

# Introduction to Physiology of the Nervous System

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# Objectives

- **At the end of this lecture the student should :**
  - ✓ **understand that the nervous system can be classified in more than one way , depending on the purpose of the study undertaken .**
  - ✓ **appreciate that animal experiments are essential for advancement of knowledge about nervous system functions**
  - ✓ **understand that , under strict ethical considerations , human studies are also carried out to understand neurophysiology .**
  - ✓ **know that much of human physiology can be learned from observing the consequences of human lesions & diseases .**
  - ✓ **be able to explain what is meant by telencephalon , diencephalon ,brainstem , basal ganglia , cerebellum and spinal cord ; & outline their function .**

# Classification of the Nervous System

- The nervous system ( NS) can be classified in more than one way :

## (I) Central & Peripheral NS

(A) Central Nervous System (CNS) : consisting of the brain and spinal cord , and

(B) Peripheral Nervous System (PNS ) : Fibers outside the CNS

## (II) Sensory & Motor NS

(A) Sensory : includes (i) sensory ( afferent ) fibers , ascending ( sensory ) pathways , & brain sensory centers

(B) Motor : includes brain motor centers , descending (motor ) pathways & motor ( efferent ) fibers .

## (III) Somatic & Autonomic NS

(A) Somatic ( Voluntary) Nervous System

(B) Autonomic ( Involuntary) Nervous System

# Methods of Studying Physiology of the Nervous System

- Understanding anatomy : Since very old times in the history of medicine , it was appreciated that understanding anatomy (what structures make up the human body & how arranged ) has been essential for understanding physiology ( how the body functions) .
- Learning from animals :
- Making lesions or injecting chemicals in brain & then studying their effects on neuronal behavior & structure , & on animal behavior .
- Recording ( with or without stimulation ) of electrical activity from nerves , muscles , brain or spinal cord in animals .
- Learning from humans ( under strict ethical laws ) :
- Studying effects of lesions ( disease , trauma etc ) and chemicals ( drugs or toxins ; taken accidentally or administered intentionally) on human wellness , function and behavior .
- Recording spontaneous and evoked nerve activity , muscle electrical activity , and brain waves .
- Functional radiological methods

# Overview of the Brain

# Components of The Brain

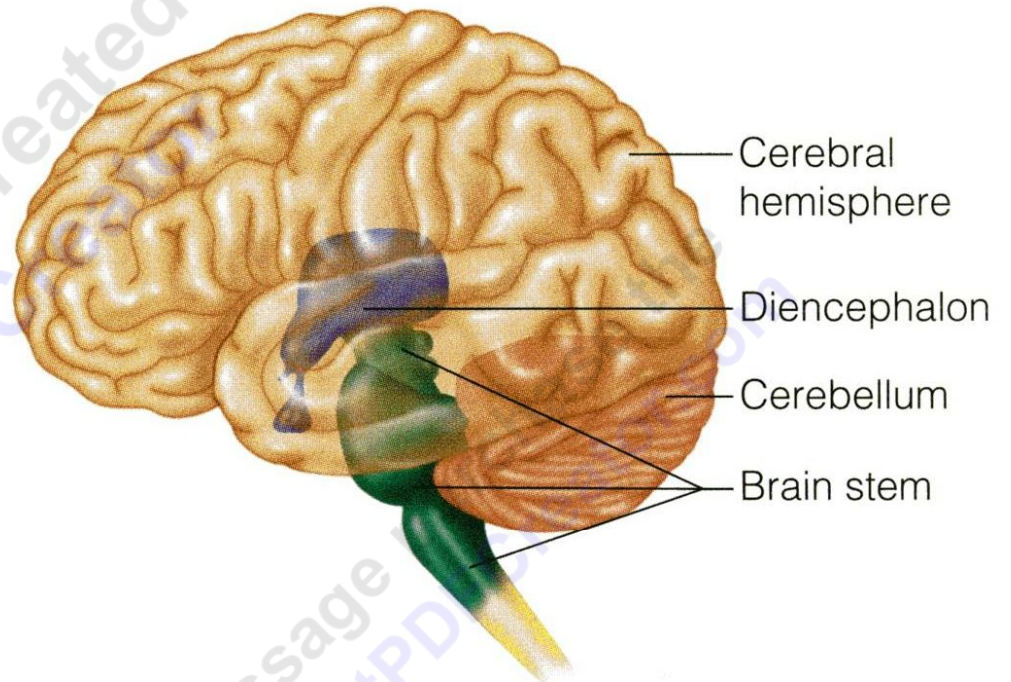
- **A/ Telencephalon →**

- (1) Cerebrum and
- (2) Basal Ganglia ( collection of grey matter situated inside the cerebral hemispheres )

