

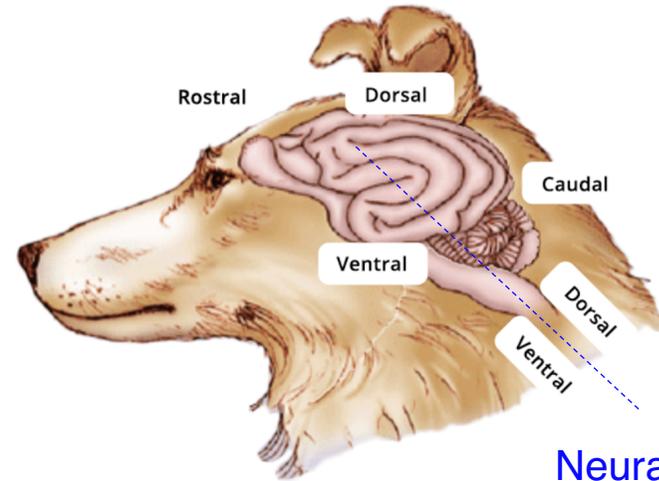
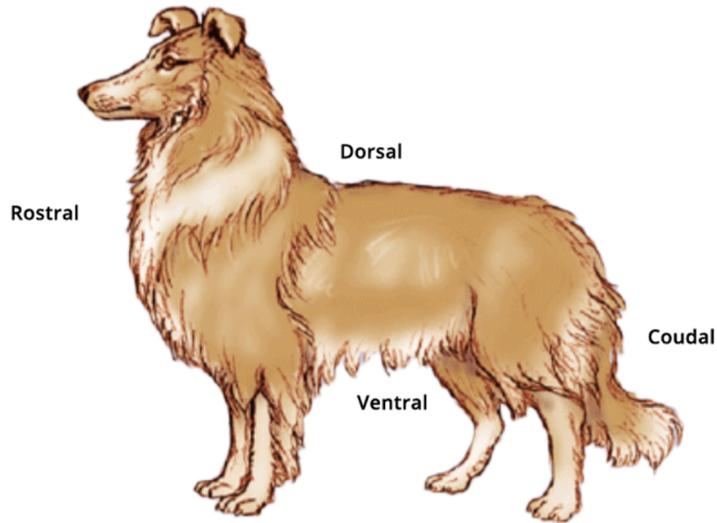
Anatomical Divisions of the Brain



Learning Objectives

- ❓ Navigate to different regions of the brain using common neuroanatomical reference terminology
- ❓ Discuss key structural features of the human brain.
- ❓ Associate core functional roles to different sub-cortical regions of the brain

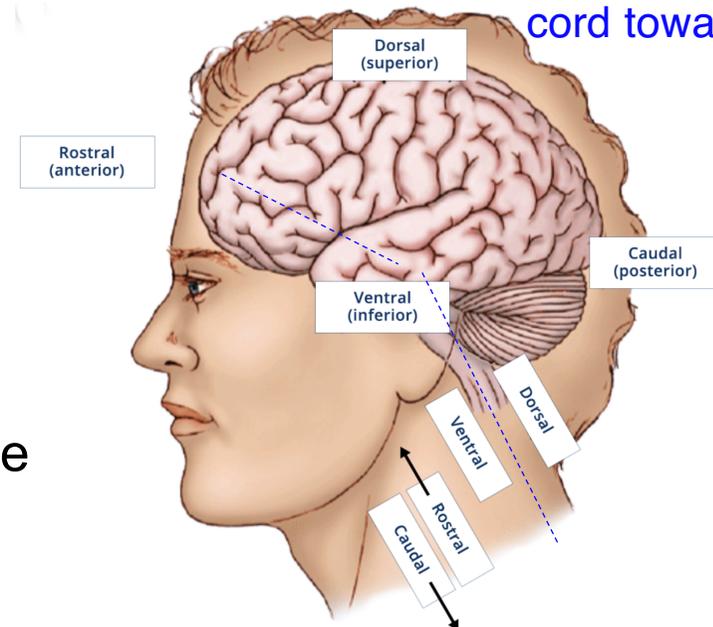
Navigating neural space



Neural axes - imaginary line drawn through spinal cord toward front of brain

- ? *Rostral* (anterior) – ‘toward the beak’
- ? *Caudal* (posterior) – ‘toward the tail’
- ? *Dorsal* (superior) – ‘toward the back’
- ? *Ventral* (inferior) – ‘toward the belly’

