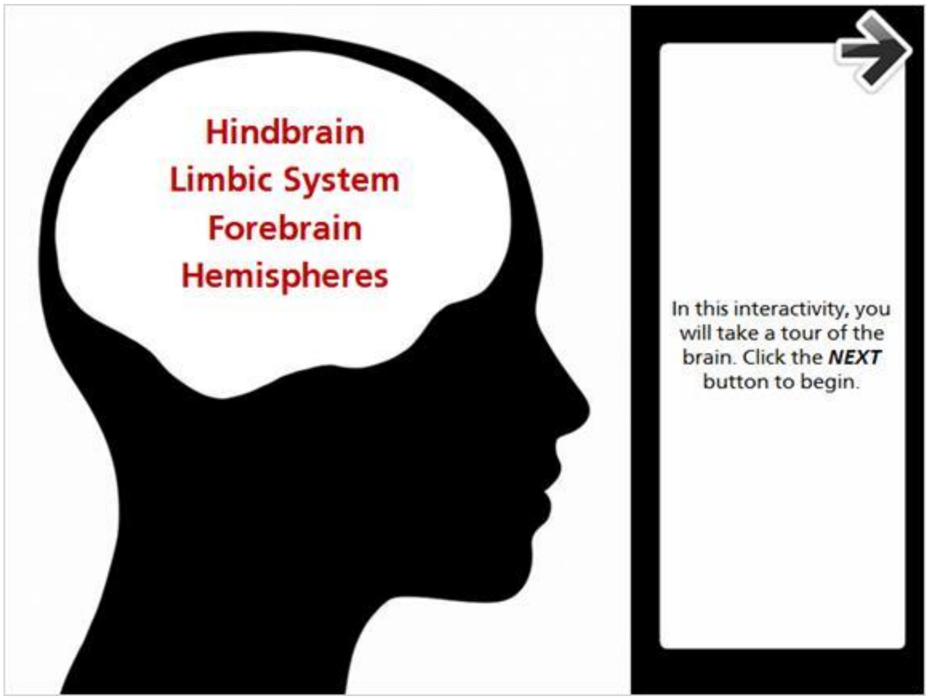
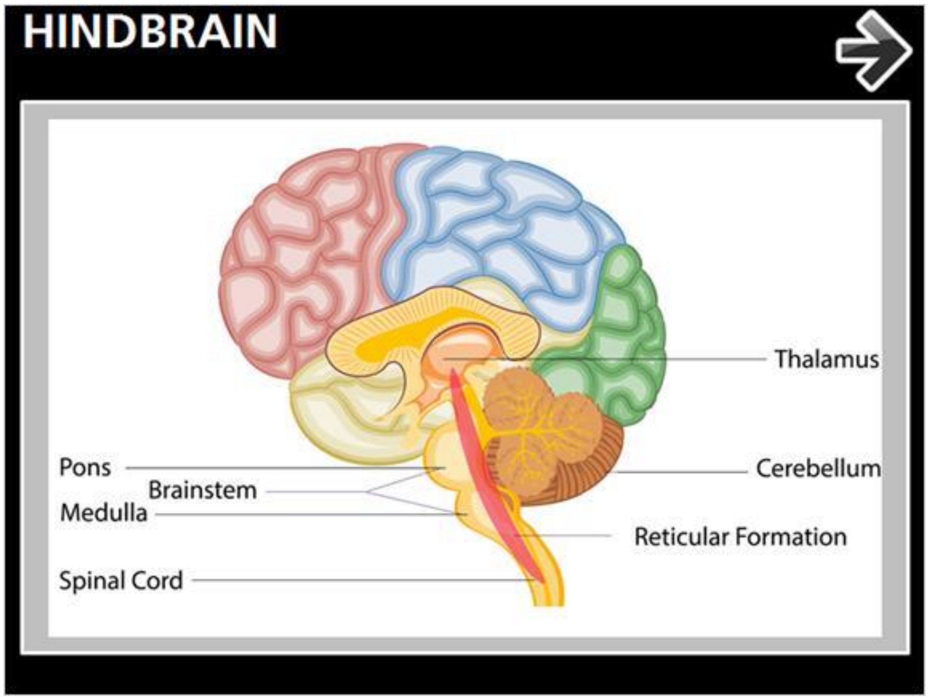
# Module 2: Biological Basis of Behavior
## Topic 3 Content: Tour of the Brain

### Introduction




In this interactivity, you will take a tour of the brain. Click the right arrow at the top of your screen to begin.

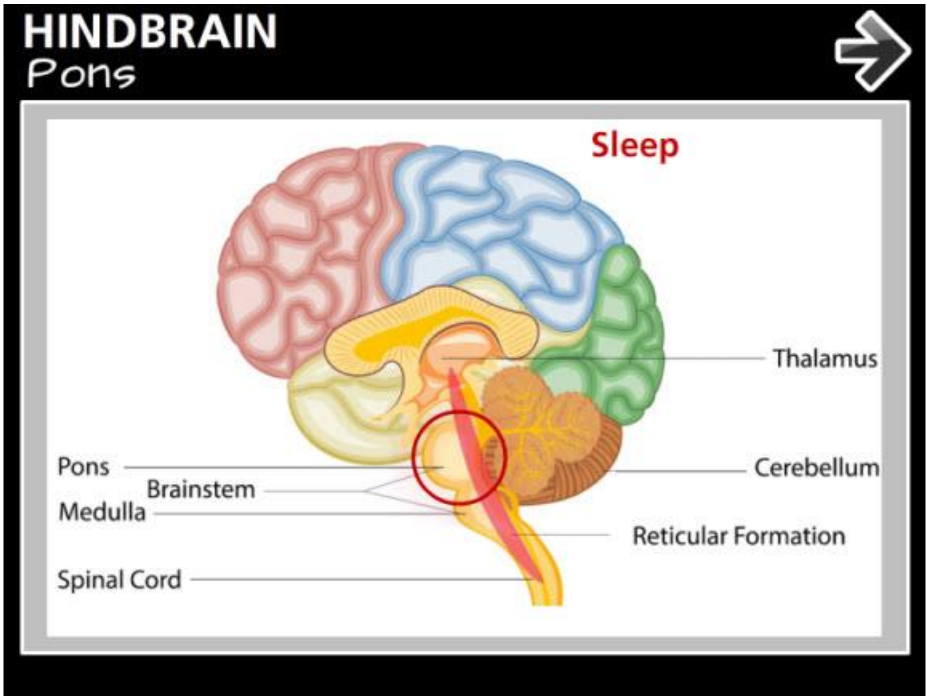
### Hindbrain




The first stop on the brain tour begins in the area called the hindbrain. The hindbrain is the most basic part of the brain, where the spinal cord ends and begins to swell as it approaches the brain itself. All mammals share these parts of the brain with humans, and they are important for the most basic life functions.

