



About the brain

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Introduction

The brain is responsible for everything that we do. It is made up of billions of nerve cells that communicate with one another, transmitting complex chemical and electrical signals. The texture of it is similar to jelly, but it is held in shape by a fluid called cerebrospinal fluid. It is wrinkled in appearance and has two halves known as the left and right hemispheres.

The brain has many different and intricate parts that are associated with specific functions. This publication gives an overview of some of the main parts. For a more detailed description of the brain, refer to neuroanatomy textbooks or websites.

The cerebrum, cerebellum and brainstem

The brain can be divided into three parts: the cerebrum (the largest part), the cerebellum and the brainstem.

The cerebrum is made up of the cerebral cortex (the outer layer that we tend to imagine when we think of what a brain looks like) and subcortical structures (which are located underneath the cerebral cortex). The cerebrum is responsible for a wide range of skills including processing emotions, sensation, movement, personality, language and executive functions, among others.

The cerebellum is a small and distinct structure at the back of the brain. It is responsible for movement, balance, muscle tone and fine motor skills.

The brainstem is deep inside the brain. It is responsible for basic functions such as breathing, sleep/wake cycles, awareness and blood pressure.

Cerebrum

The cerebrum is the largest part of the brain. It is divided into two halves, known as the left and right hemisphere. The right hemisphere controls the left side of our body and the left hemisphere controls the right side of the body.

These hemispheres are connected by a bridge-like structure called the corpus callosum, through which signals are transmitted back and forth.

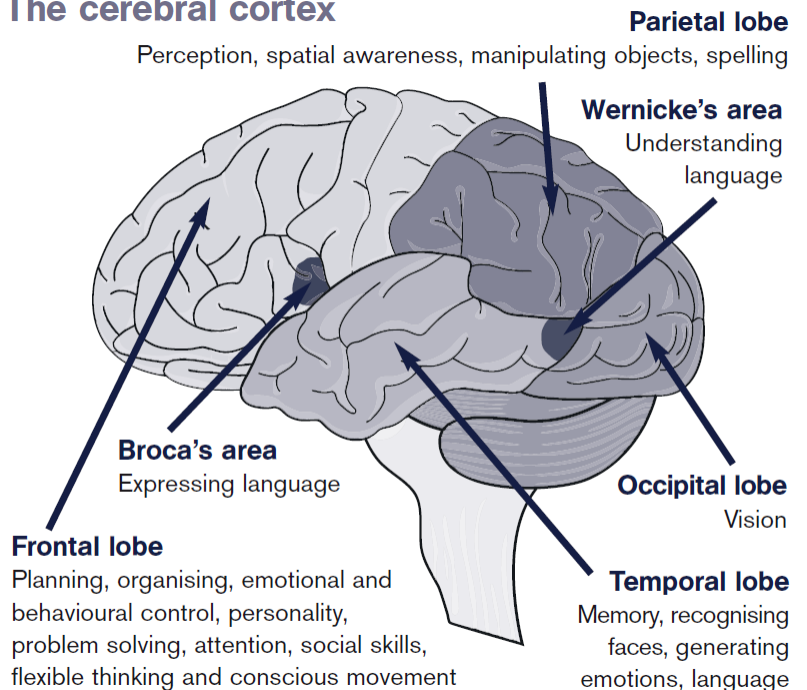
The cerebrum is made up of the cerebral cortex and subcortical structures.

The cerebral cortex

The cerebral cortex is the outer layer of the cerebrum and is wrinkled in appearance, which makes it resemble a walnut. These wrinkles are deep folds, which gives the cerebral cortex a wider surface area, allowing for more processing to take place - the folds are called gyri and the grooves are called sulci. Deeper grooves are known as fissures, which can be used to distinguish between different parts of the brain, such as the four lobes. These are the frontal, parietal, temporal and occipital lobes.

- Frontal lobes - involved in emotional and behavioural control, personality, problem-solving, attention, social skills, conscious movement and executive functions such as planning and organising, among others.
- Parietal lobes - involved in perception, spatial awareness, manipulating objects and sensory perception.
- Temporal lobes - involved in memory, recognising faces, generating emotions and language.
- Occipital lobes - involved in all aspects of vision.

