Session 2:

The Brain, Spinal Cord and Cranial Nerves

This is a complex network of nerves that coordinates actions and sensory information by transmitting signals to and from different parts of its body.

DOCTORS LIVE

What is the nervous system?

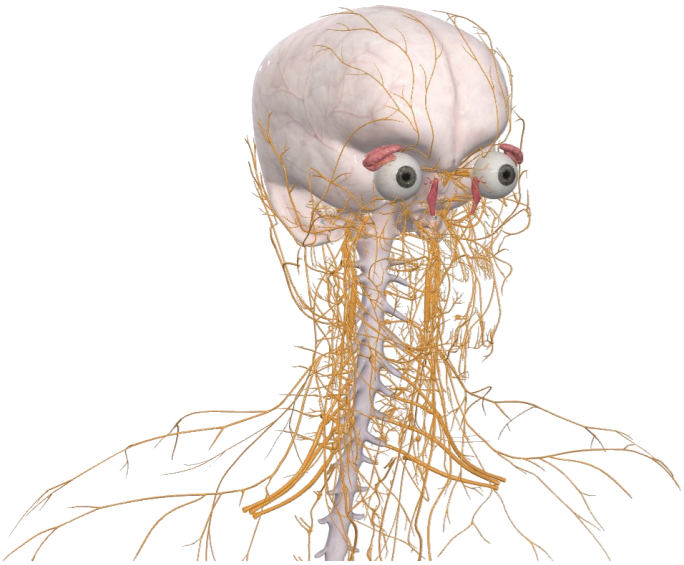
⇒ The nervous system is the major controlling, regulatory, and communicating system in the body.

⇒ The fundamental cell type of the brain and nervous system is called a neurone.

⇒ Neurones produced electrical impulses to transmit messages.

⇒ The neurones connect like a network and there are around 100 billion of them (about as many as there are stars in the milky way!).

⇒ Neurones are supported by other cells. These support cells are called glial cells.



What is the function of the nervous system?

The nervous system is responsible for controlling everything in your body. The nervous system is involved in receiving information about the environment around us (sensation) and generating responses to that information (motor responses). There are also many relay centers and interconnection between neurons . So we can divide the role of the nervous system into 3 main roles:

⇒ Sensory
⇒ Integrative
⇒ Motor

What does a neuron look like?

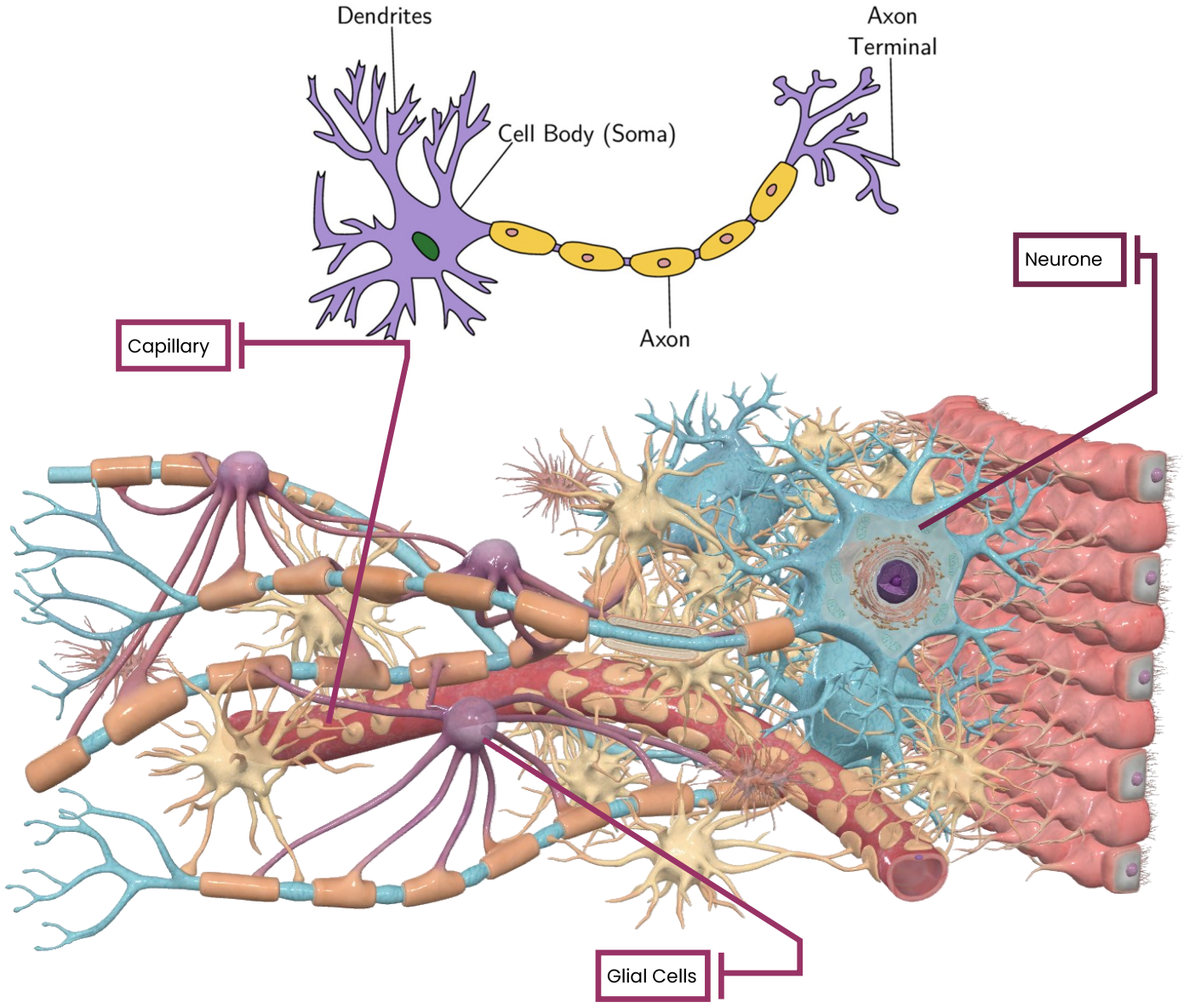
Cell body (soma) — this portion of the neuron receives information. It contains the cell's nucleus—the cell's genetic makeup.

