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All about the brain

This section will tell you more about the brain. It's quite complicated so please feel free to read as much or as little you would like to know. I've split it into sections to make it easier:

- **Overview of the brain and the central nervous system**
- **How the central nervous system works**
- **A Quick reference to all parts of the brain**
- **Protecting the brain: The skull, Cerebro Spinal Fluid (CSF) and the meninges**
- **The different parts of the brain**
- **Journey to the centre of the brain: the ventricles and CSF, the thalamus and the limbic system**
- **Keeping the brain working properly**
- **What can go wrong in brain injury.**

Overview of the brain and central nervous system

The brain controls everything we do with our body. It also controls what we think and say, and controls our emotions and who we are.

The brain could be seen as the central control station of the body or a very powerful computer.

If you were to look under the microscope you would see that the brain is made of 100 billion nerve cells called neurons!

These neurons connect the brain to the rest of the body by the spinal cord. In this respect the spinal cord is part of the brain. Together, the brain and spinal cord make up the central nervous system.

How the central nervous system works

Nerves run throughout the body. Imagine nerves as roadways, the spinal cord as the motorway, and the brain as the destination. The messages from your body are like the cars that have to drive through this road network to get up to the brain. This will give you an idea as to how the brain receives the messages.

Once the messages have been received by the brain they are organised and the brain decides what needs to be done.





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A quick reference to all parts of the brain

There are so many parts of the brain that you can sometimes feel swamped by the information available. You could almost imagine the brain like a car engine. There are lots of different things that go on inside to make the whole thing run smoothly! We hope this section will help you to understand.

- **The skull** – what the brain is kept in.
- **The meninges** – The outside layer of the brain that is split into three smaller layers called:
 1. **dura mater**
 2. **arachnoid**
 3. **pia mater.**
- **The brain itself** – split into three main sections:
 1. **the brain stem** – made up of the mid-brain, pons, medulla.
 2. **cerebellum**
 3. **the cerebrum (also known as the cerebral cortex)** – split into two identical halves called hemispheres; the **right hemisphere** and the **left hemisphere**.

Each hemisphere is symmetrical and split up into smaller lobes called:

the occipital lobe
the temporal lobe
the frontal lobe
the parietal lobe.

- The very inside of the brain made of:
 - **ventricles and the thalamus**
 - **Cerebro Spinal Fluid (CSF)**
 - **blood**

Now, let's have a look at each one in more detail. Please refer back to the brain diagram when you need to!





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Protecting the brain

The brain is protected by three things in total:

- The skull
- Cerebro spinal fluid (CSF).
- The meninges.

Each one has a very specific task in keeping the brain safe.

The skull

The skull is very hard bone and protects the brain from most knocks and falls that you have. Babies are born with a soft skull in order to give the brain chance to grow. When it has finished growing the skull becomes hard to keep the brain safe.

Cerebro Spinal Fluid

The brain floats in the CSF, which acts like a shock absorber. Without CSF your brain would bang into the skull and get damaged. Not only does it protect the brain, it also washes waste substances away that get reabsorbed back into the bloodstream and removed by the kidneys when you go to the toilet. There is more about CSF in the part about ventricles.

The meninges

The meninges is like a tough protective layer or membrane around the brain. The meninges is split into three layers: the dura mater (outer layer); the arachnoid (middle layer) and the pia mater (inner layer). It forms a tough protective layer around the brain, a bit like onion skin or orange peel.

The different parts of the brain

There are three major areas of the brain:

- the brain stem
- the cerebellum
- the cerebrum (also known as the cerebral cortex).

The brain stem

The brain stem sits at the very top of the spinal cord. The brain stem is the most primitive part of the brain. This means it hasn't developed very much over the years. The brain stem's only job is to keep you alive! The brain stem is separated into three other areas: mid-brain, pons and the medulla.





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The mid-brain sits at the top and allows both sides (or hemispheres) of the brain to communicate with each other. The pons acts like a bridge. It has lots of nerves bundles that run through it. It also contains the fourth ventricle where the CSF passes through to go down the spine. The medulla controls our heart and lungs which is also known as cardiac and respiratory function. It sounds very complicated but it basically means the brain stem keeps you alive and kicking!

The cerebellum

The cerebellum sits behind the brain stem and sits in the very back of the skull. The cerebellum controls our sense of balance and helps us to co-ordinate movement.

The cerebrum (also known as the cerebral cortex)

The cerebrum is the biggest part of the brain. It is split into two parts called hemispheres. Each hemisphere is further divided into smaller parts called lobes. Each lobe has a very special function - have a look at our brain diagram.

Parietal lobes

The parietal lobes have two main jobs. Firstly they interpret what our senses detect and how this fits with what we see - for example, when your skin feels heat and your eyes see fire. The parietal lobes figure out that fire must be hot.

The parietal lobes also tell us what is part of our body and what is part of the environment. For example, if you stand in a field you are aware of wide open spaces and maybe a few cows. This is known as 'spatial awareness'.

Occipital lobes

The occipital lobes are responsible for interpreting what the eyes see by recognising shapes and colours. The occipital lobes work together with the parietal lobes in that they 'figure out' what we see. They also figure out what we are looking at in order to help the parietal lobes figure out how big something is - like the field with the cows in it, for example.

Frontal lobes

The frontal lobes control so much of what we do with our bodies that doctors are learning new things about the frontal lobes all the time.