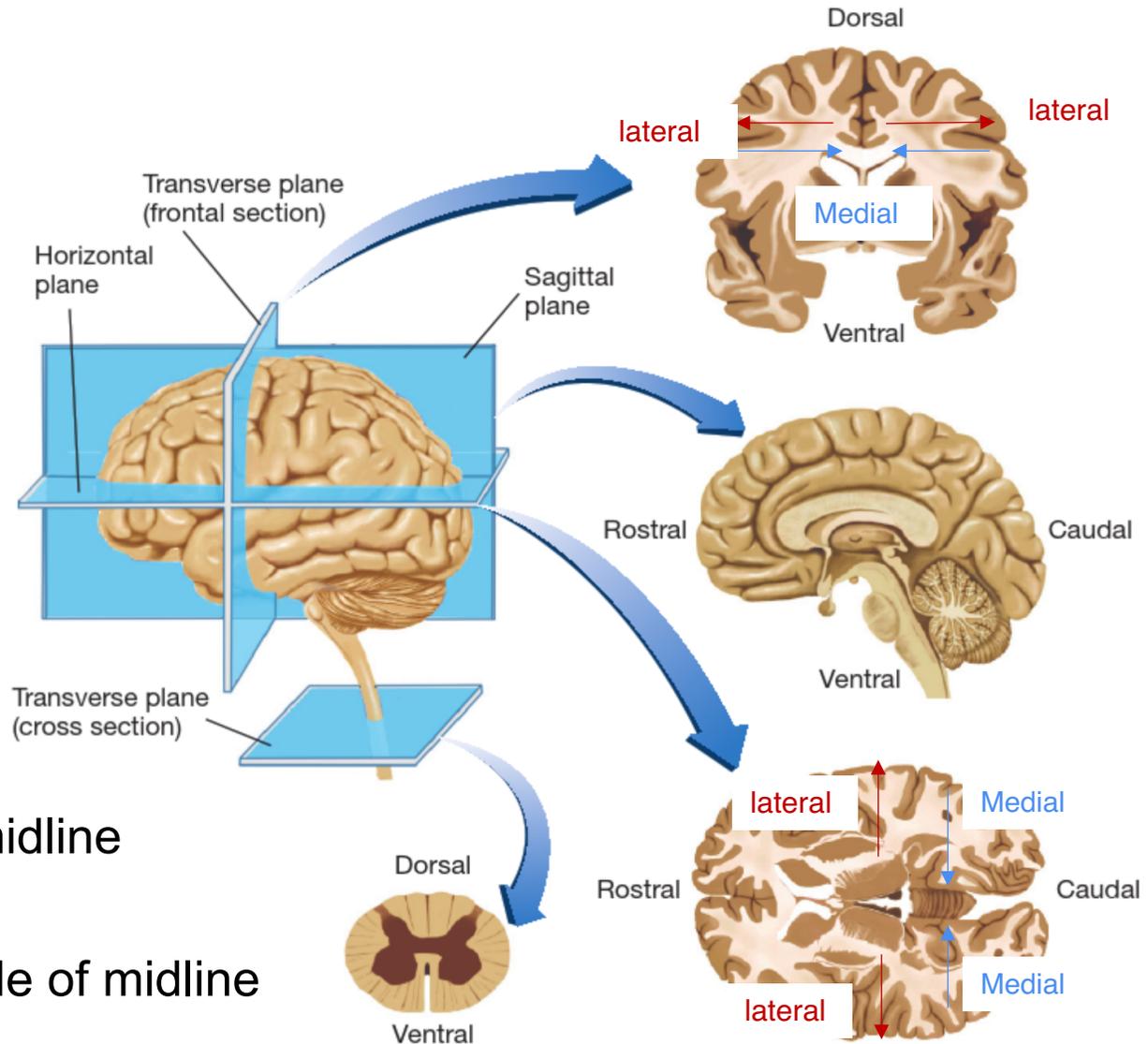
- ? Human neural axis bends because the head is perpendicular to the back



Navigating neural space

? *Lateral* - toward the side

? *Medial* - toward the midline

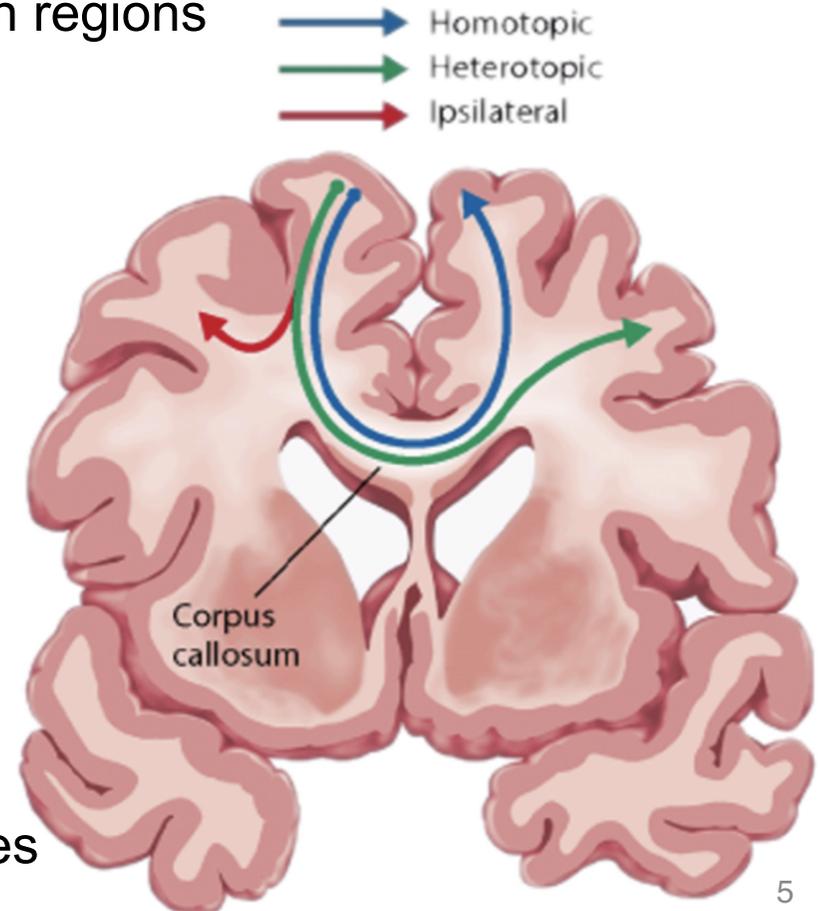
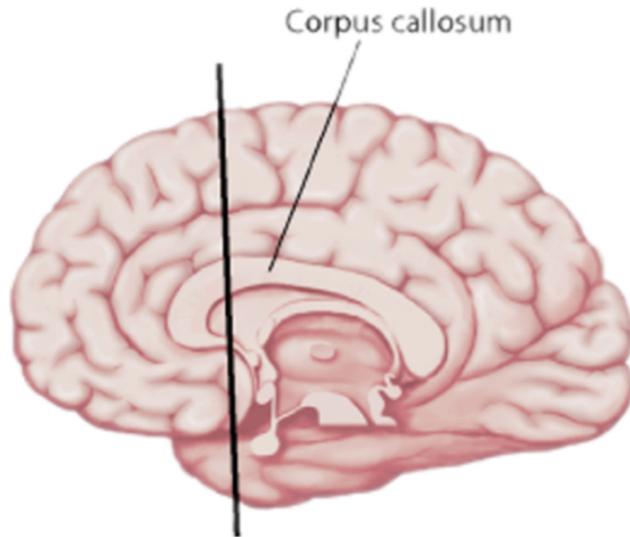


