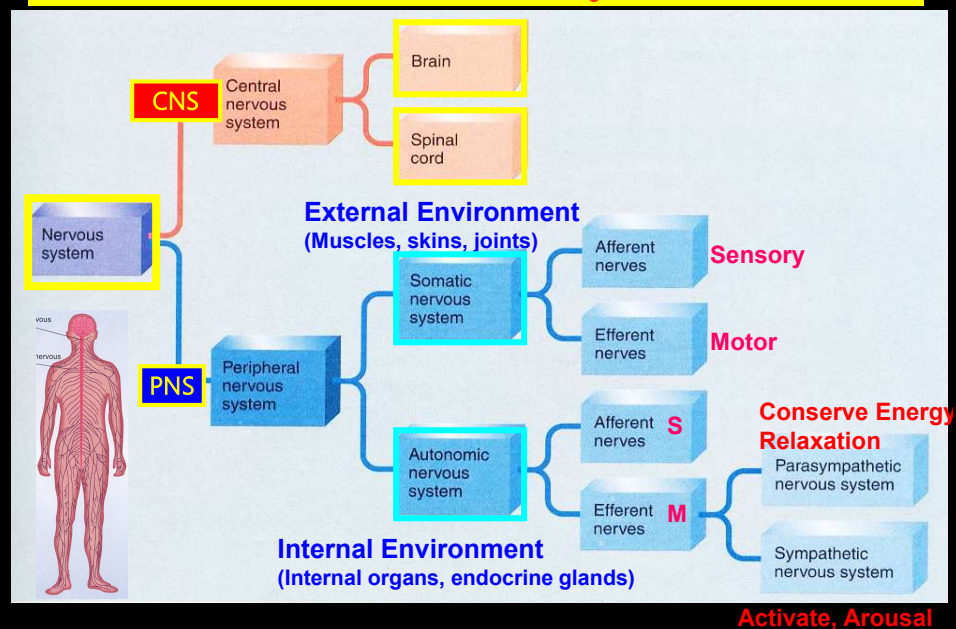


# Biological Foundations of Psychology

## (Behavior Neuroscience)

Asst. Prof. Dr. Panrapee Suttiwan, Ph.D.  
Faculty of Psychology, Chulalongkorn University