The cerebral cortex



Between the frontal and parietal lobes are the motor cortex (which controls movement) and the sensory cortex (which controls sensation).

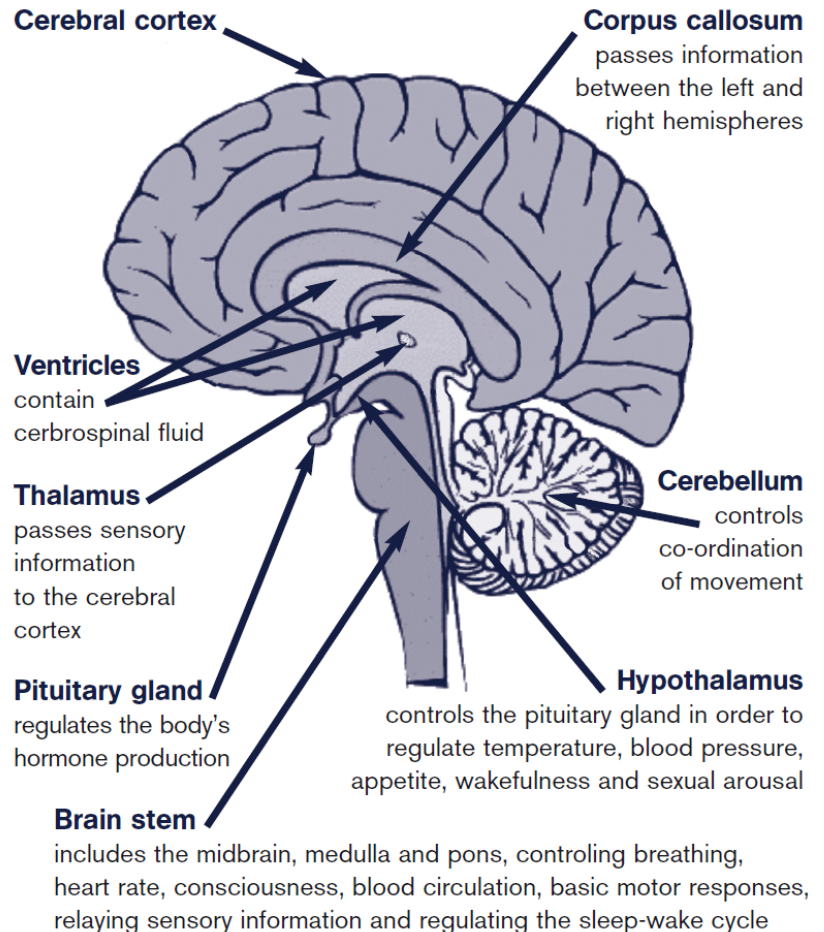
Wernicke's area and Broca's area are also distinct parts of the cerebral cortex; they are involved in processing language.

Subcortical structures

Subcortical structures refer to a group of structures beneath the cerebral cortex of the brain. There are several structures responsible for functions such as cognition, social interaction, emotions and behaviour.

Some of the main subcortical structures are described below.

- The limbic system - above the brainstem are the hippocampus and amygdala, which are collectively called the limbic system. They are responsible for regulating emotions and behaviour. Other parts of the brain such as the hypothalamus and cingulate gyrus are also sometimes suggested as being part of the limbic system.
- Hypothalamus - this is a small, pea-sized structure which is responsible for appetite regulation, sexual arousal, thirst and temperature control, and some aspects of memory. The hypothalamus has a key role in producing and regulating hormones.
- Thalamus - the thalamus is responsible for organising and relaying information across the brain.
- Basal ganglia - the basal ganglia is made up of the caudate nucleus, the putamen and the globus pallidus. It is a group of nuclei that are collectively responsible for motor control, emotions, behaviour and executive functions.



