The brain

The human brain is an amazing organ. It controls memory and learning, the senses (hearing, sight, smell, taste, and touch), reasoning and emotions. It also controls other parts of the body, including muscles, breathing and the heartbeat.

The brain is made of specialised cells called neurons, along with other structures. These neurons (and there about 80 billion of them in your brain!) form complex networks with one another and send chemical messages down these pathways when you need to respond to something.

Scientists have known for many decades that the brain is highly adaptable. The networks neurones form are not fixed—when you learn new things you make new connections. The brain also removes any networks that aren’t used in sufficient quantity—this is called synaptic pruning and is thought to ‘fine tune’ the brain’s functioning. Most synaptic pruning happens in adolescence and occurs mostly in the grey matter of the brain, which is involved in thought and memory processing.

The adolescent brain

Scientists have long suspected that significant developmental events occur in the brain during adolescence and research in recent years has shown just how significantly different the adolescent brain is to the adult brain. These differences probably explain why so many (but not all) adolescents engage in what adults generally perceive as risky, impulsive behaviours—rates of death by injury for people aged 15 to 19 are about six times that of the rate between ages 10 and 14.

Key facts about brain development during adolescence include:

- The amygdala is the area of the brain responsible for ‘gut’ emotional behaviour and the frontal cortex responsible for judgement and high order thinking. Neuroimages (brain scans) show that teens tend to use the amygdala more than adults during thinking tasks whilst adults rely more on the frontal cortex.

- The corpus callosum connects the two hemispheres of the brain. It has a period of significant growth during adolescence.

- Adolescents produce the neurotransmitter dopamine in far greater quantities than adults. Dopamine is critical in exciting neurones which I essential for learning, suggesting that teens have a greater capacity to learn than adults. Increased dopamine activity also explain why adolescents gravitate towards exciting experiences and impulsive behaviours.
Increased dopamine release also affects people during adolescence by increasing in the susceptibility to addiction. All behaviours and substances that are addictive involve the release of dopamine and teens are more likely to experiment with new experiences and respond with significant dopamine release that for some can become part of an addictive cycle.

So we know teenage brains and adult brains are very different. Are the brains of people with mental health problem different as well?

There are special types of scans—neuroimaging—that allow scientists to see the brain and its activity but in most cases of mental illness the images don’t look much different between someone who has a mental illness versus someone who doesn’t. They certainly can’t be used alone to diagnose a mental illness. The brain is so complex that there could be lots of different reasons why mental illness occurs. For some mental illnesses, it’s possible that the brain over pruned itself during adolescence and lost important network connections. Scientists think other mental illnesses may be due to faults occurring with the types or quantities of the chemical messages (neurotransmitters) needed in the brain. Other experts believe mental illness could be due to certain neurones forming connections with one another that they shouldn’t have done. Scientists are hopeful that their research will increase our understanding of mental health in the coming years. What we can already say is that mental illness is caused by something going wrong in the brain, exactly the same as heart attacks being caused by something going wrong in the heart.

Most mental health problems start in adolescence.

How are Scientists investigating the relationship between brain development and mental health?

Scientists are carefully exploring the relationship between genetic factors, life experiences, external factors and mental health. There are so many variables to take into account that it’s impossible to say who will develop a mental health problem and who won’t. Research however can look at individual factors and their effect on the brain’s development. We know that the brain changes significantly during adolescence to adulthood and some of these changes happening incorrectly may explain why some mental illnesses develop.