

Brain explained

The brain oversees bodily functions and allows consciousness. This delicate organ can be affected by a wide range of disorders and events such as trauma, stroke and tumours. Symptoms and effects depend on which brain areas are affected.

The brain is connected to the sensory and motor nerves of the body by the spinal cord. The brain and spinal cord are wrapped in membranes (meninges) and nourished by a special liquid called cerebrospinal fluid. The average adult brain weighs around one to two kilograms.

Neurones

The brain consists of specialised cells called neurones, and electrical impulses are sent from one neurone to another. A neurone has three basic parts:

- The cell body (soma)
- A long 'tail' (axon)
- A branching of tiny projections (dendrites) that connect to other neurones.

There may be around 100 billion neurones, with each neurone connected to around 10,000 to 100,000 others. This complicated circuitry makes the human brain sophisticated enough to oversee all bodily systems and allow higher functions such as awareness, judgement and thought.

Main components

The brain is a soft, gelatinous organ made up of multiple folds. The main components of the brain include:

- Brain stem
- Cerebellum
- Thalamus
- Cerebrum (including cerebral cortex and two hemispheres)
- Corpus callosum.

Brain stem

The brain stem is the bridge between the brain and the spinal cord. Messages relay from the brain to the motor and sensory nerves of the body and vice versa in a constant 'conversation'. The three portions of the brain stem include:

- **Medulla oblongata** - responsible for functions of the autonomic nervous system such as breathing, heart beat and digestion.
- **Pons** - regulates sleep and wakefulness and breathing.
- **Midbrain** - oversees hearing and seeing reflexes (startle response) and produces the brain chemical, dopamine, which is important to regulate movement.

Cerebellum

The cerebellum is located behind the brain stem. It is responsible for motor skills such as movement, coordination and balance.

Thalamus

The thalamus sits on top of the brain stem. Sensory information from the body is sorted by the thalamus, which then routes the information to the most appropriate 'receiving stations' in the cerebral cortex.

Cerebrum, cerebral cortex and brain hemispheres

The cerebrum is involved in functions of higher consciousness. Most of the brain, around 85 per cent, is taken up by the cerebrum. It is this structure that gives the brain its distinctive shape of two halves - the right and left hemispheres. The cortex is essentially a sheet of neurons about 3mm thick, which forms the 'grey matter'.

The cerebral cortex is folded in on itself; this provides the characteristic ridges and valleys of the brain. Connections between neurons and with remote nuclei are carried by a myriad of axons, forming the 'white matter'. The right and left hemispheres are further divided into four lobes. These include:

- **Frontal** - located behind the forehead. Functions include consciousness, thinking, emotions, language and memory.
- **Parietal** - located on the top and rear of the head. These lobes process information from the sensory nerves and contribute to voluntary movement.
- **Temporal** - located over each ear. Functions include memory and processing sounds, face recognition, recognition of complex objects and multi-sensory integration.
- **Occipital** - located at the back of the head. The main function is interpretation of sensory information from the eyes.

Corpus callosum

The two hemispheres are connected by a thick band of nerve fibres called the corpus callosum. The brain halves are able to communicate with each other via this 'bridge'.

Other important structures

Other structures of the brain include:

- **Hypothalamus** - located underneath the thalamus. This structure plays an important role in regulating many bodily processes including temperature, thirst, hunger, sleep and libido. It works hand in hand with another brain structure, the pituitary gland. The pituitary gland is considered to be the 'master gland' of the endocrine (hormonal) system.
- **Limbic system** - made up of various structures including the hippocampus and amygdala. This primitive area of the brain is responsible for basic emotions like anger, happiness and sexual desire.

A range of disorders

The brain can be affected by a wide range of disorders and events. The specific symptoms or losses of functioning depend on which brain areas are affected. Some of the causes of brain damage include:

- **Diseases affecting the nervous system** - such as Parkinson's disease, multiple sclerosis or Alzheimer's disease.
- **Tumours** - growths usually start in the cells of the meninges, the glial cells of the cerebellum or cerebral hemispheres, or in the pituitary gland.
- **Stroke** - the rupturing of a blood vessel in the brain or a blockage of blood vessels.
- **Congenital defects** - including genetic disorders such as Down syndrome, or developmental problems caused by maternal consumption of alcohol or drugs during pregnancy.
- **Trauma** - such as a blow to the head or a penetrating injury.
- **Drugs** - including alcohol. Some drugs are neurotoxins (poisonous to nerve cells).
- **Lack of oxygen** - brain cells can be damaged or killed by a lack of oxygen, such as in the case of near-drowning.

Symptoms of disease

The symptoms depend on which area of the brain is affected but, generally, may include:

- Speech difficulties
- Swallowing difficulties
- Paralysis or weakness
- Numbness
- Tremors
- Loss of balance or coordination
- Loss of certain senses, such as sight or feeling
- Visual problems
- Vertigo
- Personality changes
- Severe mood changes
- Confusion
- Sleeping problems
- Memory loss.

Diagnosis and treatment

Diagnosis methods depend on the underlying cause, but may include general tests, x-rays, computed tomography (CT) scans and magnetic resonance imaging (MRI).

Treatment depends on the cause. In some cases, the degree of damage and long term function loss depends on the speed of first aid. For instance, if a person suspects they are having a stroke and seeks immediate medical help, the bleeding - and its associated destructive effects - may be able to be stopped quickly. Generally, children recover better from brain injury or damage because their developing brains are more flexible than those of adults.

Where to get help

- Your doctor
- Neurologist
- Brain Foundation Victoria Tel. 1300 886 660 or (02) 9437 5967

Things to remember

- The main components of the brain include the brain stem, cerebellum, thalamus, cerebrum and corpus callosum.
- The brain can be affected by a wide range of disorders and events such as trauma, nervous system diseases, stroke and tumours.
- The specific symptoms or losses of functioning depend on which brain areas are affected.

This page has been produced in consultation with, and approved by:

Swinburne - Brain Sciences Institute

Content on this website is provided for education and information purposes only. Information about a therapy, service, product or treatment does not imply endorsement and is not intended to replace advice from your doctor or other registered health professional. Content has been prepared for Victorian residents and wider Australian audiences, and was accurate at the time of publication. Readers should note that, over time, currency and completeness of the information may change. All users are urged to always seek advice from a registered health care professional for diagnosis and answers to their medical questions.

For the latest updates and more information, visit www.betterhealth.vic.gov.au

Copyright © 1999/2011 State of Victoria. Reproduced from the Better Health Channel (www.betterhealth.vic.gov.au) at no cost with permission of the Victorian Minister for Health. Unauthorised reproduction and other uses comprised in the copyright are prohibited without permission.

