



NEURAQUEST

NQ50

Encyclopedia of 50 Regions of the Human Brain

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Welcome to the NQ 50, our very own brain encyclopedia, detailing 50 of the most important brain regions along with their locations, functions, and key parts, arranged in alphabetical order. Note that this is just the tip of the iceberg, with there being hundreds of other parts of the brain not covered in this document.

1. Amygdala

Location: The amygdala is located deep within the temporal lobe of the brain, near the hippocampus.

Function: The amygdala is primarily involved in the processing of emotions such as fear, anger, and pleasure. It plays a key role in forming and storing memories associated with emotional events.

Key Parts: The amygdala consists of several nuclei, but the most important ones for emotional processing are the basolateral complex, which is involved in attaching emotional significance to stimuli, and the central nucleus, which is involved in producing the physical responses associated with emotions.

2. Angular Gyrus

Location: The angular gyrus is located in the parietal lobe of the brain, near the back, where the parietal lobe meets the temporal and occipital lobes.

Function: This region of the brain is involved in a variety of processes, including language, number processing, spatial cognition, memory retrieval, attention, and theory of mind (the ability to understand that others have thoughts and feelings different from one's own).

3. Basal Ganglia

Location: The basal ganglia are a group of nuclei located deep within the cerebral hemispheres.

Function: The basal ganglia are involved in coordinating movement, controlling voluntary motor movements, procedural learning, and habits. They also play roles in emotions and cognitive functions.

Key Parts: The basal ganglia include several key nuclei:

- **Caudate Nucleus:** Involved in motor processes and various other functions like learning and memory.
- **Putamen:** Works with the caudate nucleus in motor control.
- **Globus Pallidus:** Involved in the regulation of voluntary movement.
- **Substantia Nigra:** Produces dopamine and is involved in reward and movement.
- **Subthalamic Nucleus:** Plays a role in regulating movements.

4. Brainstem

Location: The brainstem is located at the base of the brain, connecting the brain to the spinal cord.

Function: The brainstem controls many basic life functions, including breathing, heart rate, and blood pressure. It also plays a role in regulating the sleep-wake cycle and reflexes such as swallowing and coughing.

Key Parts: The brainstem consists of three main parts:

- **Midbrain:** Involved in vision, hearing, eye movement, and body movement.
- **Pons:** Helps relay messages between the cortex and the cerebellum and plays a role in sleep and arousal.
- **Medulla Oblongata:** Controls vital life-sustaining functions such as heartbeat, breathing, blood pressure, and digestion.

5. Broca's Area

Location: Broca's area is located in the frontal lobe of the brain, typically in the left hemisphere, in the posterior part of the frontal gyrus.

Function: Broca's area is primarily responsible for speech production and language processing. Damage to this area can result in Broca's aphasia, which is characterized by difficulty in speech production while comprehension remains relatively intact.

6. Caudate Nucleus

Location: The caudate nucleus is located deep within the brain, in the basal ganglia, near the center of the brain. It has a C-shaped structure that curves around the thalamus.

Function: The caudate nucleus plays a crucial role in motor control and learning. It is involved in the regulation of voluntary movement, procedural learning, associative learning, and the reward system. It also plays a part in various other cognitive functions, including memory and motivation.

7. Cerebellum

Location: The cerebellum is located at the back of the brain, beneath the occipital lobes and behind the brainstem.

Function: The cerebellum is essential for coordination, precision, and accurate timing of movements. It helps regulate posture, balance, and fine-tunes motor activity. The cerebellum is also involved in motor learning, helping the body learn new motor skills and adapt to changing conditions.

Key Parts: The cerebellum consists of two hemispheres and three main functional parts:

- **Cerebrocerebellum:** Involved in planning and initiating voluntary activity.
- **Spinocerebellum:** Regulates muscle tone and coordinates skilled, voluntary movements.
- **Vestibulocerebellum:** Maintains balance and controls eye movements.

