Module 6: Methods of Communication in the Brain II

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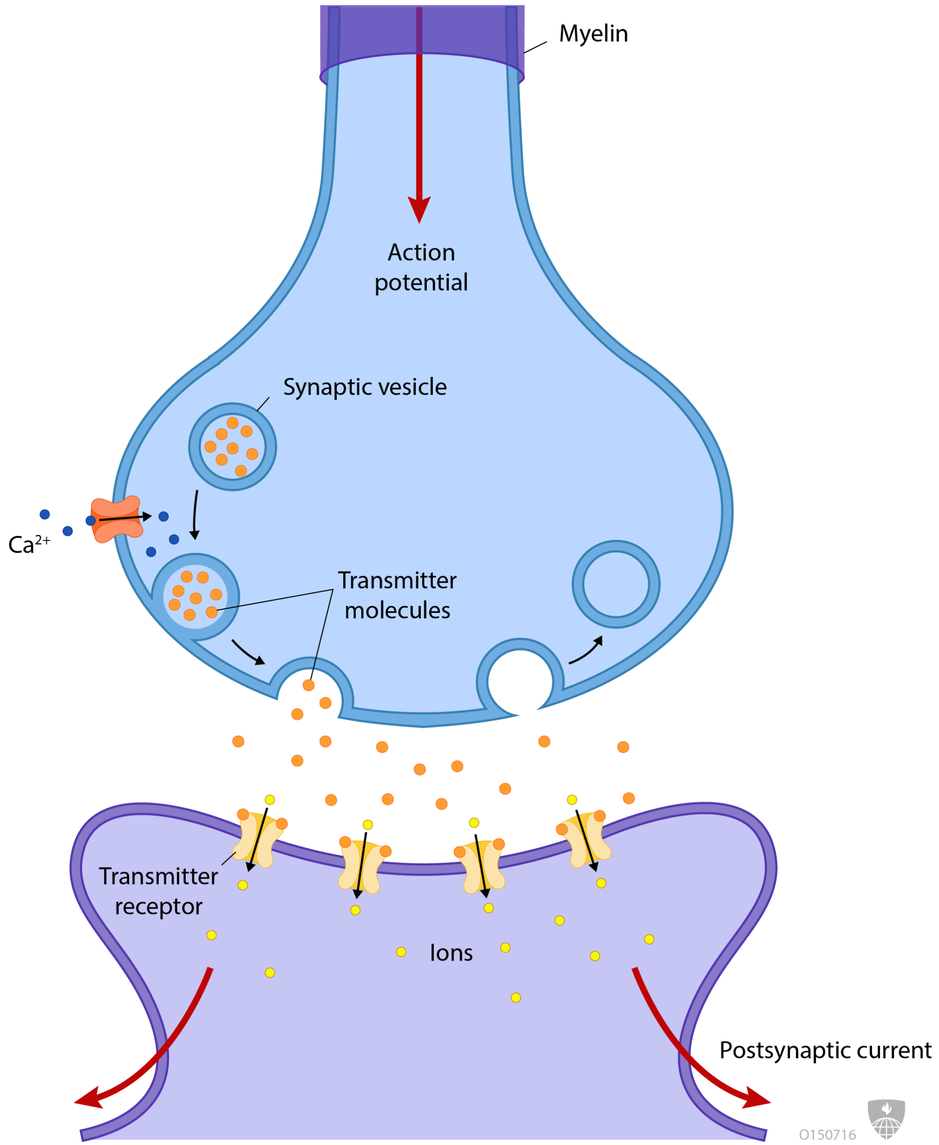
Methods of Communication

