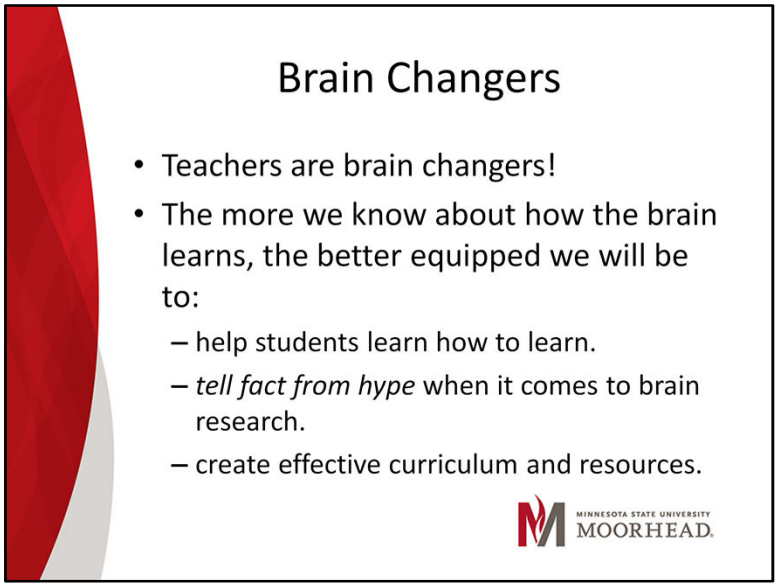
Brain research and its interpretation. Is the research valid?

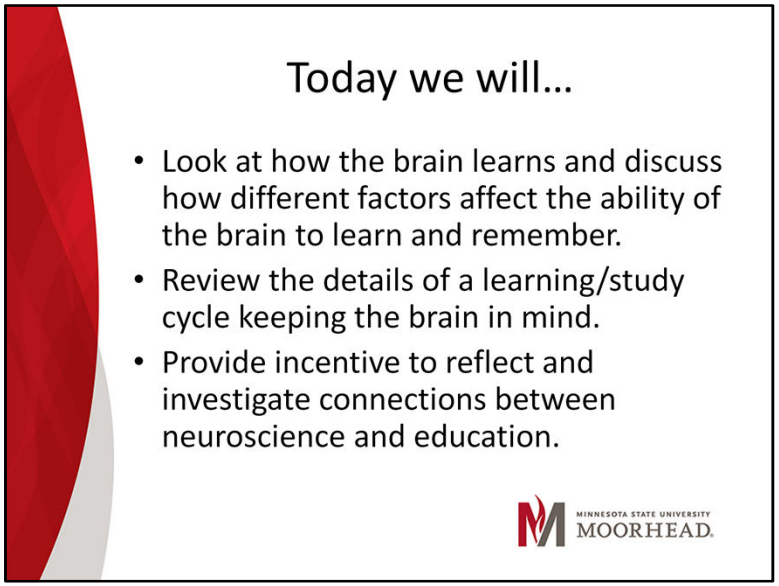
Educational neuroscience

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



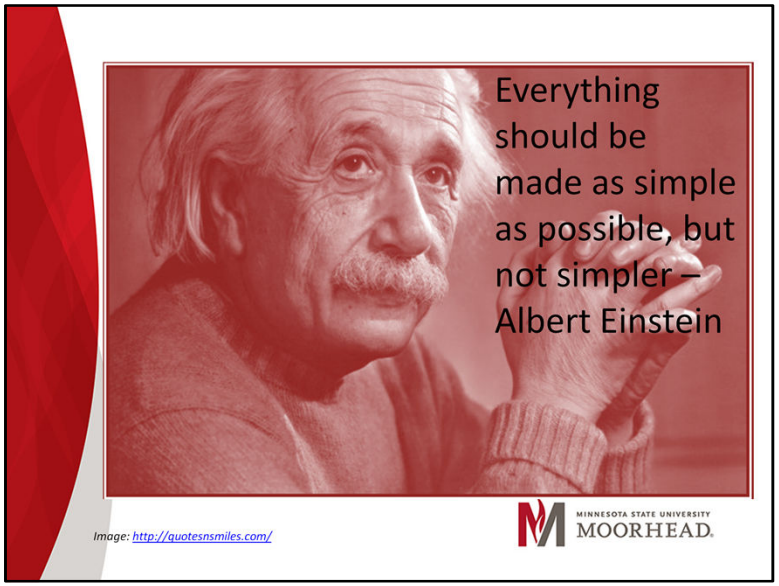
Knowing how the human brain seems to process information and learn can help teachers plan lessons that students are more likely to understand and remember. The more we know about how we learn, the more we can be in control of our learning…metacognition.

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)



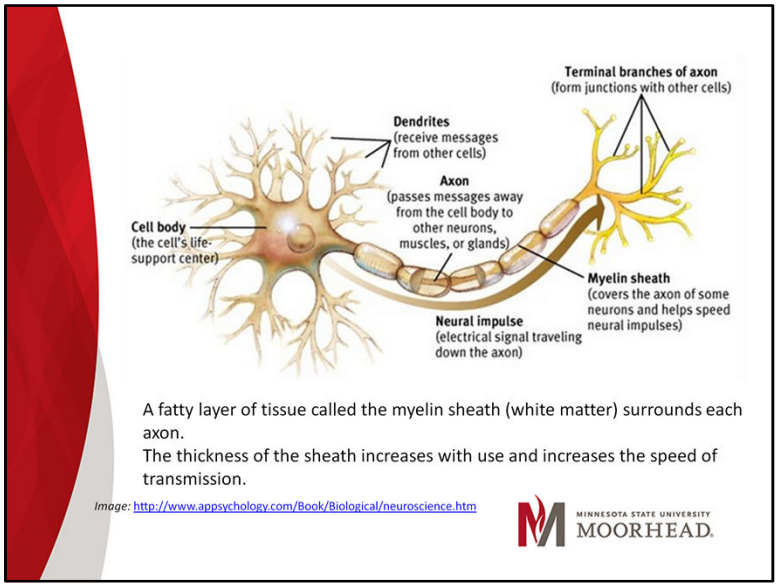
As scientific understanding of learning includes understanding about learning processes, learning environments, teaching, sociocultural processes, and the many other factors that contribute to learning. Research on all of these topics, both in the field and in laboratories, provides the fundamental knowledge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

This presentation will summarize these areas concentrating on the learning processes.

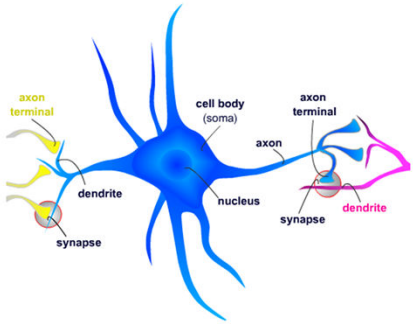


We take the ‘complicated’ and make it understandable without jeopardizing the integrity of the facts or true intentions of the research.

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



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



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.

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

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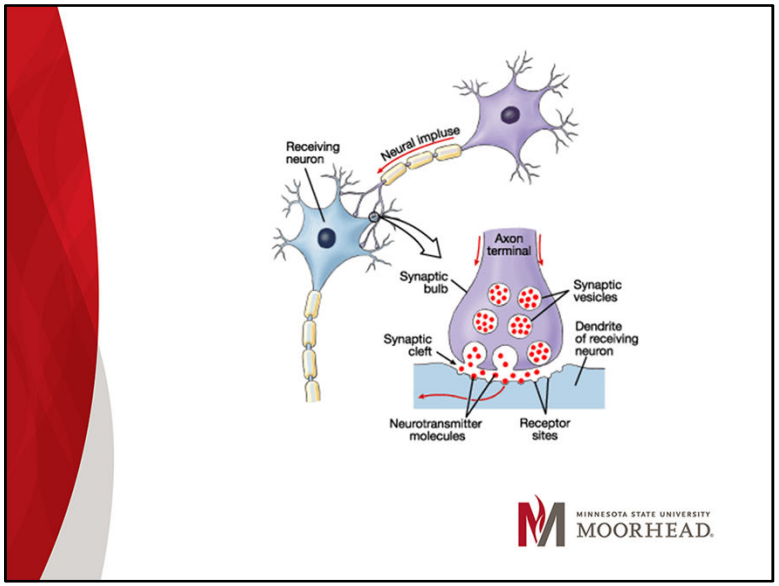

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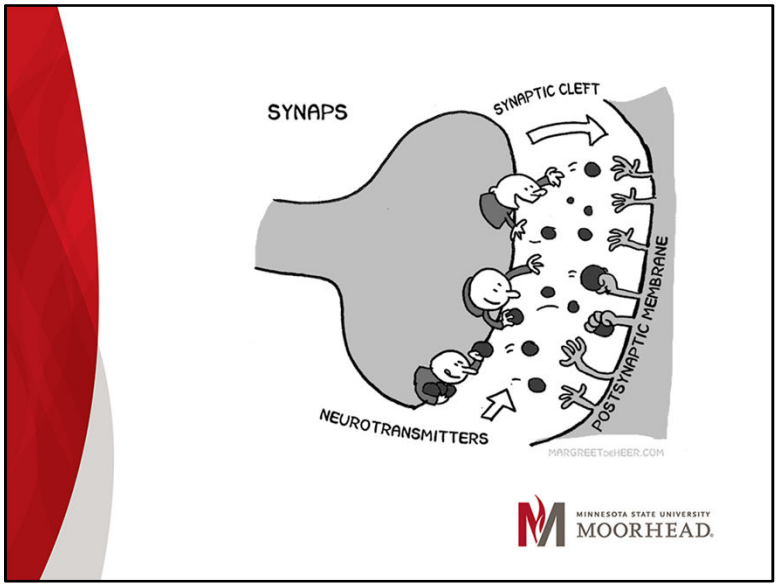

