Neurology Lectures

Introduction

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Introduction

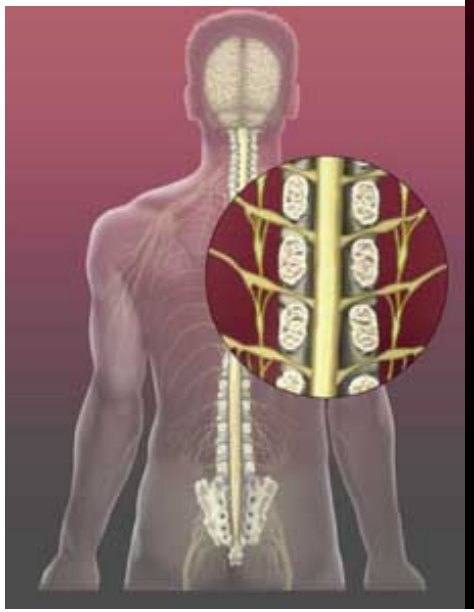
Neurological disorders are common, and all clinicians must be capable of recognizing and managing them. Many steps are required in solving a neurologic problem.

- Generally, a problem can solved by using one of two methods:

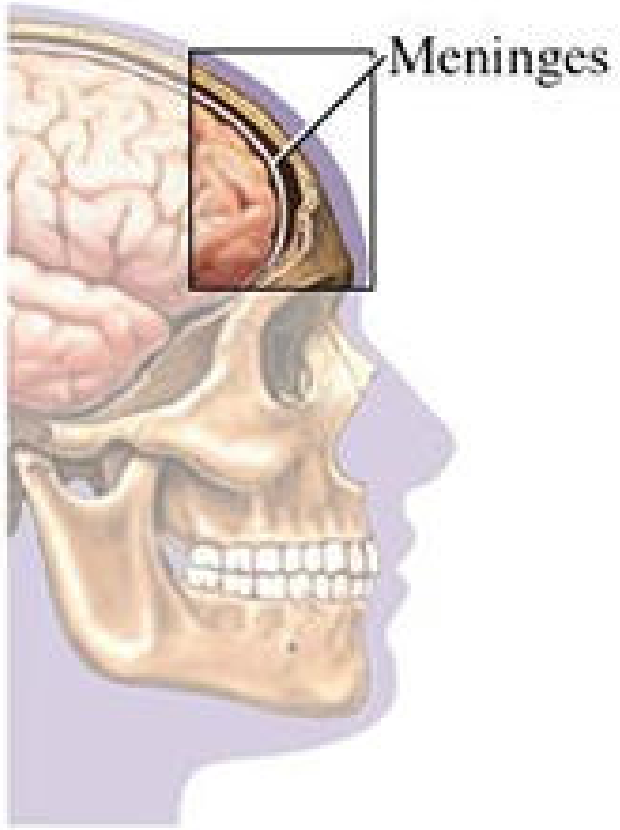
1. Pattern recognition: If the problem is similar to or identical to one encountered previously and the solution is recalled, one move quickly to an answer.
2. Inductive reasoning: Logical analysis is applied by tracking the problem to its source through a series of steps based on knowledge of underlying structure and function.

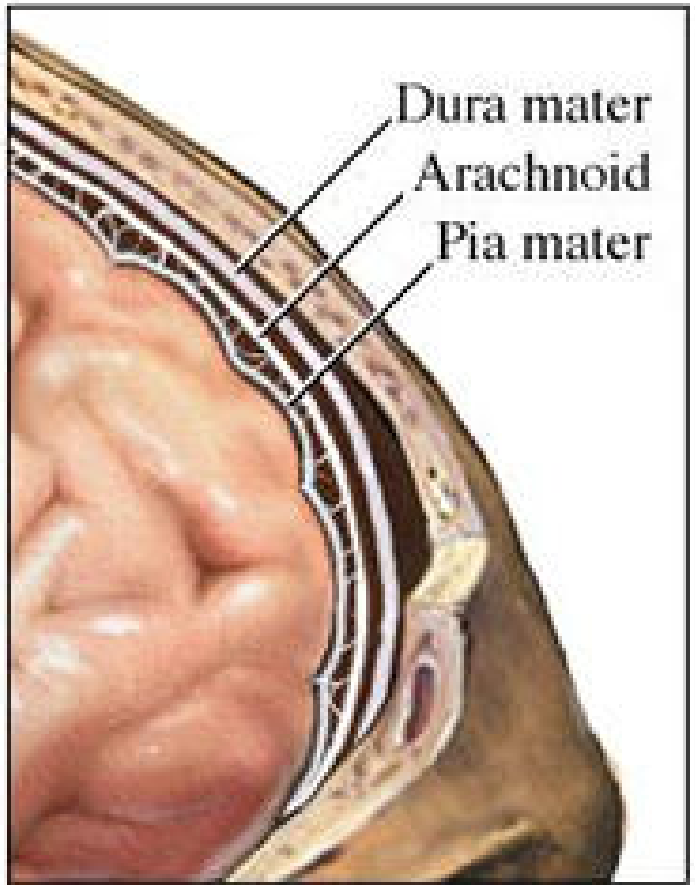
Neuro-Anatomy

1. CNS: Refers to the brain and spinal cord.
2. PNS: Refers to The cranial and spinal nerves once they have exited the skull and vertebral column, respectively.

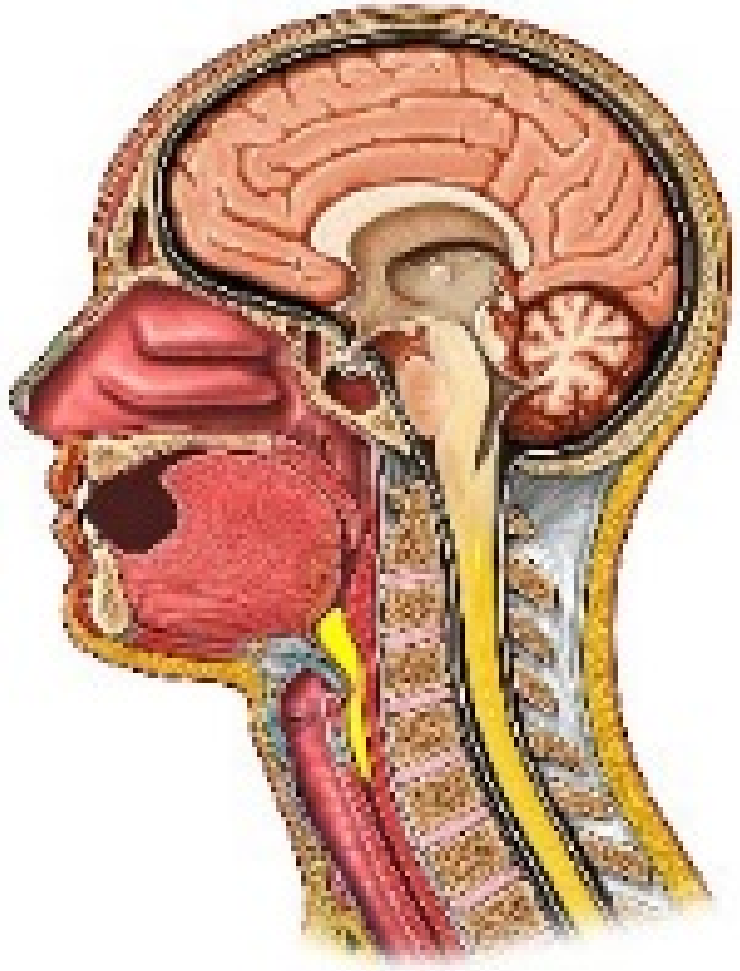


- There are three fibrous connective tissue linings called meninges which serve as a protective coverings to the CNS.





- The floor of human skull is divided into three distinct compartments (fossae) on each side: anterior, middle and posterior. A rigid membrane, the tentorium cerebelli, separates the anterior and middle fossae from the posterior fossa.



