

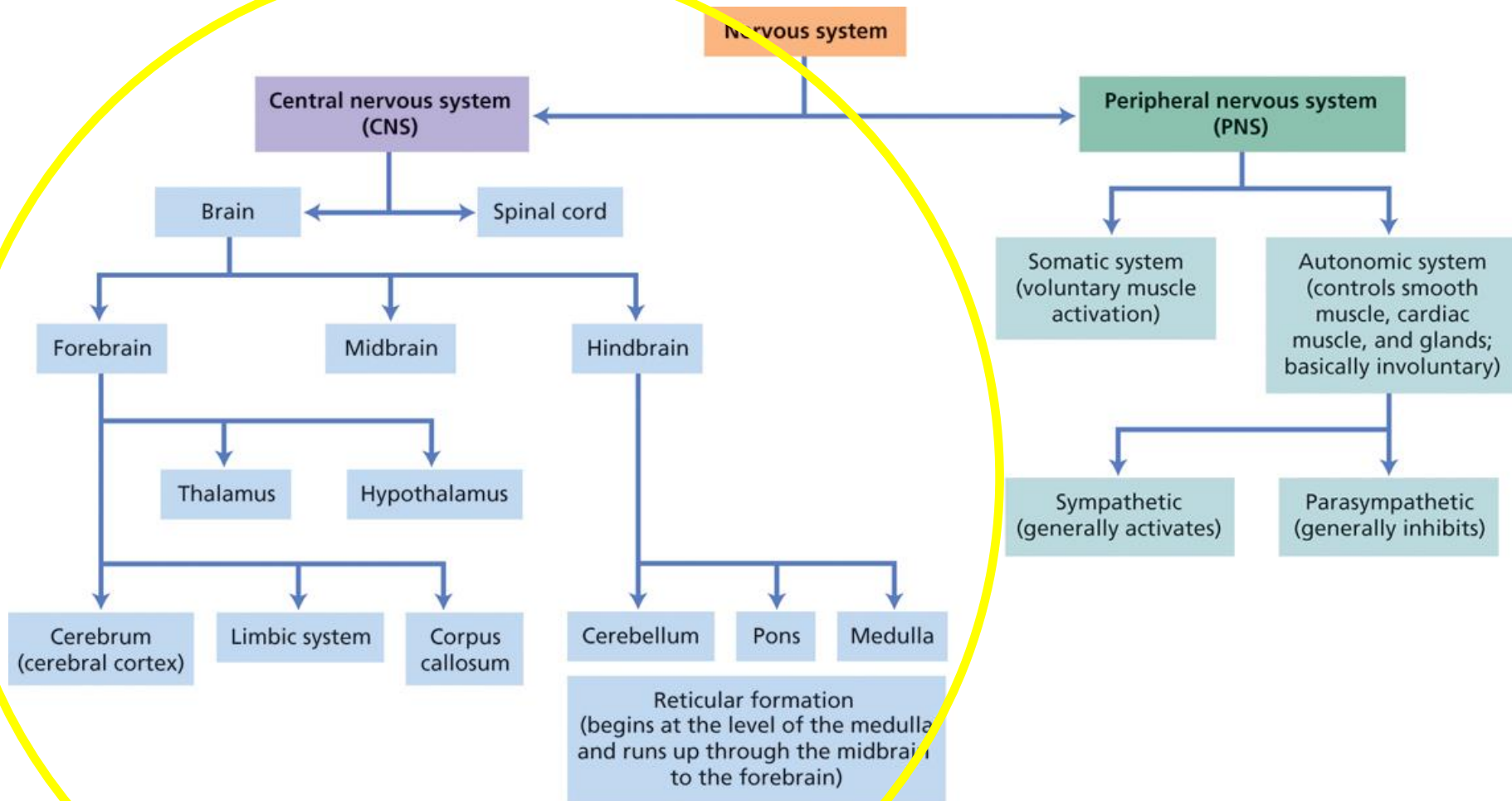
## Lecture Five

---

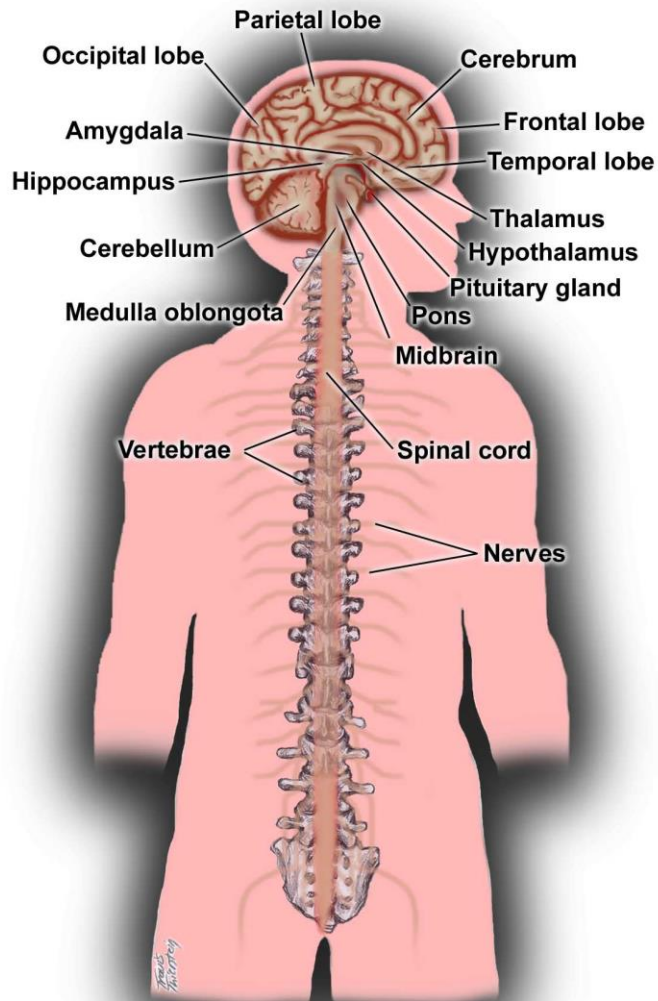
### Biological Psychology: Brain Structures & Functions



# The Nervous System



# The Central Nervous System



CNS contains:

- **Brain**
- **Spinal cord**

Links these to the **peripheral nervous system**.

Spinal cord contains:

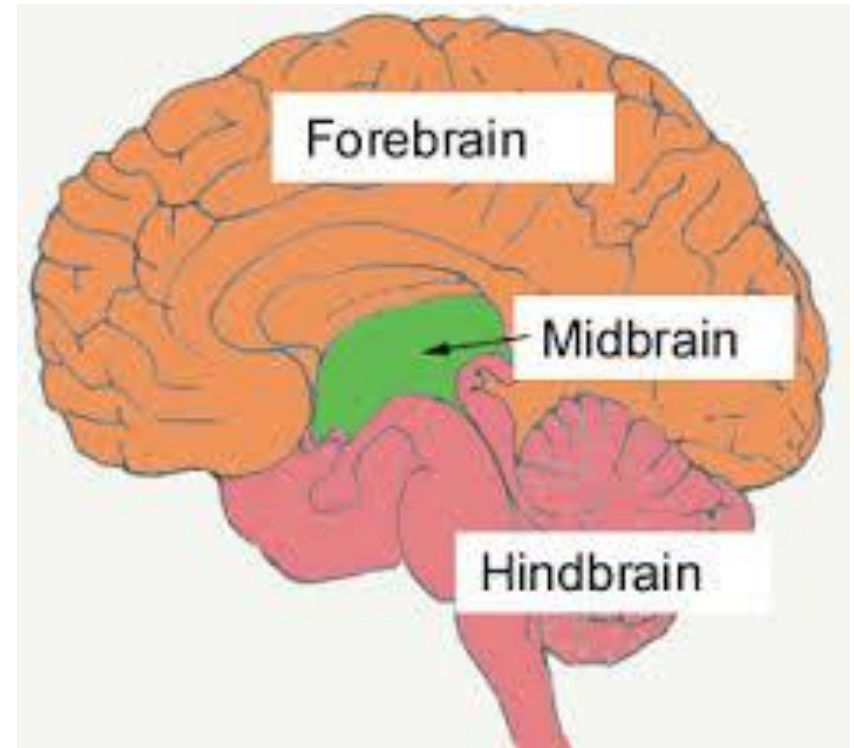
- **Sensory neurons**
- **Motor neurons**