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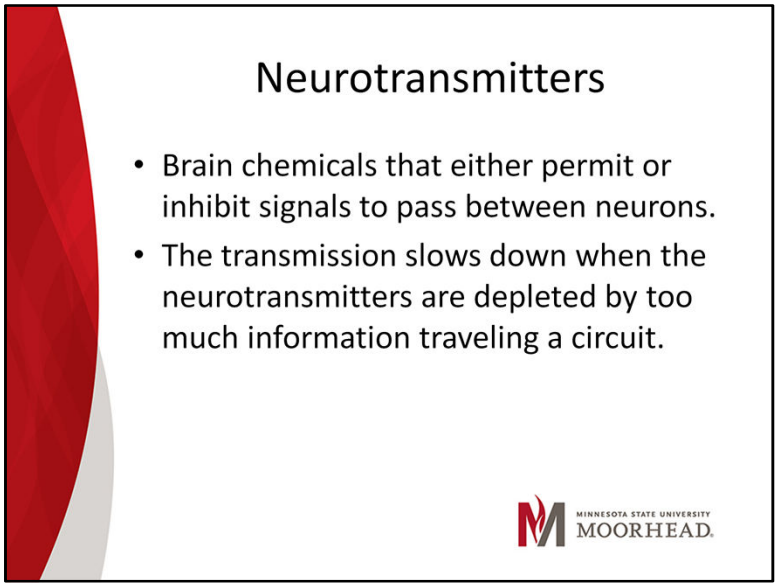


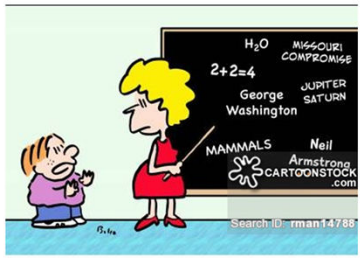
INHIBITORY : does not stimulate the brain
Serotonin: necessary for a stable mood and to balance excessive excitatory neurotransmitters.
Gaba: sent to attempt to balance excitatory overfiring.
Dopamine: can be both. Helps with depressions and focus.

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).



"Whoa! — too much information!"

https://s3.amazon.com/...

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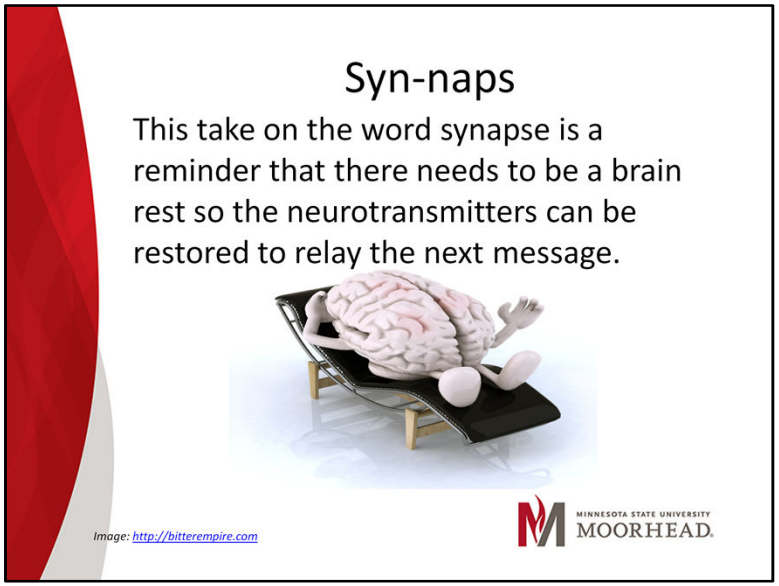
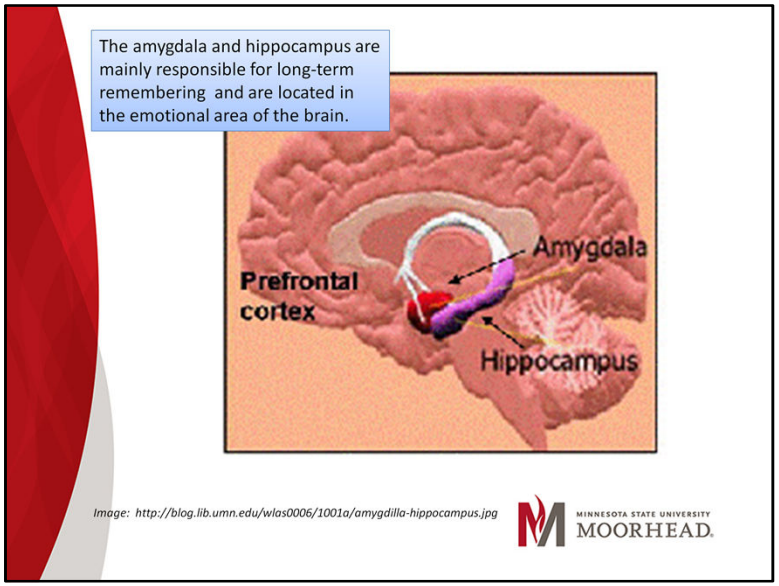
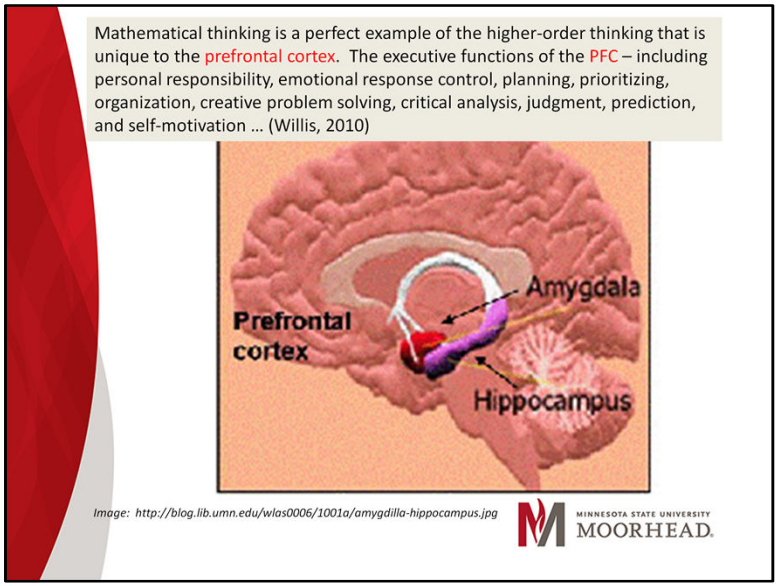


Daily lesson: Introduce some new material, practice, repeat. Example: practice worksheet.

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)



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 be 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)

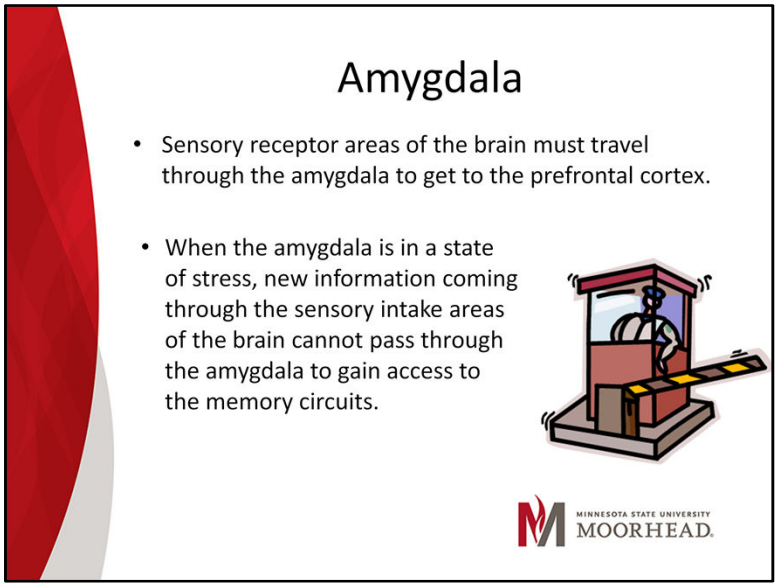


Information has to get past the brains' emotional filters located in the amygdala to get to the conscious thinking and long-term memory parts of the PFC.