Dendrites — these thin filaments carry information from other neurons to the cell body. They are the "input" part of the cell.

Axon — the long part of the nerve cell. This carries information from the soma and sends it off to other cells. This is the "output" part of the cell. It normally ends with a number of 'synapses' connecting to the dendrites of other neurons.

Synapses are the meeting points of different neurones.

Both dendrites and axons are sometimes referred to as nerve fibres.

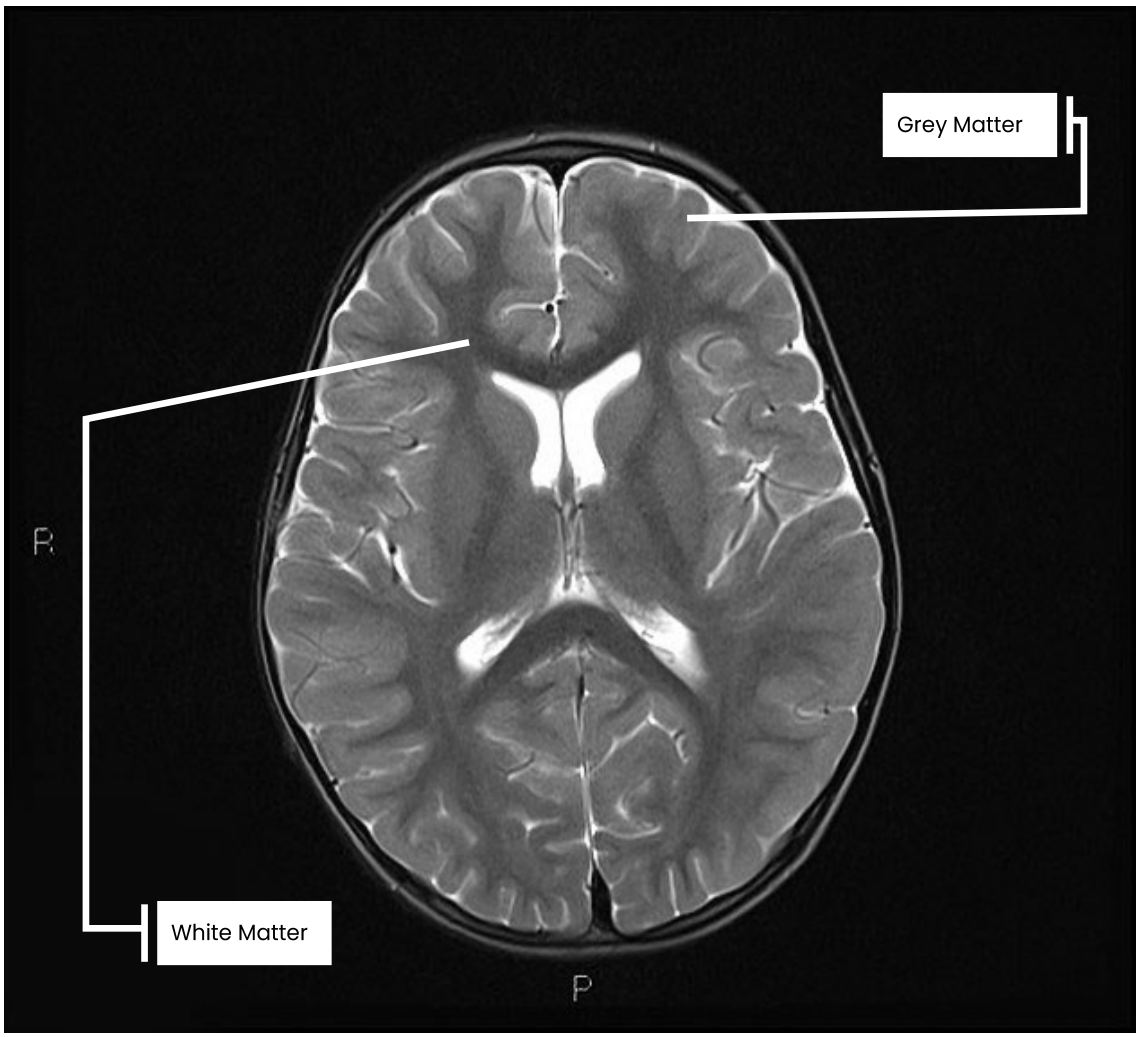


What is grey and white matter?