Levels of the nervous system

- **Supratentorial level**

- The portion of the nervous system located above the tentorium cerebelli and consists of:

1. Cerebral hemispheres.
2. Basal ganglia.
3. Thalamus.
4. Hypothalamus.
5. Cranial nerves I and II.

- **Posterior fossa level**

- The portion of the nervous system below the tentorium cerebelli and consists of:

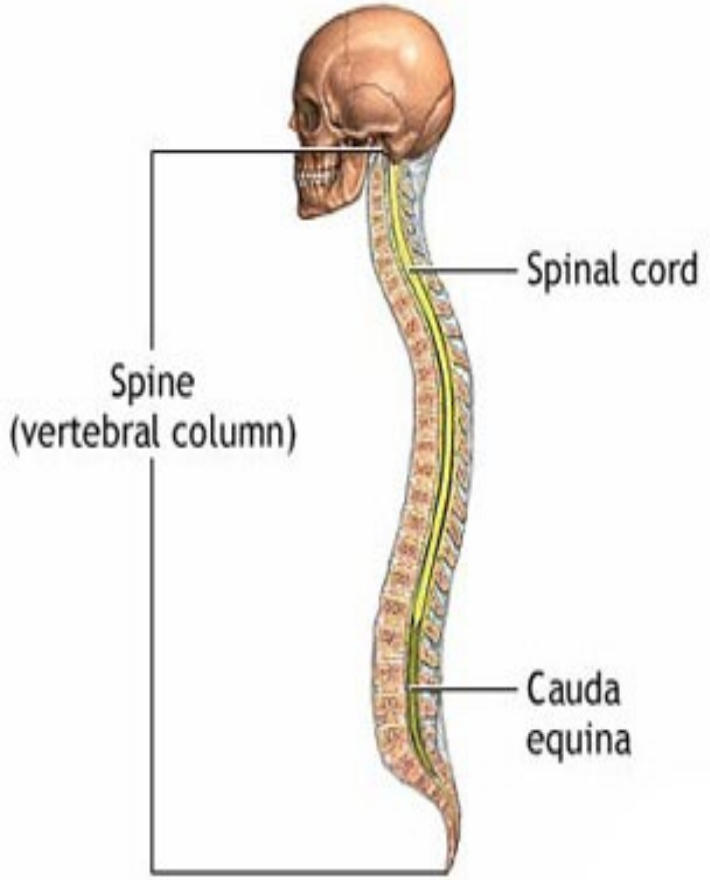
1. Brain stems
2. Cerebellum
3. Cranial nerves III through XII.

• Spinal level

• The portion of the CNS located below the foramen magnum of the skull but contained in the vertebral column constitutes the spinal level.

• Peripheral level

• Includes all neuromuscular structures located outside the skull and vertebral column, including the cranial and spinal nerves, neuromuscular junctions and muscles.



Functional Neuro-Anatomy

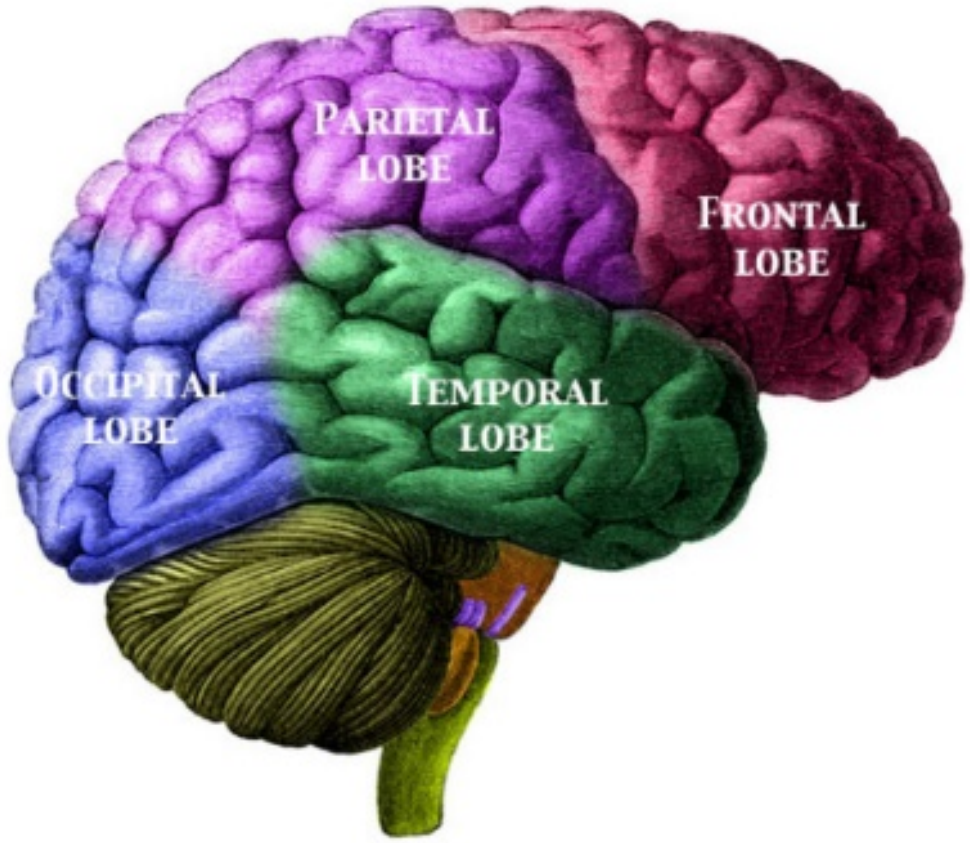
The cerebral hemispheres

The cerebral hemispheres coordinate the highest level of nervous function.

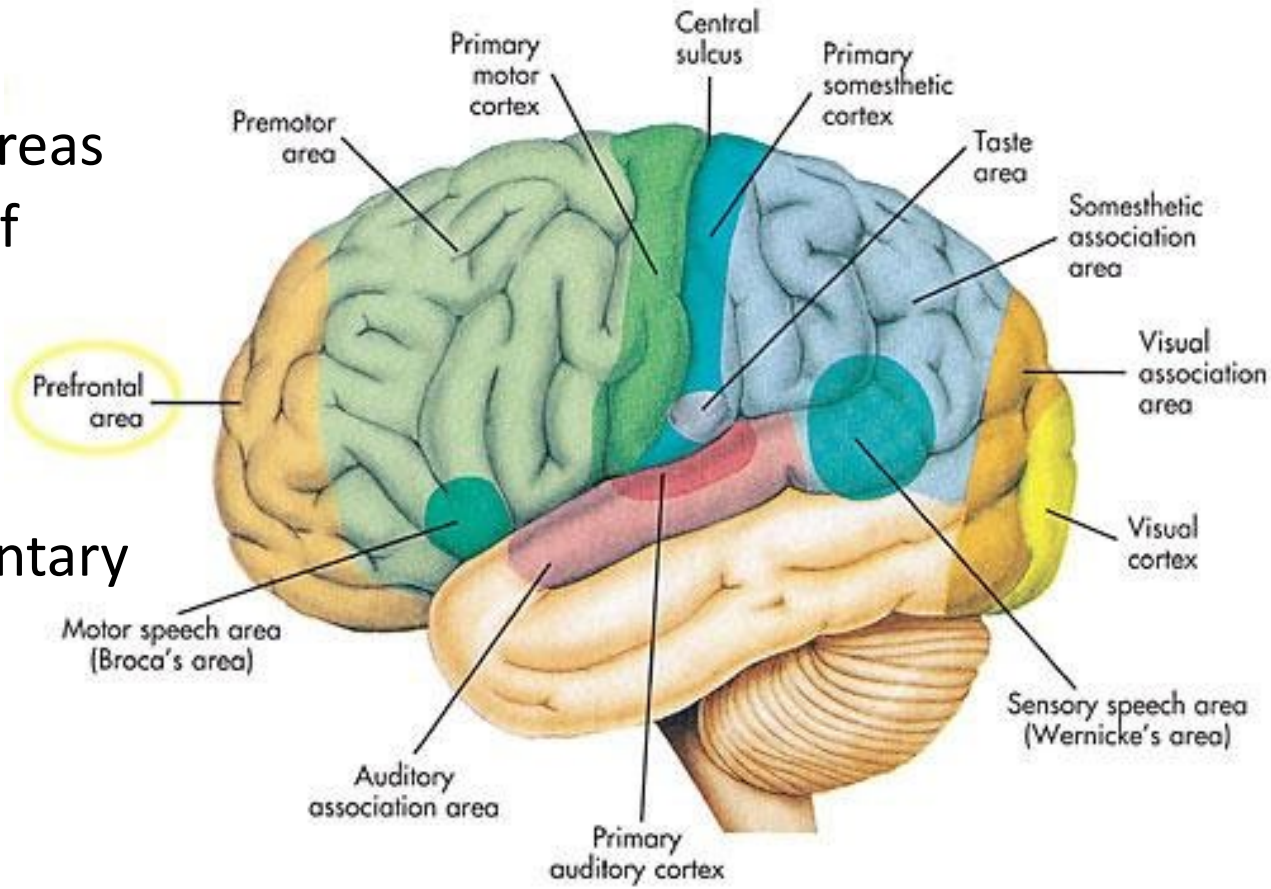
It consist of four anatomical lobes:

1. Frontal lobe: main components:

- Prefrontal cortex (responsible for motivation, judgment, planning and personality)

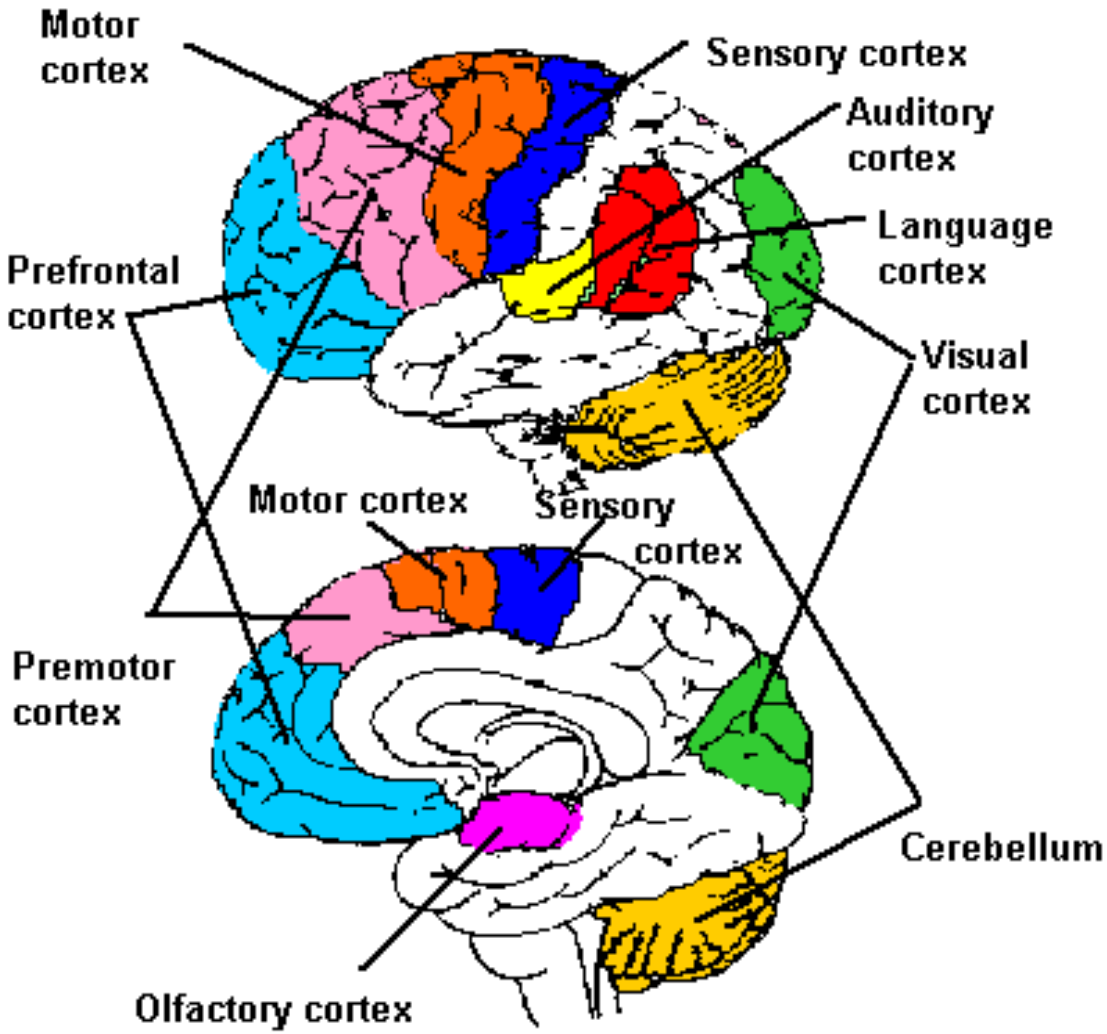


- Supplementary motor and premotor areas (responsible for motor programming of complex movement)
- Primary motor cortex (responsible for contralateral voluntary movement)
- Frontal eye fields (responsible for voluntary conjugate movement of the eyes)
- Broca area (responsible for language)



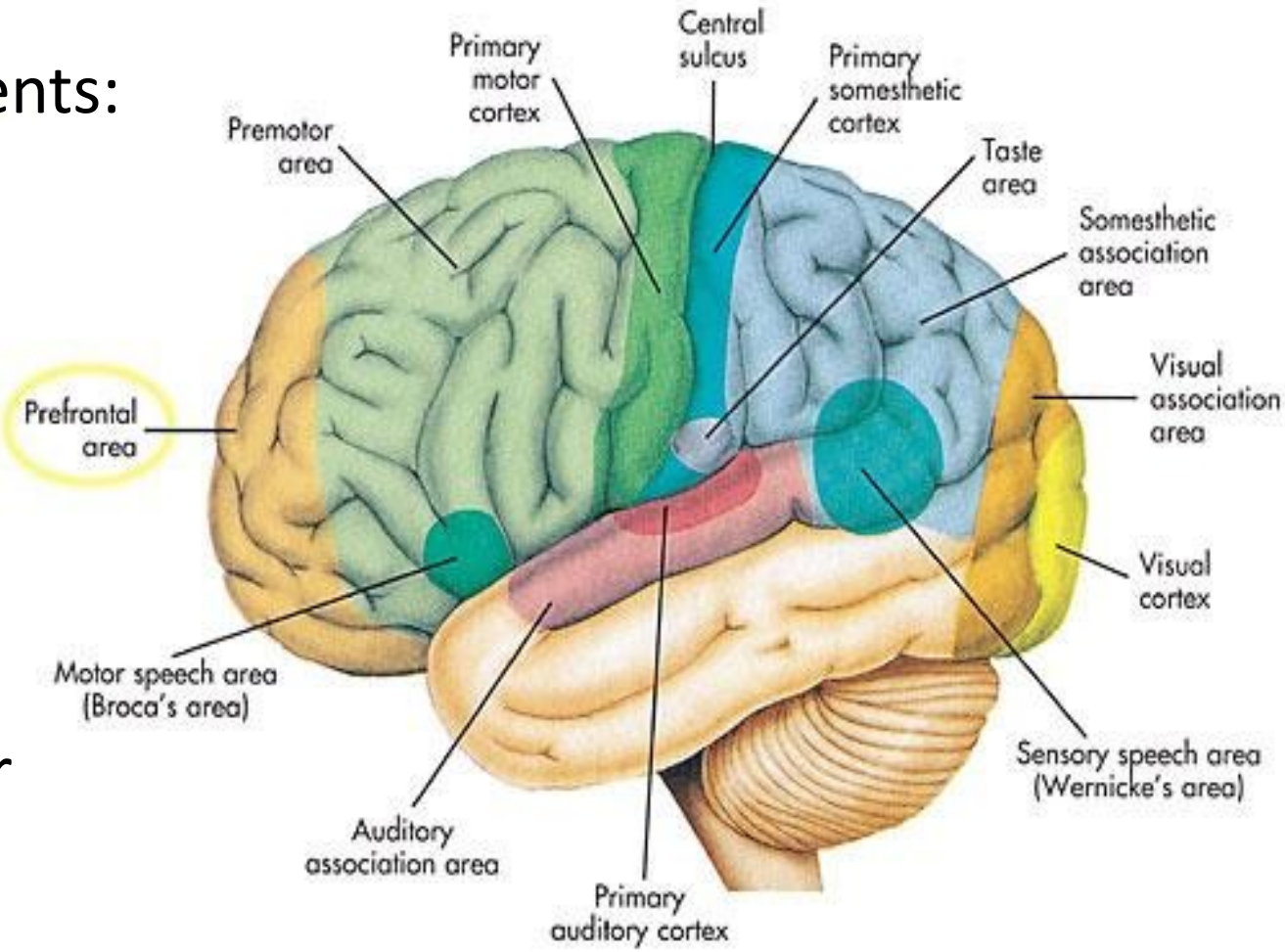
2. Parietal lobe: main components:

- Primary somatosensory cortex (responsible for contralateral sensation of face and limbs)
- Somatosensory associated cortex (responsible for complex somatosensory information integration)



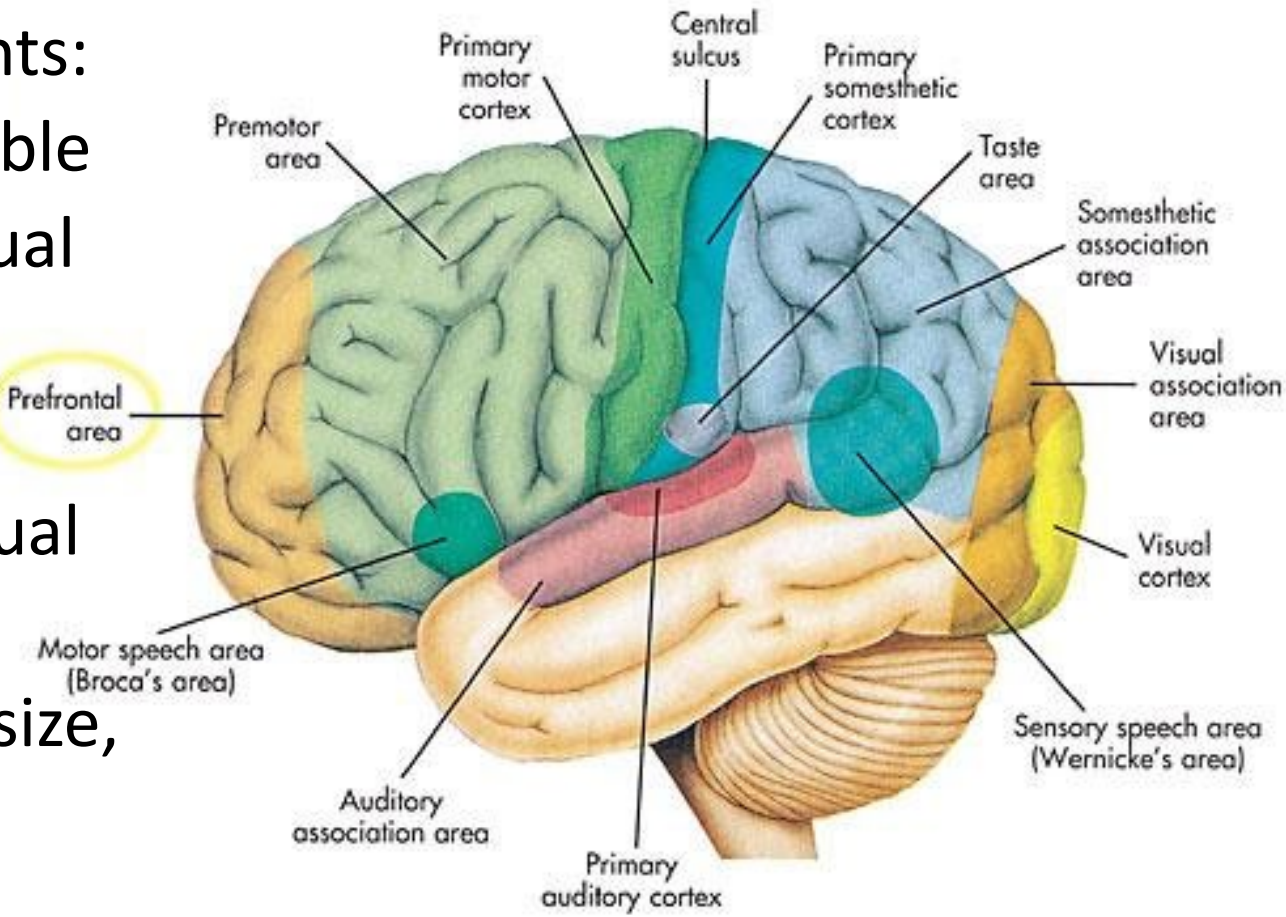
3. Temporal lobe: main components:

- Primary auditory cortex (responsible for hearing)
- Auditory association cortex (responsible for auditory processing)
- Hippocampus (responsible for memory)
- Wernicke area (responsible for language)



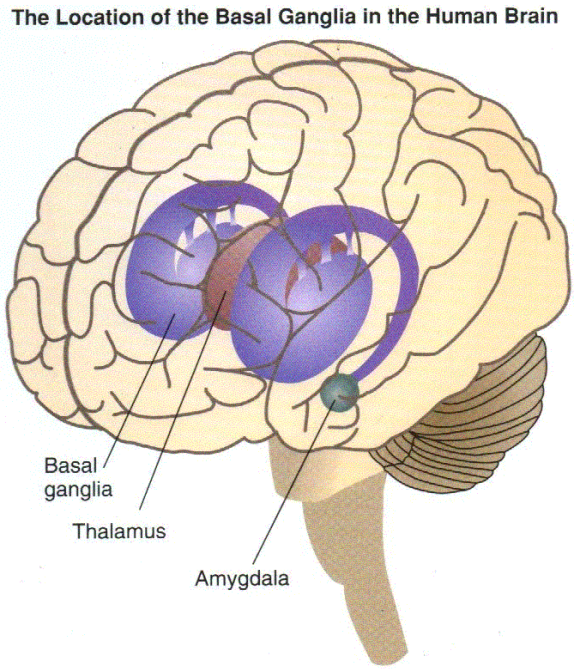
4. Occipital lobe: main components:

- Primary visual cortex (responsible for visualizing contralateral visual field)
- Visual association cortex (responsible for integrating visual information, including interpretation of shape, color, size, motion, and orientation)



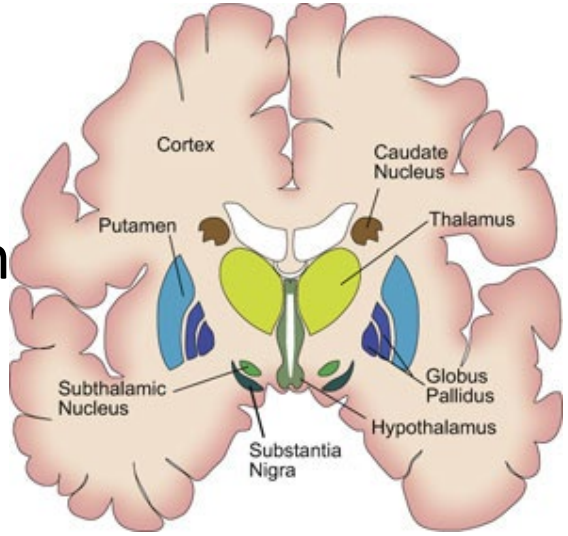
Basal ganglia

- It is a collections of cells in the depths of the hemispheres deal with motor programming and initiation of motor programs.



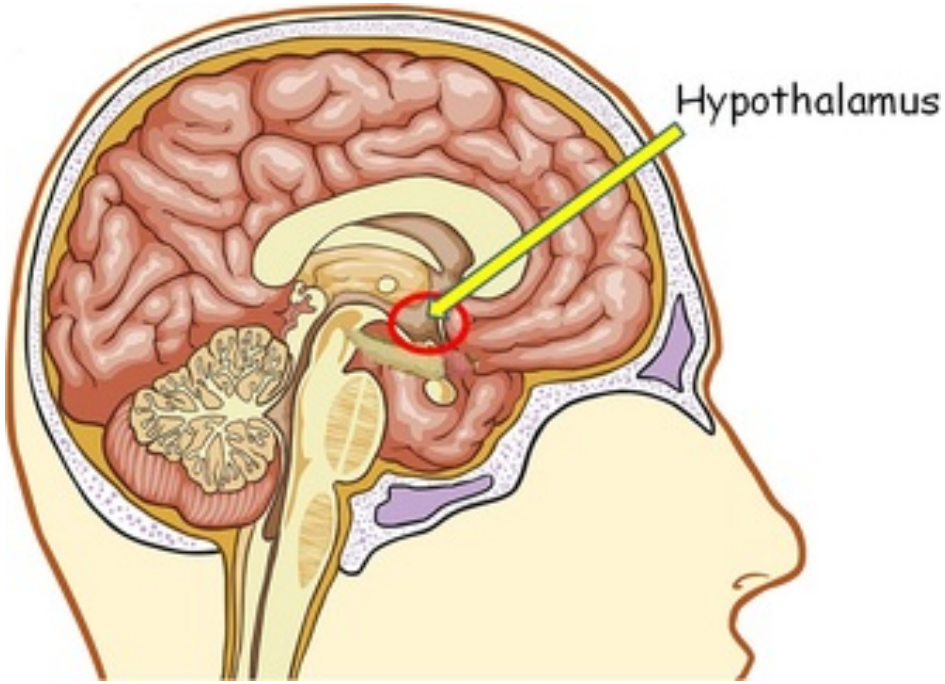
Thalamus

- It consists of two masses on either side of the third ventricle, it serves as a relay center in the CNS with appropriate attention to sensory perception.



