Parts of the Brain- Brain Anatomy

What are the different parts of our brain? The human brain is one of the most complex organs in our body. It is made up of diverse parts or structures that carry-out different functions and work together using thousands of connections that connect the brain to the rest of the body. Below, we will give you a description of the brain's structure, its different parts, and how each part works.

Brain structure

The Central Nervous System is made up of the encephalon and the spinal cord.

- **The encephalon** is the central part of the CNS that is enclosed and protected by the skull.
- **The spinal cord** is a long, whitish cord that is located in the vertebral canal and connects the encephalon to the rest of the body. It acts as a type of information highway between the encephalon and the body, transmitting all of the information provided by the brain to the rest of the body.

Therefore, the encephalon and the brain are not the same thing. In order to be able to differentiate well between what is encephalon and what is the brain, we must know the division of the phylogenetic development of the CNS. Initially there are three **primary brain vesicles**: prosencephalon, mesencephalon, and rhombencephalon. These develop into five **secondary brain vesicles** – the prosencephalon is subdivided into the telencephalon and diencephalon, and the rhombencephalon into the metencephalon and myelencephalon.

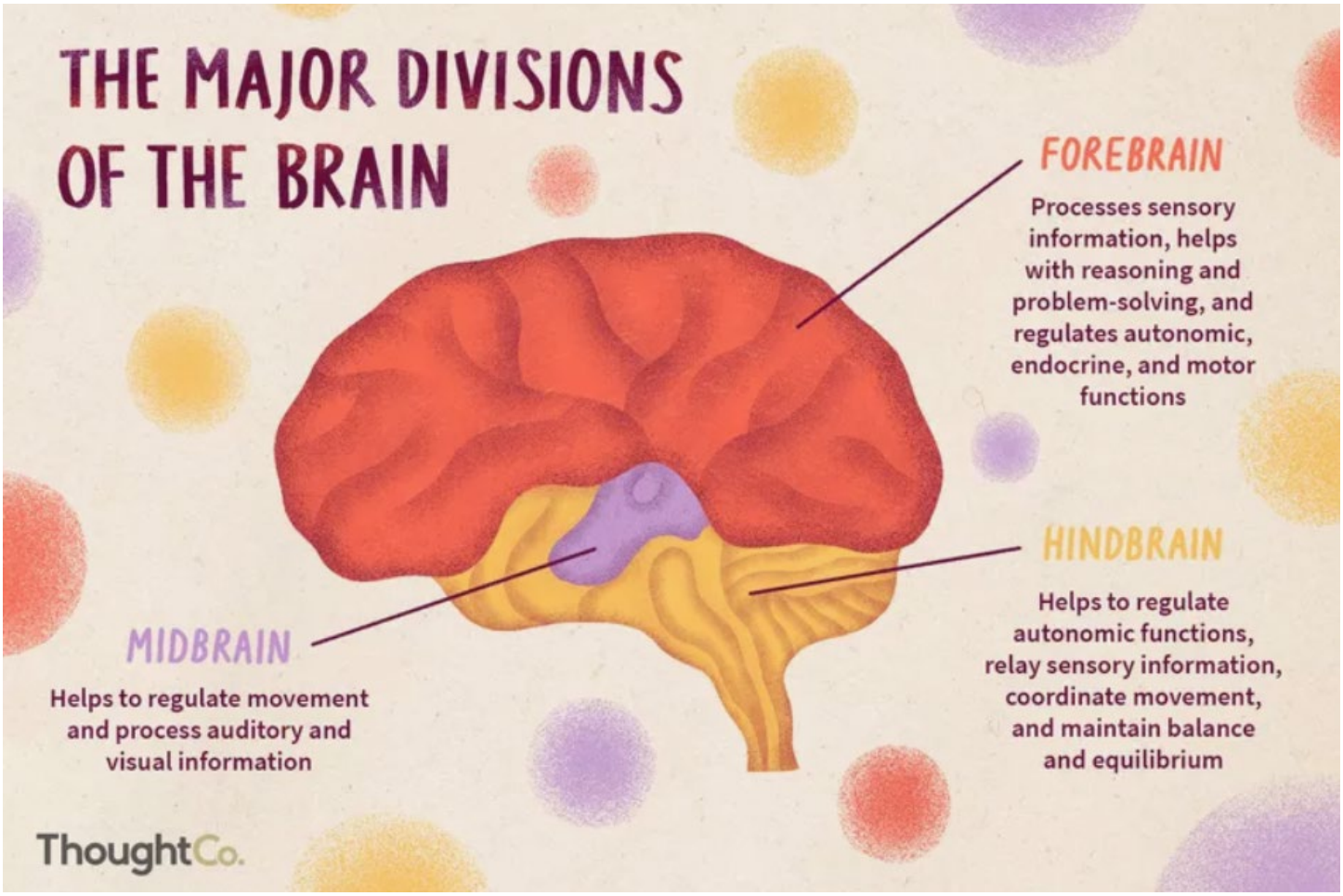
During these early vesicle stages, the walls of the neural tube contain neural stem cells in a region called the neuroepithelium or ventricular zone. These neural stem cells divide rapidly, driving growth of the early brain, but later, these stem cells begin to generate neurons through the process of neurogenesis Broadly speaking, during its development, **the human brain is divided into three "brains"**

