HOW THE BRAIN LEARNS

During the first few weeks of the semester we will have lessons regarding the brain and how it learns interspersed with the regular lessons. Why? …you may ask, because one of the goals of this math class is to improve your study skills to help you with your future math courses and other college courses and understanding how your brain works will be one way to accomplish that.

Understanding how the brain learns will help you understand the reasoning behind the study cycle that is used in this class and how each step in the cycle is essential.

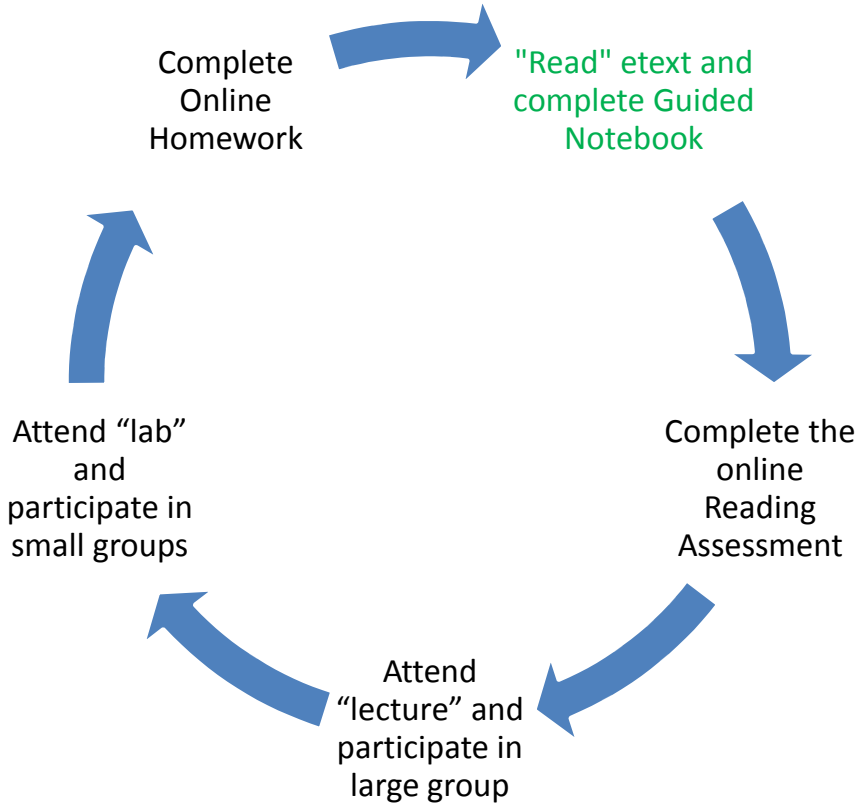

Figure 1: Study Cycle

This will lead to improving your metacognition skills, which are the skills for you to diagnose what, or if you have learned the content.

These lessons are not just busy work. Understanding why you are doing something and how it is helping you learn can be a key to your success. It is all tied together with the course in the effort to make you the best student you can be and a successful student.

The lessons will consist of information from resources for you to read followed by activities or questions for you to complete. So, let's get started with the first lesson.

How the Brain Learns: Lesson 1 Neurons

Objective: Upon completing this lesson, you will be able to identify the parts of the neuron and their function(s).

The brain is composed of a trillion cells of at least two known types, nerve cells (***neurons***) and ***glial cells***. Neurons represent about 10% of the total – roughly 100 billion. Glial cells hold the neurons together and act as filters to keep harmful substances out of the neurons. Each brain neuron is about one hundredth of the size of the period at the end of this sentence. (Sousa, 2011)

Even though most of the neurons where information is stored are present at birth, there is lifelong growth of the support and connecting cells that enrich the communication between neurons. ***Dendrites*** are treelike extensions (dendrite actually comes from the Greek word meaning tree-like) that protrude from a neuron and receive information from other neurons and transmit information to other neurons along axons. The dendrites receive electrical impulses from other neurons and transmit them along a long fiber, the ***axon***. Each neuron can have up to 10,000 branches, dendrites, emerging from its core but only one axon.

New dendrites grow as branches from frequently activated neurons. Once these dendrites are formed, the brain's ***plasticity*** allows it to reshape and reorganize the networks of dendrite-neuron connections in response to increased or decreased use of these pathways.

Axons are surrounded with a fatty layer of tissue called the ***myelin sheath*** which helps speed up the neural impulses between neuron. The sheath insulates the axon from the other cells and increases the speed of impulse transmission. It makes up what is called the "white matter" in our brains. Practice thickens the myelin sheath by requiring repetition of the same impulses again and again. Both quantity (repetition) and quality (correctness) of practice is important to myelinate axons.

