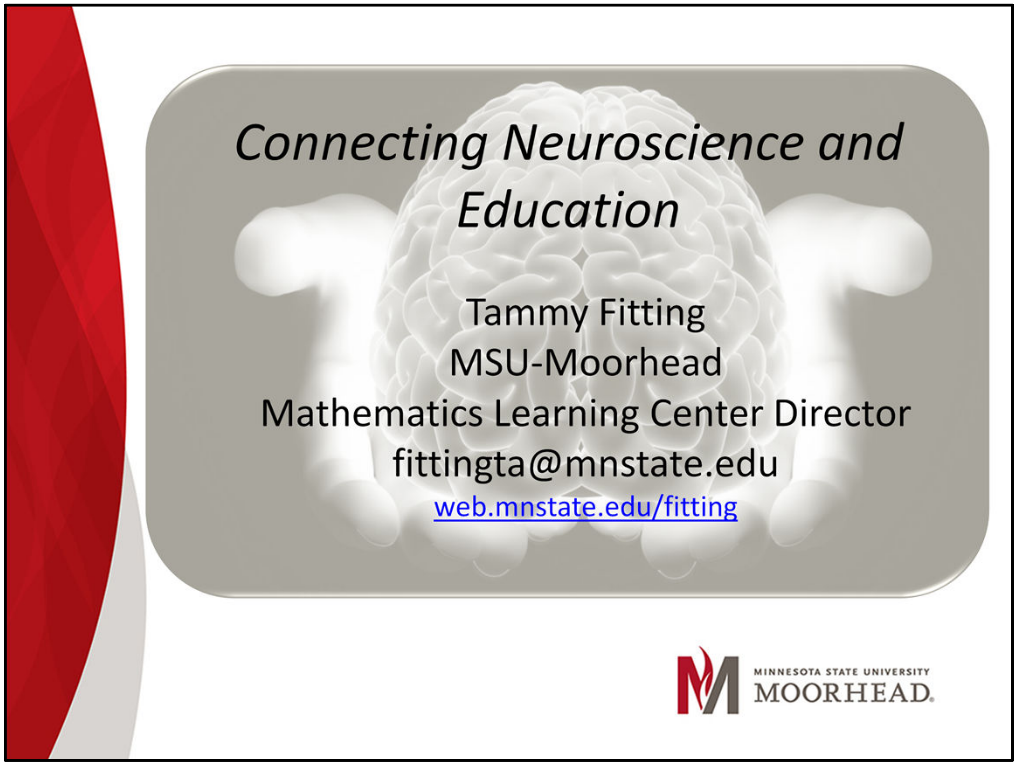
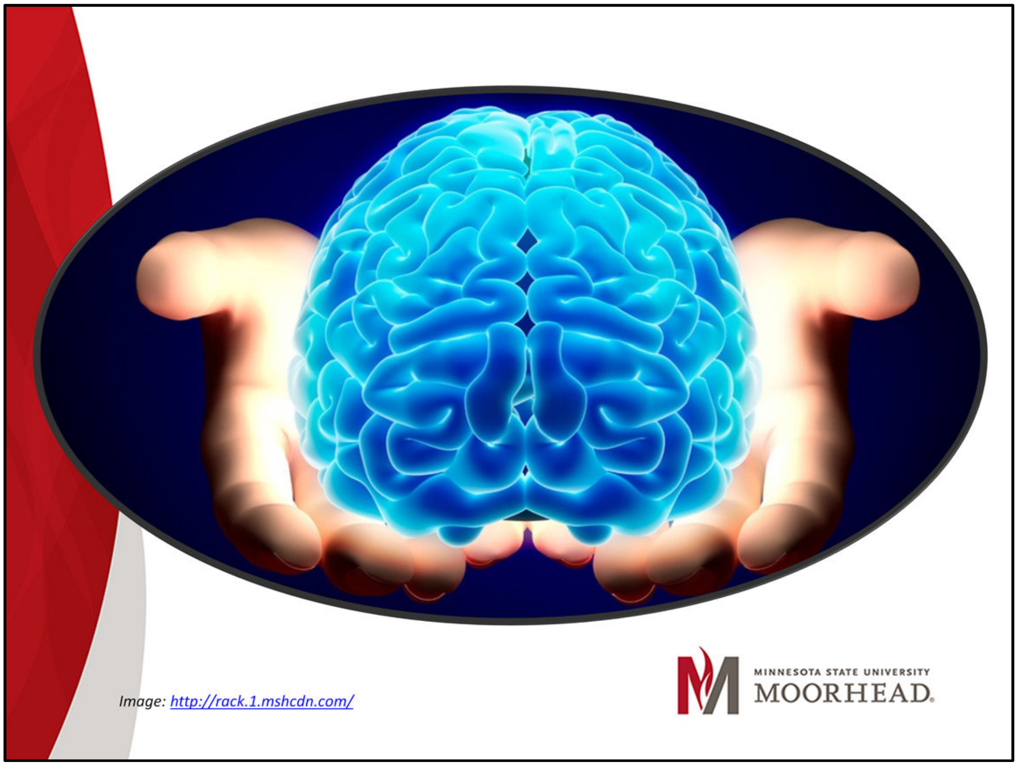
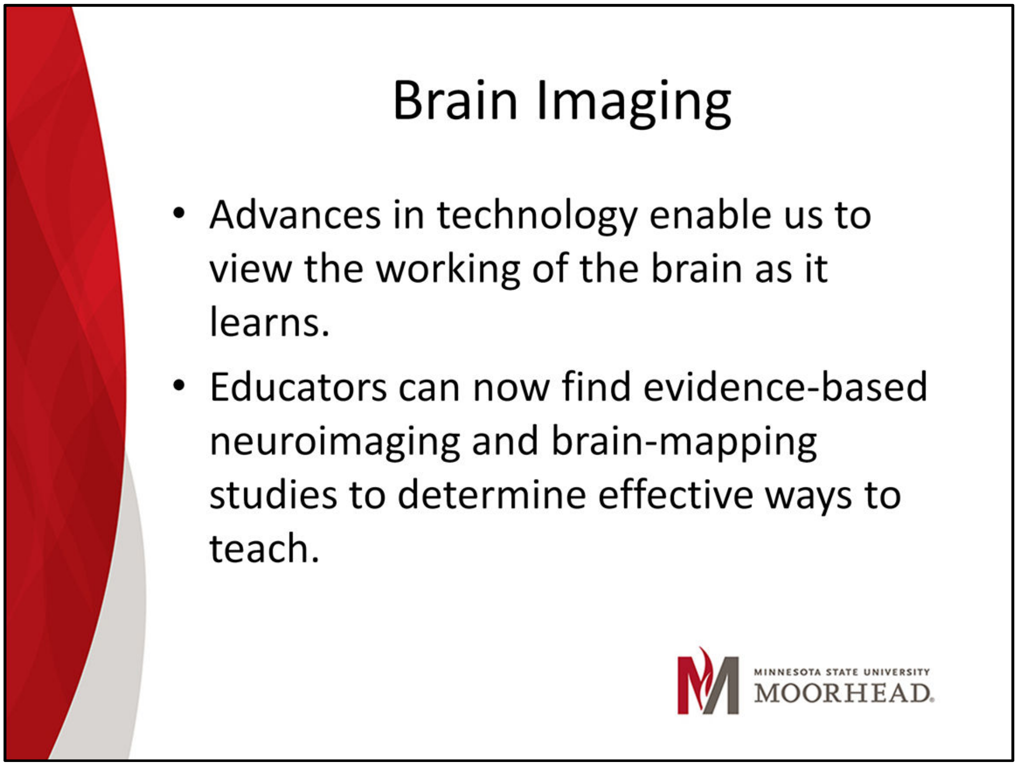


Brain research and its interpretation. Is the research valid?

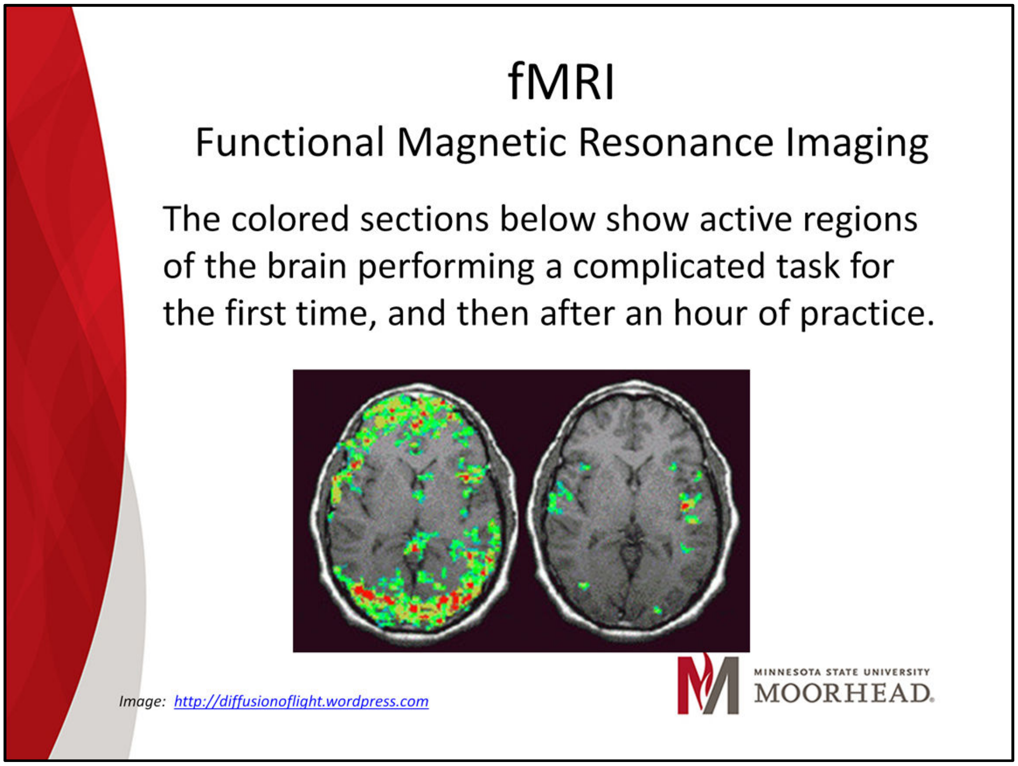


Educational neuroscience

http://www.dana.org/News/NeuroEducation/

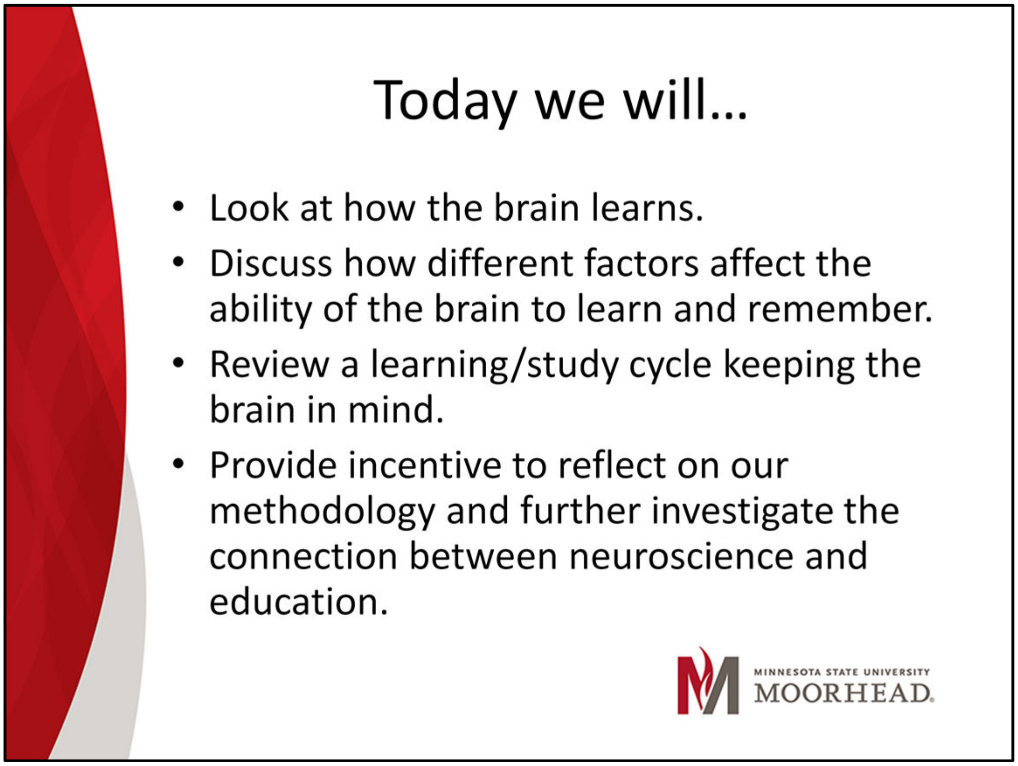


Helpful in overcoming brain injuries or understanding diseases that affect the brain.

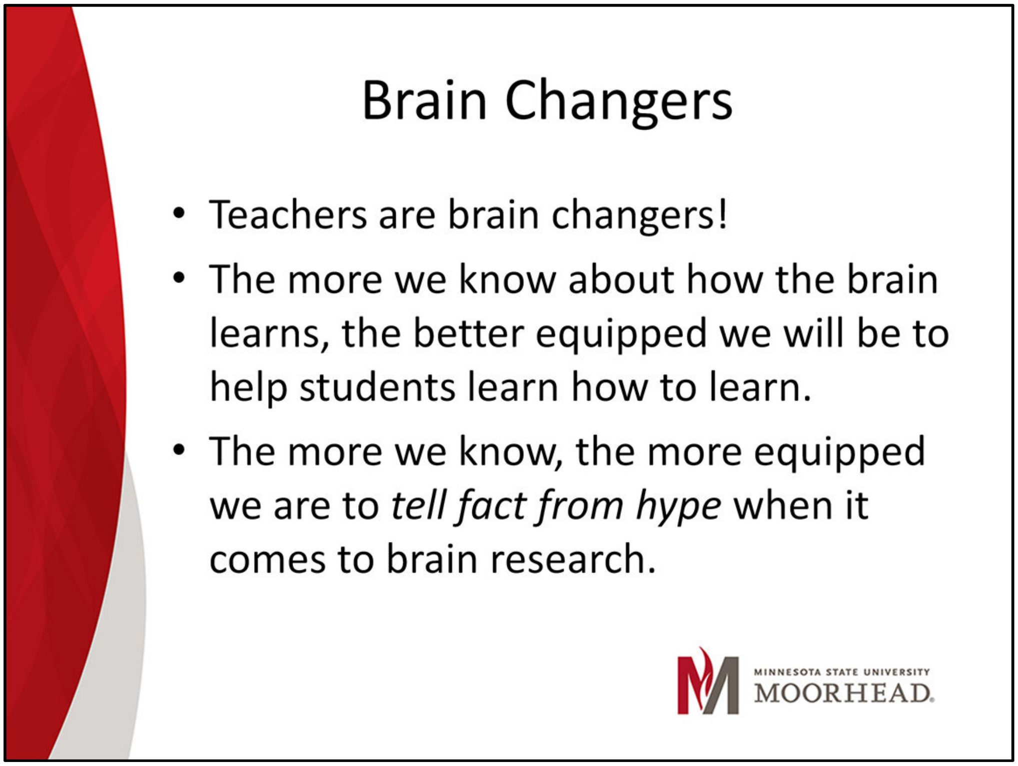


When a part of the brain becomes active, the need for oxygen and nutrients increases. Oxygen is carried to the brain cells by hemoglobin. Hemoglobin contains iron, which is magnetic. The fMRI uses a large magnet and compares the amount of oxygenated hemoglobin entering brain cells with the amount of deoxygenated hemoglobin leaving cells. The computer colors in the brain regions receiving more oxygenated blood and can locate the activated brain region to with one centimeter. (Sousa, How the Brain Learns, 2011)

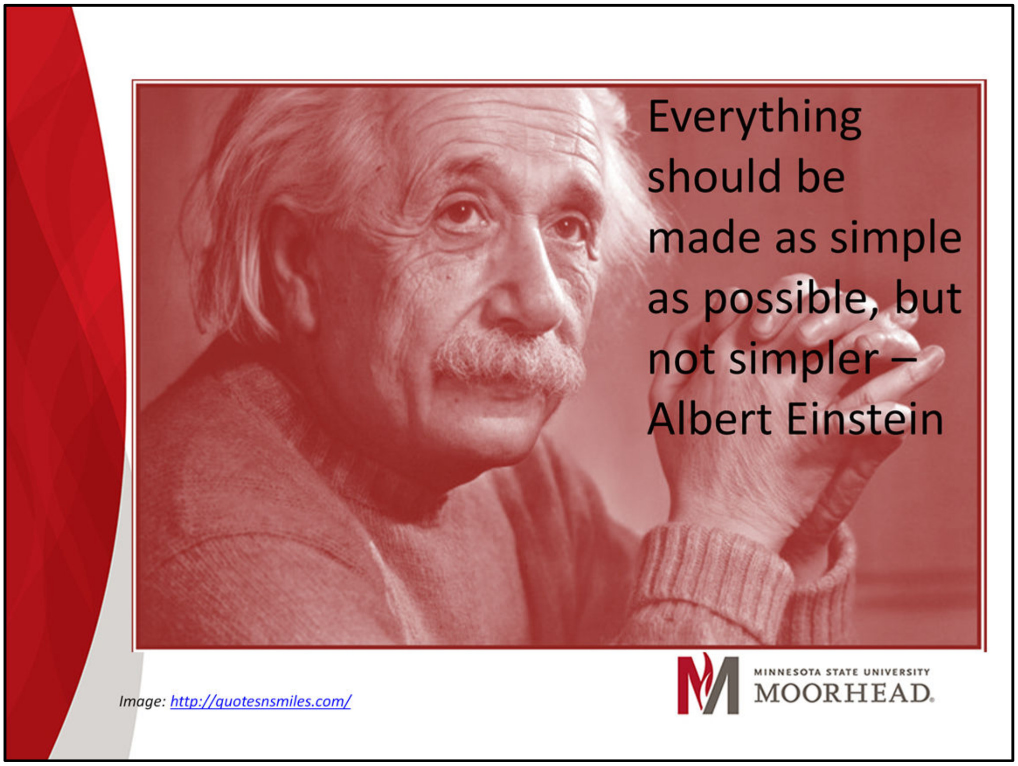
The scientific study of the nervous system is entering a new golden age. Researchers and clinicians continue to advance the treatment of conditions such as Alzheimer’s syndrome, Parkinson’s disease, epilepsy, and traumatic brain injury.