- **B/ Diencephalon →**

- Mainly :

- (1) Thalamus ( mainly a relay station for sensory pathways in their way to the cerebral cortex )
- (2) Hypothalamus ( contains center for autonomic and endocrine control )



- **C/ Brainstem →**

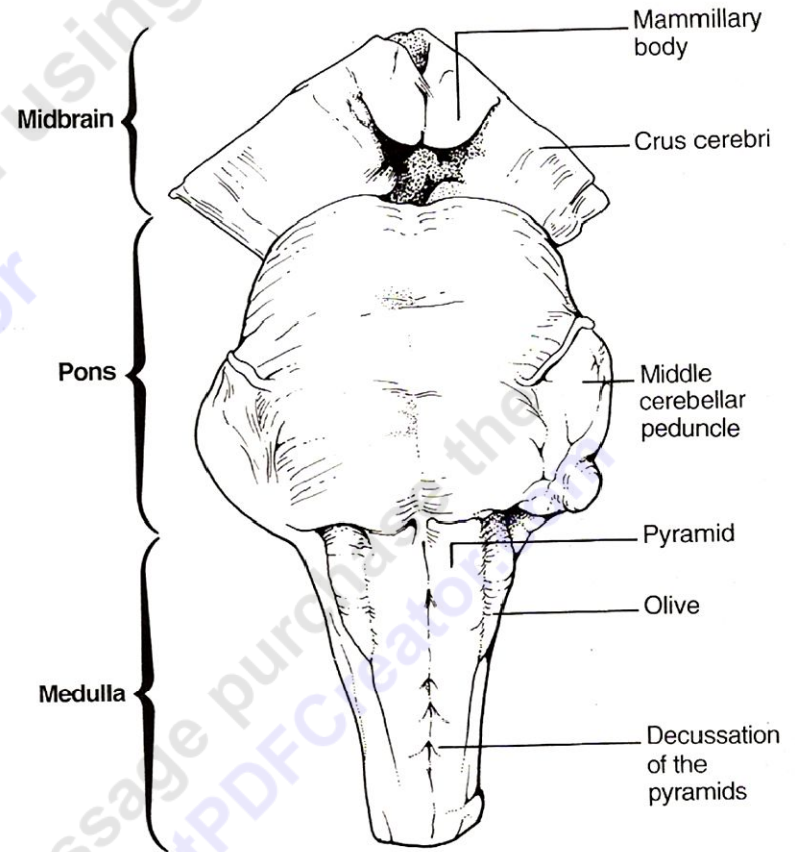
- (1) Midbrain
- (2) Pons
- (3) Medulla

- **E/ Cerebellum**



# The Brainstem

- The term "brainstem" is actually an anatomic rather than physiologic term, because it is easier, in terms of anatomy, to group "all CNS structures that hang between the cerebrum and spinal cord" together.
- However, in terms of Physiology, the situation is more complicated, because brainstem structures are involved in many diverse & different bodily functions.

