Running Head: STUDENTS' BRAINS … ENERGIZED AND EAGER

Getting and Keeping Students' Brains Energized and Eager

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"Nine tenths of education is encouragement."
Anatole France (1844 – 1924)

Our brain is capable of absorbing a great deal of information and can make decisions about what role or roles, major or minor, that data will play in its life. While it is most likely true that we learn one new thing every day, our brain, the controller of our thoughts, can decide what number of new things we can learn and remember each day. The more time I spent researching literature on neuroscience, the more enthusiastic I became about how I would apply the knowledge to a specific educational context. I chose secondary education because I teach English Language Learners at an urban high school. In the upcoming school year, my students will have English as their first or even second language, but they will come firstly to me as teenagers. Hence my decision to illustrate the importance of research into brain-based learning as it applies to secondary-school students. In this paper, my goal is to discuss ways to utilize the principles to create a comfortable classroom environment and provide lessons that energize students and make them enthusiastic to learn. In my classroom, my goal is to make my students' academic journeys more relaxing and attention-grabbing, by using brain-based principles of learning as my foundation.

As an educator, it is extremely satisfying to scan a classroom and witness a sea of cheerful and motivated students, who feel safe and at ease in your presence. Unfortunately, casting your eyes in this way will not always provide the same level of reassurance. Students' brains could be prevented from absorbing information for many reasons and their education could be hindered. Individual students could be distracted, confused, disinterested, hungry, tired, angry about an insurmountable problem, or suffering from another ailment. In my role as a high-school teacher, I know that students face concerns that I hope they might share, but I also know that they could choose to conceal them. Apart from students' concerns and the anxiety that accompanies being introduced to new teachers, whose teaching styles may vary considerably, teenagers have internal workings that affect their thinking and actions.

In her article, Brain Development and Adolescent Behavior, Dr. Linda Patia Spear (2007) lists typical aspects of adolescent behavior as "changing focus of social behaviors, restorative behaviors such as eating and sleeping, cognitive alterations and affect regulation, risk taking and novelty seeking, and drug use and reward sensitivity." Dr. Spear (2007) adds that, "During the adolescent sculpting of the brain, the energy-inefficient brain of the child is eventually converted into the learner, more rapidly communicative and energy-efficient of the adult. At the same time that the brain of the developmental past is being massively pruned and sculpted into a brain suitable to meet future demands, the brain of the adolescent must also multitask to support critical adolescent behaviors and facilitate attainment of puberty and other physiological transformations of this age period" (2007). Teenagers are caught in between their youthful side and the side that must start addressing the more adult-like demands. This can create a great deal of internal stress. Research into this area has illustrated that utilizing knowledge of the functions

of the brain and how it responds to various emotions will help teachers understand the importance of having an appealing classroom setting that gets students excited about their education.

Firstly, however, I feel that it is essential to describe, in simple terms, a model of brain behavior. On the Neuroscience For Kids website, there is a very informative video explaining how the brain works. It is presented by Dr. Eric H. Chudler, who maintains the site. However, for this paper, I will use a version of the Information Processing Model from *How the Brain Learns*, by David A. Sousa, notes from *Research-Based Strategies to Ignite Student Learning*, (2006) and the article, The Neuroscience of Joyful Education (2007), by Dr. Judy Willis, a neurologist and classroom teacher, to do this. I have also included a diagram of the brain to show the position of the limbic system, which will be discussed on the next page.