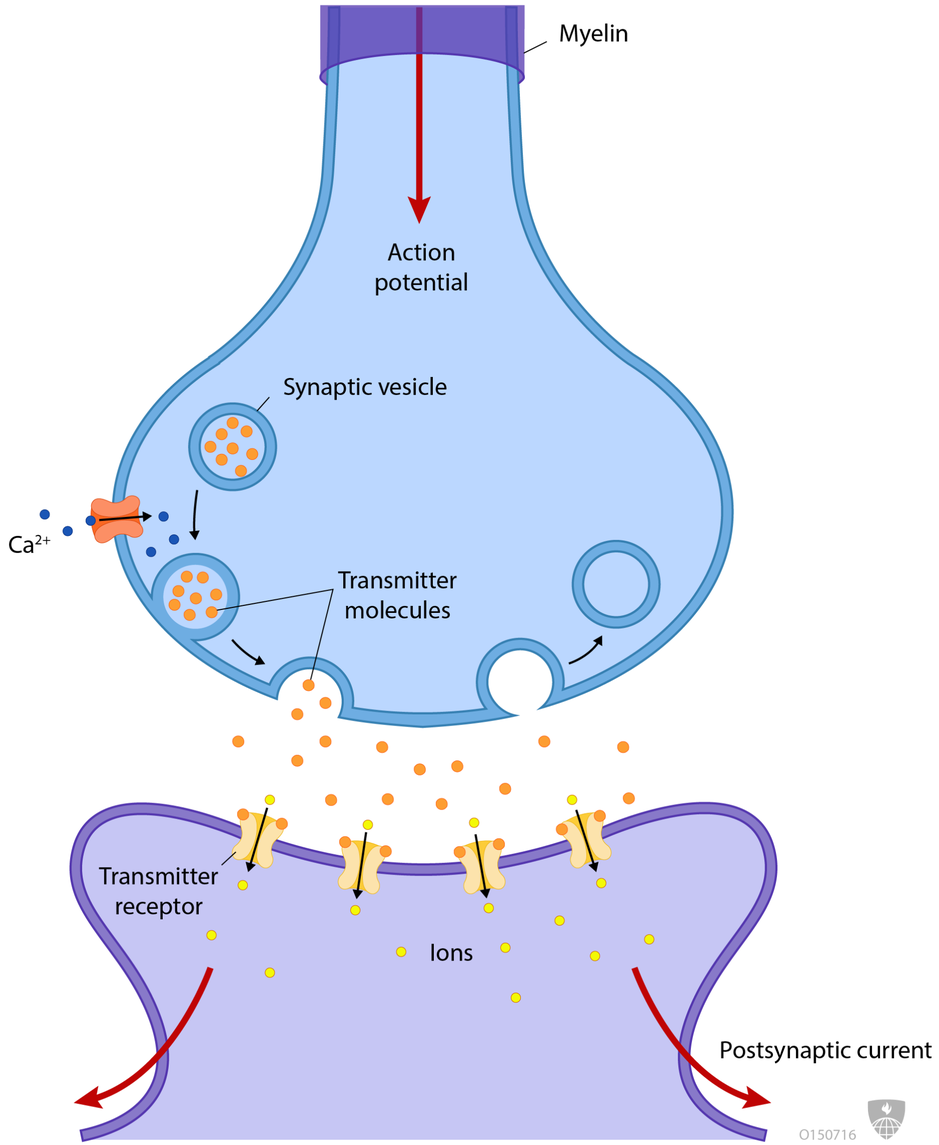
Communication between neurons:

- Electrical - concentration of sodium and potassium inside and outside neuron creates a membrane potential
- Chemical - Neurotransmitters released in to the synapse influence post-synaptic cell



Methods of Communication

Although mechanisms of electrical transmission are highly similar there is a great variety of neurotransmitters that have different effects on the post-synaptic cell



Neurotransmitters

Categories of Neurotransmitters:

Amino Acids	Peptides	Others
Glutamate	Somatostatin	Serotonin
Aspartate	Vasopressin	Norepinephrine
Glycine	Oxytocin	Histamine
D-Serine	Opioid peptides	Melatonin etc.

Neurotransmitters

Categories of Neurotransmitters:

Amino Acids	Peptides	Others	
Glutamate	Somatostatin	Serotonin	
Aspartate	Vasopressin	Norepinephrine	50+
Glycine	Oxytocin	Histamine	
D-Serine	Opioid peptides	Melatonin etc.	

