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Memory Boot Camp

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Rationale

If I could improve one thing about myself, it would be my memory. So when I started teaching Gifted and Talented students, I took the TCS/2 Test of Cognitive Skills to see what my students were expected to know, remember, or reason. It was no surprise to me that my lowest score was Memory. This helped explain why I couldn't remember phone numbers and why I was writing everything down so as not to forget. I assumed my students couldn't remember phone numbers either, because all their numbers were logged into their cell phones.

As I began researching about memory, I found that our memory problems were not unique. Ninety-four percent of the students where I teach receive free or reduced lunch, indicating low income or poverty. Are memory problems related to poverty? According to a recent study published by the Proceedings of the National Academy of Sciences, it is. A study led by Gary Evans of Cornell University found that the longer children lived in poverty, the lower their scores for working memory. Previously, low achievement was attributed to such factors as genetics or environmental factors, such as lead paint. In contrast, this fourteen year study found that chronic stress from poverty has a direct relationship to working memory. "Those who spent their entire childhood in poverty scored about 20% lower on working memory than those who were never poor", according to Evans. [1] After reading this article, the focus for my unit became clear. I address how to improve the short-term (immediate and working) and long-term memory of my students, by providing them with strategies, and by attempting to relieve some daily stressors through a boot camp format that incorporates exercise, a known stress reliever.

It seemed an oxymoron that my gifted students could have poor memories. In order to be smart, don't students need good memories? I had assumed so, incorrectly. I came to find out that the skill of retrieval of memory is independent of intelligence. One may be intelligent, even gifted, but have slow retrieval of memory. Retrieval is the process of retrieving a fact or concept from long-term memory and sending it back to working memory. Retrieval times vary among individuals because of how information is stored. Jensen uses the analogy of an auto parts store. [2] The brain has all the components to make a memory, like an auto parts store has components to make a car. During retrieval, these parts need to be found and assembled to create a memory. If the working memory is not performing optimally (for example, because of stress), then it would follow that a student could be intellectually gifted, but have retrieval issues.

Students have been categorized according to their ability to learn and retrieve. A genius is fast at learning and retrieval. An underachiever is a fast learner who has slow retrieval. An overachiever is a slow learner who has fast retrieval. A person with slow learning and slow retrieving is labeled as a slow learner. [3] Unfortunately, memory labels incorrectly assume that learning and retrieval are fixed for an individual over a lifetime. But, retrieval "is a learned skill, it can be taught." [4] This unit's goal is to help students increase their retrieval rate, and recognize that stress may adversely affect it.

Historically, memorization has been valued as a sign of intelligence. The smartest people were those with the best memories. There is a historical reason for this: before written records or books, an education had to be memorized. Significant religious documents such as the Koran had to be memorized by Muslims, the Torah by Jews, and the Bible by Christians. "Peter of Ravenna, a noted Italian jurist and author of a renowned memory textbook in the 15 th century, was said to have used the Logi method to memorize the Bible, the entire legal cannon, 200 of Cicero's speeches and 1000 verses of Ovid." [5]

In the first half of the twentieth century, students were expected to memorize long documents, such as the Gettysburg address; students were asked to recite poems and speeches by heart. These educational practices have changed. Students now have many devices to record thoughts that are used to avoid memorizing: i.e. programming cell phone numbers. Memory is not considered essential. The phrase "use or lose it" suddenly has more implications. "Use it or lose it" is a real concept that memory research is currently studying. This concept questions whether memory is lost, if not used. Students are not utilizing their memories, so they are losing them. However, students are also expected to recall individual facts for Standards State Test. Being the sympathetic teacher that I am, I would sometimes excuse my students if they forgot something, attributing it to the gifted geeky attribute, but NO MORE! The goal for me and my students in this unit is to find ways to improve all forms of memory. Our goal is to define whether we want something to be an immediate, working, or long-term memory, and use the strategies necessary to make it happen. For me, it will be a personal goal in an attempt to lead a healthy brain life in my later years and stave off such diseases as Alzheimer's. For my students, the goal is to improve memory for academic success. When students see their teacher participating in the same exercises, it might make them see the connection between memory for school and memory as an important factor in life-long learning.

Objective

My students have no problem remembering inconsequential things like what someone wore last week, or what I said verbatim, so I know their memory works. What they seem to need help remembering is factual content. I intend to teach my students ways to solve this problem. They will be drafted into Memory Boot Camp. This intense program will use physical activity and a simulation of being in the military service to help them improve their memory. At the conclusion of this unit, students will understand that their long-term memory is unlimited. To remember something, they have to want to remember it, to value the information. Students will be able to quantify how their short term memory has improves with practice, practice, practice. Students will be able to describe how memory works in the brain. They will be able to answer: What is memory? How does the brain store memories? Where is memory located? What are the types or pathways of memory? What are the stages of memory? Why do we remember certain events and not others? After completion of this unit, students will be able to determine, when given a memory task, whether they need this information short-term

or long-term and devise a strategy to achieve the desired outcome. All the information and activities they participate in will be recorded in a portfolio. This portfolio will be the evaluation tool indicating if they have improved their memory.