### The Nervous System



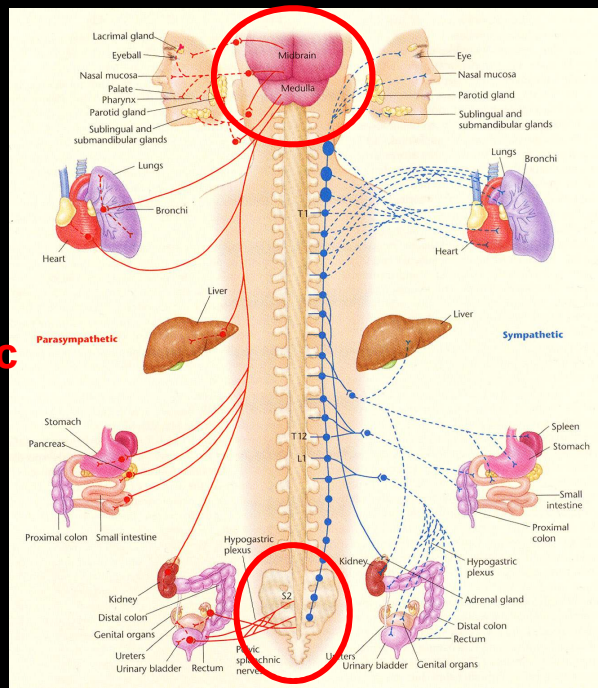
# The Autonomic Nervous System

## Parasympathetic

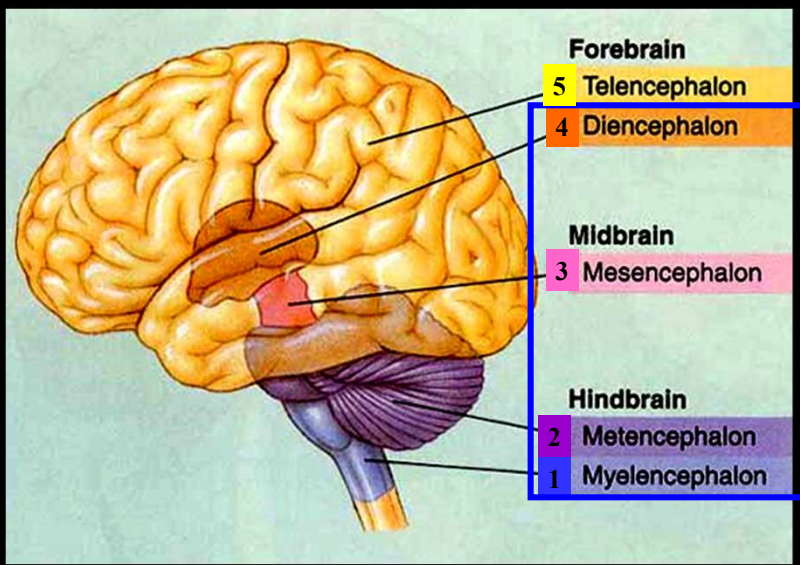
- Conserve Energy
- Relaxation

## Sympathetic

- Activate
- Arousal

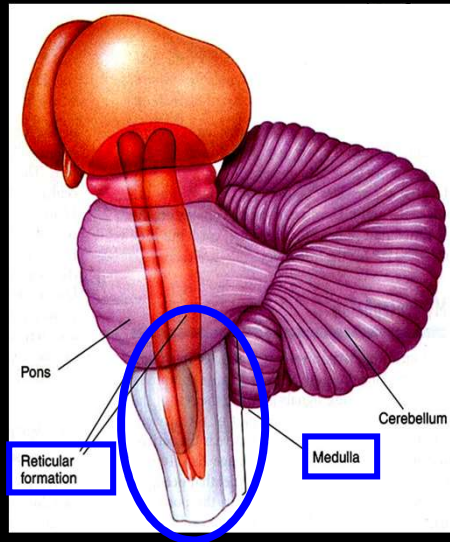


# The Organization of the Brain



**Brain Stem**

## 1. Myelencephalon (Hindbrain)



- **Medulla**

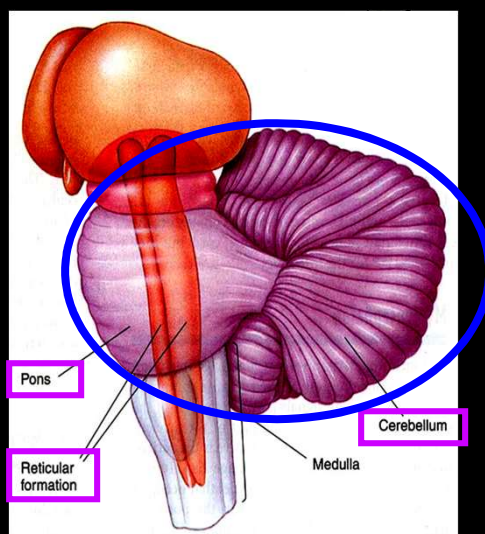
Vital function :

Respiration, heart, breathing, some reflexes

- **Reticular formation**

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

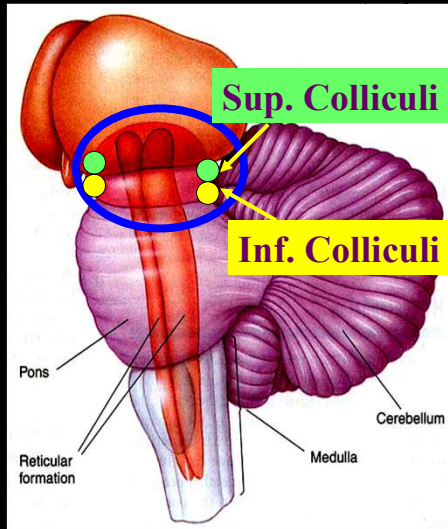
## 2. Metencephalon (Hindbrain)



- **Cerebellum** – Coordination of movement and motor learning

- **Pons - Reticular formation** – arousal system

### 3. Mesencephalon (Midbrain)



#### • Tectum & Tegmentum

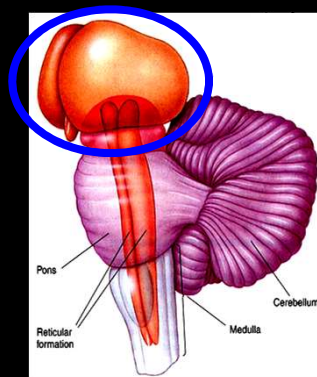
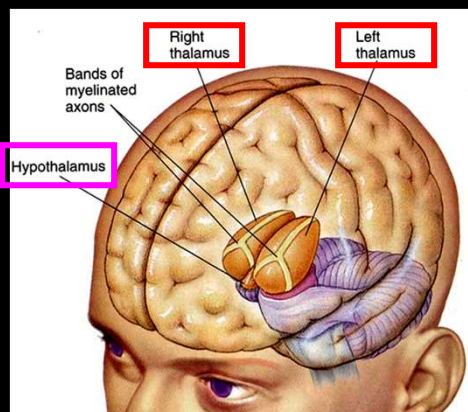
##### • Tectum (2 pairs)

- 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)

