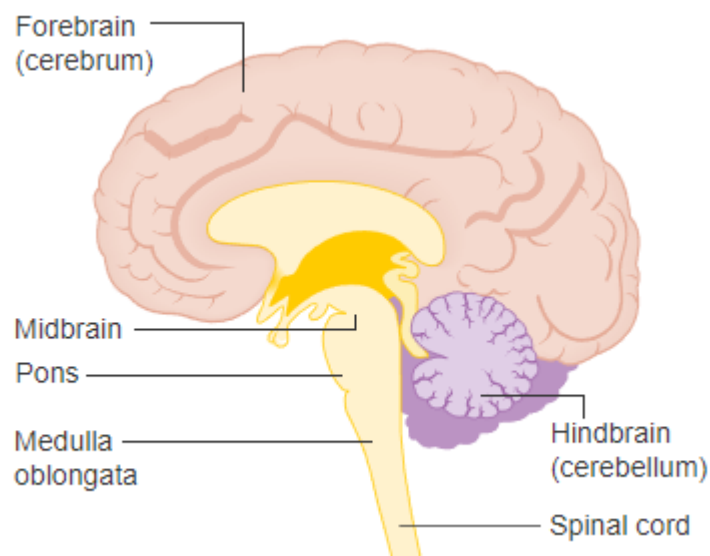


## 11.2.4

# Brainstem

The region of the brain that connects the brain to the spinal cord is the brain stem. The brain stem is subdivided into three regions: the **midbrain**, the **pons**, and the **medulla oblongata**.



**Brain Stem.** By Cancer Research UK [CC BY-SA 4.0 (<http://creativecommons.org/licenses/by-sa/4.0>)], via Wikimedia Commons

The brain stem is also the site where groups of axons (nerve tracts) either exit the brain as cranial nerves or continue on into the spinal cord. Indeed, ten of the twelve pairs of cranial nerves (III - XII) exit the central nervous system from the brain stem. It should also be noted the brain stem is essential for maintaining critical body functions, such as respiration and regulation of the heart, and that we cannot survive without its functions. We can survive without a cerebrum, although we would not be conscious that we were alive, but the body cannot survive without the brain stem.

## The Midbrain

The midbrain is the upper most portion of the brain stem and is situated between the diencephalon and the pons. Running through the midbrain is a hollow tube which connects the third and fourth ventricles (The ventricles of the brain are hollow spaces filled cerebral spinal fluid). Three unique clusters of cell bodies (nuclei) are observed in the midbrain; the **corpora quadrigemina**, the **substantia nigra**, and the **red nucleus**.

Spend time looking at the image search on [the midbrain](#).

The corpora quadrigemina are subdivided into two regions, the two superior colliculi and the two inferior colliculi. The paired **superior colliculi** (colliculus; singular) coordinate the movement of our eyes as we track a moving object. This reflex involves input from the eyes via the optic nerves, integration of the signal in the superior colliculi, and efferent signals to the muscles that control eye movements via cranial nerves III, IV and VI. The **inferior colliculi** help coordinate head and eye movements in responding to sudden sounds that cause you to abruptly move your head and turn your eyes toward the sound. For example, “Jaws,” or “Watcher in The Woods” kind of stuff.

The substantia nigra (dark substance) gets its name from its dark appearance in fresh tissue. This is due to the pigment neuromelanin (similar to melanin) which is produced in these cells. The neurons from this region produce dopamine as their neurotransmitter and neuromelanin which is derived from the same precursor that produces melanin, L-dopa. Neurons from the substantia nigra ascend to the cerebrum and synapse with structures of the basal nuclei, a part of the brain involved in skeletal muscle control. Degeneration of these neurons is the cause of Parkinson’s disease, a condition in which the patient is unable to suppress unwanted muscle contractions resulting in constant tremors of the extremities. Parkinson’s disease also results in some muscles being overly “stiff” and others having too little tone. Parkinson’s disease makes it difficult to coordinate voluntary and involuntary contractions.

Neurons in the red nucleus contain inordinate amounts of iron which when oxidized conveys a red hue. In many vertebrates, it is a relay center for motor pathways that affect limb flexion. It is thought that in humans; the red nucleus influences arm swing during gait, crawling in babies and motor control of some of the larger shoulder and arm muscles, but not the legs.

## The Pons

The pons region of the brain stem contains nuclei that contribute to the control of sleep, respiration, swallowing, bladder control, hearing, equilibrium, taste, eye movement, facial expressions, and posture. It may also play a role in generating dreams. In addition, the pons (which means bridge) connects the cerebellum to the cerebrum.

## The Medulla Oblongata

“Alligators are ornery cause of their Medulla Oblongata!” (Water boy, 1998). Actually, the medulla oblongata probably has nothing to do with ornery ... surprise! As if movies ever tell the truth ... Anyway, the medulla oblongata has a crucial role in body homeostasis. It has been said that the medulla oblongata controls many of the vital reflexes for life. Neurons in the medulla oblongata adjust the force and rate of heart contractions, they generate and modify the depth of breathing and regulate other fun activities like vomiting, hiccupping, coughing and sneezing. Additionally, the medulla is where most of the neurons that control voluntary skeletal muscle contraction cross over to the opposite side of the brain stem. The result of this crossing over is that the right side of the brain controls muscles on the left side of the body and the left side of the brain controls muscles on the right side of the body. The structure in the medulla where this crossing over is the olives of the medulla. The technical name for crossing over is **decussation**. This word comes from “deca” the prefix for the number 10 and the Roman Numeral for 10 which is X. The symbol X implies crossing over.



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