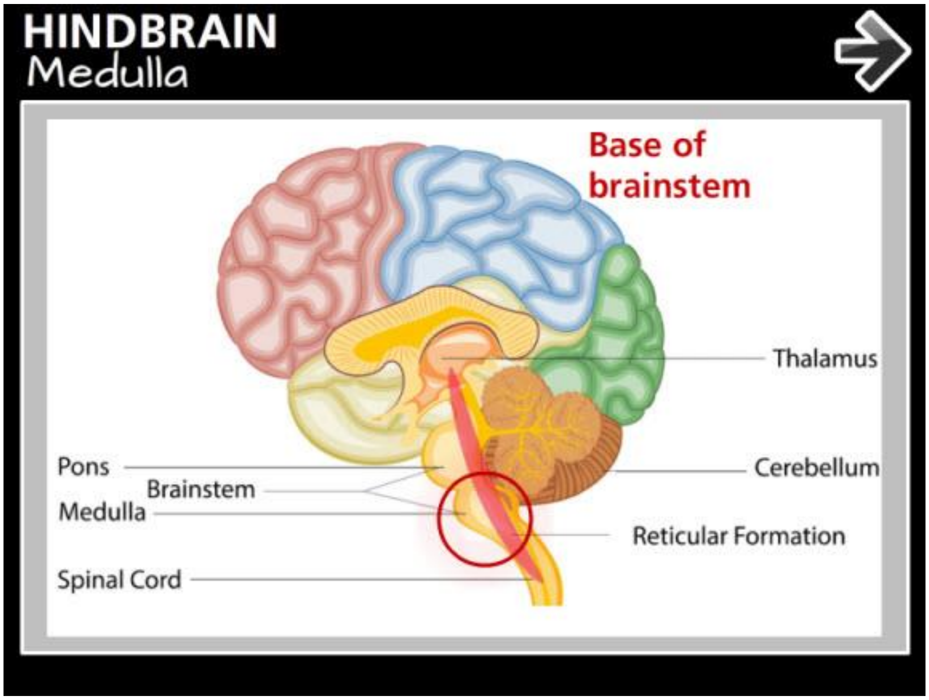
Take a moment to view the image of the hindbrain. Click the right arrow at the top of the screen to explore information about the pons, medulla, thalamus, cerebellum, and reticular formation.

## Pons



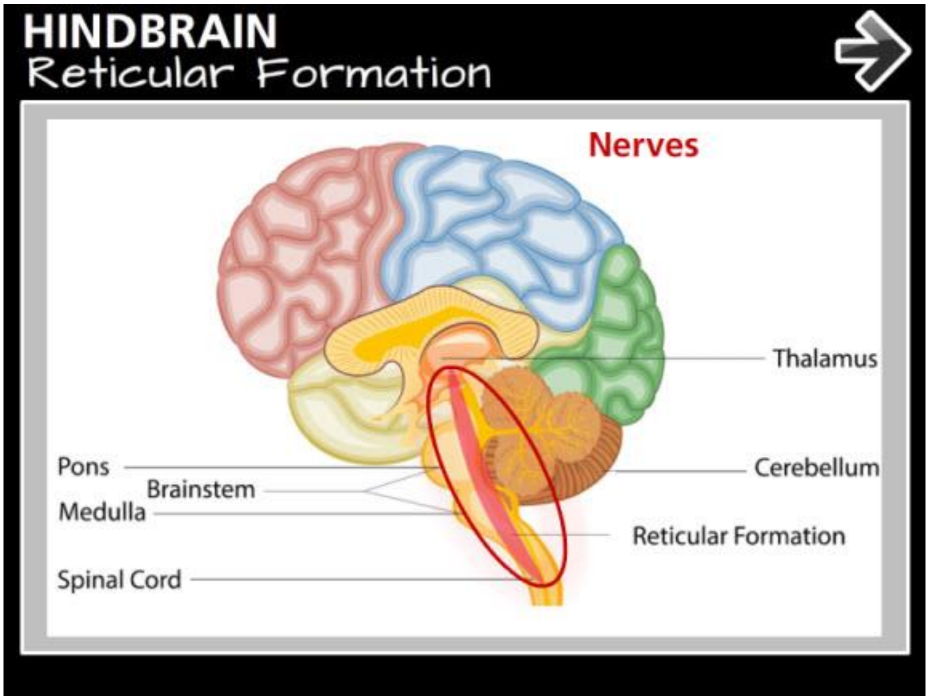

Pons is Latin for "bridge," and refers to the swollen area near the top of the brainstem. Think of the brainstem as the link between the brain and spinal cord. The brainstem contains the pons and the medulla. The pons serves as a bridge between the more recently evolved higher portions of the brain and the more basic functions of the brainstem. The pons also helps control basic autonomic, or automatic, functions. It also plays an important role in sleep.