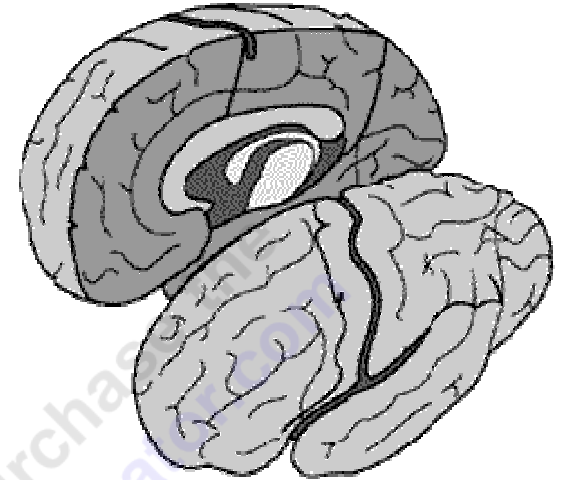
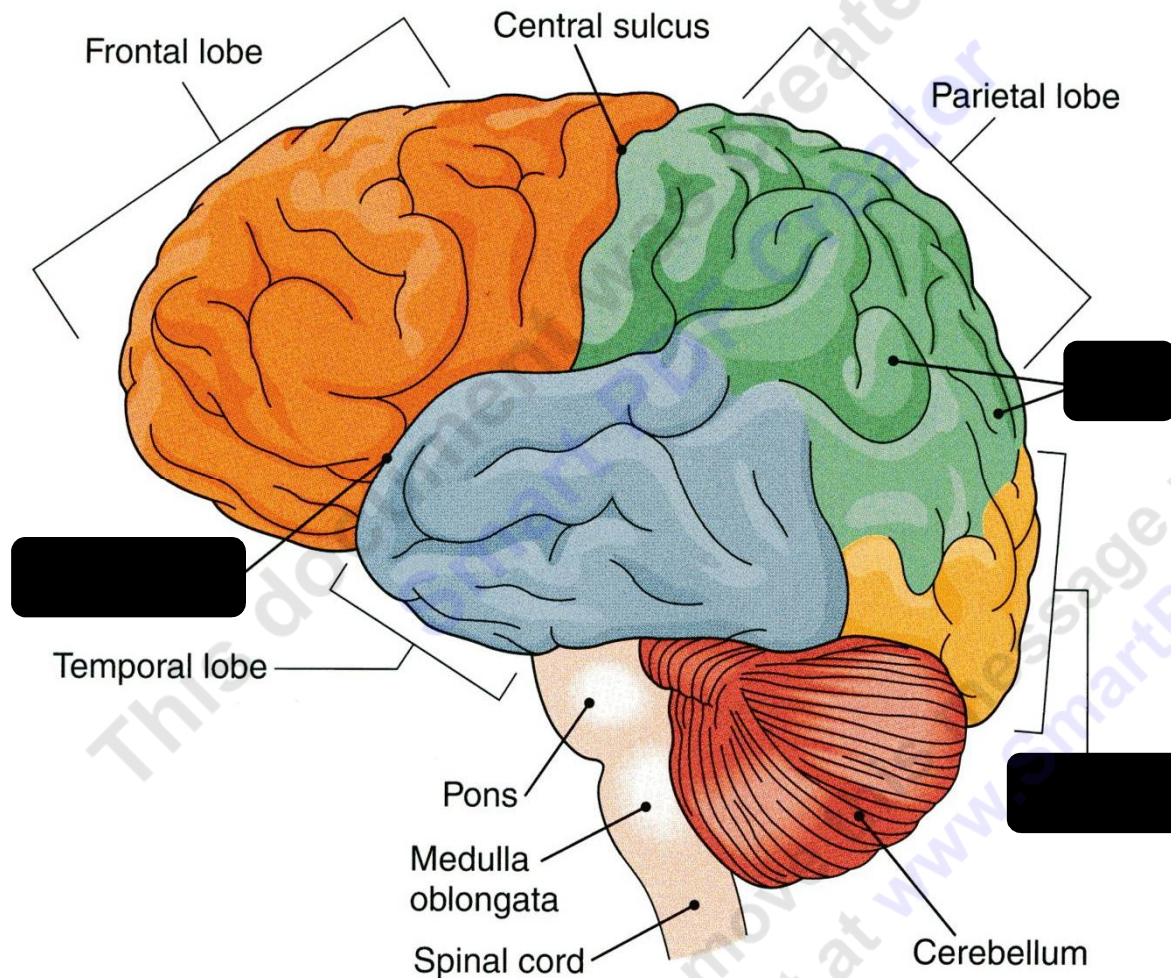


- These functions include
- (1) regulation of Consciousness, Wakefulness & Sleep,
- (2) Respiratory, Cardiovascular and Gastrintestinal control,
- (3) Balance ( Vestibular nuclei ).
- (4) Moreover, it contain several Cranial Nerve nuclei.