? *Ipsilateral* – on same side of midline

? *Contralateral* – on opposite side of midline

Corpus callosum

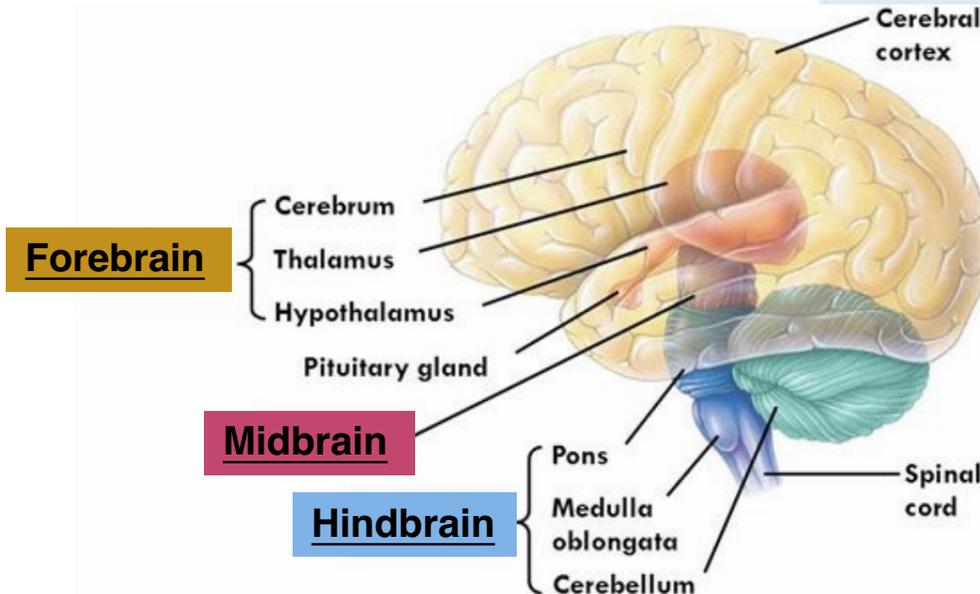
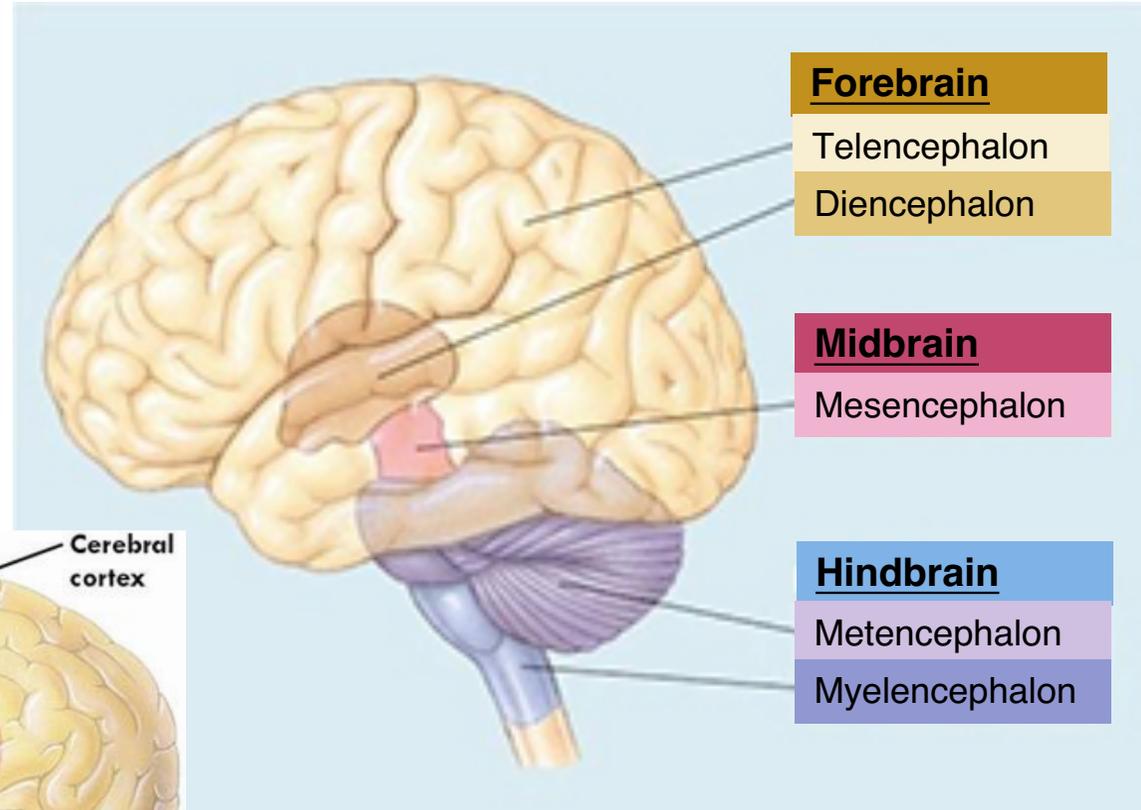
- ? Consists of large bundle of axons that connect two hemispheres
- ? Green & Blue represent *contralateral* connections
- ? *Homotopic* connects complementary region of other hemisphere
- ? *Heterotopic* communicates to a different brain regions
- ? *Ipsilateral* is on the the same side



