called releasing or inhibiting hormones



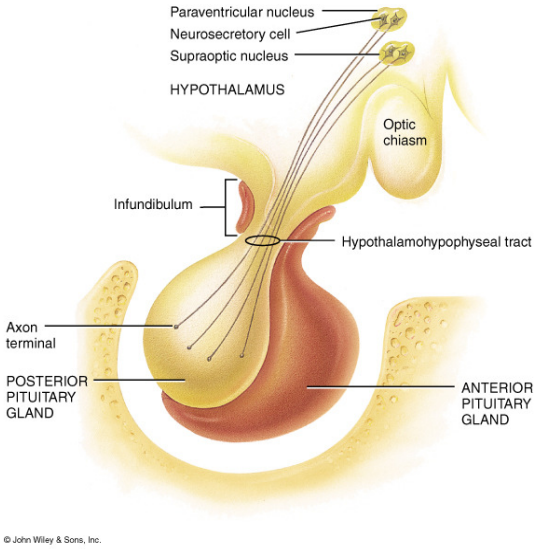
(c) Diencephalon

Actions of the Posterior Pituitary or Neurohypophysis

Neurohypophysis

does not synthesize hormones, however, it stores and releases two hormones produced by the neurosecretory cells of the hypothalamus

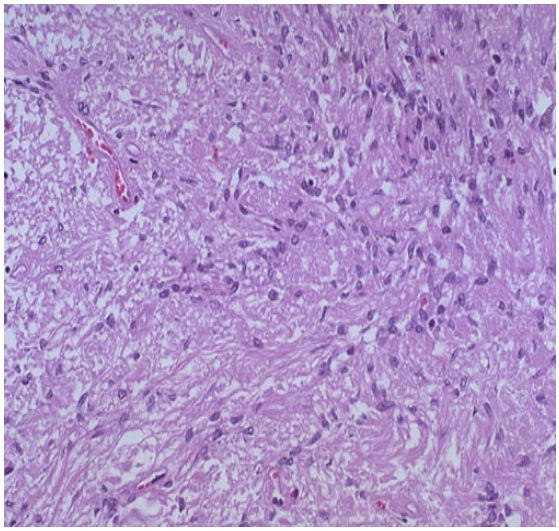
- **ADH**
- **Oxytocin**



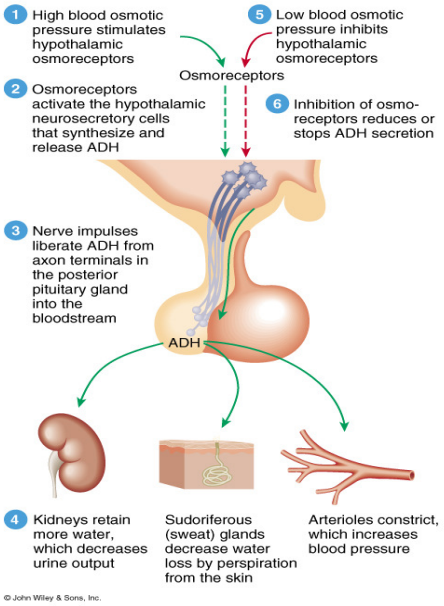
Histology of the Neurohypophysis

Neurohypophysis

Shown here, resembles neural tissue, with glial or supportive cells and nerve fibers which are part of the hypothalamohypophyseal tract



Actions and Regulation of ADH



Major Actions of Oxytocin

- **Stimulates contraction of smooth muscle cells of the uterus during childbirth**
- **Stimulates contraction of myoepithelial cells in the breast to cause milk letdown**

Hormones Released from the Anterior Pituitary or Adenohypophysis

Somatotrophs:

Human growth hormone or somatotrophin (hGH)

Hypothalamic control:

hGH releasing hormone (GHRH)

hGH inhibiting hormone (GHIH)

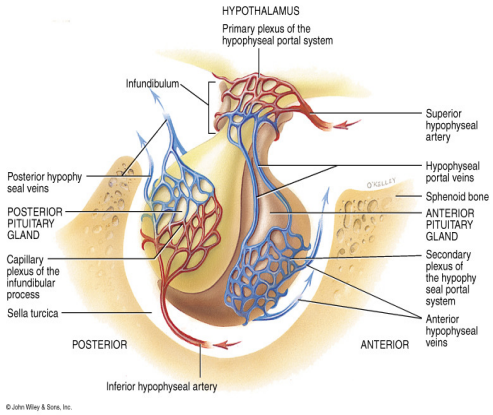
Thyrotrophs:

Thyroid-stimulating hormone (TSH)

Hypothalamic control:

Thyrotropin releasing hormone (TRH)

(GHIH)



Hormones Released from the Anterior Pituitary or Adenohypophysis

- **Gonadotrophs:**

Follicle-stimulating hormone (FSH)

Luteinizing hormone (LH)

Hypothalamic control:

Gonadotropic releasing hormone (GnRH)