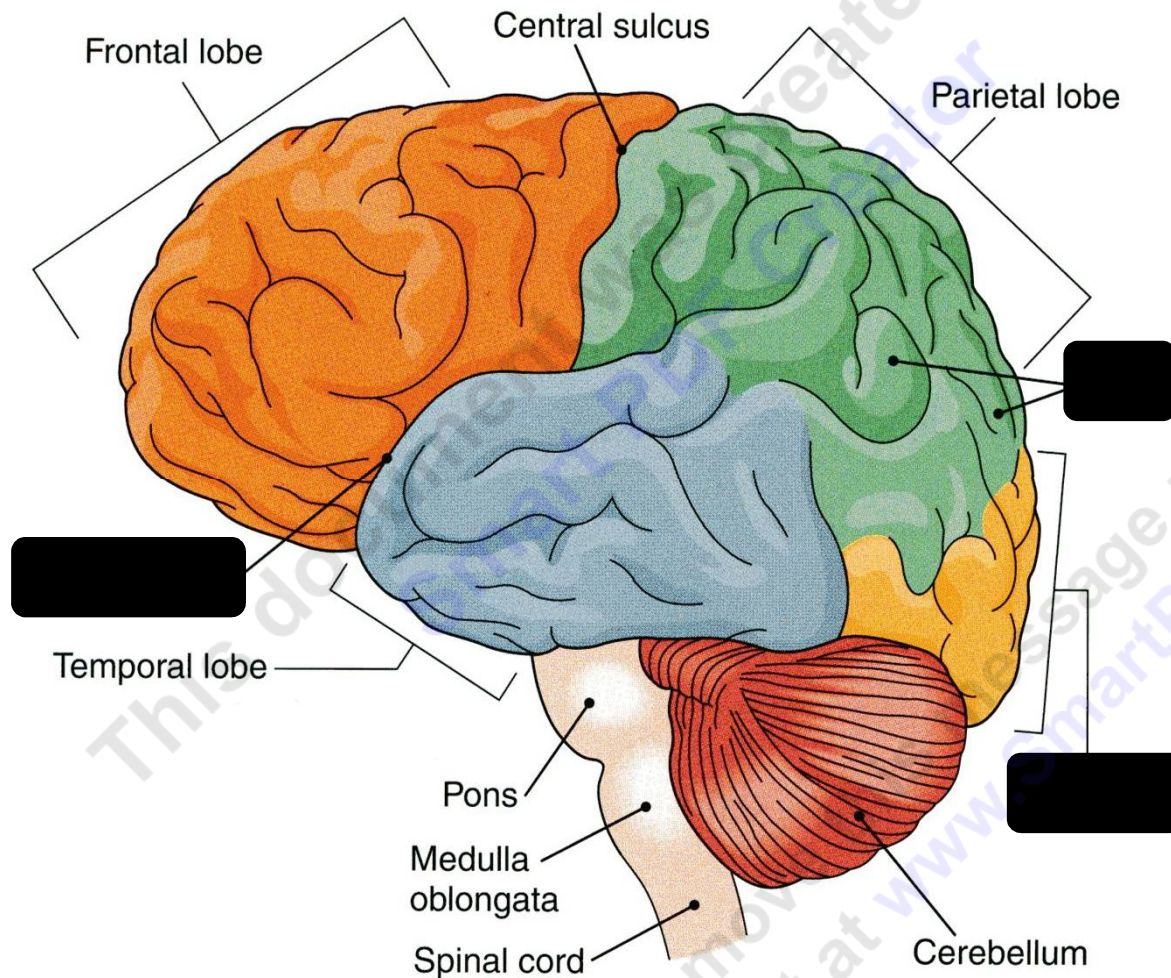
# Cerebrum

## The Cerebrum : Composed of 2 Cerebral Hemispheres , each of which controls functions on the opposite half of the body



- Each hemisphere is divided by big Sulci ( fissures ) into 4 lobes :
- Parietal lobe
- Occipital lobe
- Temporal lobe
- Frontal lobe

