Biological Foundations of Psychology
(Behavior Neuroscience)

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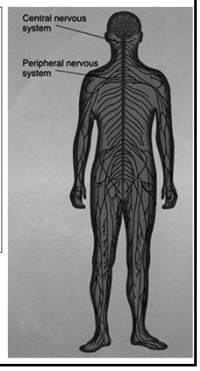
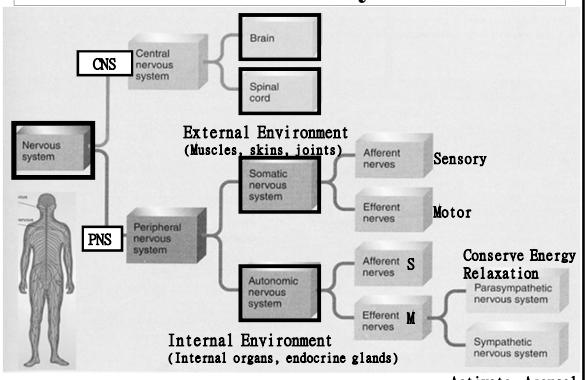
The Nervous System

The Organization of the Nervous System

- **CNS (Central Nervous System)**
  - **All the neurons in the brain and spinal Cord**
- **PNS (Peripheral Nervous System)**
  - **The nerves connecting the brain and spinal cord**

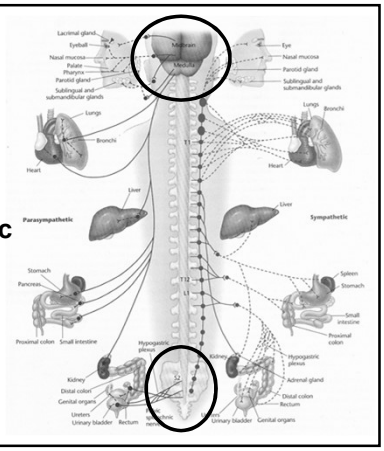


The Nervous System



Activate, Arousal

The Autonomic Nervous System



Parasympathetic

- Conserve Energy
- Relaxation

Sympathetic

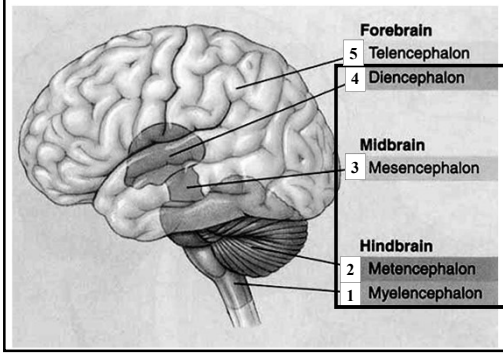
- Activate
- Arousal

The CNS

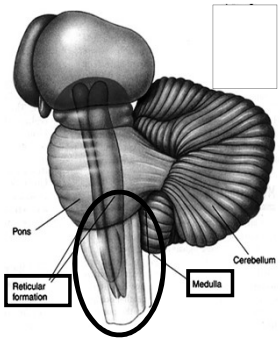
Brain

- 

The Organization of the Brain



1. Myelencephalon (Hindbrain)



- **Medulla**

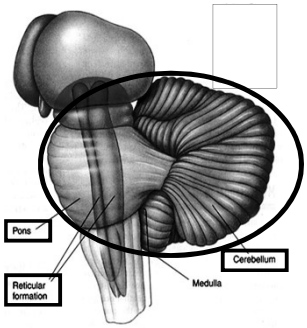
  <u>Vital function</u> :

  Respiration, heart, breathing, some reflexes

- **Reticular formation**

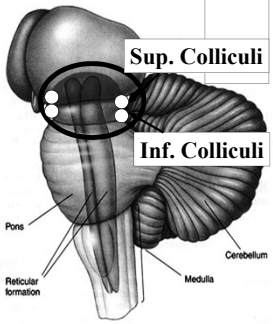
  <u>Arousal system</u> : The network of neurons (nerve cells) that controls arousal, sleep-wake, focus attention, conscious awareness.

