

The Brain Structure and Function



Aim of the Lecture

- To outline the main structures of the Brain.
- To discuss how these structures relate to function.
- To discuss the Limbic system and how that related to behaviour.



Aim of the Lecture

- To discuss the development of the Brain.

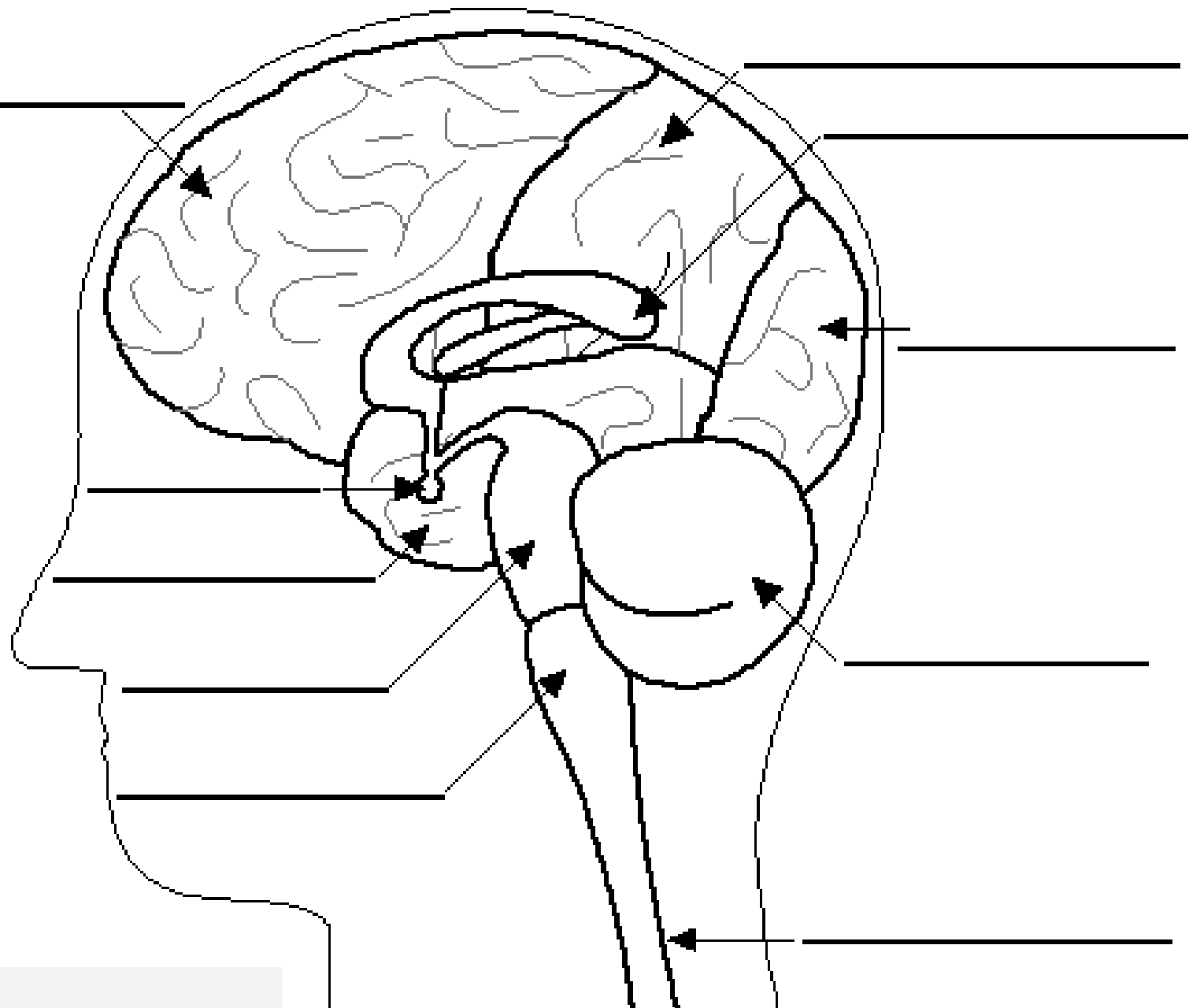


Task

- Label the parts of the Brain (in the Diagram)
- Give a brief outline (no more than a couple of sentences) on the main function/s of each labelled part.



Lateral View of the Brain



The Brain



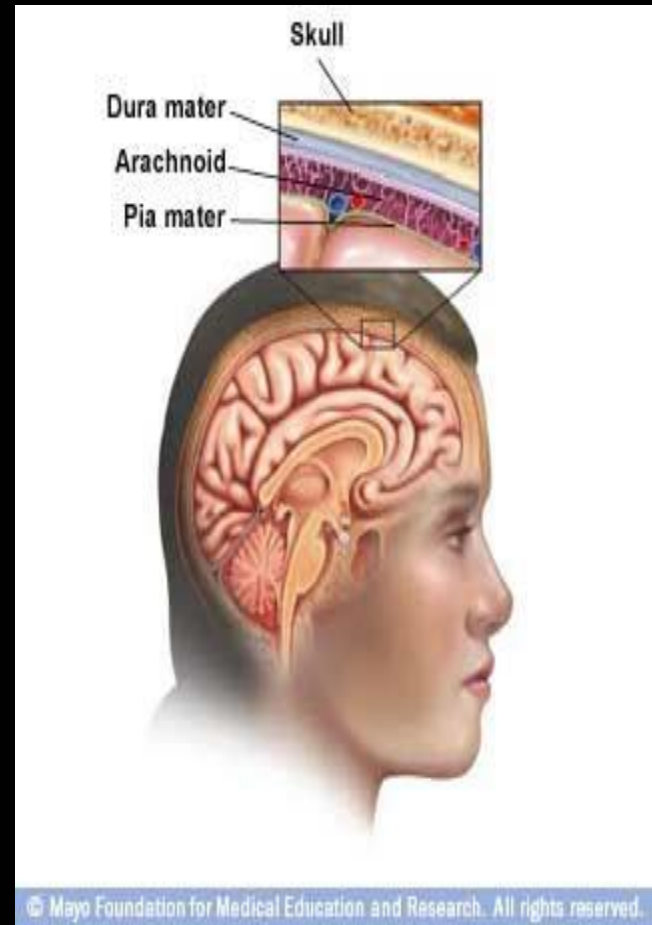
BRAIN FACTS

- Brain weighs approximately 3 lbs (1500 grms)
- Brain has approximately 100 billion neurons and 1 trillion supporting cells
- Neurons grow and organize themselves into efficient systems that operate a lifetime
- Brain controls ALL activities
- Emotion and cognition are intertwined
- Neurons can re-route circuits
- Brain and environment involved in delicate duet
- Brain never stops adapting and changing