# Sulci that divide the cerebrum into lobes



- Central Sulcus ( Rolandic Fissure ) : separates Parietal & Frontal lobes
- Lateral Sulcus ( Sylvian Fissure ) separates Parietal & Temporal Lobes
- Parieto-Occipital Sulcus : Separates Parietal and Occipital Lobes .
- Lobes are further divided by smaller Grooves into ridges called Gyri

- ✓ Most people ( about 90 %) have the left cerebral hemisphere dominant , and are therefore right-handed .
- ✓ The remaining ( around 10 % ) of the population usually have their right hemisphere dominant , and are therefore left-handed .
- ✓ The frontal lobe of the dominant hemisphere contains Broca's area (the area for production of speech ) .
- ✓ Therefore, if a right-handed person gets a stroke involving his left cerebral hemisphere , he is likely to have right-sided hemiplegia ( paralysis ) and aphasia ( loss of the power of speech).



# Occipital Lobe

- Contains primary visual Cortex +
- Visual Association Cortex
- Disease : blindness

# Parietal Lobe

Contains →

- ✓ (1) Primary Somatosensory in the post-central gyrus  
→ to receive general sensations from opposite ( contralateral ) half of the body
- ✓ (2) Sensory Association Cortex  
( for integration & association of sensory information )
- ✓ Parietal lobe is essential for our feeling of touch, warmth/heat , cold, pain , body position and appreciation of shapes of palpated objects .
- ✓ When damaged , the person loses the ability to recognize shapes of complex objects by palpation (palpation = examination of objects by touch ) .
- ✓ & develops Sensory Inattention on opposite side

# Temporal Lobe

- (1) contain centers for hearing and taste ,
- (2) contribute to smell perception .
- (3) essential for memory function .
- (4) lesion → may lead to memory impairment & can be associated with temporal lobe epilepsy

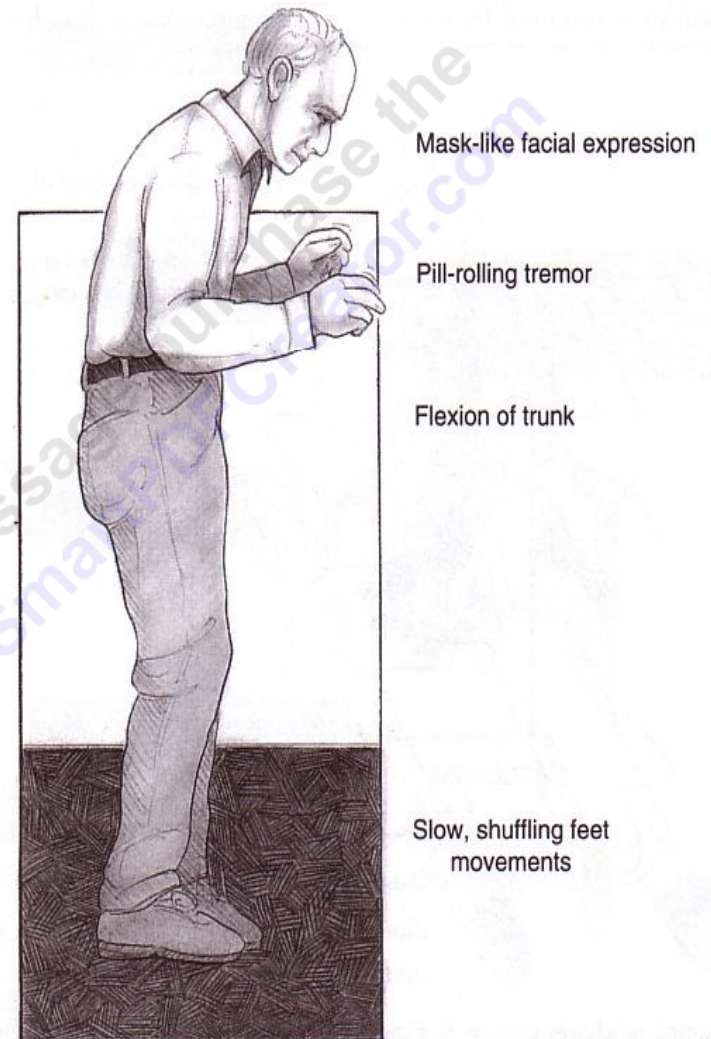


# Frontal Lobe

- Responsible for initiation and execution of voluntary movement .
- Also contains Broca's area of speech in the dominant hemisphere ( i.e., in the left hemisphere in most people ) .
- Lesion can cause →
  - (1) paralysis on opposite side of the body ,
  - (2) aphasia ( loss of ability to speak ) if lesion involves Broca's area in the dominant hemisphere ) .