As scientific understanding of learning includes understanding about learning processes, learning environments, teaching, sociocultural processes, and the many other factors that contribute to learning. Research on all of these topics, both in the field and in laboratories, provides the fundamental knowledge base for understanding and implementing changes in education. (National Research Council, 2000)
This presentation will summarize these areas concentrating on the learning processes.

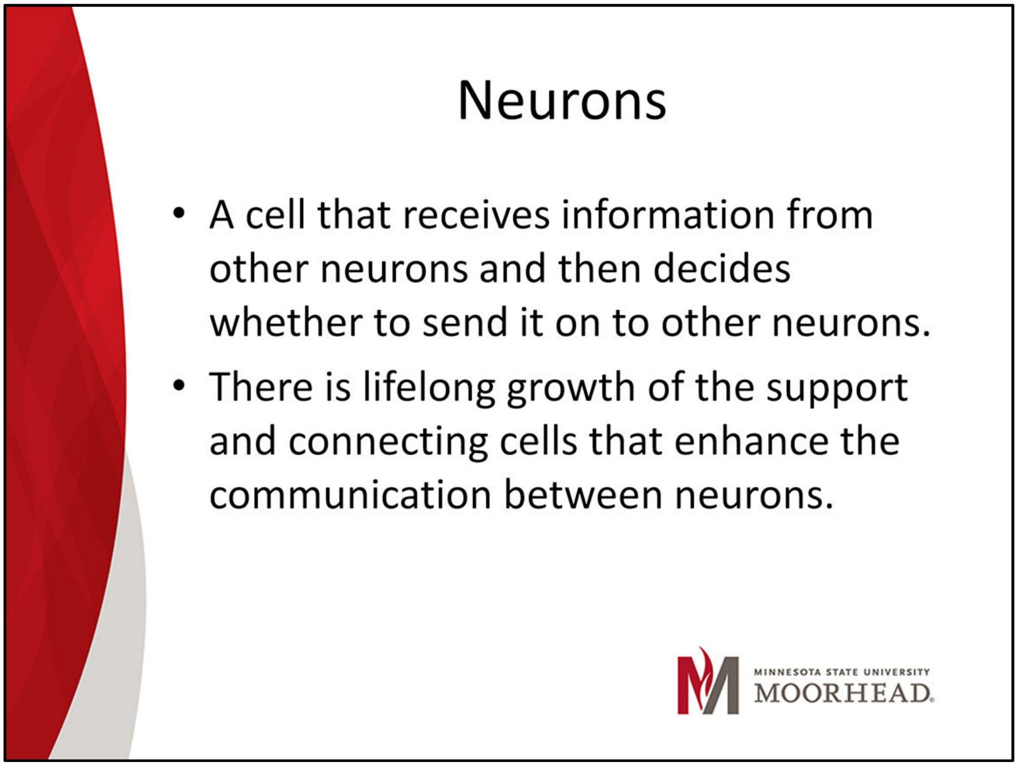


Knowing how the human brain seems to process information and learn can help teachers plan lessons that students are more likely to understand and remember. The more we know about how we learn, the more we can be in control of our learning…metacognition.
Education seems to be a fertile area for the development of "neuromyths", and despite this kind of criticism, new variants have flourished in the last few years. …They promise easy fixes and quick gains, based on "proven" research. Scientists need to be bolder in refuting some of these claims. At the same time, educators and business leaders need to be more critical in approaching them. (Wall, 2014)

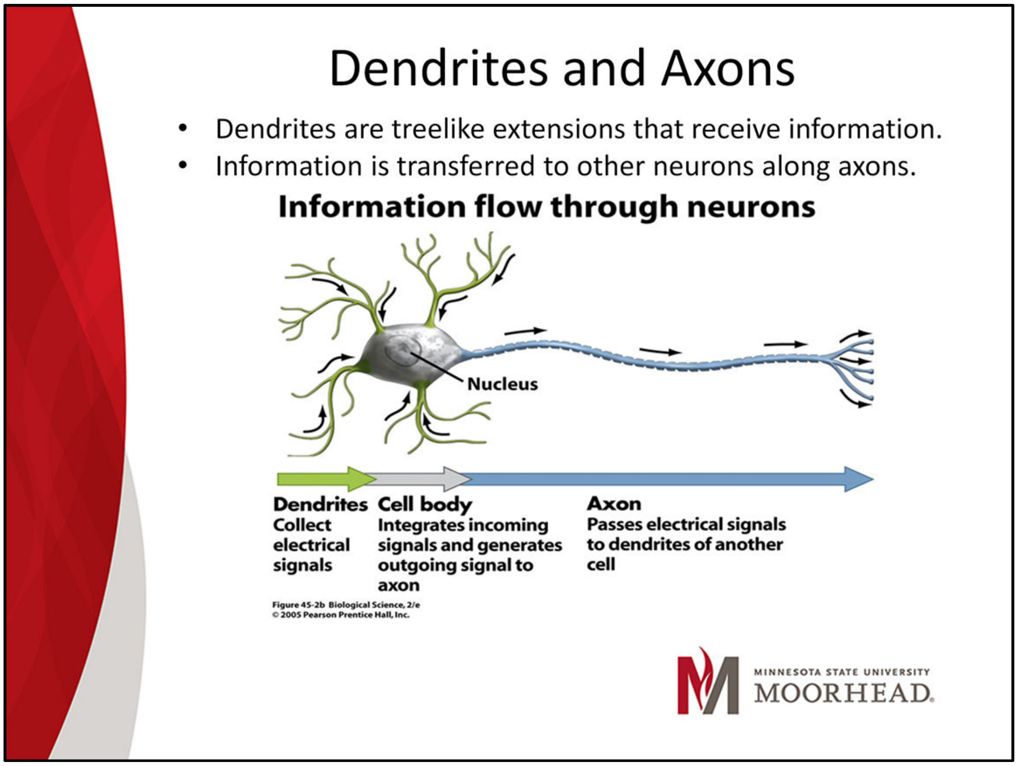


We take the ‘complicated’ and make it understandable without jeopardizing the integrity of the facts or true intentions of the research.

We don’t ‘read’ too much into the results and overextend the application hap-hazardly.



Glial cells hold neurons together and act as filters to keep harmful substances out of neurons. A neuron is about 1/100th the size of a period on a page. Neurons represent 10% of the brain cells – roughly 100 billion.



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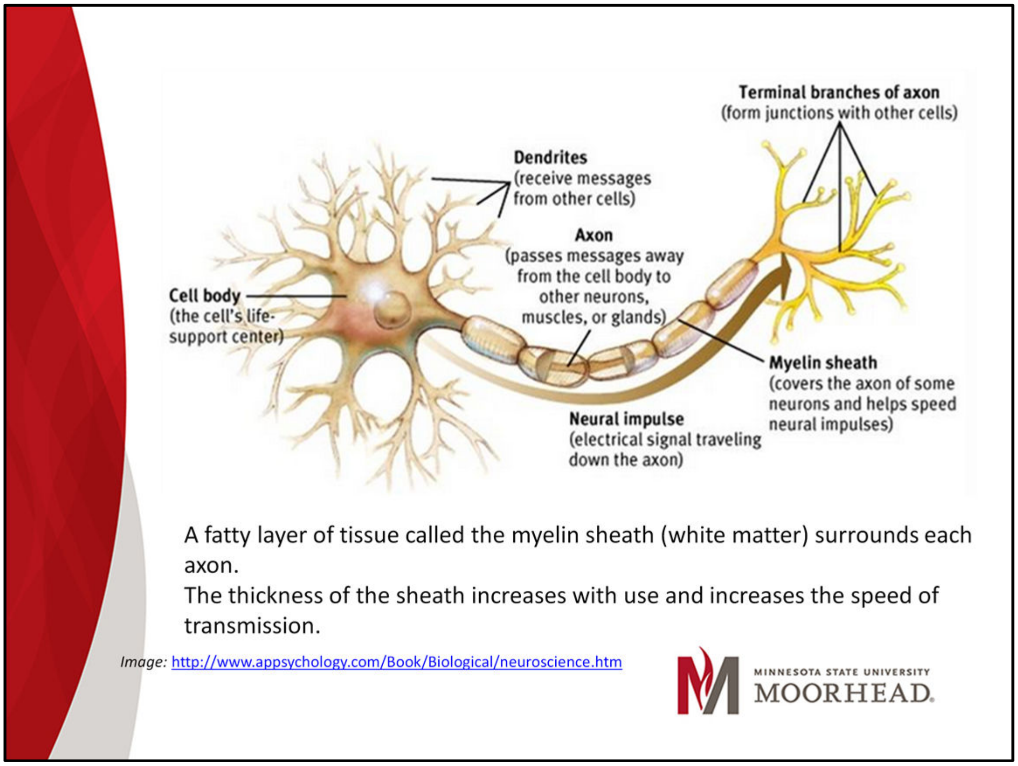

A neuron can transmit between 250 and 2500 impulses per second. Its possible to have up to one quadrillion (1 x 10^15) synaptic connections in one brain. So as we practice, … we trigger a pattern of electrical signals through our neurons. Over time, that triggers the glial cell duo to myelinate those axons, increasing the speed and strength of the signal. **Like going from dial-up to broadband**. http://blog.bufferapp.com/why-practice-actually-makes-perfect-how-to-rewire-your-brain-for-better-performance

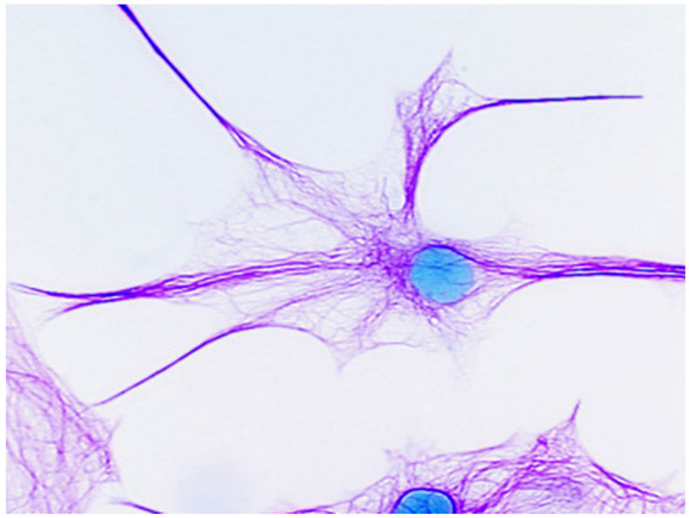

Image: http://www.mybraintest.org/

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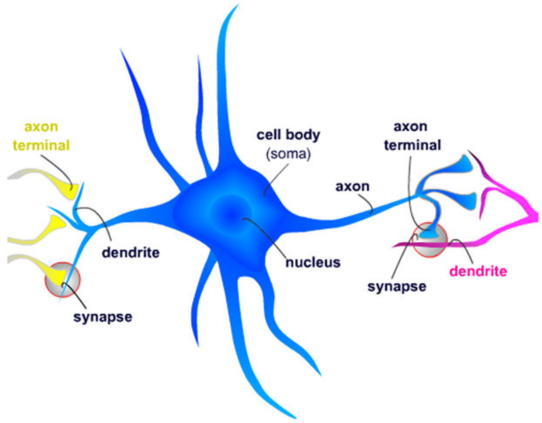
Each neuron can have up to 10,000 branches, dendrites.



Impulses are sent to other cells along the axon by shooting neurotransmitters across the synapse to their dendrites, which is a little space between neurons. Neurons do not touch each other.

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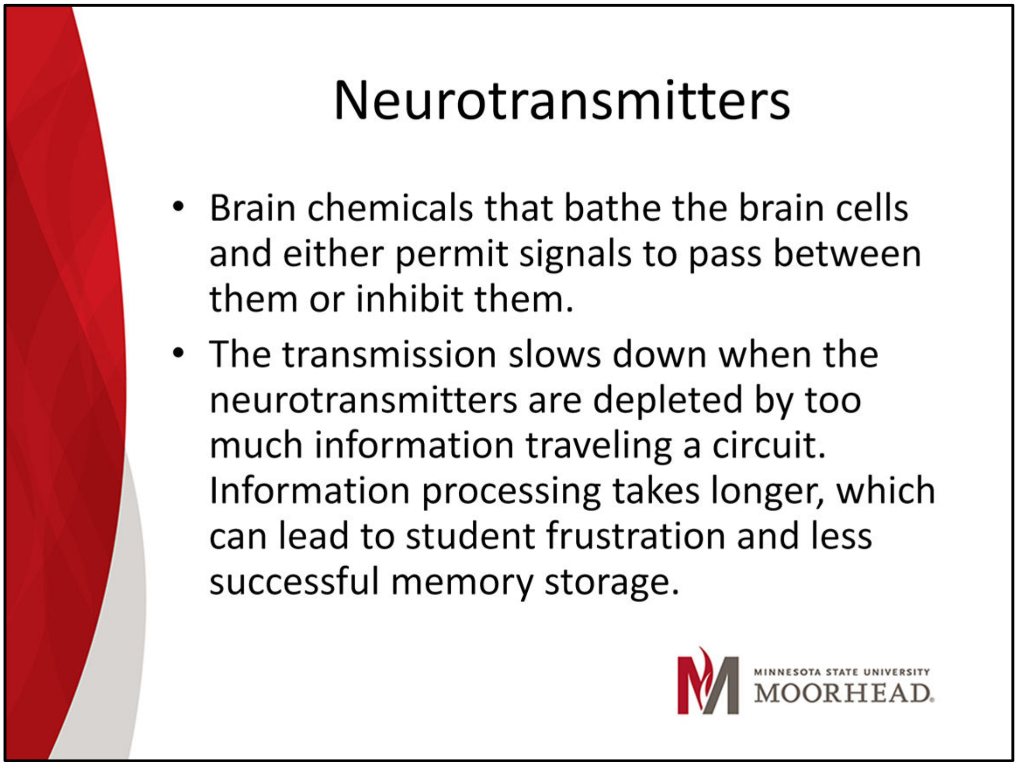
Image: http://www.mybraintest.org/



INHIBITORY : does not stimulate the brain
Serotonin: necessary for a stable mood and to balance excessive excitatory neurotransmitters.
Gaba: sent to attempt to balance excitatory overfiring.
Dopamine: can be both. Helps with depressions and focus.

EXCITATORY
Dopamine: is our main focus neurotransmitter. Dopamine is also responsible for our drive or desire to get things done – or motivation. Stimulants such as medications for ADD/ADHD and caffeine cause dopamine to be pushed into the synapse so that focus is improved. Unfortunately, stimulating dopamine

consistently can cause a depletion of dopamine over time.

Norepinephrine: is an excitatory neurotransmitter that is responsible for stimulatory processes in the body. Norepinephrine helps to make epinephrine as well. This neurotransmitter can cause ANXIETY at elevated excretion levels as well as some “MOOD DAMPENING” effects. Low levels of norepinephrine are associated with LOW ENERGY, DECREASED FOCUS ability and sleep cycle problems.

