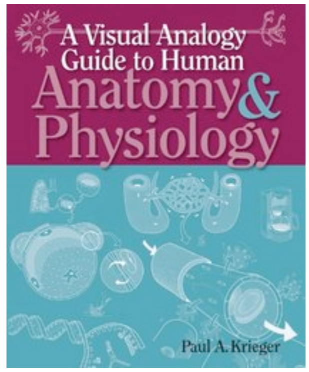
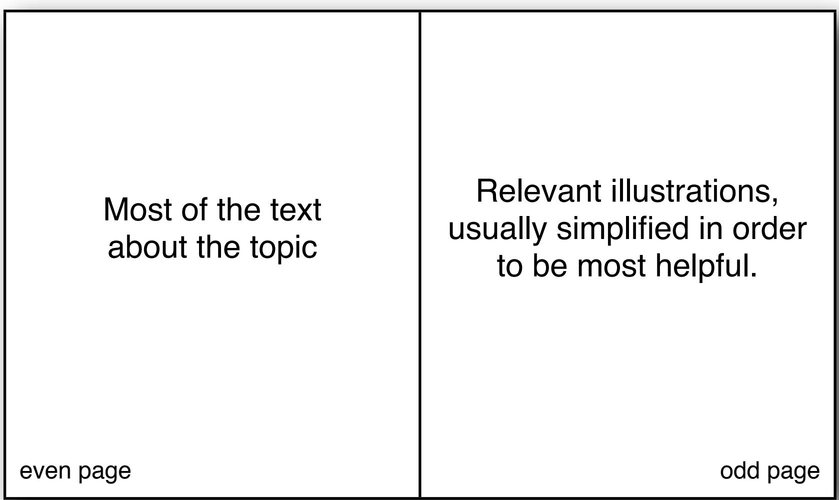


The following pages are an excerpt from *A Visual Analogy Guide to Human Anatomy and Physiology* by Paul A. Krieger.

It consists of five pairs of pages (ten pages total) that cover much of the relevant brain material for Week 13. While this isn't intended to replace your Week 13 reading, you may find that it strips out most of the unnecessary information

TABLE OF CONTENTS

In its original printed form, the information is presented like this:



Items marked with an asterisk (*) on the Week 13 Reading Guide are probably better answered using this document than the textbook.

Description

The three *largest regions* of the brain are the **brain stem**, **cerebellum**, and **cerebrum**.

1. The **brain stem** is located at the base of the brain and contains regulatory centers to control things we take for granted, such as respiration, cardiovascular activities, and digestion.
2. The **cerebellum** is located posterior to the brain stem and inferior to the cerebrum. It is divided into two left or right halves, or **hemispheres**, and is extensively folded to increase surface area. Its general function is to work with the cerebrum to coordinate skeletal muscle movements, and it also allows the body to maintain proper balance and posture.
3. The **cerebrum** is the largest part of the brain and contains billions of neurons. Like the cerebellum, it is divided into two **hemispheres**. The deep division between these two hemispheres is called the **longitudinal fissure**. The term **fissure** indicates a deep groove or depression that separates major sections of the brain.

The surface of the cerebrum is not smooth but is folded into many little hills and gulleys. Each hill is called a **convolution** (or *gyrus*) and each valley is a shallow groove called a **sulcus**.

The cerebrum is the part of the brain associated with higher brain functions including planning, reasoning, analyzing, and storing/accessing memories. Ironically, without it, you would not be able to read and learn about the brain as you are doing now. It also perceives and interprets sensory information and coordinates various motor functions such as those involved in speech. The cerebrum is divided into four major lobes named after the bones that cover them: *frontal*, *parietal*, *temporal*, and *occipital*.

Brain Stem

The **brain stem** consists of three parts: *medulla oblongata*, *pons*, and *midbrain*. The table below gives a description and general function of each part.