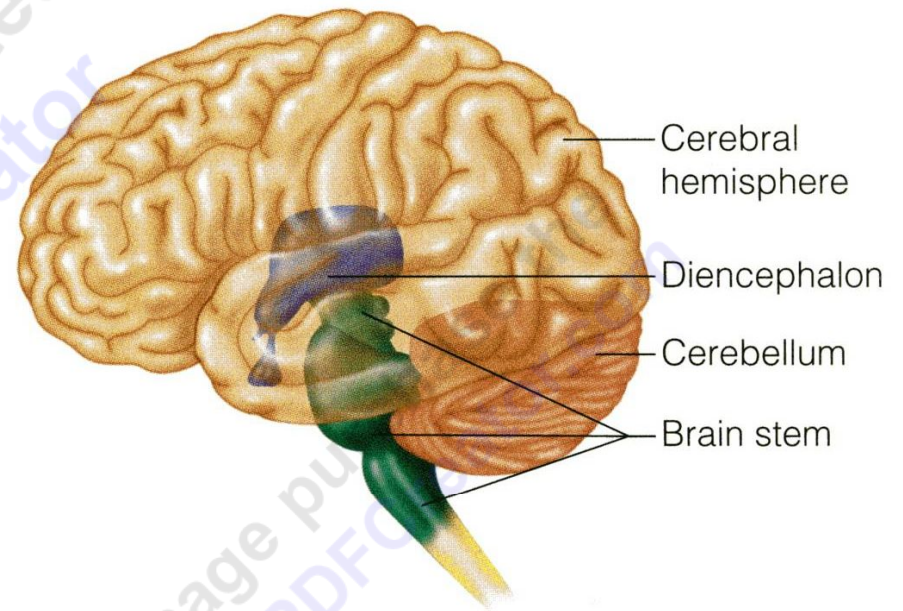
# Basal Ganglia ( BG)

- Collection of grey matter situated inside the cerebral hemispheres .
- Lesions may cause a variety of conditions that affect movement e.g. →
- Parkinson's disease → which is associated with rigidity of muscles & difficulty of movement .



# Cerebellum

- Important for coordination of body movements and balance .
- Diseases can result in incoordination of movement and ataxia .