- connected by Interneurons

- Produce simple stimulus-response sequences

# Brain Structure and Function

- Three major subdivisions of the brain:
  - Hindbrain
    - Lowest and most primitive level of the brain
  - Midbrain
    - Contains clusters of sensory and motor neurons
  - Forebrain
    - The brain's most advanced portion from an evolutionary standpoint



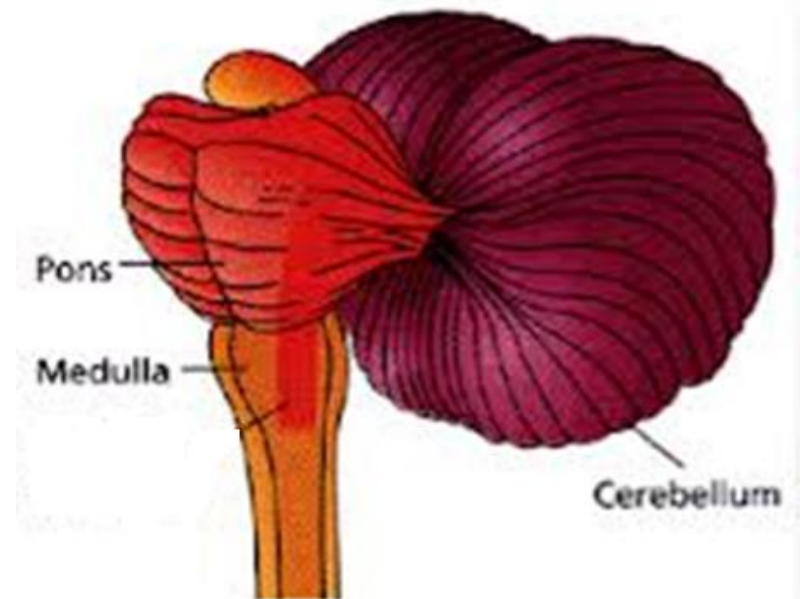
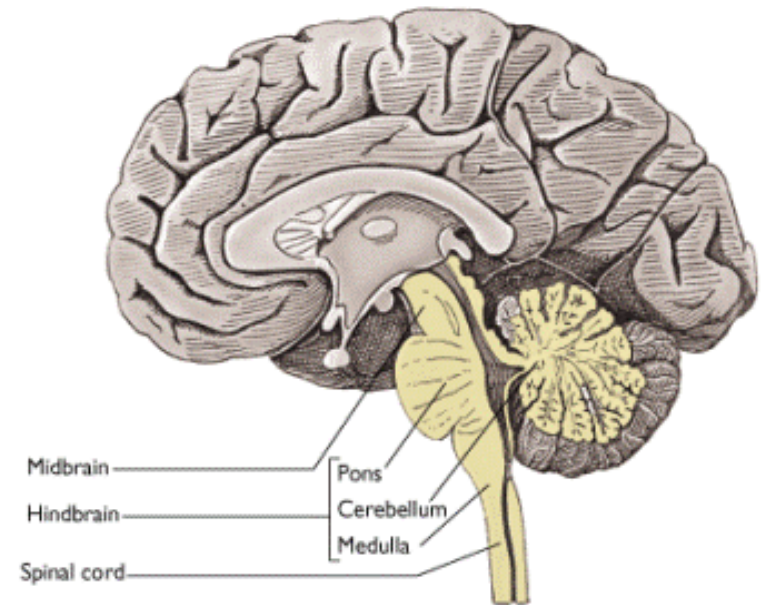
# Hindbrain

## Brain stem:

- Supports vital life functions
  - Medulla
  - Pons

## • Cerebellum:

- Concerned with muscular movement coordination, learning and memory
- Coordination of voluntary movements



# Hindbrain:

## Brain Stem

- **Medulla oblongata**

- Plays an important role in vital body functions such as heart rate, respiration and reflexes

- **Pons**

- Lies just above the medulla and carries nerve impulses between higher and lower levels of the nervous system
- Regulates sleep and arousal

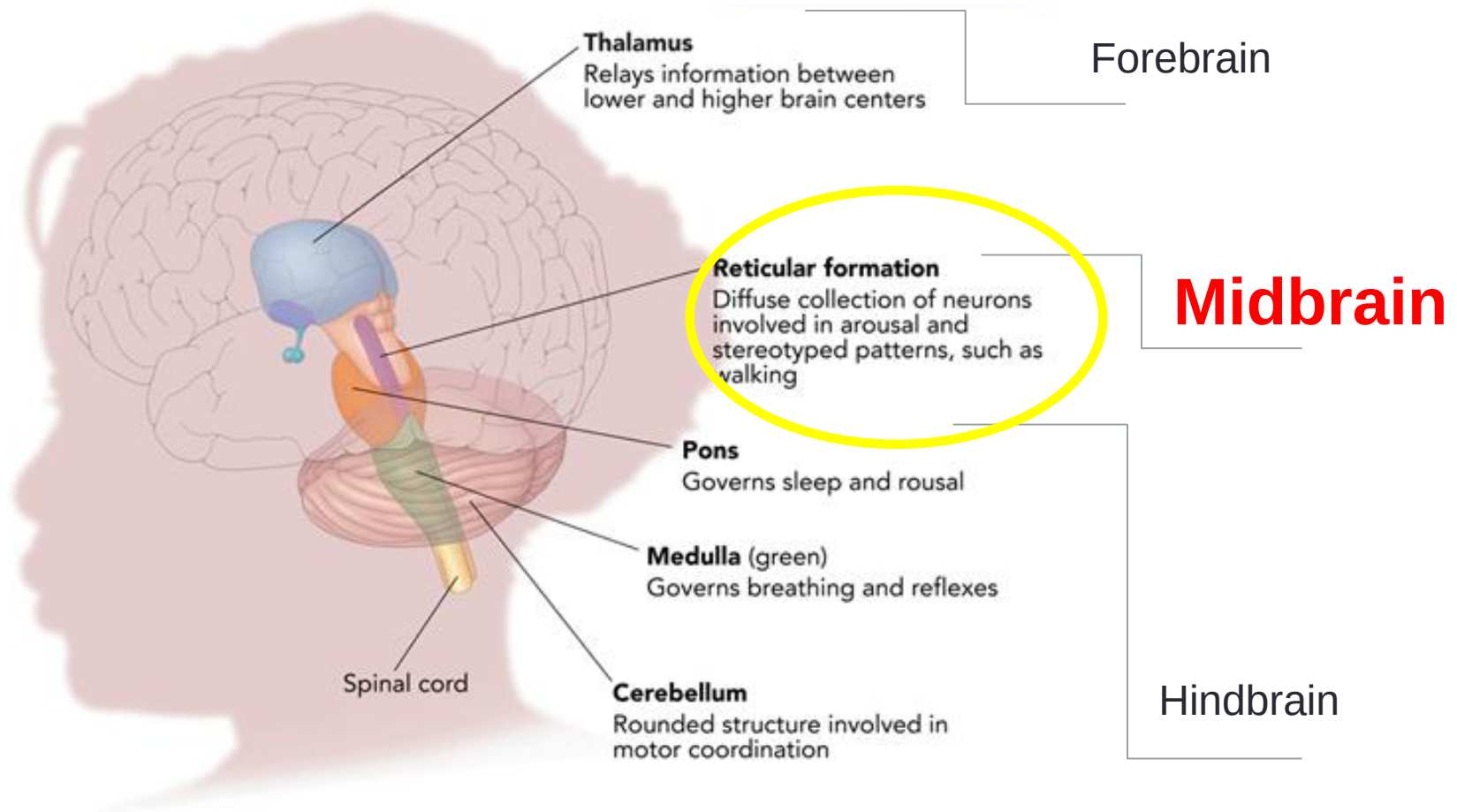
# Hindbrain:

## Cerebellum

- Primarily concerned with muscular movement coordination, but also plays a role in learning and memory
  - Regulates complex movement that require precise timing
  - Cerebellum functions are easily disrupted by alcohol

# Midbrain

## 3a Brain Stem Structures



# Midbrain

- Contains clusters of sensory and motor neurons
  - Visual and auditory systems
  - Motor neurons that control eye movements
- **Reticular Formation:**
  - The 'brains gatekeeper' – regulates flow of incoming sensory information
  - Alerts higher centres of the brain that messages are coming and then either blocks or allows those messages
  - Plays a role in consciousness, sleep and attention

# Forebrain

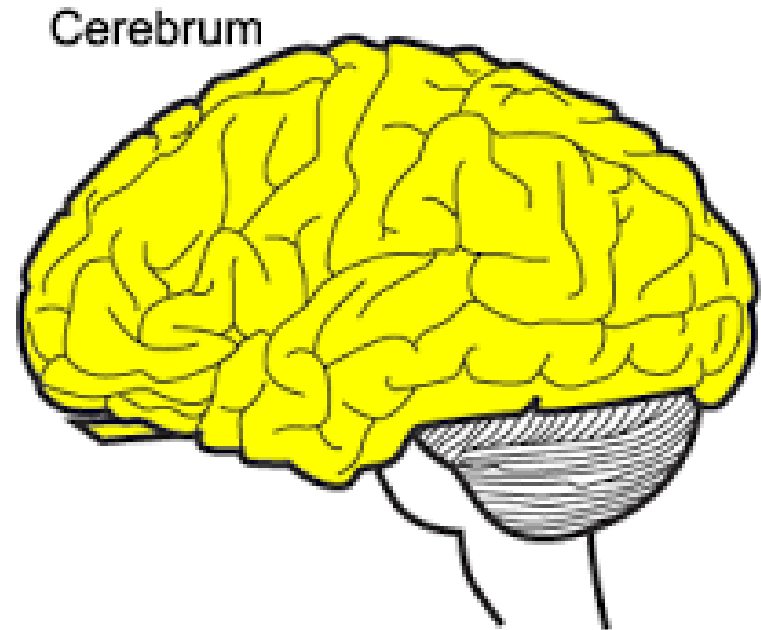
Most advanced part of the brain - from an evolutionary perspective

- Cerebrum
- Thalamus
- Hypothalamus
- The Limbic System
  - Hippocampus
  - Amygdala

# Forebrain

- **Cerebrum**

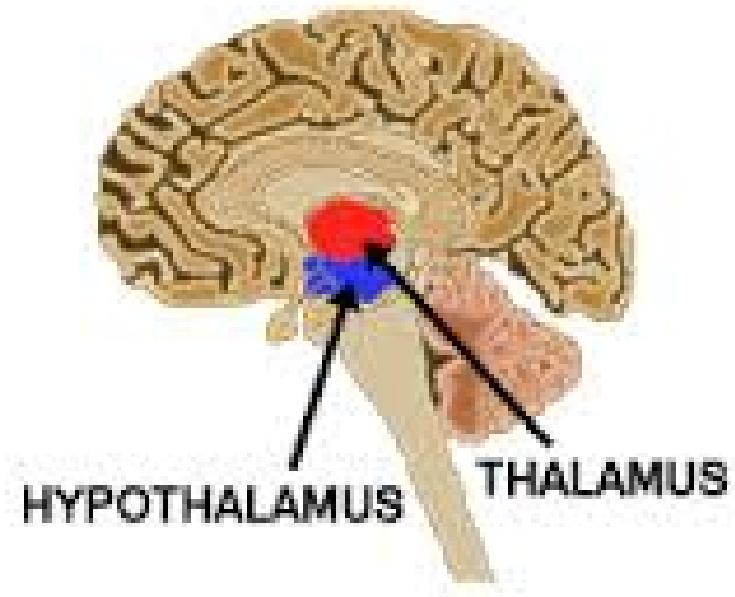
- Consists of two large hemispheres that wrap around the brain stem.



## Forebrain

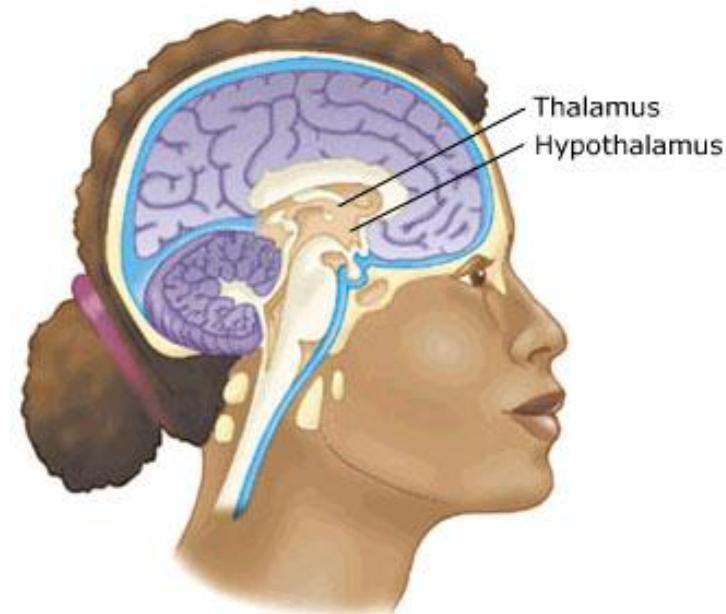
- **Thalamus**

- “**Switchboard**” that organises inputs from sensory organs and routes them to the appropriate areas of the brain



- **Hypothalamus**

- Plays a major role in motivation and emotion
- Controls hormonal secretions that regulate sexual behaviour, temperature regulation, sleeping, metabolism, reactions to stress, and pleasure/pain



# Forebrain

- **Limbic System: “The Emotional Brain”**

Includes: **hypothalamus, hippocampus, amygdala, olfactory bulbs**

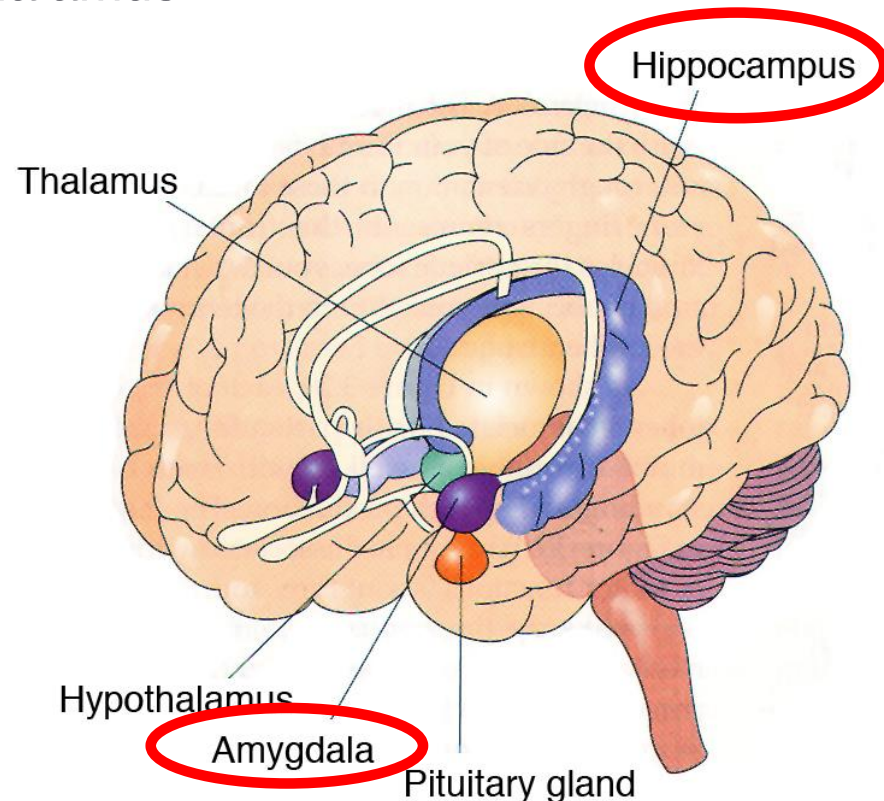
Helps coordinate behaviours needed to satisfy motivational and emotional urges that arise in the hypothalamus