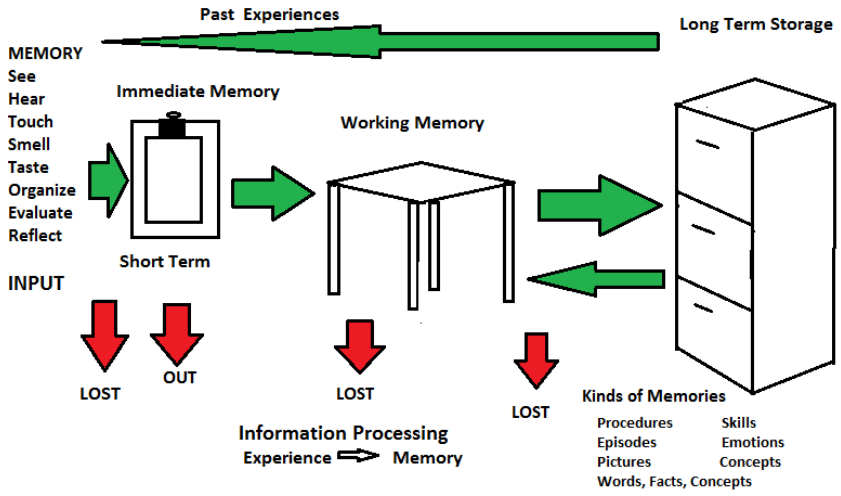
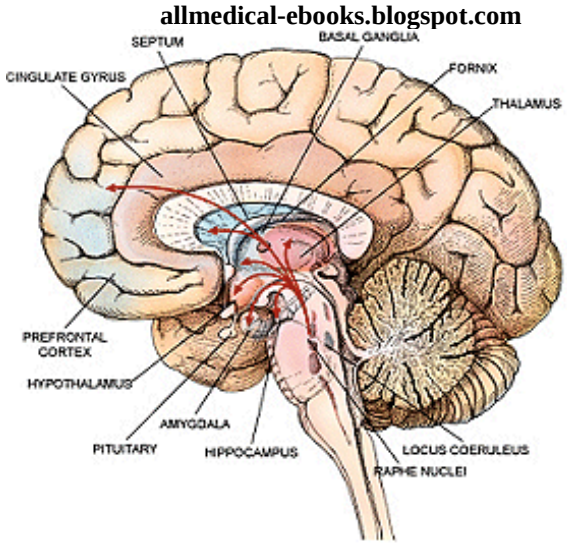


Figure 1: The Information Processing Model , representing a simplified version of how the brain responds to information from the environment.



Parts of normal human brain
Source: Washington University

The functions of the hypothalamus, hippocampus, and amygdala are discussed on the following page.

To start, any information that is learned must enter our brains through "one or more of the senses (hearing, seeing or visualizing, touching, tasting, smelling, and emotionally feeling). David A Sousa (2006) writes that our senses then either reject this information or accept it "for further processing" (p. 38.) Dr. Willis notes (2006) that the information is then decoded by the sense-specific receptors and from there it "travels through the nerves in the skin or body to the spinal cord and up through the reticular activating system to the specialized part of the brain that receives input from the particular senses." (p. 15). If this process works well, the information is carried to the limbic system, which is an important part of the brain intended for memory and learning. Sousa (2006) states that "its [the limbic system] placement between the cerebrum and the brainstem permits the interplay of emotion and reason." (p. 18). It is an educator's quest and responsibility to find meaningful ways to get material to this part of the students' brains, where long-term memories are stored.

The limbic system includes the thalamus (recipient of all incoming sensory data, except smell, and monitor of all outside information), the hypothalamus (monitor of internal systems so that a normal body state is maintained), the hippocampus (a major role player in consolidating learning and converting information from working/short-term memory into long-term memory), and the amygdala (major role player in emotions, and in particular, fear.) Sousa (2006) writes that the amygdala "regulates the individual's interactions with the environment that can affect survival" (p. 19.) Dr. Willis (2006) states that the "amygdala is a switching station (there's one on each side of the brain) in the brain's emotional-monitoring limbic system that determines if input will go to the reflective, higher cognitive brain (the prefrontal cortex) or down to the reactive, involuntary brain." Unless information can get through to the amygdala, there is little hope that it can be called upon for future reference.

Thus, from the time that the brain picks up a signal through the senses, it is making decisions about the plans for its future. Being cognizant of the brain's role in absorbing, processing, and storing information allows educators to see the value in scrutinizing the type of material they are presenting and how they are providing it so it will be more meaningful for students. Dr. Willis (2007) uses "the acronym RAD" tool as a way of making teachers aware of three vital concepts in neuroscience to consider when planning lessons. The letters R, A, and D, signify parts of the neural system that are very important for memory and learning. "Novelty promotes information transmission through the **R**eticular activating system, stress-free classrooms propel data through the **A**mygdala's affective filter, and pleasurable associations linked with learning are more likely to release more **D**opamine."

Dopamine is a neurotransmitter that "stimulates the memory centers and promotes the release of acetycholinem, which increases focused attention" (Willis, 2007). This succinct

description demonstrates why teachers must find the most advantageous ways to convey material to their students and provide lessons that captivate them in a comfortable environment. I was amused to read that Dr. Willis' (2007) wrote, "there are no neuroimaging or brain wave analysis data that demonstrate a negative effect of joy and exuberance in classrooms." This has validated my objective to continue keeping my students entertained and motivated.