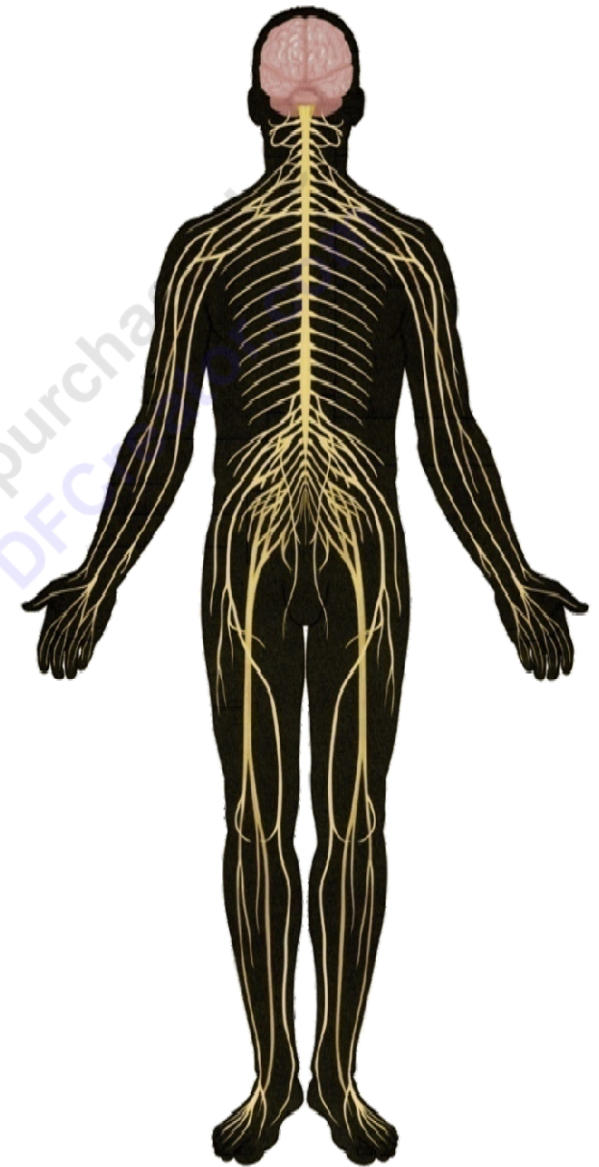
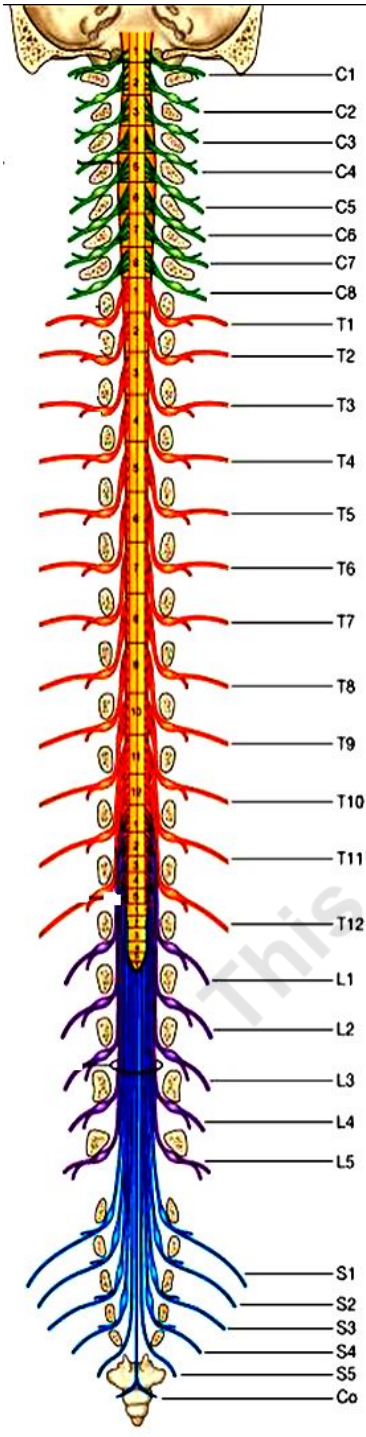


# Spinal Cord and Spinal Nerves

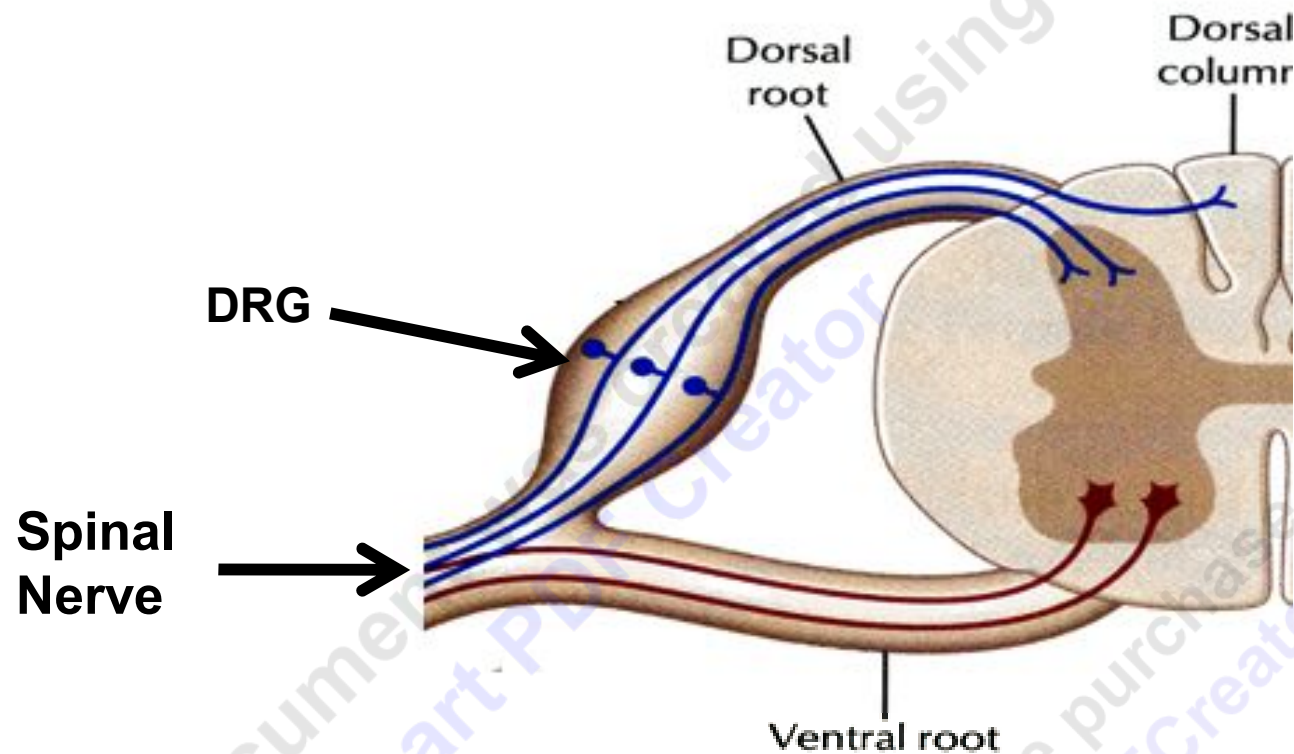
The spinal cord is generally cylindrical in shape