- Hippocampus
- Amygdala

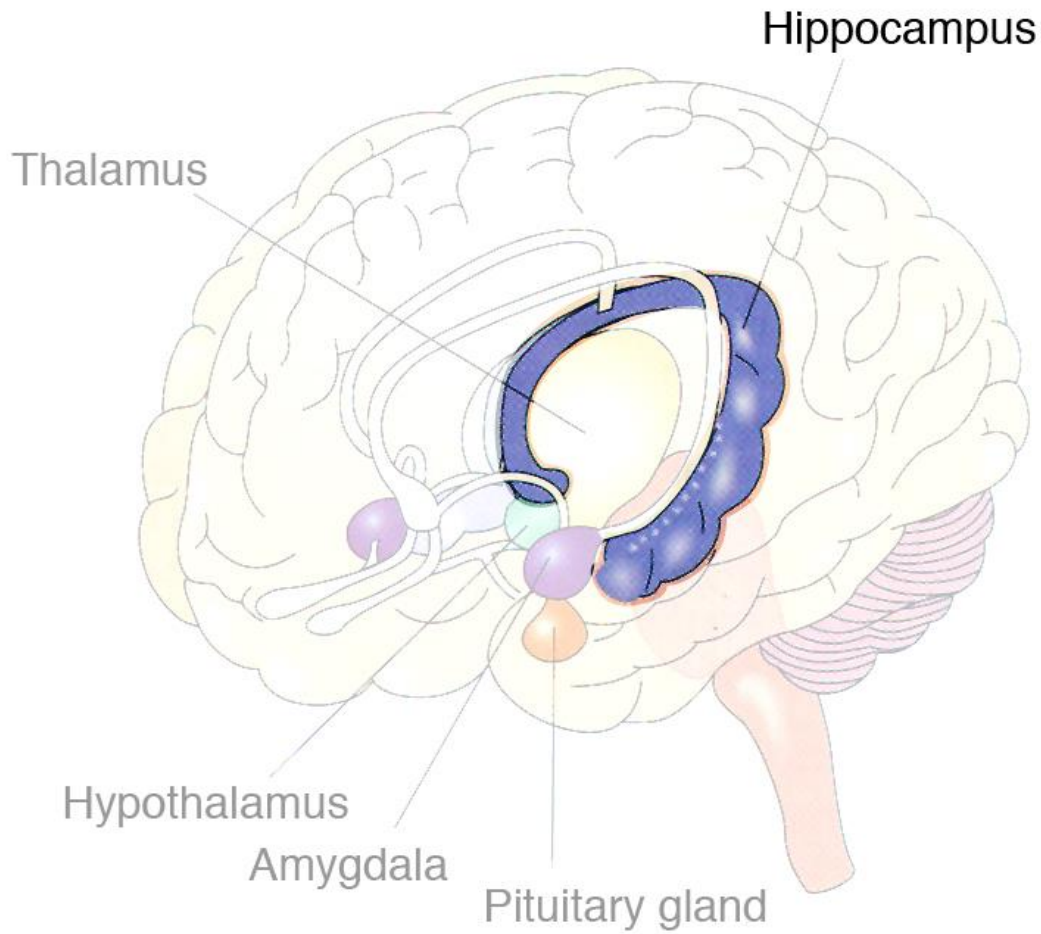
Structures lie deep within the cerebral hemispheres

Coordinates behaviours needed to satisfy emotional and motivational urges arising in the hypothalamus