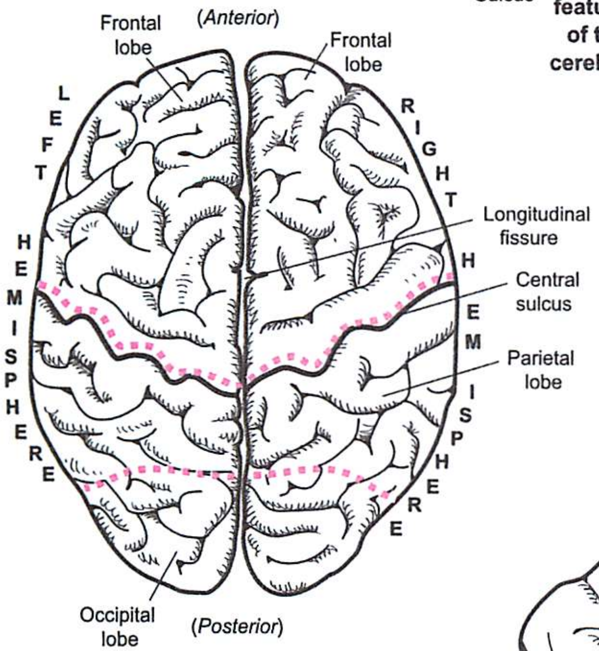
Brain Stem Region	Description	General Functions
Medulla oblongata	Between spinal cord and pons	Respiratory control center; cardiovascular control center
Pons	Between medulla and midbrain; bulges out as widest region in brain stem	Controls respiration along with medulla; relays information from cerebrum to cerebellum
Midbrain	Between diencephalon and pons; includes corpora quadrigemina (*sensory relay station*) and cerebral aqueduct (*connects third and fourth ventricles; contains cerebrospinal fluid*)	Visual and auditory reflex centers; provides pathway between brain stem and cerebrum

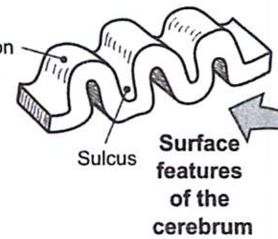
Diencephalon

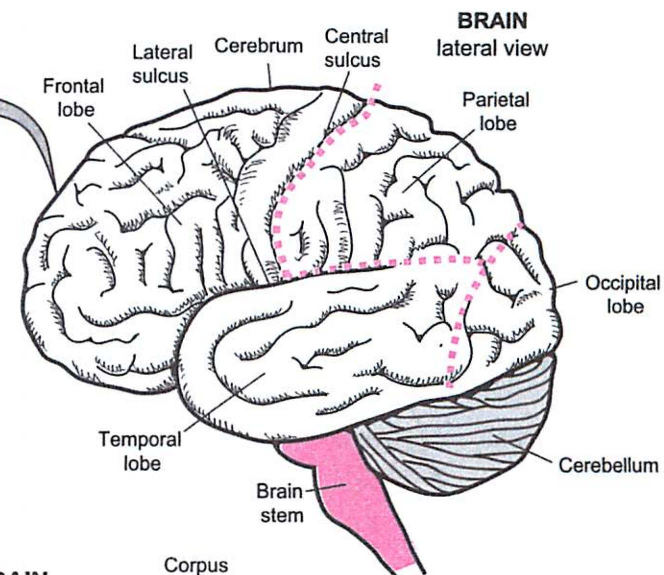
The **diencephalon** is located above the brain stem and contains three parts: *epithalamus*, *thalamus*, and *hypothalamus*. The table below gives a description and general function of each part.

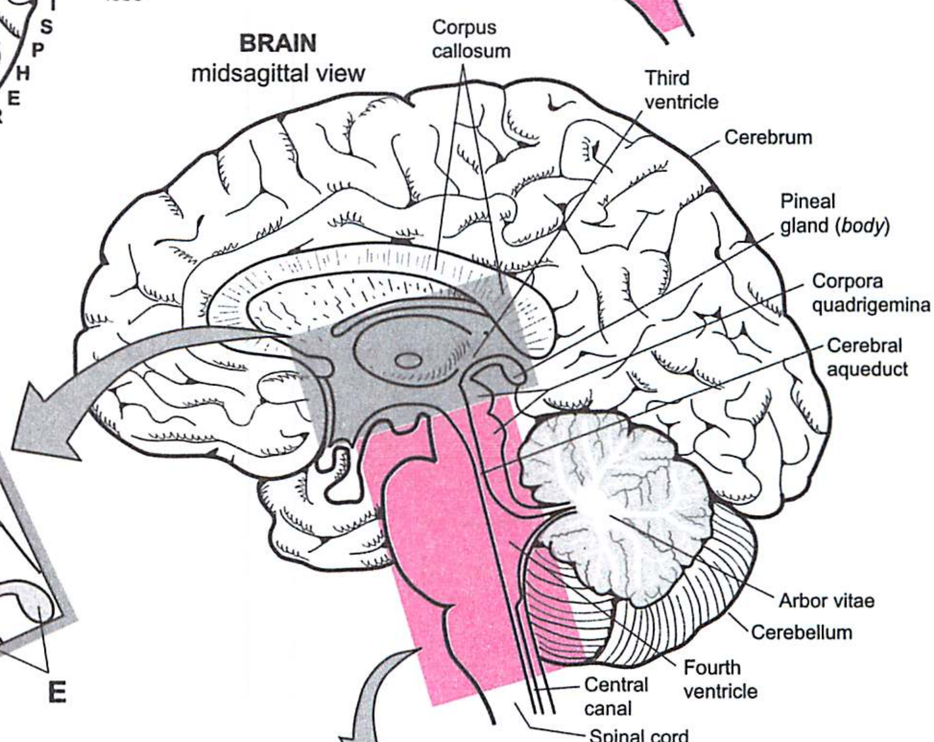
Diencephalon Region	Description	General Functions
Epithalamus	Roof of third ventricle; includes pineal gland; choroid plexus (*forms cerebrospinal fluid*)	Pineal gland makes hormone melatonin, which regulates day–night cycles.
Thalamus	Two egg-shaped bodies that surround the third ventricle	Relays sensory information to cerebral cortex; relays information for motor activities; information filter
Hypothalamus	Forms floor of third ventricle; between thalamus and chiasm	Controls autonomic centers for heart rate, blood pressure, respiration, digestion, hunger center, thirst center, regulation of body temperature, production of emotions

