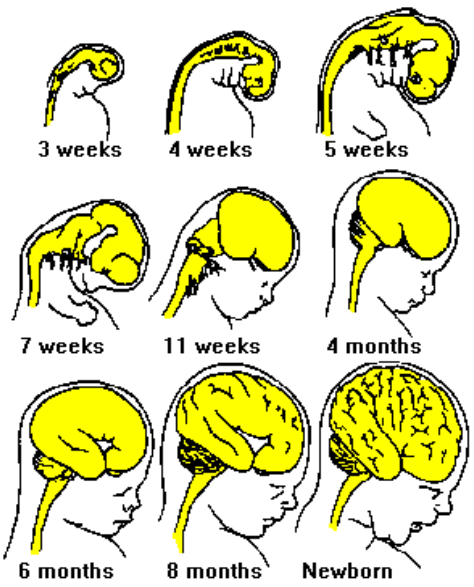
The Development of the Brain

The brain is an organ located in the skull that is made up of a large mass of nerve tissue. It plays a major role in nearly every body system and overall is the command centre of the brain. Its development starts in the womb and continues all the way into adulthood.

Foetal brain development



Overtime, while the foetus is developing in the womb, the nervous system starts to form from an embryonic tissue known as ectoderm. This system starts off as a neural plate (16 days after foetal development) which soon forms into a neural tube (21 days after development). At the front end of this tube three major parts of the brain start to develop, the prosencephalon (front brain), the mesencephalon (midbrain), and the rhombencephalon (hindbrain). Around week seven these areas further divide in a process known as encephalization. These subsections will develop various structures which will end up controlling different functions of the body.

Brain development after birth (0 – 3 years)

At birth the brain has already reached 25% of its adult size and has all the brain cells needed for the rest of its lifespan (up to 100 billion), however despite this, it still has a long way to go in development. For starters, connections between these cells need to be made so as to enable the ability to move, think, and communicate. These connections are shaped by the daily experiences (both positive and negative) the child has, along with how they interact with their surroundings, and by the age of three up to a quadrillion connections will have developed, forming the foundational architecture of the child's neural network.

Brain development throughout childhood (3 – 12 years)

With this foundational network now established the brain seeks out new learning opportunities so as to activate certain neurons, create even more neural connections and strengthen already existing connections through the process of **myelination**. The various unused connections will be slowly eliminated in a process known as **synaptic pruning**. Both these processes will be affected by the child's life experiences, their parental care, along with their school and educational environment.

Brain development throughout adolescence (13 – 19 years)

During early adolescence this process of myelination and synaptic pruning has allowed certain areas of the brain to become well developed, such as the limbic system, specifically the amygdala. This region of the brain is responsible for emotions, impulses, aggression and instinctive behaviour and for a time is the main governing body of various actions a teenager may perform. This is because the prefrontal cortex, the region of the brain associated with decision making, logical thinking, self-control, planning and strategizing, along with other higher brain functions is still under development. As such, many decisions made by teenagers are governed by the amygdala and explains why risk taking behaviour is typically seen throughout early adolescence. It isn't until late adolescence that we see the prefrontal cortex take over from the amygdala, after now having undergone significant myelination and synaptic pruning changes.

- 13 – 15 years: Around this age period, the brain (especially the frontal lobe region) undergoes a small growth spurt, and the pituitary gland (located at the base of the brain) starts to secrete hormones throughout the body which allows for sexual maturation and reproductive capabilities.

- 16 – 17 years: The brain now undergoes a second growth spurt and various neural connections throughout become stronger due to the synaptic pruning process. By the time you reach seventeen your brain has now reached its maximum adult size and weight (approx. 3lbs).

- 18 – 19 years: The pruning process continues and the brain sheds the weaker connections between neurons leaving only the strong efficient ones. Overall the number of connections has been reduced from 1000 trillion to 500 trillion.

Brain development after adolescence (20 years and onwards)

At this point in life, the brain is well developed, however still needs a few more years before it reaches full development. This is largely due to the prefrontal cortex which finishes development around the age of 25 (on average). Further development and growth then starts to slow down as the brain has now become a fully matured version of itself, however despite this, it will always continue to form new neurons and neural connections as new experiences are had. These connections form the memories of our lives and are seen in the hippocampus and the olfactory region of the brain.

As we continue to age and reach late adulthood the development of the brain becomes reversed and shrinkage is seen in several areas (specifically the prefrontal cortex and hippocampus), leading to a decline in cognitive processes such as inhibition, coordination and planning. Similarly, the levels of myelin surrounding neurons starts to thin, having a negative impact on reaction times, movement, speech and general cognitive processing. Despite this decline in size and efficiency the brain employs its plasticity ability and compensates by now using multiple brain areas while performing certain tasks.