## Medulla



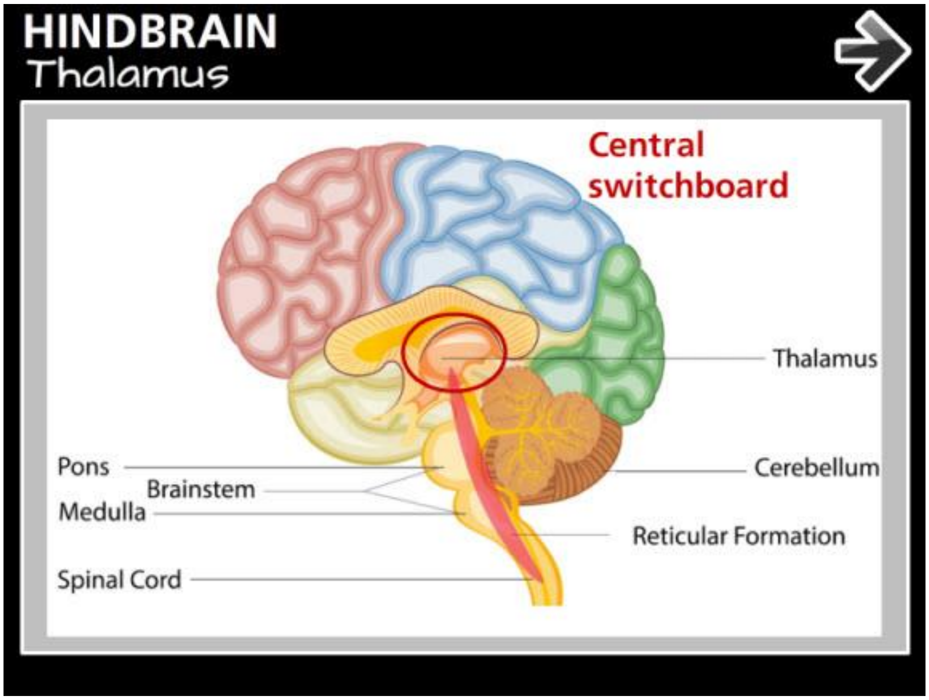

The medulla is the base of the brainstem. It is the first part of the spinal cord to swell into something more complex. The medulla controls basic autonomic functions like breathing, heartbeat, and circulation. For this reason, damage to the medulla can often prove fatal.

## Reticular Formation



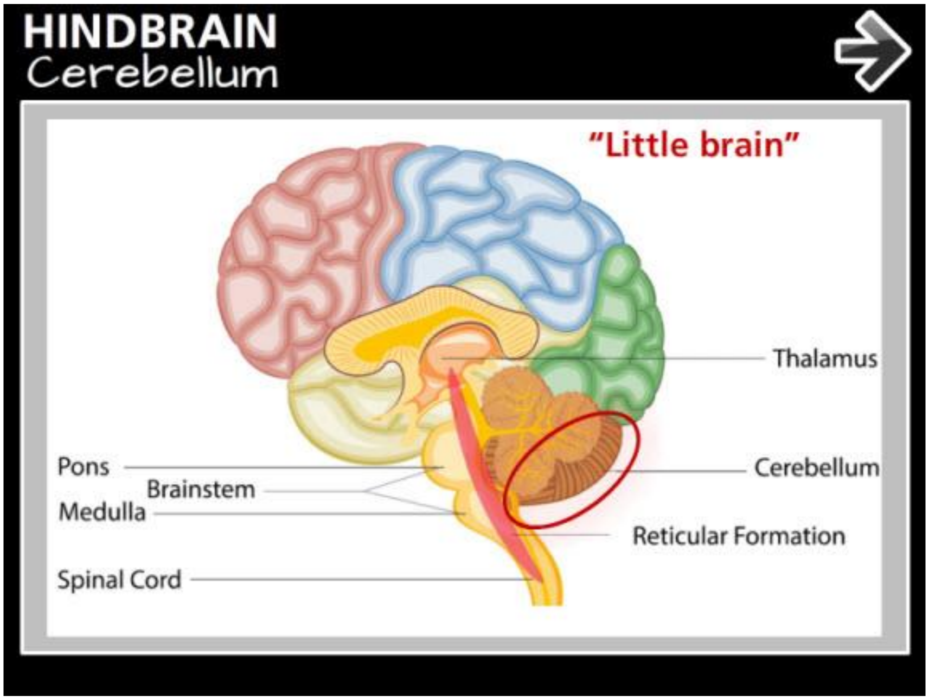

The reticular formation is a web-like series of nerves that begins at the back of the spinal cord and extends upward through the medulla and the pons, branching out as it reaches the thalamus. The reticular formation is particularly important with regard to alertness and wakefulness. If a person sustains damage to the reticular formation, it could result in a permanent coma.

### Thalamus



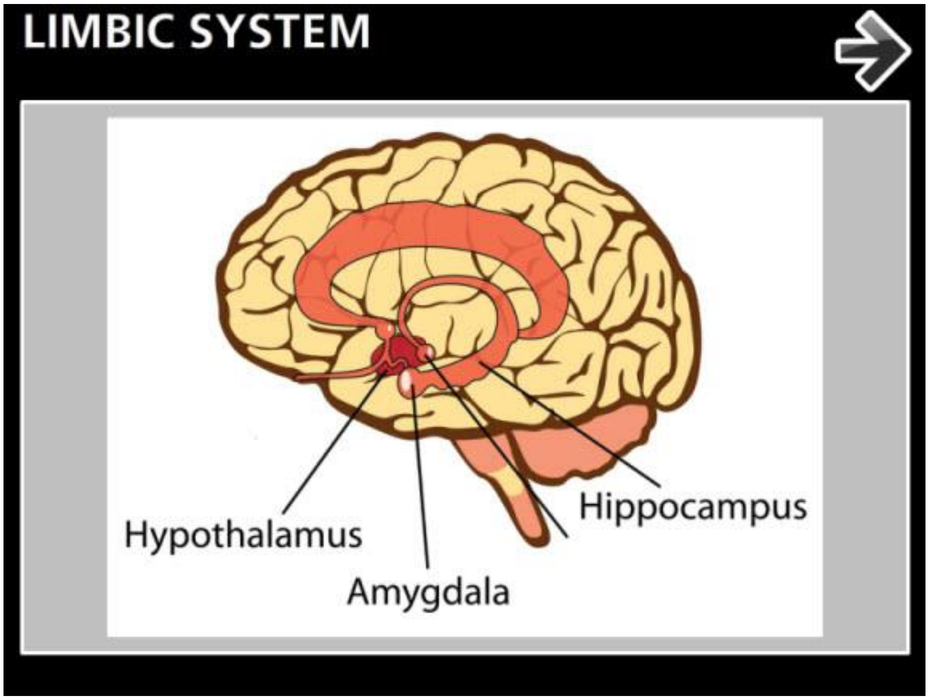

Think of the thalamus as the central switchboard of the brain. Located roughly at the center base of the brain, the thalamus relays sensory input from all of the senses, except smell, from one part of the brain to another. For example, as you are looking at the screen, light is travelling into your eyes. Your eyes convert this information into basic signals that continue on to your thalamus. The thalamus then sends that visual information to be processed in the back of your brain, so you can make sense of what you see on the screen.