Having students free of fear and anxiety when administering material and exercises can help them maximize their brain's capacity to absorb and keep information. Dr. Willis (2007) adds that, "Neuroimaging studies and measurement of brain chemical transmitters reveal that students' comfort level can influence information transmission and storage in the brain." (Thanos et al., 1999). "When students are engaged and motivated and feel minimal stress, information flows freely through the affective filter in the amygdala and they achieve higher levels of cognition, make connections, and experience "aha" moments (Willis, 2007). Such learning comes not from quiet classrooms and directed lectures, but from classrooms with an atmosphere of exuberant discovery (Kohn, 2004)."

Dr. Willis (2007) continues that this research into neuroimaging and neurochemistry supports an educational environment that does not contain stress and anxiety. (Chugani, 1998; Pawlak, Magarinos, Melchor, McEwan, & Strickland, 2003). When time in the classroom situation is "enjoyable and relevant to students' lives, interests, and experiences," "superior learning" is evident. Education theorists such as Dulay and Burt and Stephen Krashen (Dulay & Burt, 1977; Krashen, 1982) have evidenced that when strong positive feelings are present, students can retain what they learn. "Cognitive psychology studies provide clinical evidence that stress, boredom, confusion, low motivation, and anxiety can individually, and more profoundly in combination, interfere with learning (Christianson, 1992)."Brain scans and measurements of

neurotransmitters (brain chemicals) indicate that when a person is stressed, information is blocked from getting into the areas of the brain where higher cognitive memory can be consolidated and stored. The learning process is hindered or even halted because what is reaching the "higher cognitive networks" is limited in scope.

As well as providing a safe and relaxed classroom, I believe that it is an educator's role to look out for signs that students might be experiencing problems, especially during the middle-school and high-school ages when students are more likely to be exposed to harmless substances and temptations to engage in risky behavior. Some signs to look out for are changes in students' appearance and the way they are performing or behaving. In her book, *Beautiful Brain Beautiful You*, neurologist Dr. Marie Pasinski (2011) writes that the brain is in charge of all the body organs and communicates to them via hormones and "through the nerves that extend from the brain and spinal chord." Although the brain only makes up 2 percent of our body, "it uses a full 20 percent of the body's blood flow" to carry out its duties. A body makes sure that there is an adequate supply of oxygen in order to function, but when it is "out of tune," so is its brain and this affects how a person looks or functions. "Maximizing blood flow to your brain is vital to keeping your mind beautifully fit." (Pasinski, 2011, 76) If you notice that a student starts acting differently from usual, it would be a good idea to check if he or she is in need of help or advice.

Dr. Pasinksi (2011) notes that we can choose from a variety of avenues to help keep our brains healthy: do some mental or physical exercise, make healthy food choices, or sign up to take a class in something new. As an individual, I can choose whether or not to engage in any of these activities. As an educator, however, I believe that it is my duty to strengthen my students' brains and this year, I will be doing this through the use of brain-based principles in learning. I will also be starting to teach students about their brains and the importance of keeping them

healthy. The Neuroscience For Kids website posts the official Brain Awareness Week (BAW) as March 12 – 18, 2012. The site posts lesson ideas on the brain and the nervous system from a middle-school science teacher, Ms. Lynne Bleeker, and I will use and modify those notes for inclusion in my lessons.

On the following pages, I have listed and included notes on the brain/mind principles that are presented in *12 Brain/Mind Learning Principles in Action*, by Caine, Caine, Mcclintic, and Klimek (2009). In the book, the authors present a set of 12 Principles that sum up what is currently known about learning. In the table for each principle, I have highlighted some suggestions on how to engage students from Caine et al (2009) and some from my own resources. I was comforted to discover that colleagues and I have already been employing brain-based strategies. For the suggestions, I have kept high-school students in mind, but many can be applied to students in lower grades. I have included quotes and notes from various neurologists, neuroscientists, and educators that help support the merit of these principles.

