**Brain-Based Learning Part II**

**Introduction to Reading**

Before beginning this reading, review the previous reading on Brain-Based Learning.

This first excerpt discusses how anxiety and stress impact learning. You will be discussing this in class. As you read, consider the following questions:

* What types of classroom-related situations trigger anxiety for you?
* What strategies do you use for dealing with stress and anxiety?
* How can students either create or alleviate a stressful environment for other students in the classroom?
* How can you respond positively to a challenge without allowing yourself to become anxious?

**Excerpt from: *Research-Based Strategies to Ignite Student Learning by Judy Willis*, *pp 24-26***

**Limbic System Stimulation—Not Too Hot—Not Too Cold, but Just Right**

The amygdala is part of the limbic system in the temporal lobe. It was first believed to function as a brain center for responding only to anxiety and fear. Indeed, when the amygdale senses threat, it becomes over activated (high metabolic activity as seen by greatly increased radioactive glucose and oxygen use in the amygdala region on a PET scan). In students, these neuroimaging finds are seen when they feel helpless and anxious. When the amygdala is in the state of stress, fear, or anxiety-induced over activation, new information coming through the sensory intake areas of the brain cannot pass through the amygdala to gain access to the memory circuits.

More recent studies have found that the amygdala also is stimulated, but to a lesser degree of metabolic activity, when students are in a positive emotional state with feelings of contentment, joy, play, and a comfortable, but stimulating, amount of challenge.

During these emotional states, neuroimaging shows metabolic states of low-level stimulation in the amygdala. Students tested under these conditions show better working memory, improved verbal fluency, better episodic memory for events, and more flexible thinking yielding creative ideas for problem solving. They even show more positive social behaviors—helpfulness, sociability, focus, patience, and other higher-order executive function and decision-making abilities.

Subsequent research revealed that after presentation of pleasurable, comforting, positively reinforcing, intrinsically motivating stimuli, the amygdala could be moderately stimulated or warmed up to the alert state that actually facilitates active processing and neuronal transport of information. This represents the actual neuroimaging visualization of what has been called the affective filter—an emotional state of stress in students during which they are not responsive to processing, learning, and storing new information. This represents objective physical evidence that during periods of high stress, new learning just doesn’t get in to the information processing centers of the brain.

However, as important as it is to avoid over activation of the amygdala, it is also important to provide mild-to-moderate challenge to stimulate authentic curiosity and engagement in lessons so the amygdala, tuned to just the ideal state of activation, can enhance the speed and efficiency of information flowing through into the memory storage areas of the brain. It is just the right balance of these emotional and intellectual opportunities, and the incorporation of students’ own interests and curiosity into the lesson, that will motivate them to work toward greater understanding and connection with the material. As students access this pathway with open-ended and student-initiated questioning, they will engage their higher-order executive functions and, with practice, experience the confidence to see themselves as learners with open minds. Educators can help students unlock the gatekeeper (amygdala or affective filter) for sensory data. Once the information can get through the amygdala, it can be linked with students’ personal interpretations and teacher-guided meaning. These memories have the best chance of entering long-term memory storage banks.

**Excerpt from: *Research-Based Strategies to Ignite Student Learning* by Judy Willis, pp 35-37**

**Once They Leave the Classroom**

Most popular magazines and self-help books devote pages to theories on how diet, exercise, and lifestyle affect health and well-being. These factors are so difficult to quantity that it is challenging to make informed decisions. Fortunately, neuroimaging has provided empirical evidence about some of these factors, especially the impact of sleep on memory.

**Sleep.** During sleep, the cortical executive functioning of the frontal lobes in less active because less sensory input is entering the nervous system. This reduced-activity brain state is just what is needed to allow recently learned material to be rehearsed or repeated, sometimes in dreams. Because sleep is the time when the brain is least distracted by the sensory input bombarding it all day, it can devote a greater portion of its energy (metabolism) to organizing and filing the memories formed during the day.

**Gray Matter**

*It is known from animal experiments that memory consolidation requires the synthesis of new proteins in the hippocampus and subcortical frontal lobe memory storage areas. These changes appear on fMRI as increased brain oxygen use 24 hours after the information is stored. Thus, it is believed that memories that remain after one day are in the process of being successfully consolidated into neuronal pathways with new dendrites and synaptic connections.*

*Connections between neurons are sprouted when memories are stored through the growth and interconnections of more dendritic spines. It takes time for these to grow, and that requires not only syn-naps (brain rests), when neurotransmitters such as dopamine are replenished, but also sleep. It is during sleep that the brain reaccumulates the greatest amount of the neurochemicals needed to stimulate dendritic growth.*

*Memory storage in the brain is most efficient during the longest periods of uninterrupted deep sleep rather than during the “dream sleep” associated with rapid eye movement (REM sleep). This period of deep sleep is the critical time when the brain transforms recent memories into long-term memories by building and extending the dendritic branches. The hard-wiring of information learned during the day results in stored permanent memories.*

*The more dendrites that branch out from the nerve cells, linking more and more cells together, the more efficiently the brain can recognize similarities between new experiences and already stored ones. This once again illustrates that the more you know, the easier it is to learn.*

*Growth hormones are especially active during sleep, which is when most of the neurotrophin nerve growth factor stimulation of new dendrite branching takes place. Dendritic branching process is also enhanced by the neurotransmitter serotonin secreted by the brain predominantly between the sixth and eighth hour of sleep. This recognition of the need for sleep has led researchers to test and confirm their predictions that increasing sleep time from six or less to eight hours can increase memory and alertness up to 25 percent (Frank, Issa, & Stryker, 2001).*

Sleep helps the brain consolidate and cement new knowledge and experience into memory. This sleep research gives validity to what students have discovered through their own study habits of reviewing notes when they are still alert, rather than just before they fall asleep. Studies suggest that if students review their notes thoroughly and stop and go to sleep when they begin to feel drowsy, the quality and quantity of retained memory is superior to extending the review time any number of hours once drowsiness has set it.

Even when sleep-deprived students catch up on their sleep, their test performance on recently learned information is lowered (Stickgold, 2000). A study of students who received low grades (Cs, Ds, and Fs) revealed that they obtained about 25 minutes less sleep and went to bed an average of 40 minutes later on school nights that students with high grades (As and Bs). Adolescents who slept less than 7 hours reported increased daytime sleepiness, depressed mood, and behavior problems (Wolfson, 1998).