WHAT MAKES TEENS TICK?(5)

This article provides some of the scientific details of brain development in humans from conception to the mid-20’s. Parents who understand the brain’s development will be better able to make wise decisions that will help keep their children safe.

Humans achieve their maximum brain-cell density between the third and sixth months of pregnancy. We are born equipped with most of the neurons our brain will ever have. By the time a child is 6 years old, the brain is 90% to 95% of its adult size.

Recent MRI studies have allowed scientists to actually see the adolescent brain in action. They were surprised to learn just how much the structure of the brain was still changing during adolescence. Scientists knew that in the final months before birth our brains went through a dramatic pruning process. Unnecessary brain cells were eliminated. Through MRIs and other brain scans scientists have learned that a child’s brain, between the ages of 6 and 12, is creating new pathways for nerve signals. The thickening of all this gray matter in the brain peaks when girls are about 11 and boys 12 1/2. At this point, a serious amount of pruning of brain circuits starts again. A final and critical part of this second wave of pruning occurs in the late teen years. This last stage of brain development affects some of our highest mental abilities. During adolescence, the brain has fewer but faster connections. The brain becomes a more efficient machine. But, there’s a trade-off. The brain is probably losing some of its raw potential for learning. Scientists believe that during adolescence the connections in the brain that are used become even more efficient, but if they aren’t used, they may not survive the pruning process.

Researchers think the changes they’ve observed in the teen brain might explain some familiar adolescent behaviors: emotional outbursts, reckless risk taking, rule breaking, and their passion for adventure and thrills. Adolescent behavior is the result of two factors: an increase in hormones and a brain that has not yet developed the controls needed for mature judgment and decision-making. Structural changes in the adolescent brain may also explain the timing of some major mental illnesses. Schizophrenia typically manifests in adolescence and is a major factor in the high rate of teen suicide.

By the time the brain reaches maturity (mid-20’s), it’s made up of 10 billion neurons, 100 billion support cells, and 100 trillion connections! That’s more connections than all the internet connections in the world. It also means there’s a lot going on in the brain during adolescence (12 years to mid-20’s).
The comment often made to describe middle school adolescents is that they are “brain dead.” Their brain isn’t actually “dead,” but it is undergoing such a massive change at puberty that young people often feel their brain doesn’t work for them like it used to. Parents complain that their middle schooler seems to have major memory problems. Their ability to focus seems weaker than before. They often get buried under their own lack of organization (school work, bedroom, etc.) Young adolescents often experience themselves as different from minute to minute. They can’t predict how they’ll “be” except that it will be different. Parents can help young adolescents get through this difficult stage by helping them understand what’s going on. Once middle schoolers understand some of the changes going on inside their brains, they are more willing to accept a parent’s offer to help with the confusion and chaos. Parents can help a young adolescent develop a routine so they can get through their day-to-day tasks. Often a concrete plan to stay organized is necessary. Establishing a routine helps young adolescents re-gain some sense of being able to predict and manage their daily responsibilities when their bodies and brains feel so unpredictable.

It may be useful for parents to use the idea of a road map to explain to young adolescents what’s happening in their brains. All the parts of the brain are connected with different “roads.” At puberty the brain starts to eliminate, or prune, connections or “roads” that are not used, are not needed anymore, or are duplicates. This pruning process means the young adolescent brain is unstable and changing. It also means parents need to pay very close attention to how their adolescents are spending their time. What connections or “roads” are they using and developing?

Most brain development seems to follow a set plan which has been preprogrammed into our genes. More subtle changes in the brain seem to reflect experience and environment. The brain, more than any other organ, is where experience becomes flesh. Most scientists believe that the pruning of the brain is guided by genetics and by a use-it-or-lose-it principle. The most used connections in the brain will survive.

How teens spend their time will determine whether the adolescent brain reaches its full growth potential.
Spending time in addictive behaviors.

Spending time doing healthy and varied activities that help relieve stress and promote brain development so the adolescent brain can reach its full potential.
No matter how a particular brain turns out, its development goes in stages, generally from back to front. The regions of the brain that reach maturity earliest are in the back of the brain. They help interpret, through our senses, our direct contact with the environment. The very last part of the brain to be pruned and shaped to its adult size is the prefrontal cortex, home of the so-called “executive functions” – planning, setting priorities, organizing thoughts, suppressing impulses, weighing the consequences of one’s actions.

Once scientists started mapping where and when the brain changes were happening, they could see that the part of the brain that makes teenagers more responsible is not finished maturing yet. The teen brain is a work in progress.

The brain regions that put the brakes on risky, impulsive behavior are still under construction in the adolescent brain. Meanwhile, the parts of the brain responsible for things like seeking excitement are getting turned on in big ways around the time of puberty. But, the parts of the brain that control exercising judgment are still maturing throughout the course of adolescence.

Raging hormones, however, remain an important part of the teen-brain story. Right about the time the brain switches from growth to pruning, the body comes under the hormonal assault of puberty. Research suggests brain development proceeds on schedule even when a child experiences early or late puberty. For years, psychologists blamed the intense, explosive emotions and unpredictable behavior of teens on this hormonal onslaught. New research adds fresh support.