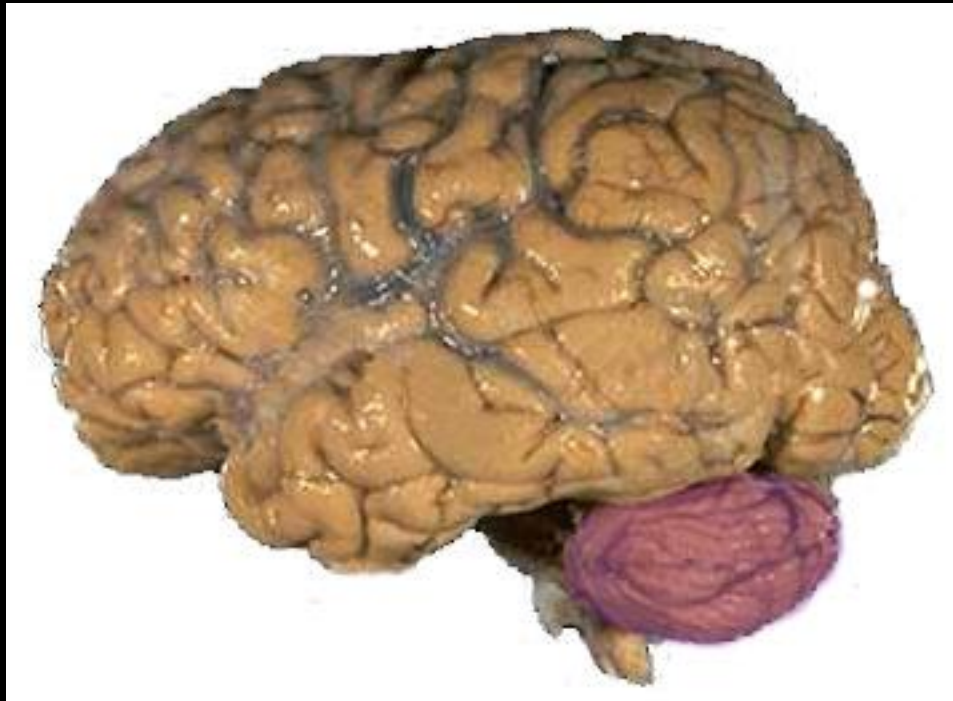


Meninges

- Three layered structure designed to protect the Brain.
- Dura Mater.
- Arachnoid Layer.
- Pia Mater

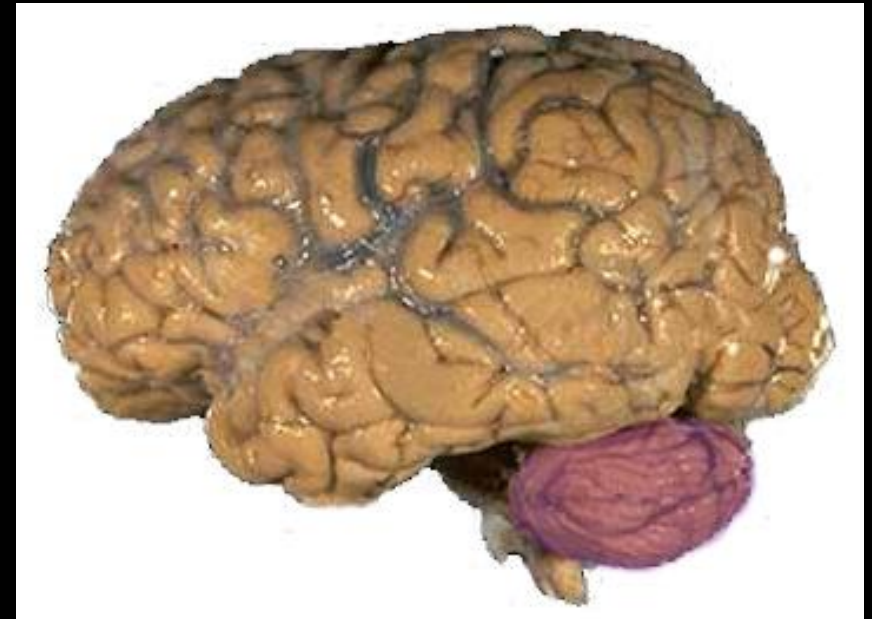


The Brain



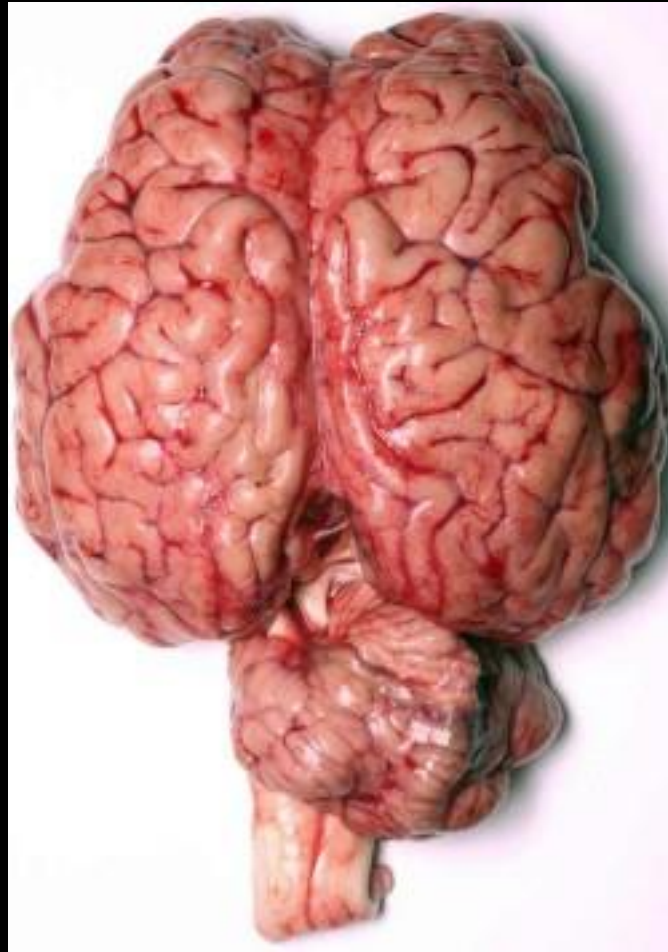
The Brain

- Orange = Cerebrum.
- Pink = Cerebellum.
- Brain Stem.



- Bumps = Gyri
 - Singular Gyrus
- Grooves = Sulci.
 - Singular Sulcus





The Brain.