1. All learning is physiological

To engage the physiological in learning:

- use various movements that facilitate memory such as music, song, or rhythm and have student choose their own (drawing, rephrasing, pair-practice …)
- use more forms of technology (iPods, cell phones, laptops, SmartBoards)
- provide activities that have students getting out of their seats
- teach your students to juggle *(This year, I am going to teach <u>all</u> of my students to juggle.)*

Dr. Marie Pasinski (2011) writes that "When we move our body and our blood starts pumping …[our] brain is … enjoying and reaping the benefits of rejuvenating blood flow. This increased blood flow physically alters that brain, bathing it in a cascade of growth factors that promote the birth of new brain cells and create stronger neural connections." Dr. Pasinski (2011) adds that the physical changes that accompany your activity allow your brain to work more efficiently and "become more resilient to disease." (p. 94)

While this "physiological" principle that Caine et al demonstrate is not specifically related to *regular* exercise, I believe that it could be linked to Principle 13 - the healthy principle, which is one of the principles that Dr. Bryan Auday (2011) developed and adapted for a "general audience who desires to apply them to an educational setting." This principle states that "regular exercise boosts cognitive performance" (Auday, 2011). This coming school year, my high school will be following a block schedule and all academic classes will be 84 minutes long. I will certainly be including physical and multisensory activities in these lessons.

2. The brain/mind is social

Some ways to engage students in social interactions:

- when implementing class rules include student discussion
- provide choices of topics for students regarding projects or writing prompts;
- have students help create guidelines for rubrics
- have students take charge of their own learning by having them set their own goals and take part in the evaluation process

"All human beings are born with a biological need to relate to others" (Diamond & Hobson, 1998). In my role as a teacher of high-school English Language Learners, social interaction with teachers and fellow students is crucial to my students' language acquisition and self-esteem. A positive inclusion in the new blocked schedule at my high school is a 30-minute advisory period, which will be held a few times each week. During this time, teachers will have 12 - 15 students whom they will advise throughout their high school year(s). They will get to know each other through various methods (discussing current affairs, having debates, role playing, playing games and so on.) Students must attend and participate in these meetings to gain a passing grade. This class will ensure that students see familiar faces and be assured of a haven to go for advice or referral if necessary.

3. The search for meaning is innate.

Some ways to engage this search:
- ask students to paraphrase their own definition of a word
- help students find ways to make their own questions and connections
- increase the range of connections between your topic and other subjects
- lengthen the time spent on a topic by introducing different genres of literature on the same topic

"Teaching the curriculum in a way that requires students of all ages to make sense of what they are learning is an indispensable aspect of creating a climate of relaxed alertness. The reciprocal benefit is that when students are relaxed and alert, their brains and bodies are more fully engaged in their learning. "(Caine, Caine, McClintic, & Klimek, 2009.) Merilee Sprenger (1999) writes that it is unnatural for us not to learn. If your students are not attentive you can be comforted knowing that the situation will not last forever. Learning will reoccur.

4. The Search for meaning occurs through patterning.

Some ways to engage this:
- model steps in a process (e.g., paragraph writing) and have students practice
- jumble the steps of a process and have students place them in order

I link this principle with Principle 12 - the organization principle, on Dr. Bryan Auday's (2011) list of brain-based learning principles in education. Dr. Auday writes that "new learning is facilitated if the information is first organized into meaningful categories." In many academic situations, patterns help guide students. For example, when writing an essay, one way of planning it is to set out your introductory paragraph so that each sentence can be used as the topic sentence for each body paragraph. While this procedure does not have to be followed for every essay, it could be a guideline for a novice essay-writer.

5. Emotions are critical to patterning

Some ways to engage these emotional connections:

- have students reflect on a real-life incident and explore various solutions
- provide opportunities for all class members to "reflect, define, and engage" in better understanding of emotions
- share and model the steps you take when solving a problem.

Dr. Willis (2006) writes that, "As they [students] develop their skills of observing, discriminating patterns and details, and making connections, they are at a higher cognitive level, which stimulates and interconnects more of the brain's memory circuitry. Eventually, new dendrite sprouts will grow and root the new information into the long-term memory storage banks." (p. 54) We know that neurons that wire together fire together. Dr. Willis (2006) adds "that powerful opportunities arise when students' responses to the emotional impact of teachable moments are supported." (p.54) Evidence of this was seen when my students and I studied a biography of Anne Frank. I have elaborated below, in principle 6.