Epinephrine: is reflective of stress. Long term STRESS or INSOMNIA can cause epinephrine levels to be depleted (low).

"Mr. Osborne, may I be excused? My brain is full."

https://s-media...

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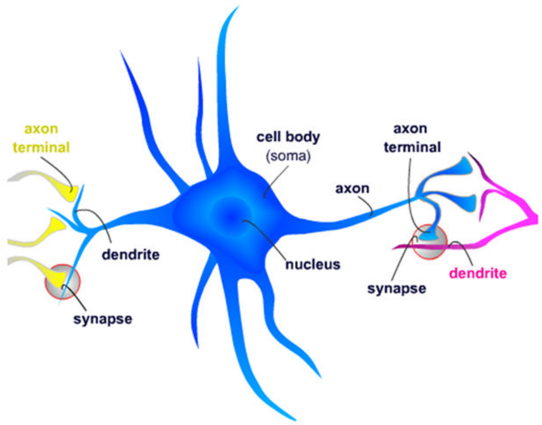
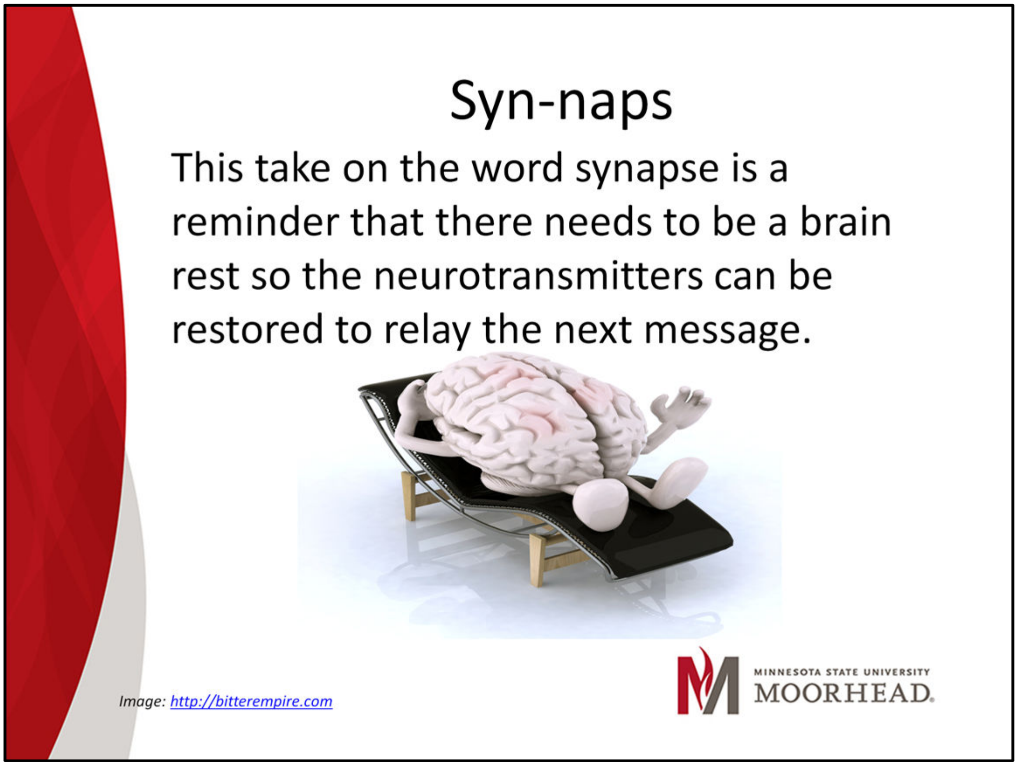
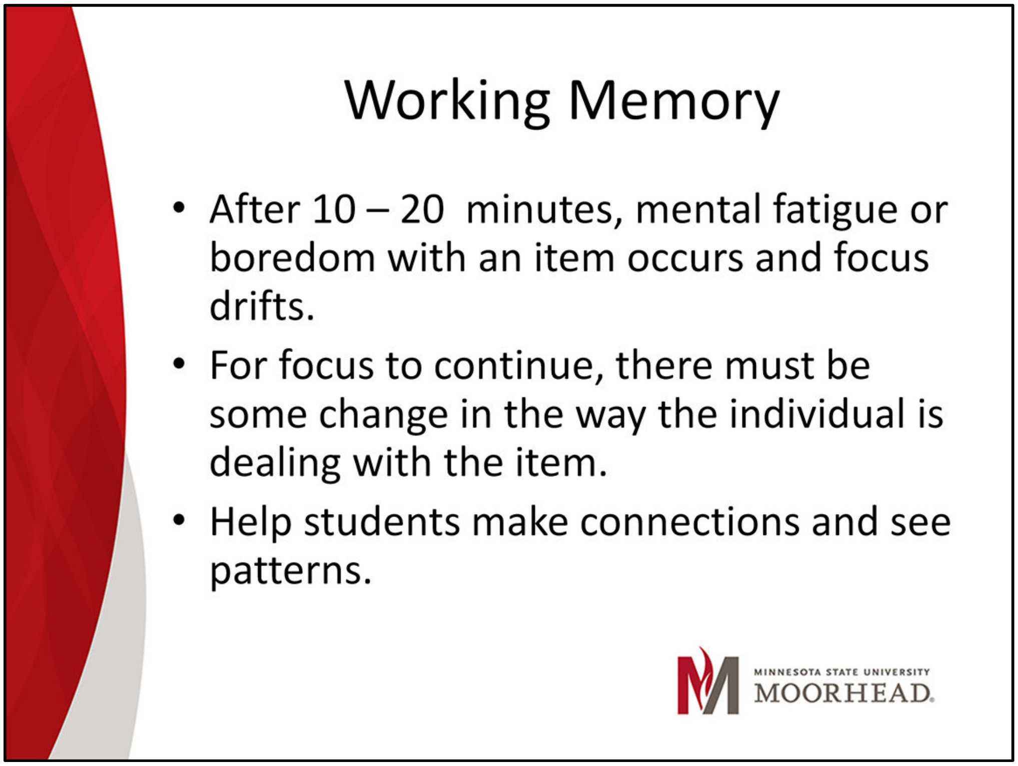
1. Draw a neuron and label the components we discussed.



Chunking. It is possible to increase the number of items within the functional capacity of working memory through a process called chunking. Keep the number of items in a lesson objective within the capacity limits of students, and they are likely to remember more of what they learned. Less is more!



Daily lesson: Introduce some new material, practice, repeat. Example: practice worksheet.
Syn-naps are brain breaks that restore neurotransmitters depleted when the same neural circuit is used for extended periods. They help the amygdala from getting overstressed. The newly learned material has the opportunity to go beyond working memory to be consolidated into relational memory in the hippocampus while students replenish their supply of neurotransmitters (dopamine and serotonin) in one circuit and use another neural pathway for a new activity. (Willis, 2010)



On average an adolescent or adult time for processing an item.
Suggests to pack lessons in 15 – 20 minute segments.
Items may stay in working memory for hours or days (Sousa)
Whenever new material is presented in such a way that students see relationships, they generate greater brain cell activity (forming new neural connections) and achieve more successful long-term memory storage and retrieval. (Willis, 2006)
Graphic organizers.
Rote learning is inefficient.

Implications:

Teach new material first.   Don't let prime time get contaminated with wrong information. (not spent taking attendance, distributing or collecting homework..)
Follow the new material by practice or review during the down-time.
Closure should take place in prime-time-2. This is where the learner determines sense and meaning.
More attention occurs when lessons are shorter and meaningful. (Sousa, How the Brain Learns, 2011)

2. Look at the list of 10 ‘words’ for 12 seconds.

KEF
LAK
MIL
NIR
VEK
LUN
NEM
BEB
SAR
FIF

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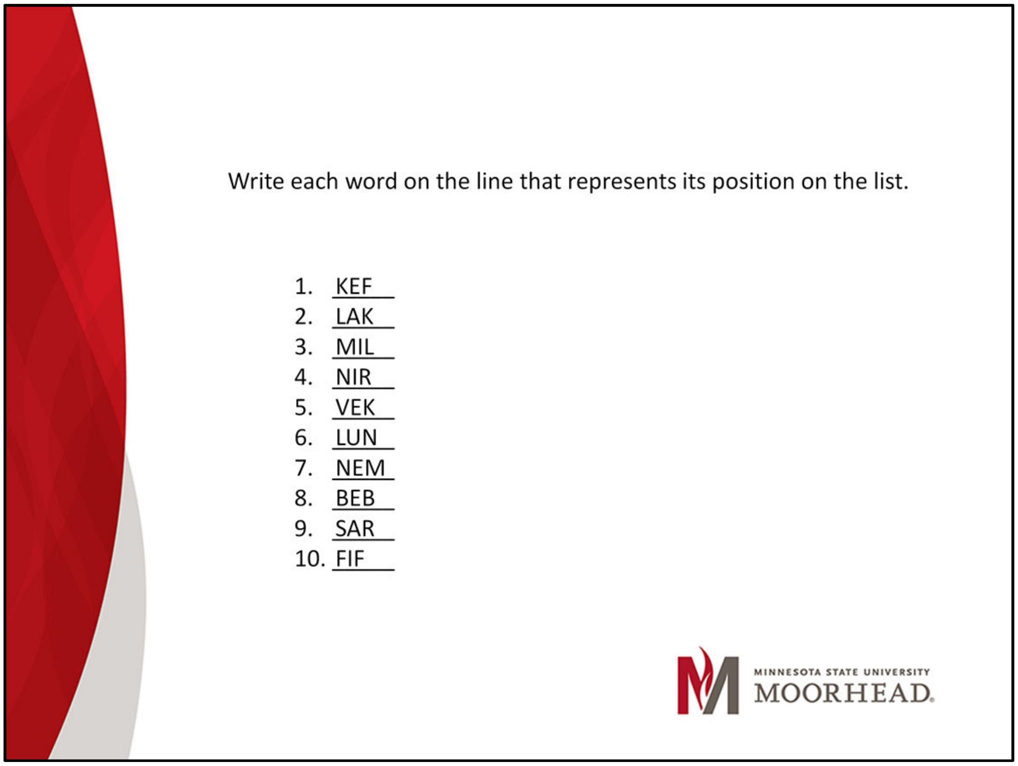
2.



Check your list. To be correct the word must be spelled correctly and in the right position. Chances are your remembered the first three to five words and the last two words, but had difficulty with the middle one. (Sousa, How the Brain Learns, 2011)

We remember best that which comes first, second best that which comes last, and least that which comes just past the middle. The first items are within the working memories capacity. As the learning episode concludes, items in the working memory are sorted or chunked to allow for additional processing of the arriving final items. Chunking is used to combine more than on item into a given chunk of items so there's more 'room' in the short term memory.

Primacy-Recency Effect

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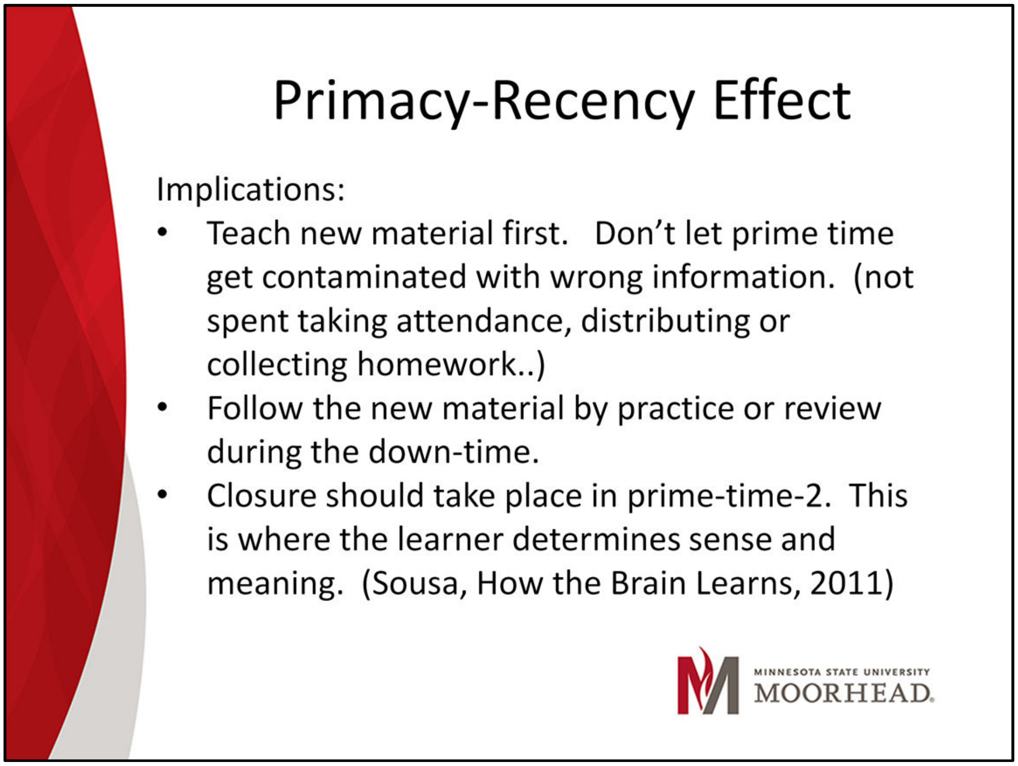

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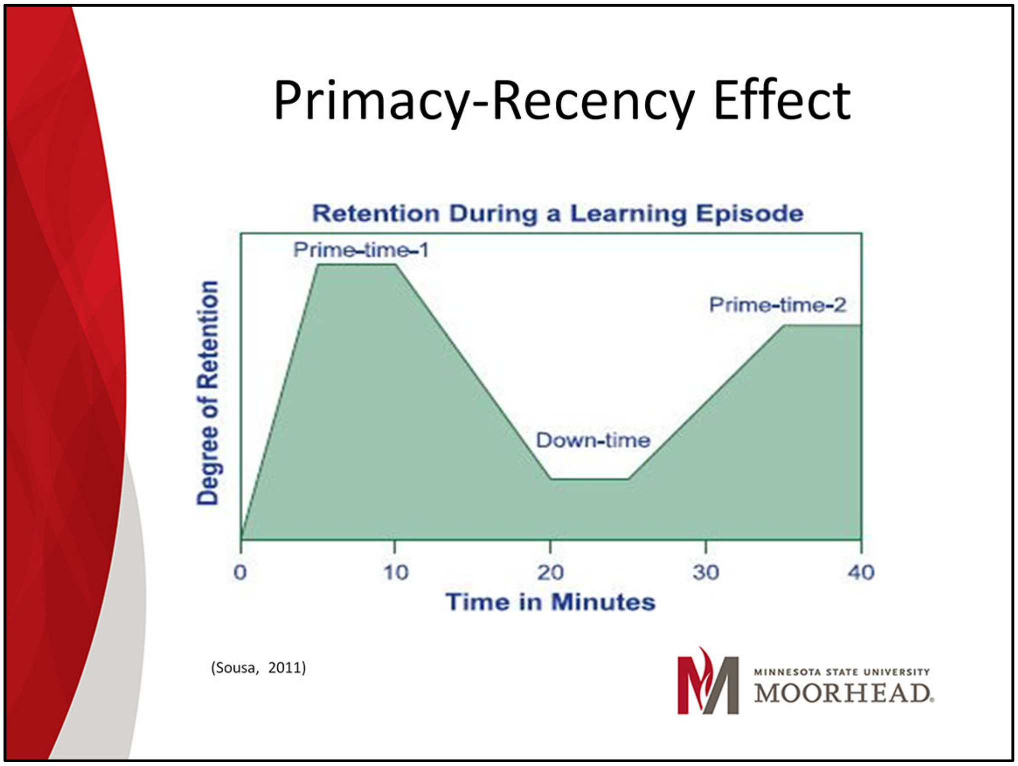

We remember best that which comes first, second best that which comes last, and least that which comes just past the middle. The first items are within the working memories capacity. As the learning episode concludes, items in the working memory are sorted or chunked to allow for additional processing of the arriving final items.