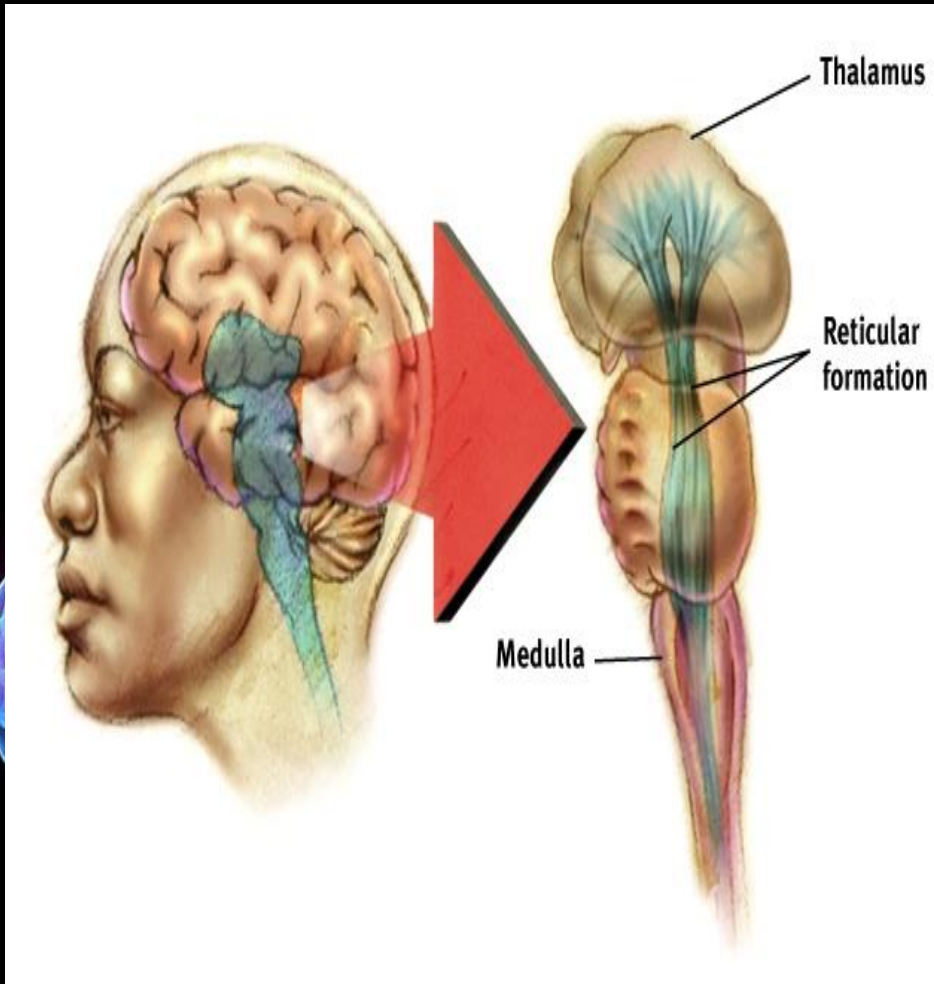
Right/Left hemisphere, joined by the

Corpus callosum



- Corpus Callosum
 - large band of neural fibers
 - connects the two brain hemispheres
 - carries messages between the hemispheres

The Brain



- Brainstem
 - the oldest part and central core of the brain, beginning where the spinal cord swells as it enters the skull
 - responsible for automatic survival functions
- Medulla Oblongata base of the brainstem
 - controls heartbeat and breathing
- Reticular Formation
 - a nerve network in the brainstem that plays an important role in controlling arousal
- Thalamus
 - the brain's sensory switchboard, located on top of the brainstem
 - it directs messages to the sensory receiving areas in the cortex and transmits replies to the cerebellum and medulla oblongata

Brain Stem

- Houses the most basic programs of survival.
 - Breathing
 - Swallowing
 - Vomiting
 - Urination.



- Connects to the Spinal Cord.

Question.

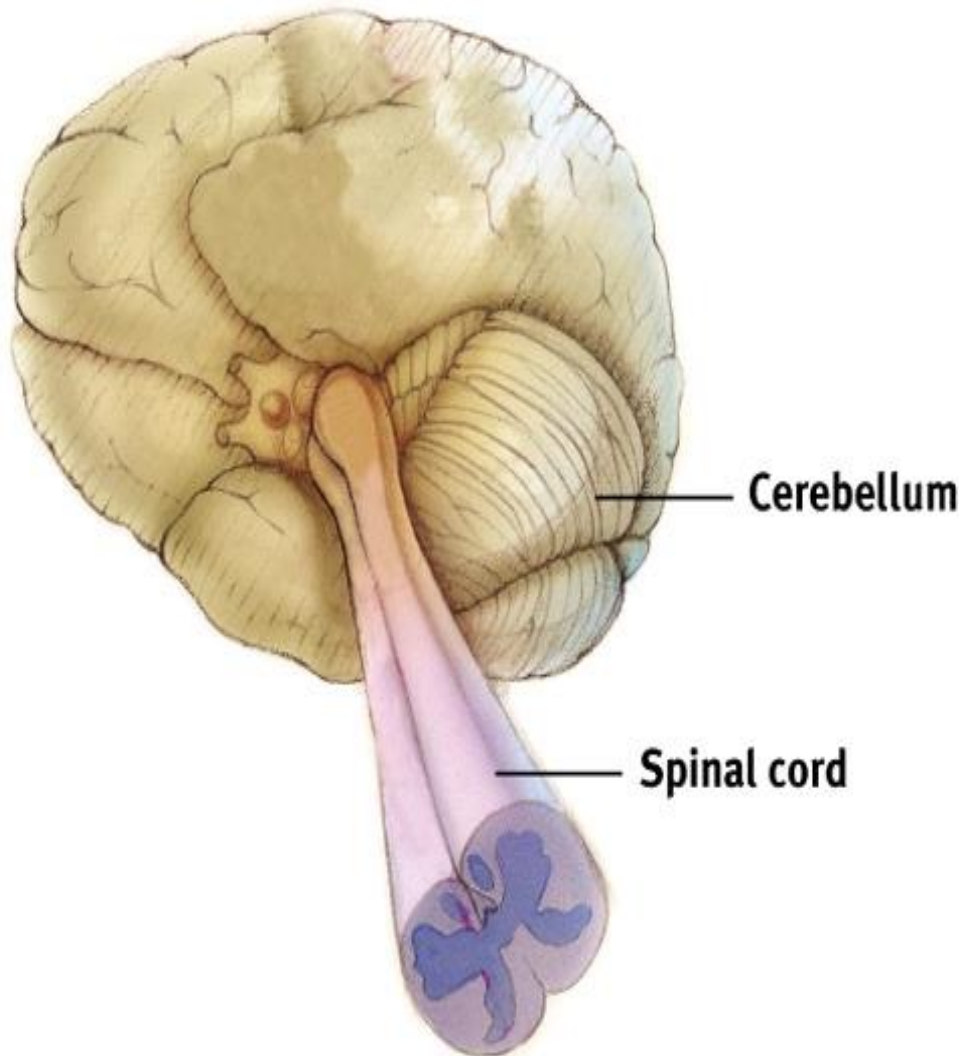
- How do we know that the Reticular Formation helps control sleep patterns?