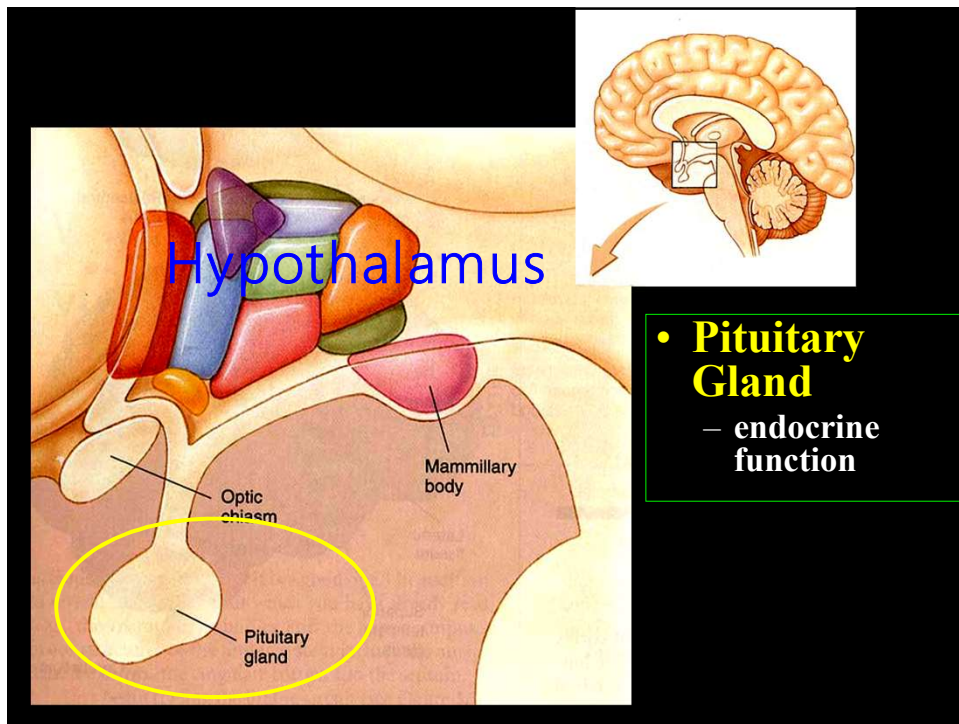


#### • Thalamus

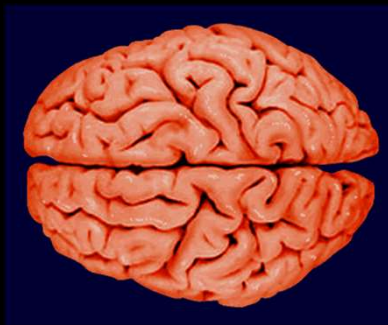
- Top of brain stem
- Sensory information to cerebrum

#### • Hypothalamus

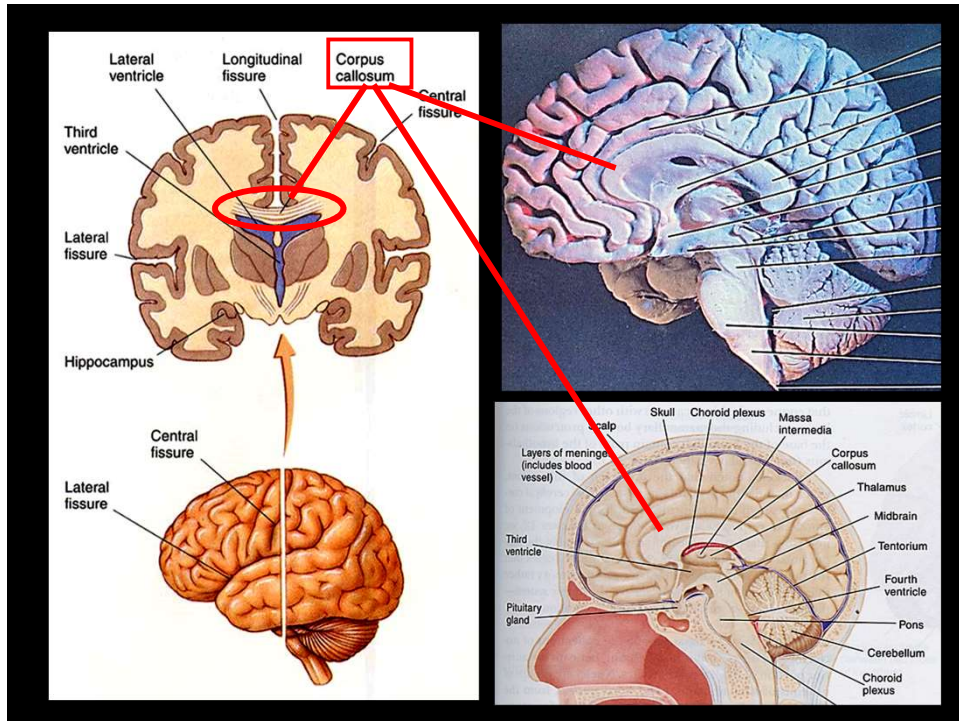
- Endocrine Functions
- Motivated behavior (Eating, drinking, sex, emotions)



