



the brain injury association

About the brain

This publication has been written to offer information about the brain and how the brain can be injured. For more guidance on how Headway supports people affected by brain injury, visit our website at www.headway.org.uk.

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Introduction

The brain is responsible for everything that we do. It is made up of billions of cells called neurons that communicate with one another through complex chemical and electrical signals. The texture of the brain 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.

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

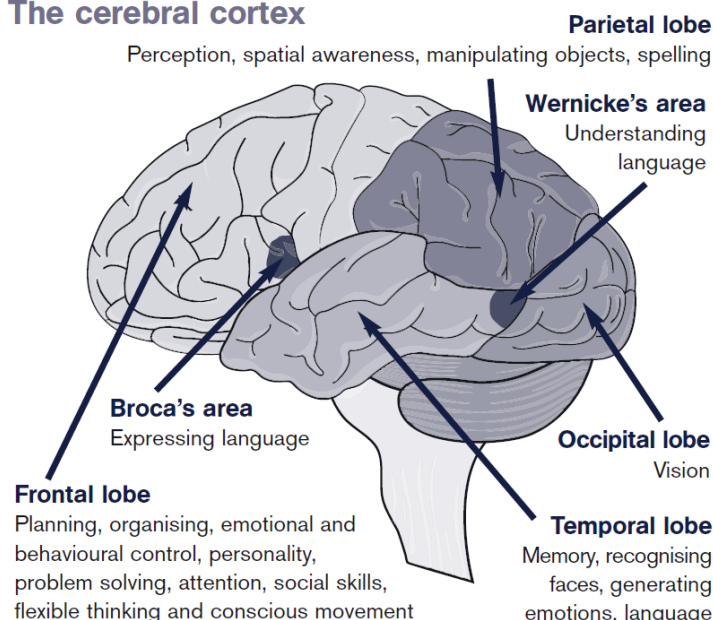
The cerebrum, cerebellum and brainstem

The **cerebral cortex** is the outer layer of the brain and is wrinkled in appearance, which makes the brain resemble a walnut. These wrinkles are 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, and can be used to distinguish between different parts of the brain, such as the four lobes. These are frontal, parietal, temporal and occipital lobes. The four lobes are generally associated with specific functions, however there is much interconnectivity between them and other parts of the brain. Some of the main functions of each lobe are described below.

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

The cerebral cortex



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

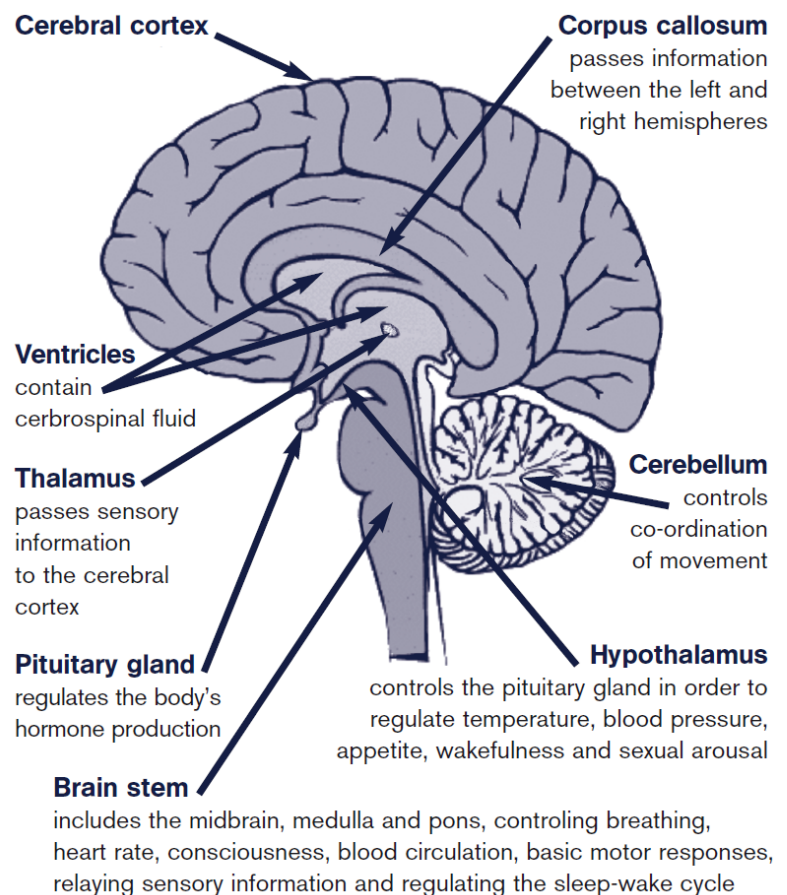
Wernicke's area and **Broca's area** are also distinct parts of the cerebral cortex; they are involved in processing language.

Subcortical structures

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

Some of the brain's 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.

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- **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 (cluster of neurons) 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 a structure called 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.

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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 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 being encased in the skull. It is covered by layers of membranes called **meninges**. The outermost, tough membrane layer is called dura mater, the middle web-like layer is called 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 also 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.

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Severity

Traumatic brain injuries (TBIs) are injuries caused to the brain from a trauma to the head. These can be mild, moderate or severe. Mild brain injuries are also 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 take longer to recover from and may result in long-term or permanent effects. They will require specialist treatment and care.

Type of injury

Focal injuries affect a single, confined part of the brain, for example injury 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.

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While the impact of any brain injury can be difficult to cope with, help is available.

Contact our helpline on 0808 800 2244 or helpline@headway.org.uk, or visit www.headway.org.uk to find out more about how we can help.

As a charity, we rely on donations from people like you to provide free information to those affected by brain injury. To donate or find out how to support our work, visit www.headway.org.uk/get-involved.

If you would like to leave feedback for this publication, please complete our short survey at www.surveymonkey.co.uk/r/hwpublications or contact us at publications@headway.org.uk.

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