- Studies of Animals.
- Naturally occurring human lesions.



The Brain



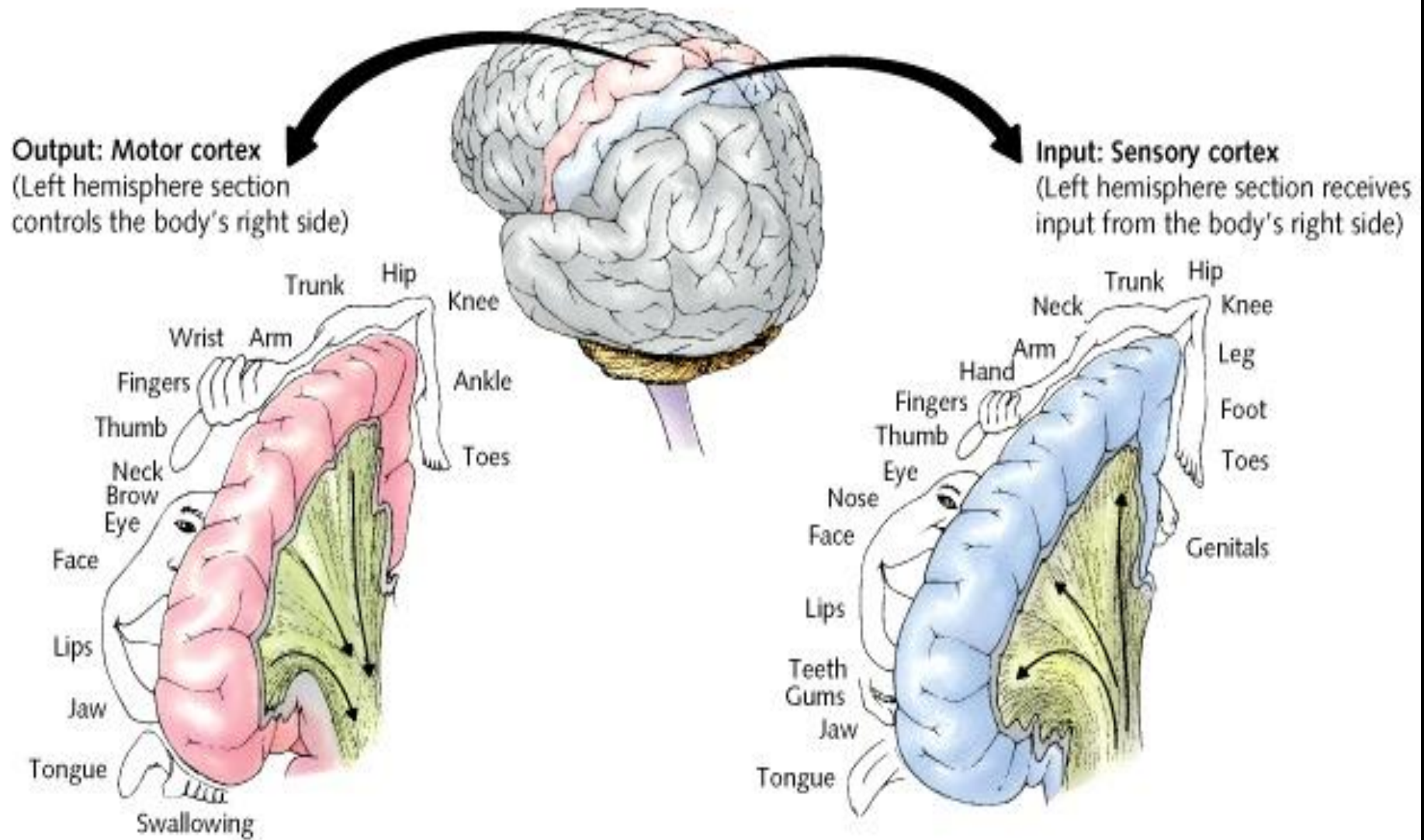
- Cerebellum
 - the “little brain” attached to the rear of the brainstem
 - it helps coordinate voluntary movement and balance

More Recently.

- Cerebellum involved in a variety of Cognitive Processes.
 - Making Plans
 - Remember Events.
 - Experiencing Emotion.
- Empathy (Singer et al, 2004).
 - Loved ones receiving pain stimulus.



The Cerebral Cortex



The Cerebral Cortex

- Cerebral Cortex

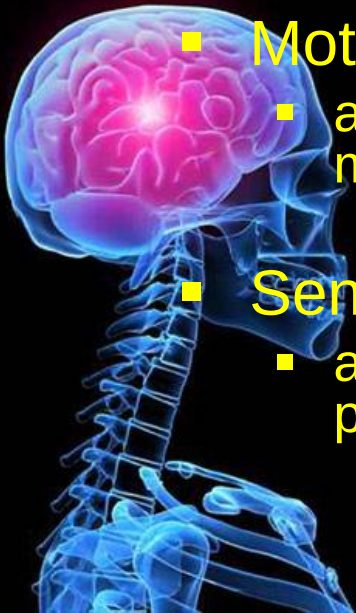
- the intricate fabric of interconnected neural cells that covers the cerebral hemispheres
- the body's ultimate control and information processing centre
- Outer most layer of the Cerebrum.

- Motor Cortex -

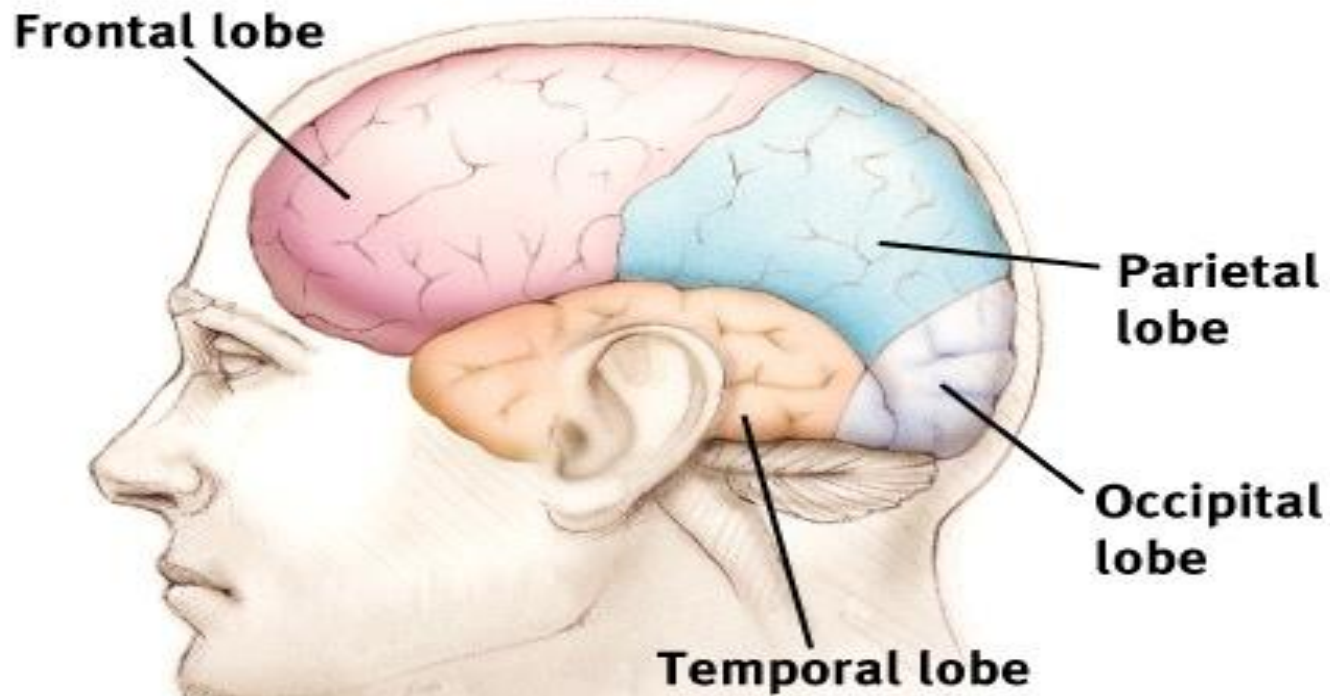
- area at the rear of the frontal lobes that controls voluntary movements