2. Metencephalon (Hindbrain)



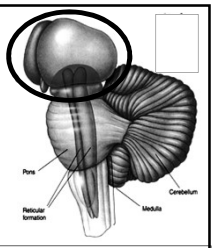
- **Cerebellum –** Coordination of movement and motor learning
- **Pons - Reticular formation**
  - arousal system

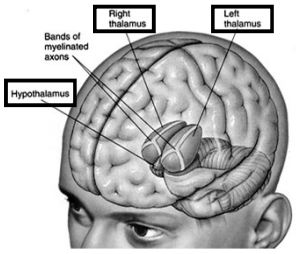
3. Mesencephalon (Middbrain)



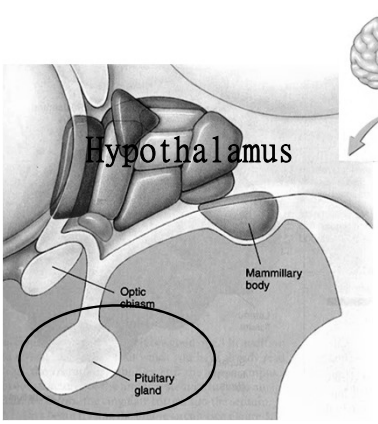
- Tectum & Tegmentum
- Tectum (2 pairs)
  - superior colliculi (Vision)
  - inferior colliculi (Auditory)
- Tegmentum
  - reticular formation (Arousal)
  - red nucleus (Movement)
  - substantia nigra (Movement / Parkinson's = cell bodies died)
  - periaquiductal gray (pain)

4.Diencephalon (Forebrain)



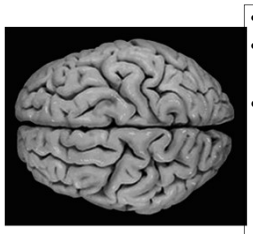


- **Thalamus**
  - Top of brain stem
  - Sensory information to cerebrum
- **Hypothalamus**
  - Endocrine Functions
  - Motivated behavior (Eating, drinking, sex, emotions)

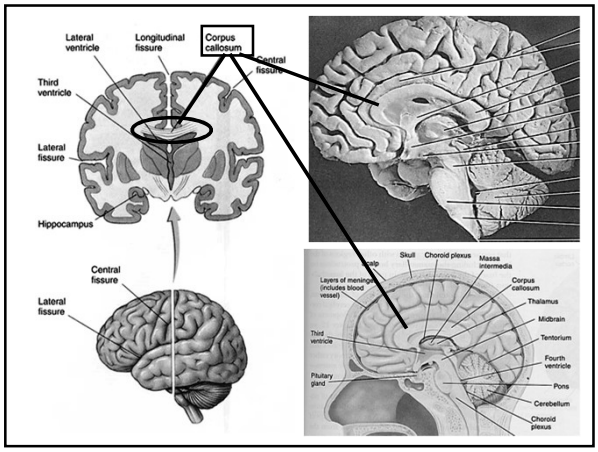


- **Pituitary Gland**
  - **endocrine function**

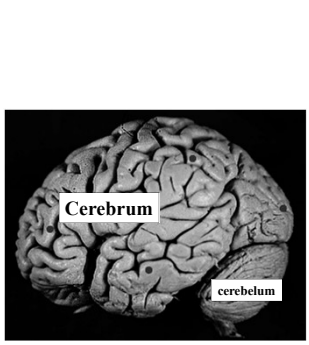
5. Telencephalon (Forebrain)

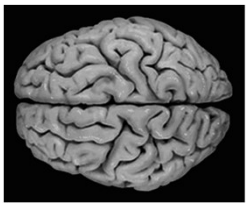


- **Largest division**
- **Complex cognitive functions**
- **CEREBRUM Cerebral hemisphere**
  - **Cerebral Cortex**
  - **Limbic System (Subcortical Region)**
  - **Basal Ganglia (Subcortical Region)**
- **Commissure = large tracts connecting between the two hemisphere**
  - **Corpus Callosum is the largest commissure**



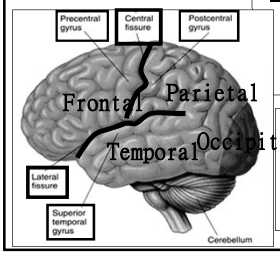
Cerebral Cortex



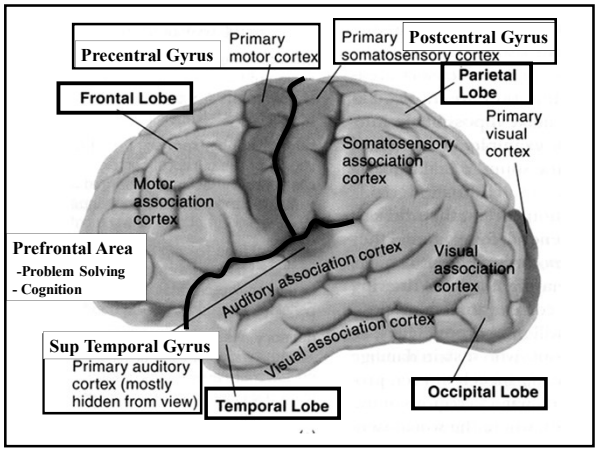


Cerebral Cortex

- **Fissures**
  - Central Fissure
  - Lateral Fissure
  - Longitudinal Fissure
- **Gyrus**
  - Precentral Gyrus (motor)
  - Postcentral Gyrus (somatosensory)
  - Superior Temporal Gyrus (Auditory)