Background Information

What makes a memory?

Memory is a process: "the creation of a persistent change in the brain by a transient stimulus." [6] In other words, a change happens in the brain because of some stimulus. How does it relate to learning? Learning is "acquiring new knowledge and skills", whereas; memory is to "retain knowledge and skills for the future." [7] Memory is what makes you who you are. Without it, all background knowledge would cease and your past would be a vacuum: no prior history, no family memories, just a void. We draw upon memories to make daily decisions. Memories are the building blocks of our education. Facts are retained in memory, but also problem solving skills, thinking patterns, and ways to do things physically, like walk or skip. Memory is what we remember and how much we can or do remember. It is our capacity to remember.

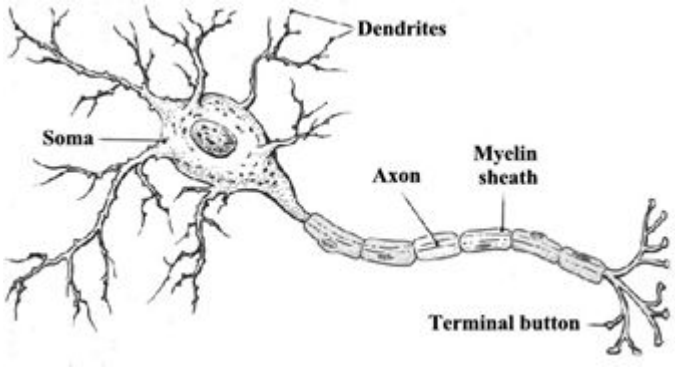
As an introduction to this unit, in the first lesson, students will be asked to:

1. Tell what they had for dinner last night (working)
2. Tell what they had for dinner last Saturday night. (working)
3. Tell what they had for dinner the Saturday before last. (probably forgotten)
4. Describe their earliest memory?
5. Describe what is their best memory?
6. Tell what the scariest memory is that they can recall?
7. Convey if they have ever had a sibling disagreed over a memory in the past?
8. Hypothesize if memories are subject to change?
9. Define memory.
10. Compare memory to learning

The purpose of these exercises is for student to conclude that memory is selective. People remember some things, but not others. Important memories, with emotional significance, are more likely to be remembered. Also, memories are subject to change over time. Often, when my sister and I discuss a childhood event, we will differ over to whom it happened. Learning is what we know, memory is what we recall.

How does Memory work?

"The brain goes through physical and chemical changes each time it learns." [8] During the second week, we will discuss how memory works. The basic component of memory is the neuron (gray matter), a nerve cell which transmits electrical impulses, at speeds up to 260 mph, throughout the body. Neurons contain "encoded genetic information that controls cell and energy producing equipment." [9] Our three pound brain has approximately 100 billion neurons. Each neuron is unique. Some may be up to three feet long and/or may last a lifetime. The components of a neuron are the cell body, the dendrites, and the axon (Figure 1). The dendrites receive and collect information or stimulus from other cells.



Like most other cells, the neuron's cell body is composed mostly of cytoplasm, includes a nucleus, and is surrounded by a cell membrane. The cytoplasm, which is largely water, contains less sodium than outside the cell; and the cytoplasm contains more potassium than outside. Diffusion of these ions creates an electrical charge across the membrane. At rest, a positive electrical charge is found outside the cell membrane, whereas the inside of the cell has a negative charge. This is known as resting potential. When a stimulus, for example, light or pressure, hits a neuron, "the stimulus opens gate-like pores in the membrane, allowing positively charged particles to rush into the cell and the negatively charged particles rush out." [10] This rapid exchange caused by the movement of charge particles, leads to an electrical event called an action potential.

Action potential provides a mechanism for sending information from region to region of a cell. When the axon hillock (the junctional region between the axon and cell body) becomes sufficiently stimulated, it generates the first action potential carrying an electrical charge to the axon. The axon ends at the synapse which is the physical site of connection with another neuron. The synapse determines whether a message is sent. Scientist believes this is where memory, as well as learning, occurs. [11] Here, neurotransmitters are sent to another cell. The axon of one neuron sends messages to the dendrite of another by the synaptic connection (Figure 2).