- Sensory Cortex

- area at the front of the parietal lobes that registers and processes body sensations

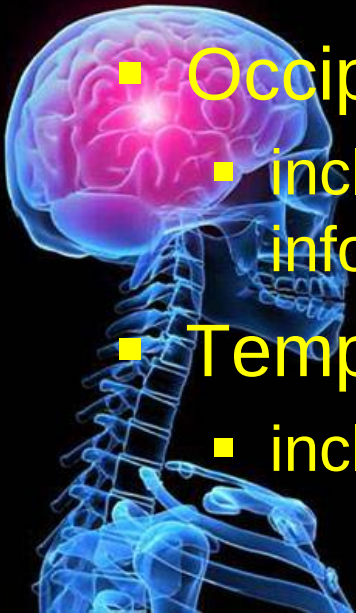


The Cerebral Cortex: the lobes



The Cerebral Cortex

- Frontal Lobes
 - involved in speaking and muscle movements and in making plans and judgments
- Parietal Lobes
 - include the sensory cortex
- Occipital Lobes
 - include the visual areas, which receive visual information from the opposite visual field
- Temporal Lobes
 - include the auditory areas



Frontal lobe

Important in a variety of higher psychological processes, (aka the 'executive control centre') - like planning, decision making, impulse control, language, memory, and others.

There is mounting evidence that neuronal circuitry in the frontal lobes is shaped and fine tuned **during adolescence**, and that **experience and practice** plays a prominent role in these changes.



Parietal lobe

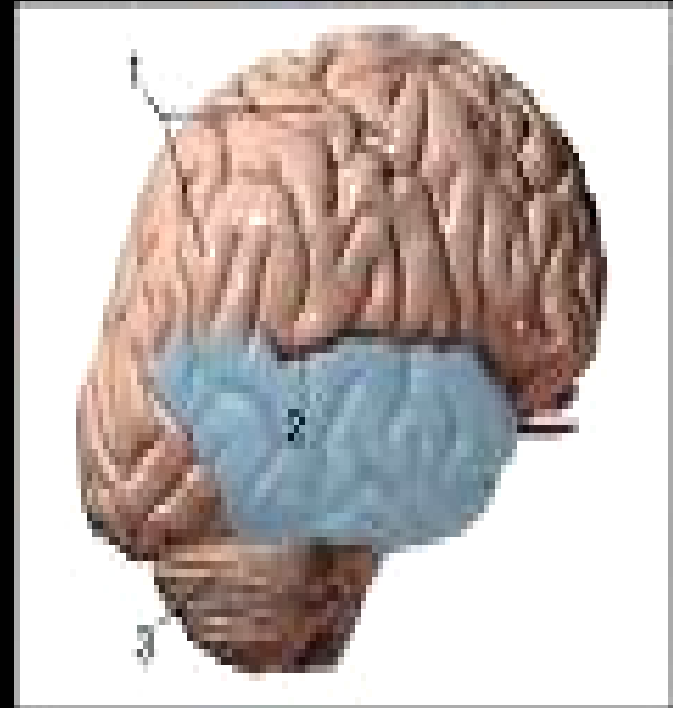
Is located in the middle section of the brain and is associated with processing tactile sensory information such as pressure, touch, and pain.

Also involved in language comprehension



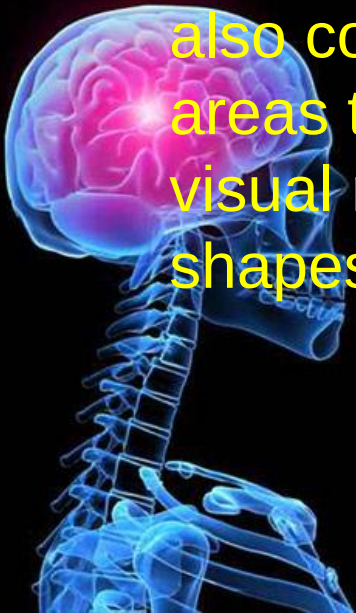
Temporal Lobe

- Responsible for hearing, understanding speech, and forming an integrated sense of self
- Responsible for sorting new information and for short term memory
- Contains the limbic-reward system (amygdala, hippocampus,
- **Maturation around ages 18-19**

