11.6A: Functions of the Diencephalon

Distinct parts of diencephalon perform numerous vital functions, from regulating wakefulness to controlling the autonomic nervous system.

Learning Objectives

• Describe the functions of the diencephalon region of the brain

Key Points

• The diencephalon is made up of four main components: the thalamus, the subthalamus, the hypothalamus, and the epithalamus.

• The hypothalamus is an integral part of the endocrine system, with the key function of linking the nervous system to the endocrine system via the pituitary gland.

• The thalamus is critically involved in a number of functions including relaying sensory and motor signals to the cerebral cortex and regulating consciousness, sleep, and alertness.

• The epithalamus functions as a connection between the limbic system to other parts of the brain. Some functions of its components include the secretion of melatonin by the pineal gland (involved in circadian rhythms) and regulation of motor pathways and emotions.

Key Terms

• subthalamus: Receives afferent connections from the substantia nigra and striatum and regulates skeletal muscle movements.
• **thalamus**: Either of two large, ovoid structures of gray matter within the forebrain that relay sensory impulses to the cerebral cortex.

• **hypothalamus**: A region of the forebrain located below the thalamus, forming the basal portion of the diencephalon, and functioning to regulate body temperature, some metabolic processes, and the autonomic nervous system.

• **epithalamus**: The dorsal posterior segment of the diencephalon, involved in the maintenance of circadian rhythms and regulation of motor pathways and emotions.

• **limbic system**: A set of brain structures located on both sides of the thalamus, right under the cerebrum. Supports a variety of functions including emotion, behavior, motivation, long-term memory, and olfaction.

The diencephalon (“interbrain”) is the region of the vertebrate neural tube that gives rise to posterior forebrain structures. In development, the forebrain develops from the prosencephalon, the most anterior vesicle of the neural tube that later forms both the diencephalon and the telencephalon. In adults, the diencephalon appears at the upper end of the brain stem, situated between the cerebrum and the brain stem. It is made up of four distinct components: the thalamus, the subthalamus, the hypothalamus, and the epithalamus.

![Diencephalon: Three-dimensional view of the diencephalon](https://med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Book%3A_Anatomy_and_Physiology_(Boundless)/11%3A_Anatomy_of_the_Human_Brain%2F11.03%20The_Diencephalon)
Embryonic Brain: Subdivisions of the embryonic vertebrate brain that later differentiate into forebrain, midbrain, and hindbrain structures.

Functions of Primary Diencephalon Structures

The thalamus is a kind of switchboard of information, believed to act as a relay between a variety of subcortical areas and the cerebral cortex. In particular, every sensory system (with the exception of the olfactory system) includes a thalamic nucleus that receives sensory signals and sends them to the associated primary cortical area. The thalamus also plays an important role in regulating states of sleep and wakefulness. Thalamic nuclei have strong reciprocal connections with the cerebral cortex, forming thalamo-cortico-thalamic circuits that are believed to be involved with consciousness. The thalamus plays a major role in regulating arousal, awareness level, and activity. Damage to the thalamus can lead to permanent coma.

The subthalamus connects to the globus pallidus, a basal nucleus of the telencephalon. It receives afferent connections from the substantia nigra and striatum and regulates skeletal muscle movements.

The hypothalamus performs numerous vital functions (e.g., regulation of certain metabolic processes), most of which relate directly or indirectly to the regulation of visceral activities by way of other brain regions and the autonomic nervous system. It synthesizes and secretes certain neurohormones, often called hypothalamic-releasing hormones, and these in turn stimulate or inhibit the secretion of pituitary hormones. The hypothalamus controls body temperature, hunger, thirst, fatigue, sleep, and circadian cycles.

The epithalamus functions as a connection between the limbic system and other parts of the brain. Some functions of its components include the secretion of melatonin by the pineal gland (involved in circadian rhythms) and regulation of motor pathways and emotions.