8. Cerebral Cortex

Location: The cerebral cortex is the outer layer of the brain, covering the cerebral hemispheres.

Function: The cerebral cortex is responsible for higher brain functions, including sensation, voluntary muscle movement, thought, reasoning, and memory. It is divided into four main lobes, each associated with different functions:

- **Frontal Lobe:** Involved in reasoning, planning, problem-solving, movement, and regulating emotions.
- **Parietal Lobe:** Processes sensory information such as touch, temperature, and pain.
- **Temporal Lobe:** Involved in processing auditory information, memory, and language.
- **Occipital Lobe:** Responsible for visual processing.

9. Cingulate Gyrus

Location: The cingulate gyrus is located in the medial aspect of the cerebral cortex, above the corpus callosum.

Function: The cingulate gyrus is involved in emotional regulation and processing, learning, memory, and attention. It plays a role in linking behavioral outcomes to motivation and helps in regulating autonomic motor function. It is also part of the limbic system, which is associated with emotions and behavior.

10. Claustrum

Location: The claustrum is a thin, irregular sheet of neurons located deep within the brain, between the insula and the putamen.

Function: The exact function of the claustrum is still not fully understood, but it is thought to play a role in coordinating and integrating information across different regions of the brain. Some researchers suggest it might be involved in consciousness and awareness by synchronizing sensory information.

11. Corpus Callosum

Location: The corpus callosum is a thick band of nerve fibers located in the center of the brain. It connects the left and right cerebral hemispheres.

Function: The corpus callosum facilitates communication between the two hemispheres of the brain. It allows for the integration of sensory, motor, and cognitive functions between the hemispheres, ensuring they work together harmoniously.

12. Dentate Gyrus

Location: The dentate gyrus is part of the hippocampal formation, located in the temporal lobe of the brain. It is situated within the hippocampus.

Function: The dentate gyrus is involved in the formation of new episodic memories and plays a role in learning. It is also crucial for a process called neurogenesis, where new neurons are formed, particularly in response to learning and memory tasks.

13. Fornix

Location: The fornix is an arch-shaped bundle of nerve fibers that acts as a major output tract of the hippocampus. It extends from the hippocampus to the mammillary bodies and the septal nuclei.

Function: The fornix is primarily involved in the transmission of information within the limbic system. It plays a key role in memory formation and recall by connecting different parts of the limbic system, including the hippocampus and hypothalamus.

14. Frontal Lobe

Location: The frontal lobe is located at the front of the brain, behind the forehead. It is the largest of the four major lobes of the cerebral cortex.

Function: The frontal lobe is responsible for a variety of higher cognitive functions. These include reasoning, planning, problem-solving, and decision-making. It also controls voluntary movement, regulates emotions and social behavior, and is involved in speech production (Broca's area is located here).

Key Parts: The frontal lobe includes several important regions:

- **Prefrontal Cortex:** Involved in complex cognitive behavior, personality expression, and moderating social behavior.
- **Primary Motor Cortex:** Controls voluntary muscle movements.
- **Broca's Area:** Responsible for speech production and language processing.

15. Globus Pallidus

Location: The globus pallidus is a subcortical structure located within the basal ganglia, deep inside the brain. It lies adjacent to the putamen and lateral to the thalamus.

Function: The globus pallidus is involved in the regulation of voluntary movement. It works with other structures in the basal ganglia to ensure smooth and coordinated muscle movements by influencing motor pathways. It helps in inhibiting unwanted movements and promoting desired ones.

Key Parts: The globus pallidus is divided into two parts:

- **External Segment (GPe):** Involved in indirect pathways of movement regulation.
- **Internal Segment (GPi):** Directly influences motor activity by sending output to the thalamus.

16. Hippocampus

Location: The hippocampus is located in the medial temporal lobe of the brain, beneath the cortical surface. It is part of the limbic system.

Function: The hippocampus plays a crucial role in the formation of new memories and is also involved in learning and emotions. It helps convert short-term memories into long-term memories and spatial navigation (e.g., remembering the layout of a place).