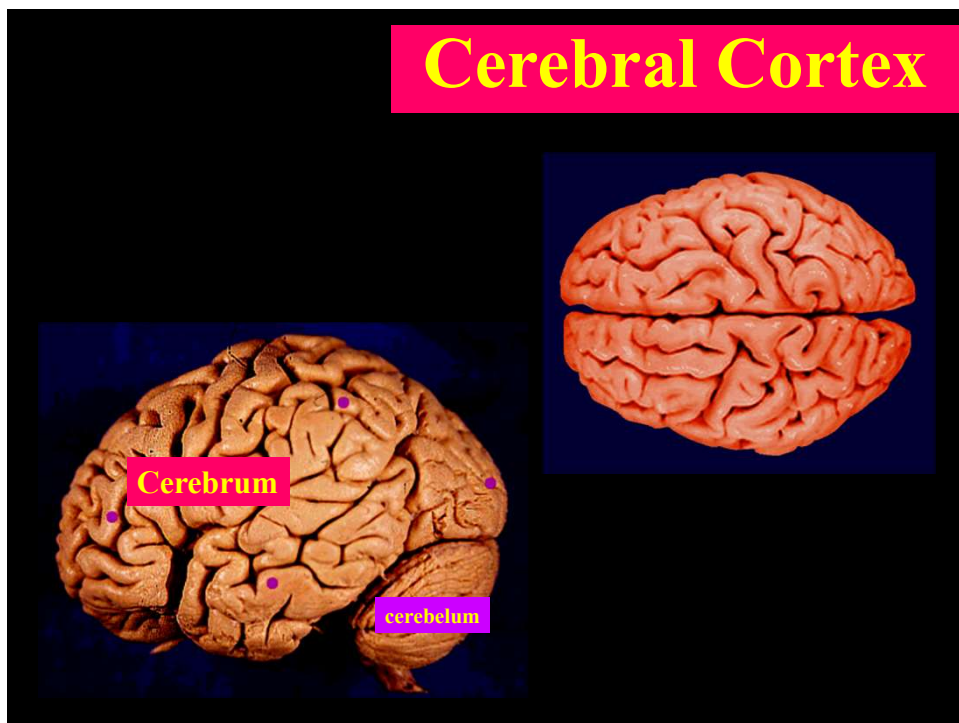
## 5. Telencephalon (Forebrain)



- 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



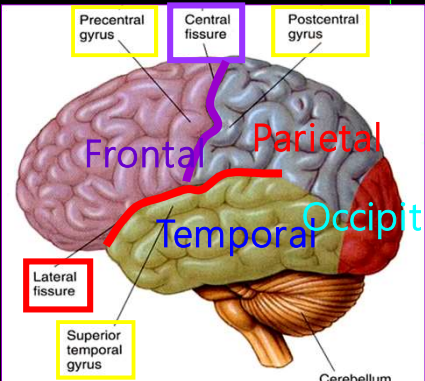
## Cerebral Cortex



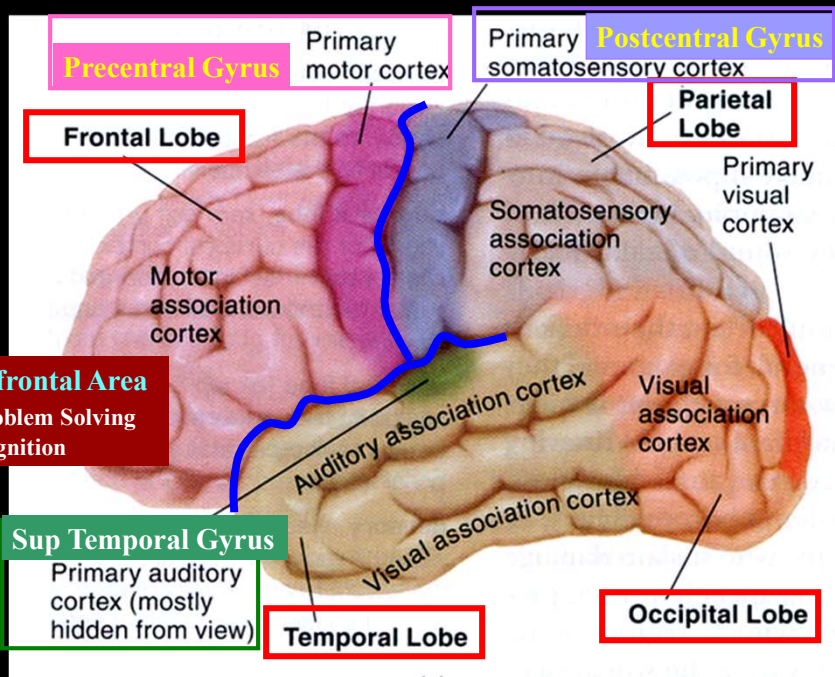


## Cerebral Cortex

- 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)