Episode Time	Prime-Times		Down-Time	
	Total Number of Minutes	Percentage of Total Time	Number of Minutes	Percentage of Total Time
20 minutes	18	90	2	10
40 minutes	30	75	10	25
80 minutes	50	62	30	38

(Sousa, 2011)

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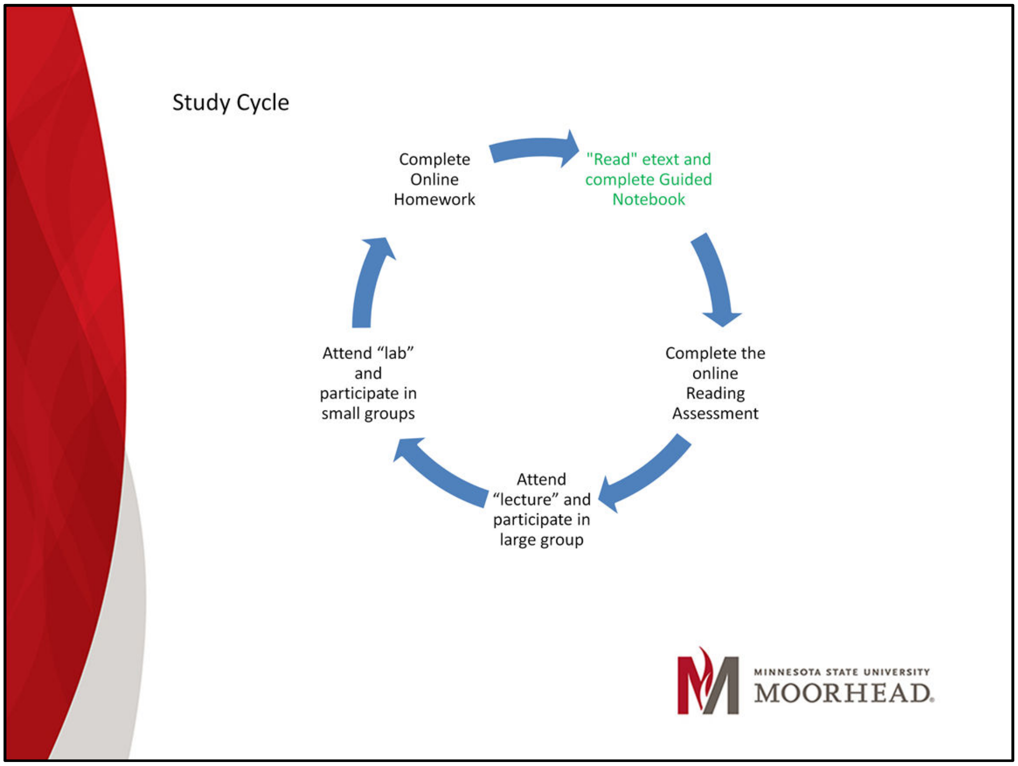
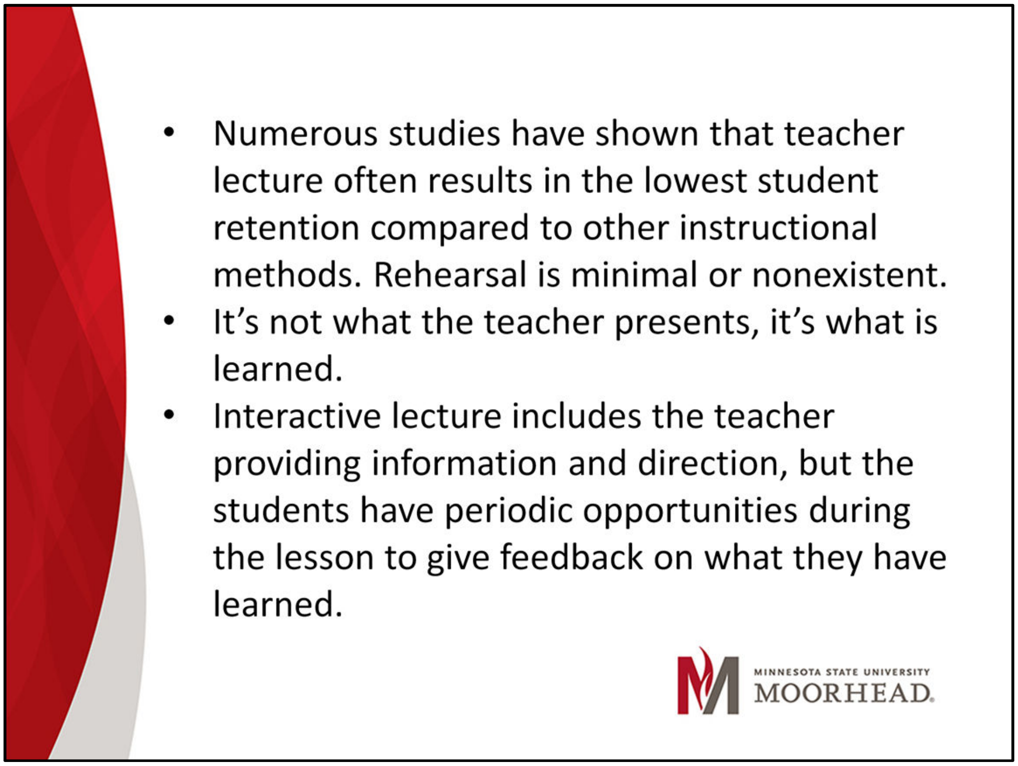
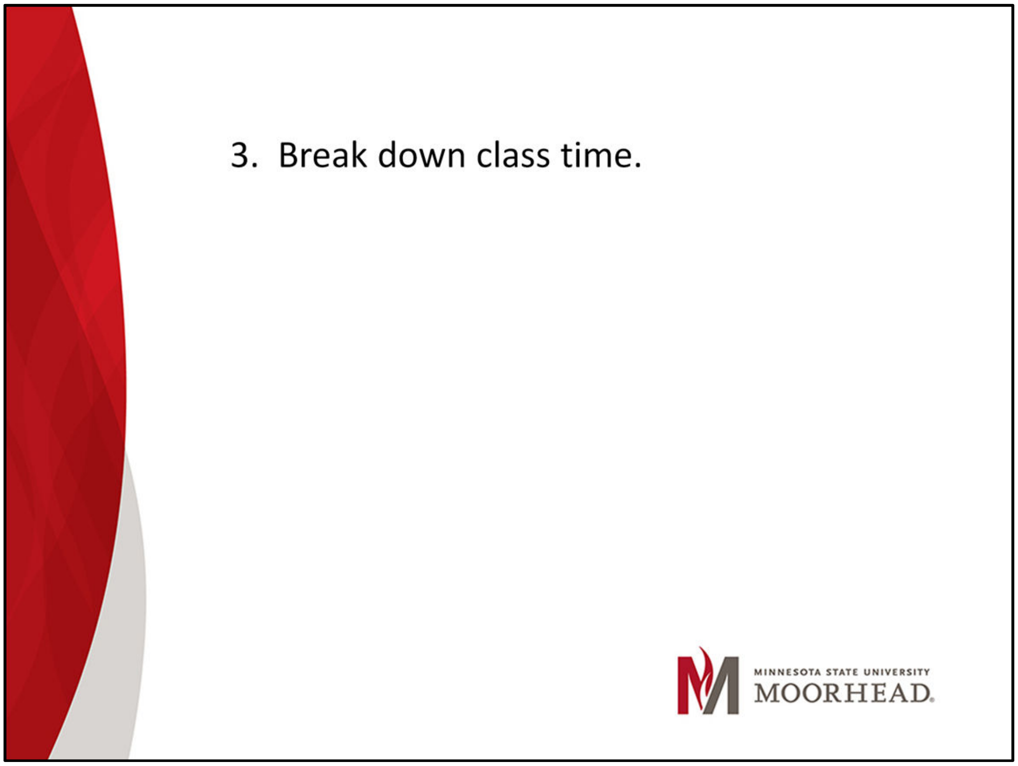


The study cycle may be familiar to many, but why does it work? How does each step of the study cycle figure in to the learning process and what it happening in the brain?

3. Lecture: Draw or outline how the time is spent in one class period.



In 2006, 81,499 students in grades 9 – 12 from 26 states participated in a survey of student engagement and reasons for dropping out. Only 27 percent said they would consider dropping out because the work was too difficult. The majority said the reason they would consider it was because it was boring, with 31% attributing their boredom to having “ no interaction with teachers” (Yazzie-Mintz, 2007)



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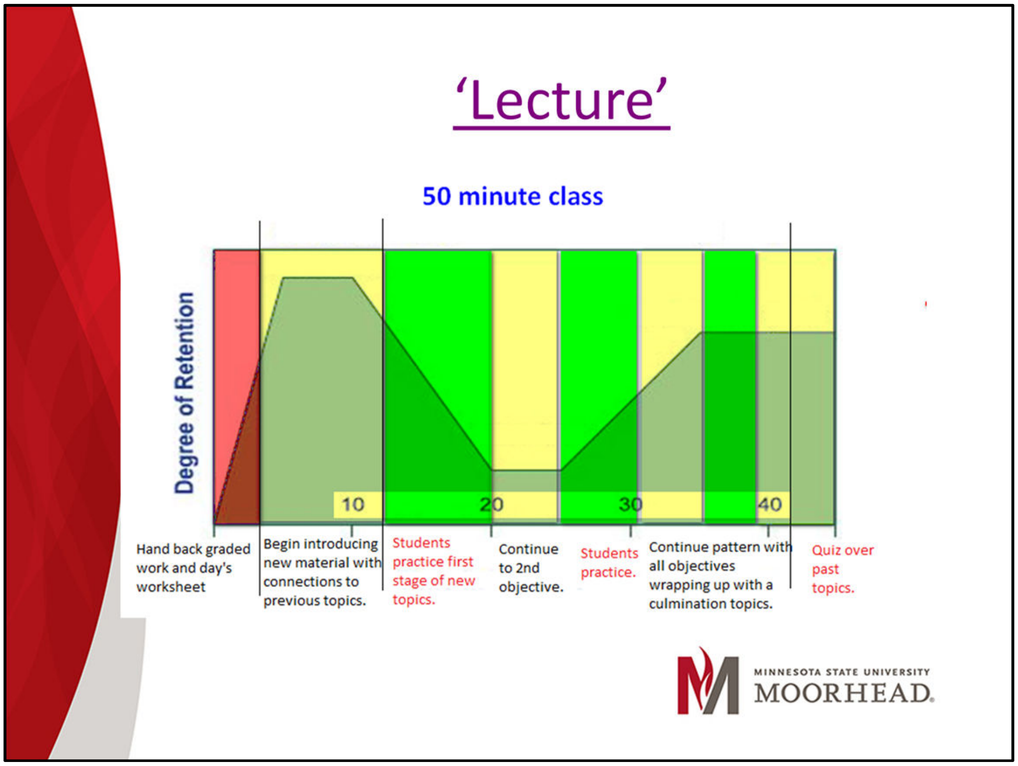
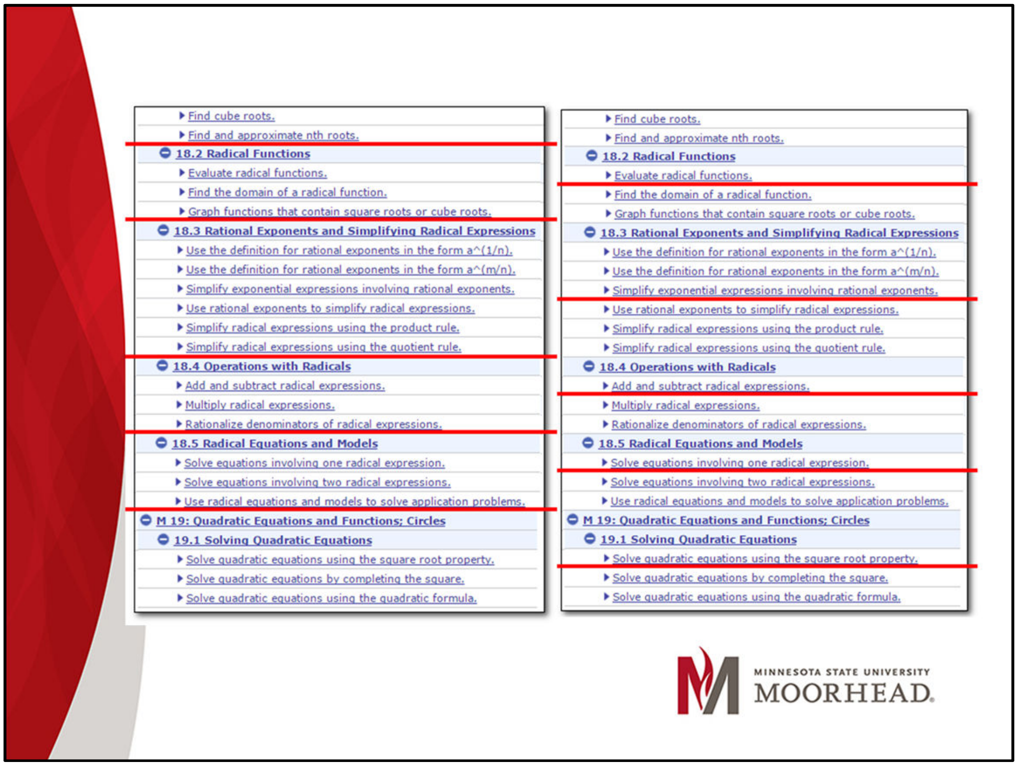
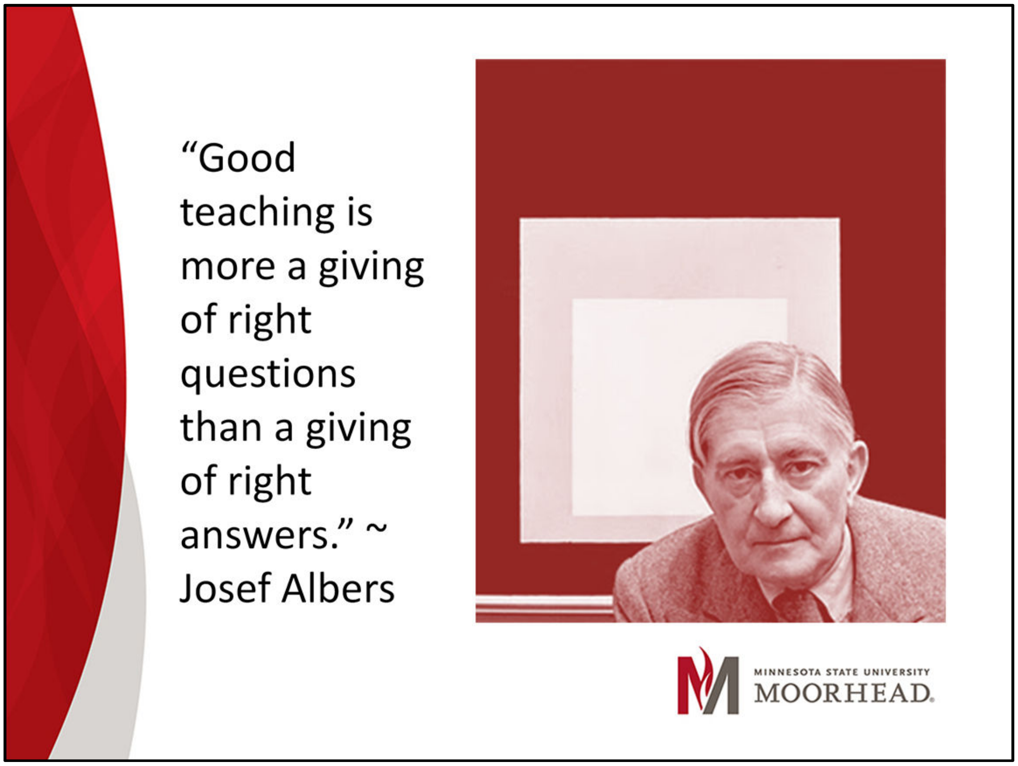


Approach the daily lessons with the primacy-recency effect in mind. The students spend as much, or more, time practicing and explaining what they did as the instructor spends talking. Worksheets provide more than enough problems to account for the various rates of completion for the students. During student practice time, incorporate a Socratic questioning technique.

Making connections to facilitate chunking.



A small of a change as breaking up a topic into two sections may help students get a better grasp of a concept before making connections with the next level.