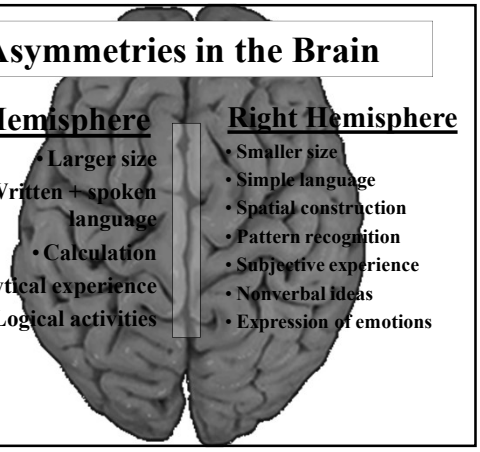


- **Frontal Lobe** (Motor, Cognition)
- **Temporal Lobe** (Auditory)
- **Parietal Lobe** (Somatosensory)
- **Occipital Lobe** (Vision)



Cerebral Cortex

Asymmetries in the Brain



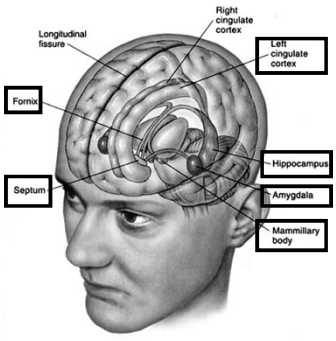
Left Hemisphere

- Larger size
- Written + spoken language
- Calculation
- Analytical experience
- Logical activities

Right Hemisphere

- Smaller size
- Simple language
- Spatial construction
- Pattern recognition
- Subjective experience
- Nonverbal ideas
- Expression of emotions

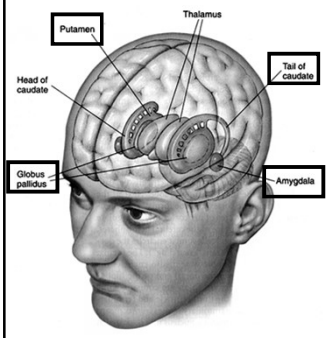
Limbic System



- **Regulation of motivated behavior**
- **Circuit (network) at midline structure that circle the thalamus**

- **Mammillary Bodies** (part of hypothalamus)
- **Hippocampus** (Learning +Memory)
- **Amygdala** (Emotion)
- **Fornix** (tract)
- **Cingulate Cortex or Limbic Cortex** (Learning +Memory)
- **Septum** (Septum nuclei)

Basal Ganglia

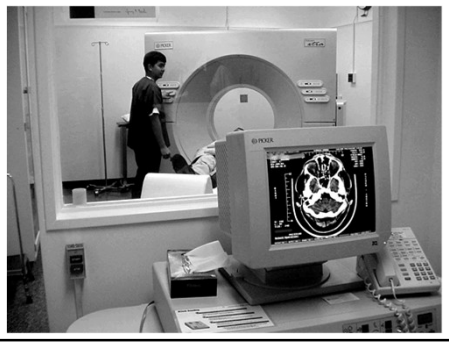


- Control movements, voluntary motor response
- Amygdala
- Caudate } Striatum
- Putamen }
- Globus Pallidus

- Important Pathway – From Striatum to Substantia Nigra in Tegmentum (Mesencephalon), Parkinson's disease

Seeing the Brain

Computerized Tomography (CT Scan)



Computerized Tomography (CT Scan)

- Provides a 3-D view of a brain structure
- The CT scan image of the brain is NOT high-resolution

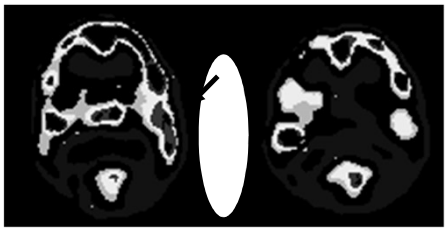
Magnetic Resonance Image (MRI)