⇒ The grey matter contains the cell bodies, dendrites and the axon terminals, where all synapses are.

⇒ The white matter is made up of axons, which connect different parts of grey matter to each other.

⇒ It is the white matter that allows communication to and from grey matter areas.



An example of a MRI scan of the head. This is the gold standard type of scan to look for brain problems. It allows doctors to have a look in great detail at the structures of the brain. In this scan you can see the grey and white matter clearly. There are many different types of MRI images, this specific image is called a T2 MRI scan. In this type of image you can see that the white matter actually looks darker than the grey matter.

What are the components of the brain?

The brain can be split into 3 main parts. The cerebellum is the most primitive part of your brain and is responsible for coordination and balance. The brain stem is responsible for the vital activities of your body to maintain life. The cerebrum is the most advanced part of your brain and is responsible for higher function and thinking (this is the part that is the most developed in humans compared with other animals).

⇒ Cerebellum

⇒ Brain stem

⇒ Cerebrum

What is the cerebellum?

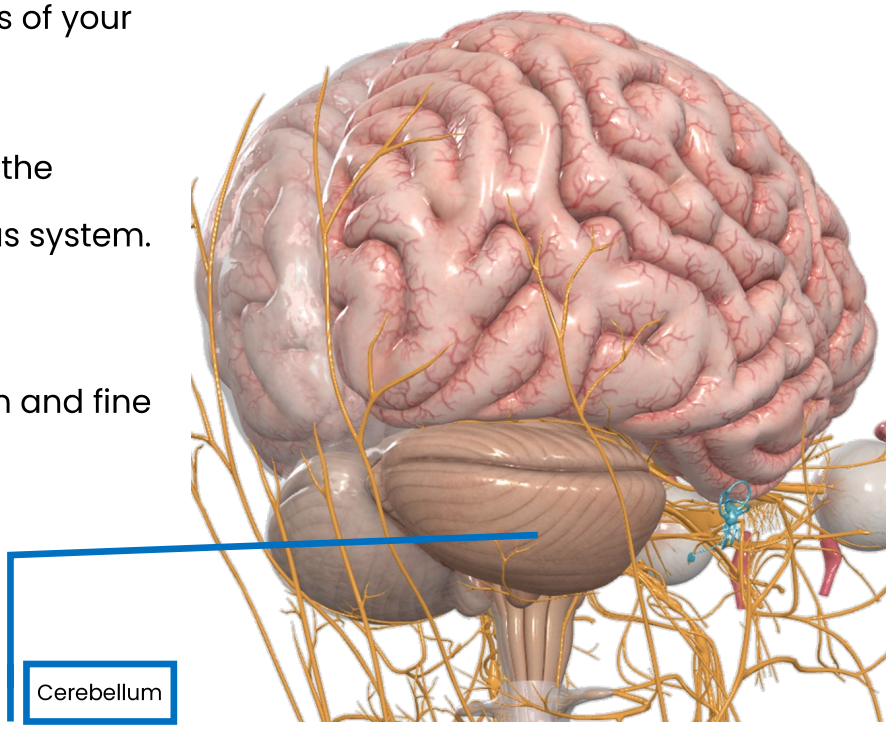
⇒ One of the most primitive parts of your brain.

⇒ Contains more than half of all the neurones in your entire nervous system.

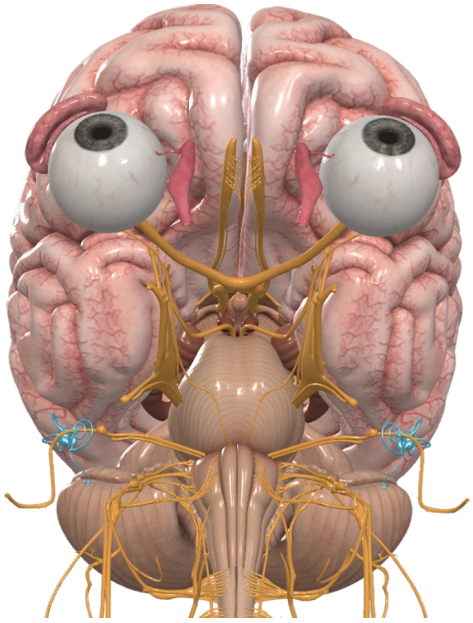
⇒ Found in the back of the brain.

⇒ Controls balance, coordination and fine muscle control (e.g., walking).