Brain: Largest Regions, Brain Stem, and Diencephalon

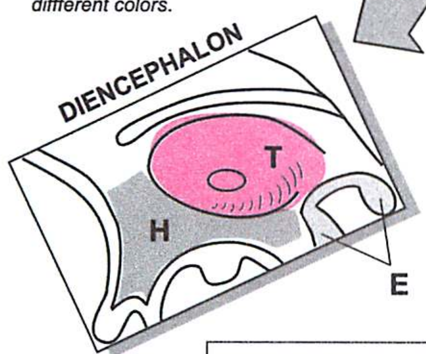








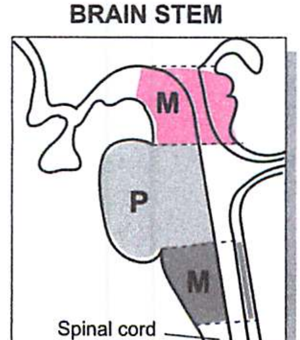
Color the different lobes of the cerebrum diffferent colors.



KEY

E = epithalamus
T = thalamus
H = hypothalamus

BRAIN STEM



TIP

To recall the parts of the diencephalon, use the mnemonic:

"Expect Total Harmony!" ➡ Epithalamus Thalamus Hypothalamus

TIP

To recall the parts of the brain stem, use the mnemonic:

"Make Peace Monday!" ➡ Midbrain Pons Medulla oblongata

Description

There are 12 pairs of **cranial nerves** that are best observed on the inferior view of a whole brain. Beginning near the frontal lobe of the cerebrum and moving down toward the spinal cord, they are numbered using Roman numerals from one (I) to twelve (XII).

Study Tips

- Use the following mnemonic device to recall the proper order of the cranial nerves:

Oscar's	=	Olfactory nerve (I)
Old	=	Optic nerve (II)
Ostrich	=	Oculomotor nerve (III)
Tasted	=	Trochlear nerve (IV)
Tomatoes	=	Trigeminal nerve (V)
And	=	Abducens nerve (VI)
Felt	=	Facial nerve (VII)
Very	=	Vestibulocochlear (*acoustic* or *auditory*) nerve (VIII)
Good,	=	Glossopharyngeal nerve (IX)
Vomited	=	Vagus nerve (X)
Any	=	Accessory nerve (XI)
How	=	Hypoglossal nerve (XII)

- Associate cranial nerves with specific landmarks on the brain—*ex:* **Oculomotor nerve** (III) is below the mamillary body, **Abducens nerve** (VI) is between the medulla and the pons
- The Thickest cranial nerve is the **Trigeminal nerve** (V)
- **Accessory nerve** (XI) runs parallel to the spinal cord