Also involved in memory

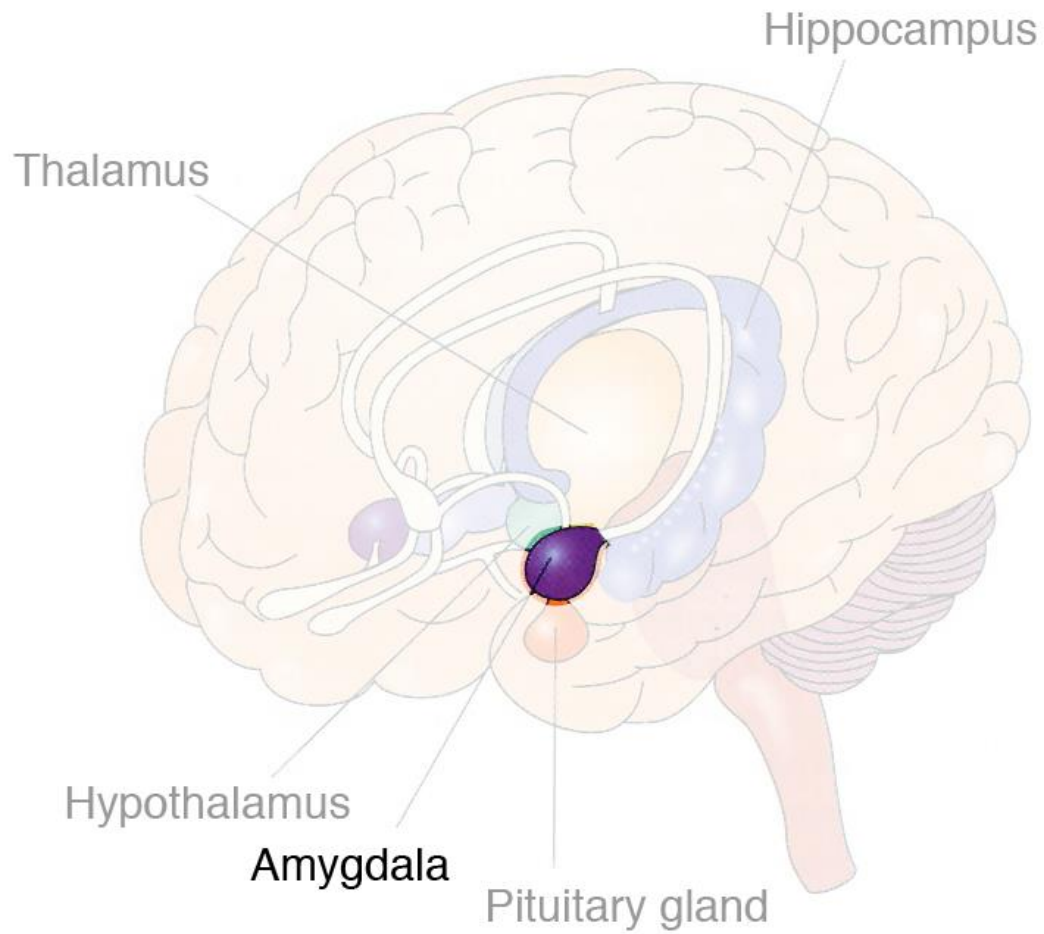


# Limbic System: Structure



**Hippocampus:**  
Learning and  
memory

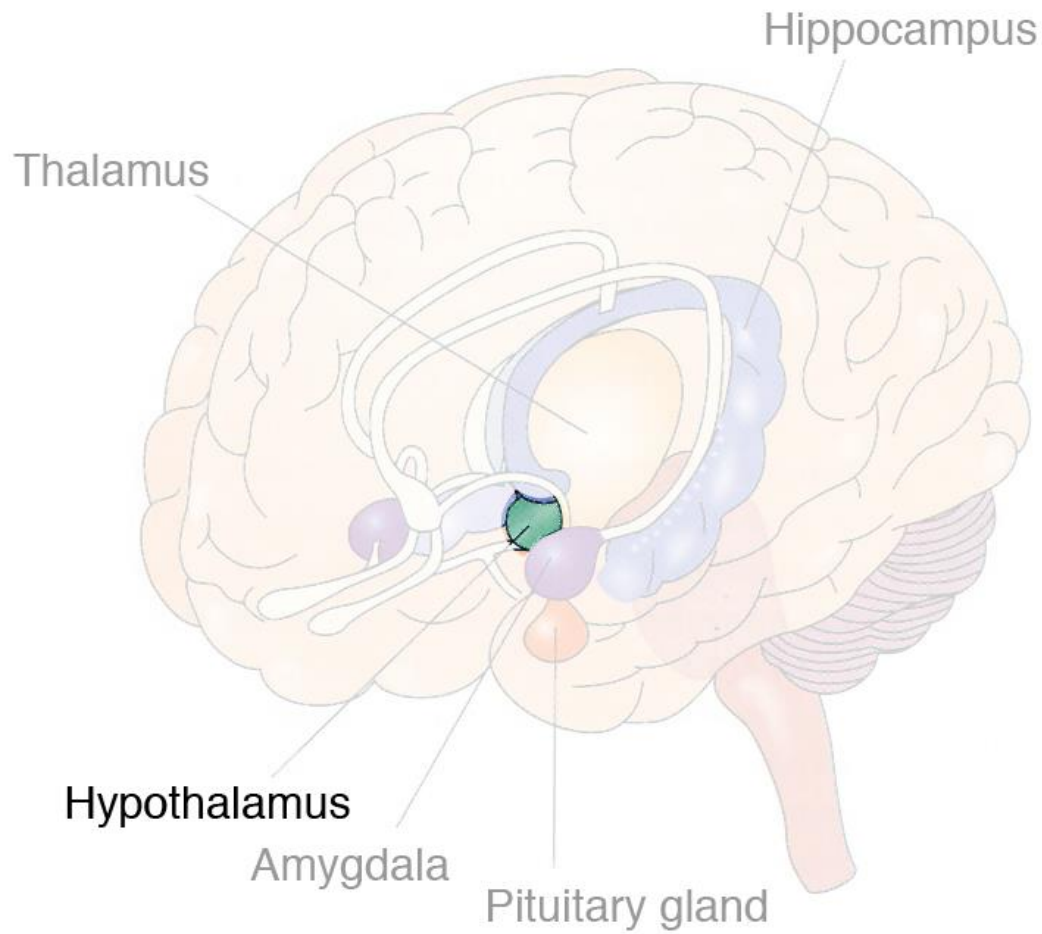
# Limbic System: Structure



**Hippocampus:**  
Learning and  
memory

**Amygdala:**  
Emotions and  
aggression

# Limbic System: Structure



## Hippocampus:

Learning and memory

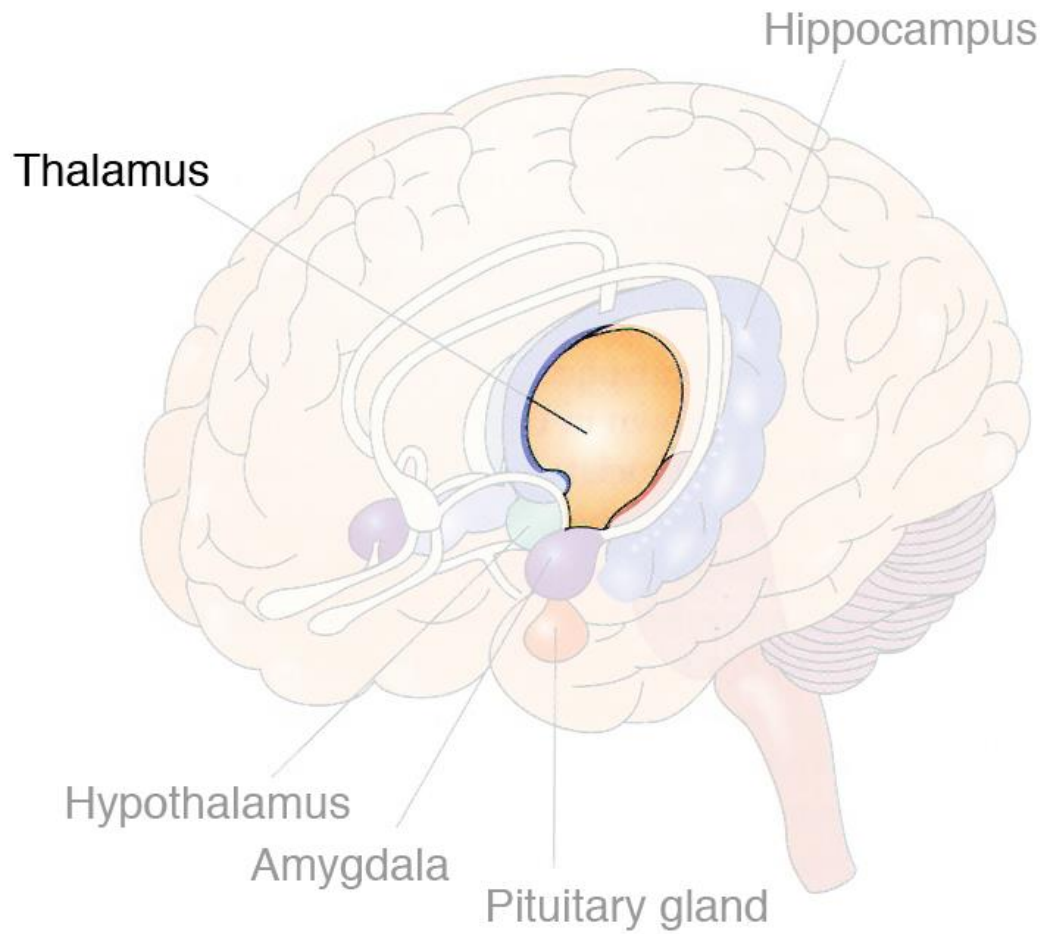
## Amygdala:

Emotions and aggression

## Hypothalamus:

Hunger, thirst, temperature control

# Limbic System: Structure



## Hippocampus:

Learning and memory

## Amygdala:

Emotions and aggression

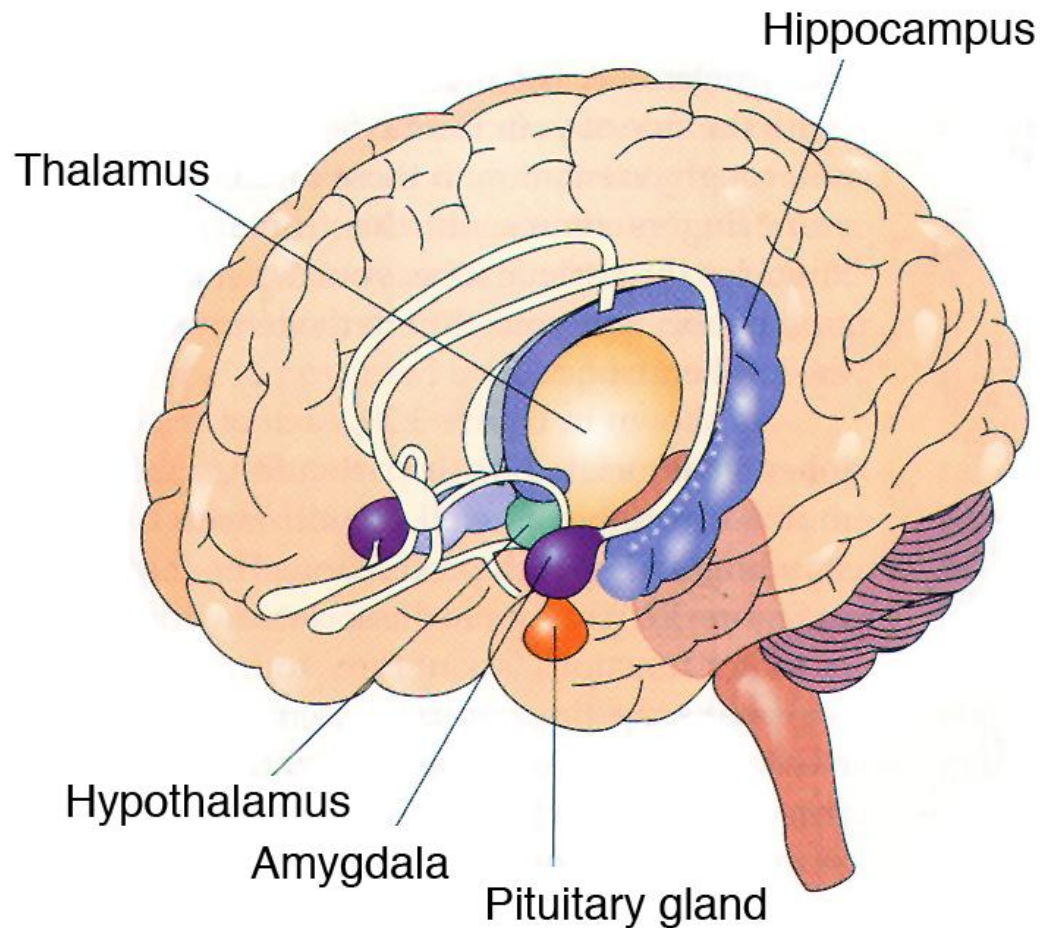
## Hypothalamus:

Hunger, thirst, temperature control

## Thalamus:

Relay centre for sensory information

# Limbic System: Structure



**Hippocampus:**  
Learning and memory

**Amygdala:**  
Emotions and aggression

**Hypothalamus:**  
Hunger, thirst, temperature control

**Thalamus:**  
Relay centre for sensory information

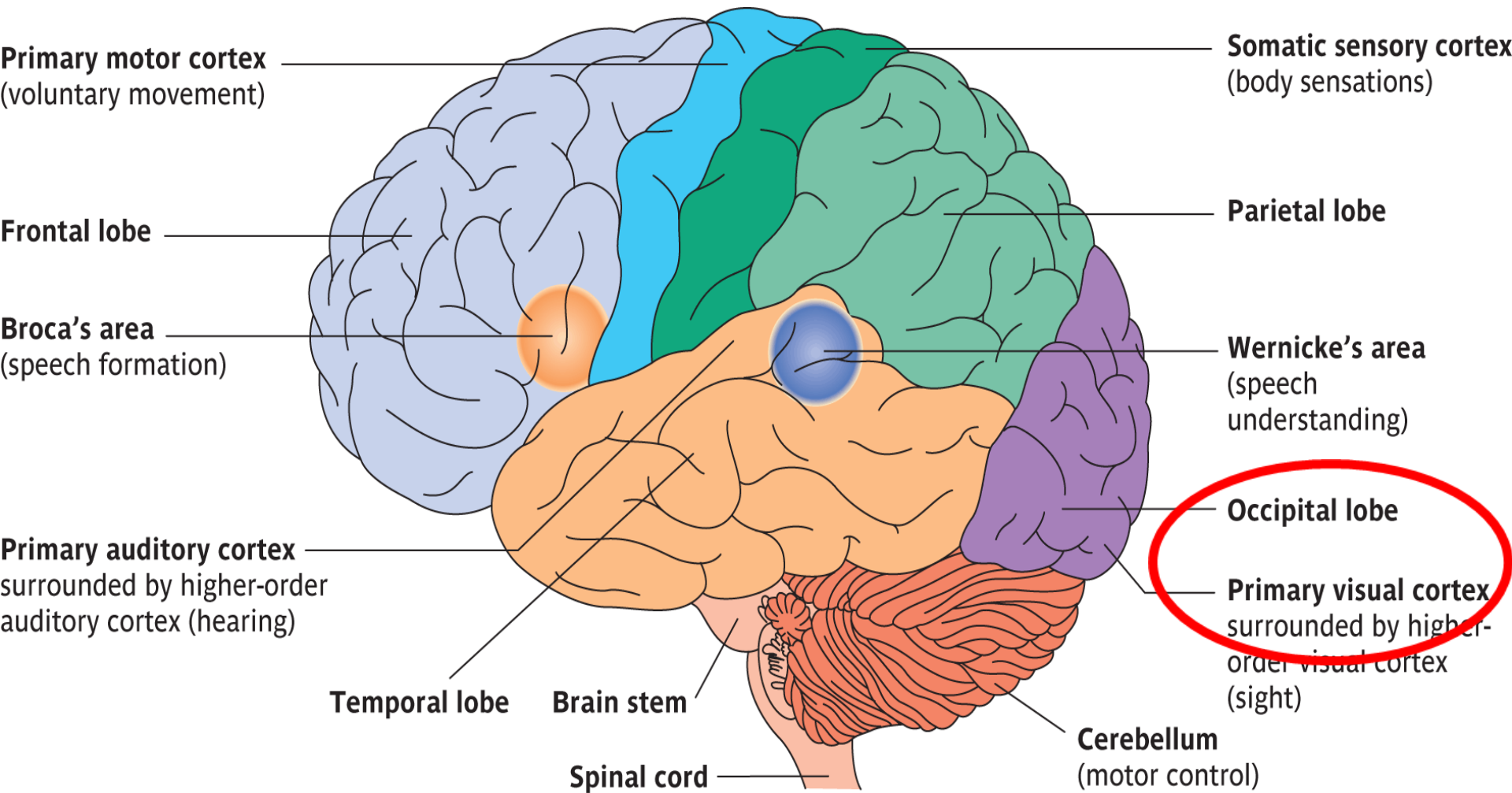
# Brain Structure and Function

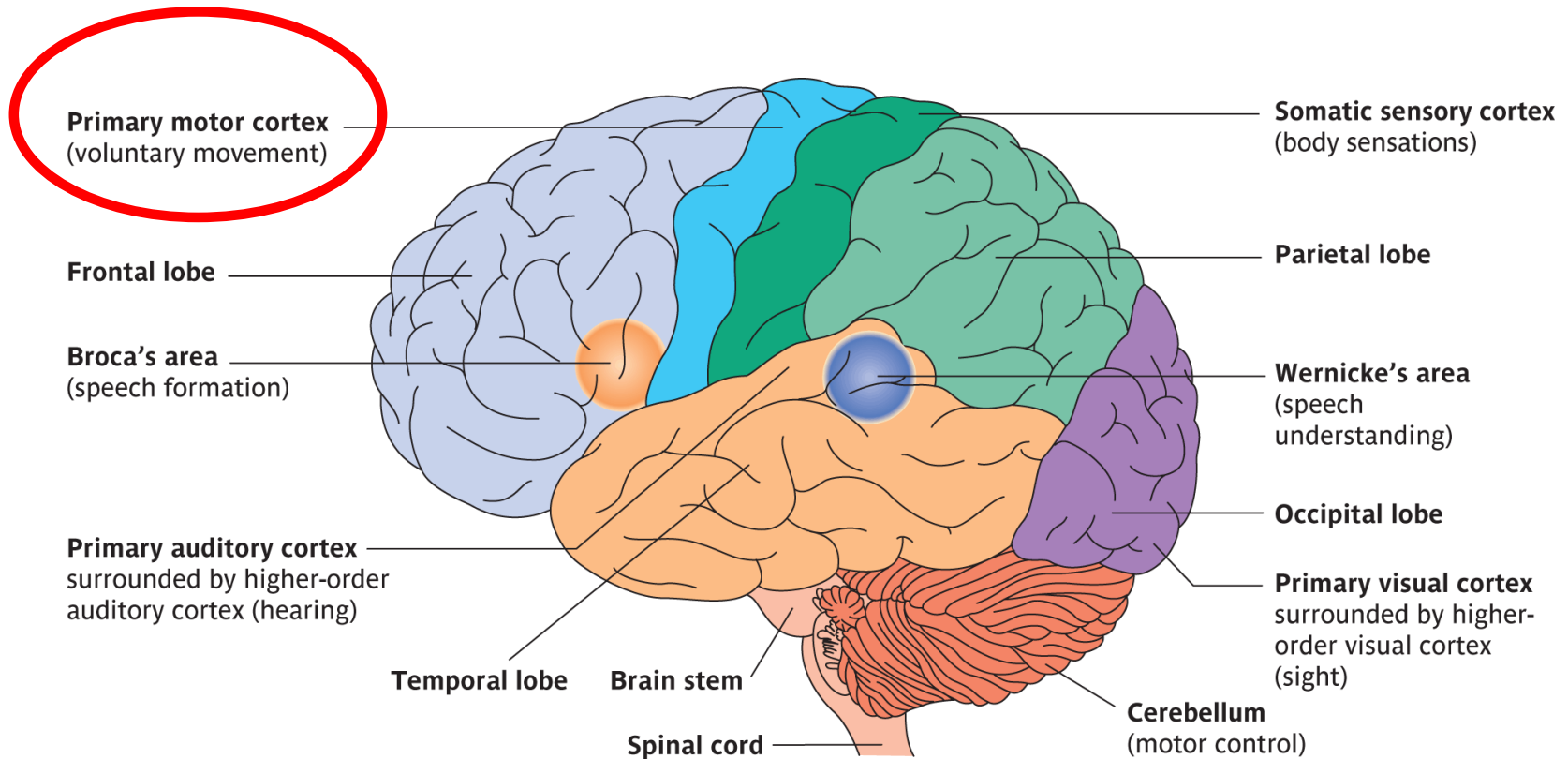
- **Cerebral Cortex:**
  - A ¼ inch sheet of grey unmyelinated cells that form the outermost layer of the human brain
  - Fissures – folds in the cerebral cortex; allows for greater surface area in a smaller space
- Fissures separate the brain into the four lobes

**Frontal**  
**Occipital**

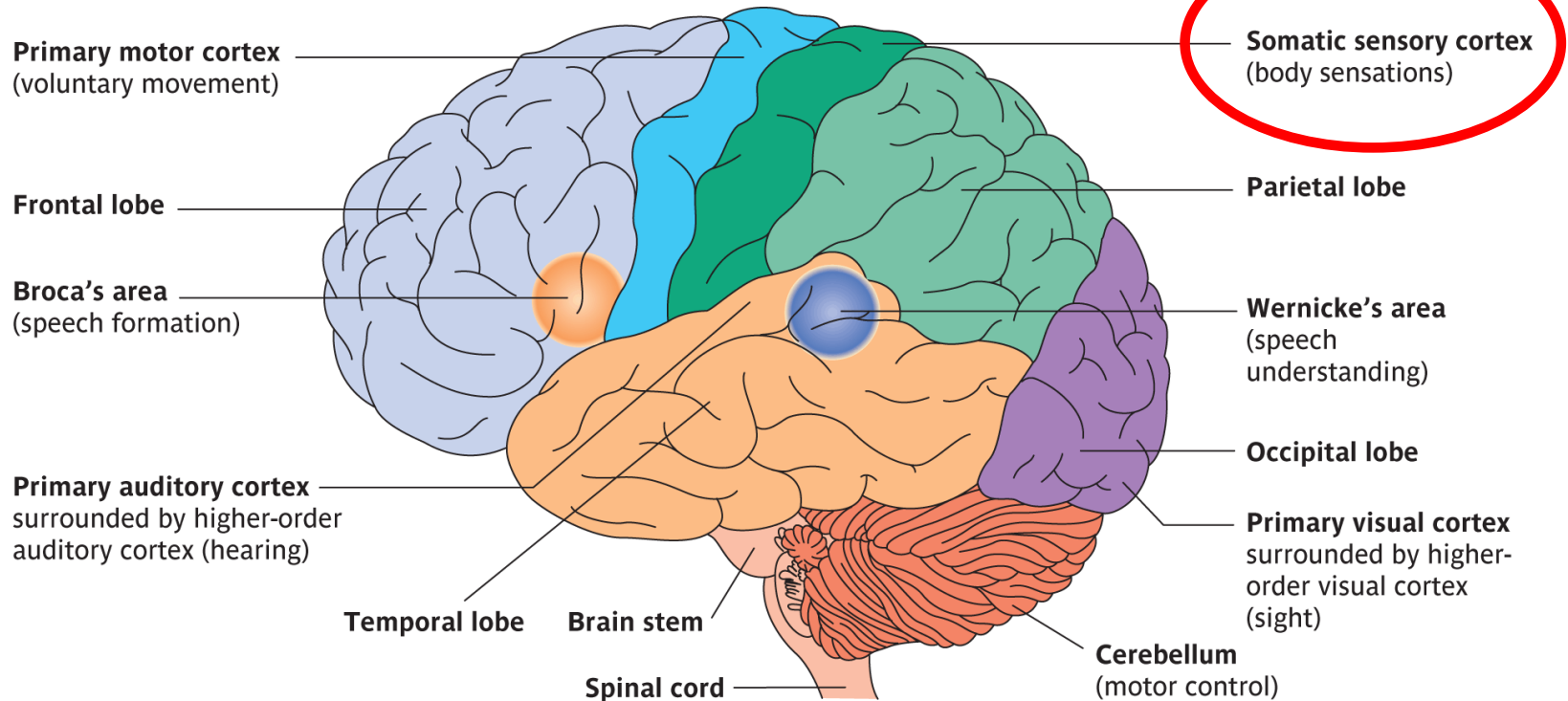
**Parietal**  
**Temporal**

# Brain Structure and Function





- **Primary motor cortex:**
  - Controls the 600+ muscles involved in voluntary body movements



- **Somatic sensory cortex:**
  - Receives sensory input that gives rise to our sensations of heat, touch and cold, and to our senses of balance and body movement (kinaesthesia)