Neurotransmitters

Categories of Neurotransmitters:

Excitatory neurotransmitters

Epinephrine

Norepinephrine

Inhibitory neurotransmitters

Serotonin

GABA

Both

Dopamine

Neurotransmitters

Acetylcholine

- Excitatory neurotransmitter
- Activates motor neurons that control skeletal muscles
- Regulates brain activity associated with attention, arousal, learning and memory
- Abnormally low levels of acetylcholine in patients with Alzheimer's disease

Neurotransmitters

Dopamine

- Critically important for motor control and movements of the body
- Involved in reward mechanisms and positive emotions
- Abnormally low levels of dopamine observed in patients with Parkinson's disease
- Abnormally high levels of dopamine observed in frontal areas of the brain in patients with Schizophrenia

Neurotransmitters

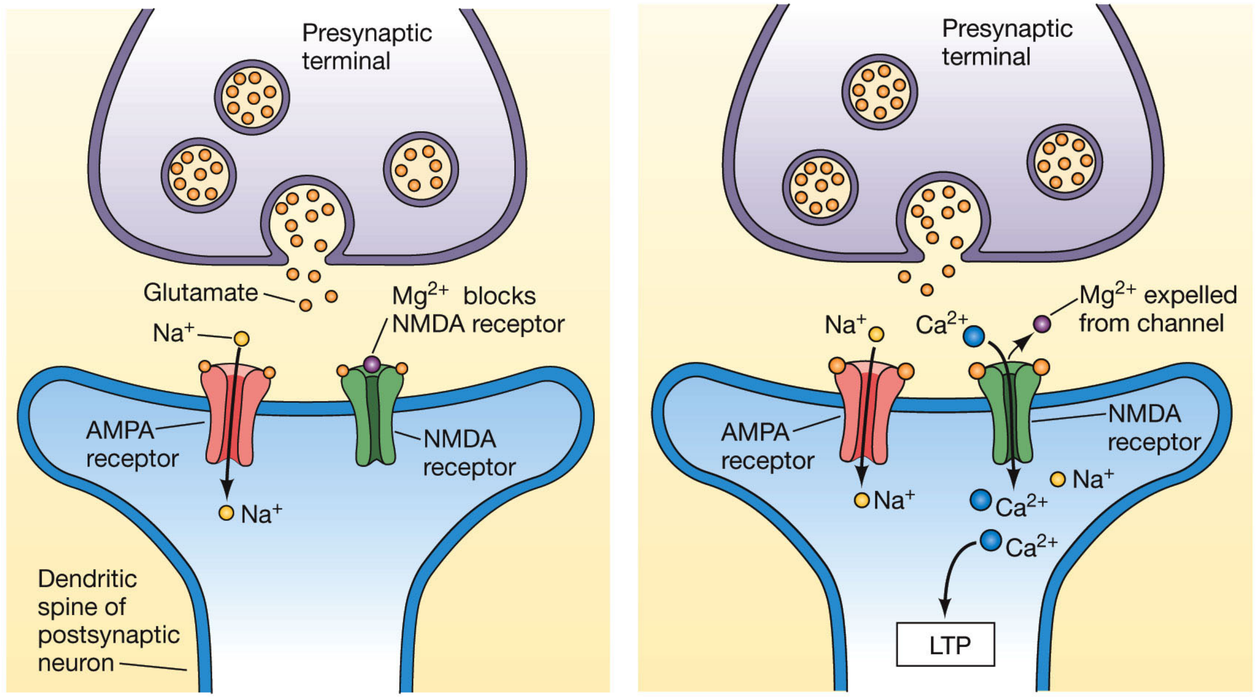
Glutamate

- Most commonly found neurotransmitter in the nervous system
- Mainly associated with learning and memory
- Excessive production of glutamate is toxic to neurons (ALS)