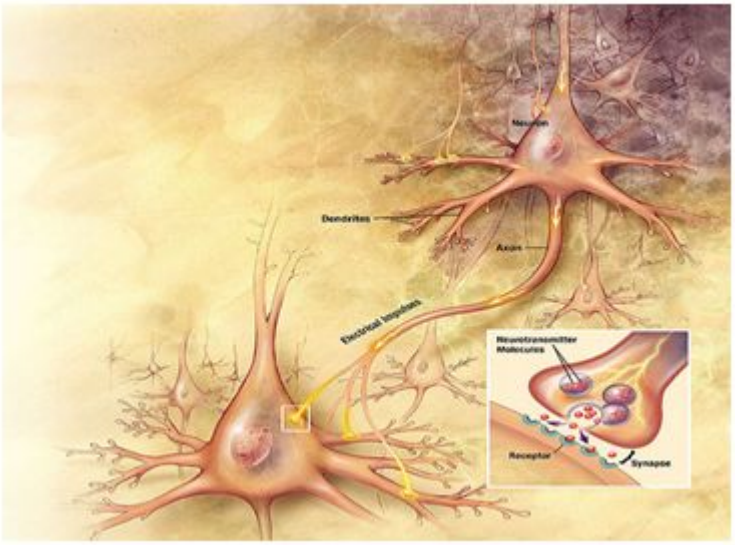


Figure 2: Illustrates how neurons are connected. The inset diagram shows the release of neurotransmitters in the synaptic connection, which is how messages are sent.

The senses receive information. Senses take in information, and electrochemical circuits form between neurons. These connections result in stored memories. Each day billions of pieces of information enter students' heads through the various senses. After being filtered, some of this information is lost and others

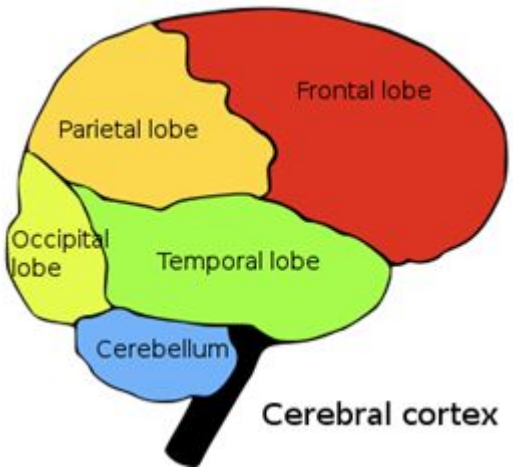
are sent to different parts of the brain for processing. "What we call memory is the process by which the brain retains learned experiences over time through these physical, hardwired synapse connections." [12]

Where is memory located?

Scientists now know that memory is not found in any one location. Higher level memory is found throughout the brain in the neurons of the cerebral cortex. This area is responsible for higher level thinking and emotions. By using functional brain imaging, which is comprised of techniques such as single photon emission, computed tomography (SPECT), positron emission tomography (PET), and functional magnetic resonance imaging (fMRI), researchers can now observe which parts of the brain are being used for different tasks. [13] The brain "breaks down a memory into informational components and routes each type of information to the area of the brain that is specialized for processing it." [14] This is why retrieval varies among individuals. Information is stored differently, and cataloged according to past experiences.

Before this imaging technology, scientists gathered information about memory by experiments and from their patients. In 1953, for example, an epileptic patient had his hippocampus removed in an effort to stop seizures. After the operation, he could not form any new memories, but could remember the past. A patient in 2001 had a viral infection that destroyed the hippocampus. The patient could not make new memories, but knew hometown classmates, and the way around town. These two patients made it clear that the hippocampus is responsible for creation of new memories.

For the third week of our study, students will learn about where in the brain memory is located. The cerebral cortex, the outermost layer of the brain is divided into two hemispheres. Each hemisphere has four lobes: frontal, occipital, parietal, and temporal. The exterior of the brain will be examined first (Figure 3). The frontal lobes are responsible for thinking and working memory. The temporal lobes process sounds, speech, and long-term memories like words, symbols, and stories. The occipital lobe processes seeing, or vision. The parietal lobe deals with recognition, calculations, and orientation, as well as working memory. The cerebellum, which is about the size of a lemon, is responsible for motor skills, procedural memory, and reflexive and conditioned responses.



The more interior regions of the brain include the brain stem and the limbic system. The brain stem is the size of a pinky finger and deals with functions basic to life, such as breathing and rate of heartbeat. Above the brain stem is the limbic system, which is comprised of the thalamus, the horseshoe shaped hippocampus, and the amygdala. The thalamus processes incoming sensory information. The hippocampus consolidates learning and is responsible for working and episodic memory. The amygdala processes emotion or fear. The focus of

this part of our study is for the students to appreciate that different brain regions are involved in different functions and that memories are not located in any one area.