### Cerebellum




The cerebellum rests just behind the brainstem and below the cerebral cortex. It resembles an additional smaller brain below the main cortical area, so it makes sense that the term cerebellum is Latin for "little brain." From the outside, the cerebellum looks a bit like a ball of spaghetti noodles around the brainstem, but is actually a complex bundle of tissue that plays a key role in fine motor movements and learning motor skills. For example, while learning to play guitar, you are using your cerebellum. If you were to damage the cerebellum, it would not paralyze you, but it might damage your fine motor skills enough to prevent you from walking with a normal gait, or completing tasks that require precise movements and coordination.

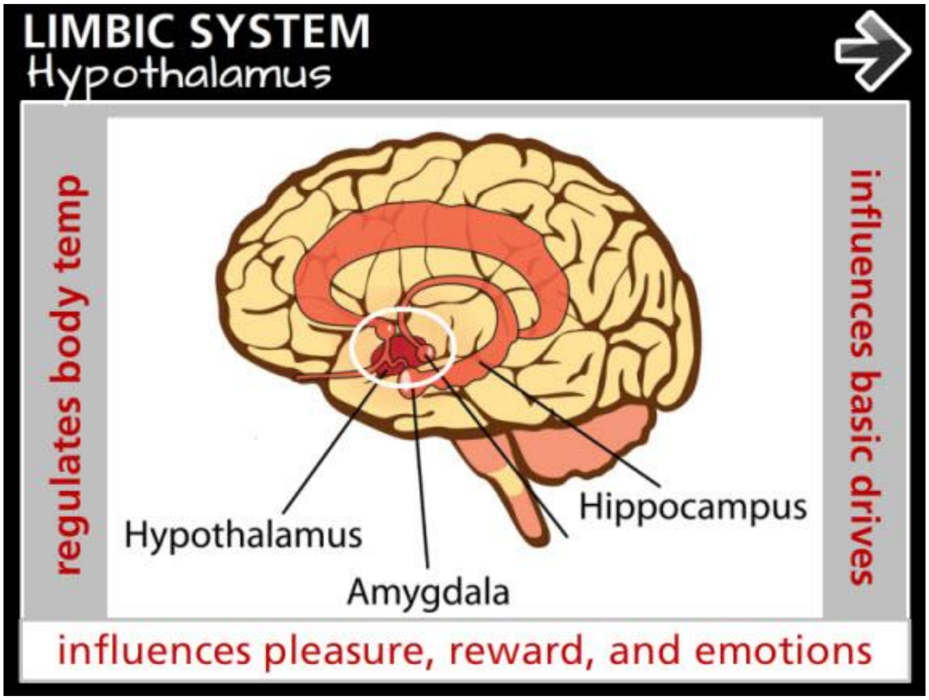
### Limbic System




The next stop on the brain tour is the limbic system. In Latin, limbic means "border." The limbic system received this name since it serves as a border region between the more basic parts of the hindbrain and the more complex portions of the forebrain. The limbic system is located on top of the brainstem and thalamus, but underneath the lobes of the cerebral cortex. The limbic system governs some basic drives, such as thirst and hunger, and also primal emotions, like fear and aggression. Additionally, the limbic system plays a key role in memory.

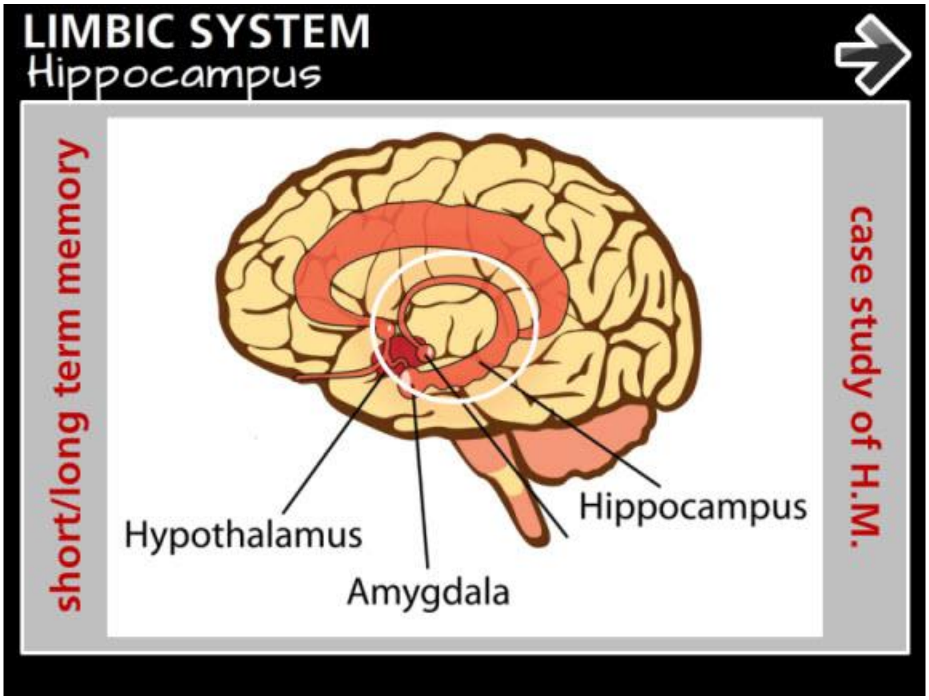
Take a moment to view the image of the limbic system. Click the right arrow at the top of the screen to explore information about the hypothalamus, hippocampus, and amygdala.