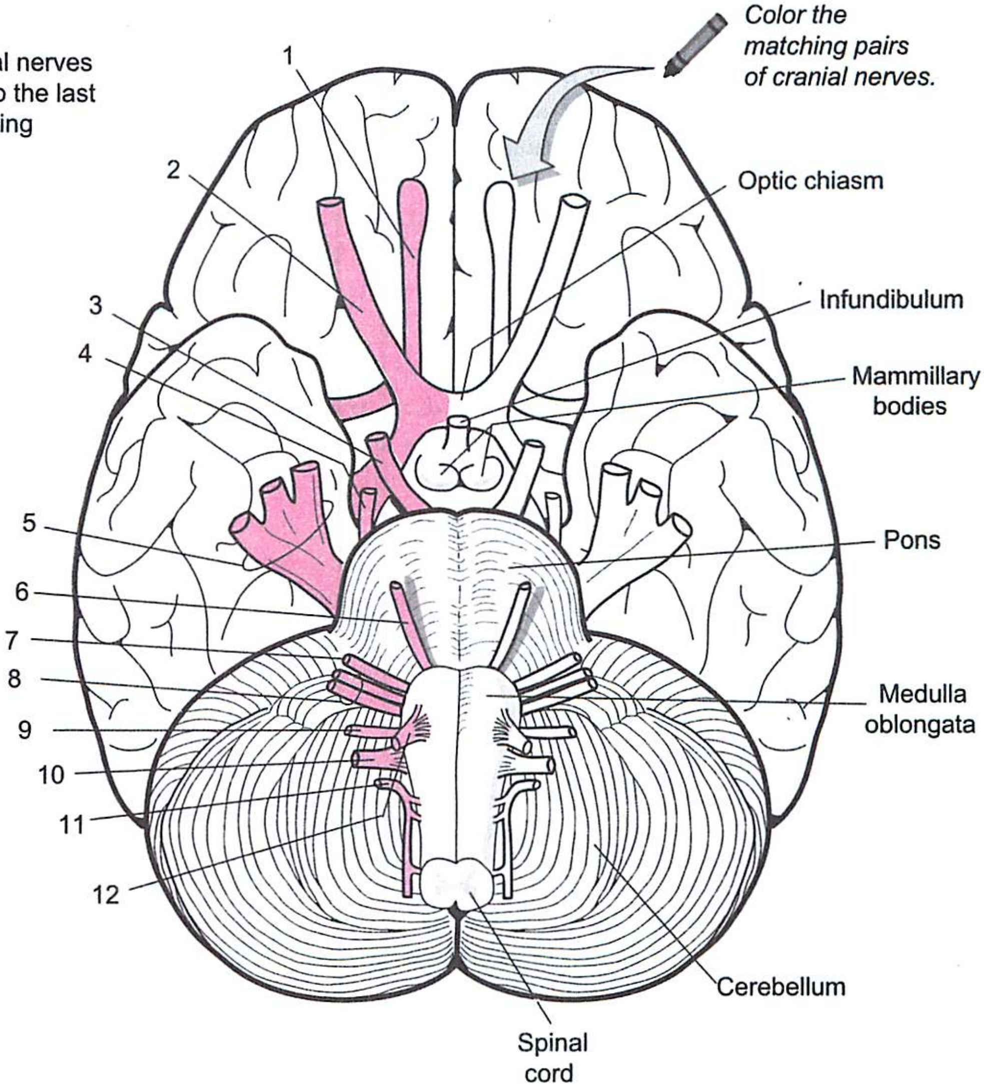
Key to Illustration

1. Olfactory nerve (I)
2. Optic nerve (II)
3. Oculomotor nerve (III)
4. Trochlear nerve (IV)
5. Trigeminal nerve (V)
6. Abducens nerve (VI)
7. Facial nerve (VII)
8. Vestibulocochlear *(acoustic* or *auditory)* nerve (VIII)
9. Glossopharyngeal nerve (IX)
10. Vagus nerve (X)
11. Accessory nerve (XI)
12. Hypoglossal nerve (XII)

To recall the cranial nerves from the first pair to the last pair, use the following mnemonic:

Oscar's
Old
Ostrich
Tasted
Tomatoes
And
Felt
Very
Good,
Vomited
Any
How

Color the matching pairs of cranial nerves.



Cranial Nerves

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________

Description

The heart contains ventricles that fill with blood, while the brain contains ventricles that are constantly filled with cerebrospinal fluid. In total, the brain has four ventricles inside it: *lateral ventricle* (of left hemisphere), *lateral ventricle* (of right hemisphere), *third ventricle*, and *fourth ventricle*. This entire network is referred to as the **ventricular system** in the brain. The lateral ventricles are the largest of the four and do not directly connect to each other as they are separated by a thin partition called the **septum pellucidum**. Both do connect to the third ventricle in the region of the diencephalon by small passageways called **interventricular foramina**. The third ventricle is connected to the fourth ventricle by a passageway called the **cerebral aqueduct** *(aqueduct of Sylvius)*. The fourth ventricle is located in the pons (of the brain stem) and the cerebellum. It communicates with a very narrow passageway called the **central canal**, which runs through the middle of the spinal cord.