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



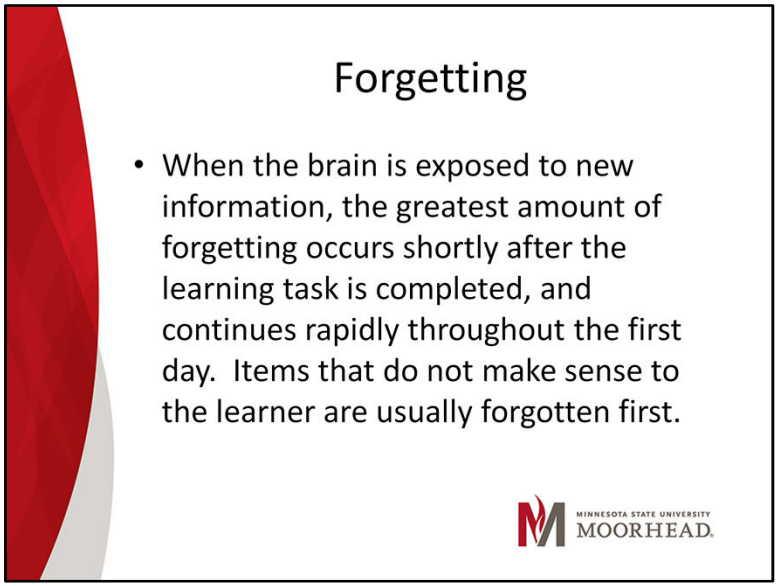
Subsequent research revealed that after presentation of pleasurable, comforting, positively reinforcing, intrinsically motivating stimuli, the amygdala could be moderately stimulated or warmed up to the alert state that actually facilitates active processing and neuronal transport of information. (Willis,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

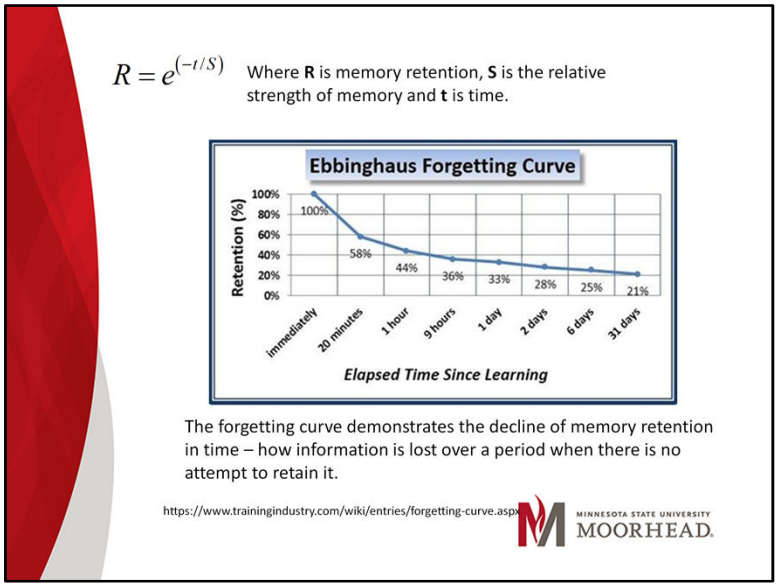
through which data must pass to be encoded as memory, stress-related release of TMT – both acute and chronic – suppresses the growth of dendrites and maintenance of neuron health.

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

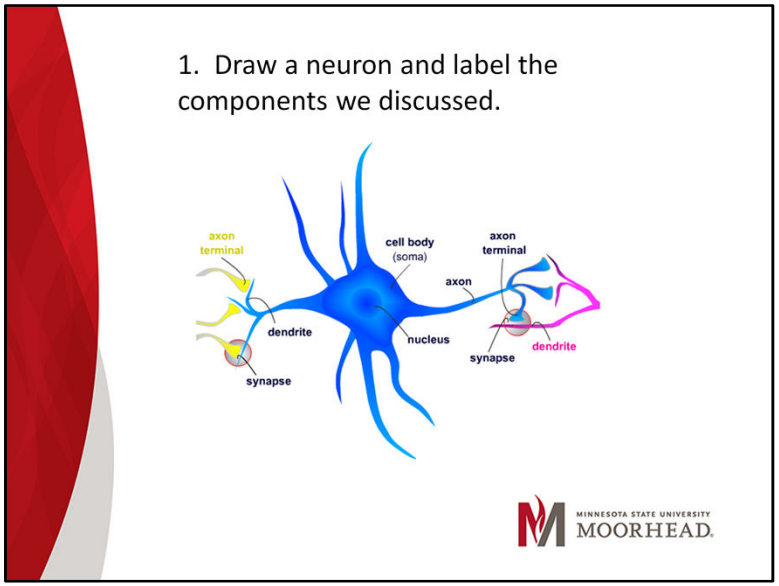
A stress state happens when a lesson is tedious, not relevant to their lives, confusing, or anxiety-provoking.



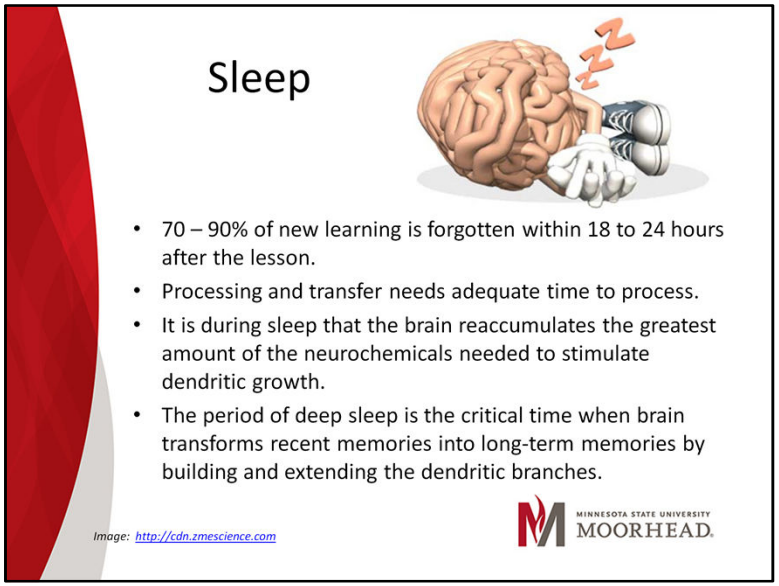
We can't possibly remember everything. We filter out the trivial to leave room for the more important.



Philosopher Hermann Ebbinghaus conducted experiments on his own memory, where he memorized a set of 3-letter nonsense syllables and then tested himself at intervals to see how much he could remember. This was the resulting data, showing that after only about 3 days, he forgot 75% of what he learned.



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!



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)

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.

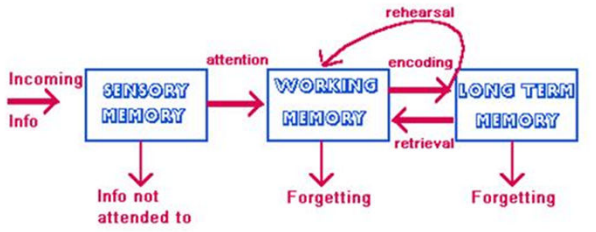


Image: http://healthpsych.psy.vanderbilt.edu/alcoholMemory_files/image007.jpg

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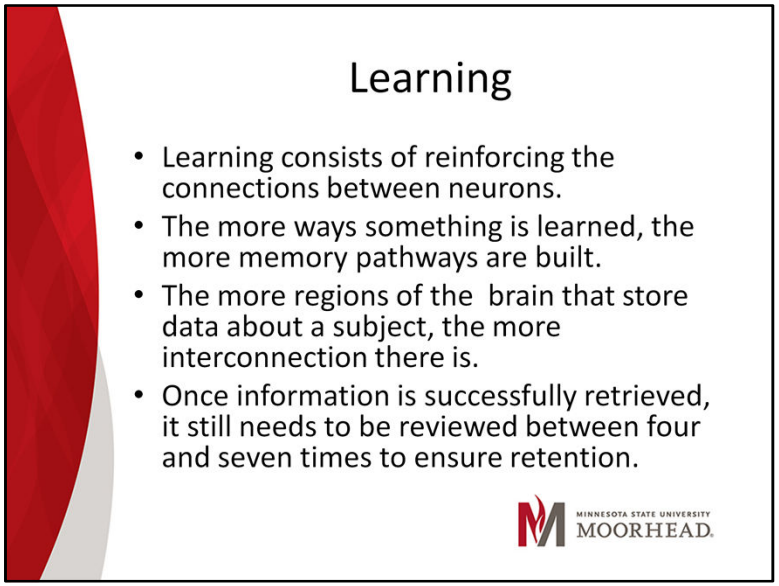


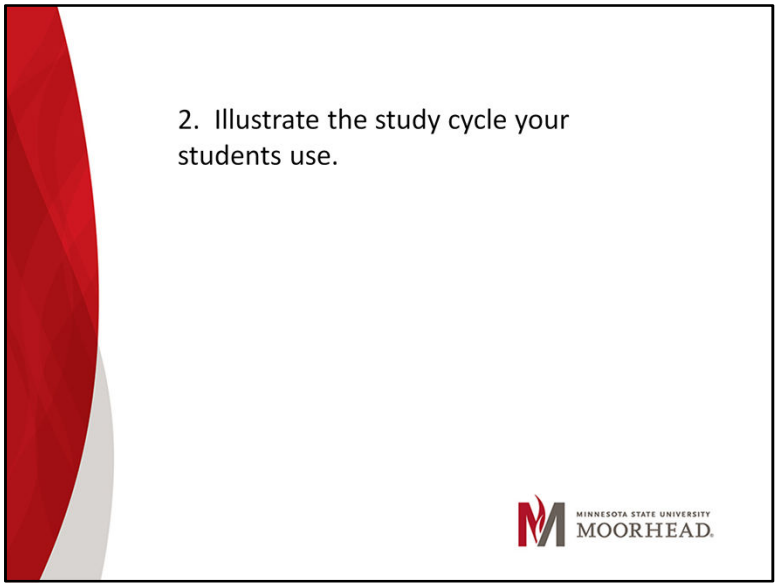
Students need to monitor their learning and actively evaluate their strategies and their current levels of understanding.

