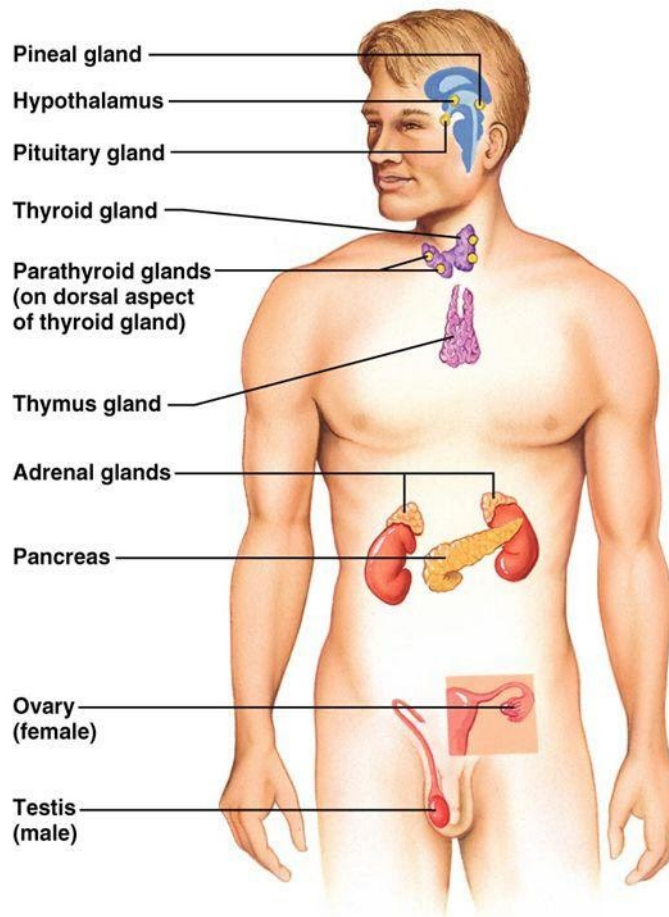


Endocrine System

Intro to Hormones

- Chemical messenger secreted by cells into ECF
- Functions
 - Travels through the blood and regulate metabolic function of other cells
 - Tells a cell to do things by binding to a *receptor* to cause a response in the target cell
- Usually have a delay period until we actually see the effects
- Long-lasting effects because hormones stay in the blood for a while

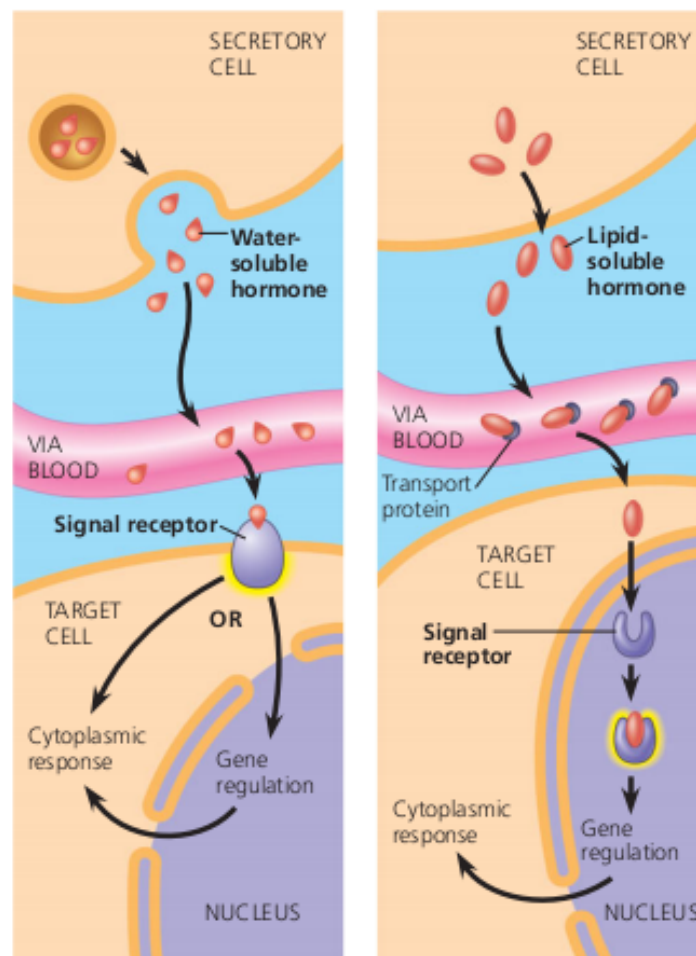
Endocrine Organs



- Endocrine gland – ductless glandular tissue
 - Pituitary
 - Thyroid
 - Parathyroid
 - Adrenal
 - Pineal
- Endocrine tissue and cells that make certain organs that are not really part of the endocrine system
 - Pancreas
 - Gonads
 - Placenta
- Hypothalamus
 - Known as the “neuroendocrine organ” because it produces and releases hormones