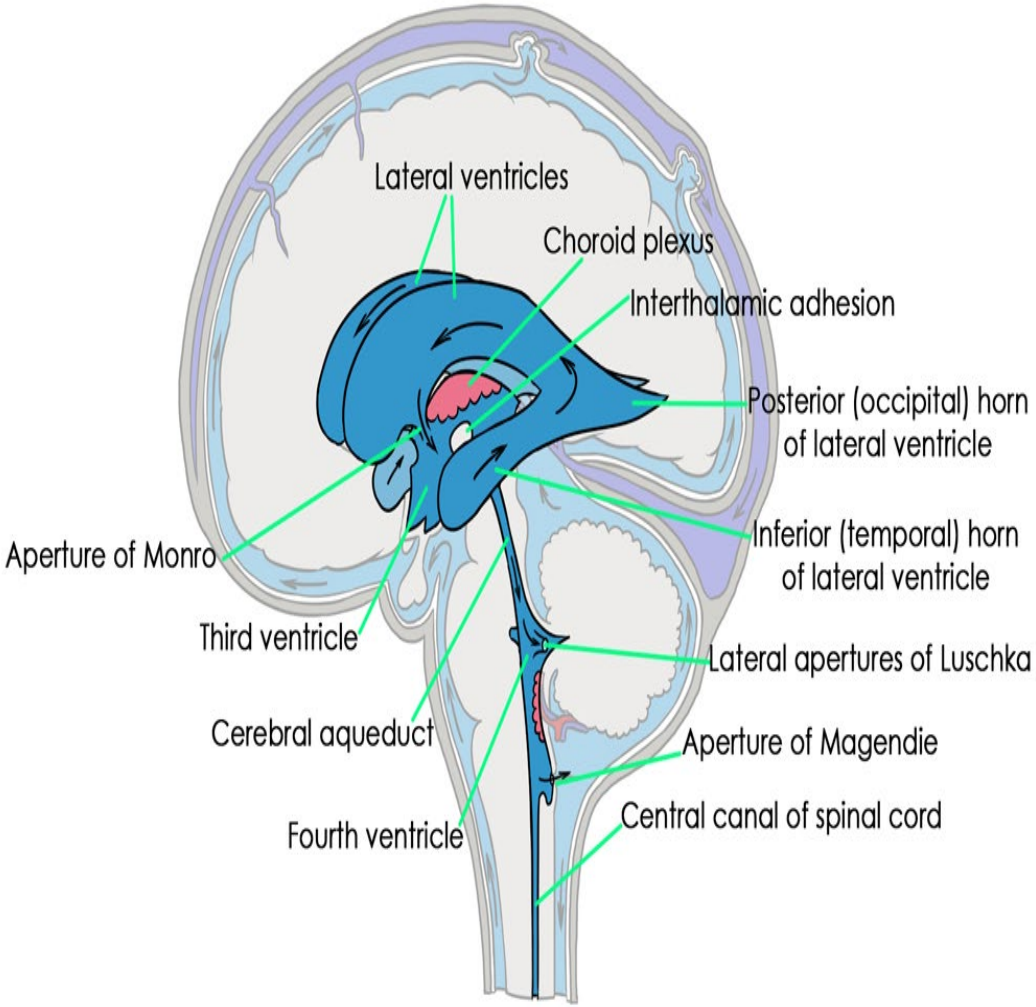
Hypothalamus

• The hypothalamus is located below the thalamus, just above the brainstem. Its functions include temperature regulation, sexual behavior, and reproduction, metabolic homeostasis, emotional response, sleep, and diurnal variations.



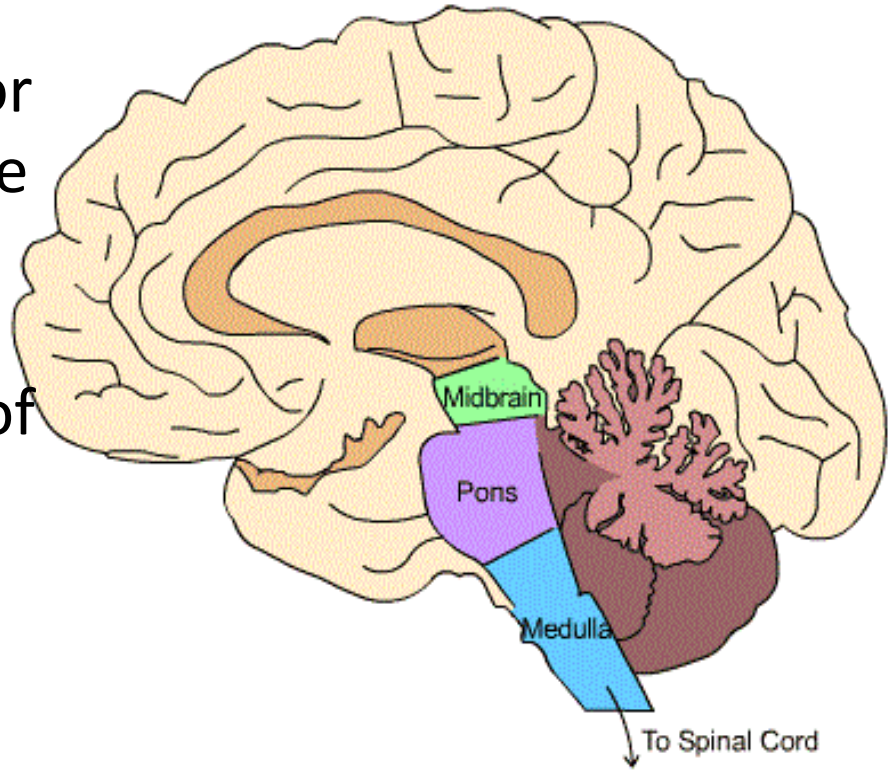
Ventricular system

- The cerebral ventricles contain the choroid plexus and this produces the cerebrospinal fluid (CSF), which cushions the brain within the cranium. The CSF flows through the third and fourth ventricles and exits the brain through foramina in the brain stem to circulate down and around the spinal cord and over the brain surface where it is reabsorbed into the cerebral venous system.