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)



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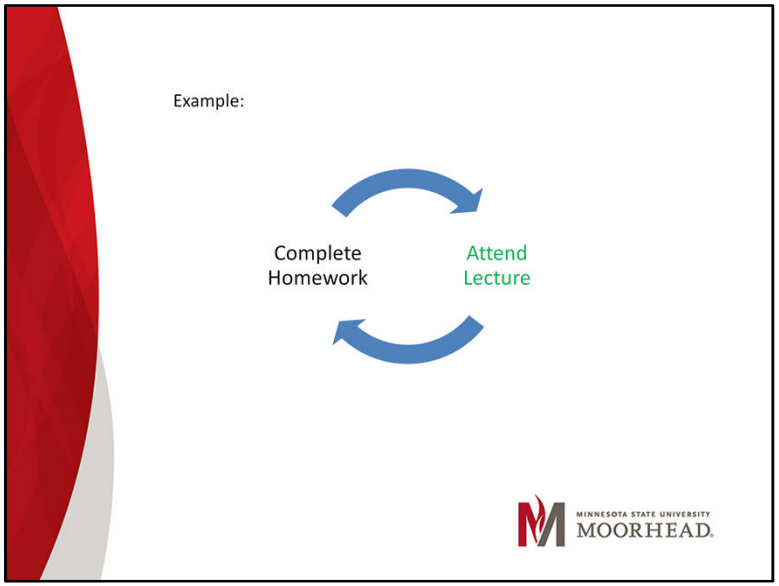
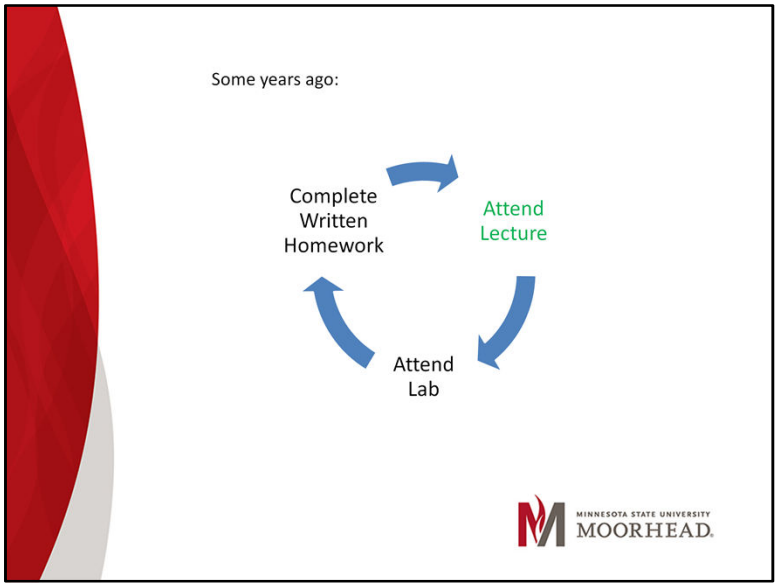


4. Draw Cycle

Old cycle vs. new cycle



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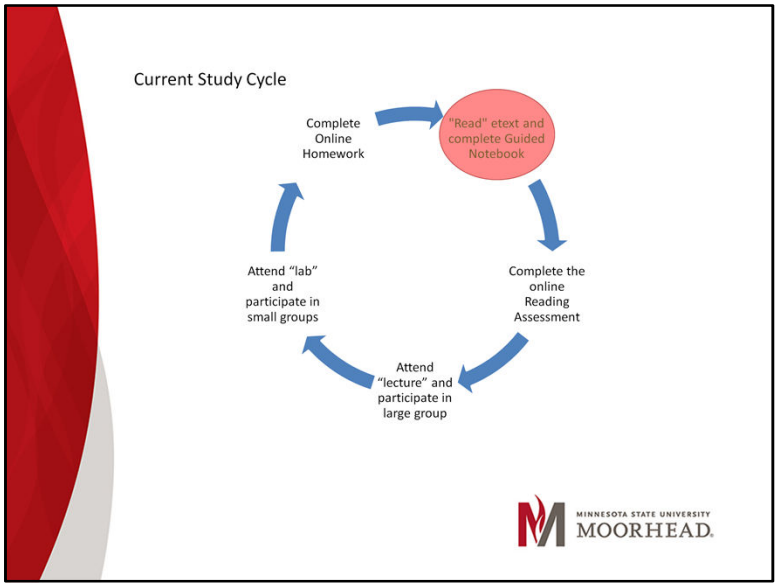
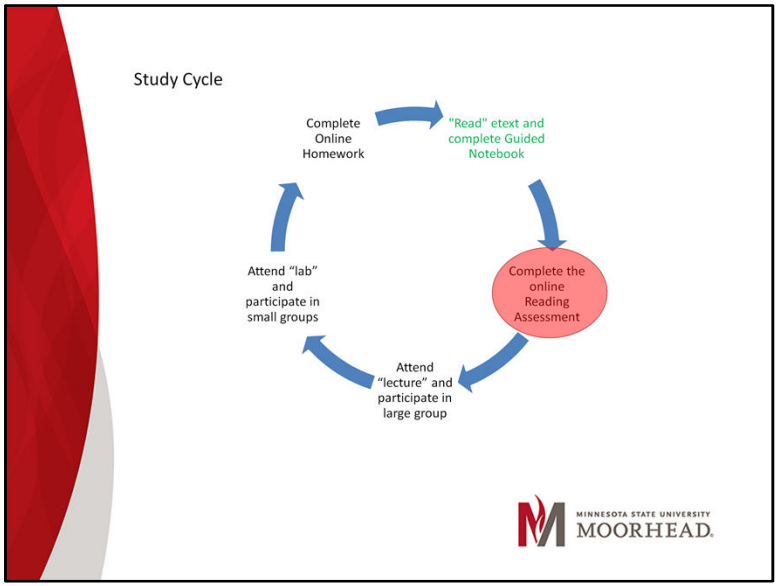


The study cycle may be familiar to many, but why does it work? How does each step of the study cycle figure in to the learning process and what it happening in the brain?

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



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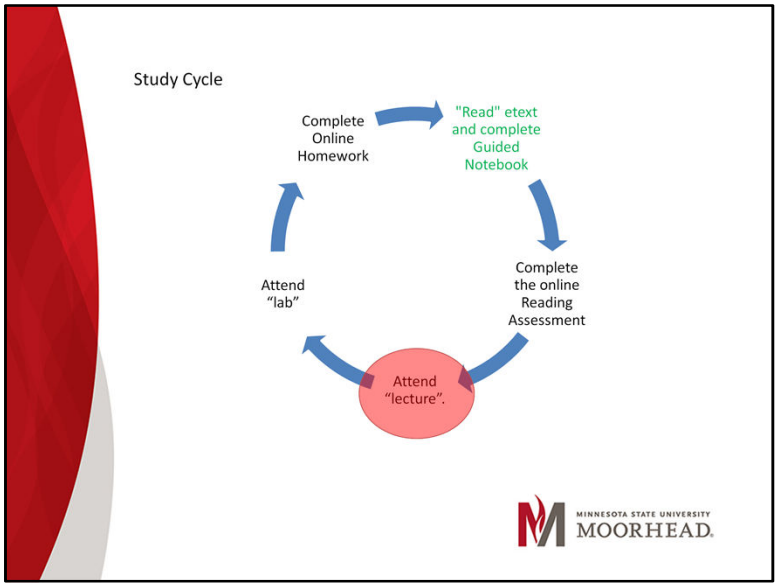

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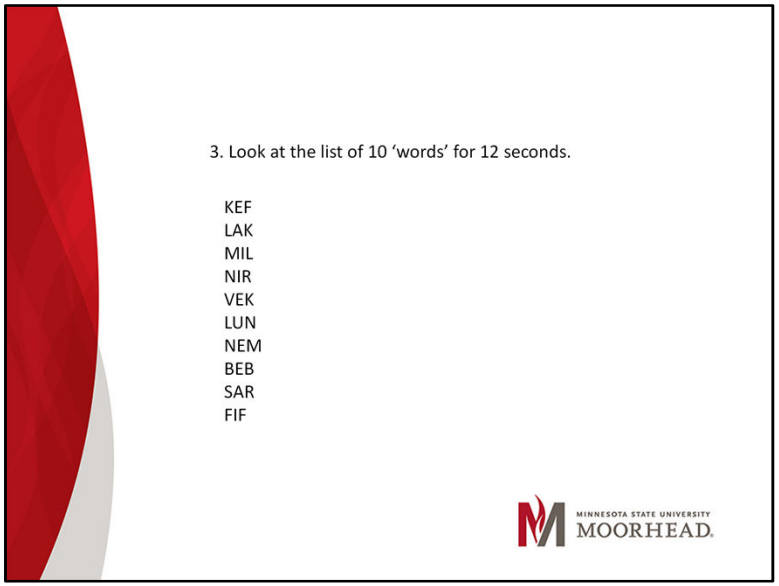
3. Look at the list of 10 'words' for 12 seconds.
KEF
LAK
MIL
NIR
VEK
LUN
NEM
BEB
SAR
FIF
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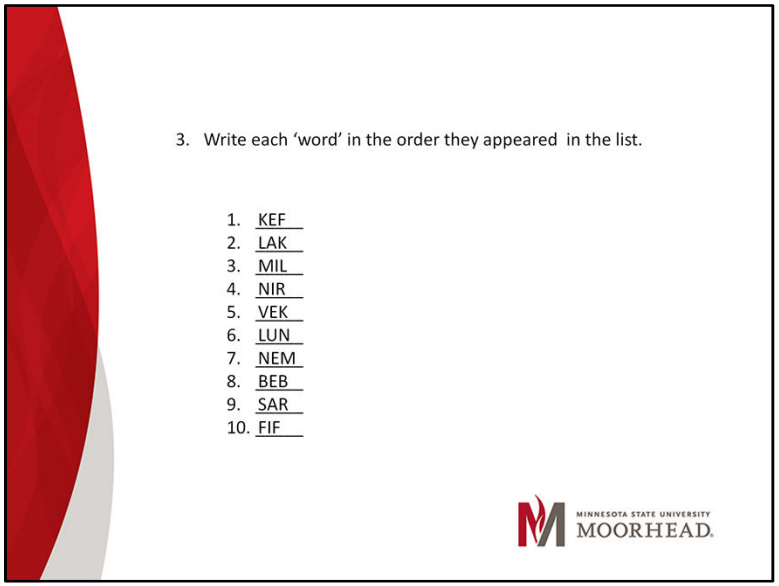
2.