Hormones

- Chemical classes
 - Amino acid based
 - Proteins, peptides, and amino acid derivatives
 - Steroids
 - Synthesized from cholesterol
 - Estrogens, testosterone, cortisol
 - Eicosanoids
 - Biologically active lipids
 - Leukotrienes and prostaglandins
- Roles of specific receptors
 - Hormones need specific receptors to act on the “target” cell
- Functions
 - Alters plasma membrane permeability, alters membrane potential, or does both by opening ion channels
 - Stimulate making of enzymes and other proteins in the cell
 - Activates or deactivates enzymes
 - Induce secretory activity
 - Stimulates mitosis
- Water soluble hormones vs lipid-soluble hormones

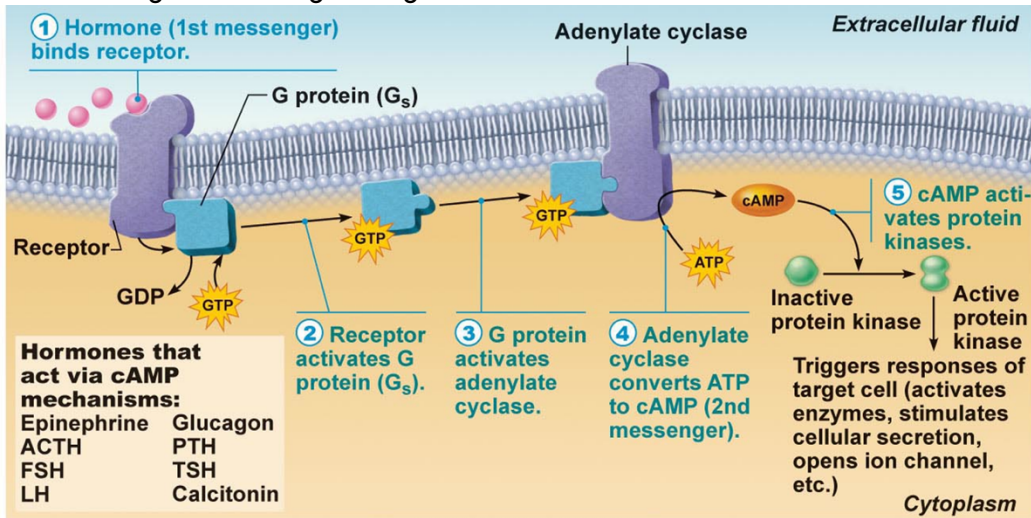


(a) Receptor in plasma membrane

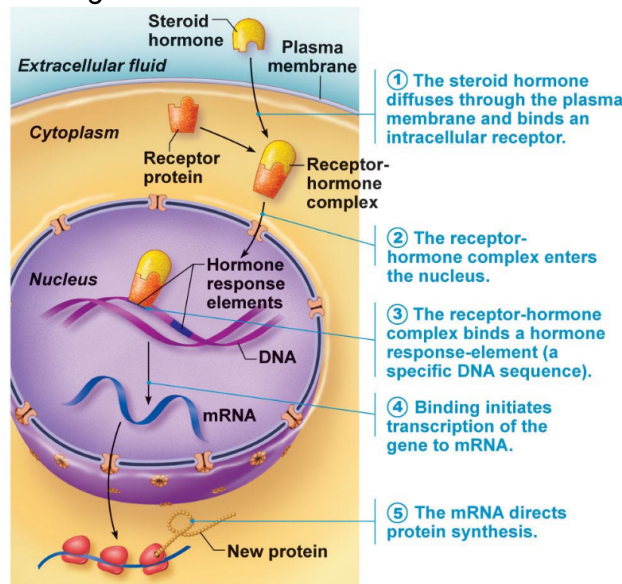
(b) Receptor in cell nucleus

- Water-soluble hormones
 - Needs a second messenger and a regulatory molecule (G-protein)