Although it appears to be straightforward where memory is located, this is not necessarily the case. Before modern technology was available, in a 1920 study, a scientist experimented to determine where memory was located. He removed different brain parts from rats. He assumed that when the correct part was removed the rat would no longer be able to navigate the maze. After systematically removing the different parts of the brain thought to be associated with memory, each rat was still able to do the task. This study proved that memory is not isolated in any one location.

How, if certain areas affect memory, can this happen? The answer is plasticity. Plasticity is the process of how our brains adapt to new situations. By brain mapping, scientist can locate different areas of the brain that control different parts of the body. In plasticity, the neurological assignments of the brain can change to enable parts identified to control one task to control another. MRI and other imaging techniques have been used to map the brain. Some people were found to have brain areas that were more developed than usual, and this correlated with their jobs, interest or disabilities. A New York cab driver had great spatial orientation, in order to find his way around town, so that part of his brain was well-developed. A violinist has a developed brain area that allows for small muscle coordination and finger movement. "The capacity of the brain to change with learning is plasticity." [15] By brain mapping, scientists can locate different areas of the brain that control different parts of the body. When plasticity occurs the neurological assignments for learning can change to other areas of the brain. Plasticity helps explain how stroke victims can learn and function even with certain areas of their brain are permanently impaired.

Memory Pathways

There are two kinds of memory: declarative (explicit) and nondeclarative (implicit). Declarative is the "conscious recall of facts and events". [16] It may be short-term or long-term memory. Declarative memory takes time to develop. For this reason, people usually do not remember events before the age of three. [17] Declarative memory is subjected to age and disease. It stores facts in the hippocampus and the cortex. Two components of declarative memory are semantic, which comprises of learned facts, and episodic, which refers to episodes or story experiences from life. Semantic memory deals with facts, such as names, where you keep your keys, and who wrote the Gettysburg's address. One does not often recall when or how the fact was learned, and the facts or events may be forgotten. "Our semantic retrieval process is affected by 'when' as much as by 'what' is learned. Studies indicate small efficiency increases when we recall details and text learned in the morning and relationships in the afternoon." [18] Episodic memory refers to a certain episode in your life. One's first date, or what was done yesterday. It contains one or more of the following: who, what, when, where, and how an event was experienced.

Nondeclarative or implicit memory deals with skills, habits, and reactions to conscious thought. [19] It may be procedural, conditioning, or priming. Procedural refers to learned skills and habits, such as how to do something, like swimming. Scientists believe this type of memory it is not affected by age because these memories are stored in several areas of the brain, not just the hippocampus, which can suffer with age. Another type of implicit memory, conditioning, is what one is trained to do, like waking up the same time each day or being hungry when the clock reads noon, lunchtime. It is learned information that triggers an automatic response. Priming, the third type of implicit memory, is the ability to recognize more quickly, a stimulus that has been previously presently. Multiple choice tests are popular among teachers and students. Priming is one reason for this; it allows the student to recognize what has been previously presented.

Types of Memory

Memory are either short-term, including immediate and working, or long-term. Immediate memory lasts from 5-20 seconds. An example is remembering a phone number for the short time it takes to dial. After this period, it is either sent to working or is discarded. Working memory lasts from a few hours to several days. When a student memorizes facts for a test, they are employing working memory. Both of these types of memory are limited: only so much can be remembered. When facts or events are reviewed, they may become long-term memory. When someone describes past events, or who they are, they are sharing long-term memories. These memories have an unlimited capacity. A long-term memory is one that is contained in strong synapse connections. Both types of memory, short-term, including working, and long-term decrease with age from the 20's until the 80's. The only thing that improves is verbal knowledge. [20] "The process of forming a memory changes the way existing neurons connect and communicate with each other. Short term memory involves temporary changes in neurons' electrical activity and the chemicals they exchange through their synapses". [21] Animal studies suggest that when one forgets, "weakening of the synapses between cells" may be responsible. [22] Short term memory involves temporary changes in neurons' electrical activity and the chemicals they exchange through their synapse.

For a long-term memory to form, these two changes MUST HAPPEN:

1. Nerve cells extend their axons, allowing for more connections to other cells.
2. Cells increase the release of neurotransmitters through the synapses, increasing "the power of each connection". [23]

Through these changes, memory is made. The more memories, the more connections are made, hence the term of the brain being wired or in the case of plasticity, rewired.

During REM sleep, studies have shown that short-term memories can become long-term. The phrase "sleep on it" actually HAS VALIDITY.

Stages of Memory

There are three stages of memory: Receive, Review and Retrieve. Information is received through our senses in the thalamus, which is part of the limbic system. The hippocampus then consolidates this information. The second stage is review, which is when a memory enters working memory. It connects new information to past experiences. In this stage, techniques such as elaboration, summarizing, or think, pair, share must be used. If not, the memory will be forgotten. The third stage is retrieve, which is when information is remembered. Retrieval is the process of bringing long-term memory back to working memory. An analogy for this is when a sled goes downhill. The more time it goes in the same path or the more times a memory has been reviewed, the deeper the rut in the snow; in this case, the rut corresponds to a long-term memory. If a memory is not used, even long-term memories can be forgotten.