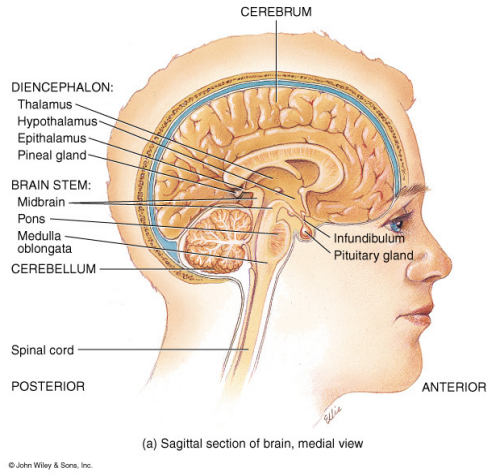
- **Lactotrophs:**

Prolactin (PRL)

Hypothalamic control:

Prolactin releasing hormone (PRH) and TRH

Prolactin inhibiting hormone PIH or dopamine



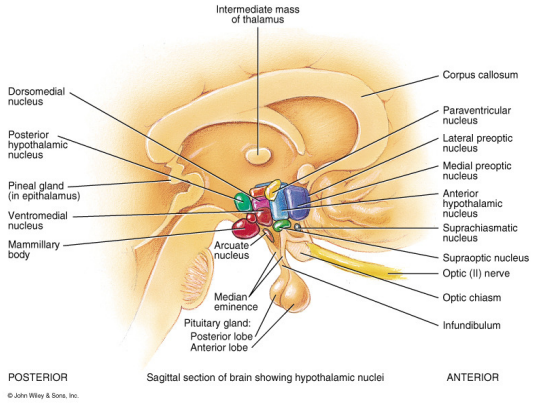
Hormones Released from the Anterior Pituitary or Adenohypophysis

Corticotrophs:

- **Adrenocorticotropic hormone (ACTH)**
- **Melanocyte-stimulating hormone (MSH)**

Hypothalamic control:

- **Corticotropic releasing hormone (CRH)**
- **For MSH inhibition dopamine**

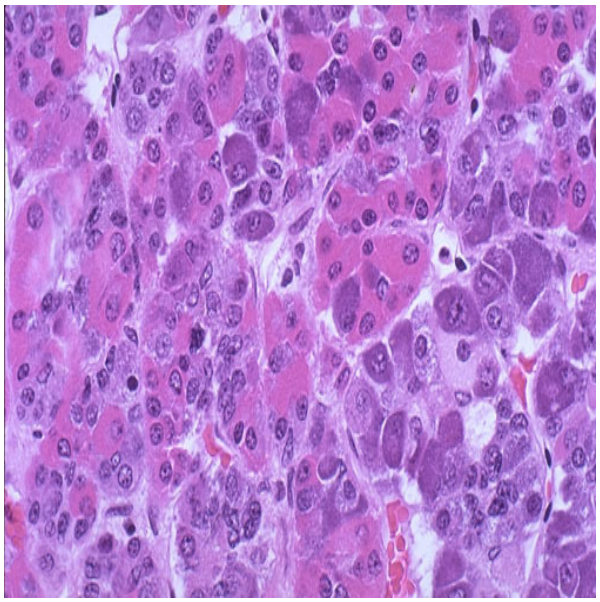


Sagittal section of brain showing hypothalamic nuclei

Histology of the Adenohypophysis

The pink cells are acidophils

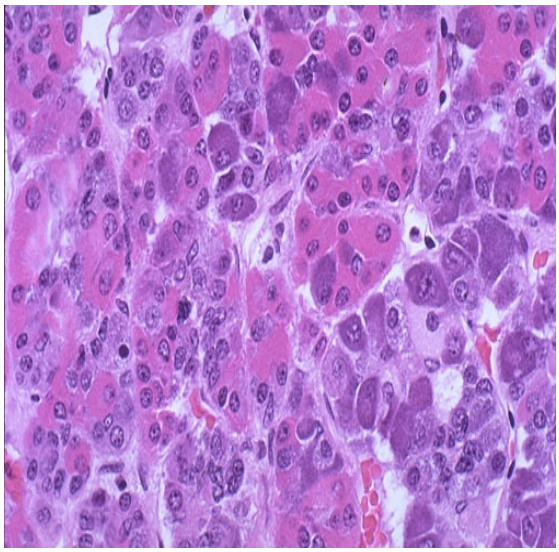
1. **Somatotrophs**
   - **Human Growth Hormone (hGH)**
2. **Lactotrophs**
   - **Prolactin (PRL)**