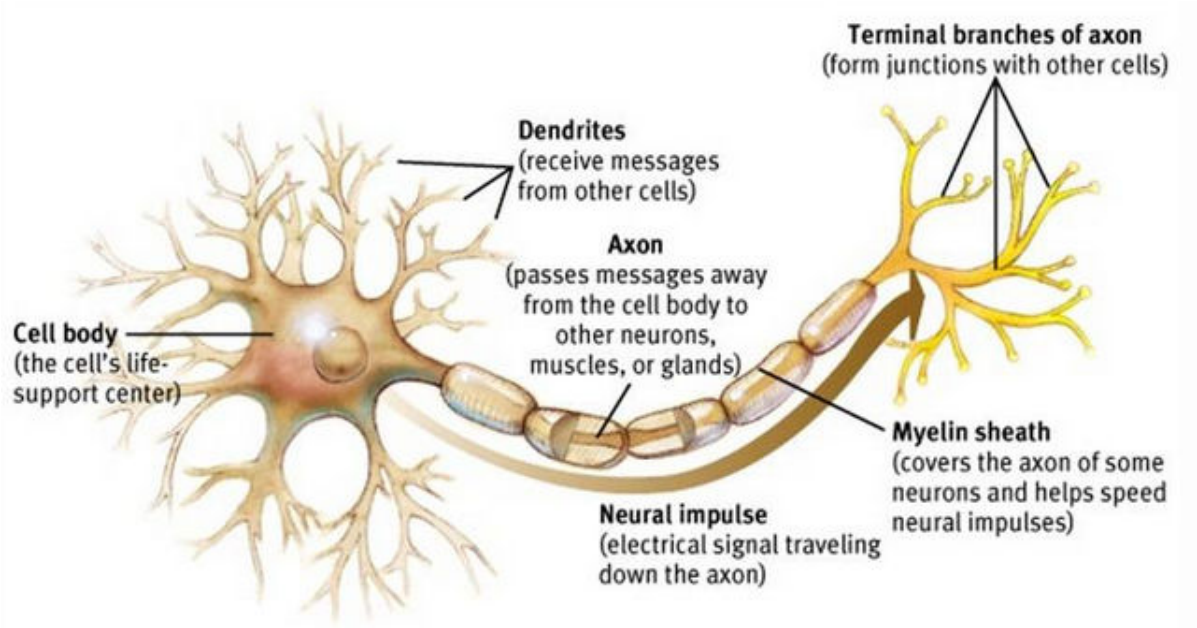

Figure 2: Neuron http://www.appsychology.com/Book/Biological/neuroscience.htm

How do we get myelin onto our nerve axons? Use the neuron again and again or in one word… practice. Practice, in a variety of formats, helps fatten up the myelin sheath, which strengthens the connections between neurons in different area of our brain and helps those neurons perform in unison. Practice also helps grow and thicken the dendrites.

Impulses are sent between neurons from the axon's terminal buttons by shooting ***neurotransmitters*** across the ***synapse***. A synapse is a little space between neurons because neurons do not touch each other. Neurotransmitters are brain chemicals like dopamine, amino acids serotonin, and tryptophan carry information across the space separating the axon extensions of one neuron, from the dendrite that leads to the next neuron on the pathway. There are also neurotransmitters that may inhibit signals to be passed between cells.

Syn-naps is a word play on synapse to remind us that there needs to be a brain rest when the neurotransmitter can be restored to be available to release the next message. When neurotransmitters are depleted by too much information traveling through a nerve circuit without a break, the speed of transmission along the nerve slows down to a less efficient level. When this happens, information processing takes longer. (Willis, 2006)

While learning does not increase the number of brain cells, it does increase their size, their dendrites, and their ability to form more complex networks. The brain goes through physical and chemical changes each time it learns. (Sousa, How the Brain Learns, 2011)

Forming and strengthening the connections between the neurons in our brain is the foundation of learning. The next brain lesson will introduce other concepts to help you understand and take charge of your learning process.

National Research Council. (2000). *How People Learn: Brain, Mind, Experience and School.* Washington, D.C.: National Academy Press.

Neuroscience. (n.d.). Retrieved October 25, 2014, from appsychology.com: http://www.appsychology.com/Book/Biological/neuroscience.htm

Sousa, D. (2011). *How the Brain Learns.* Thousand Oaks: Corwin, A SAGE Company.

Willis, J. (2006). *Research-Based Strategies to Ignite Student Learning: Insights from a Neurologis and Classroom Teacher.* Alexandria: Association for Supervision and Cirriculum Development (ASCD).

1. Sketch the neuron and label the key parts as shown in Figure 2.

2. Define the following terms and their function if they have one.
   a. neuron
   b. glial cells
   c. dendrite
   d. axon
   e. plasticity
   f. neurotransmitter
   g. synapse
   h. myelin sheath

3. Explain what is physically happening in your brain when you practice.