Inside the Teenage Brain

Source: http://www.pbs.org/wgbh/pages/frontline/shows/teenbrain/

Sleep Debt

A great concern of sleep researchers is that teens are so sleep-deprived. Bill Dement speaks about the huge sleep debt that many teens and adults carry around with them every day. With most high schools in the U.S. starting around 7:20 a.m. and with many teens going to bed between 11 and 12 p.m., sleep researchers worry that teenagers are suffering an epidemic that is largely hidden. Since students are often driving to school, to sporting events, and home from late-night parties, this sleep debt holds huge risks. Many high school students know of someone, often a high-achieving kid, who on the drive back from a sporting event or dance simply fell asleep at the wheel. On a less dramatic note, there are literally millions of adolescents who feel despondent, get poor marks, or are too tired to join high-school teams all because they are getting too little sleep. Because of their deep concern about these issues, sleep researchers are pushing for later school start times and are trying to introduce sleep issues into the high school curriculum.

Sleep, Learning, and Memory

The other area of sleep research relevant to teenagers, their parents, and teachers is the effect of sleep on learning and memory. In experiments done at Harvard Medical School and Trent University in Canada, students go through a battery of tests and then sleep various lengths of time to determine how sleep affects learning. What these tests show is that the brain consolidates and practices what is learned during the day after the students (or adults, for that matter) go to sleep. Parents always intuitively knew that sleep helped learning, but few knew that learning actually continues to take place while a person is asleep. That means sleep *after* a lesson is learned is as important as getting a good night's rest before a test or exam.

This research is done by giving students a series of tests. The students are trained, for instance, to catch a ball attached by a string to a cone-like cup. As they repeat the skill during the test day, they are able do it faster and more accurately. Let's say they go from catching a ball 50 percent to 70 percent of the time over a period of half an hour. The students who get a good night's sleep improve when they are retested. On a retest three days after they have a good night's sleep, they might catch a ball 85 percent of the time. The other students who got less than six hours sleep either do not improve or actually fall behind.

Some of the tests are more demanding. They are called cognitive procedural tasks and they mimic what a student might learn in physics or math, or in certain sports. They present the student with something new to be learned or require an ability to conceptualize, to form a picture of the task in their minds.

The brain consolidates learning during two particular phases of sleep. According to Dr. Robert Stickgold of Harvard University Medical School, who conducted a series of tests involving visual tasks, the brain seems to need lots of slow-wave sleep and a good chunk of another kind of sleep, Rapid Eye Movement, or REM. Dr. Stickgold hypothesizes that the reason the brain needs these particular kinds of sleep is that certain brain chemicals plummet during the first part of the night, and information flows out of the hippocampus (the memory region) and into the cortex. He thinks the brain then distributes the new information into appropriate networks and categories. Inside the brain, proteins strengthen the connections between nerve cells consolidating the new skills learned the day before. Then later, during REM, the brain re-enacts the lessons from the previous day and solidifies the newly made connections through the memory banks.

What these studies show is that learning a new task, whether it is sports or music, will be greatly helped by getting a good night's sleep and that students' ability to remember things, be it a lesson on geometry or the causes of the Second World War, is mediated by sleep.

Many researchers accept the proposition that sleep aids the learning process. In a review of the Harvard studies, the late Chris Gilpin described the research as "the most believable data ever collected that a specific memory function is associated with sleep." However, a recent study published in the November 2001 issue of the journal *Science* challenges that conclusion. After conducting a literature review, Jerome M. Siegel of the UCLA Department of Psychiatry and Brain Research and the Center for Sleep Research, judged the evidence of a link between REM sleep and learning to be "weak and contradictory." He pointed to inconsistent results from human and animal studies, and argued that studies of humans who do not experience REM sleep (due to brain injuries or pharmacological reasons) do not show memory problems. Siegel concludes, however, that although he does not believe that the existing literature points to a link between REM sleep and memory consolidation, "just as nutritional status, ambient temperature, level of stress, blood oxygenation, and other variables clearly affect the ability to learn, adequate sleep is vital for optimal performance in learning tasks."

Learning Good Sleep Habits

Putting good sleep habits into practice is particularly difficult for teenagers. Not only do their own circadian rhythms (internal body clock) fight against going to sleep early, but also many teens don't have any control over the time they wake up. Teens can do something to try to bring their internal body clock forward. Sleep experts say dimming the lights at night and getting lots of daylight in the morning can help. Having a routine bedtime of 10 p.m., sleeping in a cool environment and turning off music, the Internet, and televisions would help to reset the body clock. And though sleeping in is a good thing, trying to get up after only an extra hour or two is a lot better than "binge-sleeping" on the weekends. If a student is used to getting up at 6:30 a.m., they shouldn't sleep until noon on the weekend. That simply confuses their bodies. And lots of sports helps, too -- better earlier in the day than late.

Sleep research not only points out the importance of sleep to teenagers, but explodes some of the myths around sleep: principally the idea that people need less and less sleep as they grow up. There are many factors in the lives of adolescents that elude their control. Sleep is one area where the lessons are clear and the benefits of following them are quickly apparent. Use the following table to determine if you should rethink how you use your time.

Time	Activity
6 AM	
8 AM	
10 AM	
Noon	
2 PM	
4 PM	
6 PM	
8 PM	
10 PM	
Midnight	
1 AM	
2 AM	
3 AM +	