



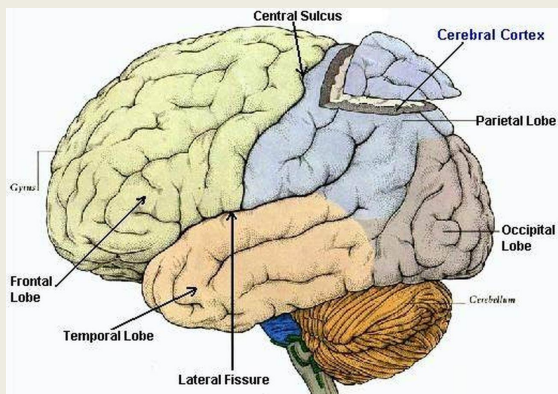
Medicine for Managers

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The Amazing Cerebral Cortex

The Cerebral Cortex is the outermost layer of the brain and is associated with the highest mental capabilities. Inspection of a brain shows that the cortex is thrown into many folds and grooves giving it a wrinkled appearance. It is composed principally of grey matter and contains neurones (nerve cells) which proved so important to Agatha Christie's Poirot. Let me try to explain its importance and functions.

The wrinkled appearance is caused by the folds and grooves and the folds increase the surface area of the cortex, allowing huge amounts of information reaching the brain to be processed by the **fifteen billion** nerve cells it contains. The cerebral cortex makes up half of the brain's total mass.



The diagram illustrates the four lobes into which the cortex is split:

- Frontal**
- Parietal**
- Temporal**
- Occipital**

Each of the lobes is responsible for processing different types of information.

The cerebral cortex as a whole is crucial for our higher level information processing including memory, the use of language, learning and decision-making, thought, reasoning, intelligence and emotion and personality.

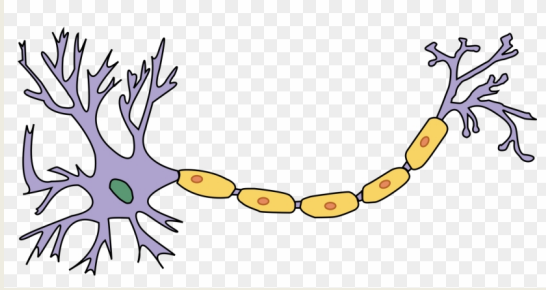
The cortex is split into two **hemispheres**, which are separated by a deep groove (**sulcus**) called the **median longitudinal fissure**.



The two hemispheres are linked by nerve fibres called the **corpus callosum** which enables communication between lobes and elsewhere.

Although the cerebral cortex is only between two and four millimetres thick, it actually constitutes about half of the total brain mass.

The cerebral cortex is called **grey matter** because of its appearance. Other parts of the brain are called **white matter**. The difference in colour is associated with the anatomy of the nerve cells.



An individual nerve cell consists of a **body**, which contains the nucleus, and an **axon** which is a long process by which the nerve connects to another nerve cell. The axon is covered by **myelin sheath**, which insulates it and the axons appear white. The cell bodies have no myelin covering and appear grey.

The cerebral cortex is, as I have said, the outer layer of the brain. The cerebral cortex, together with the rest of the brain, is called the **cerebrum**.

Functions of the Cerebral Cortex

Different parts of the cortex have different functions. Damage or disease to any part of the cortex will produce effects associated with the function of the particular lobe involved.

The Frontal Lobes

These are the largest lobes of the cortex, located at the front of the brain behind the forehead.

Its functions include:

- Decision-making, reasoning and problem-solving
- Emotion, behaviour and personality
- Attention
- Intelligence
- Speech
- Co-ordinated body movement

Within the frontal lobes are the **Pre-frontal Cortex**, the **Motor Cortex** and **Broca's Area**.

The pre-frontal cortex controls executive functions (thinking and reasoning), the motor cortex, bodily movement and Broca's area is associated with speech production. The frontal lobes also control emotion and behaviour and are activated for appropriate behaviour in social situations.

The Occipital Lobes

Located at the rear of the brain, the occipital lobes receive information from the eye retinae and inform data such as colour, motion and orientation. Visual stimuli are interpreted, object and facial recognition and depth and distance perception are provided.

The Parietal Lobes

These are located between the frontal and the occipital lobes and above the temporal lobes. They are associated with:

- Information from the sensory organs (touch, pain, pressure temperature etc.)
- Interpreting three-dimensional space and integrating received stimuli.

The Temporal Lobes

Situated below the parietal lobes, their functions include:

- Comprehension and formation of speech and learning
- Hearing

- Understanding of non-verbal information
- Memory

Within the temporal lobes are areas believed to assist in the interpretation of speech tones and sounds, and their linkage to previously learned information.

All the array of functions and specialist areas within the four lobes, come together to serve three different purposes:

- **Sensory**
- **Motor**
- **Association**

The **sensory areas** draw together all the information from the senses. Together they contextualise speech, bodily information such as touch, pain, pressure and temperature, hearing, taste and smell, to achieve a co-ordinated functional human.

The **motor areas**, largely in the frontal lobe, allow the body to respond to the sensory information by planning, co-ordinating and executing movements and learning by imitation and past experience.

The **association areas** throughout the lobes add complexity to function. They interpret information, provide spacial awareness, allow the individual to reason and to benefit from memory processing.

Damage to the cerebral cortex may occur as a result of:

- Trauma
- Cerebro-Vascular Accident (bleed)
- Tumour
- Infective or autoimmune disease

The symptoms will depend on the area(s) of the cortex which are damaged. Any one of a host of symptoms can arise in such circumstances.

Frontal Lobe damage may lead to

- Memory disturbances
- Personality change
- Emotional lability or behavioural change
- Weakness, paralysis, speech difficulty (**apraxia**)
- Problems with attention and execution of tasks

If the frontal lobe is damaged, dementia may also result.

Parietal Lobe damage

- Impairs co-ordination and causes disorientation, reduced sensation, aphasia, apraxia and difficulty with written communication

Temporal Lobe damage causes

- Memory loss
- Hearing impairment
- Difficulty with recognition
- Difficulty understanding language
- Possible association with Alzheimer's disease

Occipital Lobe damage may result in:

- Recognition and perception difficulties
- Visual hallucinations and colour blindness, or even total blindness

Compared to the panpoly of functions undertaken by the cerebral cortex every minute of every day, even the best of computers are really little more than neolithic! One can but wonder at the miracle which is the brain.

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