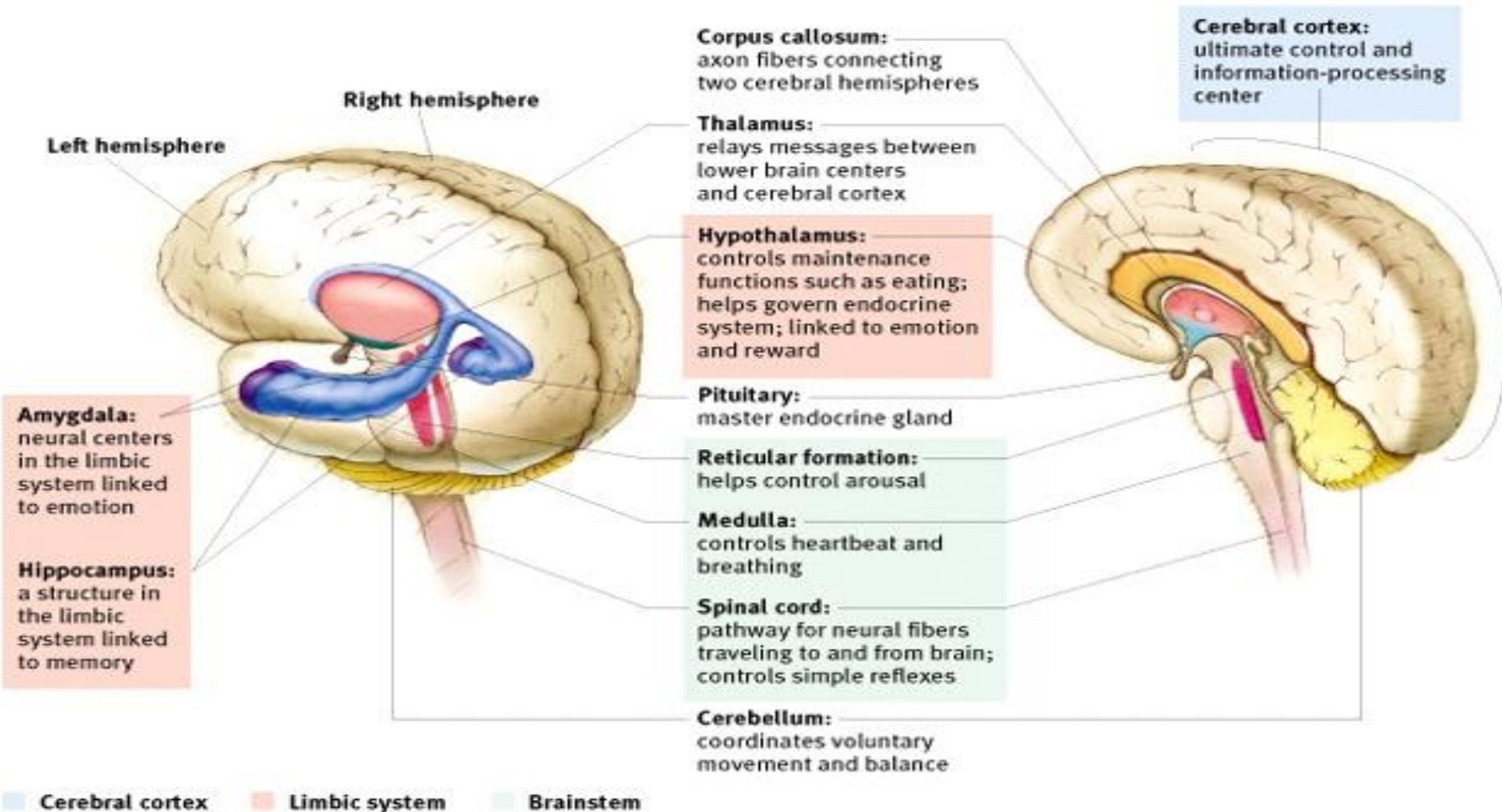


Occipital lobe

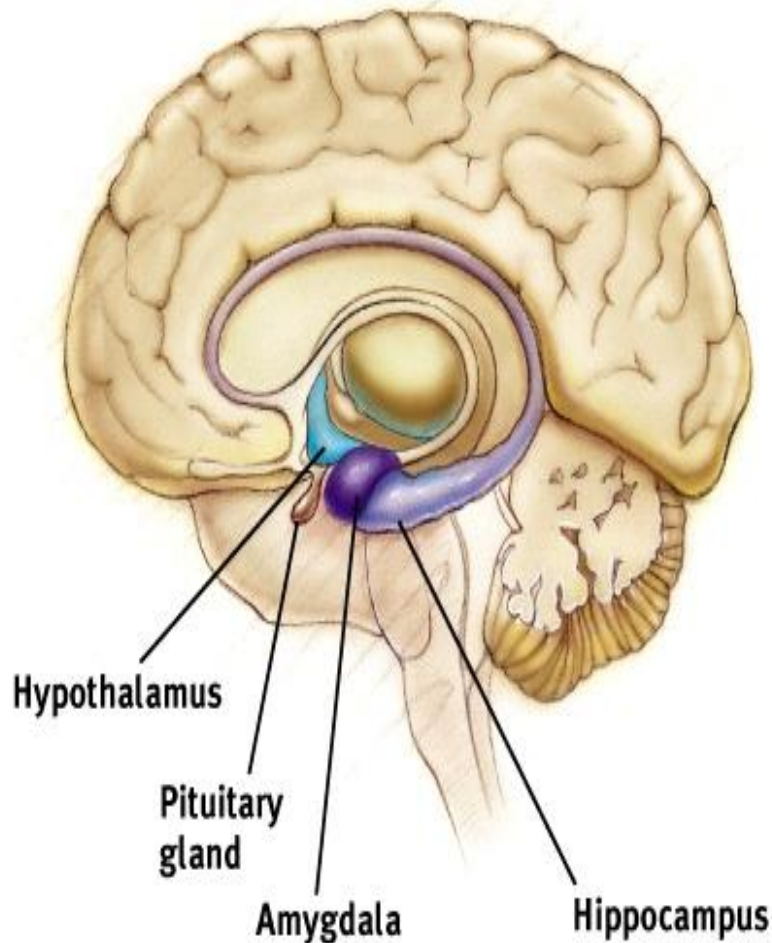
- Region in the back of the brain which processes visual information.
- Not only is the occipital lobe mainly responsible for visual reception, it also contains association areas that help in the visual recognition of shapes and colours.



Brain Structures and their Functions

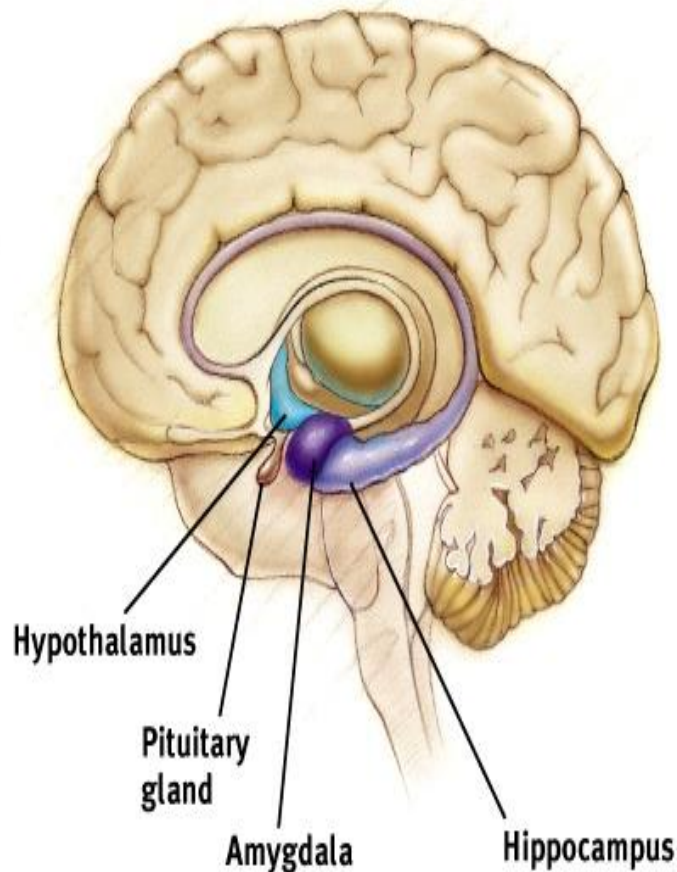


The Limbic System



- a doughnut-shaped system of neural structures at the border of the brainstem and cerebral hemispheres
- associated with emotions such as fear and aggression and drives such as those for food and sex
- includes the hippocampus, amygdala, and hypothalamus.
- **Hypothalamus**
- neural structure lying below (*hypo*) the thalamus; directs several maintenance activities
 - eating
 - drinking
 - body temperature
- helps govern the endocrine system via the pituitary gland
- is linked to emotion