Precentral Gyrus

Primary motor cortex

Primary Postcentral Gyrus somatosensory cortex

Frontal Lobe

Parietal Lobe

Motor association cortex

Somatosensory association cortex

Primary visual cortex

**Prefrontal Area**  
 -Problem Solving  
 -Cognition

Sup Temporal Gyrus

Primary auditory cortex (mostly hidden from view)

Temporal Lobe

Occipital Lobe

Auditory association cortex

Visual association cortex

Visual association cortex

## Cerebral Cortex



## Asymmetries in the Brain

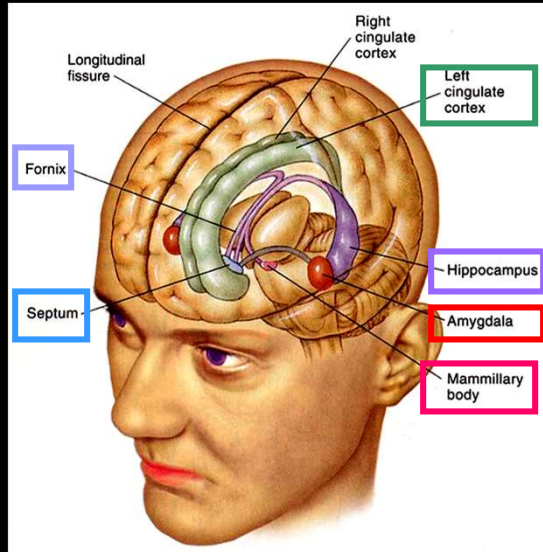
### Left Hemisphere

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

### Right Hemisphere

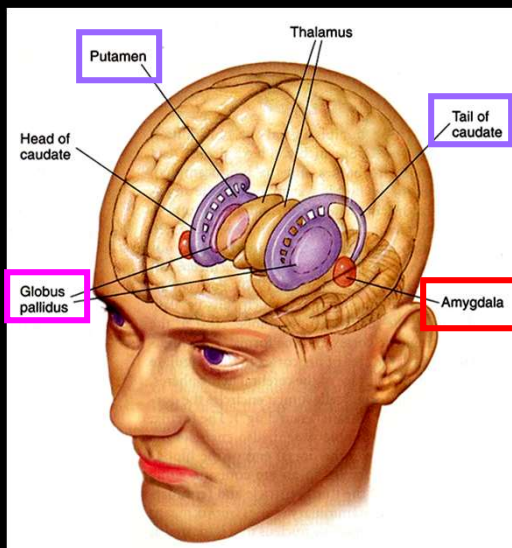
- Smaller size
- Simple language
- Spatial construction
- Pattern recognition
- Subjective experience
- Nonverbal ideas
- Expression of emotions

# Limbic System



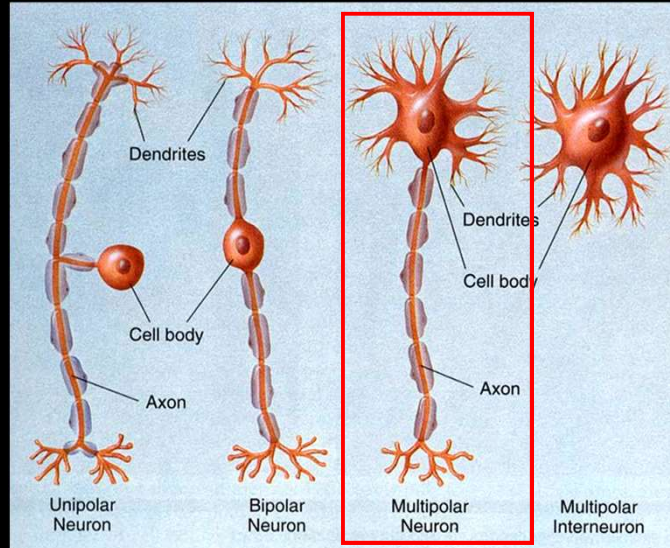
- **Regulation of motivated behavior**
- Circuit (network) at midline structure that circle the thalamus
- **Mammillary Bodies** (part of hypothalamus)
- **Hippocampus** (Learning + Memory)
- **Amygdala** (Emotion)
- **Fornix** (tract)
- **Cingulate Cortex or Limbic Cortex** (Learning + Memory)
- **Septum** (Septum nuclei)

# Basal Ganglia



- Control movements, voluntary motor response
- **Amygdala**
- **Caudate**
- **Putamen**
- **Globus Pallidus**
- **Important Pathway – From Striatum to Substantia Nigra in Tegmentum (Mesencephalon). Parkinson's disease**