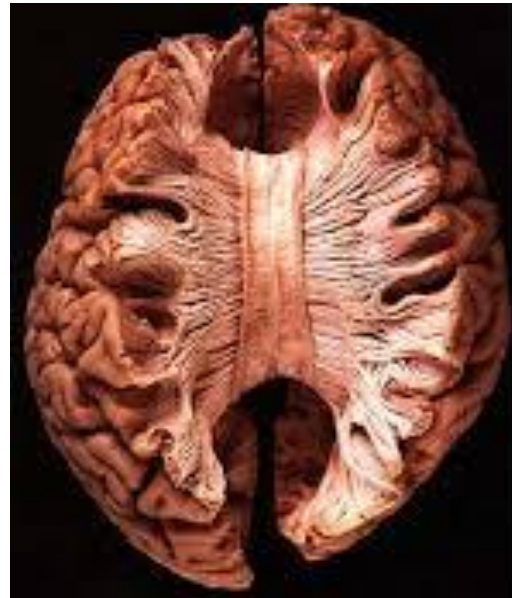
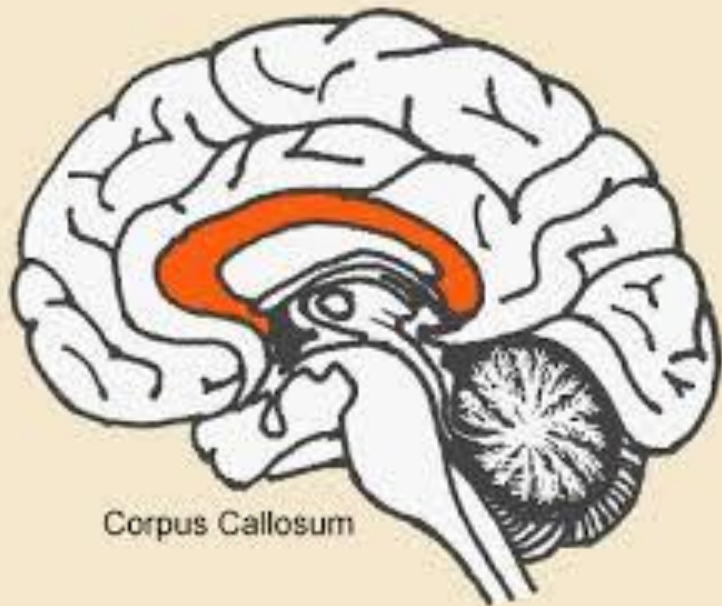
# Brain Structure and Function

- Speech Comprehension and Production
  - Broca's area: An area in the **frontal lobe** that is involved in the **production of speech** through its connections with the motor cortex region
  - **Loss of ability to talk (to put sentences together)**, but can understand spoken sentences
  - Wernicke's area: An area in the **temporal lobe** that is involved in **speech comprehension**
  - **Loss of ability to grasp the meaning of spoken words**; can speak fluently, but not with much sense

# Hemispheric Lateralization

- Corpus Callosum:

- A neural bridge that acts as a major communication link between the two hemispheres of the brain and allows them to function as a single unit



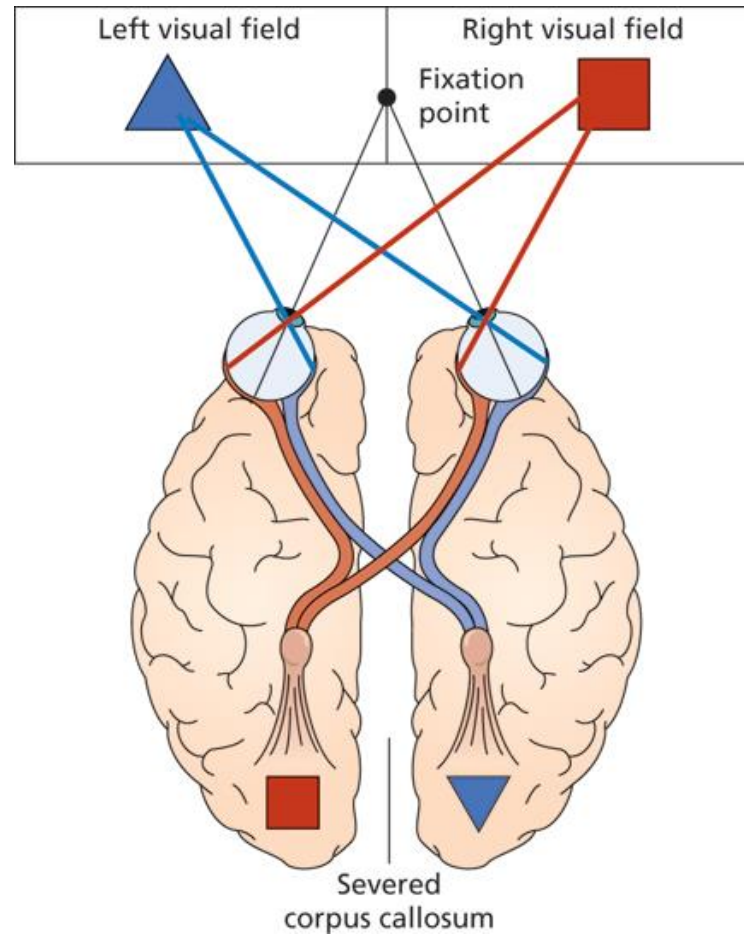
# Hemispheric Lateralization

- Lateralization:
  - The relatively greater localisation of a function in one hemisphere or the other
- Right Hemisphere
  - Spatial relations, faces, mental imagery, musical and artistic abilities, negative emotions
- Left Hemisphere:
  - Verbal abilities, speech, mathematical and logical abilities, positive emotions
  - Aphasia – the partial or total loss of the ability to communicate; results from damage to Broca's or Wernicke's area in the left hemisphere

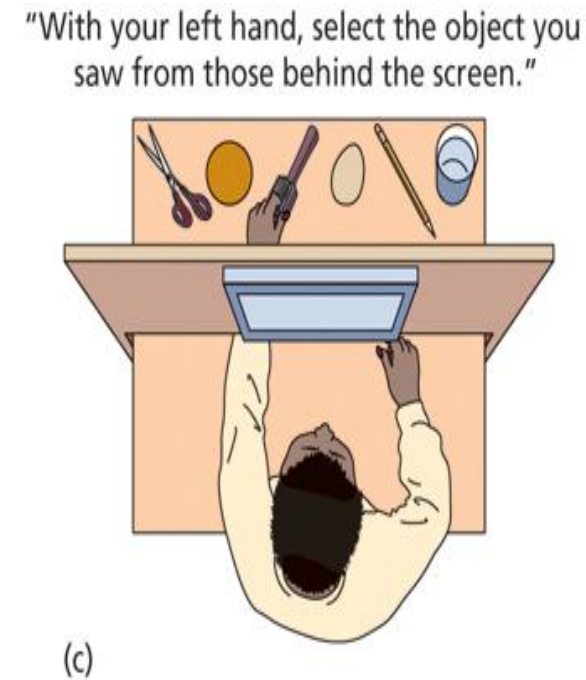
# Hemispheric Lateralization

- The Split Brain:
  - Split-brain research is conducted on people with severed corpus callosa
    - Demonstrates that visual input is not unified in these individuals
    - Input on the right side is sent to left hemisphere and vice-versa

# Hemispheric Lateralization



# Hemispheric Lateralization Sperry (1970)



# Studying the Brain

- There are several methods for studying the structure and function of the brain:
  - Neuropsychological tests measure verbal and nonverbal behaviours of brain-damage sufferers
  - Destruction and stimulation techniques
  - Electrical recording
    - EEG measures the activity of large groups of neurons through a series of large electrodes placed on the scalp

# Brain Imaging

- Allow neuroscientists to peer into the living brain
  - CT scans
  - MRIs (Magnetic Resonance Imaging)
  - PET scans
  - fMRI's

# Summary

- The central nervous system contains the brain and the spinal cord
- Three major subdivisions of the brain; hindbrain, midbrain and forebrain
- Fissures in the cerebral cortex separate the brain into the four lobes
- Our left and right hemispheres work as a single unit because of the corpus callosum

## Next week...

- The Peripheral Nervous System
  - Somatic nervous system
  - Autonomic nervous system
    - Sympathetic nervous system
    - Parasympathetic nervous system
- Neurons and neurotransmitters

### Reading:

- Gross, R. D. (2010). Psychology: The science of mind and behaviour. (6th ed.). London: Hodder Education. (E-book also available)  
Chapter 4.
- Pinel, J. P. J. (2014). Biopsychology. (8th ed.). Boston: Pearson. (E-book also available). Chapter 3.