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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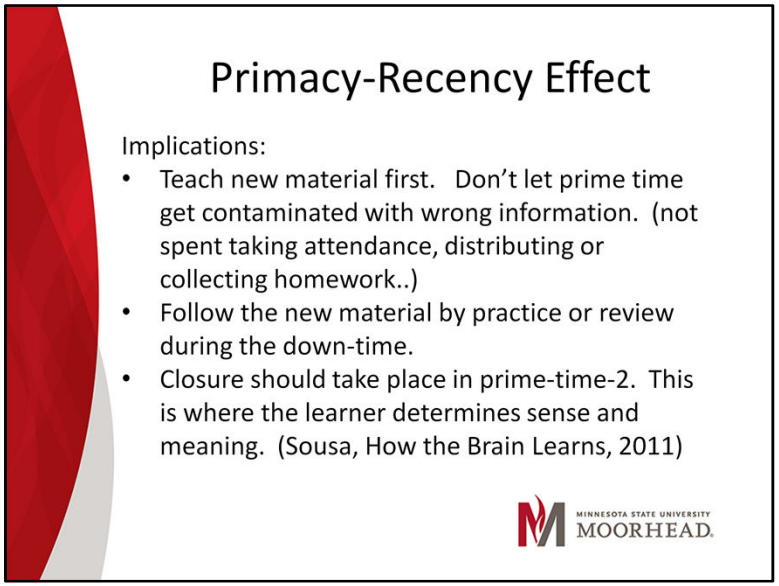
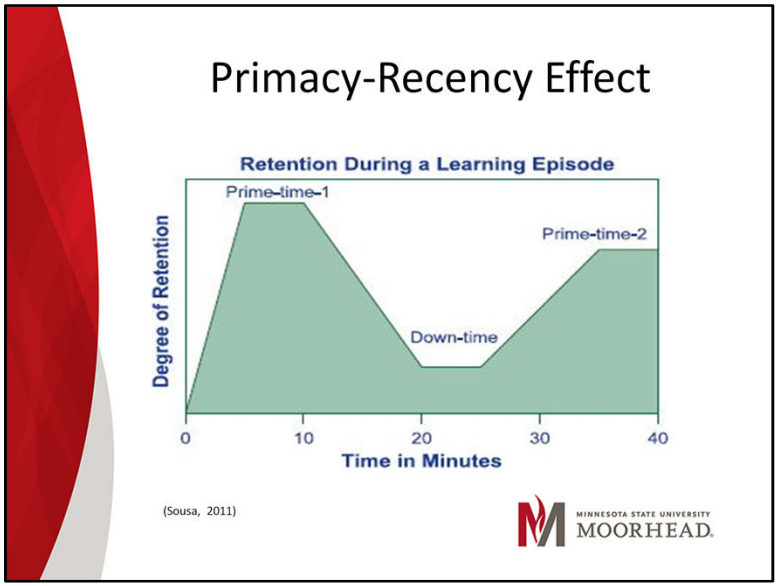


More attention occurs when lessons are shorter and meaningful. (Sousa, How the Brain Learns, 2011)



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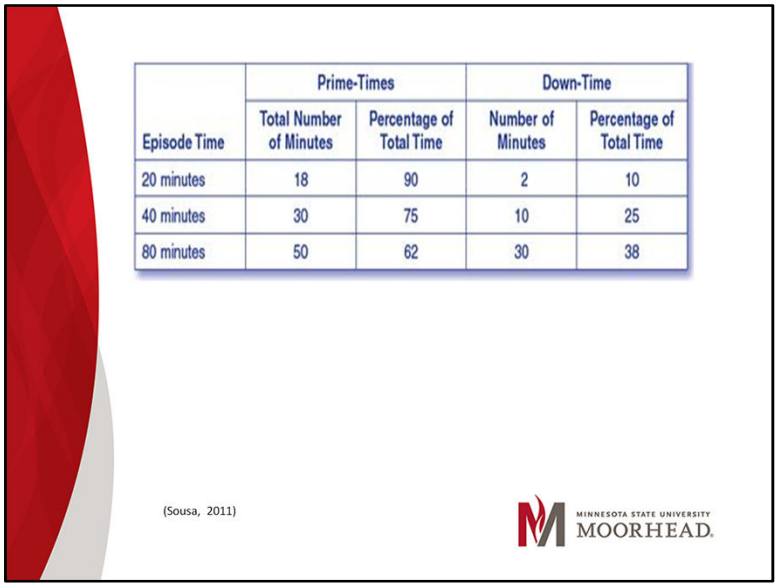
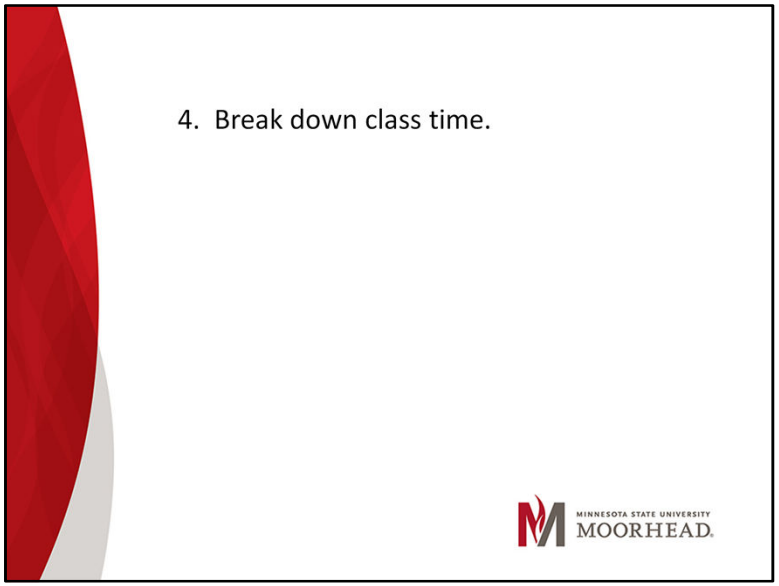


Although classes are 50 minutes, we can think of it as 2 twenty minute ‘episodes’ with 5 minutes at the beginning and 5 minutes at the end for additional tasks.



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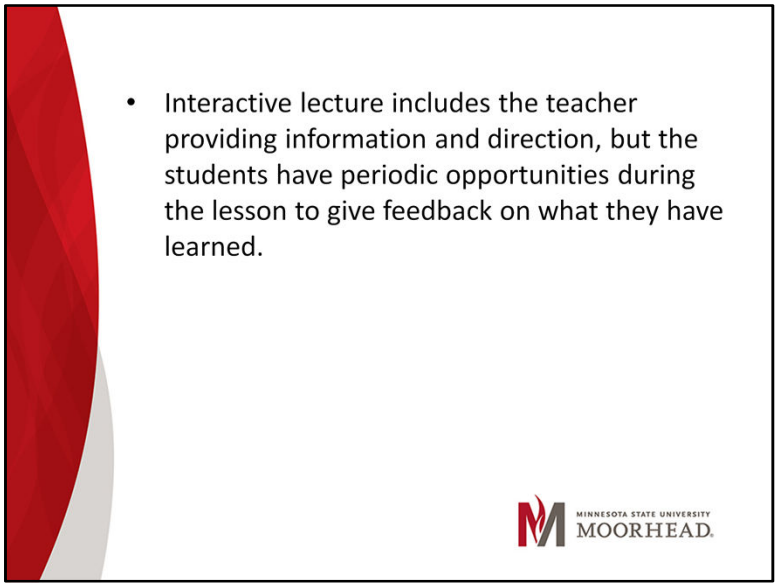
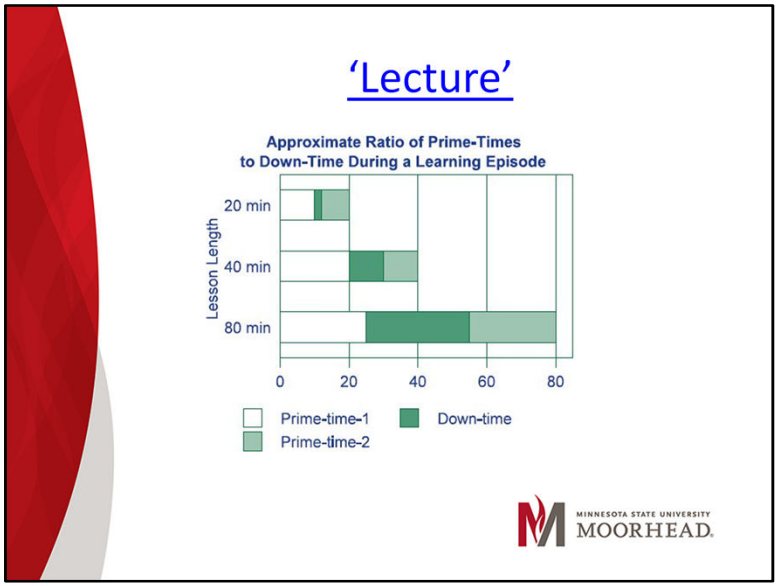
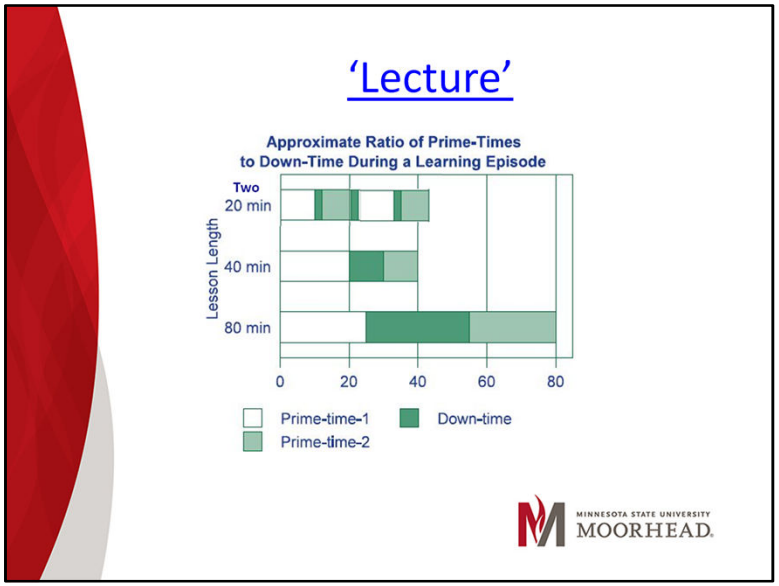