The frontal lobe is our emotional control centre and our personality also grows and develops here. It is the area in your brain that makes you





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the person you are! For example, if you are a 'happy-go-lucky person', 'a great thinker', or 'really funny' or 'serious'. It is all controlled here!

The frontal lobe also controls body movement, allows us to solve problems and do mathematics, and is also the part of the brain that learns how to speak!

Most importantly, the frontal lobe allow us to think independently and be spontaneous. We also regulate our 'impulses' here. How many times do you want to do something and then think twice before doing it? Well, that is the frontal lobe in action!

Our long-term memory is also stored here. Doctors aren't too sure how memory is stored yet be they do know it is kept here.

The frontal lobe also controls our sexual feelings or our 'sexuality' and also regulates how we interact with people, which is also known as 'social interaction'.

Temporal lobes

The temporal lobes are involved in sorting out what we feel, taste, smell and hear. If you think of all the sensations you have every second of the day you will get a sense of how busy the temporal lobes have to work in order to tell you what is happening around you. Try this exercise: what can you hear? What can you smell? What is your skin feeling or sensing? I think you'll agree there is a lot going on. The temporal lobes are busy sorting all of that information out.

A major function of the temporal lobes is to distinguish what you can hear. In particular, the temporal lobes organise sound and is how you recognise words when someone is speaking. This is also known as 'speech recognition'.

It is also thought that our short-term memory is kept here. It allows you to remember what your friend said to you five minutes ago or what you had for breakfast.

Journey to the centre of the brain

The ventricles and Cerebro spinal fluid (CSF)

CSF is made in the very centre of the brain by the ventricles. You have four ventricles in total. They are all connected and you can see where they are on our brain diagram.





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CSF is constantly produced in the ventricles and as it moves around the brain and it gets reabsorbed by something called the arachnoid villi. CSF is a bit like a moat running around a castle.

CSF flows from ventricles in the very middle of the brain and down through the brain stem. Some of the CSF then goes out of a valve called the cisterna magna which flows into the outside membrane of the brain called the meninges. This forms a big water bubble around the brain which keeps it safe. The rest of the CSF then flows down to the spinal cord to keep that safe too!

The thalamus and the limbic system: The thalamus sits in the very middle of the brain. It is a very important part of the brain because it controls so many little things that we take for granted.

The thalamus sits below the ventricles in between the two hemispheres of the brain and above the medulla, which is at the very top of the brain stem. Put simply, the thalamus is in the very middle of the brain. It is the final relay station for all messages that come from the senses. The thalamus then passes these messages on to whichever lobe needs to know.

Below the thalamus is a small pea-shaped organ that is attached to a little stalk. The stalk is called the hypothalamus. The hypothalamus is part of the limbic system which has very important functions. The hypothalamus controls your body temperature, sleep pattern, and tells you if you feel thirsty. It is important in telling your body how to break down carbohydrates and fat. It also controls your motivation and some of your strong emotional responses like rage.

Attached to the stalk is the pituitary gland. The pituitary gland is in control of your endocrine system. This means it controls the hormones in the body. The pituitary gland controls growth, stress levels, and also tells your kidneys when to work harder, the heart to beat faster, and your blood pressure, amongst other things. This part of the brain is tiny but very important in making your body work properly.

Keeping the brain working properly

You can see that the brain is very complicated and so the body has to work very hard at keeping it happy! If you imagine a very powerful computer, you can imagine all of the electricity it would need to keep it running smoothly. The brain is exactly the same, although instead of electricity it needs:

- Oxygen
- Glucose





The body will always make sure that the brain has enough of these two things. If need be it will divert oxygen and glucose away from other parts of the body to make sure that the brain gets enough!

Oxygen and glucose get's to the brain from the blood. The blood supply comes up to the brain from the heart and supplies the brain with all it needs to survive. Some blood goes to the meninges in smaller blood vessels called arterioles, although most blood gets to the brain by a complicated road junction of blood vessels called the circle of willis. It sounds very complicated so don't try and understand it all we have doctors and nurses to do that!

What can go wrong in brain injury

The skull is like a closed box. The skull is always full of three things;

- the brain (80%)
- Cerebro Spinal Fluid (10%)
- blood (10%)

These keep the brain nice and snug although it is very full in there!

The brain is very delicate so any injury to it will cause problems of some description. Brain injury is very complicated because it all depends **which** part of the brain was injured and **how** the brain was injured.

The brain can get damaged if there is a change to the contents inside the skull. This sounds complicated but it isn't really. Think of the skull being a closed box and that there is only so much room for everything! Here is what can happen:

Brain: Normally the brain takes up 80% of the space inside the skull. A tumour, cyst or 'foreign body' (an object that shouldn't be there) can make the brain mass bigger. The brain can then get squashed and damaged. A nasty knock to the head can cause the brain to swell – this is called a cerebral oedema.

CSF: CSF usually takes up 10% of the space inside the skull. CSF is constantly made and reabsorbed. If there is a problem with the flow and reabsorption of CSF the brain can develop hydrocephalus which also means the brain gets very squashed. This can cause a lot of damage and can even be life threatening.

Blood: Blood usually takes up 10% of the space inside the skull. Any damage caused to the arterioles, may cause the blood vessels to burst





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and blood to flow into parts of the brain that it shouldn't. More blood will flow into the skull and the brain gets squashed. The blood will eventually clot causing a haematoma which is just like having a hard mass there that shouldn't be.

Any head injury that involves the brain getting damaged is going to cause problems although it all depends on which part of the brain has been affected. You can read more about this in the next section will tell you more about it.