Limbic System



- **The pituitary gland**

- called the master gland because it controls several other hormone glands in your body, including the thyroid and adrenals, the ovaries and testicles. The pituitary gland is often called the master gland because it controls several other hormone glands in your body, including the thyroid and adrenals, the ovaries and testicles.

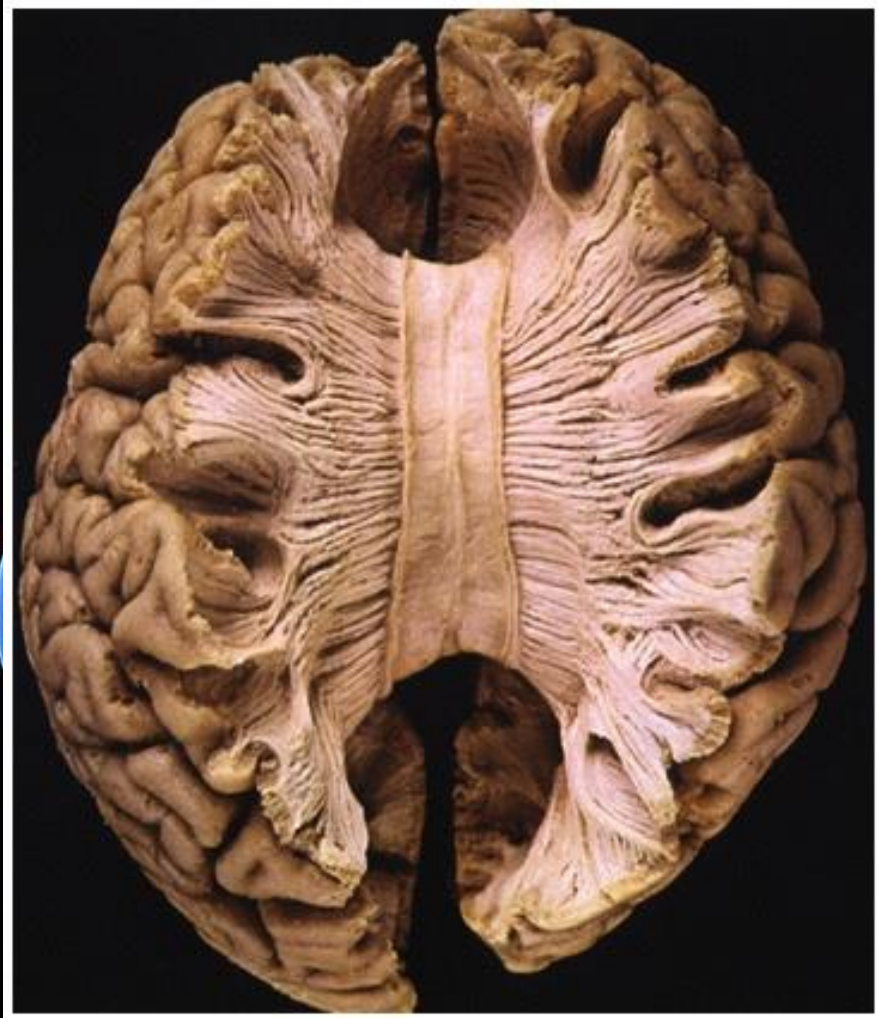
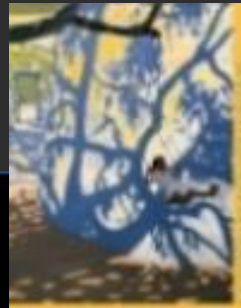
- **Amygdala**

- two almond shaped neural clusters that are components of the limbic system and are linked to emotion and memory

- **Hippocampus**

- involves memory
- Inputting current memories into 'long term memory;

Split Brain



- a condition in which the two hemispheres of the brain are isolated by cutting the connecting fibres (mainly those of the corpus callosum) between them

Split Brain



“Look at the dot.”

**Two words separated
by a dot are
momentarily projected.**

**“What word
did you see?”**

or

**“Point with
your left
hand to the
word you
saw.”**



Critical periods of development

- Brain development occurs in 3 basic stages— growth spurts/overproduction of neurons and pruning. At these stages the brain remain malleable (aka plasticity)
- Critical phases:
 - in utero
 - 0-3 years (overproduction)
 - 10-13 years

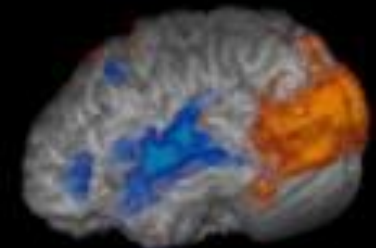
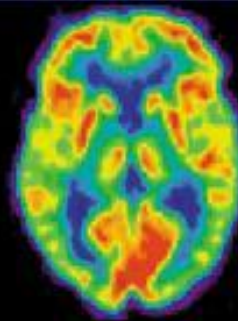
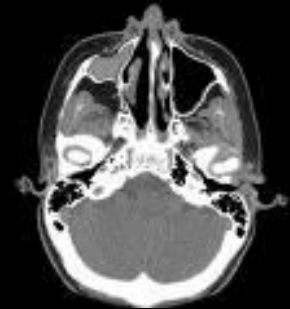
Overproduction results in significant increase in the number of neurons and synapses

