

Language Areas

- Located in a large area surrounding the left (or language-dominant) lateral sulcus
- Major parts and functions:
 - Wernicke's area – involved in sounding out unfamiliar words
 - Broca's area – speech preparation and production
 - Lateral prefrontal cortex – language comprehension and word analysis
 - Lateral and ventral temporal lobe – coordinate auditory and visual aspects of language

General (Common) Interpretation Area

- Ill-defined region including parts of the temporal, parietal, and occipital lobes
- Found in one hemisphere, usually the left
- Integrates incoming signals into a single thought
- Involved in processing spatial relationships

Visceral Association Area

- Located in the cortex of the insula
- Involved in conscious perception of visceral sensations

Lateralization of Cortical Function

- Lateralization – each hemisphere has abilities not shared with its partner
- Cerebral dominance – designates the hemisphere dominant for language
- Left hemisphere – controls language, math, and logic
- Right hemisphere – controls visual-spatial skills, emotion, and artistic skills

Cerebral White Matter

- Consists of deep myelinated fibers and their tracts
- It is responsible for communication between:
 - The cerebral cortex and lower CNS center, and areas of the cerebrum

Cerebral White Matter

- Types include:
 - Commissures – connect corresponding gray areas of the two hemispheres
 - Association fibers – connect different parts of the same hemisphere
 - Projection fibers – enter the hemispheres from lower brain or cord centers

Fiber Tracts in White Matter

Fiber Tracts in White Matter

Basal Nuclei

- Masses of gray matter found deep within the cortical white matter
- The corpus striatum is composed of three parts
 - Caudate nucleus
 - Lentiform nucleus – composed of the putamen and the globus pallidus
 - Fibers of internal capsule running between and through caudate and lentiform nuclei

Basal Nuclei

Functions of Basal Nuclei

- Though somewhat elusive, the following are thought to be functions of basal nuclei
 - Influence muscular activity
 - Regulate attention and cognition
 - Regulate intensity of slow or stereotyped movements
 - Inhibit antagonistic and unnecessary movement

Diencephalon

- Central core of the forebrain
- Consists of three paired structures – thalamus, hypothalamus, and epithalamus
- Encloses the third ventricle

Diencephalon

Thalamus

- Paired, egg-shaped masses that form the superolateral walls of the third ventricle
- Connected at the midline by the intermediate mass
- Contains four groups of nuclei – anterior, ventral, dorsal, and posterior
- Nuclei project and receive fibers from the cerebral cortex

Thalamic Function

- Afferent impulses from all senses converge and synapse in the thalamus
- Impulses of similar function are sorted out, edited, and relayed as a group
- All inputs ascending to the cerebral cortex pass through the thalamus
- Plays a key role in mediating sensation, motor activities, cortical

arousal, learning, and memory

Hypothalamus

- Located below the thalamus, it caps the brainstem and forms the inferolateral walls of the third ventricle
- Mammillary bodies
 - Small, paired nuclei bulging anteriorly from the hypothalamus
 - Relay station for olfactory pathways
- Infundibulum – stalk of the hypothalamus; connects to the pituitary gland
 - Main visceral control center of the body

Hypothalamic Function

- Regulates blood pressure, rate and force of heartbeat, digestive tract motility, rate and depth of breathing, and many other visceral activities
- Is involved with perception of pleasure, fear, and rage
- Controls mechanisms needed to maintain normal body temperature
- Regulates feelings of hunger and satiety
- Regulates sleep and the sleep cycle

Endocrine Functions of the Hypothalamus

- Releasing hormones control secretion of hormones by the anterior pituitary
- The supraoptic and paraventricular nuclei produce ADH and oxytocin

Epithalamus

- Most dorsal portion of the diencephalon; forms roof of the third ventricle
- Pineal gland – extends from the posterior border and secretes melatonin
 - Melatonin – a hormone involved with sleep regulation, sleep-wake cycles, and mood
- Choroid plexus – a structure that secretes cerebral spinal fluid (CSF)

Epithalamus

Brain Stem

- Consists of three regions – midbrain, pons, and medulla oblongata
- Similar to spinal cord but contains embedded nuclei
- Controls automatic behaviors necessary for survival
- Provides the pathway for tracts between higher and lower brain

centers

- Associated with 10 of the 12 pairs of cranial nerves

Midbrain

- Located between the diencephalon and the pons
- Midbrain structures include:
 - Cerebral peduncles – two bulging structures that contain descending pyramidal motor tracts
 - Cerebral aqueduct – hollow tube that connects the third and fourth ventricles
 - Various nuclei

Midbrain Nuclei

- Nuclei that control cranial nerves III (oculomotor) and IV (trochlear)
- Corpora quadrigemina – four dome-like protrusions of the dorsal midbrain
- Superior colliculi – visual reflex centers
- Inferior colliculi – auditory relay centers
- Substantia nigra – functionally linked to basal nuclei
- Red nucleus – largest nucleus of the reticular formation; red nuclei are relay nuclei for some descending motor pathways

Pons

- Bulging brainstem region between the midbrain and the medulla oblongata
- Forms part of the anterior wall of the fourth ventricle
- Fibers of the pons:
 - Connect higher brain centers and the spinal cord
 - Relay impulses between the motor cortex and the cerebellum

Pons

- Origin of cranial nerves V (trigeminal), VI (abducens), and VII (facial)
- Contains nuclei of the reticular formation

Medulla Oblongata

- Most inferior part of the brain stem
- Along with the pons, forms the ventral wall of the fourth ventricle
- Contains a choroid plexus on the ventral wall of the fourth ventricle
- Pyramids – two longitudinal ridges formed by corticospinal tracts
- Decussation of the pyramids – crossover points of the corticospinal tracts

Medulla Nuclei

- Inferior olivary nuclei – gray matter that relays sensory information
- Cranial nerves X, XI, and XII are associated with the medulla
- Vestibular nuclear complex – synapses that mediate and maintain equilibrium
- Ascending sensory tract nuclei, including nucleus cuneatus and nucleus gracilis

Medulla Nuclei

- Cardiovascular control center – adjusts force and rate of heart contraction
- Respiratory centers – control rate and depth of breathing

The Cerebellum

- Located dorsal to the pons and medulla
- Protrudes under the occipital lobes of the cerebrum
- Makes up 11% of the brain's mass
- Provides precise timing and appropriate patterns of skeletal muscle contraction
- Cerebellar activity occurs subconsciously

Anatomy of the Cerebellum

- Two bilaterally symmetrical hemispheres connected medially by the vermis
- Folia – transversely oriented gyri
- Each hemisphere has three lobes – anterior, posterior, and flocculonodular
- Neural arrangement – gray matter cortex, internal white matter, scattered nuclei
- Arbor vitae – distinctive treelike pattern of the cerebellar white matter

Cerebellar Peduncles

- Three paired fiber tracts that connect the cerebellum to the brain stem
- All fibers in the cerebellum are ipsilateral
- Superior peduncles connect the cerebellum to the midbrain
- Middle peduncles connect the pons to the cerebellum
- Inferior peduncles connect the medulla to the cerebellum

Cerebellar Processing

- Cerebellum receives impulses of the intent to initiate voluntary muscle contraction
- Proprioceptors and visual signals “inform” the cerebellum of the

body's condition

- Cerebellar cortex calculates the best way to perform a movement
- A “blueprint” of coordinated movement is sent to the cerebral motor cortex

Cerebellar Cognitive Function

- Plays a role in language and problem solving
- Recognizes and predicts sequences of events