Socratic vs. Didactic

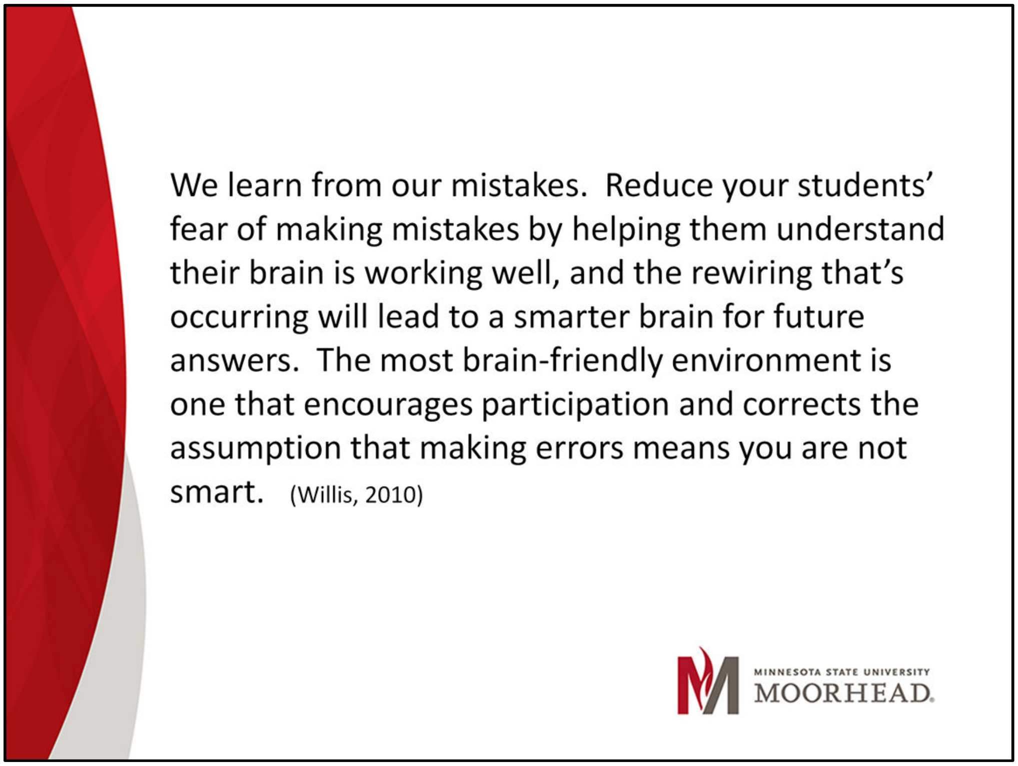
Large and Small group – instructor, MLC director, tutor(s)

Utilize Socratic tutoring style versus didactic tutoring style (both can be effective)

When a student explains their thinking out loud it enhances their learning. (Socratic versus Didactic Tutoring, 2001)

Both can use open ended questions. In socratic, the tutee does more of the talking.

6pq tutoring



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. (Willis, 2006)

Amygdala hijacking – negative feelings cause the hormone cortisol to enter the bloodstream. Cortisol puts the brain into survival mode; this shifts the brain's attention away from learning so it can deal with the source of stress.

When students feel positive about a learning situation, chemicals called endorphins (provide feeling of euphoria) and dopamine (stimulates the prefrontal cortex) become

active.
A stress state happens when a lesson is tedious, not relevant to their lives, confusing, or anxiety-provoking.

http://2.bp.blogspot.com

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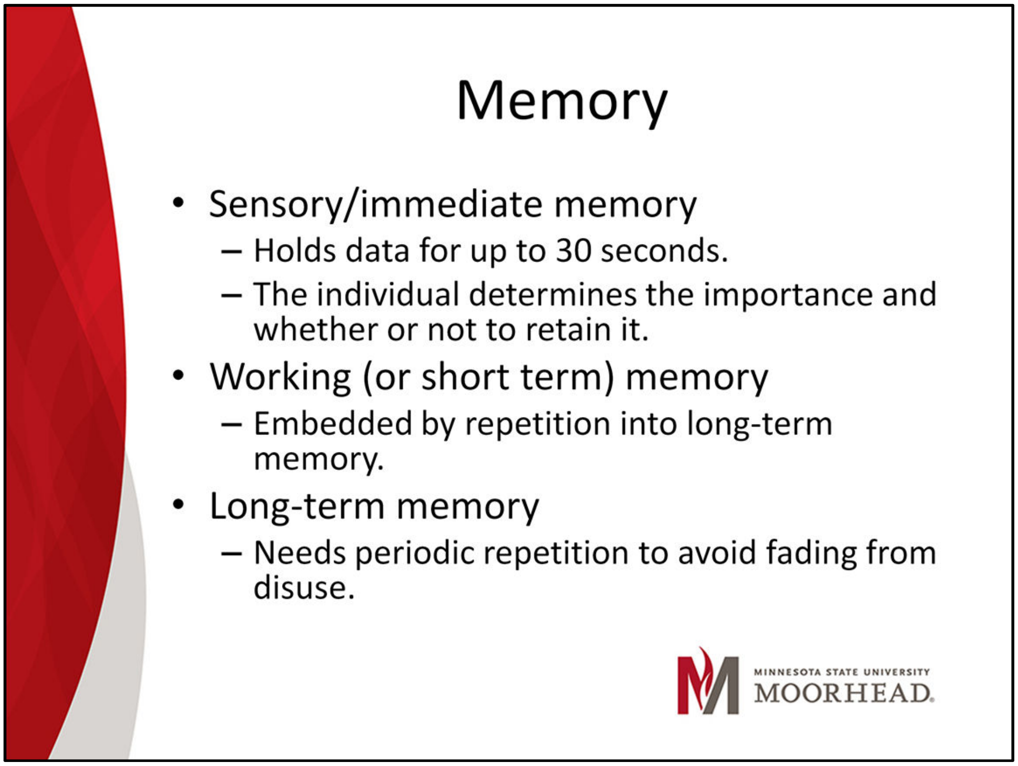
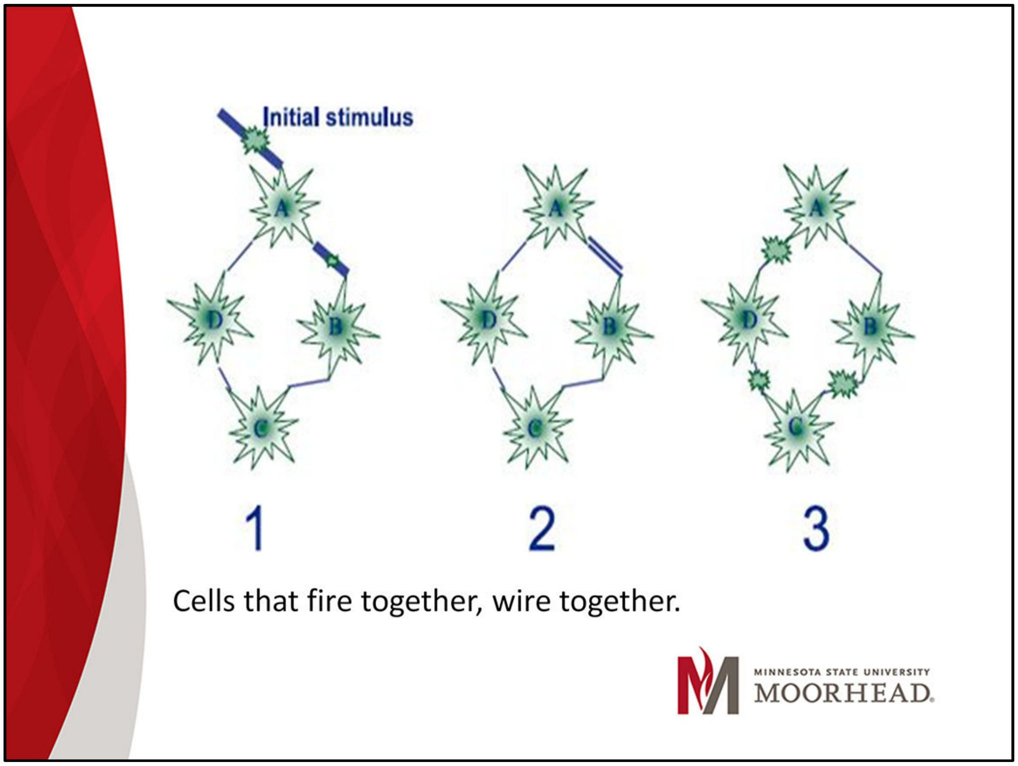
What is our definition of smart?



Memories are not stored intact. Instead, they are stored in pieces and distributed in sites throughout the cerebrum. Which storage sites to select could be determined by the number of associations that the brain makes between new and past learning. The more connections made, the more understanding and meaning the learner can attach to the new learning, and the more likely it is that it will be stored in different networks. (Sousa, How the Brain Learns, 2011)



(1)Neuron A receives a stimulus, which causes it to set off neuron B. (2) If neuron A fires again soon, a link is established. Later, neuron A can just fire weakly to set off neuron B. (3) The firing of neurons A and B may set off neighboring neurons C and D. If this happens repeatedly, the four cells become a network and will fire together in the future – forming a memory. (Sousa, How the Brain Learns, 2011)

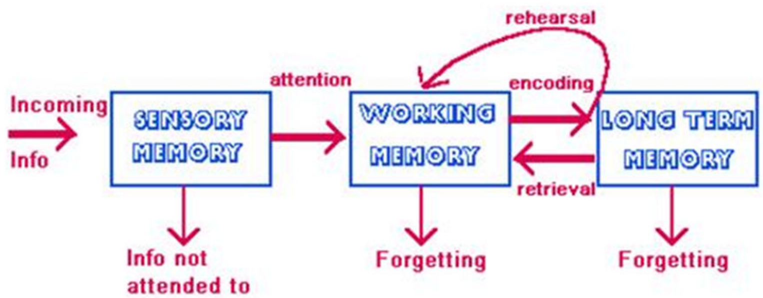


Image: http://healthpsych.psy.vanderbilt.edu/alcoholMemory_files/image007.jpg

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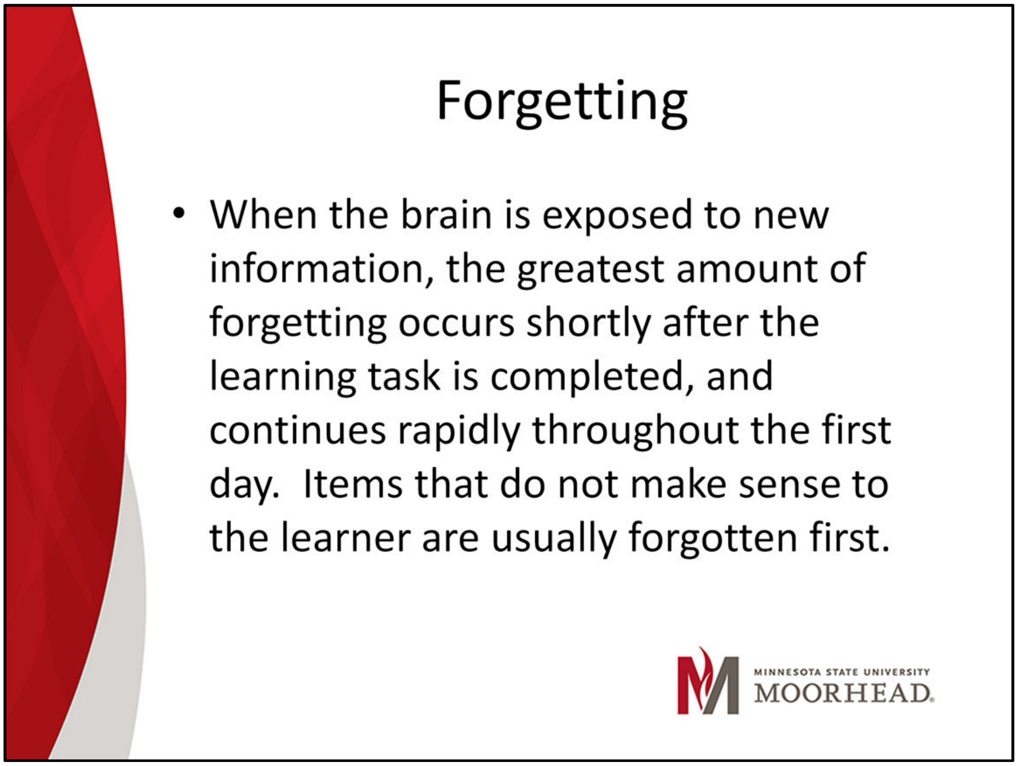
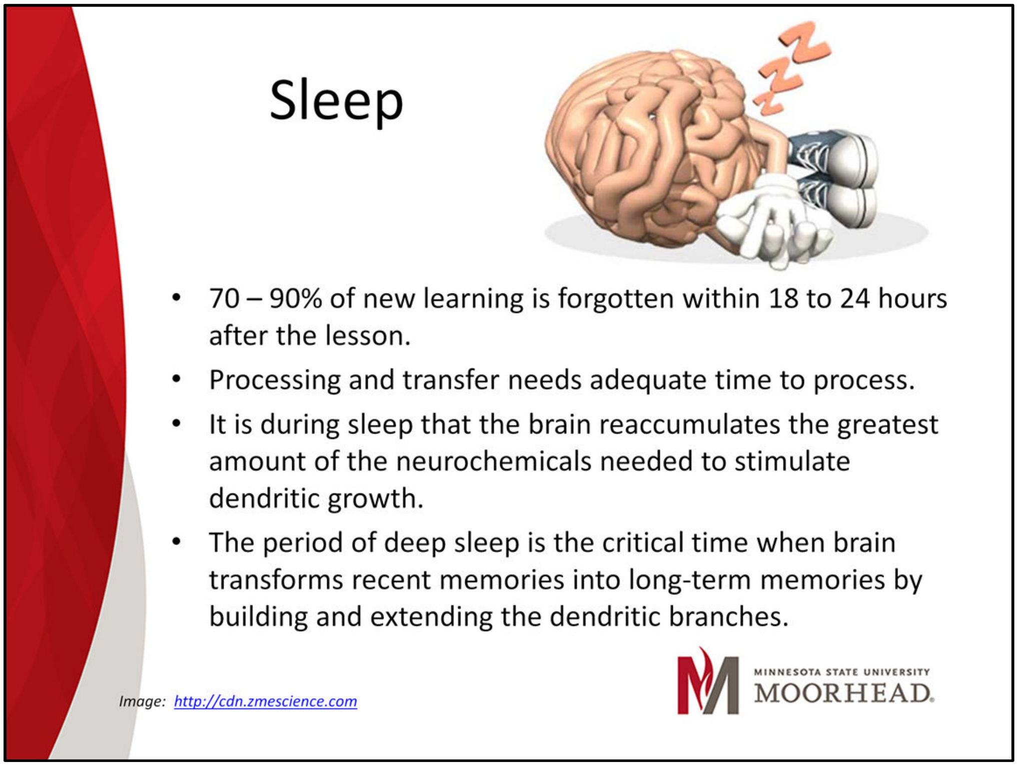


We can’t possibly remember everything. We filter out the trivial to leave room for the more important.



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 in. (Willis, 2006)

Sleep

- The 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.

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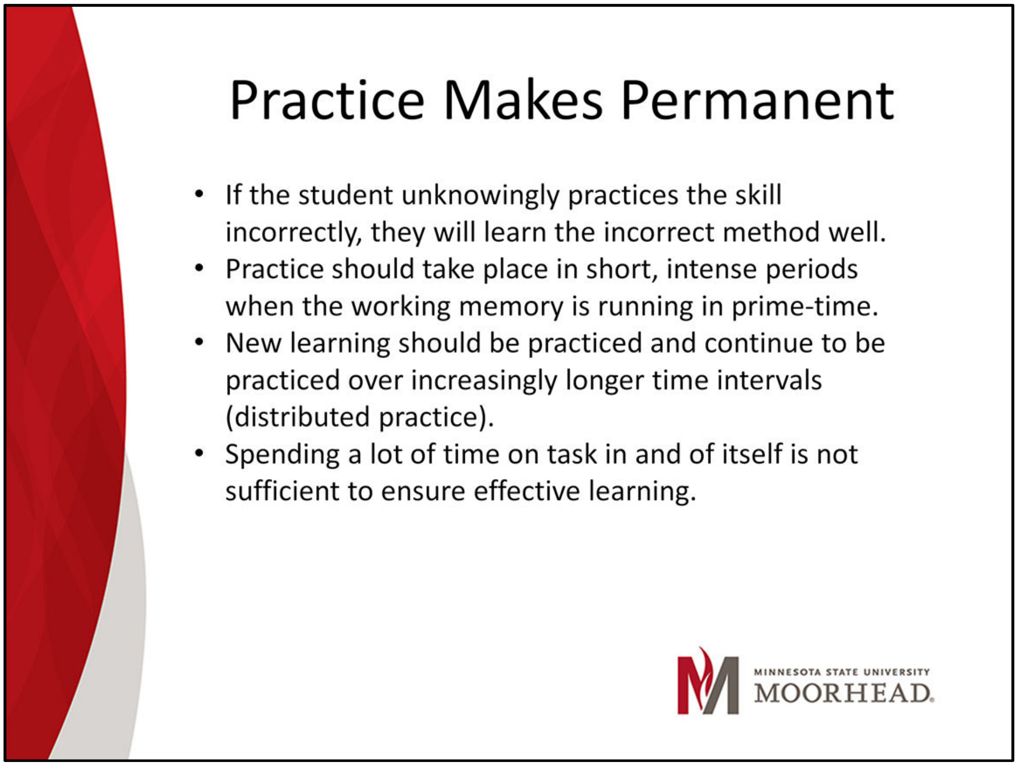

feedback messages with high content caused more learning than feedback messages with low content.

