Medulla Oblongata

- embryonic myelencephalon becomes medulla oblongata
- begins at foramen magnum of the skull
- extends for about 3 cm rostrally and ends at a groove between the medulla and pons
- slightly wider than spinal cord
- pyramids – pair of external ridges on anterior surface
  - resembles side-by-side baseball bats
- olive – a prominent bulge lateral to each pyramid
- posteriorly, gracile and cuneate fasciculi of the spinal cord continue as two pair of ridges on the medulla
- all nerve fibers connecting the brain to the spinal cord pass through the medulla
- four pairs of cranial nerves begin or end in medulla  - IX, X, XI, XII
Medulla Oblongata

Associated Functions

• cardiac center
  – adjusts rate and force of heart

• vasomotor center
  – adjusts blood vessel diameter

• respiratory centers
  – control rate and depth of breathing

• reflex centers
  – for coughing, sneezing, gagging, swallowing, vomiting, salivation, sweating, movements of tongue and head
• **pyramids** contain descending fibers called corticospinal tracts
  – carry motor signals to skeletal muscles
• **inferior olivary nucleus** – relay center for signals to cerebellum
• **reticular formation** - loose network of nuclei extending throughout the medulla, pons and midbrain
  – contains cardiac, vasomotor & respiratory centers
Medulla and Pons

Diencephalon:
- Thalamus
- Infundibulum
- Mammillary body

Midbrain:
- Cerebral peduncle

Pons

Medulla oblongata:
- Pyramid
- Anterior median fissure
- Pyramidal decussation
- Spinal cord

Cranial nerves:
- Optic nerve (II)
- Oculomotor nerve (III)
- Trochlear nerve (IV)
- Trigeminal nerve (V)
- Abducens nerve (VI)
- Facial nerve (VII)
- Vestibulocochlear nerve (VIII)
- Glossopharyngeal nerve (IX)
- Vagus nerve (X)
- Accessory nerve (XI)
- Hypoglossal nerve (XII)

Spinal nerves

(a) Anterior view

Regions of the brainstem:
- Diencephalon
- Midbrain
- Pons
- Medulla oblongata
Posterolateral View of Brainstem

- **Diencephalon:**
  - Thalamus
  - Lateral geniculate body
  - Pineal gland
  - Medial geniculate body

- **Midbrain:**
  - Superior colliculus
  - Inferior colliculus
  - Cerebral peduncle

- **Pons**

- **Fourth ventricle**

- **Medulla oblongata**

- **Regions of the brainstem**
  - Diencephalon
  - Midbrain
  - Pons
  - Medulla oblongata

- **Additional Structures:**
  - Optic tract
  - Superior cerebellar peduncle
  - Middle cerebellar peduncle
  - Inferior cerebellar peduncle
  - Olive
  - Cuneate fasciculus
  - Gracile fasciculus
  - Spinal cord

(b) Posterolateral view
- **metencephalon** - develops into the pons and cerebellum

- **pons** – anterior bulge in brainstem, rostral to medulla

- Cerebellar peduncles – connect cerebellum to brainstem, tracks for information flow in and out of cerebellum (inferior peduncles / inflow from spinal cord) (middle peduncles / inflow from all other areas of brain) (superior peduncles / outflow to thalamus-cerebrum)
Pons

- ascending sensory tracts
- descending motor tracts
- pathways in and out of cerebellum
- **cranial nerves V, VI, VII, and VIII**
  - **sensory roles** – hearing, equilibrium, taste, facial sensations
  - **motor roles** – eye movement, facial expressions, chewing, swallowing, urination, and secretion of saliva and tears
- **reticular formation** in pons contains additional nuclei concerned with:
  - sleep, respiration, and posture
Midbrain

- Short segment of brainstem that connects the hindbrain to the forebrain
  - contains cerebral aqueduct
  - contains continuations of the medial lemniscus and reticular formation
  - contains the motor nuclei of two cranial nerves that control eye movements – CN III (oculomotor) and CN IV (trochlear)
  - tectum – roof-like part of the midbrain posterior to cerebral aqueduct
    - exhibits four bulges, the corpora quadrigemina
    - upper pair, the superior colliculi function in visual attention, tracking moving objects, and some reflexes
    - lower pair, the inferior colliculi receives signals from the inner ear
      - relays them to other parts of the brain, especially the thalamus

- cerebral peduncles – two stalks that anchor the cerebrum to the brainstem anterior to the cerebral aqueduct
Midbrain

- cerebral peduncles
  - each consists of three main components
    - tegmentum, substantia nigra, and cerebral crus
  - tegmentum
    - dominated by the red nucleus
      - pink color due to high density of blood vessels
    - connections go to and from cerebellum
      - collaborates with cerebellum for fine motor control
  - substantia nigra
    - dark gray to black nucleus pigmented with melanin
    - motor center that relays inhibitory signals to thalamus & basal nuclei preventing unwanted body movement
    - degeneration of neurons leads to tremors of Parkinson disease (reduced amount of dopamine secretion from substantia nigra to basal nuclie)
  - cerebral crus
    - bundle of nerve fibers that connect the cerebrum to the pons
    - carries corticospinal tracts
Functions of **Reticular Formation Networks**

- **somatic motor control**
  - adjust muscle tension to maintain tone, balance, and posture
    - especially during body movements
  - relays signals from eyes and ears to the cerebellum
    - integrates visual, auditory, and balance and motion stimuli into motor coordination
  - **gaze center** – allow eyes to track and fixate on objects
  - **central pattern generators** – neural pools that produce rhythmic signals to the muscles of breathing and swallowing

- **cardiovascular control**
  - includes cardiac and vasomotor centers of medulla oblongata

- **pain modulation**
  - one route by which pain signals from the lower body reach the cerebral cortex
  - origin of descending analgesic pathways – fibers act in the spinal cord to block transmission of pain signals to the brain

- **sleep and consciousness**
  - plays central role in states of consciousness, such as alertness and sleep
  - injury to reticular formation can result in irreversible coma

- **habituation**
  - process in which the brain learns to ignore repetitive, inconsequential stimuli while remaining sensitive to others
Reticular Formation

- loosely organized web of gray matter that runs vertically through all levels of the brainstem
- clusters of gray matter scattered throughout pons, midbrain and medulla
- occupies space between white fiber tracts and brainstem nuclei
- has connections with many areas of cerebrum
- more than 100 small neural networks without distinct boundary