Key Parts: The hippocampus consists of several key regions:

- **CA1, CA2, CA3, and CA4 regions:** Involved in different aspects of memory encoding and retrieval.
- **Dentate Gyrus:** Involved in the formation of new episodic memories and neurogenesis.

17. Hypothalamus

Location: The hypothalamus is located below the thalamus, just above the brainstem. It forms the floor of the third ventricle of the brain.

Function: The hypothalamus is responsible for maintaining homeostasis in the body, regulating a wide range of bodily functions such as temperature, hunger, thirst, sleep, and circadian rhythms. It also controls the pituitary gland, thereby influencing hormone release throughout the body.

Key Parts: The hypothalamus has several important nuclei, each responsible for different regulatory functions:

- **Suprachiasmatic Nucleus (SCN):** Regulates circadian rhythms.
- **Paraventricular Nucleus (PVN):** Involved in stress response and controls the pituitary gland.
- **Arcuate Nucleus:** Regulates appetite and energy balance.

18. Inferior Colliculus

Location: The inferior colliculus is located in the midbrain, below the superior colliculus.

Function: The inferior colliculus is a key structure in the auditory pathway. It processes auditory information and is involved in sound localization, helping us determine where a sound is coming from.

19. Insula

Location: The insula is located deep within the lateral sulcus, which separates the frontal and parietal lobes from the temporal lobe.

Function: The insula is involved in a variety of functions, including perception, motor control, self-awareness, cognitive functioning, and interpersonal experience. It also plays a role in processing emotions and is involved in taste perception, pain processing, and autonomic functions.

20. Limbic System

Location: The limbic system is a complex set of structures located beneath the cerebral cortex and around the thalamus.

Function: The limbic system is primarily responsible for emotions, behavior, motivation, long-term memory, and olfaction. It plays a key role in forming memories and regulating emotional responses.

Key Parts: The limbic system includes several important structures:

- **Hippocampus:** Involved in memory formation and spatial navigation.
- **Amygdala:** Processes emotions such as fear, anger, and pleasure.
- **Cingulate Gyrus:** Regulates emotions and pain.
- **Fornix:** A major output tract of the hippocampus, involved in memory.

- **Mammillary Bodies:** Involved in recollective memory.
- **Septal Nuclei:** Associated with reward and reinforcement.

21. Locus Coeruleus

Location: The locus coeruleus is located in the pons, a part of the brainstem. It is situated near the fourth ventricle.

Function: The locus coeruleus is the principal site for the synthesis of norepinephrine (noradrenaline) in the brain. It plays a critical role in arousal, attention, stress response, and regulating the sleep-wake cycle. It helps the brain respond to stress and panic.

22. Mammillary Bodies

Location: The mammillary bodies are located at the end of the fornix, part of the hypothalamus, and just in front of the brainstem.

Function: The mammillary bodies are involved in recollective memory. They help relay information from the hippocampus and thalamus, contributing to the processing and recall of memories.

23. Medulla Oblongata

Location: The medulla oblongata is located at the lower part of the brainstem, below the pons and above the spinal cord.

Function: The medulla oblongata is responsible for controlling several vital autonomic functions, such as heart rate, breathing, blood pressure, and digestion. It also manages reflexes such as swallowing, coughing, and vomiting.

24. Midbrain

Location: The midbrain, or mesencephalon, is located between the forebrain and the hindbrain, above the pons and below the thalamus.

Function: The midbrain is involved in functions such as vision, hearing, motor control, sleep and wake cycles, arousal (alertness), and temperature regulation. It plays a role in processing auditory and visual information and in controlling eye movements.

Key Parts: The midbrain consists of several key structures:

- **Superior Colliculus:** Involved in visual processing and eye movements.
- **Inferior Colliculus:** Involved in auditory processing.
- **Substantia Nigra:** Involved in motor control and produces dopamine, which is important for movement regulation.