Hindbrain or **rhombencephalon** is a developmental categorization of portions of the central nervous system in vertebrates. It includes the medulla, pons, and cerebellum. Together they support vital bodily processes. medulla, pons, and cerebellum. Together they support vital bodily processes

Mesencephalon - the embryonic part of the hindbrain that differentiates into the pons and the cerebellum.

Division	Subdivision	Structures
Forebrain **Prosencephalon**	Telencephalon	Cerebral cortex
		Basal ganglia
		Limbic system
	Diencephalon	Thalamus
		Hypothalamus
Midbrain **Mesencephalon**		Tectum
		Tegmentum
Hindbrain **Rhombencephalon**	Metencephalon	Cerebellum
		Pons
	Myelencephalon	Medulla oblongata

Prosencephalon -



The structure and organization of the hindbrain is the simplest. It is in charge of the regulating the basic functions we need to survive and controlling our movements. Injuries to these structures can cause serious disabilities or death. The hindbrain is located right in the upper part of the spinal cord, and it's comprised of different structures:

The medulla oblongata: It helps control our automatic functions, like breathing, blood pressure, heart rate, digestion, etc.

The annular protuberance or pons This is the portion of the base of the encephalon that is located between the medulla oblongata and midbrain. It connects the spinal cord and the medulla oblongata to the superior structures in the hemispheres of the cerebral cortex and/or the cerebellum. It is used in controlling the brain's automatic functions and it has an important role in the awake-state levels and consciousness and sleep regulation.

The cerebellum: It is located below the brain and is the second largest structure in the encephalon. All of the information that is received by the body from its different sensory and motor pathways in the brain is integrated into the cerebellum, which is why its main function is controlling movement. It also helps to control posture and balance, as well as makes it possible for people to learn how to move, walk, ride a bike... Damages to this structure generally cause movement and coordination problems and issues controlling posture, as well as dysfunctions in some superior cognitive processes.

THE MIDBRAIN: It is the structure that joins the posterior and anterior brain, driving motor and sensory impulses. Its proper functioning is a pre-requisite for the conscious experience. Damages to this part of the brain are responsible for some movement problems, like tremors, stiffness, strange movements, etc.

THE FOREBRAIN: It is the most developed and evolved structure in the encephalon, and it has the most complex elevated organization. It consists of two main parts:

Diencephalon: Located in the interior of the brain. It is made up of important structures like the thalamus and hypothalamus.

Thalamus: It is similar to the re-transmission station of the brain: it transmits the majority of perceived sensory information (auditory, visual, and tactile), and allows them to be processed in other parts of the brain. It is also used in motor control.

Hypothalamus: It is a gland located in the center area of the base of the brain that has a very important role in the regulation of emotions and many other corporal functions like appetite, thirst, and sleep.

Brain Cerebrum: It is known informally as the brain, which covers all of the brain cortex (fine layer of gray matter, wrinkled in grooves and folds), the hippocampus, and the basal ganglia.

Brain anatomy and functions
In this area, we will look closer at the brain's anatomy and the functions of each structure

THE BASAL GANGLIA: A group of subcortical neuronal structures that work to start and integrate movement. They receive information from the cerebral cortex and the base of the encephalon, process it, and project it to the cortex, the medulla, and the base to allow for a coordinated movement. It is made up of a few structures:

- Caudate nucleus, which is a "C" shaped nucleus that is implied in voluntary movement control, although it is also implied in learning and memory processes.
- Putamen
- Globus pallidus
- Amygdala, which plays an important key role in emotions, especially in fear. The amygdala helps to store and classify memories and emotions.

THE HIPPOCAMPUS: A small subcortical seahorse shaped structure that plays a very important role in the formation of memory, both in classification and long-term memory.

THE CEREBRAL CORTEX: A thin layer of gray matter that grooves around itself, forming a type of protuberance, called convolutions, that give the characteristic wrinkled look to the brain. The convolutions are delimited by grooves or cerebral sulci and those that are especially are deep are called fissures. The cortex is divided into two hemispheres, right and left, and they are separated by the interhemispheric fissure and joined by a structure called the corpus callosum which allows transmission between the two. Each hemisphere controls a side of the body, but this control is inversed: the left hemisphere controls the right side, and the right hemisphere controls the left side. This phenomenon is called brain lateralization.