- ? Callosotomy - procedure to cut the corpus callosum to stop severe epileptic seizures
- ? Prevents communication between hemispheres

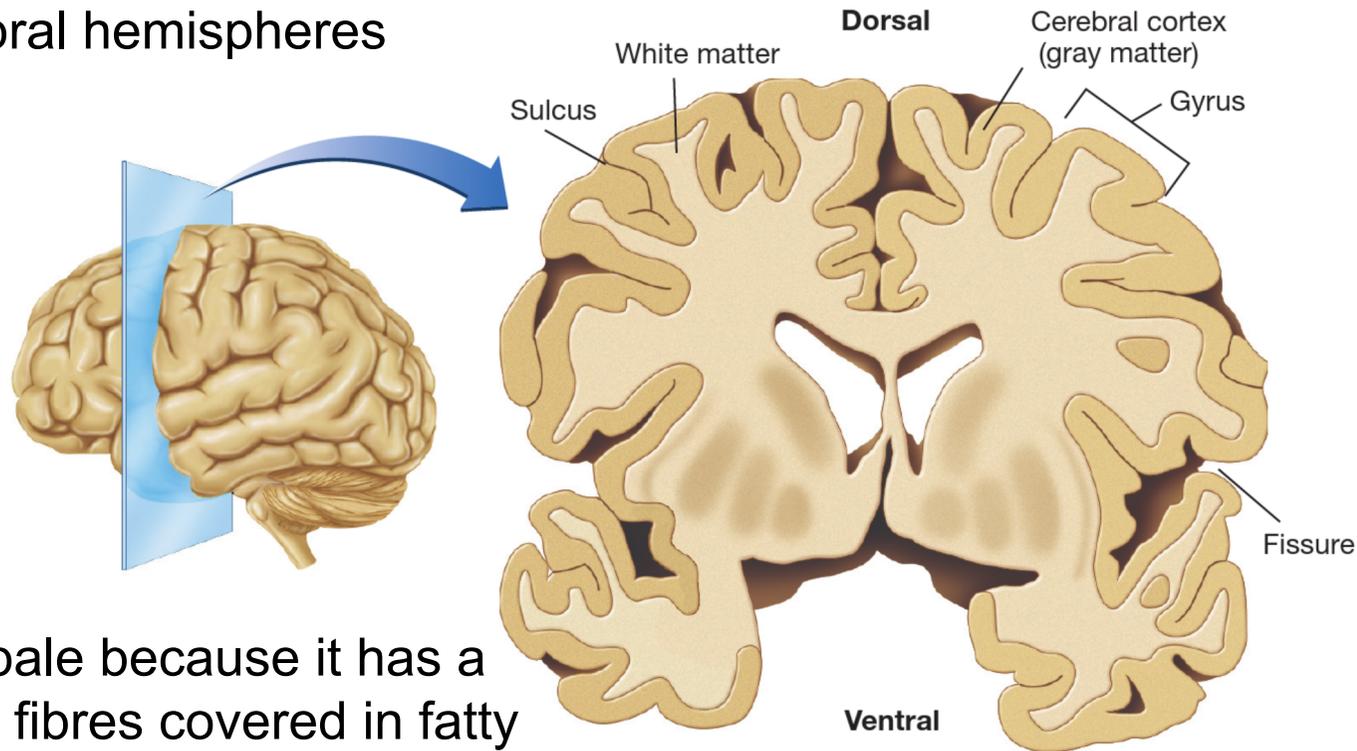
Anatomical Subdivisions of the Brain

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



Telencephalon – Cerebral Cortex

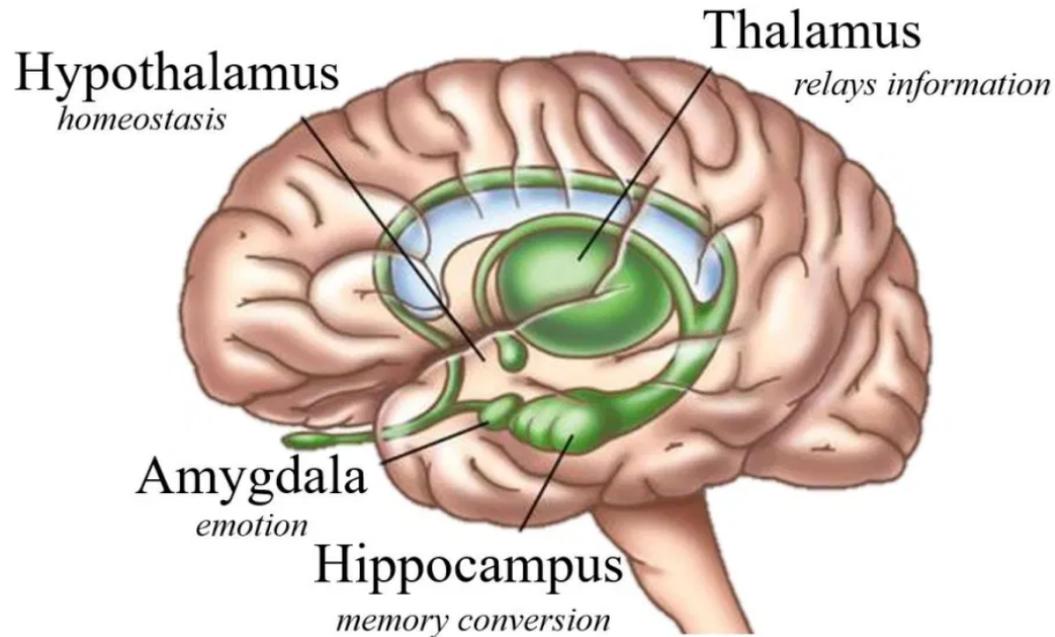
- ? **Telencephalon** is a subdivision of the forebrain & consists of the **limbic system, Basal Ganglia** and **Cerebral Cortex**
- ? **Cerebral cortex** - largest structure of human brain
- ? Divided into two cerebral hemispheres



- ? Inner “white matter” is pale because it has a high proportion of axon fibres covered in fatty myelin layer.
- ? Outer “grey matter” where the neurons synapse and connect together