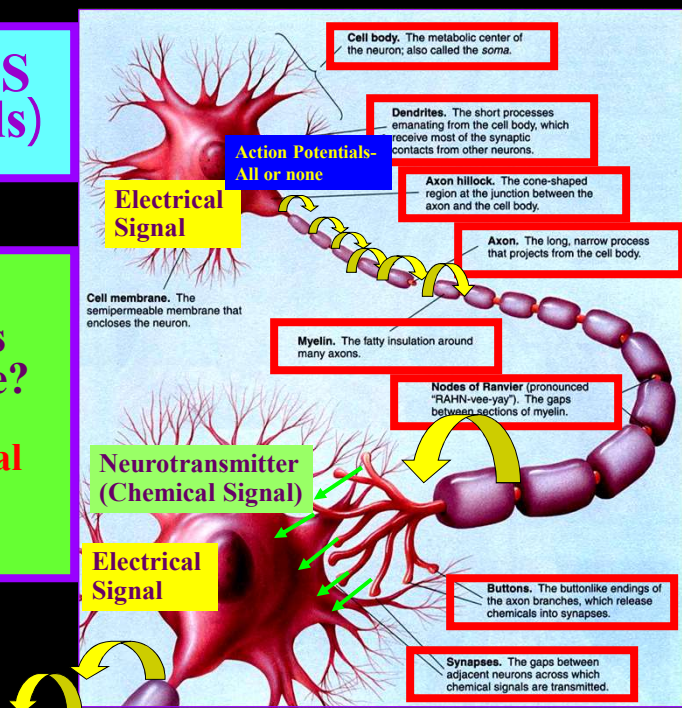
# NEURONS



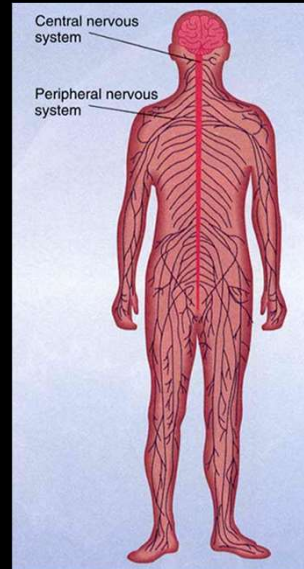
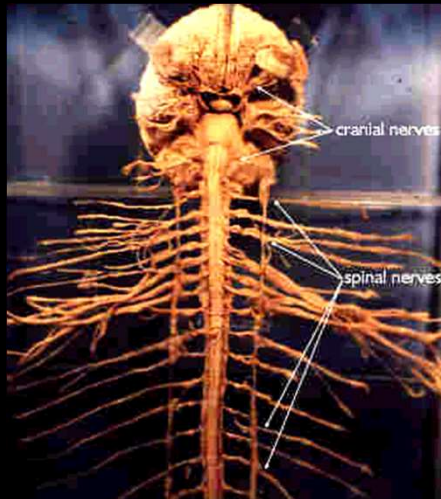
## NEURONS (nerve cells)