EACH HEMISPHERE IS DIVIDED INTO 4 LOBES: These lobes are delimited by 4 cerebral suculi (Central or Roland suculus, lateral or Silvio suculus, parietal-occipital suculus, and the singular suculus):

Frontal lobe: The biggest lobe in the cortex. It is located in the front, right behind the forehead. It extends from the anterior to the central suculus. It is the control center of you brain. The frontal lobe is involved in planning, reasoning, problem solving, judgement, and impulse control, as well as in the regulation of emotions, like empathy, generosity and behavior. It is linked to executive functions (Miller, 2000; Miller & Cohen, 2001).

Temporal lobe: It is separated from the frontal and parietal lobe by the lateral suculus and the limits of the Occipital lobe. It is used in auditory and language processing, and is also used in memory functions and managing emotions.
Parietal lobe: It's located between the central suculus and the parietal-occipital suculus. This part of the brain helps to process pain and tactile sensation. It is also involved in cognition.
Occipital lobe: It is delimited by the posterior limits of the parietal and temporal lobes. It is involved in visual sensation and processing. It process and interprets everything that we see. The Occipital lobe analyzes aspects like shape, color, and movement to interpret and make conclusions about visual images.
Some authors talk about a fifth lobe, the **limbic lobe:** The limbic system is made up of various structures, among of which is the amygdala, the thalamus, the hypothalamus, the hippocampus, the corpus callosum, and a few others. The limbic system manages physiological responses to emotional stimuli. It is related to memory, attention, emotions, sexual instincts, personality, and behavior.

BRAIN FUNCTION
What is the brain's function?
The functions of the brain as part of the Central Nervous System (CNS) is to regulate the majority of our body and mind purpose. This includes vital functions like breathing or heart rate, to basic functions like sleeping, eating, or sexual instinct, and even superior functions like thinking, remembering, reasoning, or talking. In order to carry-out any seemingly simple task, our brain has to perform thousands of processes to ensure that we properly complete the task. Proper brain function is the key to a healthy life.
On our parts of the brain page, we mention that basic vital functions are measured by the oldest brain structures. In other words, the structures located in the hindbrain (medulla, pons, cerebellum), and in the midbrain. However, superior brain functions, like reasoning, memory, and attention, are controlled by the hemispheres and lobes that form part of the cortex.

What are cognitive functions?
Cognitive functions are the mental processes that allow us to receive, select, store, transform, develop, and recover information that we've received from external stimuli. This process allows us to understand and to relate to the world more effectively.

We are constantly using our brain functions - It's impossible to do anything *without* using at least some of our cognitive functions. For example, Do you want breakfast? Thinking about starting a book? Do you have to drive anywhere? Are you having an interesting conversation with your friends?

What are the main cognitive functions?
Often times when we talk about superior cognitive functions, we're referring to the cognitive skills that we use in order to understand and interact with the world. Although sometimes we study them as separate ideas, we have to remember that cognitive functions are always interrelated and that sometimes they overlap. We'll take a look at the main brain functions:

ATTENTION: Attention is a complex mental process that cannot be reduced to one simple definition, one concrete anatomical structure, and that cannot be assessed by one single test as it encompasses diverse processes. To simplify, attention is the cognitive or brain function that we use to select between stimuli that reach our brain simultaneously, both external (smells, sounds, images...) and internal (thoughts, emotions...), that are useful for carrying-out a mental or motor activity. In reality, it is a whole set of processes that vary in complexity and allow us to carry-out the rest of our cognitive functions well. Attention can broken into different types depending on its complexity.