Magnetic Resonance Image (MRI)

- Provides a 3-D view of a brain structure
- The MRI scan image of the brain is high-resolution

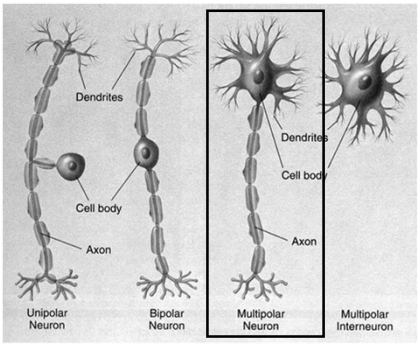
Positron Emission Tomography (PET)

- Provides a view of brain activity



- In this image the subject on the left was asked to listen subjectively to sequences of musical notes
- Note that the subjective experience was focused in the right hemisphere,
- whereas the analytical experience was focused in the left hemisphere.

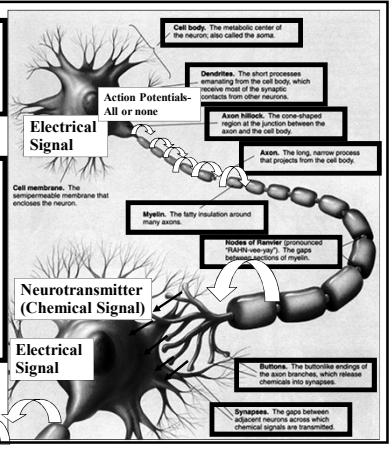
NEURONS



NEURONS (nerve cells)

How neurons communicate?

Electrochemical Signal

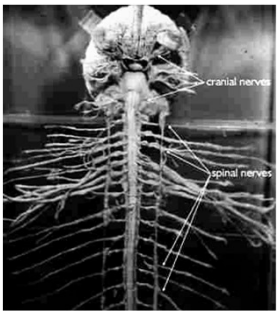


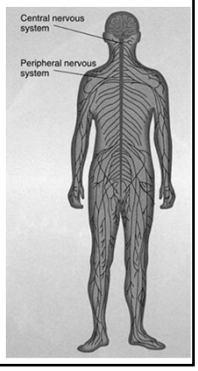
Neurotransmitters

More than 70 neurotransmitters have been identified. Examples are;

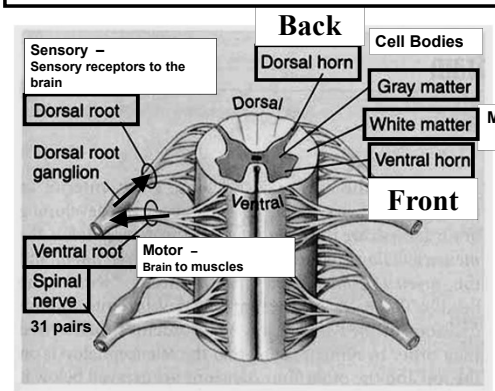
- **Acetylcholine** — **Memory and attention. Low levels in Alzheimer's disease**
- **Norepinephrine** — **Low levels contribute to depression**
- **Dopamine** — **Natural rewards (food, sex, etc.), drug abused**
- **Serotonin** — **Mood, social behavior. Anti-anxiety, anti-depression drugs increase serotonin.**
- **Glutamate** — **Major excitatory neurotransmitter in brain. Learning and memory**
- **GABA** — **Major inhibitory neurotransmitter in brain. Anti-anxiety increase GABA.**

Spinal Cord





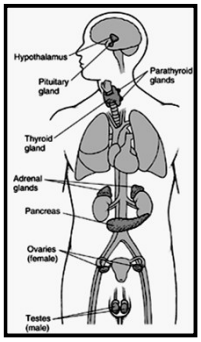
Spinal Cord



The Endocrine System

The Endocrine System

- **Endocrine Glands - Hormones**
  - **chemicals secreted by the endocrine glands into the <u>bloodstream</u> and transported to other parts of the body**



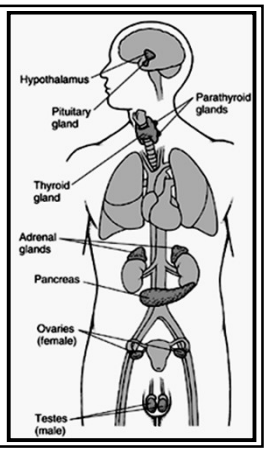
The Endocrine System

Hormones secreted by the endocrine glands are as essential as the nervous system to the integration of the organism's activity or behavior.

