

What's Going On in the Teenage Brain?

by Sue Young Wilson

Ever feel like your brain hurts? Well, maybe it's got growing pains.

Scientists used to think the brain, though it grows explosively in early childhood, was pretty much in final form by puberty. But, just in the past few years, with the help of new technologies like magnetic resonance imaging, they've discovered that the teenage brain is still very much a work in progress.

One brain area that undergoes major change in the teen years is the prefrontal cortex, the part that's in charge of setting goals, making plans, ranking priorities, organizing and inhibiting impulses. Starting around nine or ten, the prefrontal cortex goes through a growth spurt, adding many more connections. Then, a couple of years later, these tangles of connections start to get pruned away to leave the prefrontal cortex in its final form. With all this change going on in a brain area responsible for higher decision-making, no wonder teens can get a little scattered. The good news is that this pruning actually makes the connections more efficient, helping teens get it together as they finish growing up.

Scientists have also recently found evidence that in adolescence, the brain's cells aren't completely covered yet by the fatty sheaths, called myelin, that help them function. Myelination, as the growth of these sheaths is called, may not be complete until the early 20s.

The fact that a teenager's brain is still developing means that it may be particularly vulnerable to the harmful effects of alcohol and drugs, including nicotine. Researchers have done experiments on adolescent rats and found that alcohol and nicotine caused brain damage in the "teenaged" rodents in ways that they didn't in adult rats. Another good reason not to drink, smoke or take drugs.

In your teen years, your brain is completing its "hard wiring." It "decides" what connections to wire in and what to eliminate based largely on what you spend a lot of time learning and doing. That means that you, as a teenager, have a rare opportunity to mold your brain to be good at things just by doing them a lot. If you want to learn a sport or a language or how to play guitar, now is a great opportunity to develop these skills for life. (It follows that it's kind of dumb to waste this "brain-wiring window" lounging in front of the television for hours. You might want to save that for your retirement and go learn how to do something cool.)



This well-known optical illusion shows both a young lady and an older woman. Which do you see first? A key to the illusion is that if you look closely, you'll see that the young lady's chin can be the older woman's nose. Created by cartoonist W. E. Hill, it was originally published in *Puck* in 1915 as *My Wife and My Mother-in-law*.

For more optical illusions, log on to Exploratorium Web site Seeing Exhibits at www.exploratorium.com/exhibits/f_exhibits.html

Exercise and Sports: For "Brains" Only

by Faith Brynie

Want to get smarter? Get moving!

Shakespeare and calculus aside, the first job of a brain is to run a body. The brain controls, learns and coordinates movements. Movement, in turn, affects the health of the brain.

How Does the Brain Control Movement?

Two areas of the brain play major roles in physical activity. The first is the motor cortex, a region of the brain's thin outer layer. It sends impulses to muscles, initiating voluntary movements. Communication between the senses and the motor cortex coordinates motion. Your hand can catch a ball because information on a ball's position, direction and speed is relayed from the brain's visual center.

Automatic movements reside in a second area, the cerebellum. Lying at the base of the brain, this region coordinates balance, movement and posture. This area automatically keeps the body upright and the muscles working together. You don't have to think about maintaining balance, but when this part of the brain is impeded — as it might be when too little oxygen reaches the brain — the body's posture-maintaining ability is lost. What's this called? Fainting!

The cerebellum can also take over some movements that were once voluntary. Have you noticed that new skills — seeming difficult at first — become effortless with practice? The brain shifts neural activity from the motor cortex to the cerebellum as skills become automatic.

Does Exercise Affect the Brain?

A healthy brain needs two kinds of exercise daily. One kind is obvious — using the brain's reasoning and problem-solving capacities. Learning, thinking, remembering, and being active strengthen connections between neurons and stimulate new ones. Reading, writing, creative activities such as art, social interactions, hobbies, mental games and quizzes — all help build and maintain a healthy brain.

Less obvious — but equally important — are the benefits of physical activity. Exercise promotes blood flow and oxygen delivery to brain tissue. Perhaps as a result, exercise increases the number of neurons and connections

formed in the brain, especially in an area called the hippocampus. (The hippocampus makes and stores memories.)

Exercise combats stress, enhances the immune response against infection and improves mood. Exercisers perform better on learning and memory tasks than couch potatoes. They keep their mental sharpness well into old age, too. Certain patterns of physical activity — such as those used to rehabilitate stroke patients — can help repair a damaged brain.



"Still, a brisk walk can be just as effective."