In guided practice the teacher can offer corrective feedback to help students analyze and improve their practice.
Unlearning and relearning correctly is very difficult.
Distributed learning (spiraling)

“Lab”

1. Arrange in groups of three to six students.
2. Try first.
3. Compare, share and assist.

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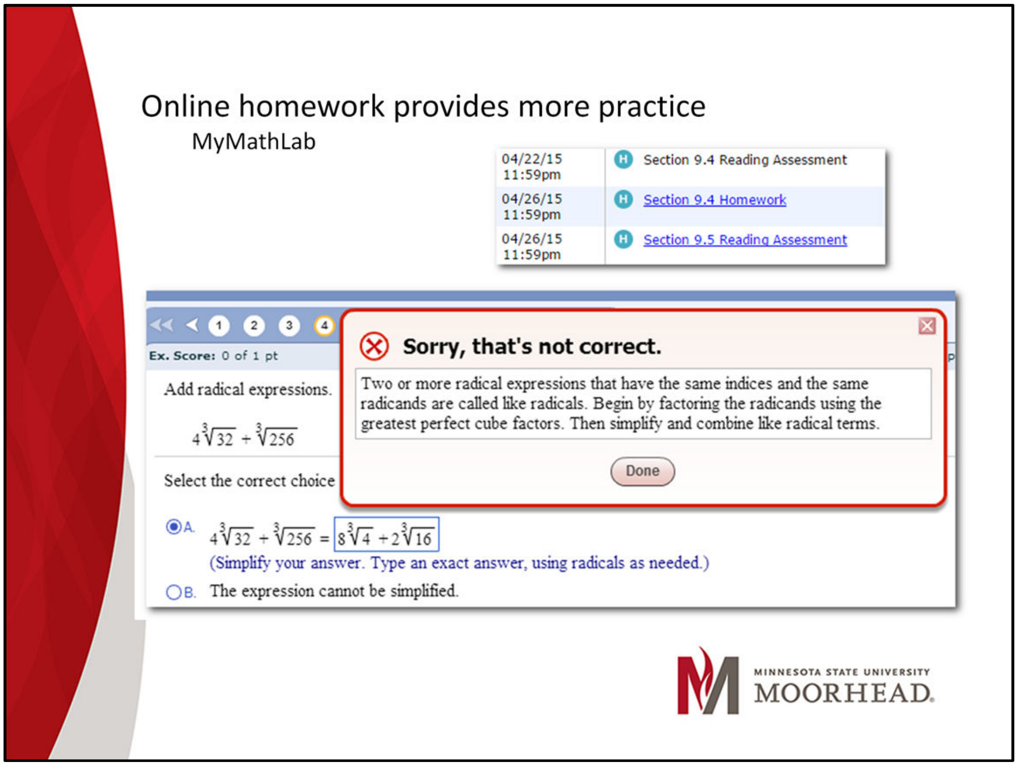

Strive for 100%
3 tries on 3 similar problem for each question.
Using ‘Help me solve this’ counts as one problem.

feedback messages
with high content caused more learning than feedback messages with low content.

Add radical expressions.

$4\sqrt[3]{32} + \sqrt[3]{256}$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

A. $4\sqrt[3]{32} + \sqrt[3]{256} = 12\sqrt[3]{4}$

(Simplify your answer. Type an exact answer, using radicals as needed.)

B. The expression cannot be simplified.

Well done!

OK

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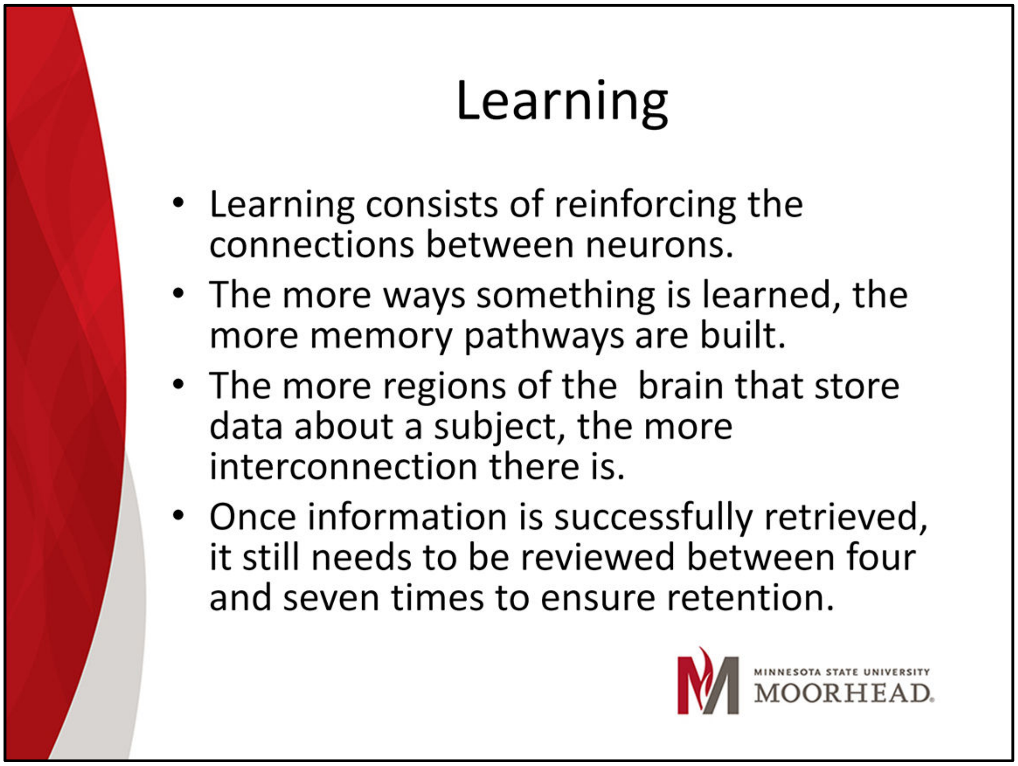
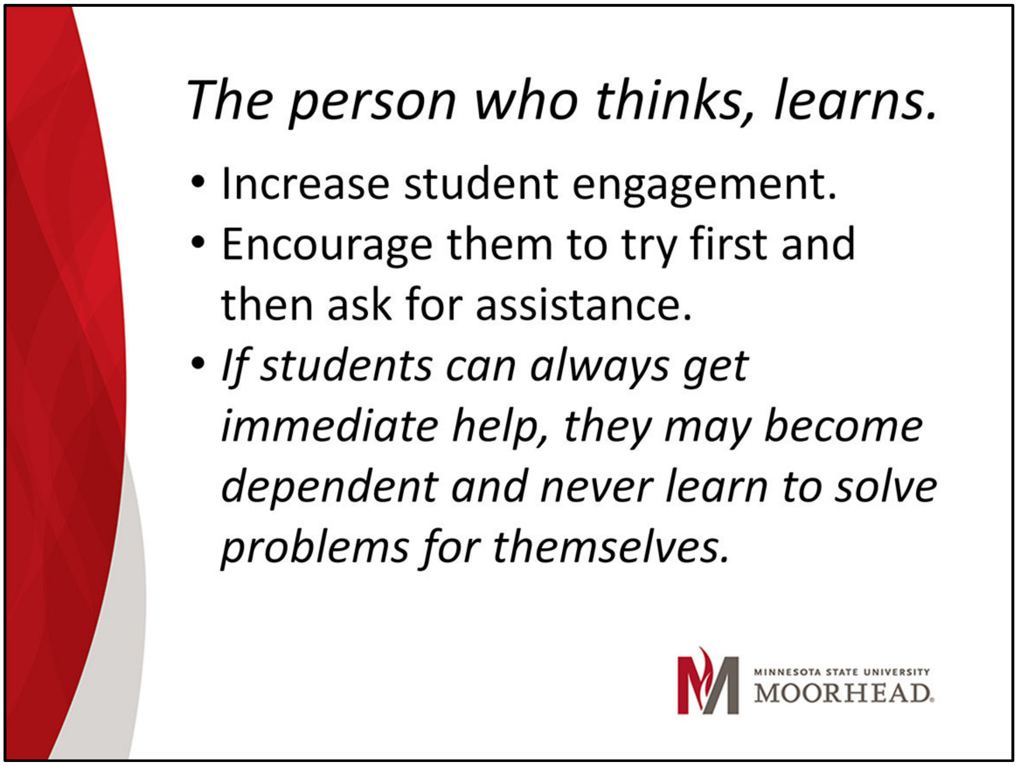
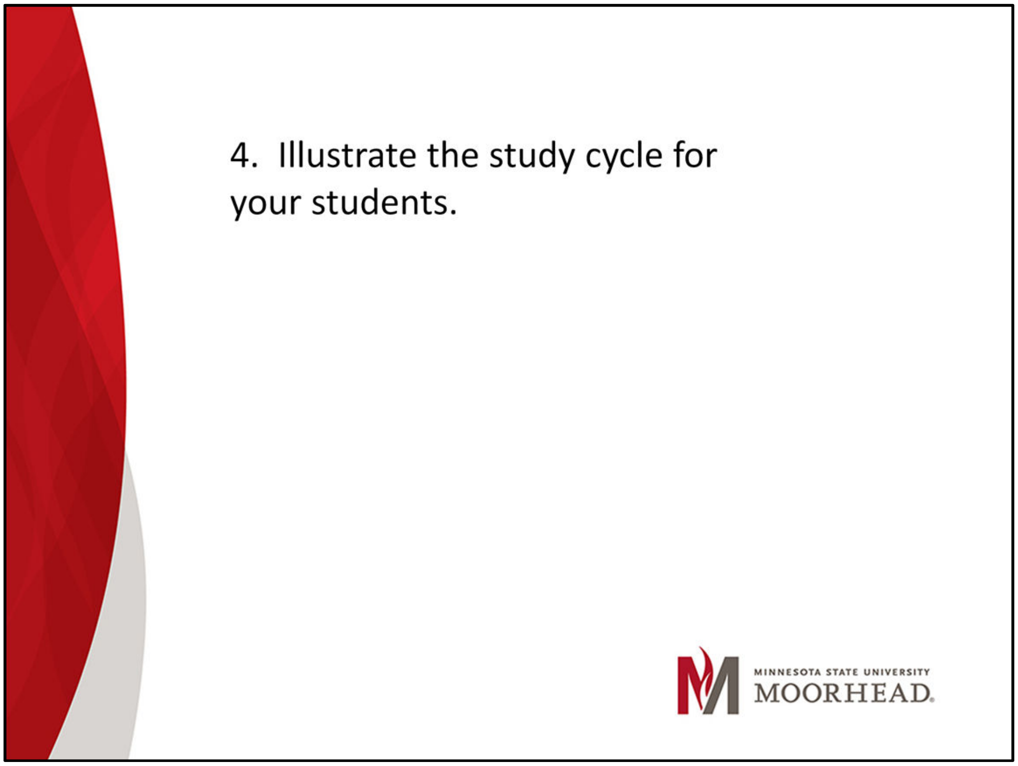


Students need to monitor their learning and actively evaluate their strategies and their current levels of understanding.
Stimulating the growth of more dendrites and synaptic connections is one of the best things teachers can learn to do for the brains of their students.
The more regions of the brain that store data about a subject, the more interconnection there is. This redundancy means students will have more opportunities to pull up all those related bits of data from multiple storage areas in response to a single cue. This cross-referencing of data strengthens the data into something we've learned rather than just memorized. (Willis, 2006)
When students build their working memories through a

variety of activities, they are stimulating multiple sensory intake centers in their brains. (Willis, 2006)



The best way to learn something well is to prepare to teach it. In other words, whoever explains, learns. (Sousa, How the Brain Learns, 2011)
In order for learners to gain insight into their learning and their understanding, frequent feedback is critical: students need to monitor their learning and actively evaluate their strategies and their current levels of understanding. (National Research Council, 2000)



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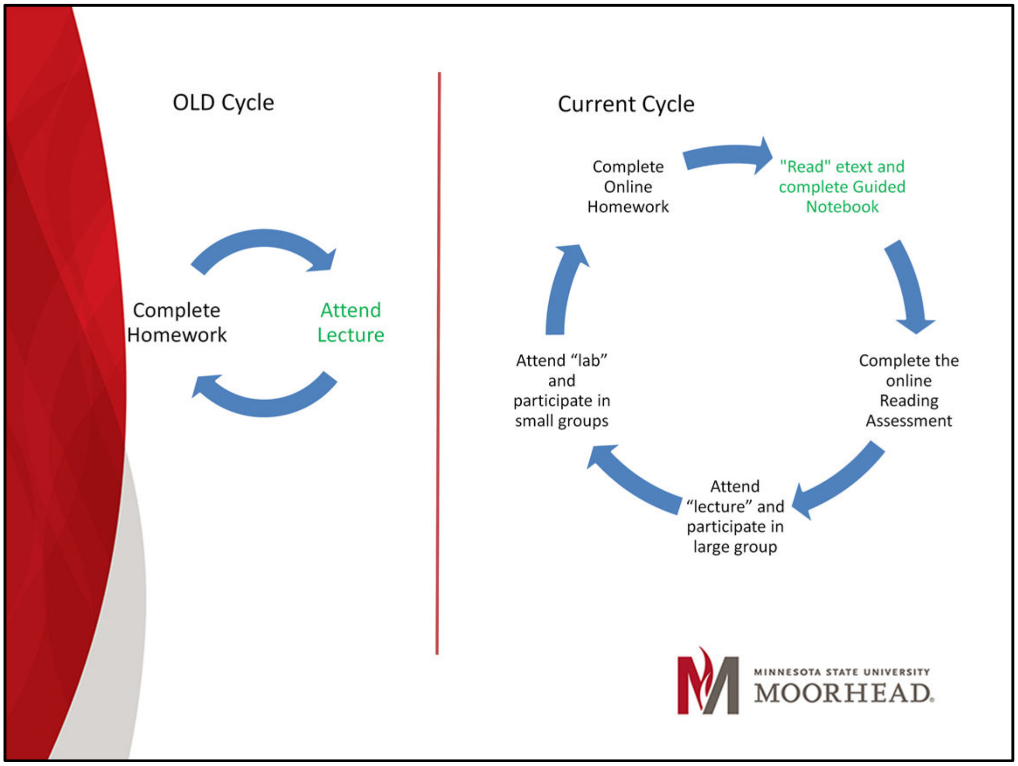
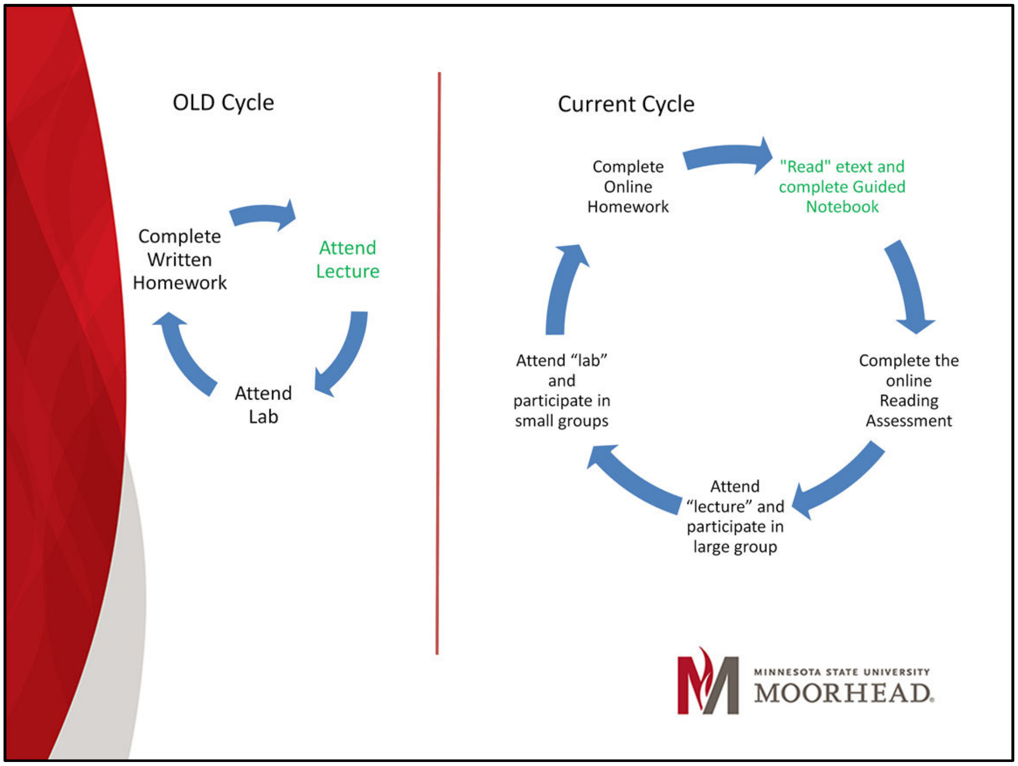


4. Draw Cycle

Old cycle vs. new cycle



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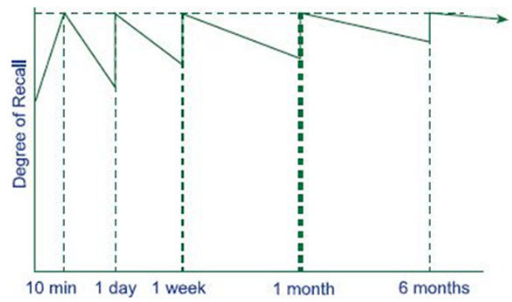
Old cycle vs. new cycle



Sustained practice over time, called distributed practice or the spacing effect, is the key to retention and is the rationale behind the idea of spiral curriculum.