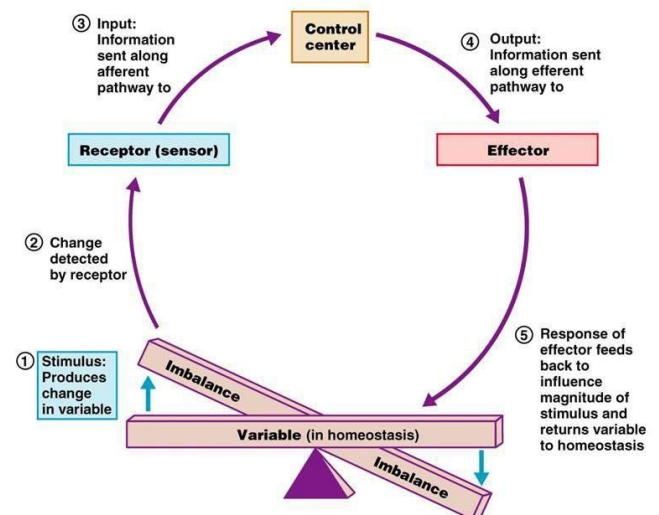
- Example of second messengers: cAMP, PIP2 –calcium, and receptor tyrosine kinases
- Cannot cross the plasma membrane
- Cyclic CAP signaling mechanism



- Lipid-soluble hormones
 - Can diffuse through the plasma membrane
 - Direct gene activation



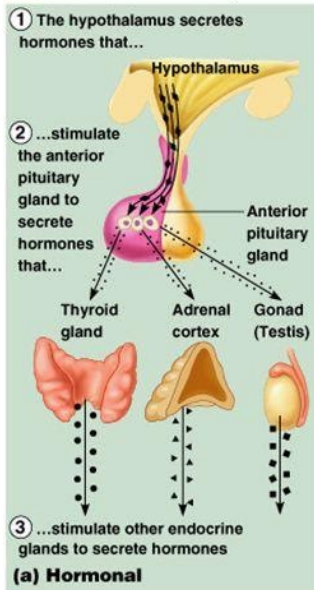
- Negative feedback
 - Regulates most synthesis and release of hormones
 - Occurs when you need to slow down a response or process
 - Outputs shuts off the original effect of the stimulus or reduces its intensity
 - Levels of a hormone increases → target organ effects increase → triggers inhibition of further hormone release
 - This allows blood levels of hormones to vary within a narrow range



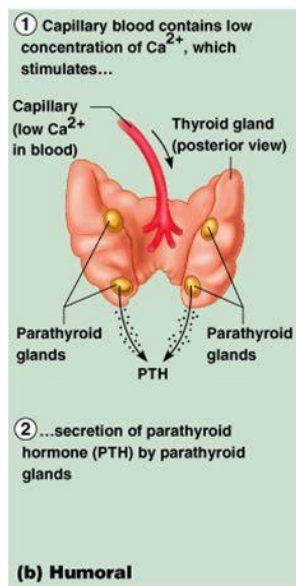
Nervous system modulation

- The nervous system can either change “turn on” factors or “turn off” factors
 - Turn on factors (triggers of hormone release)

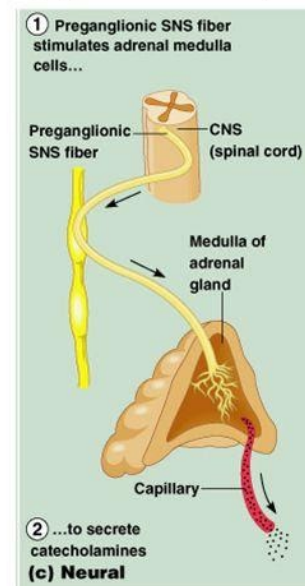
Hormonal: Chemical stimulus (i.e. endocrine glands are activated by other hormones)



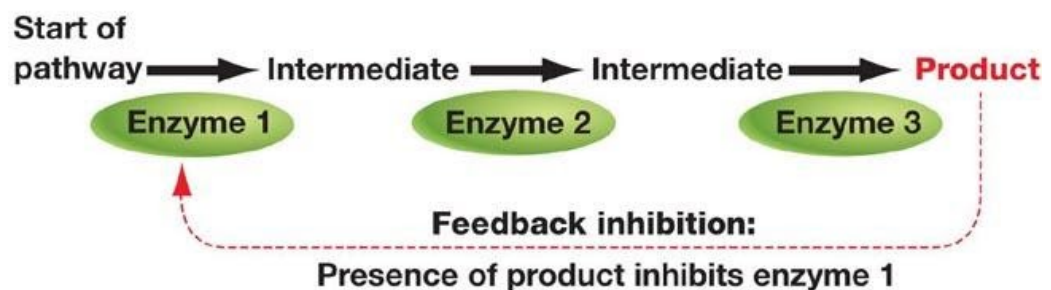
Humoral/Blood-Based: Changing blood levels of certain ions stimulate hormone release