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Activities

- Working with a partner and a stopwatch, practice folding paper with one hand. (Agree on rules for the kind of fold and the adequacy of the result.) Time a number of trials, first with your dominant hand, then with your less-used hand. Compare times between trials. Do you improve with practice?
- Interview a professional athlete, physical education teacher, physician or health club trainer. Ask about the "brainy" benefits of regular exercise.

Keep Your Brain Healthy

by William Guido, Ph.D.

The brain is the most valuable organ of your body. While other organs can be repaired or sometimes replaced, your brain cannot. It acts as the command center for all your actions, thoughts and experiences. It also controls many bodily functions that we rarely think about such as heart rate, blood pressure and breathing. Although our brain is vital for survival, it is extremely vulnerable. While it is protected by a thick bony skull and isolated from the body's bloodstream by a blood-brain barrier, a simple fall from a bicycle or skateboard can lead to permanent and serious brain damage.



Traumatic Head Injury

Each year in the United States, an estimated 5.3 million Americans, a little more than two percent of the population, live with a disability resulting from brain injury. There are two types of brain injury. Open head injuries occur when the skull is penetrated. Closed head injuries are more common and are caused by rapid movements of the head which cause the brain to bounce back and forth against the skull. Closed head injuries result from car accidents, falls or injuries sustained during recreational/sporting activities. These injuries can lead to bruising, tearing and swelling of the brain.

Brain injuries can vary in their severity from a mild concussion to prolonged unconsciousness or coma. A blow to the head during a sporting event may be a lot worse than you think. Such hits may not be hard enough to crack the skull, but they cause the brain to bounce around inside the skull. (Think of what happens to the yolk of an egg that is shaken.) Common side effects of a concussion include headaches, lightheadedness, dizziness, or a brief loss of consciousness. New studies also show that college athletes who experienced a concussion perform worse on memory tasks for up to seven days after the injury!

Simple measures can be taken to prevent the risk of head injury. Wear proper safety equipment when playing sports. Every year, there are 300,000 head injuries sustained during sporting events. Always wear a helmet when biking, skating or skateboarding. Head injury is the leading cause of death in bicycle crashes. Always wear a seat belt when driving. Motor vehicle accidents account for 37 percent of all brain injuries.

Signs of Head Injury

Headaches • dizziness • loss of consciousness • memory impairment • trouble finding the right word • increased irritability • mood swings • trouble sleeping • impulsiveness • difficulty in concentration

Ten things to do to keep a healthy brain!

1. Wear a seat belt when in a car
2. Wear a helmet biking or skating
3. Stay away from drugs
4. Don't drink and drive
5. Look before diving into pools and unknown lakes or ponds
6. Look both ways before crossing the street
7. Stay away from guns
8. Eat right
9. Stay away from harmful chemicals, pesticides and cleaners
10. Drink plenty of fluids when working or playing in the heat

Discussion Questions

- Have you ever been around someone who was drunk or suffered from a concussion? How did their behavior change as a result?
- Knowing how common mishaps can affect brain function, what will you do differently?

Mental Illness & Brain Disorders

by Sue Young Wilson

The brain is an amazing, complicated organ, but sometimes things go wrong with it. More than one out of five Americans will suffer from some kind of mental illness in their lifetime.

One of the most frequent of the serious mental disorders is depression. Researchers estimate that about 17 percent of Americans will suffer an episode of major depression in their lifetimes. Schizophrenia and bipolar disorder (also called manic depression) are less common, each afflicting about one percent of the population.

Depression

Depression is an emotional (mood) disorder in which a person feels sad, worthless and hopeless for a long period. Other symptoms include trouble sleeping or sleeping too much, restlessness or being slowed down, feeling tired all the time, changes in appetite or weight, trouble concentrating or making decisions, and repeated thoughts of death or suicide. As with other mental illnesses, scientists still aren't sure exactly what causes depression, but most think it is some combination of biological factors, primarily genetics and environmental factors like stress, loss or early childhood trauma.

What Do You Do If a Friend Says He or She Is Thinking of Suicide?

1. Listen and let the person tell you how he or she is feeling. Be accepting and caring.
2. Encourage him or her to get help. If he or she won't, tell someone else (an adult), and make sure your friend does get help. Don't promise your friend you won't tell anyone. It's not true that people who talk about suicide don't do it. Places to start: the school nurse, a suicide-prevention hotline, a community mental-health center, a youth group leader you trust.
3. Consider talking to someone like a counselor about your own feelings and experiences. Dealing with a suicidal friend is troubling and emotional.