In 2006, 81,499 students in grades 9 – 12 from 26 states participated in a survey of student engagement and reasons for dropping out. Only 27 percent said they would consider dropping out because the work was too difficult. The majority said the reason they would consider it was because it was boring,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



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.



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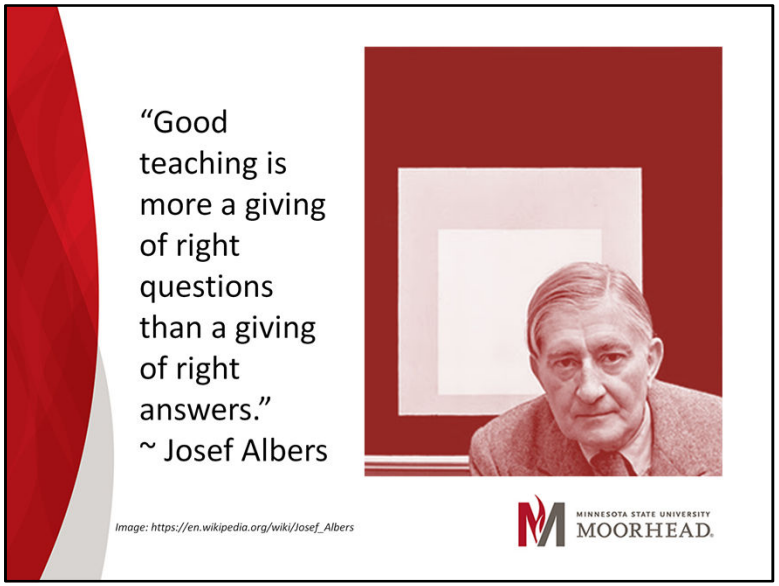
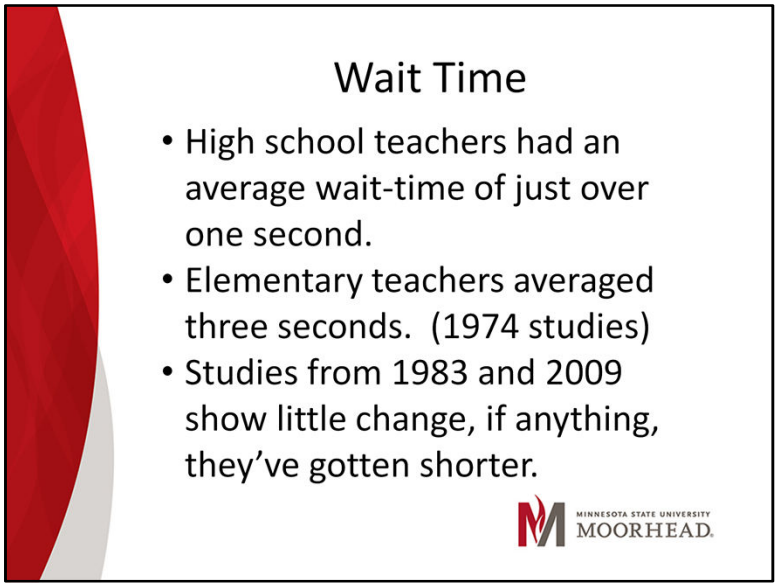


Socratic vs. Didactic

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

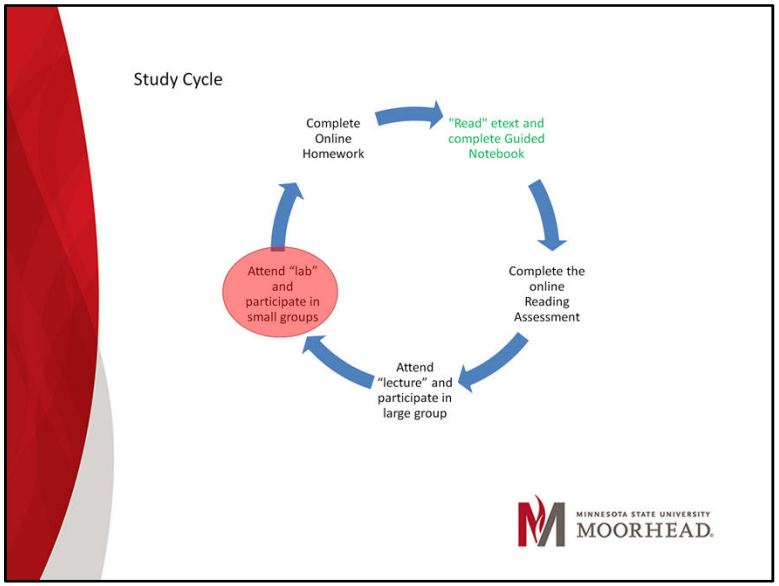
- Utilize Socratic tutoring style versus didactic tutoring style (both can be effective)
- When a student explains their thinking out loud it enhances their learning. (Socratic versus Didactic Tutoring, 2001)
- Both can use open ended questions. In socratic, the tutee does more of the talking.

6pq tutoring



Extend the wait-time to at least five seconds or more:

- The length and the quality of student responses increased.
- There was greater participation by slower learners.
- Students used more evidence to support inferences.
- There were more higher-order responses. (Sousa)
- Think-pair-share


Study Cycle
Complete Online Homework
"Read" etext and complete Guided Notebook
Complete the online Reading Assessment
Attend "lecture" and participate in large group
Attend "lab" and participate in small groups
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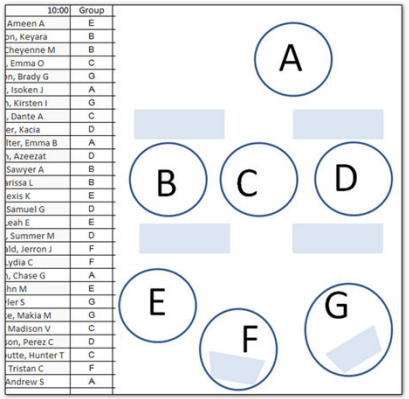
"Lab"

10:00	Group
Ameen A	E
on, Keyara	B
Cheyenne M	B
, Emma O	C
n, Brady G	G
, Isoken J	A
, Kirsten I	G
, Dante A	C
er, Kacia	D
ter, Emma B	A
, Azeezat	D
Sawyer A	B
rissa L	B
exis K	E
Samuel G	D
eah E	E
, Summer M	D
ld, Jerron J	F
ydia C	F
, Chase G	A
hn M	E
ler S	G
e, Makia M	G
Madison V	C
on, Perez C	D
utte, Hunter T	C
Tristan C	F
Andrew S	A



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"Lab"