25. Nucleus Accumbens

Location: The nucleus accumbens is located in the basal forebrain, situated where the head of the caudate nucleus and the putamen meet.

Function: The nucleus accumbens is a critical component of the brain's reward circuitry. It is involved in processing pleasure, motivation, reinforcement learning, and reward. It plays a key role in addiction and the release of dopamine in response to rewarding stimuli.

Key Parts: The nucleus accumbens is divided into two main regions:

- **Core:** Involved in motor functions related to reward.
- **Shell:** Involved in processing the emotional and motivational aspects of reward.

26. Occipital Lobe

Location: The occipital lobe is located at the back of the brain, behind the parietal and temporal lobes.

Function: The occipital lobe is primarily responsible for visual processing. It interprets information from the eyes and processes visual stimuli such as color, light, and movement. The primary visual cortex, located in the occipital lobe, is essential for visual perception.

Key Parts:

- **Primary Visual Cortex (V1):** The main area responsible for processing visual information.
- **Secondary Visual Areas (V2, V3, etc.):** Involved in further processing and interpreting visual information.

27. Olfactory Bulb

Location: The olfactory bulb is located on the underside of the brain, just above the nasal cavity and below the frontal lobes.

Function: The olfactory bulb is responsible for the sense of smell. It receives sensory input from the olfactory receptors in the nasal cavity and processes this information, sending signals to other parts of the brain involved in odor perception and emotional responses to smells.

28. Parahippocampal Gyrus

Location: The parahippocampal gyrus is located in the medial temporal lobe of the brain, adjacent to the hippocampus.

Function: The parahippocampal gyrus is involved in memory encoding and retrieval. It plays a role in scene recognition and spatial memory, helping to remember the layout of the environment and the context of events.

Key Parts: Entorhinal Cortex: Located within the parahippocampal gyrus, it serves as a major relay between the hippocampus and the cerebral cortex and is crucial for memory formation.

29. Parietal Lobe

Location: The parietal lobe is located in the upper back part of the brain, behind the frontal lobe and above the occipital lobe.

Function: The parietal lobe processes sensory information from the body, including touch, temperature, and pain. It is involved in spatial orientation, movement coordination, and manipulation of objects. It helps integrate sensory information to form a coherent perception of the environment.

Key Parts:

- **Primary Somatosensory Cortex:** Located in the parietal lobe, it processes sensory input from the body.
- **Posterior Parietal Cortex:** Involved in integrating sensory information and coordinating movement and spatial reasoning.

30. Periaqueductal Gray

Location: The periaqueductal gray (PAG) is located in the midbrain, surrounding the cerebral aqueduct.

Function: The periaqueductal gray plays a critical role in pain modulation and defensive behavior. It is involved in the suppression of pain through the release of endorphins and other neurotransmitters that inhibit pain signals. The PAG also helps coordinate responses to threats, such as fight-or-flight reactions.

31. Pineal Gland

Location: The pineal gland is a small, pea-shaped gland located deep within the brain, near the center, between the two hemispheres. It is situated just above the thalamus.

Function: The pineal gland produces and regulates hormones, primarily melatonin, which controls sleep-wake cycles and circadian rhythms. It helps regulate biological rhythms, including seasonal and reproductive cycles in some animals.

32. Pituitary Gland

Location: The pituitary gland is a small, bean-shaped gland located at the base of the brain, just below the hypothalamus. It is often referred to as the "master gland" because it controls various other endocrine glands.

Function: The pituitary gland secretes hormones that regulate growth, metabolism, and reproductive processes. It has two main parts:

- **Anterior Pituitary:** Produces hormones like growth hormone (GH), thyroid-stimulating hormone (TSH), adrenocorticotrophic hormone (ACTH), prolactin, and gonadotropins (LH and FSH).
- **Posterior Pituitary:** Releases hormones produced by the hypothalamus, such as oxytocin and vasopressin (antidiuretic hormone, ADH).

33. Pons

Location: The pons is located in the brainstem, above the medulla oblongata and below the midbrain.