Analogy

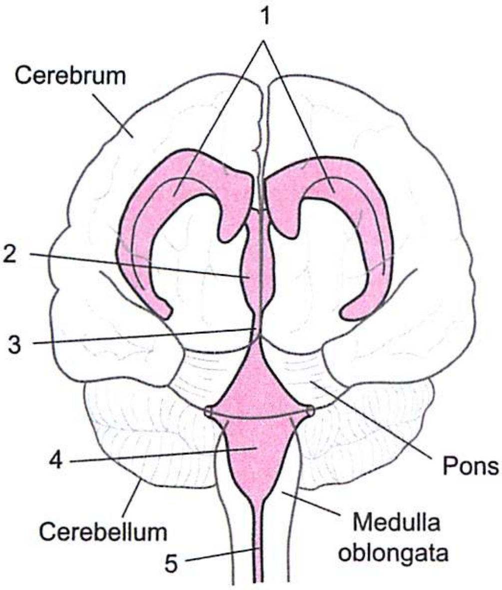
To visualize the relative positions of the ventricles, compare the whole **ventricular system** to the **hollow head of a ram**. The **fourth ventricle** is like the **neck of the ram**, the **third ventricle** is like the head, and the **lateral ventricles** are like the **two horns**. The ram's horns also follow the same general shape of the paired lateral ventricles.

Study Tip

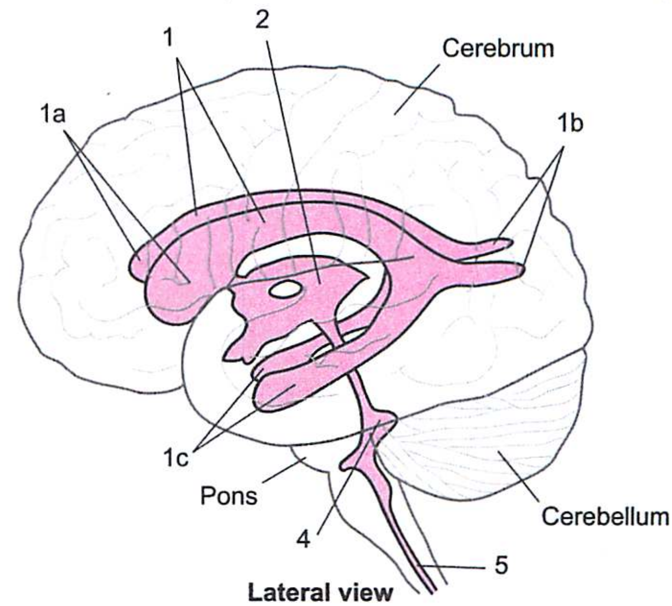
The first and second ventricles are not numbered because they are the lateral ventricles. If you think of the two lateral ventricles as *first ventricle* and *second ventricle*, the numbering makes sense in relation to the **third ventricle** and **fourth ventricle**. Ah, the goofy things that anatomists do! As the saying goes, "you are not a good anatomist unless you know 87 different names for the same structure."

Key to Illustration

1. Lateral ventricles
1a. Anterior horns of lateral ventricles
1b. Posterior horns of lateral ventricles
1c. Inferior horns of lateral ventricles
2. Third ventricle
3. Cerebral aqueduct *(aqueduct of Sylvius)*
4. Fourth ventricle
5. Central canal