### Hypothalamus



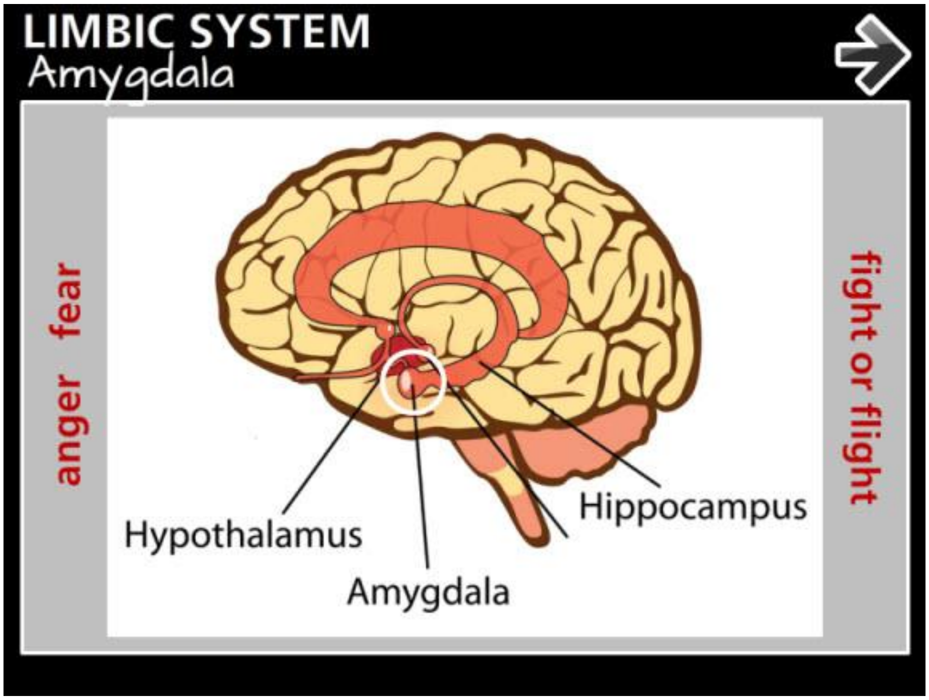

The hypothalamus is a small group of cells just below the thalamus. Although small, this part of the limbic system plays a large role in day-to-day life. The hypothalamus regulates body temperature, and is also instrumental in increasing or decreasing basic drives, such as thirst, hunger, and sexual motivation. Furthermore, the hypothalamus influences the experience of pleasure, reward, and emotions.

## Hippocampus



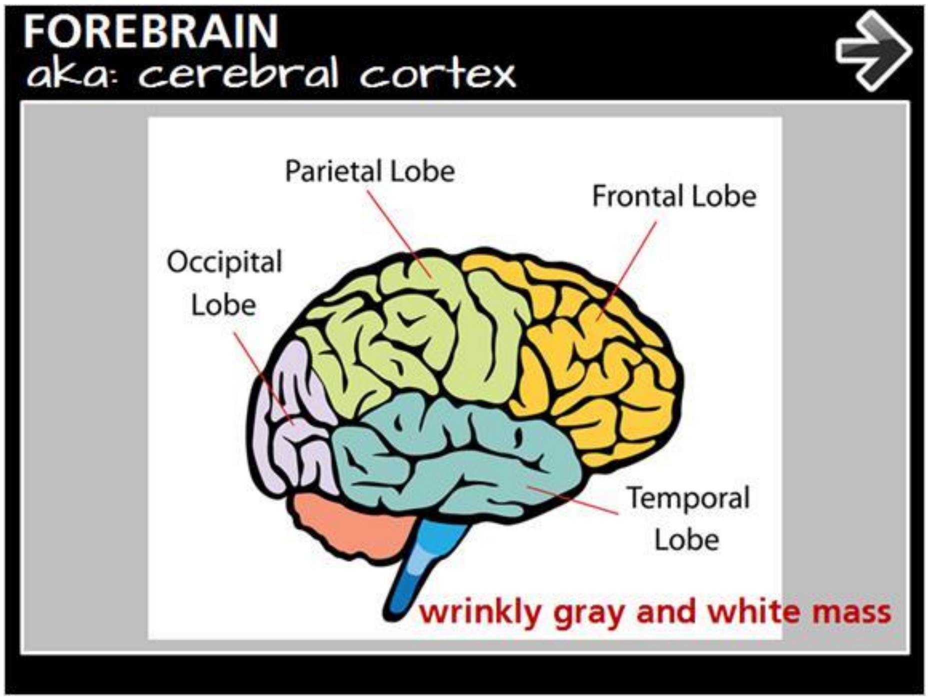

Curling around in an arc, the hippocampus is a critical structure for converting short-term memories into long-term memories. In one notable case, a patient known as H.M. had most of his hippocampus removed as an experimental procedure to stop him from having life-threatening seizures. The surgery successfully stopped his seizures, but the loss of his hippocampus prevented him from forming new long-term memories. Although he lived until 2009, H.M. always believed that the year was 1953, which was the year the procedure took place.