(Sousa, 2011)

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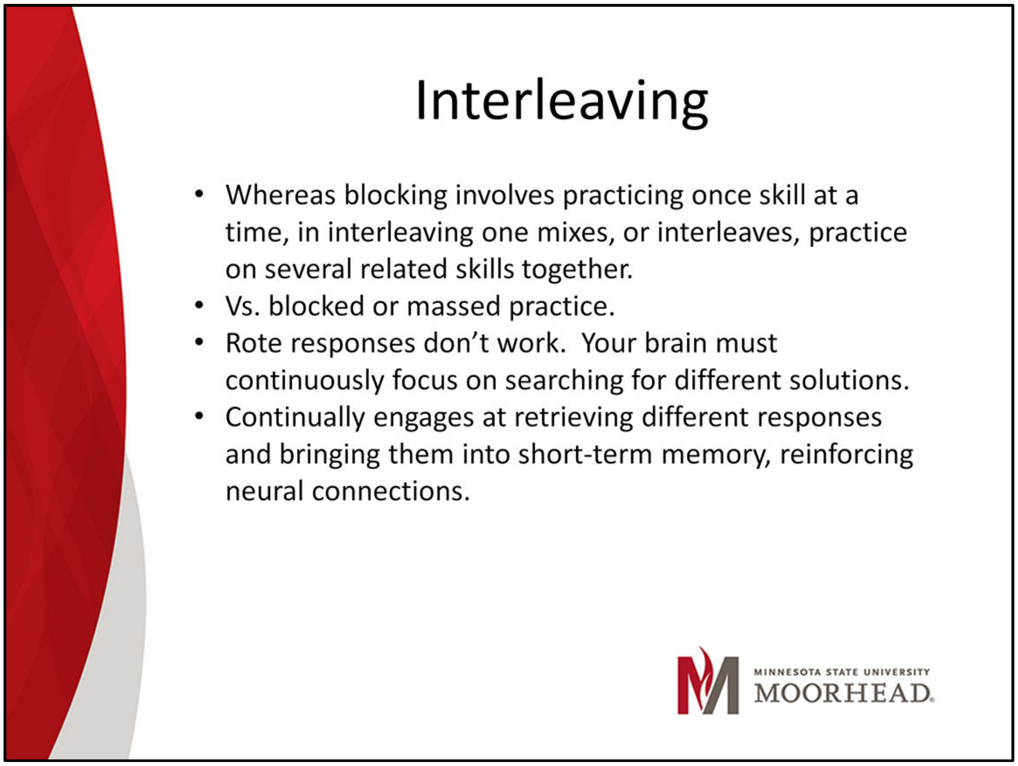
Spiral curriculum, where critical information and skills are reviewed at regular intervals within and over several grade levels.



Did it 35 years ago…Saxon text
The spacing effect was first described by Hermann Ebbinghaus in 1885.

"AAABBBCCC" vs. "ABCABCABC"
"Making it Stick"

Block practice allows a student to get into a groove and get a false sense that they understand it.
Saxon has used interleaving for years.

Section 15.7 Solving Polynomial Equations by Factoring

15.7.1 *	15.7.2 *	15.7.3
15.7.4	15.7.5	15.7.6 *
15.7.7	15.7.8	15.7.9
15.7.10 *	15.7.11	15.7.12
15.7.13	15.7.14 *	15.7.15
15.7.16	15.7.17	15.7.18 *
15.7.19	15.7.20	15.7.21
15.7.22 *	15.7.23	15.7.24
15.7.25	15.7.26 *	15.7.27
15.7.28	15.7.29	15.7.30 *
15.7.31	15.7.32	15.7.33
15.7.34 *	15.7.35	15.7.36
15.7.37	15.7.38 *	15.7.39
15.7.40		

Section 15.7 Applications of Quadratic Equations

15.8.1 *	15.8.2 *	15.8.3
15.8.4	15.8.5	15.8.6 *
15.8.7	15.8.8	15.8.9
15.8.10 *	15.8.11	15.8.12 *
15.8.13	15.8.14 *	15.8.15 *
15.8.16 *	15.8.17	15.8.18
15.8.19	15.8.20 *	15.8.21

Topic 1: 20 problems
Blocked, or mass, practice

Homework 1
Homework 2

Section 15.7 Solving Polynomial Equations by Factoring

15.7.1	1	15.7.2	2	15.7.3	3
15.7.4	1	15.7.5	2	15.7.6	3
15.7.7		15.7.8	2	15.7.9	3
15.7.10	4	15.7.11	5	15.7.12	6
15.7.13		15.7.14		15.7.15	
15.7.16		15.7.17	5	15.7.18	6
15.7.19		15.7.20		15.7.21	
15.7.22		15.7.23		15.7.24	
15.7.25	1	15.7.26	2	15.7.27	5
15.7.28	1	15.7.29	4	15.7.30	
15.7.31		15.7.32	2	15.7.33	
15.7.34	5	15.7.35	6	15.7.36	
15.7.37	6	15.7.38		15.7.39	
15.7.40					

Section 15.7 Applications of Quadratic Equations

15.8.1	1	15.8.2	2	15.8.3	
15.8.4		15.8.5	5	15.8.6	1
15.8.7	2	15.8.8	4	15.8.9	1
15.8.10		15.8.11	4	15.8.12	
15.8.13		15.8.14		15.8.15	1
15.8.16	2	15.8.17	3	15.8.18	6
15.8.19		15.8.20		15.8.21	

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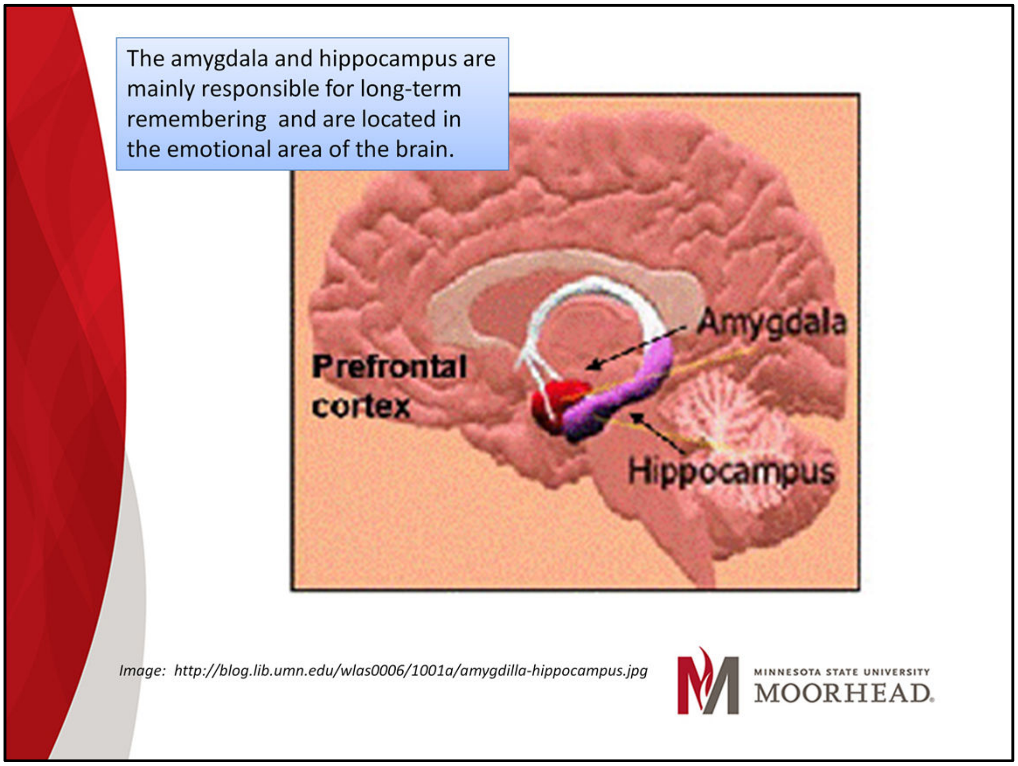
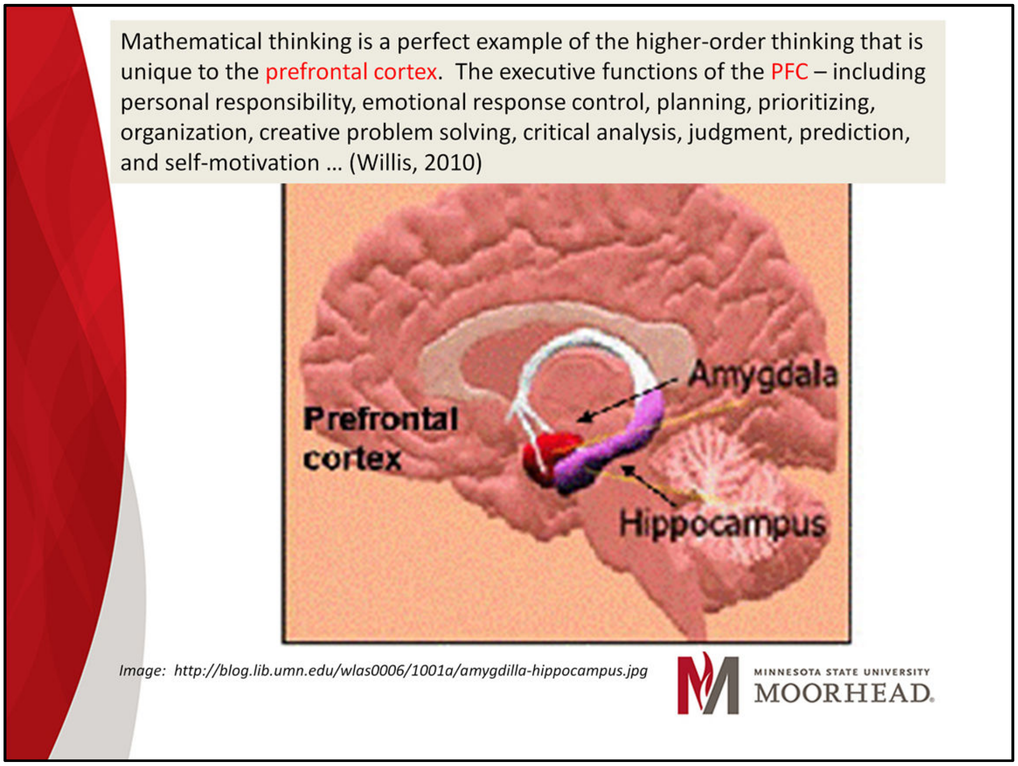
Topic 1: 8 problems, 4 review problems
Topic 2: Includes 11 problems from topic 2, 8 topic 1 topics, 2 review
Topic 3: 10 topic 3, 6 topic 1, 11 topic 2
Topic 4: 15 topic 4, 3 topic 1, 9 topic 3
Assignment 5 and 6 are just on current topics because there are also reviews assigned.



Sensory receptor areas of the brain must travel through the amygdala to get into the hippocampus, from where it can be sent to the executive function and long-term memory storage area of the frontal lobe.
The Hippocampus plays a major role in consolidating learning and in converting information from working memory via electrical signals to the long-term storage regions, a process that may take days to months. It constantly checks information to relayed to working memory and compares it to stored experiences. This process is essential to the creation of meaning. --- The hippocampus is susceptible to stress hormones that can inhibit cognitive functioning and long-term memory. (Sousa, How the Brain Learns, 2011)



Information has to get past the brains' emotional filters located in the amygdala to get to the conscious thinking and long-term memory parts of the PFC.

The prefrontal cortex is the front part of the frontal lobe.

Frontal lobe

- matures slowly – it continues to mature into early adulthood. The capability of the frontal lobe to control the excesses of the emotional system is not operational during adolescence.
- most of working memory is located here…it is where focus occurs

Remember neurotransmitters? Brain chemicals that bathe the brain cells and either permit signals to pass between them or inhibit them.

When people feel positive about a learning situation, chemicals called endorphins and dopamine become active. Dopamine stimulates the prefrontal cortex, keeping the individual attentive, interactive and likely to remember what they experience. Negative feelings cause the hormone cortisol to enter the bloodstream. Cortisol puts the brain into survival mode; this shifts the brain's attention away from learning so it can deal with the source of stress. (Educational Leadership, 2009)

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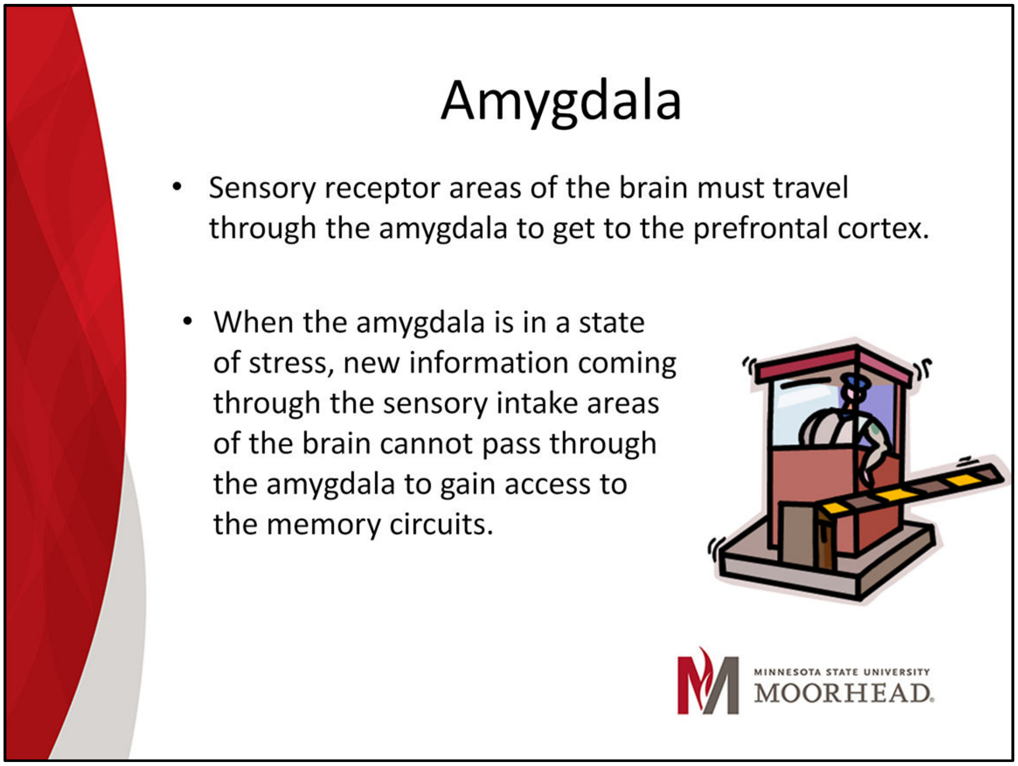
Stress in the classroom or elsewhere, especially when associated with anxiety or fear, releases a chemical called TMT, or trimethyltin, into the brain. TMT disrupts brains cell development. In the hippocampus region, through which data must pass to be encoded as memory, stress-related release of TMT – both acute and chronic – suppresses the growth of dendrites and maintenance of neuron health. (Willis, 2006)