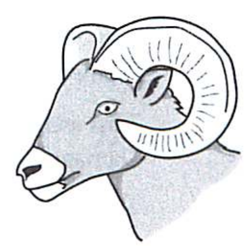


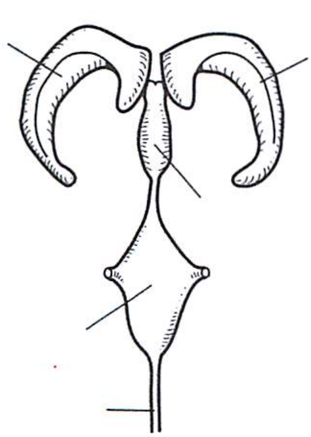
Anterior view



Lateral view

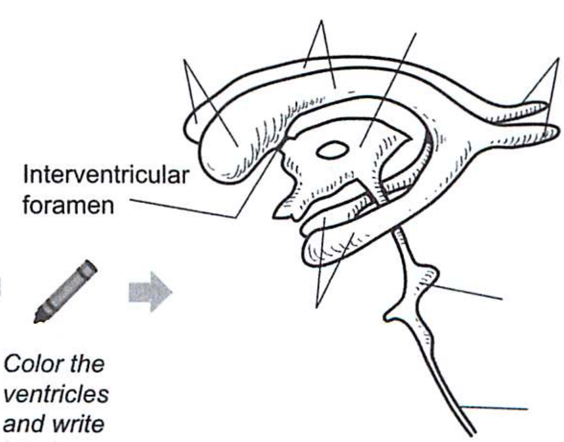
The ventricular system in the brain is like the neck, head, and horns of a ram if they were hollow.





Anterior view

Color the ventricles and write labels on the illustrations.



Lateral view

This module will describe some of the selected functional areas of the cerebral cortex. These areas have been divided into three general groups: **sensory areas, motor areas**, and **association areas**. Note that the words *cortex* and *area* are often used interchangeably.

SENSORY AREAS Control regions where sensations are perceived

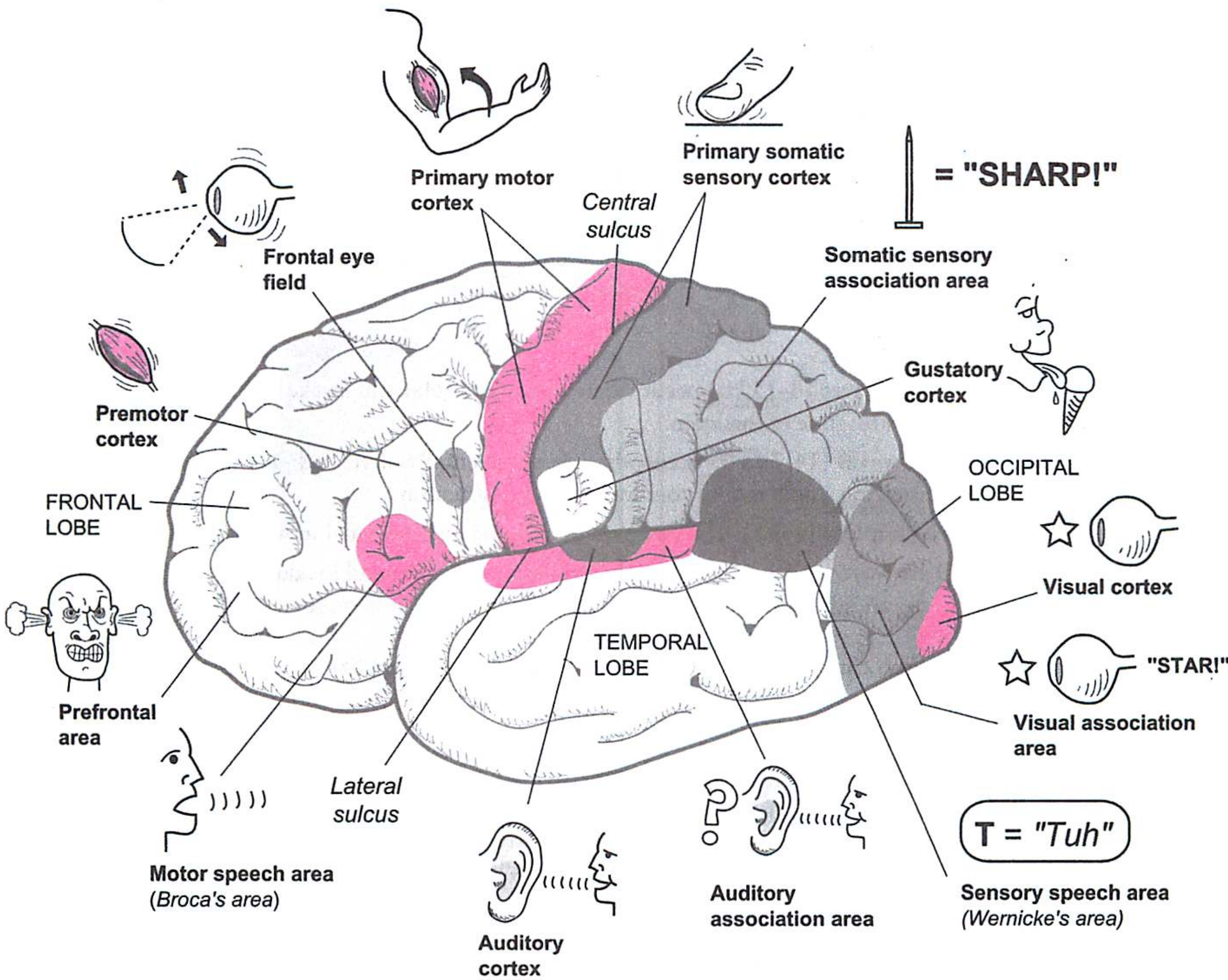
1. **Primary somatic sensory cortex**	This important region is shown in dark gray behind the central sulcus. General sensory input (e.g. touch, temperature, pressure, and pain) from all parts of the body is perceived here.
2. **Gustatory cortex**	Located in the parietal lobe; taste sensations are perceived here, such as the flavors of the ice cream shown in the icon.
3. **Auditory cortex**	Located in the temporal lobe; auditory stimuli are processed by the brain here.
4. **Visual cortex**	Located in the occipital lobe; visual images are perceived here (like the star shown in the icon).