Function: The pons acts as a bridge between various parts of the nervous system, including the cerebrum and the cerebellum. It is involved in the regulation of breathing, communication between different parts of the brain, and sensations such as hearing, taste, and balance. It also plays a role in sleep and arousal.

34. Prefrontal Cortex

Location: The prefrontal cortex is located at the front of the frontal lobe, just behind the forehead.

Function: The prefrontal cortex is involved in complex cognitive behavior, decision making, problem-solving, and planning. It regulates personality expression, social behavior, and moderates emotional responses. It plays a key role in executive functions, such as working memory, attention, and inhibition.

35. Primary Motor Cortex

Location: The primary motor cortex is located in the frontal lobe, along the precentral gyrus, just in front of the central sulcus.

Function: The primary motor cortex is responsible for the initiation of voluntary movements. It sends signals to the muscles, controlling precise and coordinated movements of different parts of the body. Different regions of the primary motor cortex control different parts of the body, a concept known as the motor homunculus.

36. Primary Somatosensory Cortex

Location: The primary somatosensory cortex is located in the parietal lobe, along the postcentral gyrus, just behind the central sulcus.

Function: The primary somatosensory cortex is responsible for processing sensory information from the body. It receives input from sensory receptors in the skin, muscles, and joints, allowing us to perceive touch, temperature, pain, and proprioception (the sense of body position). Different regions of the primary somatosensory cortex correspond to different parts of the body, a concept known as the sensory homunculus.

37. Putamen

Location: The putamen is a round structure located at the base of the forebrain. It is part of the basal ganglia and lies next to the caudate nucleus and the globus pallidus.

Function: The putamen is involved in regulating movements and influencing various types of motor skills. It works closely with other parts of the basal ganglia to coordinate and execute voluntary movements. The putamen also plays a role in learning and habit formation, particularly those involving motor skills.

38. Raphe Nuclei

Location: The raphe nuclei are a group of nuclei located in the brainstem, along the midline. They are distributed from the midbrain down to the medulla.

Function: The raphe nuclei are the primary source of serotonin in the brain, a neurotransmitter important for mood regulation, sleep, and arousal. They play a crucial role in regulating the brain's overall arousal and pain perception. The raphe nuclei are involved in controlling various functions, including mood, anxiety, and the sleep-wake cycle.

39. Red Nucleus

Location: The red nucleus is located in the midbrain, near the center, just above the substantia nigra.

Function: The red nucleus is involved in motor coordination. It plays a role in the control of muscle tone, posture, and limb movements. It helps relay motor signals from the cerebral cortex and cerebellum to the spinal cord, facilitating smooth and coordinated movements.

40. Reticular Formation

Location: The reticular formation is a network of interconnected neurons located throughout the brainstem, from the medulla to the midbrain.

Function: The reticular formation is involved in regulating the sleep-wake cycle, consciousness, and arousal. It plays a crucial role in maintaining alertness and attention. The reticular formation also helps control autonomic functions such as heart rate, respiration, and reflexes like coughing and swallowing.

41. Septal Nuclei

Location: The septal nuclei are a group of structures located in the basal forebrain, just below the corpus callosum and in front of the hypothalamus.

Function: The septal nuclei are involved in reward and reinforcement, emotional regulation, and memory. They play a role in the brain's pleasure and reward systems, influencing feelings of happiness and motivation. They also have connections with the hippocampus and are involved in memory processing.

42. Substantia Nigra

Location: The substantia nigra is located in the midbrain, just above the red nucleus. It is part of the basal ganglia.

Function: The substantia nigra is crucial for movement control. It produces dopamine, a neurotransmitter that is essential for regulating movement and coordination. The substantia nigra sends dopamine to other parts of the basal ganglia, facilitating smooth and purposeful movements. Degeneration of neurons in this area is associated with Parkinson's disease.

43. Superior Colliculus

Location: The superior colliculus is located in the midbrain, above the inferior colliculus.