### Amygdala



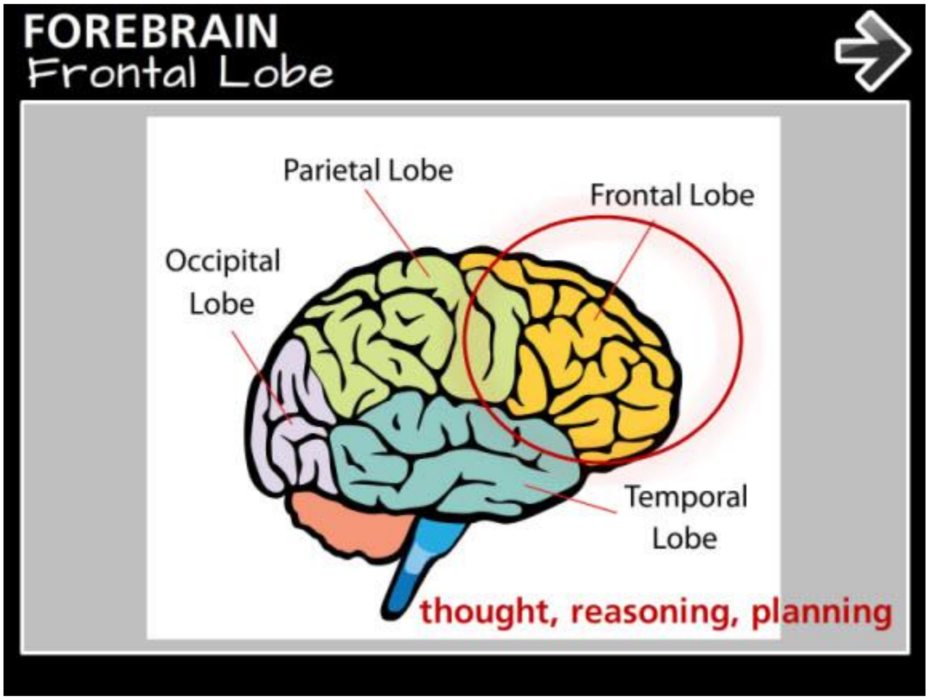

The amygdala is an almond-shaped cluster at the end of each side of the hippocampus. It plays a key role in activating the basic emotions of anger and fear. Simply stated, it is the source of the fight-or-flight response. For example, if you were being attacked by a person, you may attempt to flee from the threat, or you may attempt to fight back. Either way, your amygdalae would be activated in response to the perceived threat.

### Forebrain



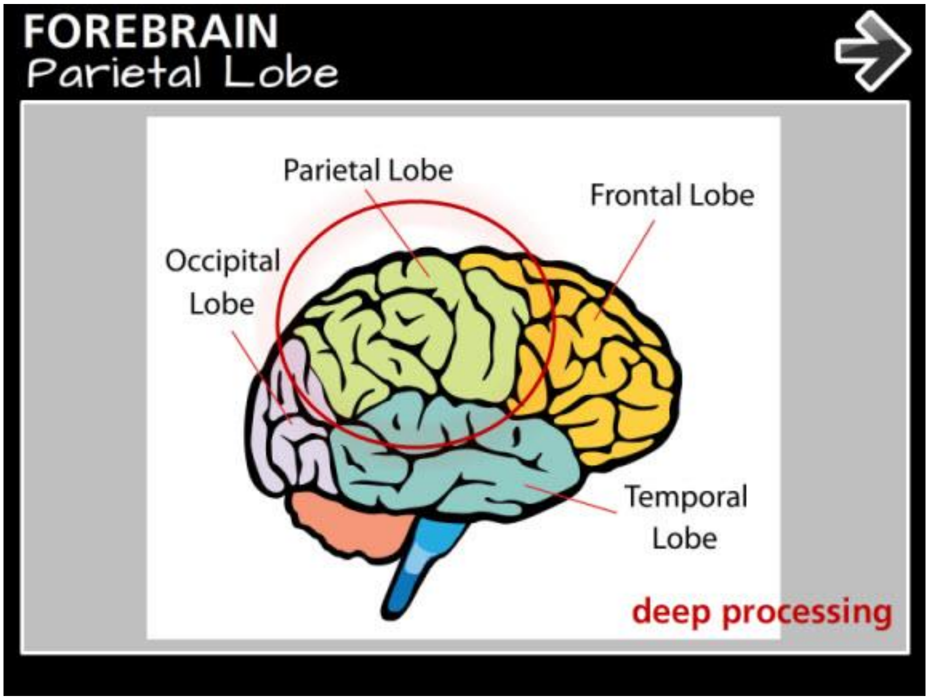

In terms of evolution, the forebrain is the most recently developed part of the brain. In humans, the forebrain, also called the cerebral cortex, is the largest and outermost part of the brain. It is the part of the brain immediately under the skull. When people visualize a brain, they are usually thinking of the forebrain: a wrinkly, gray and white mass that takes up most of the space in the head. The cerebral cortex is wrinkled in order to fit more gray matter into a small space. Relative to their body size, humans have one of the largest brains of any animal.

## Frontal Lobes



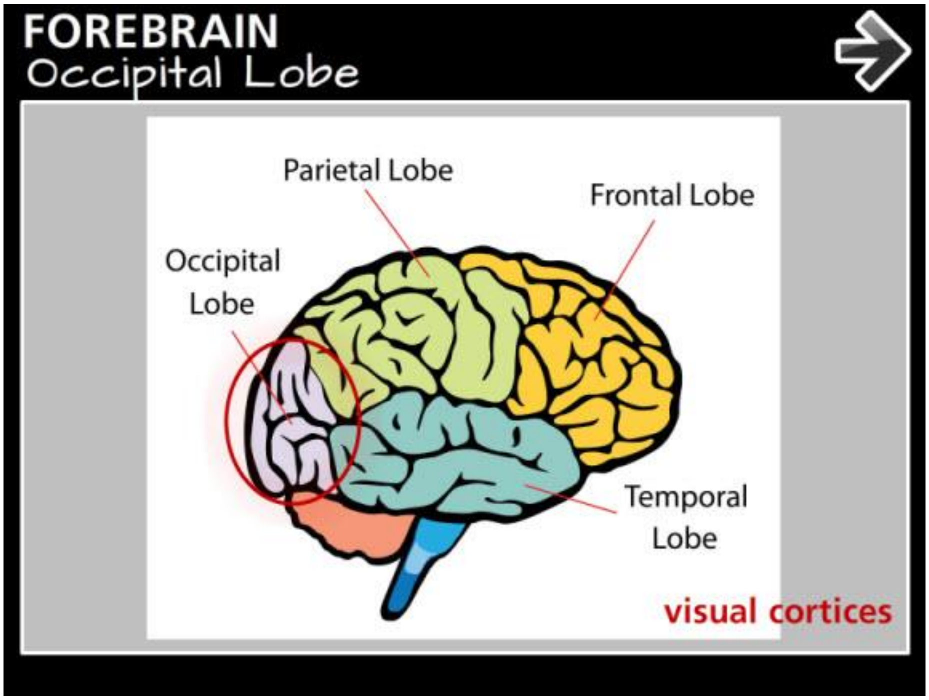

The frontal lobes are at the front of the head, behind the forehead. These lobes are associated with the most advanced processes of thought, reasoning, and planning. Moving farther back from the area just behind the forehead, toward the top of the head, is the back portion of the frontal lobe, which is responsible for motor movements. The motor cortex, found where the frontal lobe meets the parietal lobe, is a band of tissue running all the way across both frontal lobes. Along this band are neuron clusters that send signals to the voluntary muscles. If your brain was electrically stimulated in one area on the motor cortex, it may cause you to wiggle your left toe. The same stimulation could be moved to another place and it might cause your right arm to move.