MOTOR AREAS Control centers for conscious muscle movements

1. **Primary motor cortex**	This important area is shown in color in front of the central sulcus. It controls voluntary muscle movements throughout the body, including those of the hands and feet, arms and legs, face and tongue.
2. **Premotor cortex**	This area serves as the "choreographer" for the primary motor cortex. It decides which muscle groups will be used and how they will be used prior to stimulating the primary motor cortex.
3. **Motor speech area** (*Broca's area*)	This area controls and coordinates the muscles involved in normal, fluent speech. Damage to this area can result in strained speech with disconnected words.
4. **Frontal eye field**	This area controls muscle movements of the eye, such as those needed to read this page.

ASSOCIATION AREAS Control regions—near sensory areas—involved in recognizing and analyzing incoming information

1. **Prefrontal area**	This area is most highly developed in humans and other primates. It regulates emotional behavior and mood and also is involved in planning, learning, reasoning, motivation, personality, and intellect.
2. **Somatic sensory association area**	This area allows you to *predict* that sandpaper is rough, for example, even without looking at it. It also stores memories about previous sensory experiences so you can determine when blindfolded, for example, that the object placed in your hand was a pair of scissors.
3. **Sensory speech area** (*Wernicke's area*)	This area seems to be an important part of language development—processing words we hear being spoken. It also appears important for children when they are sounding out new words. Damage to this area may result in deficiencies in recognizing written and spoken words.
4. **Auditory association area**	This area allows you to comprehend, interpret, analyze, and question what you are hearing. For example, it enables you to recognize a familiar song or disregard noise.
5. **Visual association area**	This allows you to associate the perceived image of the star with the letters "S-T-A-R". You connect the word "star" with the image of a star.



Left Cerebral Hemisphere
lateral view

Description

This module explains the concept of lateralization between the left and right cerebral hemispheres. Looking at the illustration of the **brain**, the left and right cerebral hemispheres appear very similar. In fact, they are anatomically similar, and the two hemispheres work together for many functions. This is evidenced by the **corpus callosum**—a thick band of nerves connecting the left to the right hemispheres. Each hemisphere also has functional specialization. There is lateralization where certain functions are found only in one of the hemispheres. For example, in most people, the Broca's area for speech production is found only in the left hemisphere. We can make generalizations about the functional differences between the two hemispheres that apply to most people. Consider your left hemisphere to be your "analytical" hemisphere and your right to be your "creative" hemisphere.

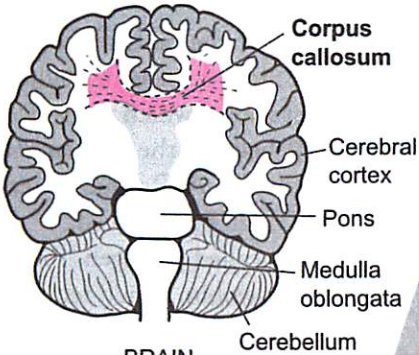
The illustration lists the functional differences. Your left brain excels at language and logic. It deals with information in an organized, logical way as a scientist would. It helps you work with mathematical equations, write, and follow directions step by step. In contrast, your right hemisphere excels at musical and artistic abilities. It helps you understand shape and pattern relationships that are useful for facial recognition and drawing. It also is the seat of insight and inspiration.