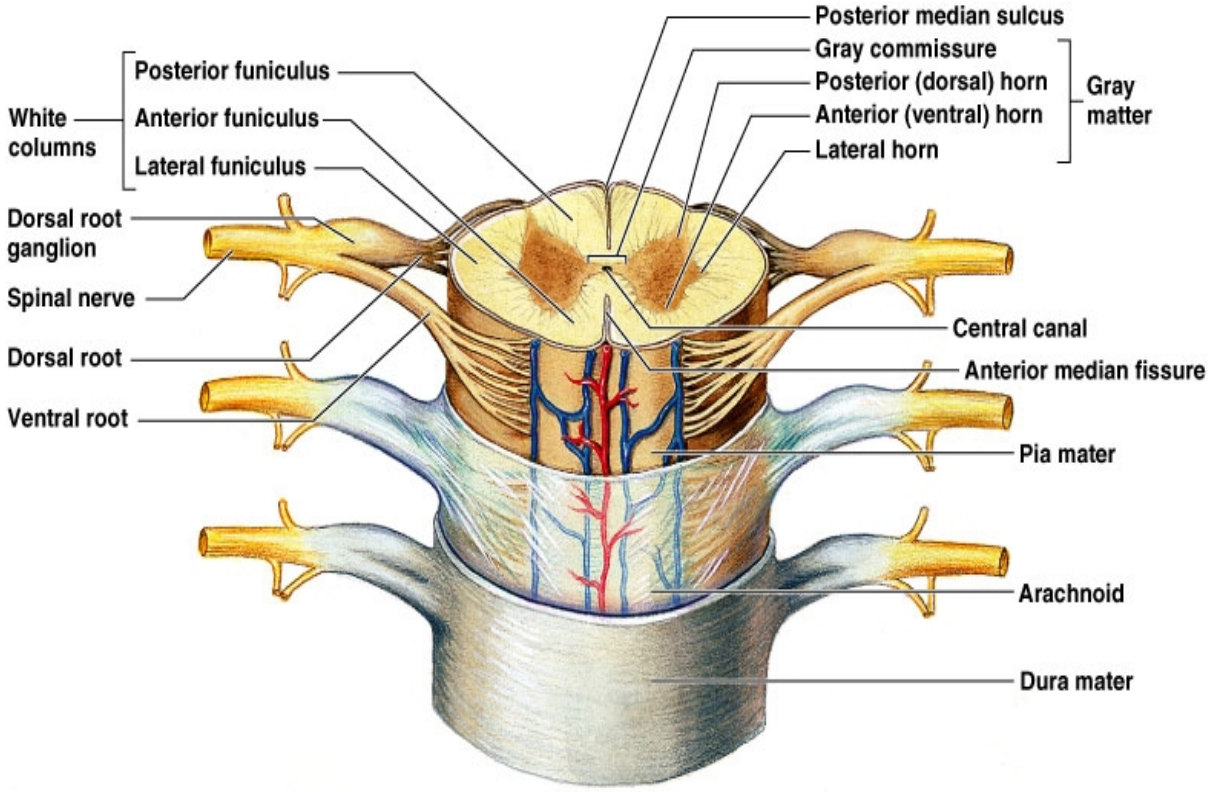
Brain stem

- In addition to containing all the sensory and motor pathways entering and leaving the hemispheres, the brain stem houses the nuclei of the cranial nerves and nuclei projecting to the cerebrum and cerebellum, as well as other important collections of neurons in the reticular formation. The reticular formation is predominantly involved in the control of conjugate eye movements, the maintenance of balance, cardiorespiratory control and the maintenance of arousal.



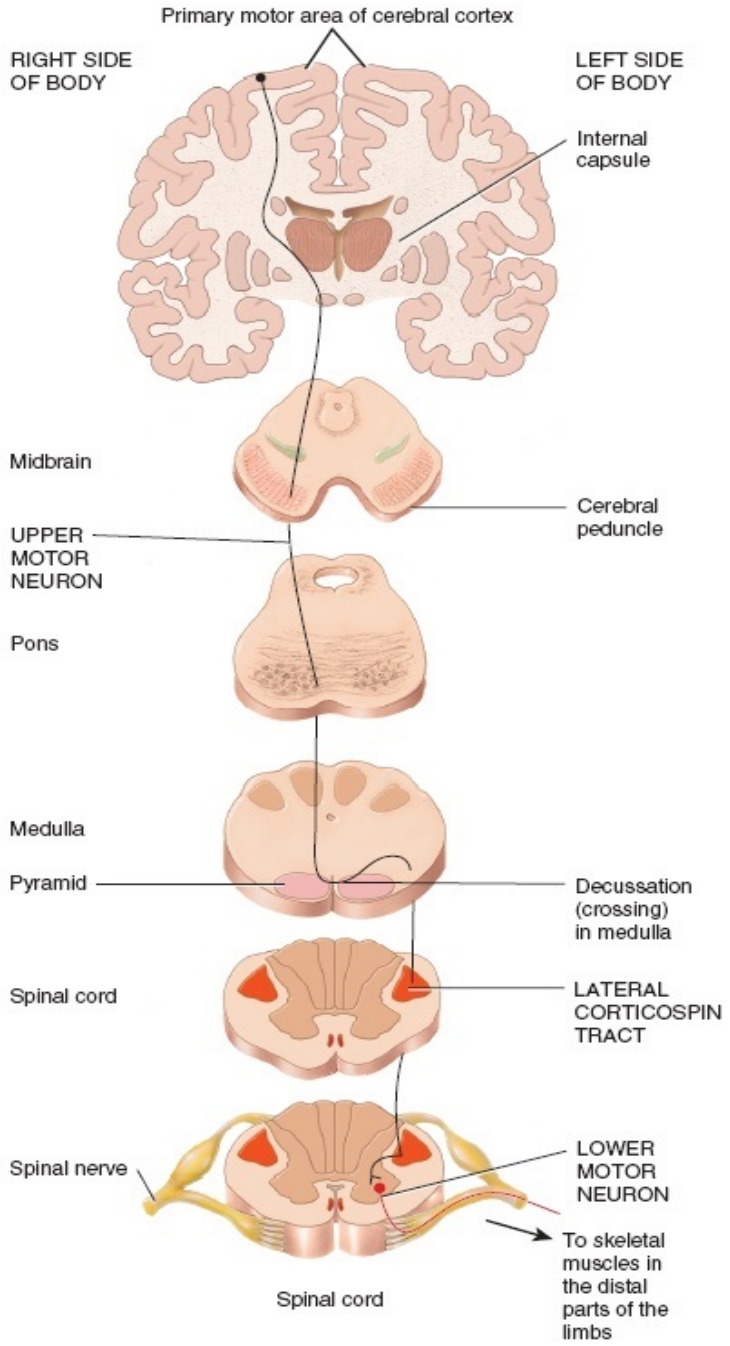
The spinal cord

- The spinal cord contains not only the afferent and efferent fibers arranged in functionally discrete bundles but also, in the grey matter, collections of cells which are responsible for lower-order motor reflexes and the primary processing of sensory information, including pain.



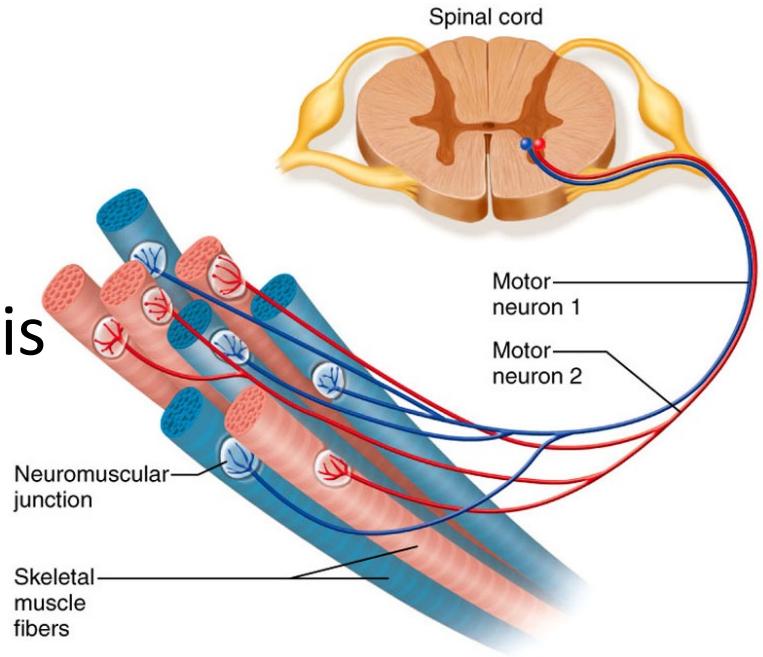
The motor system

- A program of movements formulated by the pre-motor cortex is converted into a series of signals in the motor cortex which are transmitted to the spinal cord in the pyramidal tract. This passes through the internal capsule and the ventral brain stem before decussating in the medulla to enter the lateral columns of the spinal cord. The pyramidal tract 'upper motor neurons' end by synapsing with the anterior horn cells of the spinal cord grey matter, which form the 'lower motor neurons'.



Lower motor neurons

- Lower motor neurons in the anterior horn of the spinal cord innervate a group of muscle fibers termed a 'motor unit'. Loss of function of lower motor neurons causes loss of contraction within this unit, resulting in weakness and reduced muscle tone. Subsequently, denervated muscle fibers atrophy, causing muscle wasting, and depolarize spontaneously, causing 'fibrillations' and fasciculations.

