

The Brain Notes

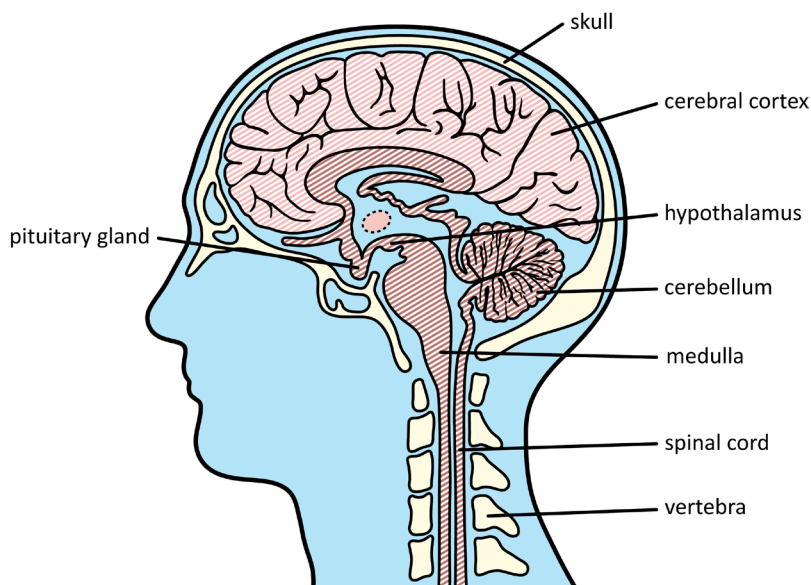
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The brain is quite literally where you live. Everything that makes you who you are, personality, memories, problem solving and of course all of the hundreds of millions of neurones which allow complex functions to run seamlessly in the background.

The brain is hugely complex but at GCSE we are only required to know what the four major regions are and what functions they have. Let's get cracking 😊 The diagram below shows a section through the brain of a human.



Structure	Function
Pituitary gland	Is a gland in the brain that produces many different hormones. Is often called the master gland . It produces various hormones into the bloodstream that regulate growth, metabolism, and stimulate other glands to release their own hormones.
Skull	The bone structure that protects the brain.
Cerebral cortex	It is divided into two hemispheres. It is responsible for our senses such as taste and smell, language, memory, consciousness and behaviours .
Hypothalamus	The region for <u>regulating</u> temperature and water concentration (homeostasis) in the <u>body</u> .
Cerebellum	It is divided into two halves and controls balance and posture .
Medulla	Controls your breathing and heart rate. It also controls reflexes such as sneezing, vomiting and swallowing .
Spinal cord	A major bundle of nerves running down the back. It carries electrical signals back and forth between the brain and the rest of the body, and it coordinates basic reflexes.

Mapping the Brain

Looking at the brain from the outside, it is impossible to tell what each part does. The brain is incredibly complex, delicate, and enclosed within the skull, making it very difficult to study.

Neuroscientists (scientists who study the brain) have developed **three main methods** to map the regions of the brain to their specific functions:

1. **Studying patients with brain damage** – if a patient has an accident or a disease that damages a specific region of their brain, neuroscientists can see what functions or behaviours the patient loses. This allows them to link that specific brain region to that function.

The example that is mentioned at GCSE is **Phineas Gage**. Phineas Gage was a railway worker and while laying railway track in 1848, an accidental explosion forced a large metal spike straight through the front of Phineas's brain. Amazingly, he didn't die and was on his feet after just a few minutes!

The spike damaged his cerebral cortex. Before the accident, Phineas was hardworking and friendly, but after the accident, his personality completely changed, becoming lazy and aggressive. This allowed scientists and doctors to determine that the cerebral cortex is involved in conscious personality and behaviour.

It's a bit like being given an brand new massive engine where all of the parts look really similar and we have no idea at all about how it works... and then when some part of it stops working or works differently we can figure out what that part does 😊

2. **Electrically stimulating the brain** – because the brain tissue itself has no pain receptors, surgery can be performed on conscious (awake) patients under local anaesthetic.

How this works: Scientists push tiny electrodes into specific tissues in the brain and apply a small, safe electrical current. By stimulating a specific area, scientists can observe the response. If stimulating one area causes a patient's arm to twitch, or if they report seeing a flash of light, scientists can confidently map that exact region of the brain to muscle movement or vision.

3. **MRI (magnetic resonance imaging) scans** – modern imaging technology allows doctors to look deep into the brain without invasive surgery. An MRI machine uses strong magnetic fields and radio waves to produce highly detailed images of the brain's anatomy.

Doctors can use MRI scans to safely identify exactly where damage has occurred (such as from a stroke or a tumour). They can also use functional MRI scans to see which parts of the brain become highly active when a patient is asked to perform a specific task (like listening to music or doing maths), allowing them to map functions to specific brain structures. The figure below shows an MRI scan of a human brain.



Treating Brain Damage and Disease

While these mapping techniques are fantastic, treating brain damage is still incredibly difficult. Medical treatments and surgery on the brain and spinal cord carry massive risks. This is because:

1. **Access is difficult:** the brain is protected by the hard skull and this has to be cut away to get to the brain.
2. **It is extremely delicate:** brain tissue is easily damaged, and any accidental damage caused during surgery is often permanent and irreversible.
3. **Complexity:** the brain is really very complex, and we still don't fully understand how all the parts of the brain are connected or work together.
4. **No stem cells:** the neurones in the central nervous system cannot repair themselves, and there are currently no treatments available to regrow them. There are no stem cells in the spinal cord. If a person damages their spinal cord that damage is permanent in most cases.

Brain Tumours

Cancer can develop in the brain. If it does so it can take up space that is meant for the brain, and this can squeeze it against the skull. This can be fatal if untreated.

Tumours can be physically cut out of the brain. Additionally, they can be treated with radiotherapy, using high energy X-rays, and chemotherapy, using drugs and chemicals that kill actively dividing cells.