Schizophrenia

Schizophrenia is a serious brain disorder in which a person's sense of reality becomes distorted. He or she often has hallucinations and delusions and trouble feeling emotions and relating to others. Tragically, this personality-distorting illness often strikes an individual for the first time during the

teen years or young adulthood, just as the person is discovering who they are. (Note: "Schizophrenic" does not mean someone has a "split personality," as the term is sometimes misused in casual conversation.) In schizophrenia, scientists currently believe that the brain isn't properly processing a brain chemical called dopamine.

Schizophrenia often has a genetic basis. It is definitely not contagious, but some researchers suspect that a viral infection in childhood may play a role in causing schizophrenia. We still know relatively little about what causes this devastating disease.

Bipolar Disorder

Bipolar disorder is a serious mental illness in which a person suffers severe mood swings, from mania (an exaggeratedly "up" or "high" state) to depression. Some people with bipolar disorder have "mixed episodes" that combine symptoms of mania and depression.

The symptoms of depression are listed above. Manic symptoms include: a "hyper" mood, agitation or irritability, excessive self-esteem (thinking that one can do anything or is "king of the world"), greatly increased energy, decreased need to sleep, talking too much and too fast, and risky behavior.

Bipolar disorder clearly seems to have a physical basis in the brain and is often treated with a drug called lithium.

There's Help for Mental Illness

Most mental illnesses are treatable, and most people who are treated return to fully productive and meaningful lives. Treatments for mental illness include medication and talk therapy. Often, a combination of both is most beneficial.

If you think you or someone you know may be suffering from depression or another mental illness, see a doctor or a counselor who can point you towards help. You might start by asking the school nurse or the adult leader of a teen group you belong to. Most communities have mental-health and suicide-prevention hotlines and crisis centers; you can check in the Yellow Pages (try under "Mental Health"). One suicide-prevention hotline with locations in many cities is the Samaritans (www.samaritans.org).



Your Brain: Sleeping and Dreaming

By Faith Brynie

What's awake when you're sleeping? Your VLPO!

At least that's what some Swiss scientists think, if your brain is anything like a rat's. They found that two-thirds of the nerve cells in the brain area called the ventrolateral preoptic nucleus (VLPO) fire during sleep. Hormones produced during the waking hours stop the cells from firing.

What else is your brain doing during sleep? Wake up and take this true-false quiz. Some of the answers may be eye-openers.

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| T | F | 1. Dreams have hidden meanings. They are messages from the subconscious mind. |
| T | F | 2. Sleep promotes healing and regrowth of the brain's outer layer, the cortex. |
| T | F | 3. Dreaming occurs only during REM (for rapid eye movement) sleep. |
| T | F | 4. The brain can detect and understand sounds while sleeping. |
| T | F | 5. During sleep, the brain keeps the heart beating in a slow, regular rhythm. |
| T | F | 6. Studying all night keeps memories fresh for an exam the next day. |
| T | F | 7. Half the brain sleeps at a time. |
| T | F | 8. A fetus sleeps before birth. |
| T | F | 9. Teens need less sleep than children do. |
| T | F | 10. Every animal sleeps, even the common housefly. |

Don't doze off before checking your answers:

www.pbs.org/brain

- True or False (trick question). The answer depends on which expert you ask. Some say dreams are nothing more than the "thinking brain's" attempt to make sense of the random firings of nerve cells in other brain regions. Other experts say that, while the brain's thinking and reasoning areas go "offline," the less sophisticated centers can get their messages through.
- True.
- False. Although most dreams occur during the sleep stage known as REM, some dreaming can occur during non-REM sleep.
- True. Scientists at Harvard watched sleeping brains using an imaging technique called fMRI (for functional magnetic resonance imaging). Pure tones activated the sound-processing regions of the brain, while speaking the sleepers' names produced increased activity in the language centers, memory regions and prefrontal cortex.
- False. The time between heartbeats varies more during sleep than during wakefulness.
- False. Memories are stored during sleep, and experiments show that those who sleep after they study consistently perform better than those who study, but don't sleep.
- False for humans, but true for many kinds of birds. Scientists at Indiana State University studied napping mallards. Their brain hemispheres (sides) take turns sinking into the slow brain waves of sleep. The eye controlled by the sleeping hemisphere closes. The other stays open.
- True. And the fetus may dream as well, as REM sleep begins around week 17 of development. What a fetus may be dreaming, however, will remain forever a mystery.
- False. Researchers at Stanford measured the spontaneous sleep and waking (no alarm clocks!) of young people, ages 10 to 18. On the average, younger children slept 9 hours and 20 minutes and awoke naturally. The older sleepers slept past the 9 hour-20 minute mark without waking. They experienced more drowsiness during the day as well.
- True, says researcher Marcos Frank of the University of California, San Francisco—although "sleep-like state" may be a more accurate description of the housefly's daily dozes.