## Parietal Lobes



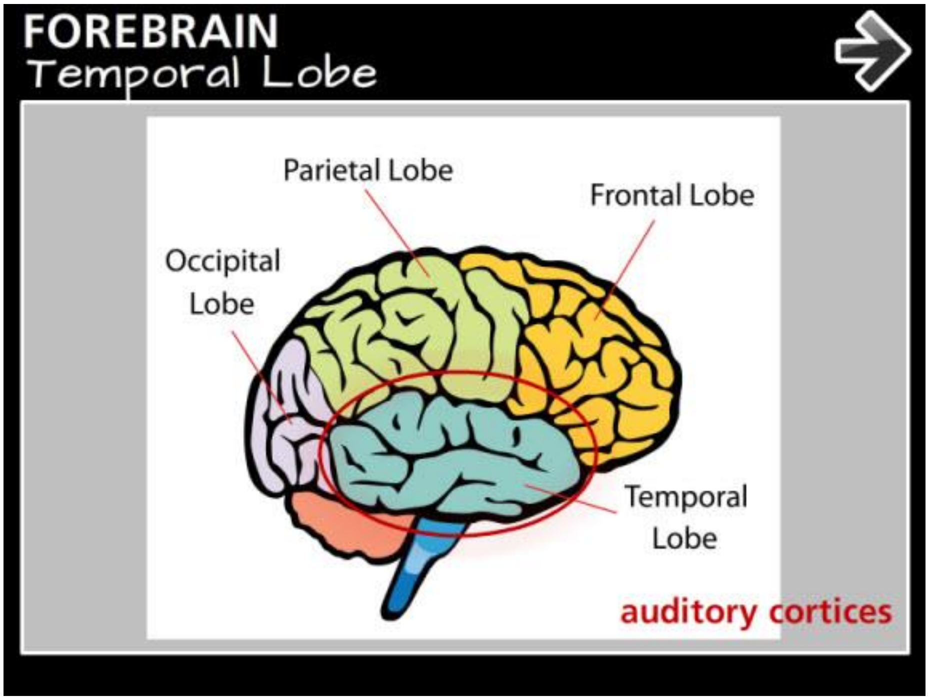

Parietal lobes are next to the frontal lobes, at the top and back of the head. The parietal lobes are primarily responsible for deeper information processing, such as mathematical reasoning and memory. The parietal lobes also integrate sensory information from the body and other parts of the brain. Specifically, next to the motor cortex of the frontal lobe, the parietal lobe contains a similar cortex called the sensory cortex. The sensory cortex runs across both parietal lobes in a band, just like the motor cortex runs across both of the frontal lobes. The sensory cortex also corresponds to different parts of the body; however, this information is incoming, instead of outgoing, as it is in the motor cortex. It is important to note that the area of the sensory cortex used by each body part is based on sensitivity, not size. For example, the lips and fingers take up a large portion of the sensory cortex, since they are highly sensitive areas. In contrast, the torso is a much larger part of the body, but it is less sensitive; therefore, it only takes up a small portion of the sensory cortex.

### Occipital Lobes



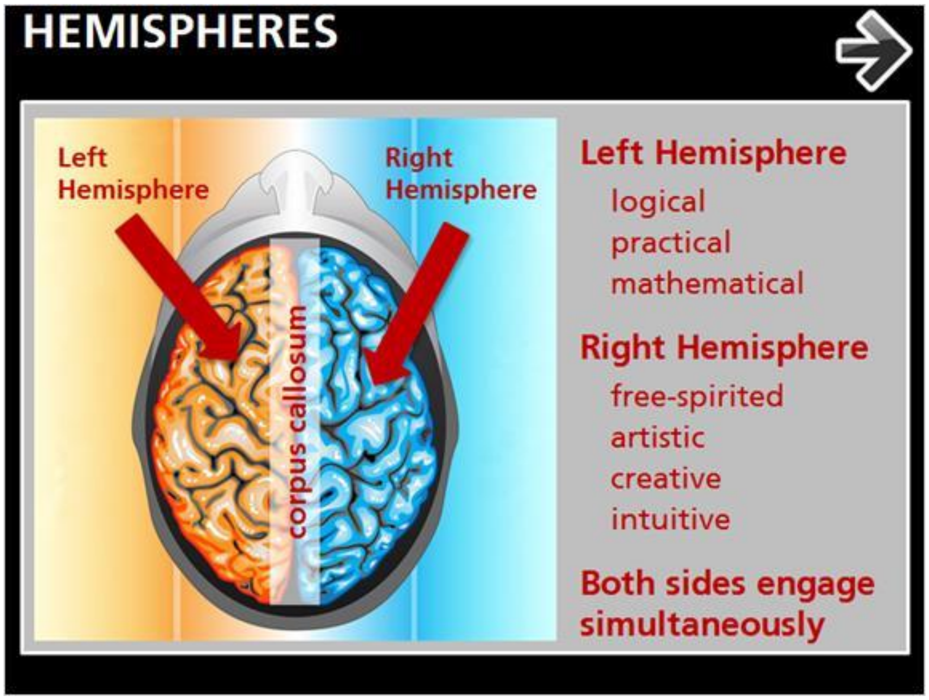

At the very back of the head, the occipital lobes contain the visual cortices, which are primarily responsible for processing visual information. Visual information travels from the eyes and the optic nerves through the thalamus, and then back to the occipital lobes for processing. Everything you see in your left visual field, regardless of which eye you see it with, crosses over to be processed in the right occipital lobe. The opposite is also true. Damage to the occipital lobes will not necessarily cause blindness, but it can cause strange difficulties in visual processing, such as the inability to recognize certain objects, shapes, or colors.

### Temporal Lobes




The lobes closest to the ears on each side are known as the temporal lobes. The temporal lobes contain auditory cortices. Sounds received by the ears become further processed in the temporal lobes, in order to recognize and make sense of them. The temporal lobes also contain areas important for memory and some higher-order functions, like facial recognition.