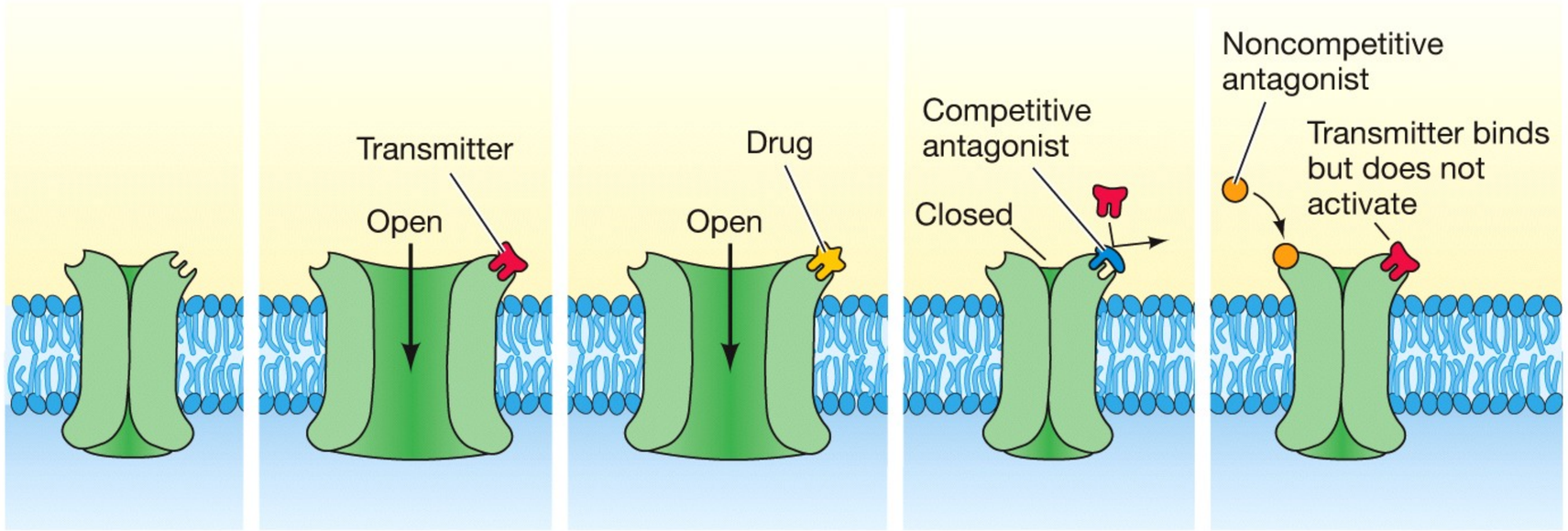
Neurotransmitters

Glutamate

- Glutamate binds to postsynaptic AMPA receptor
- Opens the receptor channel to allow influx of sodium
- Also binds to NMDA receptor to open receptor channel to allow influx of calcium
- Critical for learning and memory