Exuberant growth during these 3 phases gives the brain enormous potential

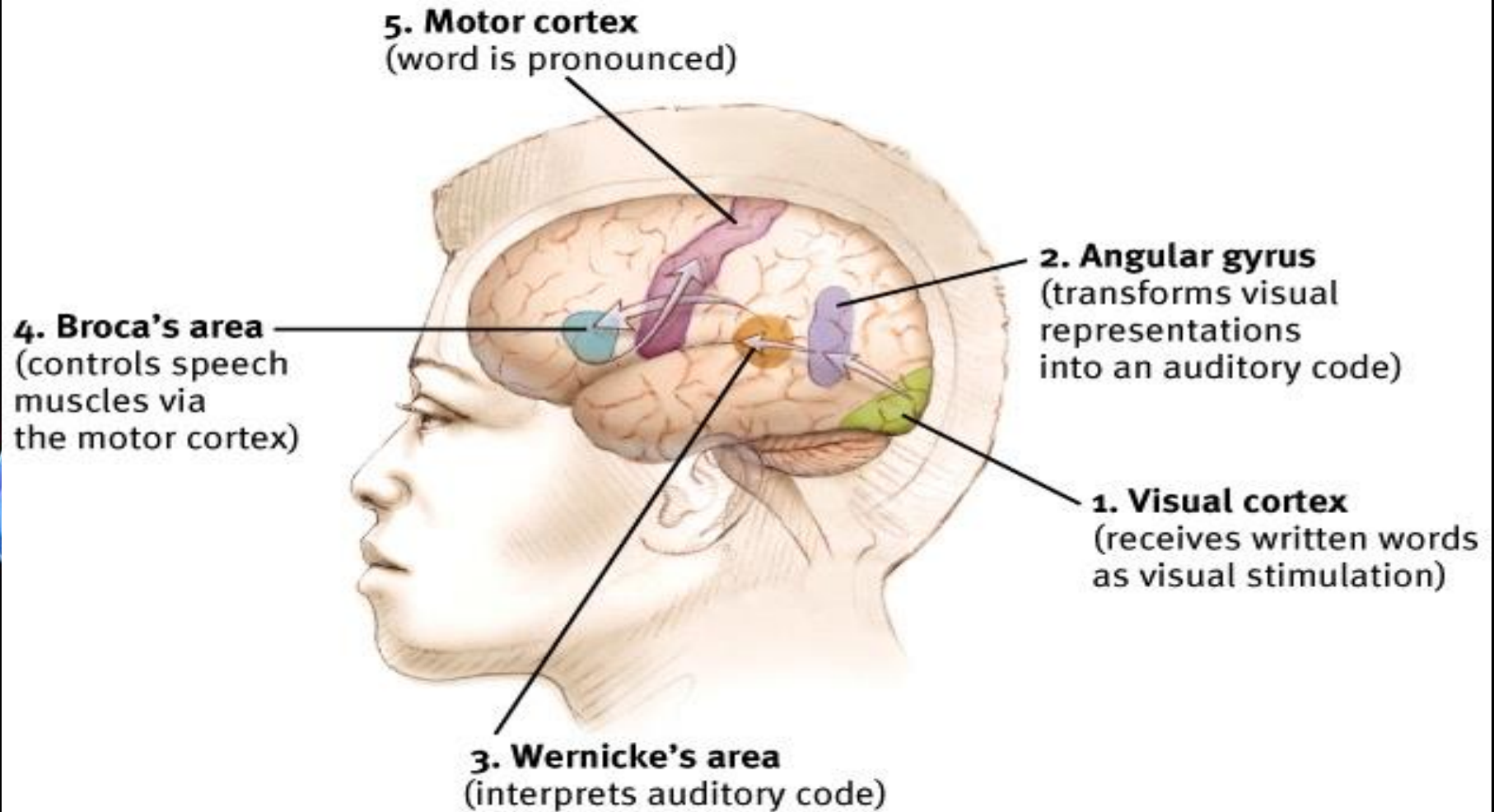


Research technology

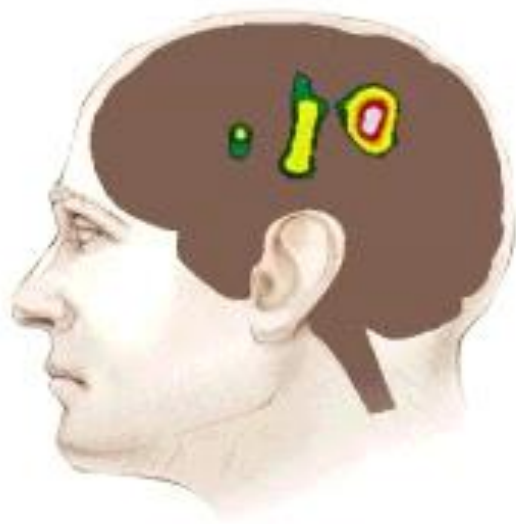
- CT Scans (*computerised tomography*) are used to examine aspects of brain structure – computer enhanced x-rays help to detect abnormalities in the brain
- PET scans (*positron emission tomography*) are used to map brain activity rather than structure. They provide colour coded maps that show areas of high activity of the brain over time.
- MRI (*magnetic resonance imaging*) and fMRI (*functional magnetic resonance imaging*) scans produce high resolution pictures of brain structure; fMRI scans monitor chemical activity (in response to an external stimulus)



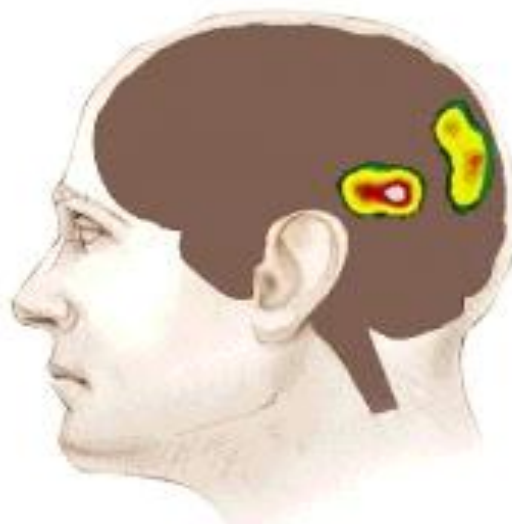
Specialization and Integration within areas of the brain



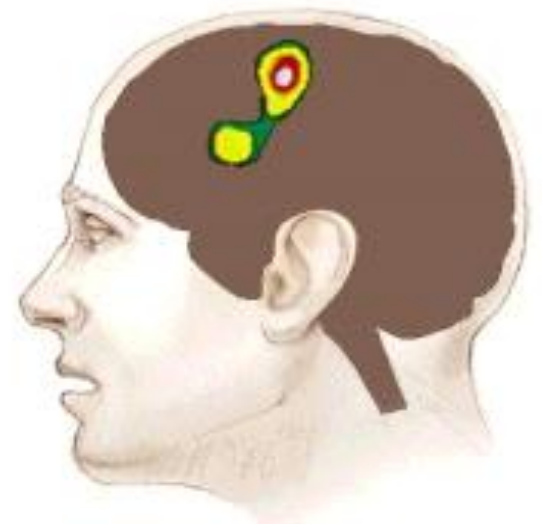
Specialization and Integration within areas of the brain as per an MRI scan



(a)
Hearing



(b)
Seeing



(c)
Speaking

Reading

- Gross, R *Psychology: the science of Mind and Behaviour* – Chapter 4

Gazzaganiga MS and Heatherton, T
Psychological Science Chapter 4