The types and stages of memory will be the topic for the fourth week of this unit. As an application for the stages, students will develop a board game under the pretense of being recruited for military service. "Receive" will be when a recruit goes through processing and basic training. "Review" will be when one gets their orders to go wherever. "Retrieve" is when they are sent back home or to another station. By designing and playing this game, students will reinforce the stages and the type of memory being used.

Future Implications

Although much has been learned using experimentation and technology about how memory works in the brain, there are still many unanswered questions. What will be the answers for amnesia, or Alzheimer's? Scientists have already been working on a drug that enhances memory. Cortex Pharmaceuticals is experimenting with "a class of molecules, known as ampakines, which facilitates the transmission of the neurotransmitter glutamate. Glutamate is one of the primary excitatory chemicals passed across the synapse between neurons." [24] By facilitating the action of this neurotransmitter, it is hoped a way to increase the brains ability to make and retrieve memories will be found.

Students will be asked to predict the future: how will new research findings on memory change the way they live. I personally want to see memory implants, and memory pills, so I can just take a pill to promote recall, or have knowledge put in my head. Not only could facts be implanted but also skills, such as how to fly a plane. I could have a GPS system implanted in my head, so I could remember where places were and not get lost. My students will pretend to be research scientists and write about their latest discovery and what implementation these discoveries will make. Through these predictions, I hope to let their creativity and imagination run wild and, just perhaps, plant a seed of interest as future scientist.

Strategies for Teaching

Memory Boot Camp, (MBC), is about to begin. As the class goes through basic training, we will be dressed in camouflage. At each class onset, we will sing as we march our newly created chant to get us motivated. Hopefully, I will be able to invite someone from the military or from the district's military high school to help me with this. After roll call and marching at each class' onset, my students will take a rote memory drill test as the first exercise. Results will be graphed daily. The second part of the lesson will be daily instruction on the brain. The third part will be one of the other strategies described below to promote memory.

Rote Memory Drills (See activity #1 for detailed descriptions.)

First Drill-The first rote memory test will be a list of four words, then five words, then six, and so on until a student misses a word. Once a word is missed, that student is eliminated. The winner of this drill will be our Drill Captain.

Second Drill - In this rote memory drill, students will construct memory wheels. These will be drills of ten words that students will try to remember in one minute time. Exchanging wheels, this drill will be done twice during each class for two weeks. The captain will run the drill.

Third Drill- Students will remember a list of ten numbers. This drill is will be done for two weeks before and after the chunking strategy is taught.

Loci Technique

This strategy uses spatial visualization to facilitate memory. An example is going on an imaginary journey to the grocery store, and going down the aisles, to remember what is on a grocery list. For our study, after the simulation on how neurons work, students will be asked to pretend they are a neuron on a journey. They will

be asked to close their eyes and imagine they are traveling through the senses. First, they will encounter the dendrite, and travel to the cell body. Here they will bump against the cell membrane in an effort to enter the cell body. They will punch in the air to represent the exchange of charges. Then punching all the way, they will travel to the synapse. At the synapse, they will leap across into another neuron's space (another student's space). This method will be shared during the second week, when neurons are explained.

Beginning, Middle, End (BEM)

Students will take their wheel data from drill #2 and record it on the data chart. They will shade in the number of each item they missed. For example, if a student missed 4, 5, and 6, they would shade in those numbers. Usually students remember what is at the beginning, first, the end, second, and what is in the middle, last. It will be interesting to compile the data and see if the results are consistent.

Chunking

As students age, their rote memory improves. A three year old child may only be able to complete one chuck: for example, pick up your toy. A five year old child usually can perform two chunks: like pick up your toy and put it in the box. A seven year old child remembers three chunks: pick up your toy, put it in the box, and close the lid. By the time the child is fifteen, they should be able to remember seven chunks, like a phone number. One way to increase memory is to group information into bigger chunks. Students will be given ten numbers, let's say for example 4856983073. With chunking students will group them: 485 698 3073. Now they need to remember only three chunks, not ten. During the fourth week, this strategy will be shared. It will be interesting to compare the results before and after this strategy is presented.

Acronyms

This strategy takes the first letter in a series to be remembered and makes a new word: for example, the program I teach is called SPACE. This is an acronym standing for Special Programs for Academic and Creative Excellence. Students will be asked to create an acronym for the exterior and interior parts of the brain.

Mnemonics

This technique makes a rhyme to remember an important fact. An example is:

Columbus sailed the ocean blue, in 14 hundred 92. Students will make up a rhyme for explicit and implicit memory.