⇒ It also functions to maintain posture and equilibrium.



What is the brain stem?



⇒ One of the most vital structures in your brain needed for survival.

⇒ One of the deepest structures of the brain so it is well protected.

⇒ Connects the cerebrum with the spinal cord.

⇒ Divided into 3 parts – **midbrain**, **pons** and **medulla**.

⇒ It controls fundamental body functions such as breathing, eye movements, blood pressure, heartbeat, and swallowing.

⇒ Most of the cranial nerves originate from here.

An example of a CT scan of the brain. This is a quick scan used to assess for any injury to the brain. It has less resolution (is less detailed) than an MRI scan.

What is the cerebrum?

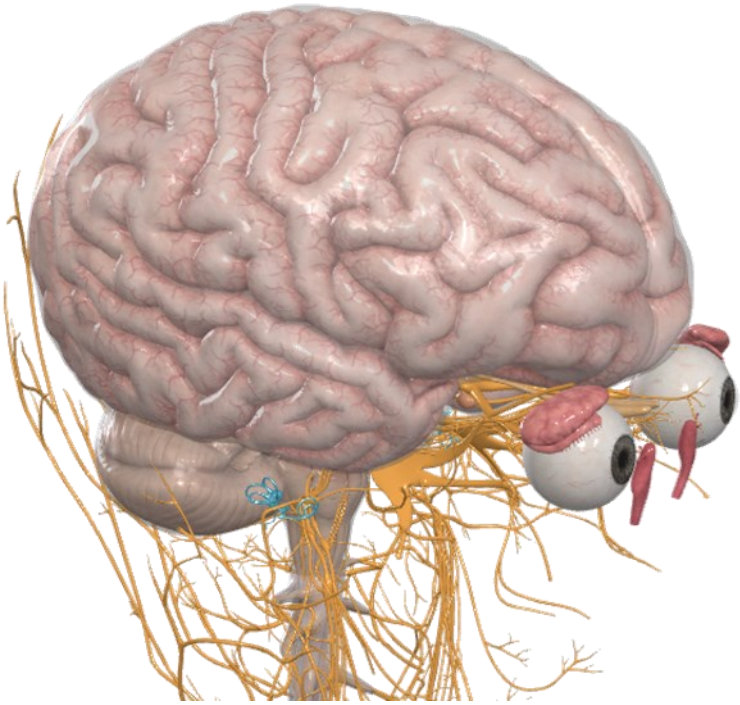
⇒ The cerebrum, the large, outer part of the brain, controls reading, thinking, learning, speech, emotions and planned muscle movements.

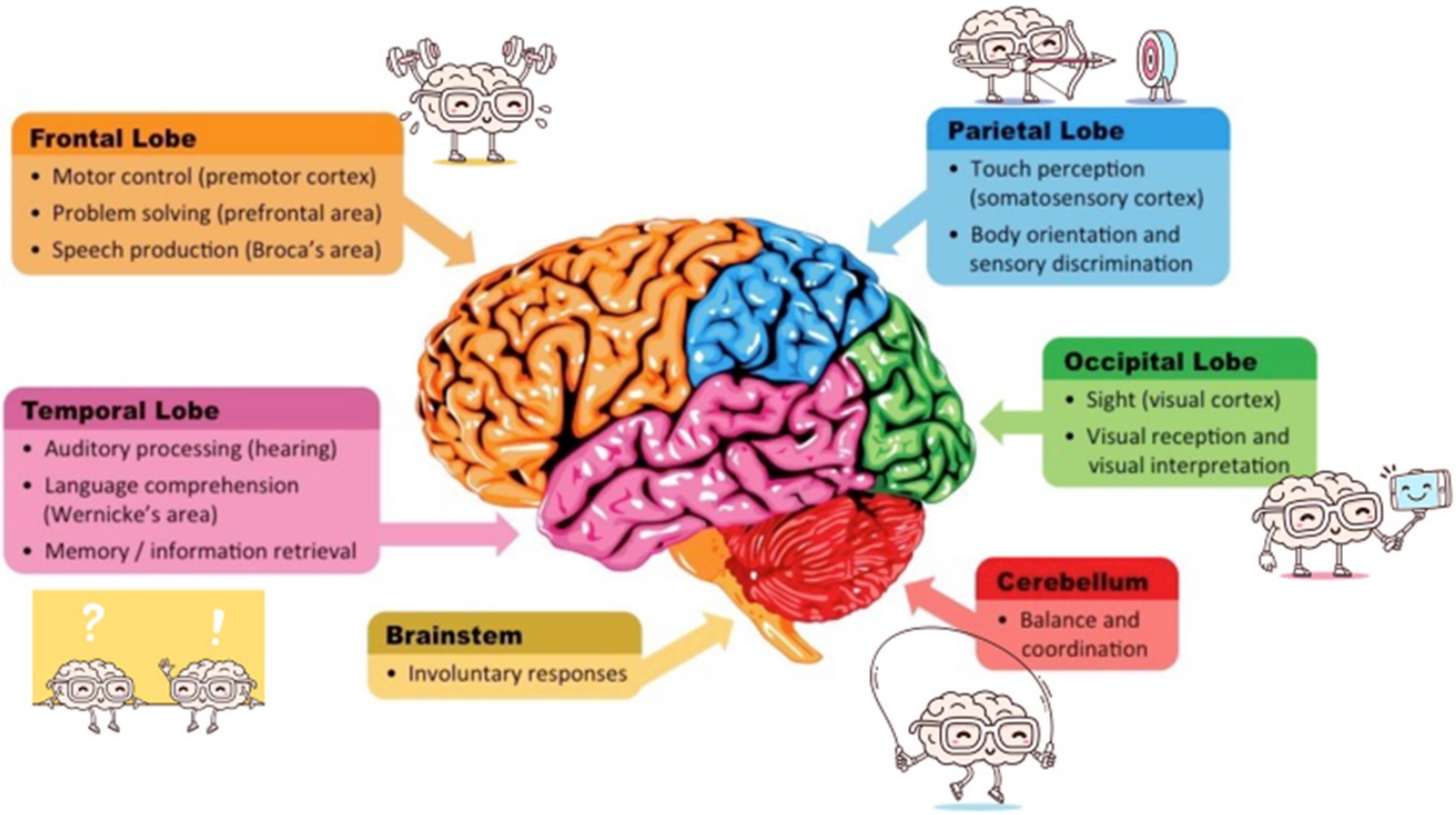
⇒ Controls senses.