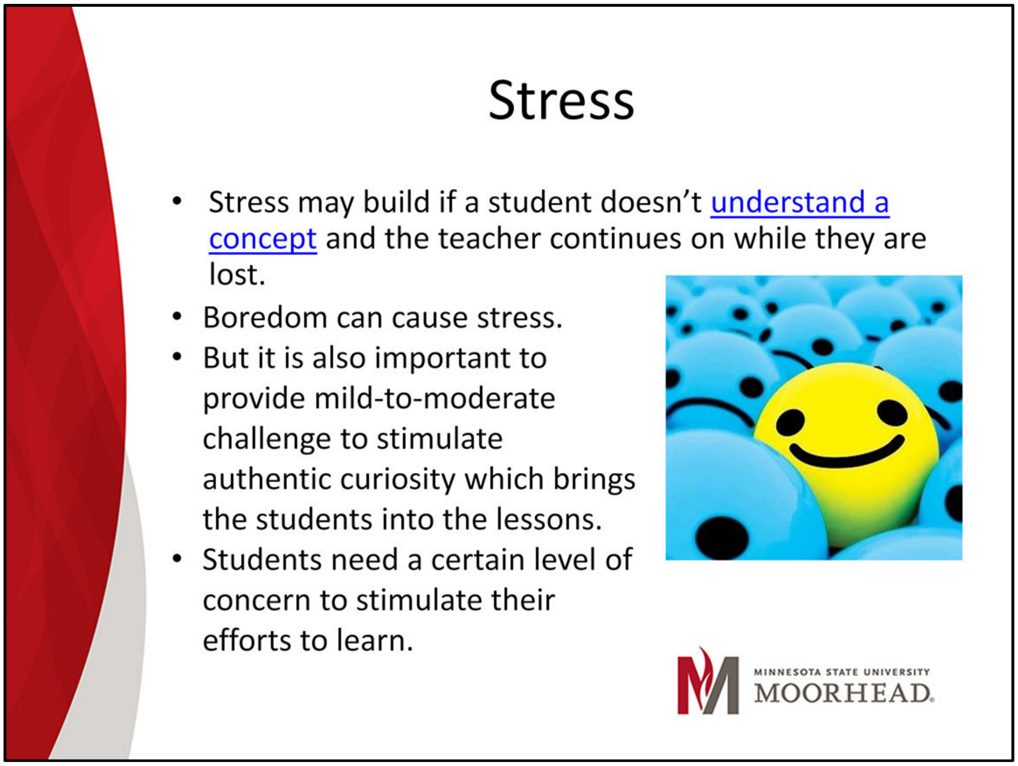


Subsequent research revealed that after presentation of pleasurable, comforting, positively reinforcing, intrinsically motivating stimuli, the amygdala could be moderately stimulated or warmed up to the alert state that actually facilitates active processing and neuronal transport of information. (Willis, 2006)

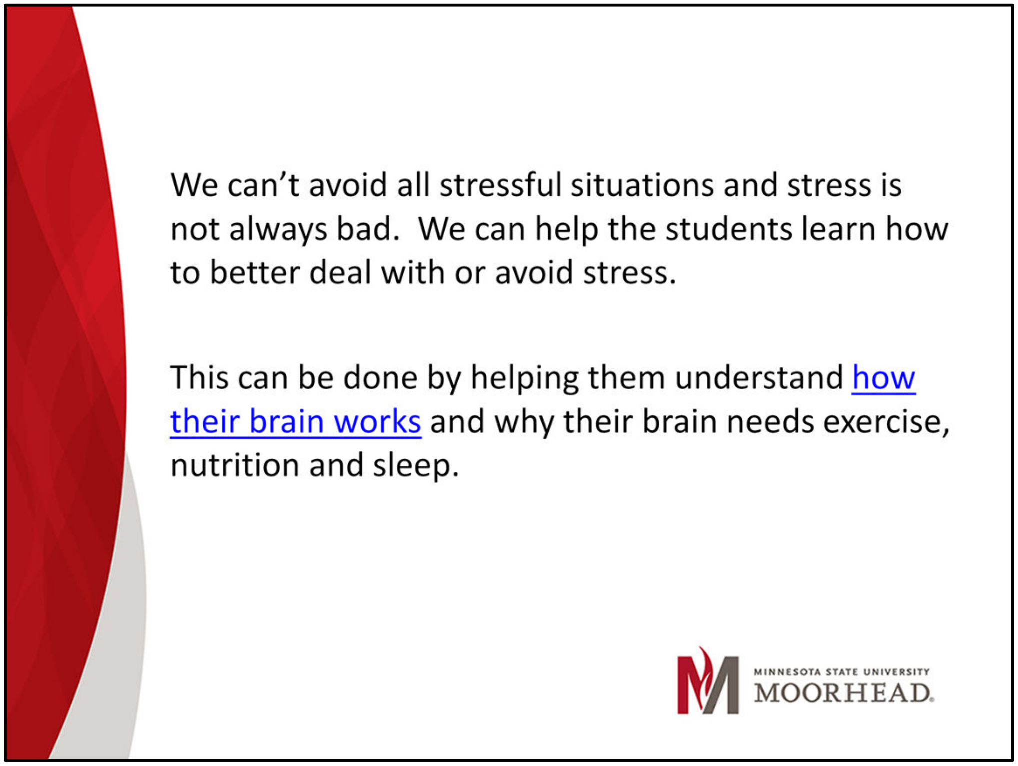
Amygdala hijacking – negative feelings cause the hormone cortisol to enter the bloodstream. Cortisol puts the brain into survival mode; this shifts the brain's attention away from learning so it can deal with the source of stress… Stress in the classroom or elsewhere, especially when associated with anxiety or fear, releases a chemical called TMT, or trimethyltin, into the brain. TMT disrupts brains cell development. In the hippocampus region, through which data must pass to be encoded as memory, stress-related release of TMT – both acute and chronic – suppresses the growth of dendrites and maintenance of neuron health.

When students feel positive about a learning situation, chemicals called endorphins (provide feeling of euphoria) and dopamine (stimulates the prefrontal cortex) become active.

A stress state happens when a lesson is tedious, not relevant to their lives, confusing, or anxiety-provoking.

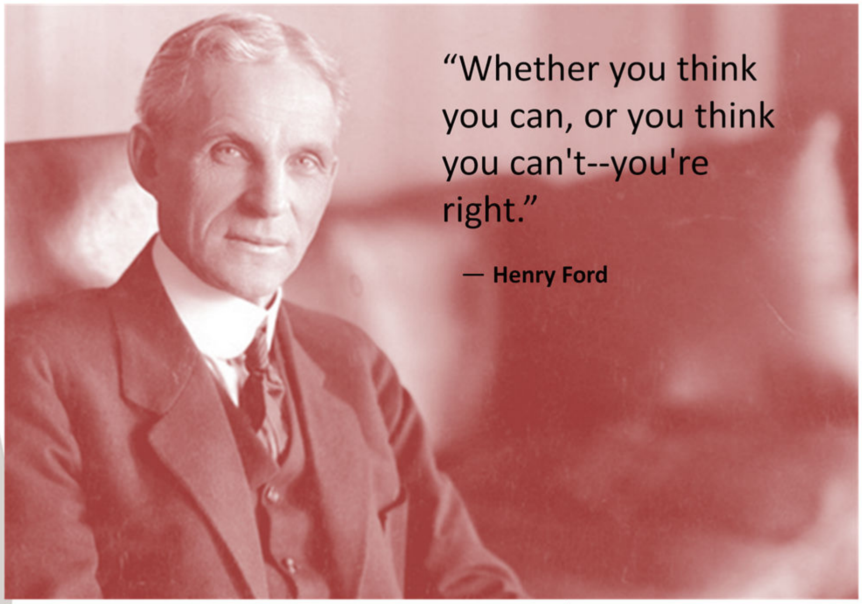


There is also helpful stress (desire to do well). Boredom is also a cause of stress.
The **guided notebook** provides some organization to prepare for class and offer some familiarity to topics before lecture.



Brain lessons were incorporated into their Guided Notebook beginning Fall 2015. Also included will be pages to help improve their metacognition skills…learning how to learn.

Brain Lessons



"Whether you think you can, or you think you can't--you're right."

— **Henry Ford**

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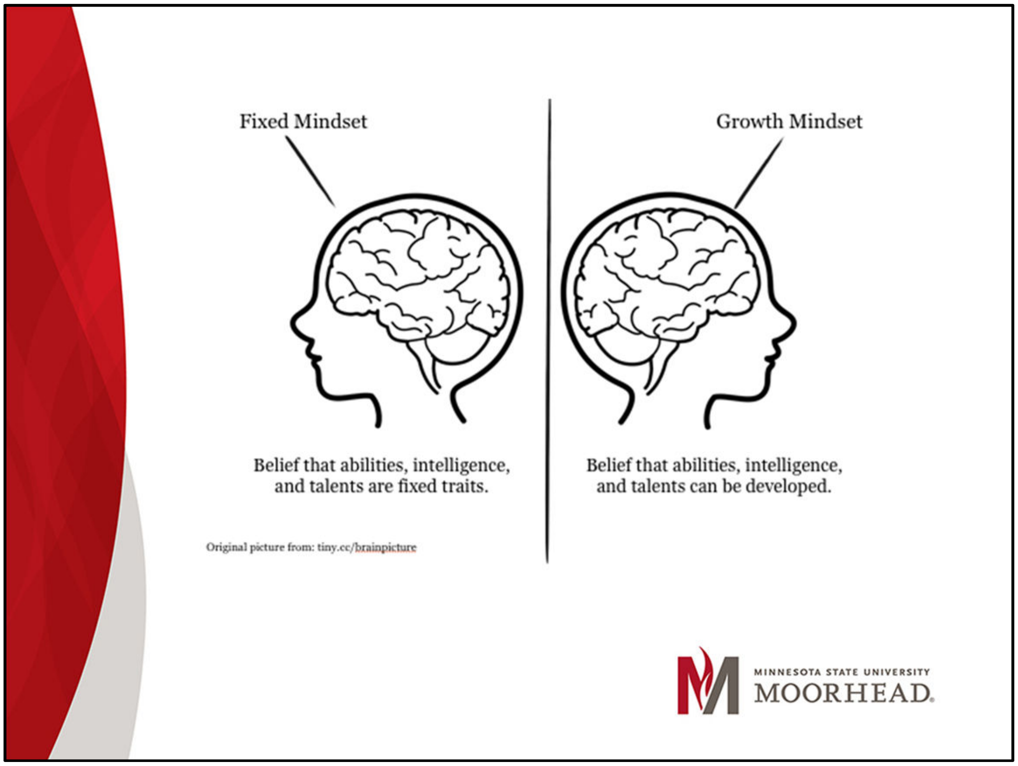
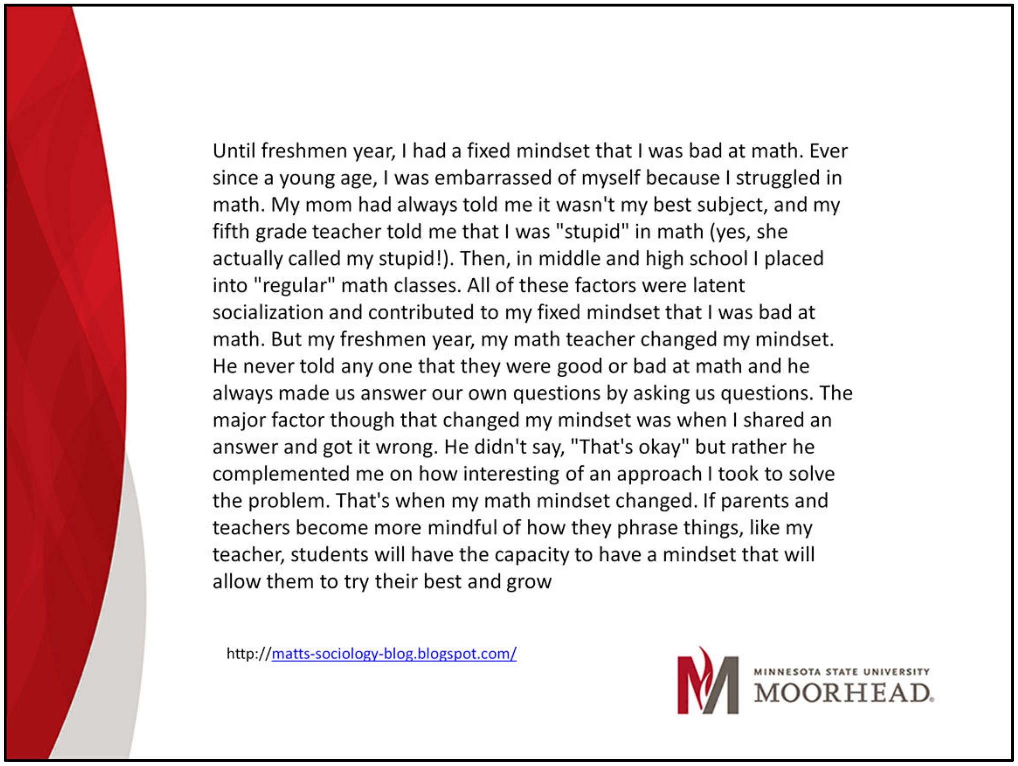


Mindset plays a key role in student's persistence and view of one's capabilities. Carol Dweck



http://matts-sociology-blog.blogspot.com/2011/10/mathematical-mindset.html
The Serendipity of Sociology

Frequent Feedback is Critical

- Recent imaging studies have shown that brain regions associated with motivation are more active in subjects who are learning tasks and receiving feedback than in subjects doing the same tasks with no feedback.
- Feedback is a key contributor to motivation.
- Effective feedback is timely.
- Good feedback is also specific.
- Positive feedback stimulates the prefrontal cortex to reflect on ways to improve.

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- Establish a climate where students feel they are treated fairly and feel free to express their opinions.
- Encourage students to make connections and be an active learner.
- Establish responsibility and accountability.
- Provide feedback.
- Educate students on how the brain learns.

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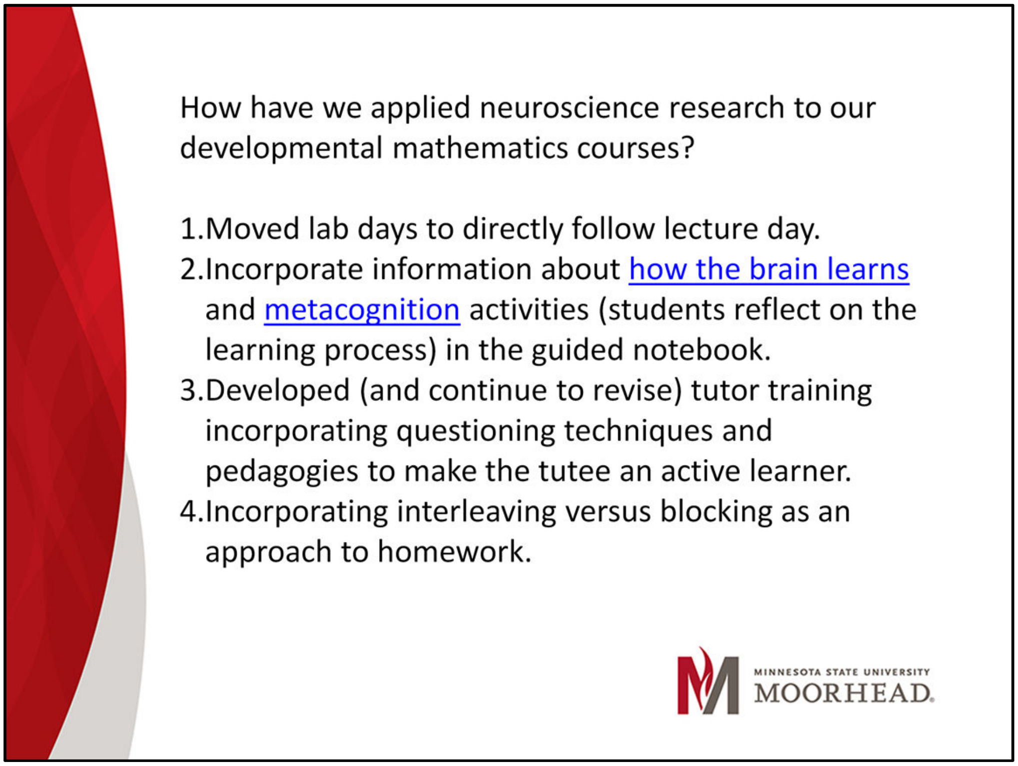

5. Points of interest to be investigated or implemented.

Sources

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Dr. David A. Sousa is an international consultant in educational neuroscience and author of 15 books that suggest ways that educators and parents can translate current brain research into strategies for improving learning.

Dr. Judy Willis, a board-certified neurologist in Santa Barbara, California, has combined her 15 years as a practicing adult and child neurologist with her teacher education training and years of classroom experience.

ASCD (Association for Supervision and Curriculum Development) Resource

Carol Dweck, a professor of psychology at Stanford, researches mindsets; fixed mindset vs. growth mindset and how a particular mindset can affect all areas of your life.

Henry Roediger, Mark McDaneil and Peter Brown, are two cognitive scientists and one story teller summarizes empirical research of how learning and memory work.