Another technique is reduction mnemonics:

Please Excuse My Dear Aunt Sally

(Parenthesis, Exponents, Multiplication, Division, Addition, Subtraction)

Action Picture

With this technique students create a visual image, or action picture using information they want to remember. Students will try this technique with words in memory drill #1.

Mind Mapping

In this technique graphic organizers may be used to review and enhance memory.

This strategy will be used for the types and stages of memory.

Cramming

In this familiar technique, repetition is used to facilitate working memory. Material is reviewed over and over to get information into short term memory.

Link and Peg

Students link information to something already known or easy to recall. An example would be to link something familiar to remember someone's name. When I met Vivie, I thought: she is vivacious. This association helped me to remember her name.

Think, Pair, Share

Students think about a question, or what is to be remembered. Next, they compare their answers with a classmate's, and then share the results with the class. This technique is helpful when reviewing concepts or muti-step questions. We will practice this strategy when the students predict how memory will change in the future.

Kids Survey

When asked what techniques worked for students, these strategies were suggested by students. [25] Some of the examples of student suggested techniques are:

1. write it down
2. put it on a calendar
3. keep a notepad beside the bed
4. read aloud
5. mnemonics
6. acronyms
7. Loci

At the end of our study, each student will compile their own list in their portfolio.

Elaboration Rehearsal Strategy

This strategy concerns the timing of reviewing information. Information should be reviewed ten minutes after learning it, again twenty four hours later, and then again seven days later to retain in long-term memory. Some strategies to review information in order to send it to long-term memory are: [26]

1. paraphrasing
2. note taking
3. predicting
4. questioning

5. summarizing

Implication for teachers/students

In a forty minute lesson, after the first twenty minutes, students have a period down time. This down time lasts for about eight minutes. During this time student's ability to retain decreases. After the down time, then retention increases. Teachers should present first, during students' prime time, new information. They should not review or do administrative tasks. The beginning of class is optimal learning time. Closure or review should be at the end of a lesson; this allows for repetition, rehearsal, reinforcement, helping it become a long-term memory. Practice should occur during the middle or during down time. In a block schedule with longer classes, the down time increases. For an eighty minute block the first twenty minutes are prime time, then from about 22-57 minutes, down time occurs. The remaining 58- 80 minutes is second segment of prime time, called prime time 2. During prime time 2, while an effective time to learn is not as optimal as the first prime time. To decrease down time and increase memory, learning should be segmented with breaks: instead of one 90 minute lesson, have three thirty minute ones. The working memory can only take in a fixed amount at a time. [27]

Multi-tasking

The brain cannot multitask efficiently if one of the tasks is conceptual. According to MRI testing, the brain "bottlenecks" the processing of tasks. [28] When multi-processing, the brain is actually switching from one task to another, making it an ineffective way to get things done. It simply does not work. [29] Try this activity. After removing the face cards flash twenty playing cards one at a time, for a brief period. Have students add the black ones and subtract the red ones mentally, then write the answer down. Time the activity. Next recite twenty letters. Ask students to mentally count the number of vowels, and record the results. Have students add the answer together for both exercises. For the third exercise have students find the answer for the playing cards, but interjecting different alphabets. It should take longer to complete and the results should be less accurate. [30]

Annotated Bibliography

Abate, Charles. "You Say Multitasking Like it's a Good Thing." neatoday, Mar. - Apr. 2009. First published in Fall 2008, NEA Higher Education Journal, Thought & Action. This article explains how neurologically multi-tasking is improbable, if not impossible. This book is informative and clearly written.

Barrett, Susan L.. It's All in Your Head: A Guide to Understanding Your Brain and Boosting Your Brain Power. Minneapolis, Minnesota : Free Spirit Publishing, 1992. A children's book that helps to explain, using simple text and illustrations, how the brain works.

Beal, M. Flint, Floyd E. Bloom, and David J. Kupfer. The Dana Guide to Brain Health. New York City: Dana Press, 2006. This is a general reference book, written so it is easy to understand the complexities of the brain.

Foer, Joshua. "Remember This: In the Archives of the Brain, Our Lives Linger or Disappear." National Geographic, November 2007. This is an excellent article giving several personal histories of people with memory issues.

Funston, Sylvia, and Jay Ingram. It's All in Your Head: A Guide to Your Brilliant Brain. Toronto, Ontario: Maple Tree Press, 2005. This is

an easy to read children's book with different, fun activities.

Hoiland, Erin. "Brain Plasticity: What Is It/ Learning and Memory." Neuroscience for Kids -Brain Plasticity. Neuroscience for Kids -Brain Plasticity.htm (accessed June 9, 2009). An explanation of what plasticity is.

Jensen, Eric. Teaching with the Brain in Mind. Alexandria: Ascd, 1998.