But these generalizations are not set in stone. Here are some variables that are exceptions to the rule:

- **Individual differences.** Some individuals have one or more control centers in the hemisphere opposite from the one where it normally is found.
- **Gender differences.** Lateralization is greater in males than females. In typical females, a portion of the corpus callosum is thicker, indicating greater hemispheric integration. This means that both hemispheres work together more frequently.
- **Age differences.** Children can "re-wire" their brains more easily than adults. For example, if part of the brain is damaged or surgically removed in a child, the opposite hemisphere can take over and compensate.

One hemisphere doesn't actually dominate the other. Even so, the hemisphere that controls spoken and written language is designated as the *categorical* (or "dominant") hemisphere. As mentioned previously, this is the left hemisphere for most people and correlates to handedness. Because nerves cross over from one side of the body to the opposite side in the brain, motor activity on the right side of the body is controlled by the left hemisphere, and vice versa.

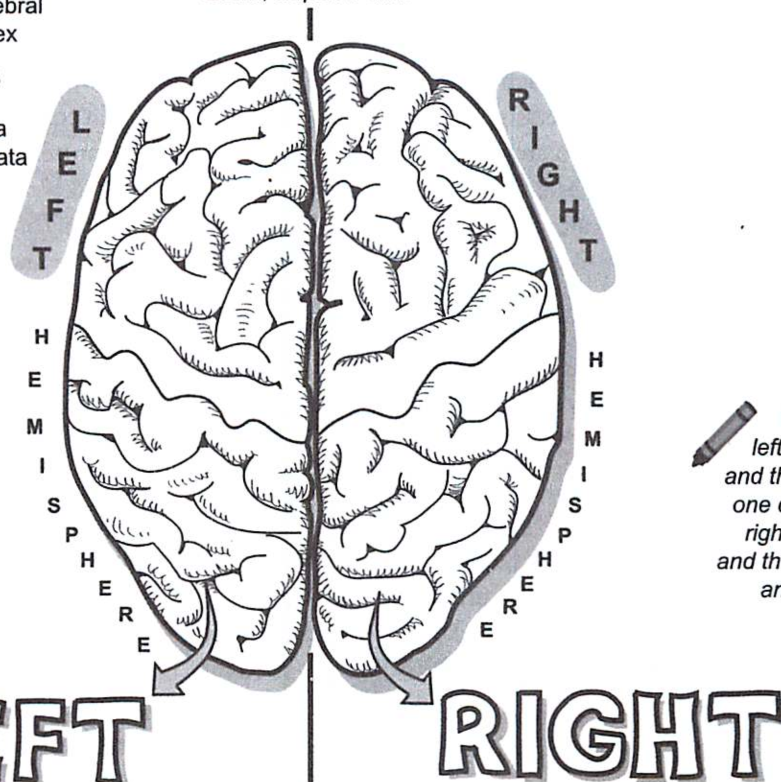
The same usually holds true for handedness. About 91% of the population is right-handed, and in most of these people the left hemisphere is the categorical one. Interestingly, the situation is a bit different for "lefties." In the majority of them, the left hemisphere is still their categorical one. In only about 15% is the right hemisphere categorical. In summary, although the two hemispheres work together all the time, they also specialize in specific functions.



BRAIN, Coronal section

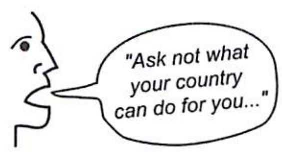
LATERALIZATION

Brain, Superior view



Color the left hemisphere and the word "LEFT" one color; color the right hemisphere and the word "RIGHT" another color.

- Speech, language ability

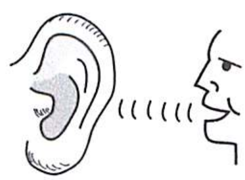


- Logical thought, mathematical ability

$F = ma$ $E = mc^2$

$a^2 + b^2 = c^2$

- Hearing vocal sounds



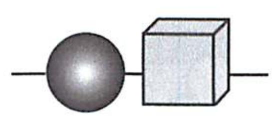
- Orderly sequence

  - Step 1
  - Step 2
  - Step 3

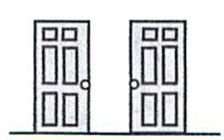
- Motor control—right side of body and right-handedness

- Musical ability

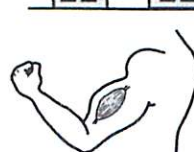
- Artistic ability



- Memory for shapes



- Shape and pattern relationships



- Motor control—left side of body and left-handedness