Neurotransmitters

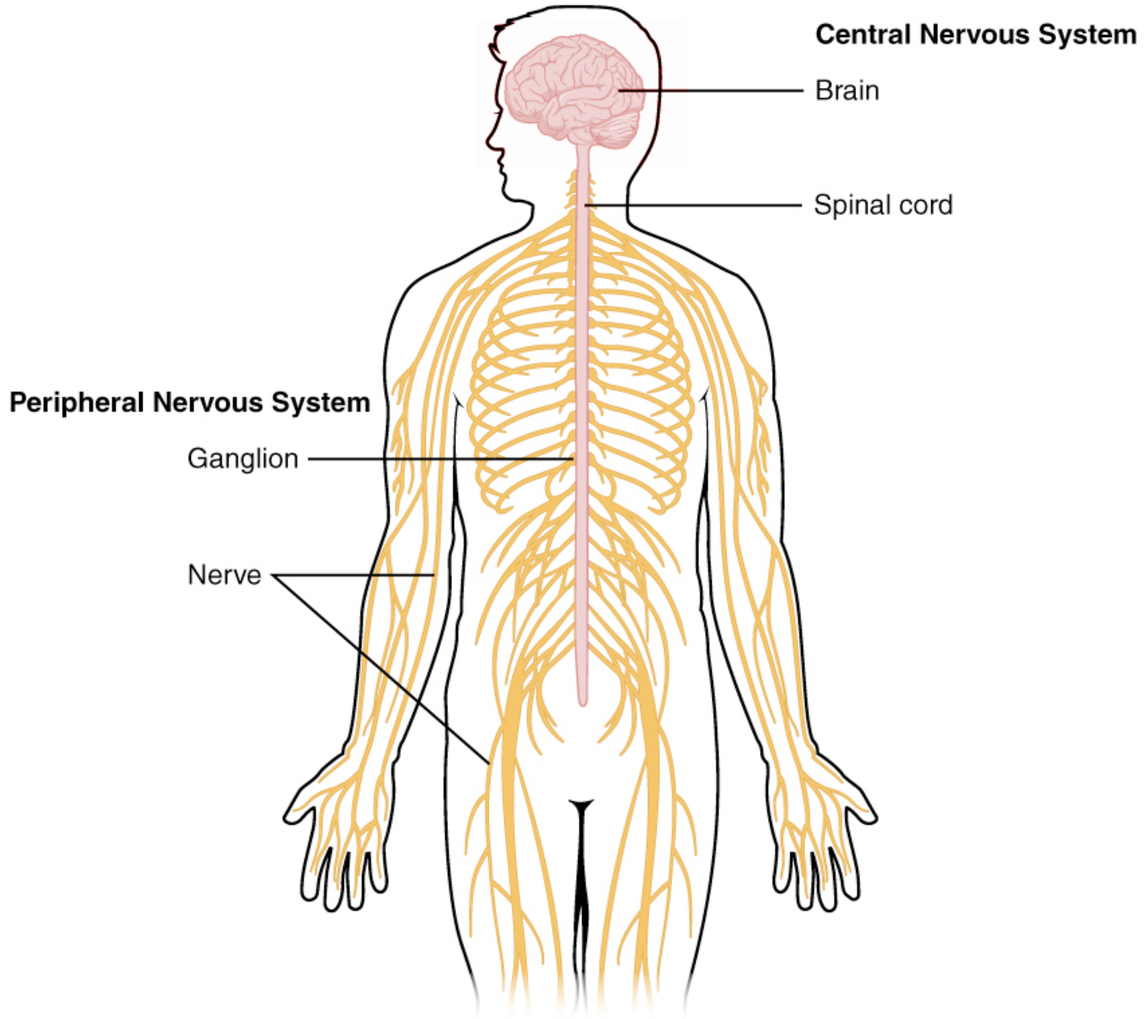


Unbound **Agonist** **Receptor Agonist** **Competitive antagonist** **Non-competitive antagonist**

Methods of Communication

Communication between brain and body :

- Direct innervation through spinal cord and peripheral nerve system
- Secretion of hormones that diffuse throughout the vasculature