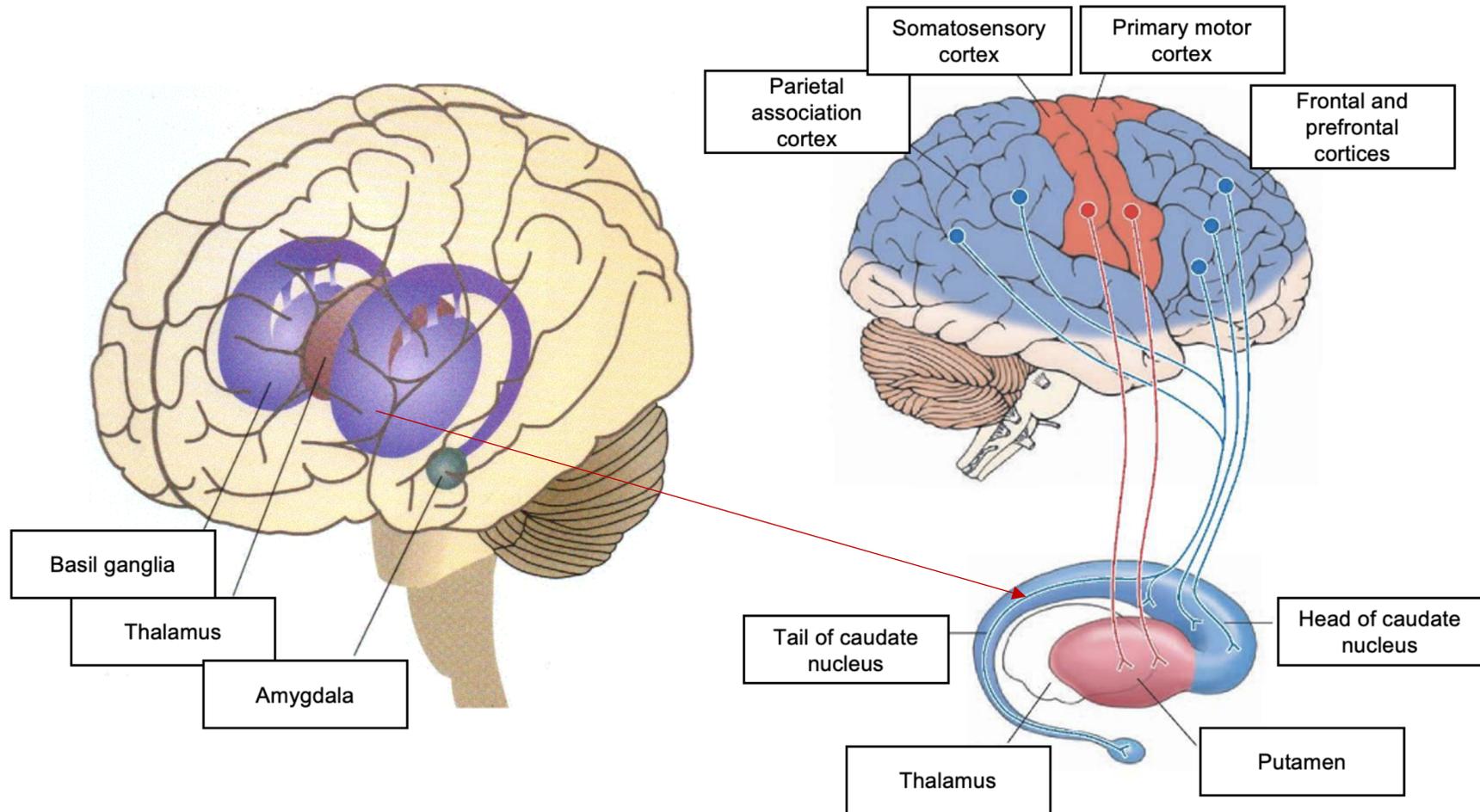
Telencephalon – Limbic System

- ? 1937 James Papez first proposed an emotion circuit in the brain
- ? 1949 Paul McLean coined term “*Papez circuit*” including the **hypothalamus**, **thalamus**, cingulate gyrus, fornix, **hippocampus**, **amygdala** & orbitofrontal cortex and some nuclei of the **basal ganglia**



- ? Concept of Limbic system still used today to describe an emotion circuit in the brain, however, this view has shortcomings.
- ? While the **amygdala** plays a crucial role in emotion, it is now known the **hippocampus** & parts of surrounding cortex are involved in learning & memory.