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

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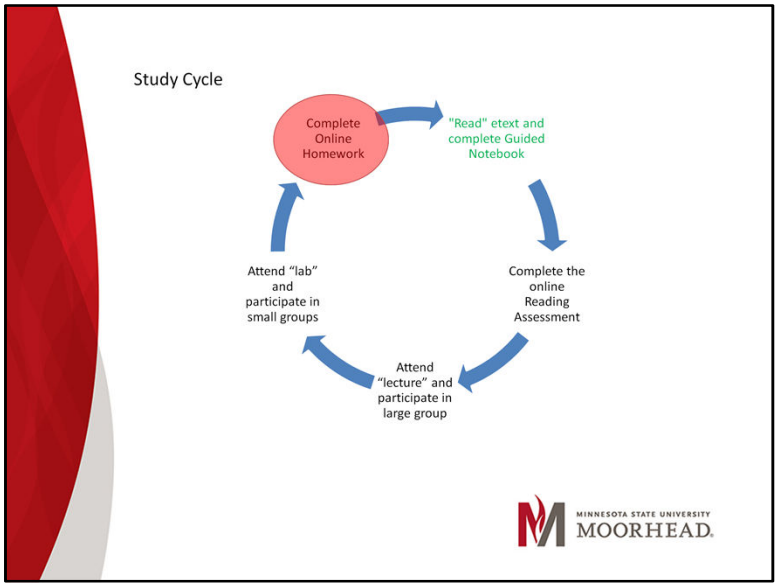
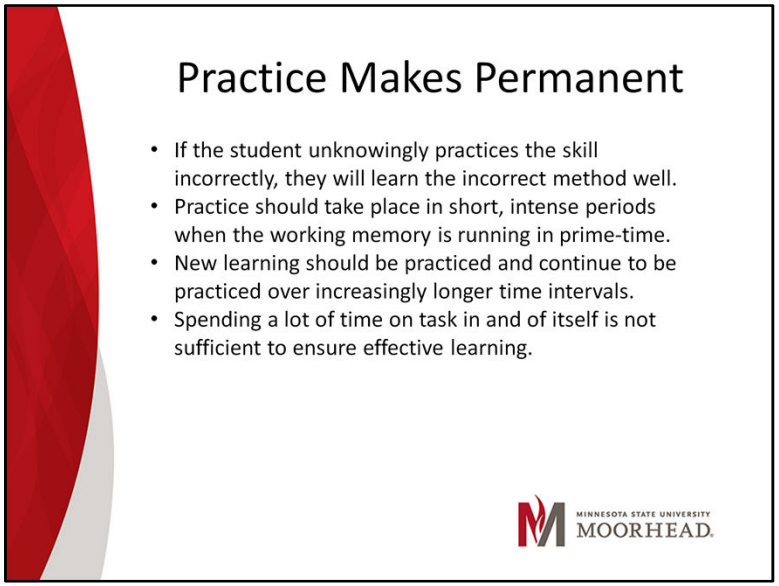


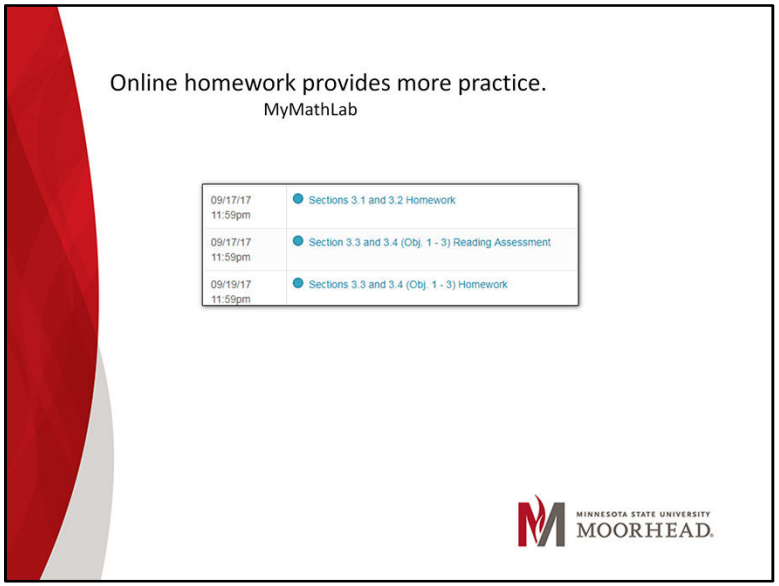
The study cycle may be familiar to many, but why does it work? How does each step of the study cycle figure in to the learning process and what it happening in the brain?

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



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)



Strive for 100%

3 tries on 3 similar problem for each question.

Using ‘Help me solve this’ counts as one problem.

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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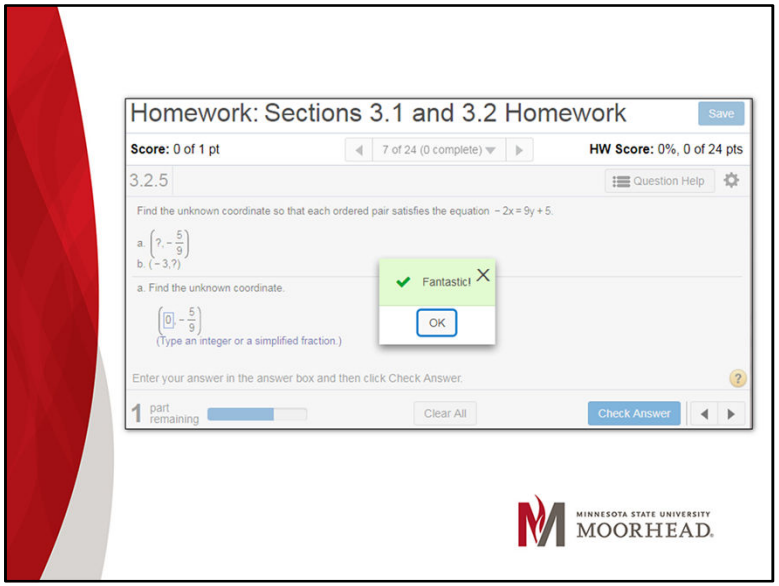
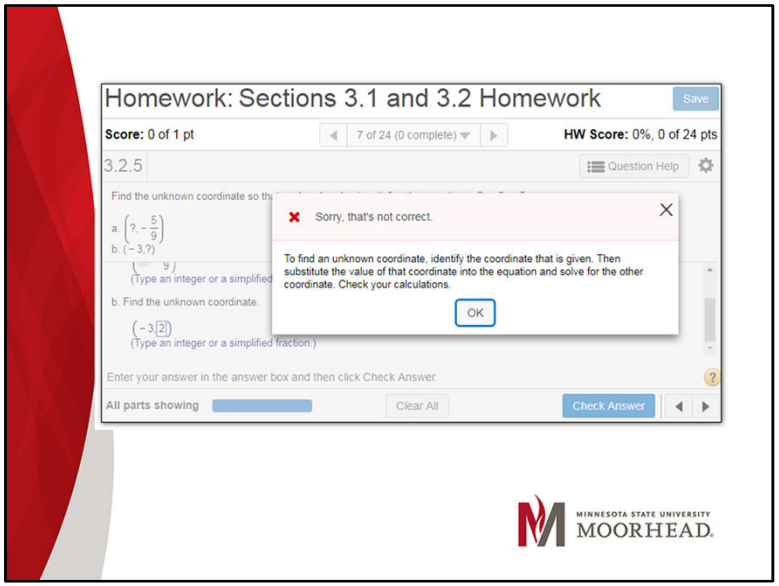


feedback messages
with high content caused more learning than feedback messages with low content.



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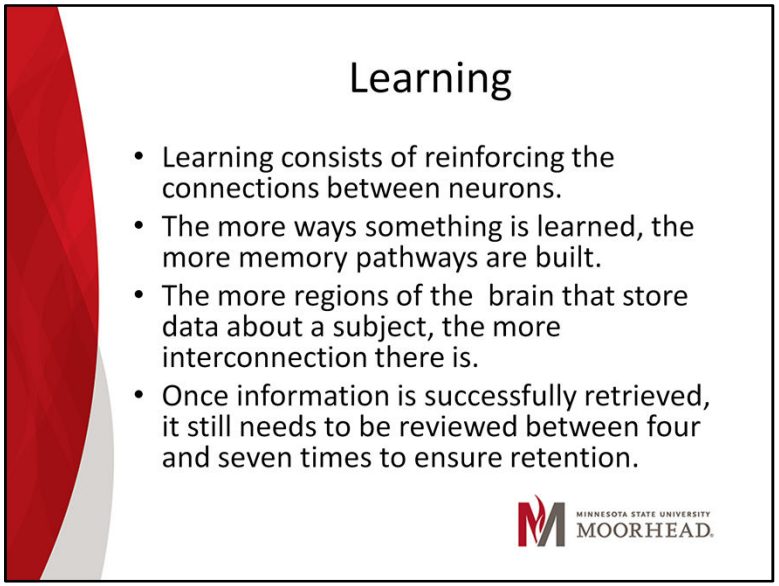


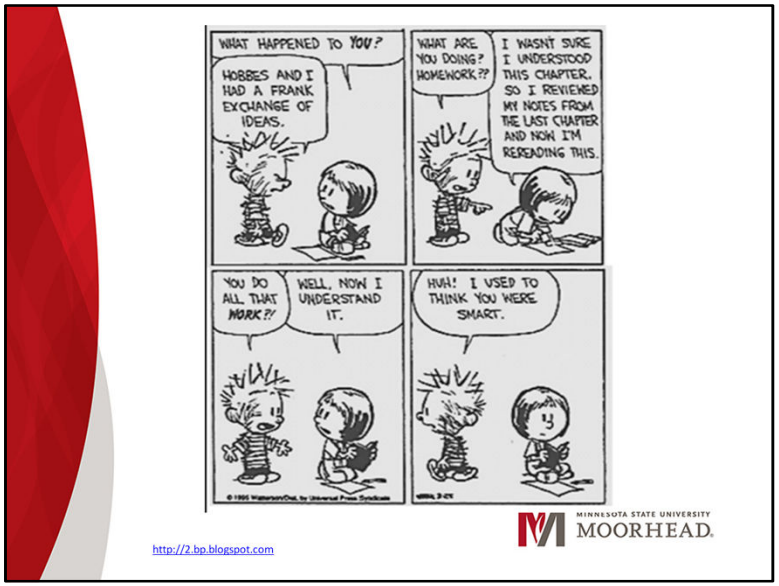
Students need to monitor their learning and actively evaluate their strategies and their current levels of understanding.

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.