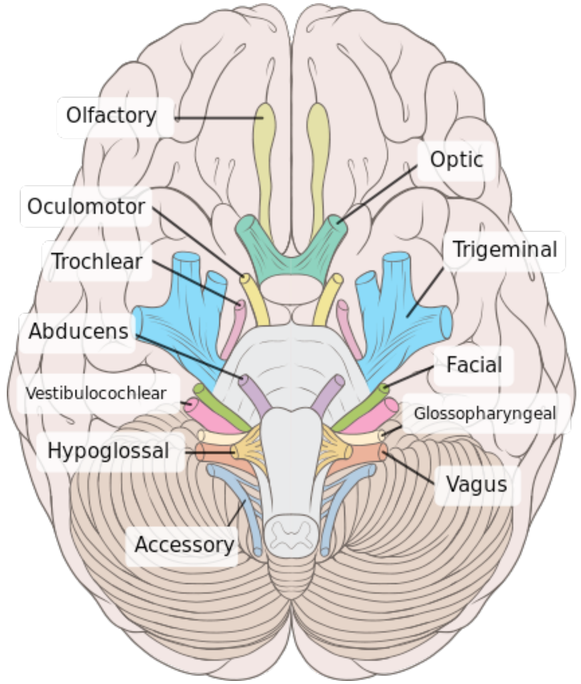


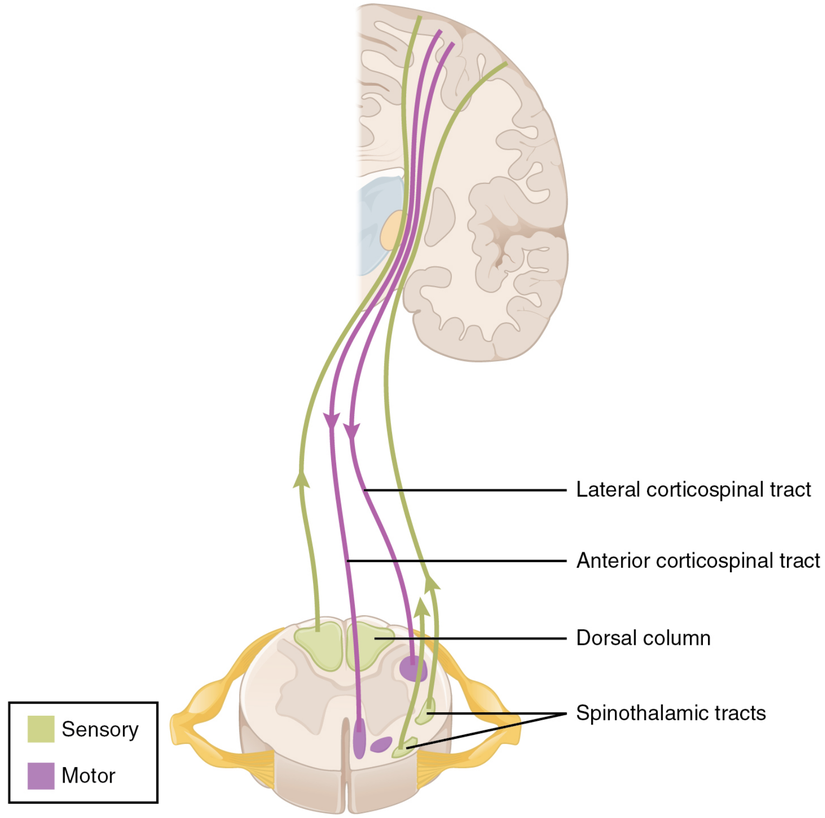
By OpenStax College - Anatomy & Physiology, Connexions Web site. http://cnx.org/content/col11496/1.6/, Jun 19, 2013.,

Methods of Communication

Communication between brain and body :