Telencephalon – Basal ganglia



- ? the nuclei of the basal ganglia (including caudate nucleus & Putamen) are responsible for controlling involuntary movement, particular aspects that are highly automatised or involuntary (such as walking).
- ? The basal ganglia are dysfunctional in patients with **Parkinson's disease** which leads to weakness, tremors, limb rigidity, poor balance and difficulty initiating movements

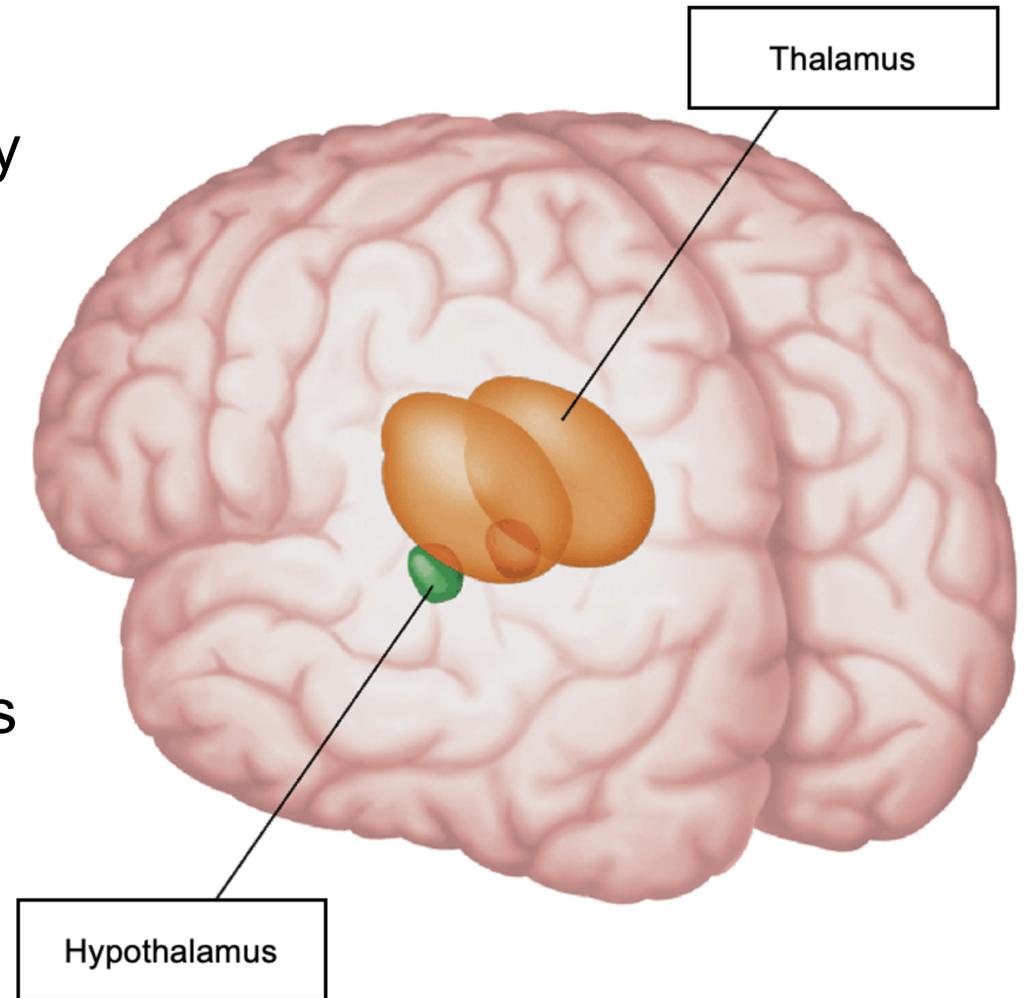
Diencephalon - thalamus & hypothalamus

Thalamus:

- ? Major relay station for sensory inputs to cerebral cortex
- ? Divided into several nuclei