Function: The superior colliculus is involved in visual processing and control of eye movements. It helps orient the eyes and head toward visual stimuli. It plays a role in coordinating visual attention and reflexive eye movements, such as tracking moving objects and orienting to sudden changes in the visual field.

44. Suprachiasmatic Nucleus

Location: The suprachiasmatic nucleus (SCN) is located in the hypothalamus, just above the optic chiasm.

Function: The suprachiasmatic nucleus is the brain's primary circadian pacemaker. It regulates the body's internal clock, controlling the sleep-wake cycle and other daily rhythms, such as hormone release and body temperature. The SCN receives direct input from the eyes, allowing it to synchronize the body's rhythms with the external light-dark cycle.

45. Temporal Lobe

Location: The temporal lobe is located on the sides of the brain, beneath the lateral sulcus, and is situated between the frontal lobe and the occipital lobe.

Function: The temporal lobe is involved in processing auditory information, memory, and language. It plays a key role in recognizing sounds, understanding speech, and forming and retrieving memories. The temporal lobe is also involved in processing complex visual stimuli, such as faces and scenes.

Key Parts:

- **Primary Auditory Cortex:** Located within the temporal lobe, it processes auditory information from the ears.
- **Hippocampus:** Located within the medial temporal lobe, it is crucial for memory formation.
- **Wernicke's Area:** Typically located in the left temporal lobe, it is involved in language comprehension.

46. Thalamus

Location: The thalamus is located deep within the brain, just above the brainstem and between the cerebral cortex and the midbrain. It is part of the diencephalon.

Function: The thalamus acts as a relay station for sensory and motor signals to the cerebral cortex. It processes and transmits sensory information (except for smell) and plays a role in regulating consciousness, sleep, and alertness. The thalamus helps filter and prioritize information, ensuring that important signals reach the cortex.

Key Parts:

- **Lateral Geniculate Nucleus (LGN):** Processes visual information.
- **Medial Geniculate Nucleus (MGN):** Processes auditory information.
- **Ventral Posterior Nucleus (VPN):** Processes somatosensory information (touch, temperature, pain).

47. Uncus

Location: The uncus is located on the medial surface of the temporal lobe, part of the parahippocampal gyrus, near the hippocampus.

Function: The uncus is involved in processing olfactory (smell) information. It is part of the olfactory cortex and plays a role in the perception and identification of odors. Additionally, it is involved in the formation of emotional responses related to smells.

48. Ventral Tegmental Area (VTA)

Location: The ventral tegmental area (VTA) is located in the midbrain, near the floor of the midbrain, adjacent to the substantia nigra.

Function: The VTA is a critical component of the brain's reward system. It produces dopamine and is involved in motivation, reward, and reinforcement learning. The VTA plays a key role in the release of dopamine in response to rewarding stimuli and is involved in addiction and the pleasure response.

49. Ventricles

Location: The ventricles are a series of interconnected, fluid-filled cavities located within the brain. There are four main ventricles: the two lateral ventricles, the third ventricle, and the fourth ventricle.

Function: The ventricles produce and circulate cerebrospinal fluid (CSF), which cushions the brain and spinal cord, provides nutrients, removes waste, and helps maintain intracranial pressure. The ventricles also serve as pathways for the flow of CSF throughout the central nervous system.

Key Parts:

- **Lateral Ventricles:** Located in each hemisphere, they are the largest ventricles.
- **Third Ventricle:** Located in the midline of the brain, between the two halves of the thalamus.
- **Fourth Ventricle:** Located between the brainstem and the cerebellum, connected to the third ventricle via the cerebral aqueduct.

50. Wernicke's Area

Location: Wernicke's area is typically located in the left temporal lobe, near the auditory cortex, at the junction of the temporal and parietal lobes.

Function: Wernicke's area is crucial for language comprehension. It is involved in the processing and understanding of spoken and written language. Damage to Wernicke's area can result in Wernicke's aphasia, characterized by fluent but nonsensical speech and difficulty understanding language.