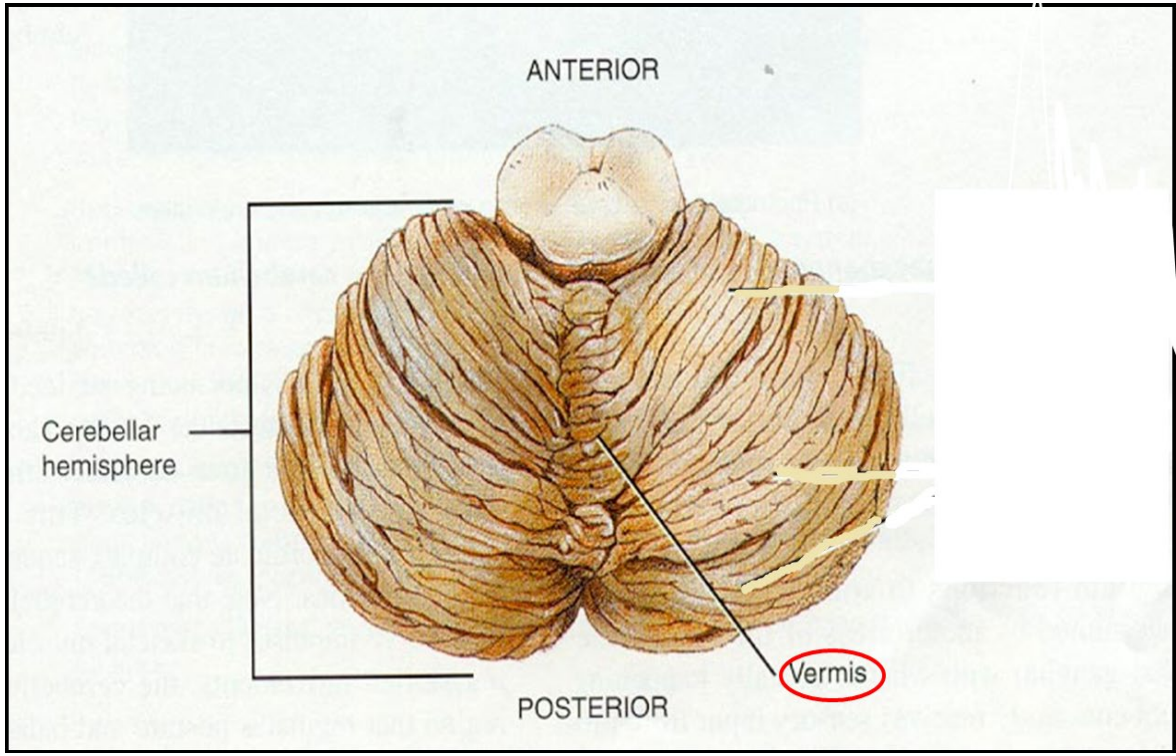


Upper motor neurons

- Upper motor neurons have an inhibitory influence on the function of anterior horn motor neurons. When upper motor neuron lesions occur, motor units have an exaggerated response to stretch. In the limbs, this results in reflex patterns of movement, such as flexion withdrawal to noxious stimuli and spasms of extension. An upper motor neuron lesion therefore manifests clinically with an increased muscle tone greater in the extensors of the lower limbs and the flexors of the upper limbs (spasticity), brisk tendon reflexes, and extensor plantar responses.

Cerebellum

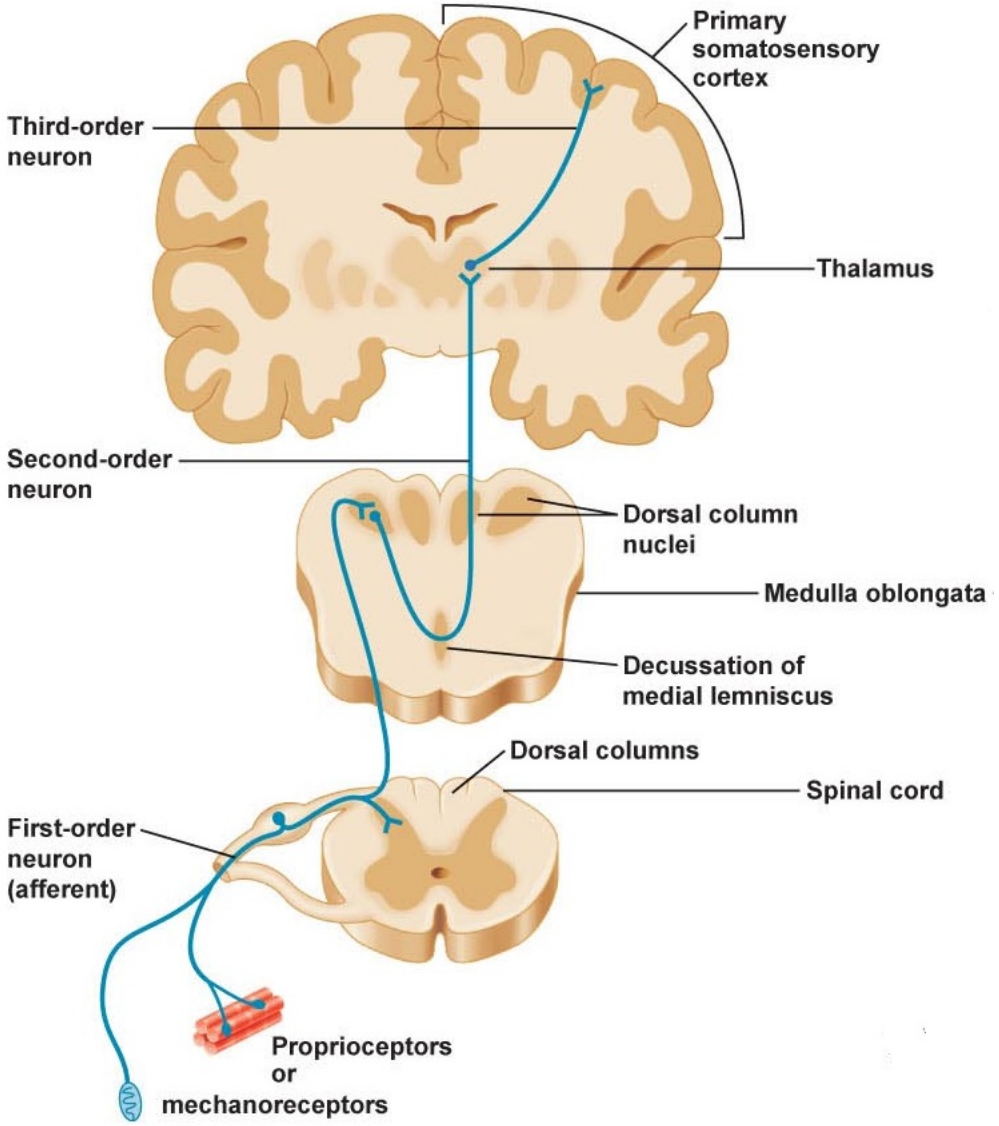
- It consists of two hemispheres, a midline vermis, and a small flocculonodular lobe. The cerebellum lies dorsal to the fourth ventricle, the pons, and medulla. It is responsible for fine-tuning and coordinating goal-directed movements initiated by the motor cortex.



