Brain Stem
Parts of the Brain Stem

- Pituitary and Pineal Glands
- Pineal gland
- Cerebellum
- Pituitary gland
- Pons
- Medulla oblongata
- Spinal cord
Functions of the Brain Stem

• In vertebrate anatomy, brain stem is the posterior part of brain, adjoining and structurally continuous with spinal cord.

• Though small, brain stem is an extremely important part of brain:

  A- The nerve connections from motor & sensory systems of cortex pass through brain stem to communicate with peripheral nervous system.

  B- It provides the main motor and sensory innervation to the face and neck via the cranial nerves.

  C- It also plays an important role in regulation of cardiac & respiratory function, consciousness, & sleep cycle.

• Brainstem consists of medulla oblongata, pons & midbrain.
Midbrain

- Midbrain or mesencephalon is a portion of CNS associated with vision, hearing, motor control, sleep/wake, arousal, & temperature regulation.
- Between diencephalon and pons
- Anatomically, it comprises tectum, tegmentum, ventricular mesocoelia, & cerebral peduncles & several nuclei & fasciculi
- During embryonic development, midbrain arises from 2\textsuperscript{nd} vesicle, also known as mesencephalon, of neural tube.
• Four rounded masses of gray matter that are hidden by cerebral hemispheres form the superior part of the midbrain.
• These four bodies act as centers for certain reflexes involving eye & ear, for e.g., moving eyes in order to track an image or to read.
• The white matter at the anterior of midbrain conducts impulses between higher centers of cerebrum & the lower centers of pons, medulla, cerebellum, & spinal cord.
• Cranial nerves III & IV originate from midbrain.
• The Pons
• Named the Latin word for "bridge".
• It lies between midbrain & medulla, anterior to cerebellum.
• It is composed largely of myelinated nerve fibers, which connect the 2 halves of cerebellum with brainstem & with cerebrum above & spinal cord below.
• It is an important connecting link between cerebellum & the rest of nervous system, and it contains nerve fibers that carry impulses to and from the centers located above and below it.
• Certain reflex actions, such as those regulating respiration, are integrated in it.
• Within pons is pneumotaxic center (2 respiratory center), a nucleus (a network of neurons) that regulates respiratory rate; change from inspiration to expiration.
  (pneumotaxic center also known as pontine respiratory group (PRG).
• Pons also contains sleep paralysis center & plays a role in generating dreams.
• Cranial nerves V through VIII originate from the pons.
Raphe nuclei is an area located in pons that is the principal site of synthesis of neurotransmitter serotonin, which plays an important role in mood regulation, particularly when stress is associated with depression & anxiety.
Medulla Oblongata
• It is the lower half of brainstem.
• It connects the higher levels of brain to spinal cord.
• It appears white externally because, like the pons, it contains many myelinated nerve fibers. Internally, it contains collections of cell bodies (gray matter) called nuclei, or centers. Among these are vital centers, such as the following:
  1- **Respiratory center** controls the muscles of respiration in response to chemical & other stimuli.
  2- **Cardiac center** helps regulate the rate and force of heartbeat.
  3- **Vasomotor center** regulates contraction of smooth muscle in blood vessel walls & thus controls blood flow and blood pressure.
• It responsible for regulating several basic functions of **ANS** including: respiration (resp. rhythm), cardiac function (HR, BP), vasodilation (BP), & reflexes (like vomiting, coughing, sneezing, & swallowing).
• Contains cardiac, respiratory, vomiting & vasomotor centers & deals with autonomic, involuntary function eg. Breathing, HR & BP.
**Medulla Oblongata**

- Ascending sensory fibers that carry messages through spinal cord to cerebral cortex & cerebellum.
- Travel through medulla, as do descending motor fibers.
- Motor fibers from motor cortex of cerebral hemispheres extend down through medulla, & most of them cross from one side to the other (decussate) while going through this part of brain.
- The last four pairs of cranial nerves (IX through XII) are connected with medulla.
- Olivary body either of a pair of oval structures in medulla oblonga., containing olivary nuclei that are involved in cerebellar motor-learning & perception of sound.
Reticular formation

- Complex network of nerve fibers scattered throughout brain stem Extends into diencephalon
- Connects to centers of hypothalamus, basal nuclei, cerebellum, and cerebrum
- Filters incoming sensory information
- Arouses cerebral cortex into state of wakefulness (involved in regulating sleep-wake cycle & filtering incoming stimuli to discriminate irrelevant background stimuli).
Reticular Formation

• It consists of more than 100 small neural networks, with varied functions including motor control, cardiovascular control, pain modulation, sleep & habituation.

• Bilateral damage to reticular formation of midbrain may lead to coma or death.

• Traditionally nuclei of reticular formation are divided into three columns: median column or Raphe nuclei; medial column or magnocellular nuclei; & lateral column or parvocellular nuclei.
Parvocellular nuclei within reticular formation that are involved in regulation of expiration during breathing and other motor functions.
• Parvocellular nuclei

Nuclei within reticular formation that are involved in regulation of expiration during breathing and other motor functions.