The cerebellum

Behind the brainstem is the cerebellum. The name cerebellum means 'little brain' in Latin. It is at the back of the brain and is largely responsible for muscle tone, movement, balance and fine motor skills (e.g. fastening buttons, writing).

Unlike the cerebral cortex, each hemisphere of the cerebellum controls the same side of the body (i.e. damage sustained to the right hemisphere of the cerebellum will cause issues on the right side of the body).



The hemispheres of the cerebellum are connected by the vermis.

The brainstem

The brain is connected to the spinal cord by the brainstem. It is the oldest part of the brain. It is made up of the medulla, the pons and midbrain, which are collectively responsible for our most basic and automatic functions such as breathing, levels of awareness, blood pressure and sleeping cycle. It is also responsible for passing messages to and from the brain to the rest of the body. The brainstem is rather like a thick telecommunications cable, with countless nerve fibres, like wires, carrying messages back and forth.

Ventricles

Within the brain are hollow cavities known as ventricles. There are four ventricles altogether, which are collectively called the ventricular system. These are filled with cerebrospinal fluid, which provides nourishment for the brain and removes waste products from it.

Communication across the brain

The brain is made up of billions of cells. Neurones are cells that pass electrical and chemical signals back and forth in the brain. Under a powerful microscope, these cells look like small dots with a long body and a network of hair-like tentacles. The 'long body' is called the axon, while the 'hair-like' tentacles are called dendrites.

Signals are passed along the axons of neurones and communicated across the brain through highly complex patterns of communication. These signals are how we do things such as think and learn, regulate our bodies, process information, talk and move, among other functions.

While different parts of the brain are broadly responsible for different functions, the brain is very well interconnected, so multiple parts of it are often involved in a single skill. Memory, for example, relies on many different parts of the brain working together.

Protection of the brain

The brain is protected by the skull and is covered by layers of membranes called meninges. The outermost, tough layer is called dura mater, the middle web-like layer is the arachnoid, while the innermost layer is called pia mater. The space between the arachnoid and pia layers is known as the subarachnoid space; this is where blood vessels that supply and drain the brain pass through.

The brain is cushioned by a sea of cerebrospinal fluid, which fills in all of the gaps around it. The cerebrospinal fluid is also responsible for providing nourishment and



removing waste products from the brain.

Injury to the brain

The brain is responsible for everything that we do. Injury to it can therefore cause a wide range of effects depending on the severity, type and location of injury.

Severity

Traumatic brain injuries (TBI) are injuries to the brain from a trauma to the head. These can be classified as mild, moderate or severe. Mild brain injuries are sometimes called concussion, mild traumatic brain injury or minor head injury. Effects from a mild brain injury typically improve by themselves over a few weeks. Moderate and severe brain injuries often take longer to recover from and require specialist treatment and care.

Type of injury

Focal injuries affect a single, confined part of the brain, for example from a gunshot wound. The effects of a focal injury may be limited to the function of the particular part of the brain injured. Diffuse injuries affect multiple parts of the brain, for example from carbon monoxide poisoning. There may be widespread damage, affecting multiple skills.

Injury can be sustained through trauma, such as a road traffic collision or assault, or through a medical condition such as a brain tumour or encephalitis. Some conditions cause specific effects, for example stroke commonly causes one-sided weakness or paralysis and problems with speech.

Location

Different parts of the brain are broadly responsible for different functions - for example, the occipital lobe is responsible for processing vision. A person who has sustained injury to their occipital lobe may therefore have visual impairment. Similarly, the frontal lobe is responsible for monitoring behaviour. A person who has sustained an injury to their frontal lobe may therefore behave inappropriately in public, for example shouting and swearing loudly.

Some effects of brain injury are common regardless of severity, type or location of injury, such as memory problems and fatigue. Furthermore, many people report difficulties with work, relationships and mood following their brain injury.

While the impact of any brain injury can be difficult to cope with, help is available. Contact our helpline for advice and support on 0808 800 2244 or helpline@headway.org.uk, or visit www.headway.org.uk to find out more about how we can help.

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Helpline: 0808 800 2244
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Website: www.headway.org.uk