### How neurons communicate?

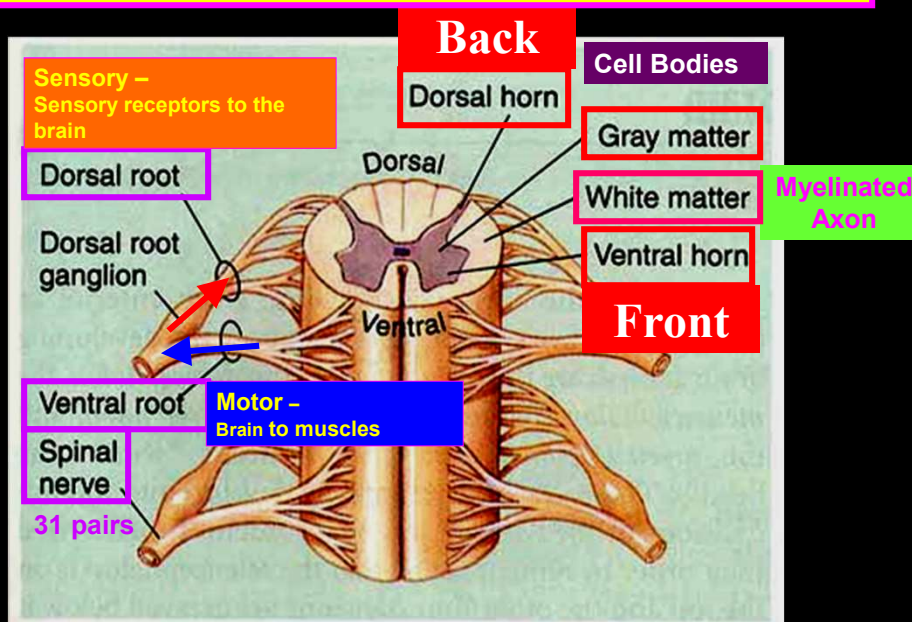
### Electrochemical Signal



# Spinal Cord



# Spinal Cord

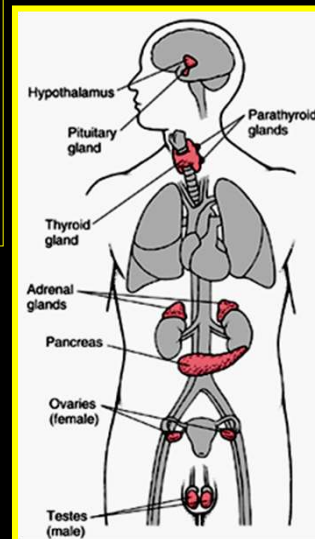


# The Endocrine System

## The Endocrine System

- **Endocrine Glands - Hormones**

—chemicals secreted by the endocrine glands into the bloodstream and transported to other parts of the body



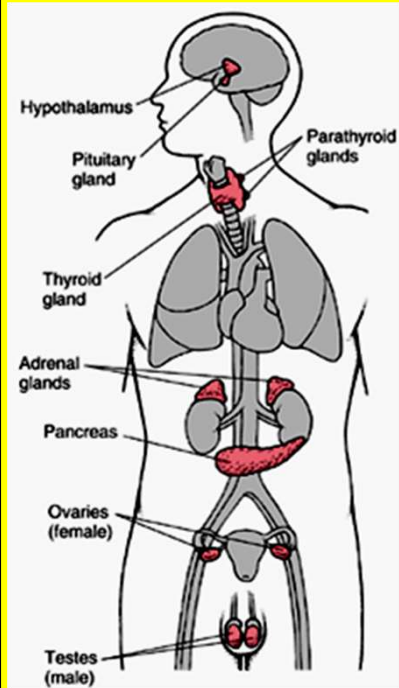
## The Endocrine System

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.



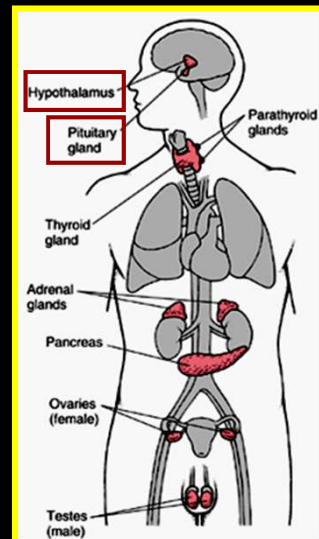
## The Endocrine System

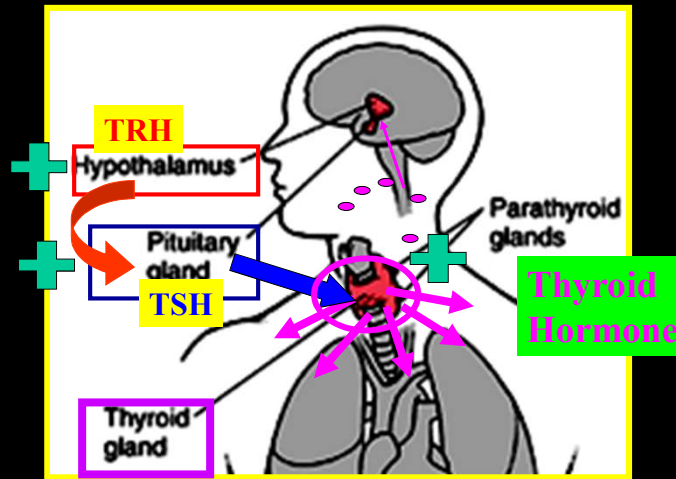
### • Pituitary Gland

–the “master gland”, controls the secretion activity of other endocrine glands (Thyroid gland, Adrenal gland, ovaries, testes, etc.)

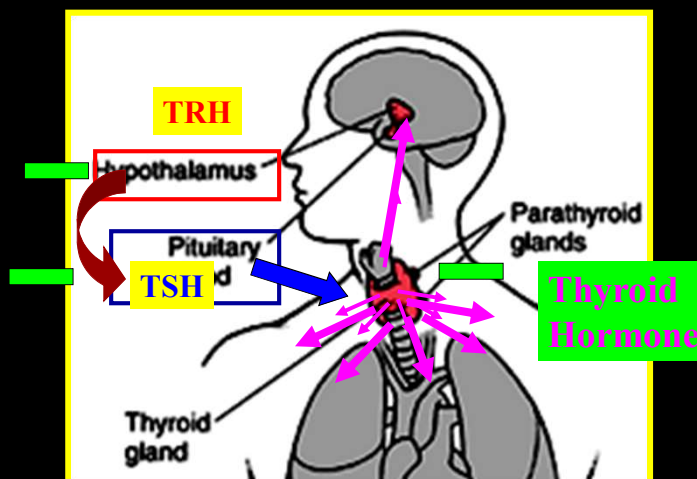
### • Hypothalamus

–Control Pituitary Gland





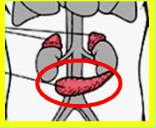
**Positive Feedback**  
– Increase hormone release