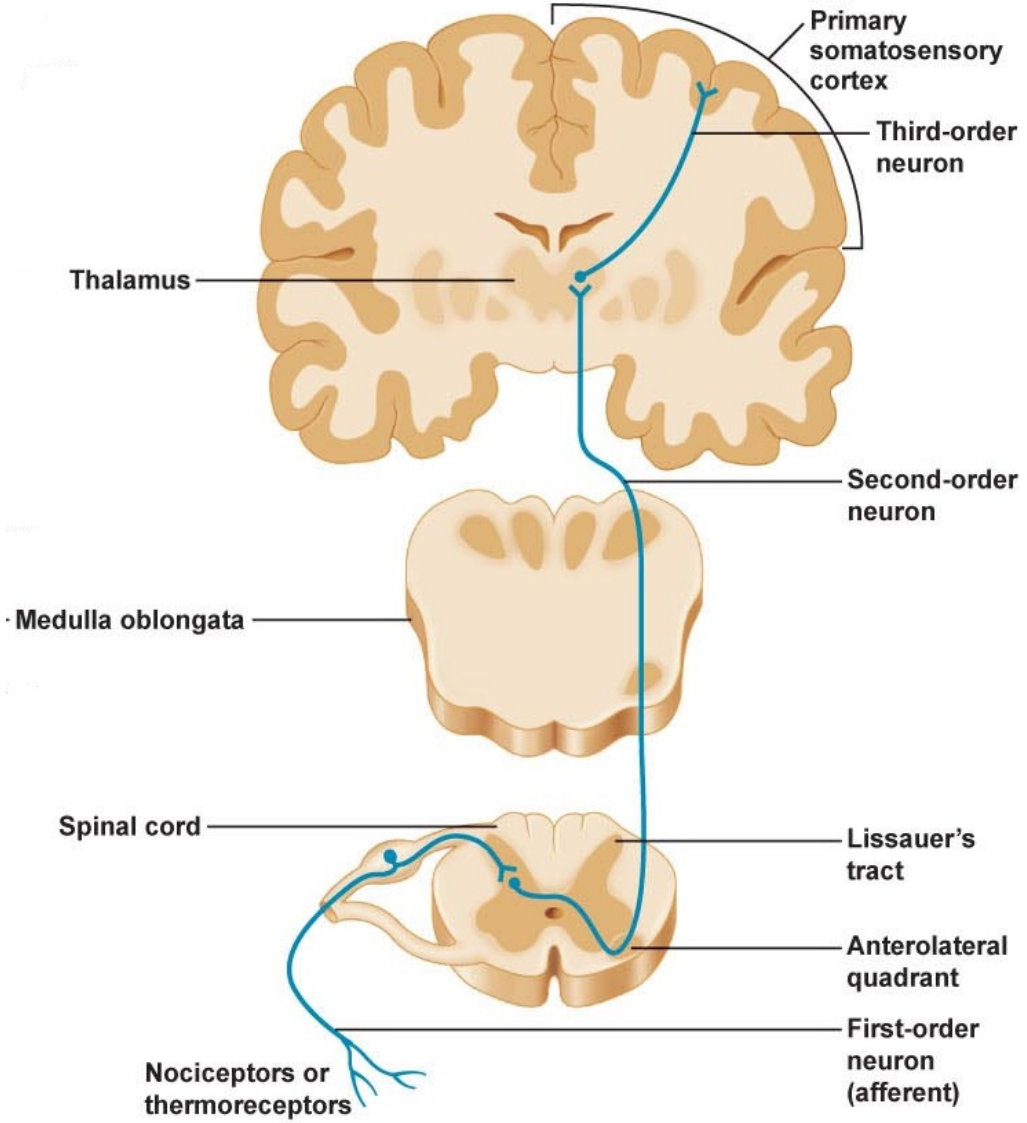
The somatosensory system

- Somatic sensory information from the limbs ascends the nervous system in two anatomically discrete systems.

- Fibers from proprioceptive organs and those mediating well-localized touch (including vibration) enter the spinal cord at the posterior horn and pass without synapsing into the ipsilateral posterior columns. The second-order neurons of the dorsal column sensory system cross the midline in the upper medulla to ascend through the brain stem. Here they lie just medial to the (already crossed) spinothalamic pathway.

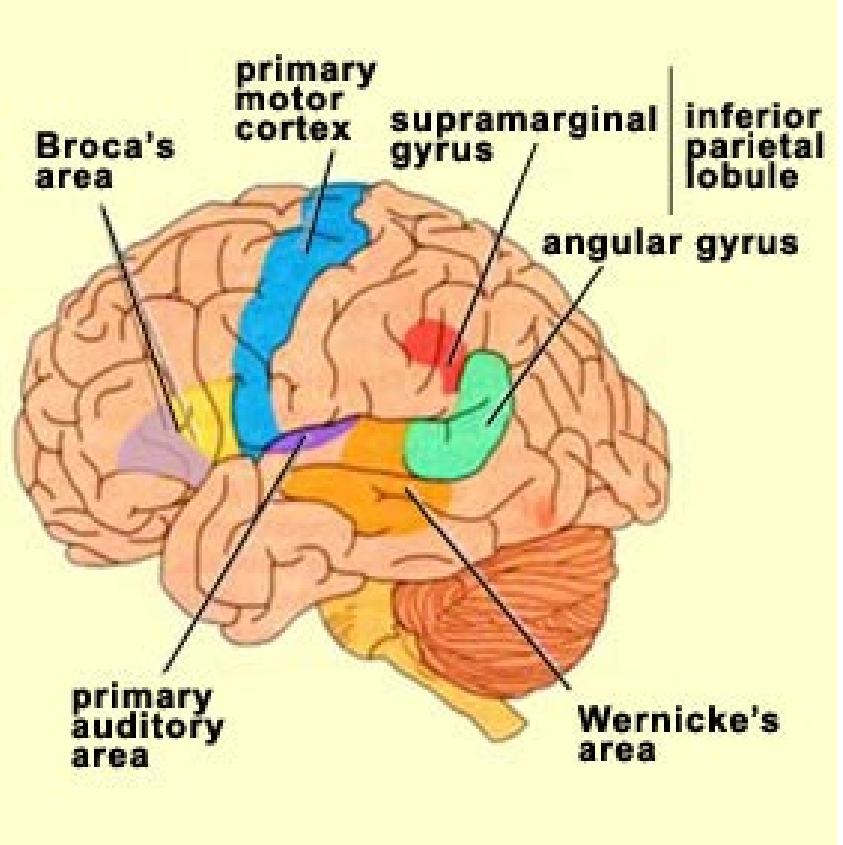


- Neural fibers conveying pain and temperature sensory information (nociceptive neurons) synapse with second-order neurons which cross the midline in the spinal cord before ascending in the contralateral anterolateral spinothalamic tract to the brain stem.

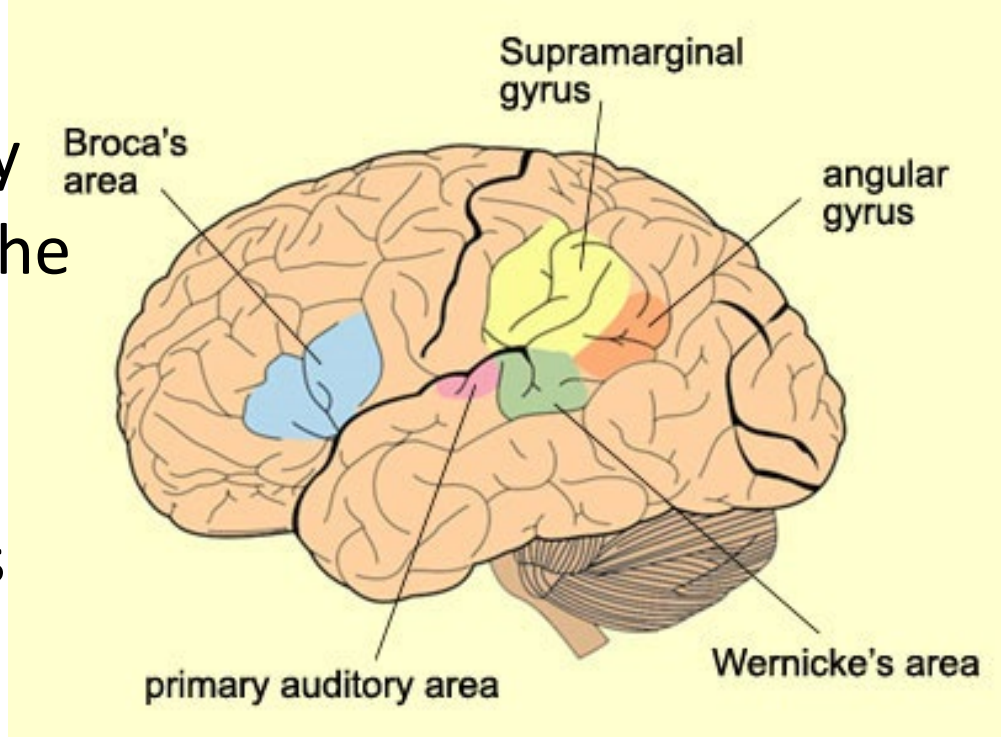


Speech

- Speech is the process whereby vocal sounds are used to convey meaning between individuals.
- The perception of these sounds as meaningful language, as well as the formulation of the language required for the expression of ideas and concepts, occurs predominantly in the lowe parts of the anterior parietal lobe (the angular and supramarginal gyri).



- The language information generated in the temporal and parietal lobes passes anteriorly via the arcuate fasciculus to Broca's area in the posterior end of the inferior frontal gyrus on the dominant side.
- The motor commands generated in Broca's area then pass to the cranial nerve nuclei in the pons and medulla, as well as to the anterior horn cells in the spinal cord.



- Nerve impulses then travel to the lips, tongue, palate, pharynx, larynx and respiratory muscles via the facial nerve and cranial nerves 9, 10 and 12, and result in the series of ordered sounds known as speech. The cerebellum also plays an important role in coordinating speech, and lesions of the cerebellum lead to a speech disorder termed dysarthria.