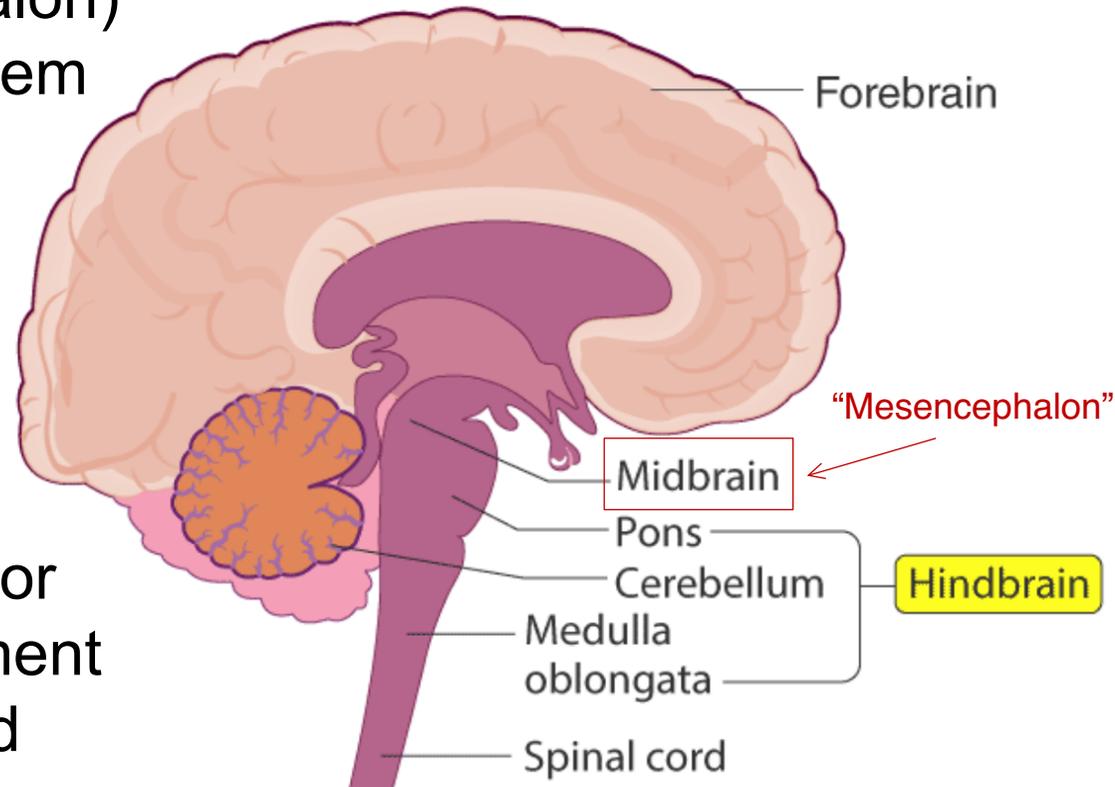
Hypothalamus:

- ? Controls autonomic nervous system and endocrine (hormone) system
- ? Regulates survival behaviours (fighting, feeding, fleeing, mating)



Midbrain – Mesencephalon

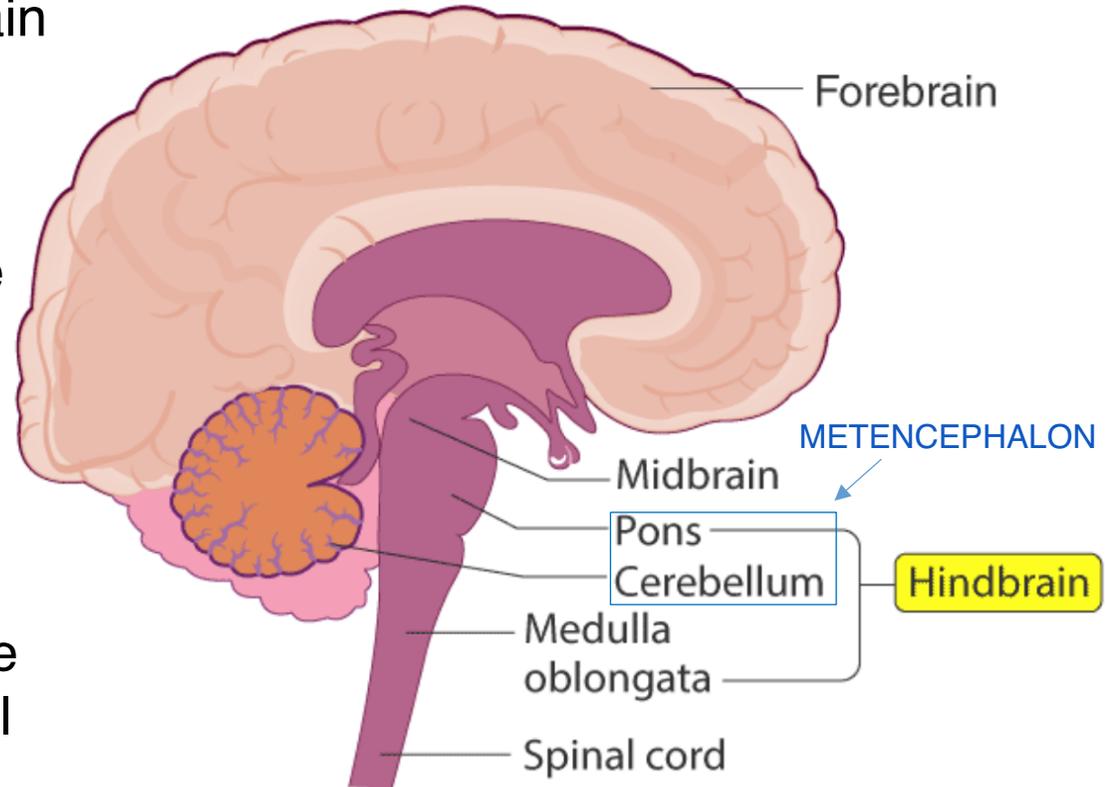
- ? The midbrain (and hindbrain) are located within the brainstem.
- ? The midbrain (or mesencephalon) is at topmost region of brainstem and sits directly above the hindbrain.
- ? It connects the pons and cerebellum with the forebrain.
- ? plays an important role in motor movement particularly movement of the eye, and in auditory and visual processing.