This is an outstanding book with clear explanations and teaching strategies.

Kincher, Jonni. Psychology for Kids, 40 Fun Tests That Help You Learn About Yourself. Minneapolis, Minnesota : Free Spirit Publishing, 1995.

This book has fun test for students to learn more about themselves.

McCleary, Larry. The Brain Trust Program: A Scientifically Based Three-Part Plan to Improve Memory. Chicago: Perigee Trade 9/4/, 2007.

This book has a great program to help improve memory, including numerous

drills.

Nelson, Aaron. Harvard Medical School Guide to Achieving Optimal Memory (Harvard Medical School Guides). New York: McGraw-Hill, 2005.

This book is an excellent resource that explains memory in detail.

Nickelsen, Leann. Memorizing Strategies and Other Brain-Based Activities That Help Kids Learn, Review, and Recall. New York: Scholastic, 2004.

This book describes strategies that promote memory. It compares the stages of

memory to a parking lot.

Sousa, David A.. How the Brain Learns. Thousand Oaks, CA: Corwin Press, 2001.

This book is a great resource. It is clearly written giving strategies to promote

memory.

"The Human Brain." Teacher Professional Development and Teacher Resources by Annenberg Media. http://www.learner.org/discoveringpsychology/brain/brain_flash.html (accessed July 8, 2009). This website has helpful diagrams of the brain.

Washington Post. "Study Links Stress, Poor Memory of Children in Poverty." Richmond Times-Dispatch, April 7, 2009. This is an informative article that hypothesizes the reason why memory is poorer in at risk students.

Wood, Pam Walker & Elaine. Understanding the Human Body - The Brain and Nervous System (Understanding the Human Body). Farmington Hills, MI: Lucent Books, 2003. This is a children's book that is helpful in explaining how the brain works.

Notes

[1] Washington Post. "Study Links Stress, Poor Memory of Children in Poverty." in Richmond Times- Dispatch, A5.

[2] E. Jensen, "Teaching with the Brain in Mind", 102

[3] D. Sousa, "How the Brain Works", 108.

[4] D. Sousa, "How the Brain Works", 108.

[5] J. Foer, "Remember This: In the Archives of the Brain, Our Lives Linger or Disappear." in National Geographic, 49.

[6] E. Jensen, "Teaching with the Brain in Mind", 100.

[7] D. Sousa, "How the Brain Works", 78.

[8] D. Sousa, "How the Brain Works", 79.

[9] L. McCleary, The Brain Trust Program: A Scientifically Based Three-Part Plan to Improve Memory, 16.

[10] Wood, Pam Walker & Elaine. Understanding the Human Body - The Brain and Nervous System, 14.

[11] Barrett, S. It's All in Your Head: A Guide to Understanding Your Brain and Boosting Your Brain Power, 17.

[12] L. McCleary, The Brain Trust Program: A Scientifically Based Three-Part Plan to Improve Memory, 26.

[13] A. Nelson, Harvard Medical School Guide to Achieving Optimal Memory, 16.

[14] A. Nelson, Harvard Medical School Guide to Achieving Optimal Memory, 14.

[15] Hoiland, Erin, "Brain Plasticity: What Is It/ Learning and Memory." in Neuroscience for Kids -Brain Plasticity, 3.

[16] Beal, M. Flint, Floyd E. Bloom, and David J. Kupfer. The Dana Guide to Brain Health, 217.

[17] Beal, M. Flint, Floyd E. Bloom, and David J. Kupfer. The Dana Guide to Brain Health, 218.

[18] E. Jensen, "Teaching with the Brain in Mind", 106.

[19] Beal, M. Flint, Floyd E. Bloom, and David J. Kupfer. The Dana Guide to Brain Health, 218.

[20] Beal, M. Flint, Floyd E. Bloom, and David J. Kupfer. The Dana Guide to Brain Health, 223.

[21] Beal, M. Flint, Floyd E. Bloom, and David J. Kupfer. The Dana Guide to Brain Health, 222.

[22] Beal, M. Flint, Floyd E. Bloom, and David J. Kupfer. The Dana Guide to Brain Health, 222.

[23] Beal, M. Flint, Floyd E. Bloom, and David J. Kupfer. The Dana Guide to Brain Health, 222.

[24] J Foer, "Remember This: In the Archives of the Brain, Our Lives Linger or Disappear." in National Geographic, 54.

[25] Barrett, S. It's All in Your Head: A Guide to Understanding Your Brain and Boosting Your Brain Power, 90.

[26] D. Sousa, "How the Brain Works", 110.

[27] D. Sousa, "How the Brain Works", 88.

[28] Abate, Charles. "You Say Multitasking Like it's a Good Thing" in neatoday, 40.