⇒ Divided into two cerebral hemispheres (halves): left and right.

⇒ The right half controls the left side of the body. The left half controls the right side of the body.

⇒ Each hemisphere has four lobes.





What is the spinal cord?

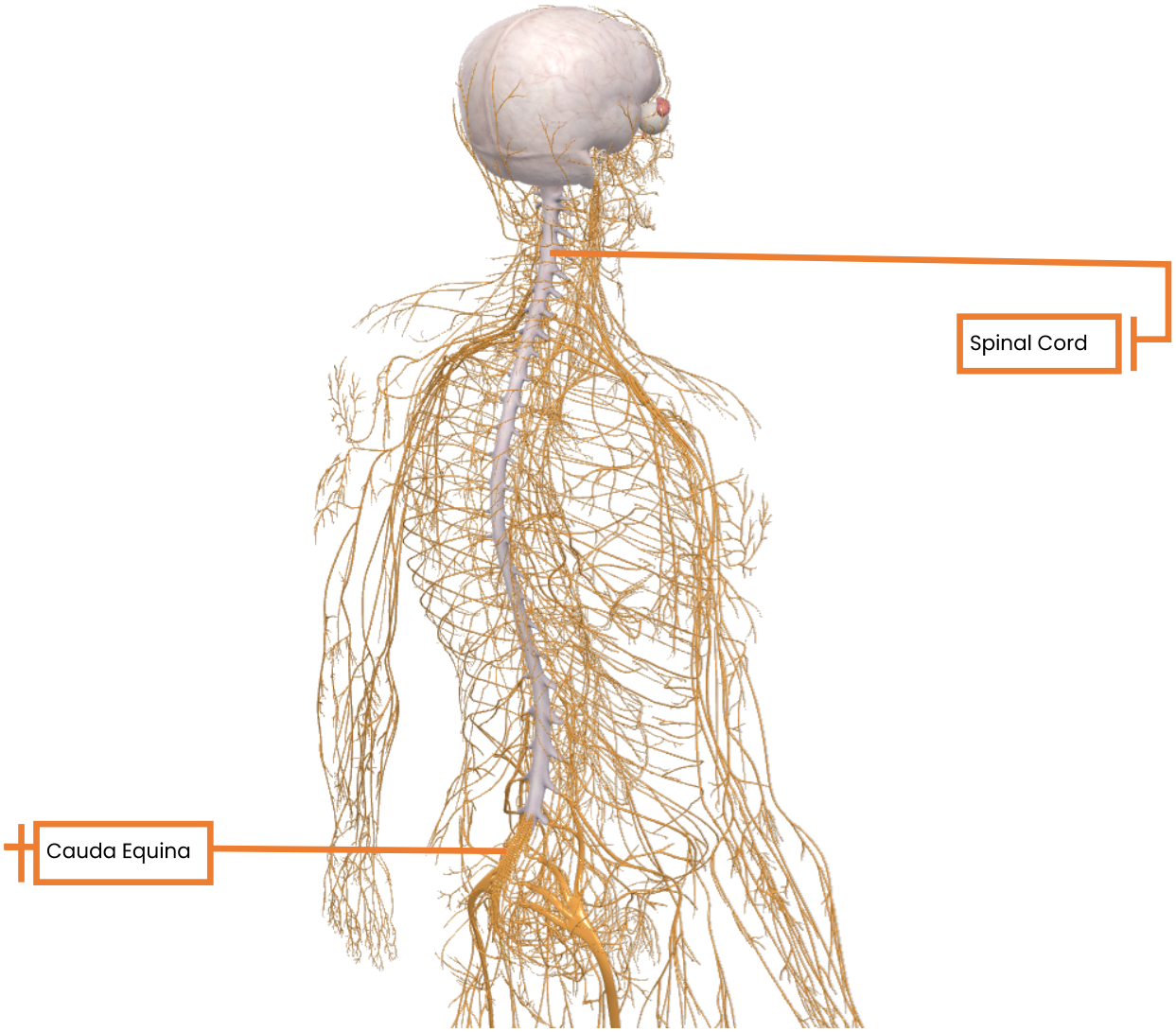
⇒ The spinal cord is a tubular bundle of nervous tissue and supporting cells that extend from the brainstem to the lumbar vertebrae.