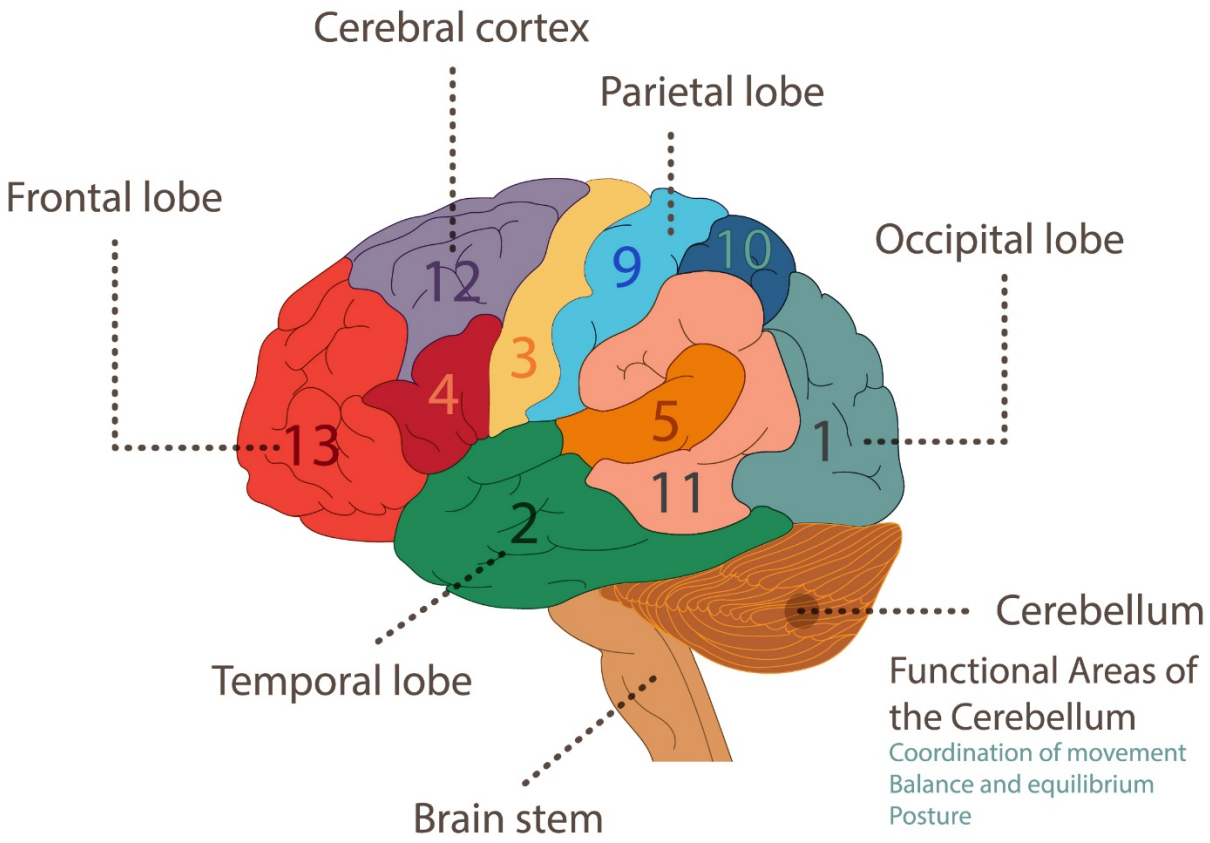
MEMORY: Memory is a complex process that allows us to code, store, and recover information. If the attentional system doesn't work properly, we won't be as efficient in doing such tasks. If we don't pay attention to something, we cannot code, store, or recover this information. In order to understand memory, we can classify it according to two criteria:

EXECUTIVE FUNCTIONS: Executive functions are the most complex cognitive functions. While there are different definitions for cognitive functions, most of them include cognition control and thought and behavior control through various related processes. They comprise a set of complex skills, like attention focus, planning, programming, regulation, and intentional behavior verification. Executive functions are located in the frontal lobe. According to Lezack, these functions can be grouped into a series of components:

LANGUAGE: Language is a symbolic communication system that is presented through languages. Language isn't only important for communicating with others, but also for structuring our internal thoughts. Language processing uses different brain areas that act together through different functional systems that involve the left hemisphere especially. We could talk about two cortical areas that are in charge of expression and reception of language, mainly in the left cerebral hemisphere:

VISUAL-PERCEPTIVE AND VISUAL-SPATIAL FUNCTIONS: Visual-perceptive functions are the functions that allow us to recognize and differentiate between stimuli. They help us interpret, attribute, and associate what we're seeing into known categories and integrate them into our knowledge. When these functions work properly, we are able to recognize friends' and family's faces, or distinguish between keys, a hat, and a comb.

• Anatomy and functional Areas of the Brain •



1	2	3	4
Visual Area: Sight Image recognition Image perception	Association Area Short-term memory Equilibrium Emotion	Motor Function Area Initiation of voluntary muscles	Broca's Area Muscles of speech

Why do we use brain functions?
In the course of just one day, we use our brain functions constantly. Thousands of tasks are being performed, which require milliones of complex mental calculations from different parts of the brain. Here we will show you some examples of you will use these cognitive skills and brain functions daily in a multitude of tasks.

- **Making food is good for your brain?** When you're cooking, you have to watch various pots and pans at the same time, all while attending to your guests and the recipe.
- **Run a meeting?** Properly running a business or family meeting is a complex task. It requires your brain to activate determined neural networks and brain functions related to attention, concentration, active listening capacity, response speed, etc.
- **Fly a kite?** Most people assume that relaxation comes naturally, but you couldn't do it without a few key cognitive abilities.
- **Drive a car?** Even if you're an experienced driver, getting to your destination quickly and safely requires skill, concentration and a wide array of cognitive abilities.

- **Meet with friends?** Life would be lonely without the cognitive skills that allow us to meet and greet one another.