Histology of the Adenohypophysis

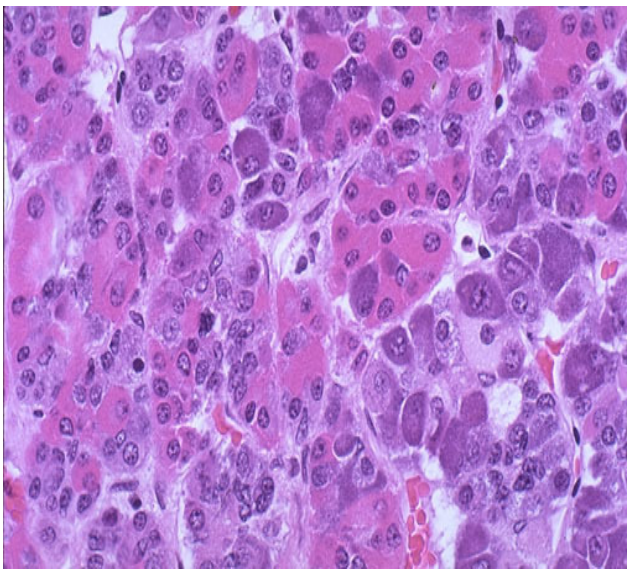
The dark purple or blue cells are basophils:

1. **Corticotrophs**
   - **Adrenocorticotropic Hormone (ACTH)**
   - **Melanocyte-stimulating Hormone (MSH)**
2. **Thyrotrophs**
   - **thyroid stimulating hormone (TSH)**
3. **Gonadotrophs**
   - **follicle stimulating hormone (FSH)**
   - **Luteinizing hormone (LH)**



Histology of the Adenohypophysis

The pale-staining chromophobes have few cytoplasmic granules, but may have secretory activity



Actions of Prolactin

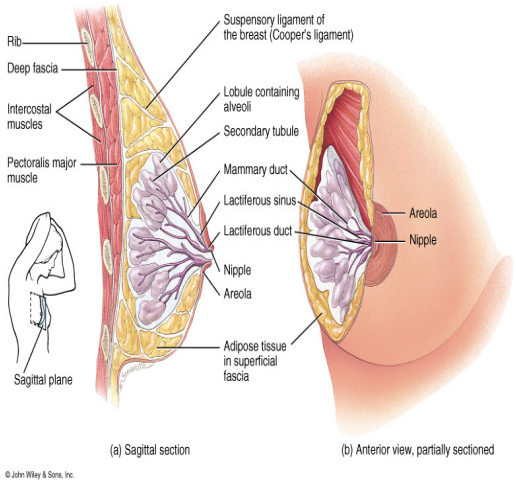
Hypothalamic control:

PRH, PIH

- **Released by lactotrophs of the adenohypophysis**

Target Tissue: Lactiferous cells for the breast

Effect: Initiates and maintains milk production in breasts that have been prepared by other hormones



Actions of Prolactin

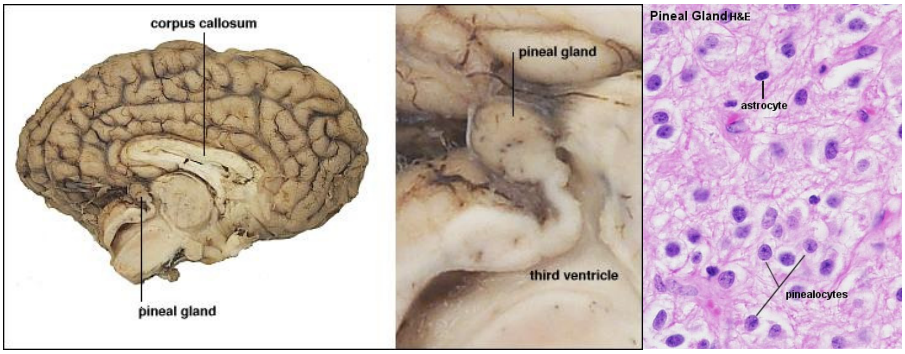
- **Also along with progesterone causes breast tenderness before menstruation.**
- **Hyposecretion: Decreased milk production**
- **Hypersecretion:**

  Females: galactorrhea

  and amenorrhea

  Males: erectile dysfunction or impotence and production of fluid from the nipple

Pineal Gland



***Descartes* regarded it as the principal seat of the soul and the place in which all our thoughts are formed**

Pineal Gland

Melatonin:

- Synthesis is regulated by light, due to a rate-limiting enzyme in melatonin synthesis - serotonin N-acetyltransferase.
- Increases at night and decreases during day time.
- **Regulates circadian rhythms**, a roughly-24-hour cycle in the physiological processes .
- Induces Sleep
- Hypersecretion: Sleepiness, SAD, Jet Lag
- Hyposecretion: Insomnia

Pineal Gland

Serotonin:

- Synthesized in the pineal gland, blood platelets, the digestive tract, and the brain.
- Acts both as a chemical messenger that transmits nerve signals between nerve cells and that causes blood vessels to narrow.
- Involved in the inhibition of anger and aggression.
- Helps with the regulation of body temperature, mood, sleep, vomiting, sexuality, appetite, and (?) love.
- Hypersecretion: **Serotonin syndrome** a rare, but potentially life-threatening adverse drug reaction that results from intentional self-poisoning, therapeutic drug use, or inadvertent interactions between drugs
- Hyposecretion: Insomnia, (?) increase in anger and aggression.