⇒ The spinal cord is the highway taking nerve impulses to control the other parts of your body and your limbs and relaying nerve impulses back to the brain.

⇒ Together the brain and spinal cord form the central nervous system.

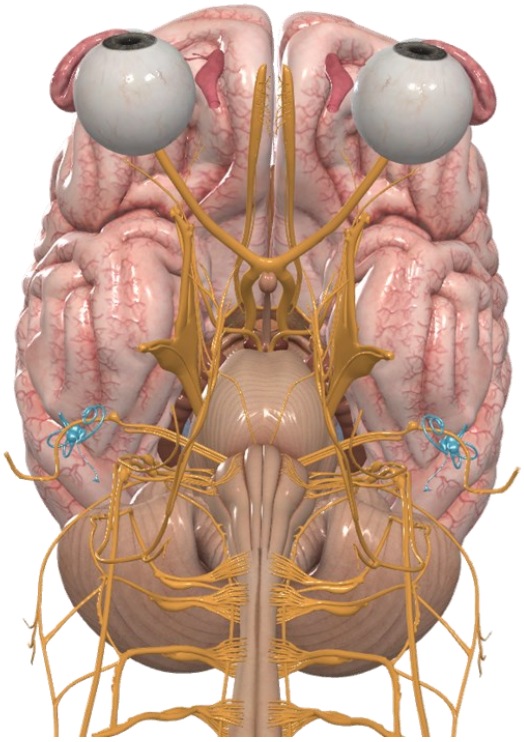
⇒ The spinal cord is a continuation of the medulla, which is the bottom part of your brainstem.

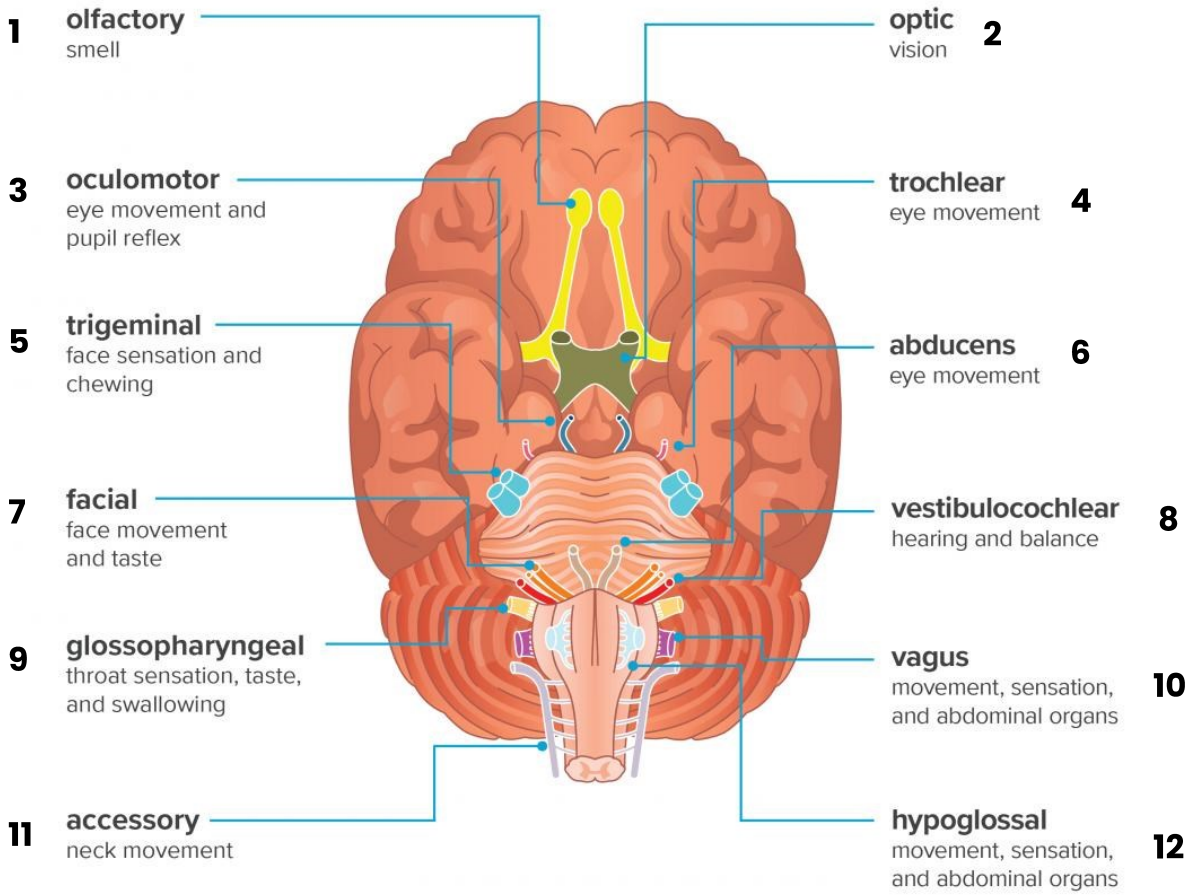
⇒ The spinal cord ends at a point called the 'conus medullaris'. Nerves that arise from the end of the spinal cord are bundled together , forming a structure knows as the cauda equina (because it resembles a horse's tail).