From it emerge 31 pairs of spinal nerves:

- 8 cervical,
- 12 thoracic,
- 5 lumbar,
- 5 sacral and
- 1 coccygeal.

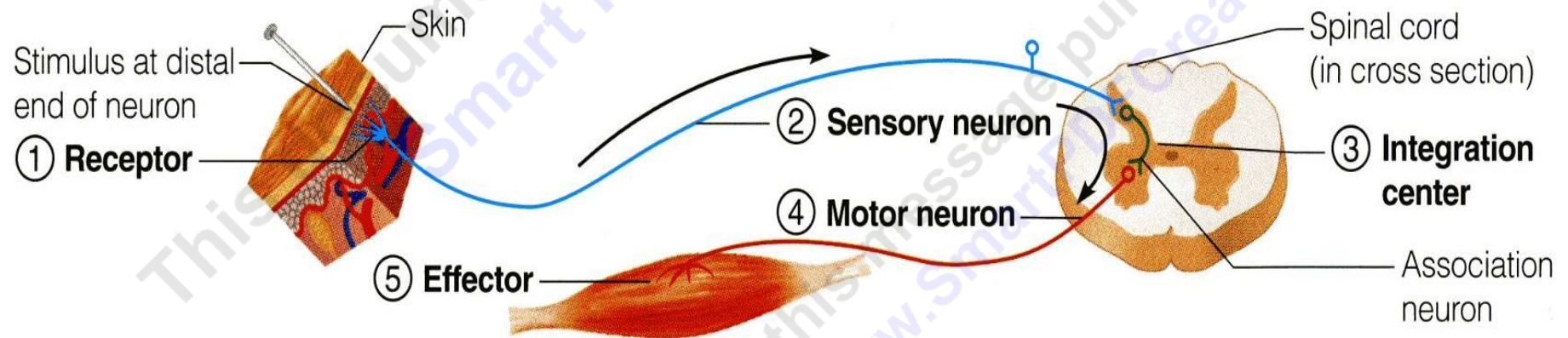






- The spinal arise from the spinal cord with dorsal and ventral roots .
- The dorsal root contains afferent ( sensory ) fibers
- The afferent fiber is usually a pseudobipolar cell whose cell-body ( soma) is located in the dorsal root ganglion ( DRG)
- The ventral root usually contains efferent ( motor ) fibers ( somatic or autonomic) .
- The 2 roots unite at or close to the intervertebral foramen to form the spinal nerve .

- ✓ The spinal cord , beside carrying sensory ( ascending ) and motor ( descending ) tracts ,
- ✓ Also contains the centers of Spinal Reflexes



- Thanks , that is all for now !