6. The brain/mind processes parts and wholes simultaneously

Some ways to engage this:

- connect topics to a topic that preceded and one that will follow
- introduce human elements for students to see useful and important connections
- give students opportunities to examine each other's responses to units of study

When my students and I studied a biography of Anne Frank last year, many genres of literature and the media were used, including the biography, a mini-series of Anne's life, footage of Adolf Hitler's speeches and World War II, the movie Freedom Writers, and various types of speaking and writing activities. An added resource was the presentation of slides of concentration camps in Poland that my ELL 3 friend and colleague had visited on a recent unit of study there. One of my friend's aunts had been murdered in one of the children's labor camps. This personal involvement gave my students an emotional connection to the appalling war and

within this area of study they had many opportunities to consolidate material on that horrific historical period.

7. Learning involves both focused attention and peripheral perception

Some ways to engage this:
- give breaks for students' brains to rest
- provide elements of surprise and increase the use of visuals
- create classroom settings that relate to the topic being studied *(The Anne Frank unit is a good example of this.)*

Dr. Judy Willis (2007) states that, "Any pleasurable activity used as a brief break can give the amygdala a chance to cool down and the neurotransmitters time to rebuild." Learning is not going to be very productive if your brain is suffering from fatigue or angst. It needs rest to prepare itself for more work.

8. Learning always involves conscious and unconscious processes.

Some ways to engage this:
- create a drawing to illustrate key concepts or processes
- help students become aware of what they feel
- help students think about their own thinking (metacognition). Metacognition is "essential for enhancing the executive functions, all of which are strengthened as people become aware of their own behaviors, capacities, and predispositions." (Caine et al, 232)

Dr. Willis (2006) writes, "Students benefit from multiple opportunities to practice the metacognitive process of making the unconscious conscious." (p. 33) Dr. Willis (2006) adds that teachers can encourage students to become more involved by asking questions. To help find out what excites students, especially the quieter ones, it is a good idea to ask students to brainstorm answers to questions about various topics, such as: Who is a hero (who is not famous) to you? What is a special talent you have? What is something that you could teach the class to do?

9. There are at least two approaches to memory: archiving isolated facts and skills or making sense of experience.

Some ways to engage this:

- invite novelty, creativity or humor when asking students to recall facts (songs, rounds, puzzles, exaggeration, imitation, modeling, visualization)
- explore various question forms (E.g., While a student is working on a project: What is your goal? Can you explain what you did here? ..)

In my experience, students have really enjoyed the element of surprise – whether it is giving them unexpected down or entering the classroom in an elevated or depressed mood and having them predict what made you that way. This year, I will be surprising my students by teaching them all to juggle … *and they will succeed* because I have done my research!

10. Learning is developmental

Possible ways to engage and acknowledge developmental steps and shifts:

- give students opportunities to observe, test, decide, and communicate discoveries
- check an individual students' understanding of an activity while they are doing it
- have students share their methods for completing a homework or class task
- have students teach you, or even role play how you teach them.

I believe that this principle is related to Dr. Auday's Principle 9: the distributed practice principle, that states that studying material in smaller units spread out over different time periods promotes long-term retention better than massing study time altogether (e.g., cramming) (Auday, 2011). Dr. Pasinski (2011) writes that a person will learn a new skills better by practicing it in shorter time periods than in a session of one hour. "This not only maximizes your brain's learning potential but also makes more productive use of your time." (p. 33)

11. Complex learning is enhanced by challenge and inhibited by threat, helplessness, and fatigue.

Complex learning is enhanced by challenge and inhibited by threat, helplessness, and fatigue: To engage this:

- provide a positive, safe, interesting, and relaxed classroom environment
- provide activities that interest and excite students
- provide opportunities for rest
- ensure each student that he or she is a vital person in your class
- listen to students and pay attention to their moods and behavior

Alfie Kohn, lecturer and author, writes about the link between the "release of the hormones cortisone and adrenaline and the response to stress. When the stress is a manageable but stimulating challenge, rather than a threat, these hormones (released in the right quantities) result in memory improvement. It is when the cortisol is released in high amounts over substantial periods of time that it appears to result in shrinkage of the cells in the hippocampus (Kohn, 2004)."