What are the cranial nerves?

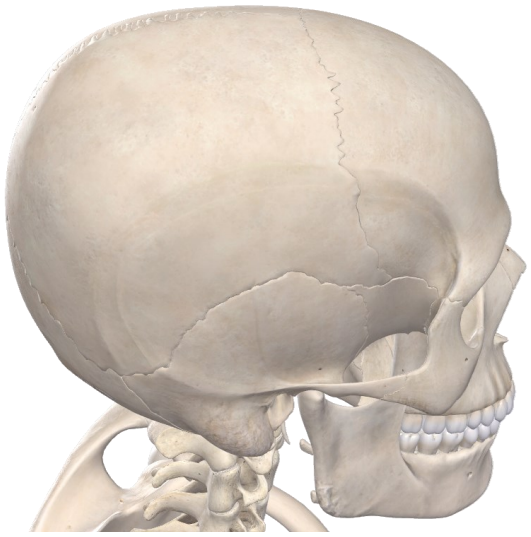
- ⇒ Cranial nerves are pairs of nerves that connect your brain to different parts of your head, neck, and body.
- ⇒ There are 12 of them. 12 on the left and 12 on the right.
- ⇒ Their functions are usually categorized as being either sensory or motor.
  - ⇒ Sensory nerves are involved with your senses, such as smell, hearing, and touch.
  - ⇒ Motor nerves control the movement and function of muscles or glands.



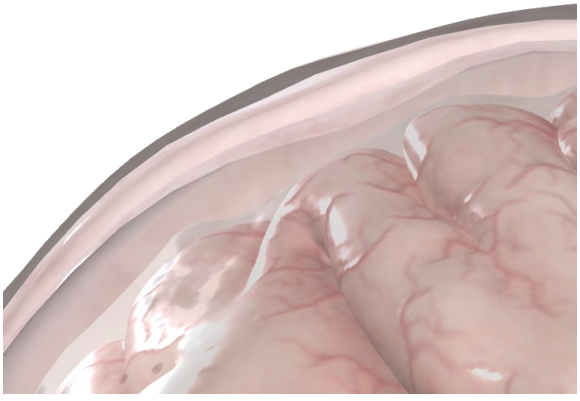


What protects the nervous system?

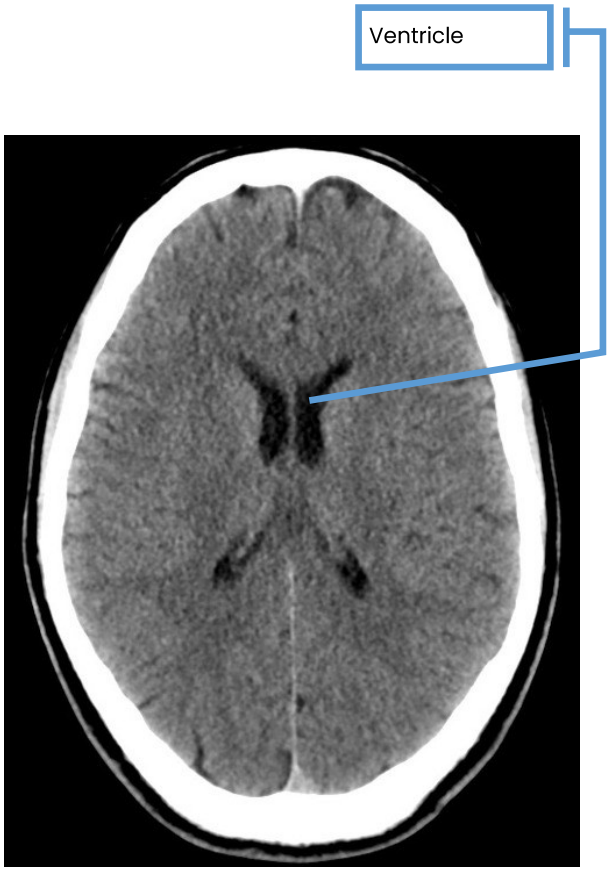
- **Bone** - The skull protects the brain and the vertebrae protects the spinal cord. The skull cap is made up of 6 major bones but the whole cranium is around 21 bones. There are 33 vertebrae
- **Tissue**- meninges lining the brain. This is made up of 3 layers – dura, arachnoid and pia.
- **Fluid** – cerebrospinal fluid (CSF) is a watery fluid that flows in and around the hollow spaces of the brain (called ventricles) and the spinal cord.