Neural: Nerve impulses stimulate hormone release; most are under control of the sympathetic nervous system



- Turn off factors
 - Feedback inhibition –breaking of a reaction cycle via the end product of a process
 - This is not the only factor that exists but is the most important



- Function of nervous system
 - Make adjustments to maintain homeostasis by overriding normal endocrine controls
 - Change the homeostatic set point
 - The endocrine system only tries to maintain the set point

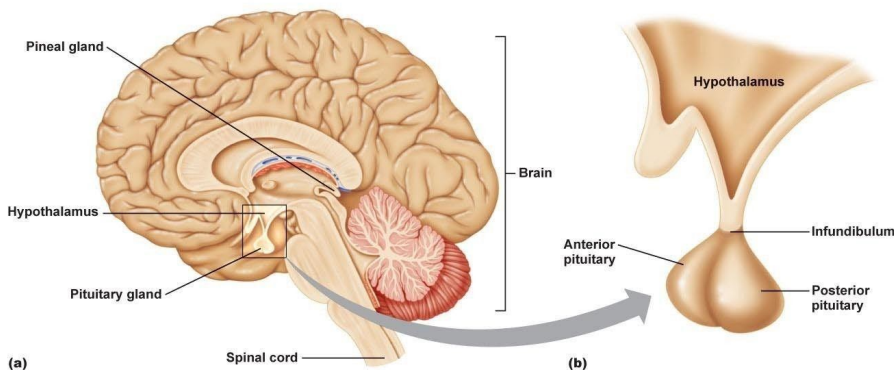
Target Cell Activation

- Cell needs specific receptor proteins on its plasma membrane or in its interior so that hormone can bind
- Hormone receptor's functions
 - Tells a cell to perform a certain job
 - Turns on a cell
- Factors that affect degree of target cell activation:

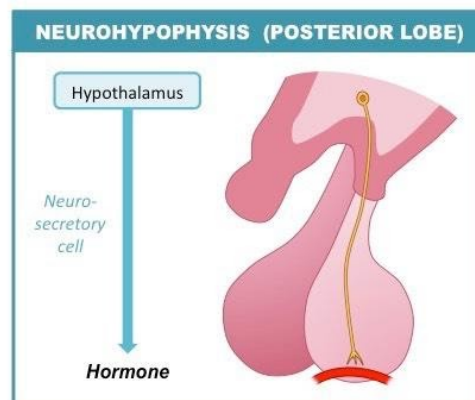
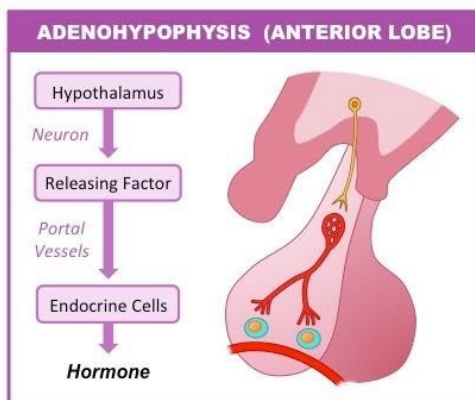
- Blood levels of hormone
 - More hormone gives higher effect
- Relative number of receptors for a certain hormone or in target cells
 - More receptors gives higher effect
- Affinity (strength) of the binding between the hormone and the receptor
 - Large number of high-affinity receptors gives a significant hormonal effect while smaller numbers of low-affinity receptors reduces the target cell response or may cause endocrine dysfunction
- Receptors are “dynamic structures”
 - Up-regulation –persistently low levels of a hormone causes the cell to develop extra receptors for that hormone
 - Down-regulation –persistently high levels of a hormone causes the cell to decrease the number of receptor for that hormone
 - Hormones can also alter the number of receptors for other hormones
- Interaction of hormones at target cell: multiple hormones may act synonymously
 - Permissiveness
 - Working together of 2 hormones because one hormone cannot exert full effect by itself
 - Synergism
 - When multiple hormones producing the same effect work together to produce amplified effect
 - Antagonism
 - When one hormone opposes the action of another hormone