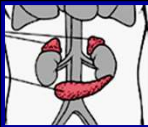


**Negative Feedback**  
– Decrease hormone release

# Endocrine Glands

|                                                                                                                   |                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Pituitary Gland</b></p>  | <ul style="list-style-type: none"> <li>• Antidiuretic hormone (vasopressin)</li> <li>• <b>Corticotropin (ACTH)</b></li> <li>• Growth hormone</li> <li>• <b>Luteinizing hormone (LH) and follicle-stimulating hormone (FSH)</b></li> <li>• Oxytocin</li> </ul> | <p>Causes <b>kidneys</b> to retain water and, along with aldosterone, helps control blood pressure</p> <p>Controls the production and secretion of hormones by the <b>adrenal cortex</b></p> <p>Controls growth and development; promotes protein production</p> <p>Control <b>gonads</b> 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 <b>personality traits</b>)</p> <p>Causes muscles of the uterus and milk ducts in the breast to contract</p> |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                             |                                                                                                                   |                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Pituitary Gland</b>                                                                                      | <ul style="list-style-type: none"> <li>• Prolactin</li> <li>• <b>Thyroid-stimulating hormone (TSH)</b></li> </ul> | <p>Starts and maintains milk production in the ductal glands of the breast (mammary glands)</p> <p>Stimulates the production and secretion of hormones by the <b>thyroid gland</b></p> |
| <b>Parathyroid glands</b>  | <ul style="list-style-type: none"> <li>• Parathyroid hormone</li> </ul>                                           | <p>Controls bone formation and the excretion of calcium and phosphorus</p>                                                                                                             |
| <b>Thyroid gland</b>       | <ul style="list-style-type: none"> <li>• <b>Thyroid hormone</b></li> </ul>                                        | <p>Regulates the rate at which the body functions (<b>metabolic rate</b>)</p>                                                                                                          |
| <b>Pancreas</b>            | <ul style="list-style-type: none"> <li>• <b>Glucagon</b></li> <li>• <b>Insulin</b></li> </ul>                     | <p>Raises the blood sugar level</p> <p>Lowers the blood sugar level; affects the processing (metabolism) of sugar, protein, and fat throughout the body</p>                            |

|                                                                                                           |                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Adrenal glands</b>  | <ul style="list-style-type: none"> <li>• Aldosterone</li> <li>• <b>Cortisol</b></li> <li>• Dehydroepiandrosterone (DHEA)</li> <li>• <b>Epinephrine and norepinephrine</b></li> </ul> | <p>Helps regulate salt and water balance by retaining salt and water and excreting potassium</p> <p>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</p> <p>Has effects on bone, mood, and the immune system</p> <p>Stimulate the heart, lungs, blood vessels, and nervous system</p> |
| <b>Kidneys</b>         | <ul style="list-style-type: none"> <li>• Erythropoietin</li> <li>• Renin</li> <li>• Angiotensin</li> </ul>                                                                           | <p>Stimulates red blood cell production</p> <p>Controls blood pressure</p> <p>Controls blood pressure</p>                                                                                                                                                                                                                                                                                                                        |

|                                                                                                     |                                                                                                                         |                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ovaries</b><br> | <ul style="list-style-type: none"> <li>• <b>Estrogen</b></li> <li>• Progesterone</li> </ul>                             | <p>Controls the development of <b>female sex characteristics</b> and the reproductive system</p> <p>Prepares the lining of the uterus for implantation of a fertilized egg and readies the mammary glands to secrete milk</p> |
| <b>Testes</b><br>  | <ul style="list-style-type: none"> <li>• <b>Testosterone</b></li> </ul>                                                 | <p>Controls the development of <b>male sex characteristics</b> and the reproductive system</p>                                                                                                                                |
| <b>Digestive tract</b>                                                                              | <ul style="list-style-type: none"> <li>• Cholecystokinin</li> <li>• Glucagon-like peptide</li> <li>• Ghrelin</li> </ul> | <p>Controls muscle contractions that move food through the intestine and gallbladder contractions</p> <p>Increases insulin release from pancreas</p> <p>Controls growth hormone release from the pituitary gland</p>          |
| <b>Adipose (fat) tissue</b>                                                                         | <ul style="list-style-type: none"> <li>• Resistin</li> <li>• Leptin</li> </ul>                                          | <p>Blocks the effects of insulin on muscle</p> <p>Control appetite</p>                                                                                                                                                        |