The two systems differ, however in the speed with which they can act.

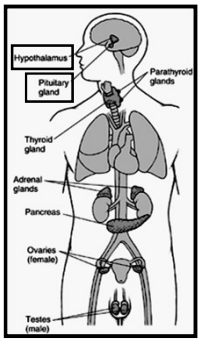
A nerve impulse can travel through the organism in a few hundredths of a second.

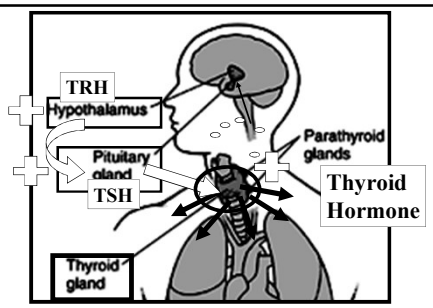
Seconds, or even minutes, may be required for an endocrine glands to produce an effect. The hormone, once released, must travel to its target site via the bloodstream-a much slower process.



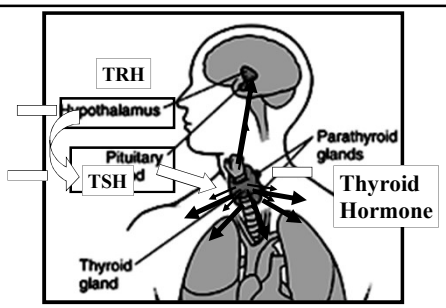
The Endocrine System

- **Pituitary Gland**
  - –**the "master gland", controls the secretion activity of other endocrine glands** (Thyroid gland, Adrenal gland, ovaries, testes, etc.)
- **Hypothalamus**
  - –**Control Pituitary Gland**



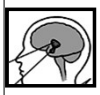


Positive Feedback
– Increase hormone release



Negative Feedback
– Decrease hormone release

Endocrine Glands

Pituitary Gland 	• Antidiuretic hormone (vasopressin)	Causes kidneys to retain water and, along with aldosterone, helps control blood pressure
	• Corticotropin (ACTH)	Controls the production and secretion of hormones by the adrenal cortex
	• Growth hormone	Controls growth and development; promotes protein production
	• Luteinizing hormone (LH) and follicle-stimulating hormone (FSH)	Control gonads for reproductive functions, including the production of sperm and semen, egg maturation, and menstrual cycles; control male and female sexual characteristics (including hair distribution, muscle formation, skin texture and thickness, voice, and perhaps even personality traits)
	•Oxytocin	Causes muscles of the uterus and milk ducts in the breast to contract

Pituitary Gland	• Prolactin	Starts and maintains milk production in the ductal glands of the breast (mammary glands)
	• Thyroid-stimulating hormone (TSH)	Stimulates the production and secretion of hormones by the thyroid gland
Parathyroid glands 	• Parathyroid hormone	Controls bone formation and the excretion of calcium and phosphorus
Thyroid gland	• Thyroid hormone	Regulates the rate at which the body functions (metabolic rate)
Pancreas 	• **Glucagon**	Raises the blood sugar level
	• **Insulin**	Lowers the blood sugar level; affects the processing (metabolism) of sugar, protein, and fat throughout the body

Adrenal glands 	• Aldosterone	Helps regulate salt and water balance by retaining salt and water and excreting potassium
	• Cortisol	Has widespread effects throughout the body; especially has anti-inflammatory action; maintains blood sugar level, blood pressure, and muscle strength; helps control salt and water balance
	• Dehydroepi-androsterone (DHEA)	Has effects on bone, mood, and the immune system
	• Epinephrine and norepinephrine	Stimulate the heart, lungs, blood vessels, and nervous system
Kidneys 	• Erythropoietin	Stimulates red blood cell production
	• Renin	Controls blood pressure
	• Angiotensin	Controls blood pressure

Ovaries 	• Estrogen	Controls the development of female sex characteristics and the reproductive system
	• Progesterone	Prepares the lining of the uterus for implantation of a fertilized egg and readies the mammary glands to secrete milk
Testes 	• Testosterone	Controls the development of male sex characteristics and the reproductive system
Digestive tract	• Cholecystokinin	Controls muscle contractions that move food through the intestine and gallbladder contractions
	• Glucagon-like peptide	Increases insulin release from pancreas
	• Ghrelin	Controls growth hormone release from the pituitary gland
Adipose (fat) tissue	• Resistin	Blocks the effects of insulin on muscle
	• Leptin	Control appetite