The Hypothalamus and Pituitary Gland

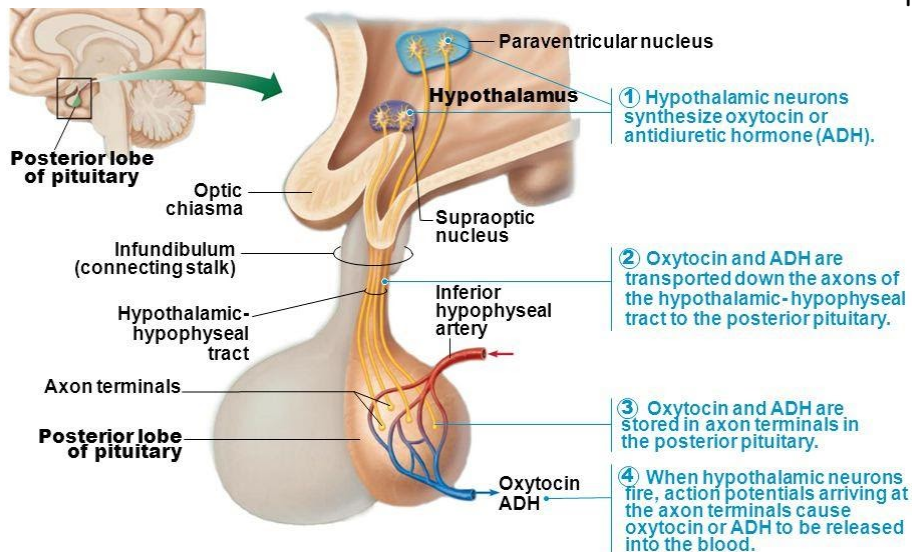
- Pituitary gland/hypophysis
 - Connected to hypothalamus via the infundibulum



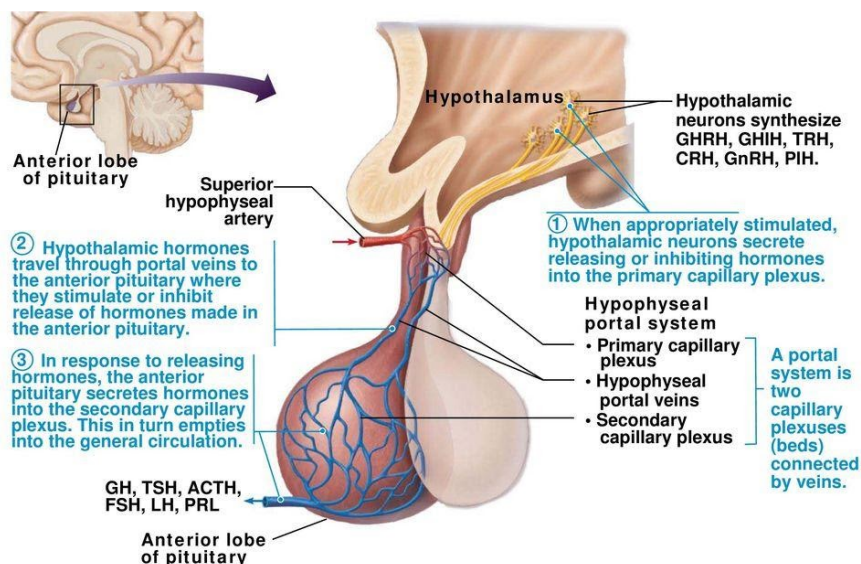
- Divided into 2 lobes:



- Posterior
 - Made of neural tissue
 - Releases neurohormones (hormones made by neurons)
 - Not really an endocrine gland because it does make its own hormone
- Anterior
 - Made of glandular tissue
 - Makes and releases different hormones
- Hypothalamus and pituitary relationship
 - The posterior lobe of pituitary gland originates from hypothalamic tissue
 - Hypothalamic tissue is connect with posterior pituitary via hypothalamic-hypophyseal tract (inside the infundibulum)
 - The anterior lobe of pituitary gland originates from epithelial tissue
 - Not directly connect to hypothalamus but indirectly connected via blood vessels
 - Hypophyseal portal system: releasing and inhibiting hormones are released to the primary capillary plexus → hypophyseal portal veins → secondary capillary plexus
 - Hypothalamus controls release of hormone from the pituitary 2 ways
 - Posterior pituitary –action potential travel down the axons of hypothalamic neurons and those neurons release their hormones to the posterior lobe



- Anterior pituitary –hypothalamic hormones are released into the hypophyseal portal system and control the release of the hormones in the anterior pituitary



Hormones Released by Pituitary Gland (and Hypothalamus)