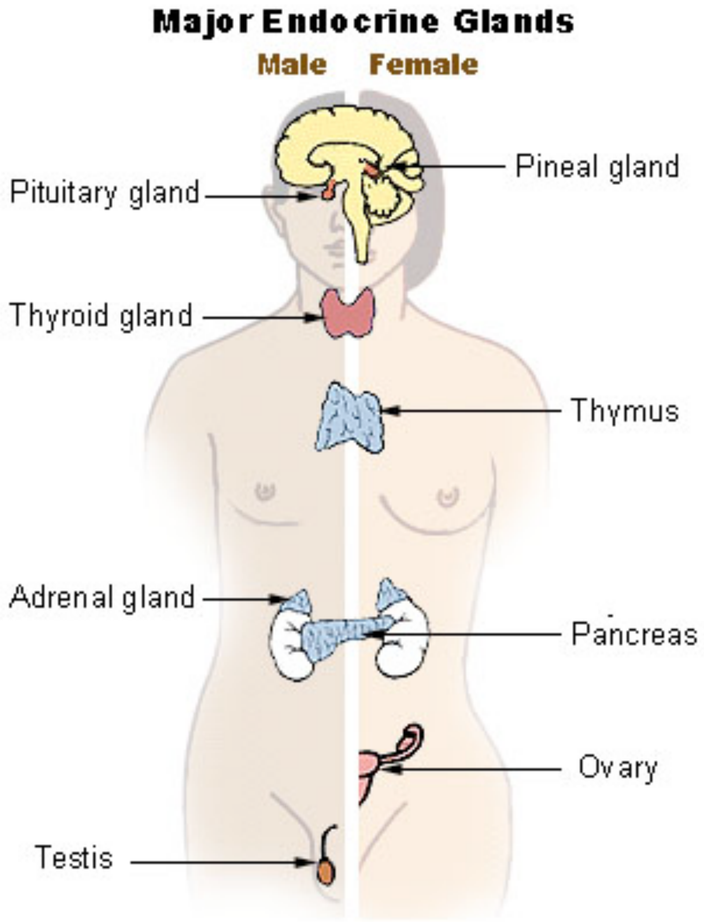
- Cranial nerves
- Corticospinal tracts





Hormones

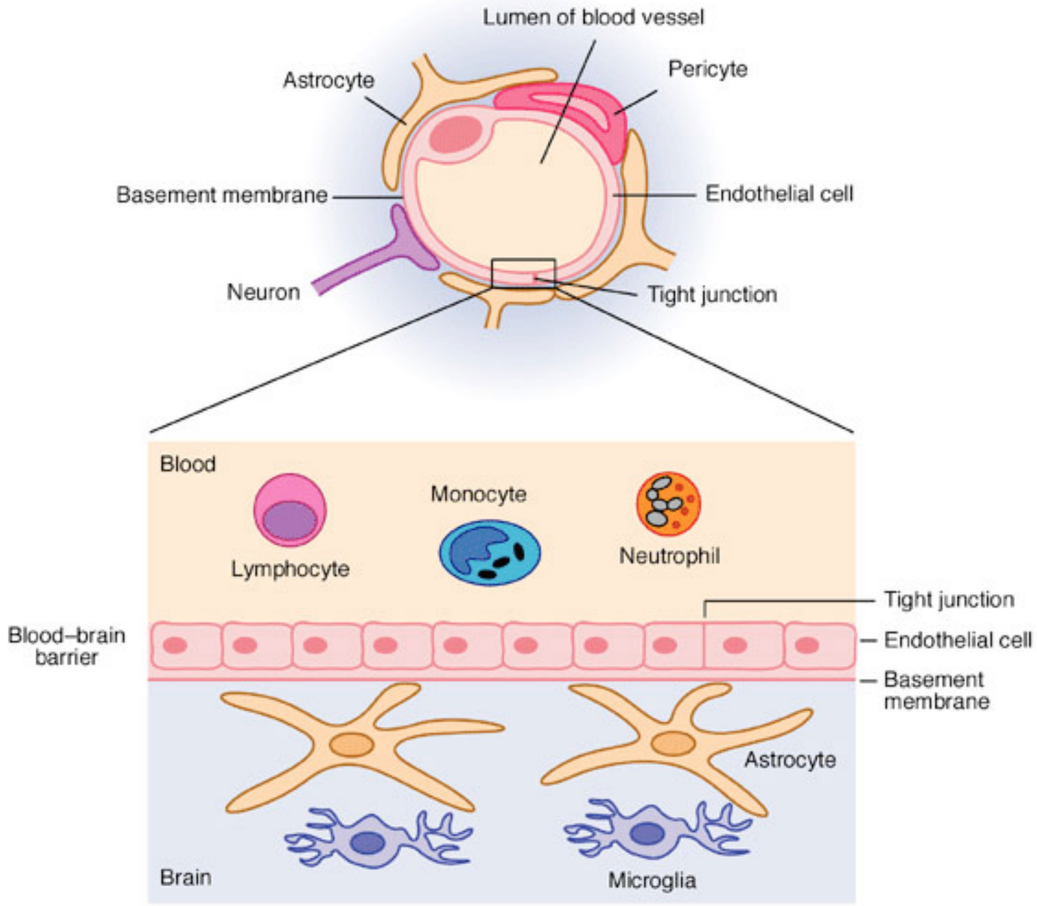
- Signaling molecules produced by glands throughout the body
- System of glands is referred to as the endocrine system
- Transported by the circulatory system to distant target organs
- Used to communicate between organs and tissue and regulates physiological and behavioral activities including heart rate, breathing, digestion, metabolism sleep, reproduction, mood etc.
- Examples of common hormones are: adrenaline,



Hormones

Brain is neurochemically protected through blood-brain barrier:

- Endothelial cells line blood vessels
- Prevent entry of microscopic objects like bacteria and macroscopic molecules
- Only small hydrophobic molecules like oxygen are allowed through
- Actively transports metabolic products like glucose