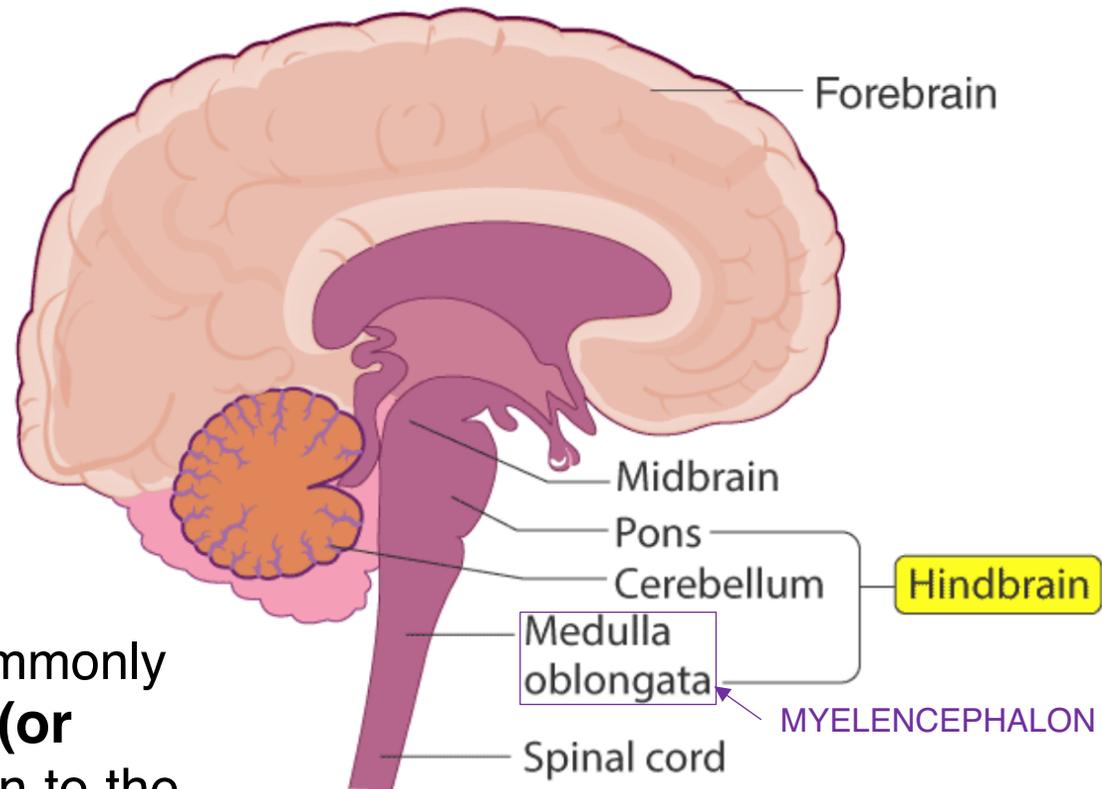
Hindbrain - Metencephalon

? Includes the **cerebellum** ('little brain') which receives information from visual, auditory, somatosensory & vestibular (balance) systems helps coordination of movement. Damage to the cerebellum causes problems with walking and leads to jerky, poorly coordinated movements and problems maintaining balance.

? The **pons** lies on the ventral surface of the brainstem. It contains several nuclei important in regulating sleep and arousal; it also relays information from the cerebral cortex to the cerebellum.



Hindbrain - Myelencephalon



- ?** The myelencephalon is more commonly called the **Medulla oblongata (or Medulla)** and links the hindbrain to the spinal cord and contains neurons important for autonomic functions like respiration and hear rate.

Additional Resources

In your own time you may like to watch this fantastic 14min movie of a brain dissection and observe the anatomical structures of the brain that you have been learning about.



https://youtu.be/_aCCsRCw78g

Section Summary

- ❓ Navigational terms allow brain locations to be described with a common language.
- ❓ The brain itself is divided into division (Forebrain, Midbrain & Hindbrain).
- ❓ These divisions are further divided into subdivisions that include multiple structures that each serve different important functions from motor control to emotion.

Section Reading: Physiology of Behaviour, EBook Global Edition By Carlson & Birkett (2016). Chapt 3 p 72-75 (covers first part of section)

•<https://ebookcentral.proquest.com/lib/unimelb/reader.action?docID=5187674&ppg=97>