At puberty, the ovaries and testes begin to pour estrogen and testosterone into the bloodstream. This starts the development of the reproductive system. At the same time, testosterone-like hormones, produced differently in males and females, are released by the adrenal glands and begin to circulate. Recent discoveries show that these adrenal sex hormones are extremely active in the brain. They attach to receptors everywhere and have a direct, powerful influence on the chemicals in the brain that regulate mood and excitability. These sex hormones are especially active in the brain’s emotional center, or the limbic system.

This creates a tinderbox of emotions. Not only do feelings reach a flash point more easily, but adolescents tend to seek out situations where they can allow their emotions and passions to run wild. Adolescents are actively looking for experiences to create intense feelings.
There is strong evidence of a particular hormone-brain relationship that contributes to an appetite for thrills, strong sensations and excitement.

This thrill seeking behavior may have evolved to promote exploration - an eagerness to leave the nest and seek one’s own path. But in a world where fast cars, illicit drugs, gangs and dangerous relationships beckon, it also puts a teenager at risk. There’s this time gap between when things push young people toward taking risks, early in adolescence, and when things come on-line that allow them to think before they act. It’s like turning on the engine of a car without a skilled driver at the wheel! In the teen brain, the prefrontal cortex, where judgments are formed, is practically asleep at the wheel. At the same time, the teen brain’s limbic system, where raw emotions such as anger are generated, is entering a stage of development in which it goes into hyper-drive.

More sophisticated brain research that actually showed brain activity while subjects were doing assigned tasks provides interesting information. When compared to adults, teens were much more likely to misread emotional signals - seeing anger and hostility where none existed in photos they were shown. Teens tended to incorrectly identify expressions of fear, confusion, disappointment, frustration, or sadness.

Teenagers often don’t do very well interpreting the social signals that are communicated through body language. Human beings need to be taught how to read emotions expressed in facial expressions and body language.

Another study comparing adolescent and adult brain activity levels, using the same advanced technology, found that teens showed less activity in the part of their brain that directs motivation. If adolescents have a motivational deficit, it may mean they are likely to engage in behaviors they experience as very exciting or that require really low effort. Their behaviors might be a combination of both factors. The most effective way for parents to motivate their adolescents to do something is to emphasize the more immediate, not distant future, benefit of some activity. Some things adolescents need to do aren’t exciting and require effort. Getting what we want can motivate human behavior. All adolescents want more fun, more time with friends, more control over their daily lives, and more independence. Those “wants” can become the pay-off for doing something less fun or exciting right now.
For social and biological reasons, teens have increased difficulty making mature decisions and understanding the consequences of their actions.

Most brain researchers now agree that the final stage of brain development begins around 16 years of age and continues into the mid-20’s and sometimes until around 30 years of age. It’s useful to learn that teenage behavior is not just a matter of willful pigheadedness or determination to drive a parent crazy. There is debate over how much conscious control young people have. You can tell a teen to “shape up,” but making mistakes and learning from them is part of how the brain grows and matures. It is much better if adults help teens navigate their complex world by providing structure, organizing their time, guiding them through tough decisions (even when they resist), and using the time-tested virtues of patience and love.

**ADULT THINKING TAKES A LONG TIME TO DEVELOP. ADOLESCENTS CANNOT BE EXPECTED TO THINK LIKE ADULTS.**

Researchers feel they have only begun to probe the workings of the adolescent brain. Young people need parents, teachers, and other adults to be educated about what is realistic to expect from them. Without understanding how the brain operates and changes over the first two decades of human life, parents can miss opportunities to encourage and guide their young person into age-appropriate activities. During adolescence, many higher mental skills will become automatic. *Teens who exercise their brains by learning to develop and use their critical thinking abilities, to limit their impulses, and to understand abstract concepts, are laying down the connections in their brains that will serve them for the rest of their lives.* During the teen years, adolescents are hard-wiring their brains. This means adolescents need to experience many different things so their brains will be “wired” for the variety of tasks that must be mastered to be successful in life.

Parents need to make sure that their adolescent’s brain is being hard-wired for at least three distinctly different activities: playing a sport, acting, playing music, studying mathematics, reading, woodworking, or anything that challenges the brain to achieve mastery. Three seems to be the magic number to help the brain reach its peak growth potential during its final phase of change and development.
“WHAT MAKES TEENS TICK?” has been edited from a TIME article, with the same title, published May 10, 2004, in the “Science” section of the magazine.

Some of the most recent brain research is helping scientists begin to understand how to keep the brain capable of learning as the body ages. Work with brain injured patients has convinced scientists that the brain possesses amazing abilities to heal and develop new circuits after suffering trauma. Many scientists believe our understanding of the human brain is still in its infancy. Keeping our brain healthy, at any age, is as important to our quality of life as maintaining the health of all the other major organs.

If your child plays a lot of violent video games, this website provides important information about playing violent video games and how it affects your adolescent’s brain development. [http://www.sciencenewsforkids.org/articles/20070124/Feature1.asp](http://www.sciencenewsforkids.org/articles/20070124/Feature1.asp)

The process of hard-wiring the brain that’s going on during adolescence is also why it is dangerous for adolescents to take illegal drugs or alcohol. Introducing “alien” chemicals may permanently alter the balance of chemicals in the adolescent brain - a balance necessary for the brain to fully develop to its maximum adult abilities.

http://www.pbs.org/wgbh/pages/frontline/shows/teenbrain/interviews/todd.html

The brain, more than any other organ, is where experience becomes flesh.