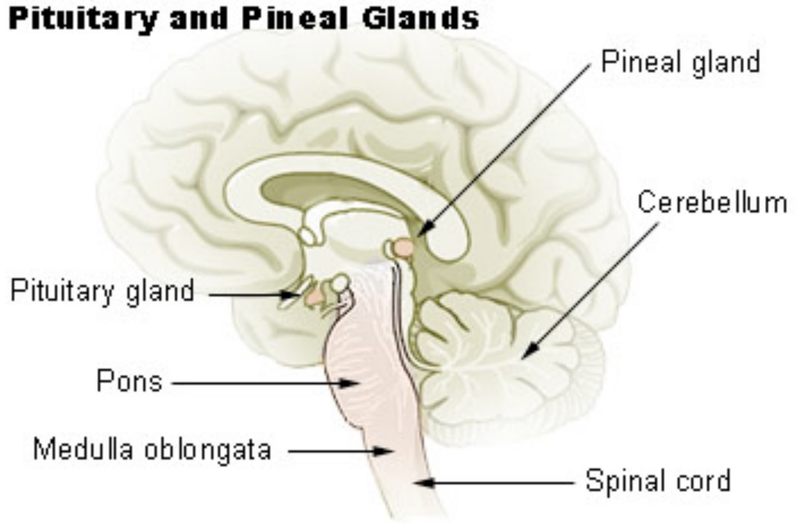


The blood–brain barrier (BBB)

Hormones

Some endocrine glands in the brain:

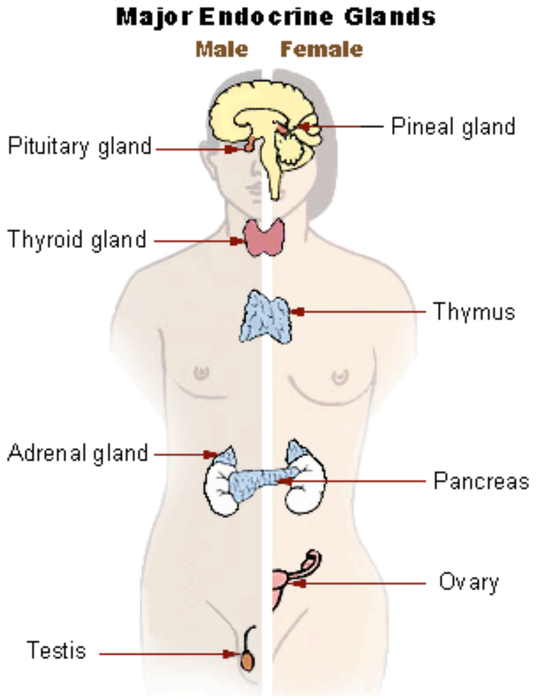
- Hypothalamus, Pituitary and Pineal glands
- Not protected by the Blood-Brain-Barrier
- Important modes of communication that regulate temperature regulation, thirst, hunger, circadian rhythm, sleep wake cycles, stress response, etc.

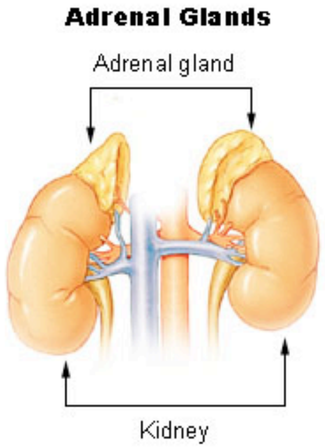


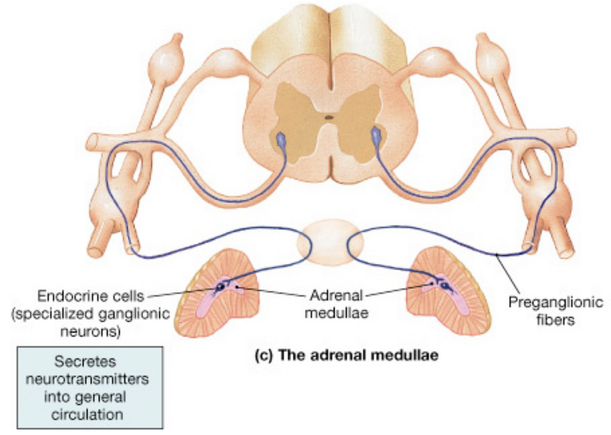
Hormones

Hormone - brain communication is bidirectional:

- Hormones secreted in the blood can influence brain function
- For example, startling or dangerous events cause adrenal gland to excrete adrenaline in to the blood stream







Hormones

- Through blood activates the Sympathetic nervous system
- Epinephrine binds to receptors on the vagal nerve which then releases glutamate on to synapses in the brain stem facilitating the encoding of the event