12. Each brain is uniquely organized. *(This is the final principle.)*

- provide activities that cover all students' different learning styles and memory lanes.
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Merilee Sprenger (1999) writes that each student comes to a classroom as an individual. "No two have come to you with the same backgrounds, the same experiences, or the same desires. No two have come with the same dendritic growth, myelination, or lobe development. They have all come with the same need to learn and remember. " (p. 44) Sprenger lists the five memory lanes (semantic, episodic, procedural, automatic, and emotional) and stresses the benefits of providing activities that encompass all five lanes, so that students' varying learning styles are addressed.

Capturing the interest of every individual student is a very demanding task, but it can be assisted by being mindful of the benefits of presenting brain-tested exercises. While it is

daunting to imagine having to tailor-make a curriculum for each student, it is not difficult to learn more about what is going on inside your student's brain so that you can discard the types of activities that will cause minds to wander and embrace those that will rouse interest.

In addressing brain-based principles for this paper, I made the decision to become personally involved in the research. I incorporated some of the principles into my own life to help me work on a number of tasks, such as: complete some overdue tasks, learn to play a new favorite song on the piano, organize family outings, and devote time to my college commitments.

While trying to tackle these goals, a feeling of helplessness overcame me, even though I was on summer vacation from teaching and could devote extra time to achieving them. However, as I became more involved in the process, I started to feel more confident that I would be able to complete my work. I enlisted the following principles for assistance:

- Principle 1: All learning is physiological
- Principle 2: The brain is social
- Principle 3: The Search for Meaning is Innate
- Principle 10: Learning is Developmental
- Principle 11: Complex Learning is enhanced by challenge and inhibited by threat, helplessness, and fatigue
- Dr. Auday's Principle 9: the distributed practice principle

Any passages that I encountered about stress confirmed that anxiety hinders education and an enriched environment enhances it. I fueled my brain with colorful fruit (Pasinski, 2011) and protein, took breaks from tasks, made sure that I did not ignore my family responsibilities, started planning my college commitments, and calmly came to the decision that my targets *would* be met. Looking after my body and lessening my stress made me consider how vital it is to do the same for my students.

In my years of teaching in Australia, the United Kingdom, and the United States, I have met many teenagers and adults who have understood and been able to apply what they have learned to academic and personal situations. However, I have also encountered struggling students who have appeared complacent and uninterested. During each teaching year, I have been fortunate to have taken courses, read literature, participated in conversations, and been exposed to vital material that has helped improve my classroom performance. This year, learning about the brain in more depth has given me valuable information to apply to my lessons and my daily life. Acting on the saying, "Use it [your brain] or lose it" has certainly helped me make advances.

My research has shown me that the brain goes through the process of neuroplasticity, meaning that it is continually reorganizing itself based on what information is going into it. This procedure continues throughout a person's life, but it moves extremely quickly during the early years. David A. Sousa (2006) writes, "…the experiences that a young brain has in the home and at school help shape the neural circuits that will determine how and what that brain learns in school and later."(p. 5) It is therefore very important for educators to ask themselves what they are delivering to students' minds and how they are delivering it.

In the article, "Writing and the Brain: Neuroscience Shows the Pathways to Learning," published in National Writing Project, May 3, 2011, Dr. Judy Willis states that teachers should build on their professional skills by "incorporating strategies confirmed as beneficial through neuroimaging of the brain during the process of learning." Modifications can be made as they meet students with different needs, skills, learning styles, personalities, and moods. Awareness of the internal changes that occur in all teenage bodies and taking time to recall some of the things that motivated them when they were students will also help. Improvements in how

teachers set up and maintain a classroom that challenges students, no matter what the topic, can be nothing but encouraging.

What students' brains absorb, process, and choose to store depends on a number of factors, such as how the information is presented, the type of environment in which it is taught, and students' emotions at the time of instruction. Our brains control our thoughts and responses to new and previously learned information, so they must be helped to function at their best. Ensuring that students maintain healthy brains and incorporating brain-based principles of learning into education are ways for educators to work towards the creation of a classroom of energized and eager students.

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(Dr. Marie Pasinski, Bust a Myth Boost Your Brain, posted 5/22/11

http://www.nwp.org/cs/public/print/resource/3555

(article in National Writing Project, on Dr. Judy Willis)

http://www.uwtv.org/video/player.aspx?dwrid=4909

(www.neuroscienceforkids.org: video of the brain and its parts and functions, presented by Dr. Eric H. Chudler, Research Associate Professor, University of Washington, Department of Bioengineering)