[29] Abate, Charles. "You Say Multitasking Like it's a Good Thing" in neatoday, 37.

[30] Abate, Charles. "You Say Multitasking Like it's a Good Thing" in neatoday, 39.

Activities

Activity #1

Rote Memory Drills

Word Recall Drill # 1

The teacher will recite to students a list of words. The students will then be asked to write the words on their papers. The teacher will then read the list again. The students will check their papers, indicating how many they remembered. Next, they will record the results on the bar graph in their portfolio. The teacher will continue adding one word to a list of words until there is only one student with a perfect score. That person is the Drill Captain.

First Drill Second Drill Third Drill Fourth Drill

Hunt Play Brain Pickles

Erase Swing Parent Rabbit

Quickly Over Run Hidden

Remove Dog Light Snow

Through Forbidden Lawyer

Shadow Operate

Kitchen

Rote Memory Wheels Drill # 2

Students will draw a circle on tag board using a safety compass and cut it out. Around the circle from outside in, students will equally space and write ten words. Making a smaller circle, the students will place it on top of the larger and cut out a window, to allow for one word at a time to be viewed. The circles will be fastened together with a brad and students are to put their names on the back. Student will pick a classmate's circle, study it for one minute and flop it over. Next students will write as many words as they can remember. Results will be graphed. (Kincher, p.99) By rotating the circles, this exercise may be done for as many days as the number of students in the class. (Day 2- pass circles to person on the right. Day 3 each student gets their circle and the class passes it to the right twice, etc.)

Number Recall Drill # 3

The teacher will recite ten digits. Have students record them. Next, have students check their papers and record the results on the graph. Do this five times and have the students calculate the average number of digits they recalled. Then, the teacher will teach the chunking method, which is to have the numbers grouped. For example 6497453208, would be 649 745 3208. The teacher will do this exercise another five times, and have the students calculate the average number of digits remembered using chunking. Students will be asked to summarize the results in their portfolios.

Activity #2 How Neurons Work

The process of how a neuron works is very complicated for sixth graders to understand, so I have devised a simulation. One student, dressed in a dendrite costume, will send via PVC pipe an electrical charge (plastic egg with wrapped candy inside) to the cell body. The cell body, another student encircled in a hula hoop will transfer the electrical signals, (egg) from one pipe to another. This transfer demonstrates the exchange of positive and negative charges, or action potential. Next, the cell body sends the charge off to the axon through the pipe illustrating the charge being carried to the axon. The axon ends at the synapse. At this point, the candy should shoots out of the pipe, simulating the release of neurotransmitters. If this does not work, another student may be the synapse and release the neurotransmitters. After the first demonstration, students may do it again, but this time sending the charge to another neuron, (dendrite, cell body, and axon). Of course, at the end of the simulation, the students eat the neurotransmitters.

Activity #3 Pick your Brain

To help students remember the parts of the cerebral cortex, a kinesthetic approach will be used in this unit. Referring to the diagram of the cerebral cortex, pairs of students will design the brain parts out of clay. After the parts are fired, they will paint each part an assigned color. Using masking tape and newspaper, students will combine the two hemispheres of the brain, creating a shared brain. At the next class, the students will "pick their brains", quizzing each other on the name and function of the parts of the brain.

Graphs

Use one graph to record data each of the following test. One for the rote memory drill, one for the memory wheel drill, and one for the number drill.

Memory Wheel Drill

Trials

	Trials									
#correct	1	2	3	4	5	6	7	8	9	10
10										
9										
8										
7										
6										
5										
4										
3										
2										
1										

Conclusion:

Numbers Drill

Trials

# correct	1	2	3	4	5	6	7	8	9	10
10										
9										
8										
7										
6										
5										
4										
3										
2										
1										

Conclusion:

Beginning, Middle and End Data

Trials

Word #	1	2	3	4	5	6	7	8	9	10
10										
9										
8										
7										
6										
5										
4										
3										
2										
1										

Lesson Plan Format

	Memory Drill	Strategy	Lesson	Strategy	Strategy
Week #1	Rote Memory Drill #1	Cramming	What Makes A Memory?	Questioning	
Week #2	Memory Wheel	Beginning, Middle, & End	How Memory Works	Loci Activity	Activity #2 How Neurons Work Lesson Simulation
Week #3	Memory Wheel	Beginning, Middle, & End	Where is Memory?	Activity #3 Pick your Brain	Acronyms Link, Peg
Week #4	Rote Memory Drill # 3 Ten Numbers	Chunking	Memory Pathways & Types of Memory	Rhyming Mnemonics	Mind Maps
Week #5	Multi-tasking	Card Game	Stages of Memory	Receive, Review Retrieve, Game	Mind Maps
Week #6	Kids Survey	Write Memory Prescription	Future Implications	Think, Pair, Share	Action Picture