The Skull Vault



The Meninges



A CT scan showing the ventricles (dark spaces) in the brain which contains cere-brospinal fluid (CSF).

Let's have a look at a case

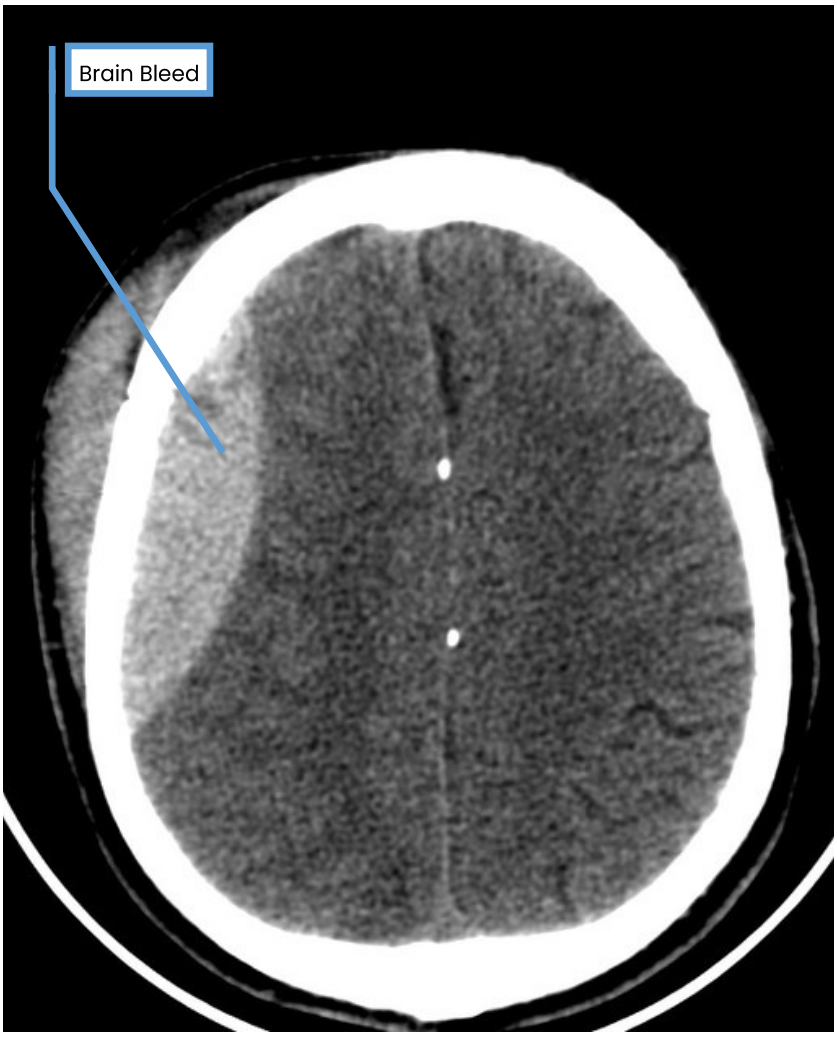
35 year old patient was involved in a road traffic accident. He presents with worsening headache and reduced GCS score.

In this patient given the history of trauma and headache we need to make sure the patient has not suffered from any injury to his brain. A reduced GCS score should also raise alarm bells. A GCS (Glasgow Coma Scale) score is a quick score used by healthcare professionals to assess a patient's consciousness level. It is out of 15 (maximum score is 15, minimum score is 3) and tests 3 components:

⇒ Eye (if the patient's eyes are responding)

⇒ Verbal (if the patient can speak)

⇒ Motor (if the patient can move their arms/legs)



A CT scan was ordered for this patient and you can see an abnormal white density in the right hemisphere. This is what a brain bleed looks like. You can see the area of bleeding is compressing on the right brain hemisphere. This patient will need to be referred to the neurosurgeons urgently to be assessed for an operation to decompress the brain and stop the bleeding.

Session 2 – CNS Learning Points

The CNS is made up of billions of neurones organised in an intricate way to provide sensory, motor and integrative functions.

Anatomy

The brain sits in the cranium. The cerebrum is the higher processing part and is composed of 4 lobes. The brainstem sits in the middle and is composed of 3 parts. The cerebellum is at the back of the brain.

Physiology

The brain is a complex network of neurons. Different lobes of the cerebrum have differing functions. The brainstem is responsible for vital function. The cerebellum is responsible for balance and coordination.

Pathology

The best way to diagnose brain pathology is by imaging (via CT or MRI scans). The symptoms of brain diseases depends on the part of the brain affected.