## Hemispheres

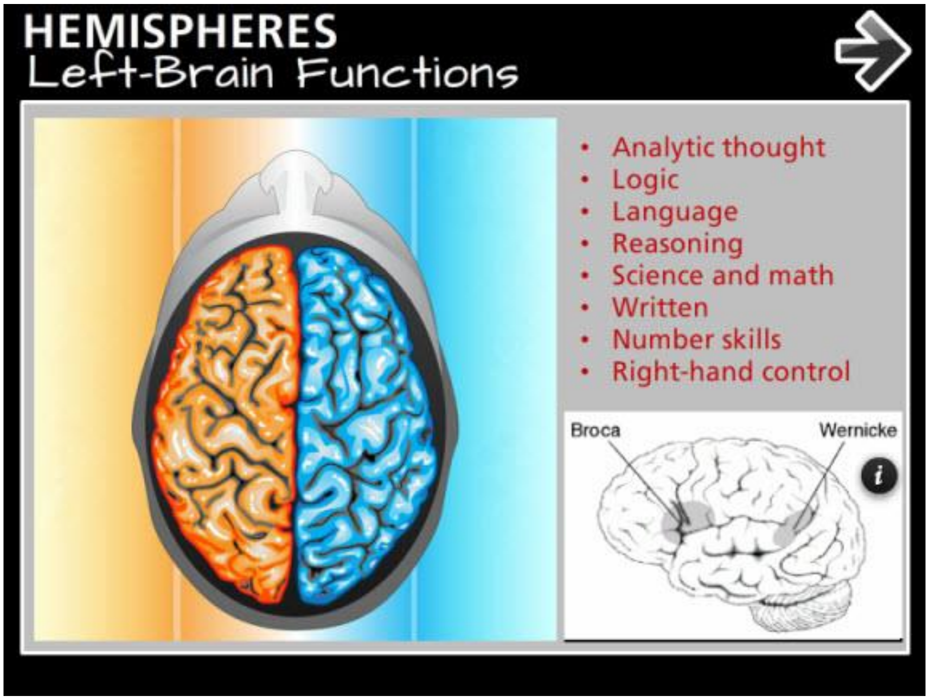



Take a moment to step back and examine the brain as two separate hemispheres. The division of the brain into right and left hemispheres is quite dramatic. The only structure connecting the right hemisphere with the left hemisphere is a band of neural fibers, called the corpus callosum.

The left hemisphere of the brain is typically associated with logical, practical, and mathematical traits. The right hemisphere is often associated with free-spirited, artistic, creative, or intuitive traits. While it is true that the hemispheres specialize to a certain degree, there is a false belief that complex tasks, like painting a portrait or designing a building, are limited to only one side of the brain. In reality, any time you engage in a rich experience or challenging task, you are using both sides of your brain.

Our basic sensory and motor processes are lateralized, meaning they flip from one side of the body to the other side of the brain. For example, if you move your left foot, the impulse to do so comes from the motor cortex on the right hemisphere of your brain. If a sound wave travels into your right ear, it is processed in the left temporal lobe. The cross-over of signals from one side to the other could not happen without the thalamus and the corpus callosum.

## Left Hemisphere and Right Hemisphere




The following processes are controlled by the left hemisphere of the brain:

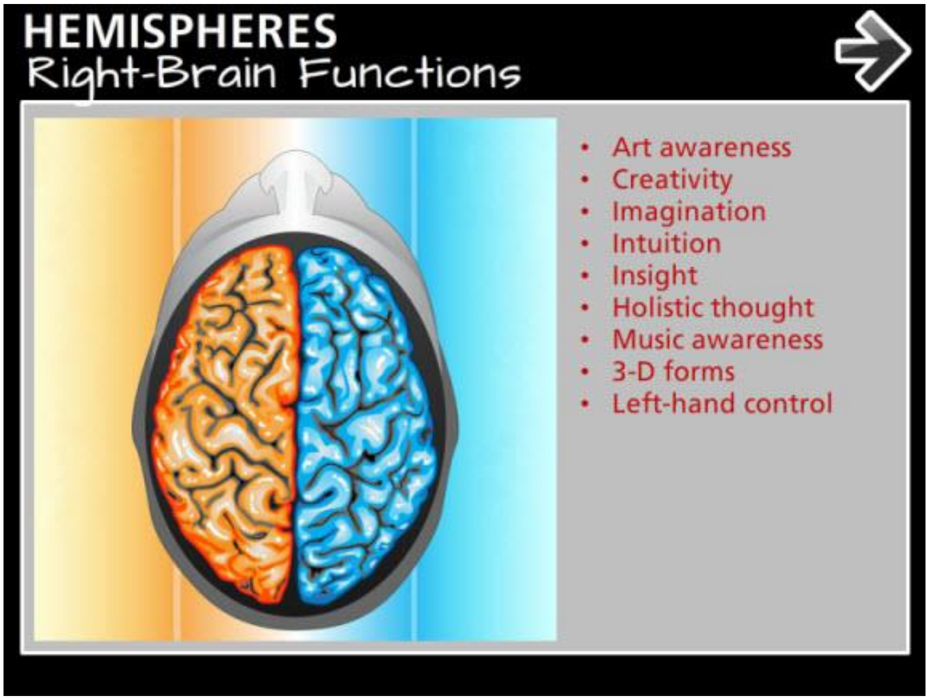
- Analytic thought
- Logic
- Language
- Reasoning
- Science and math
- Writing
- Numbers skills
- Right-hand control

Wernicke's and Broca's Areas are located in the left hemisphere. These areas help process speech and produce words.

Wernicke's area is located in the left temporal lobe. This area helps you make sense of what another person says to you. If Wernicke's area becomes damaged, a person might be able to hear you speak, but he or she might be able to understand what you are saying.

Broca's area, is typically located in the left frontal lobe. Broca's area allows people to move their lips, breathe, and use their vocal chords in the complex patterns needed to produce speech. If someone suffers a stroke that damages Broca's area, he or she may be able to understand what a person says to them, but his or her answers might not be coherent.

## Wernicke's and Broca's Areas




The following processes are controlled by the right hemisphere of the brain:

- Art awareness
- Creativity
- Imagination
- Intuition
- Insight
- Holistic thought
- Music awareness
- 3-D forms
- Left-hand control