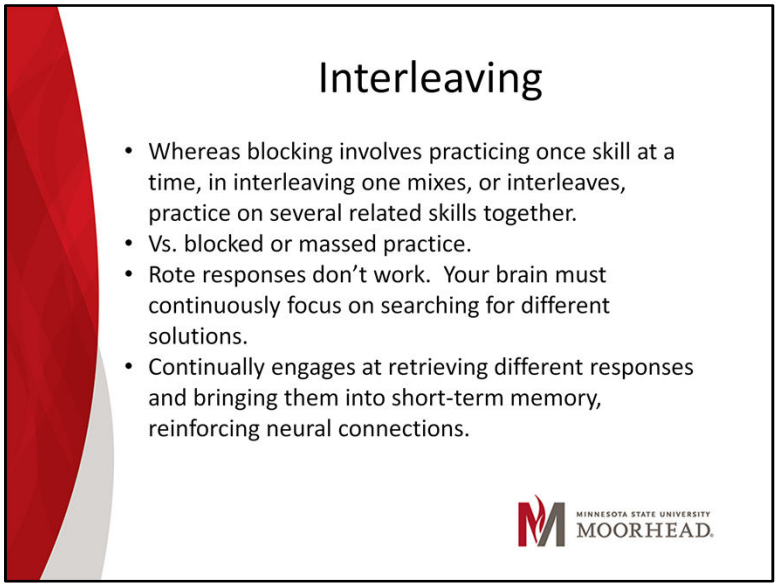
The more regions of the brain that store data about a subject, the more interconnection there is. This redundancy means students will have more opportunities to pull up all those related bits of data from multiple storage areas in response to a single cue. This cross-referencing of data strengthens the 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)



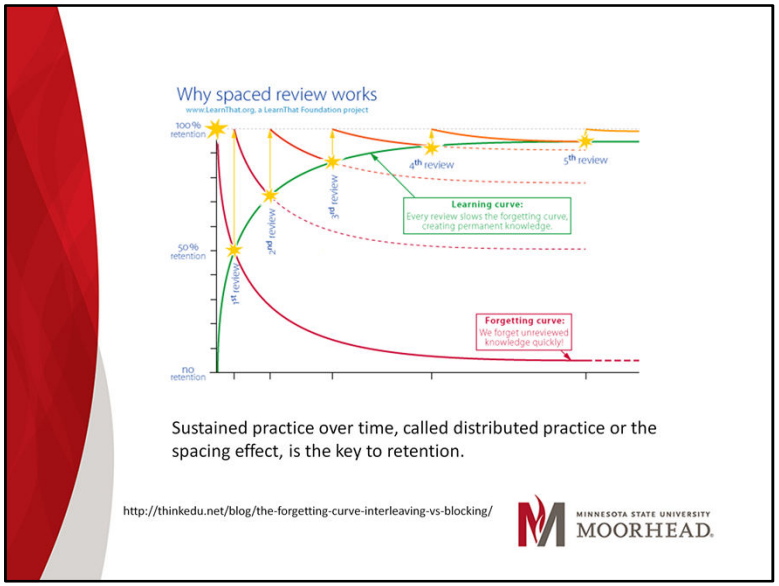
What is our definition of smart? Carol Dweck…Mindset



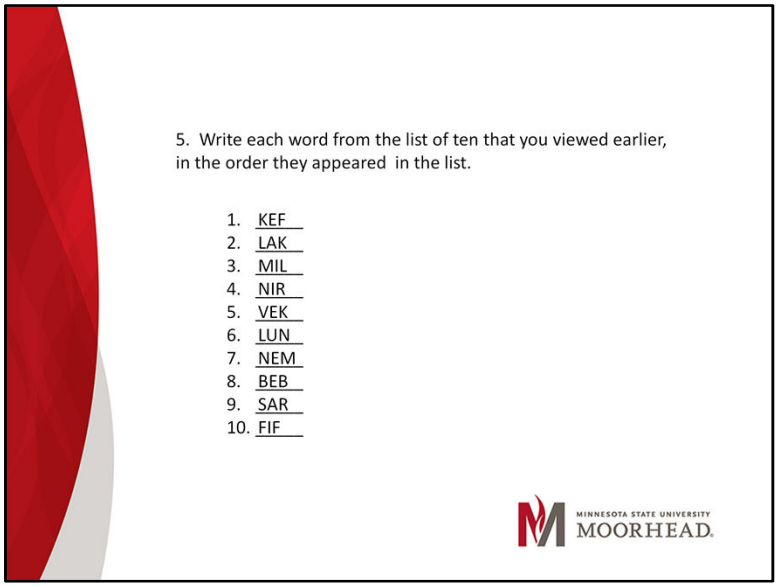
Did it 35 years ago…Saxon text
The spacing effect was first described by Hermann Ebbinghaus in 1885.

"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.



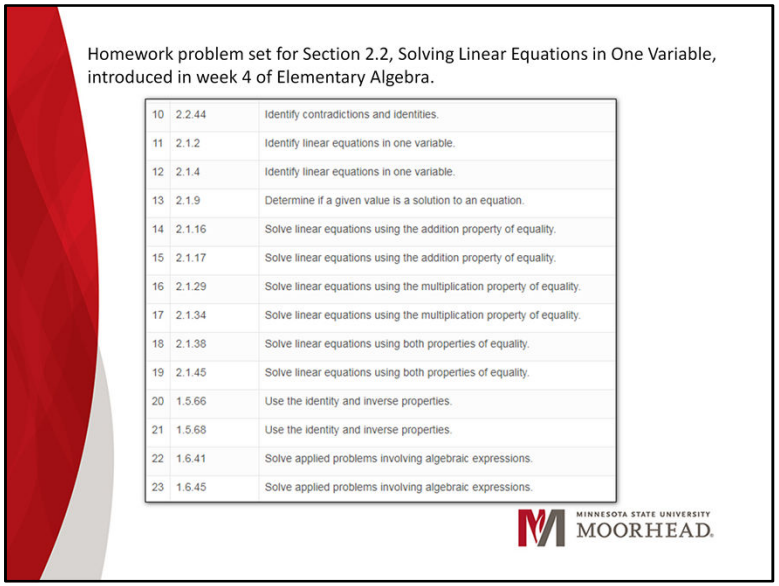
Spiral curriculum, where critical information and skills are reviewed at regular intervals within and over several grade levels.



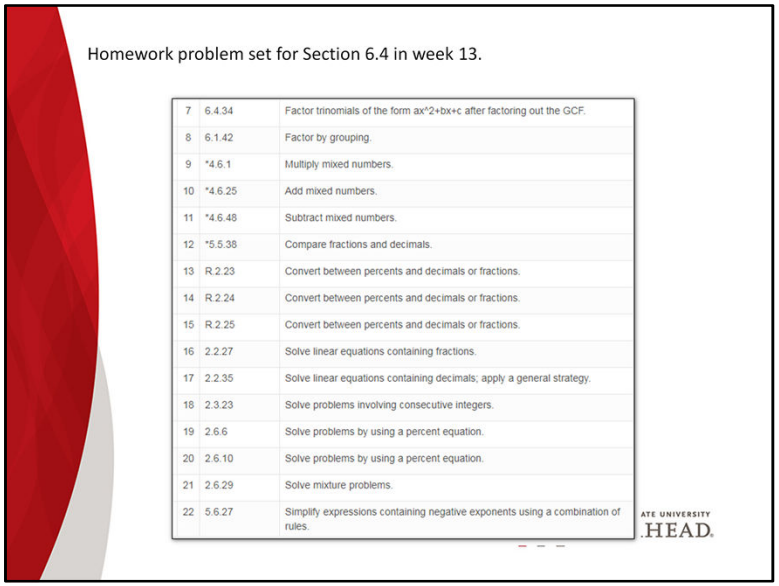
Check your list. To be correct the word must be spelled correctly and in the right position. Chances are your remembered the first three to five words and the last two words, but had difficulty with the middle one. (Sousa, How the Brain Learns, 2011)

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.



1/3 of the problems in this homework assignment are review…the first part is from current topic 2.2



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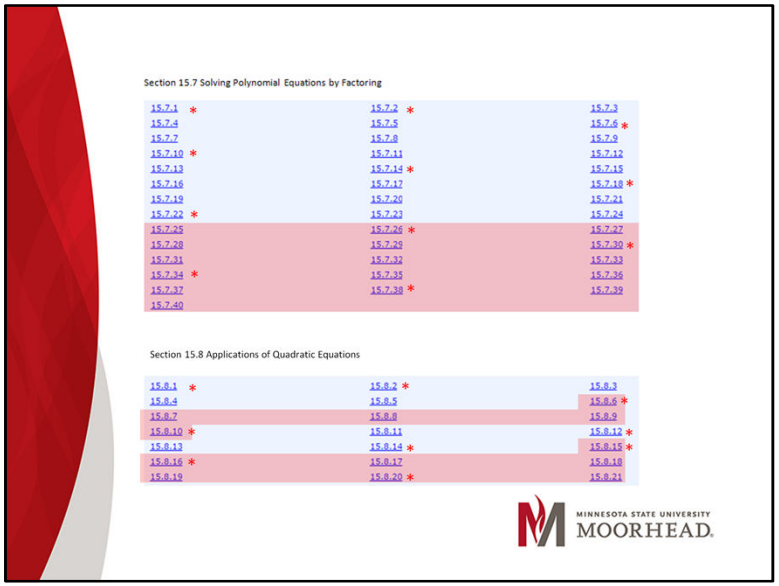
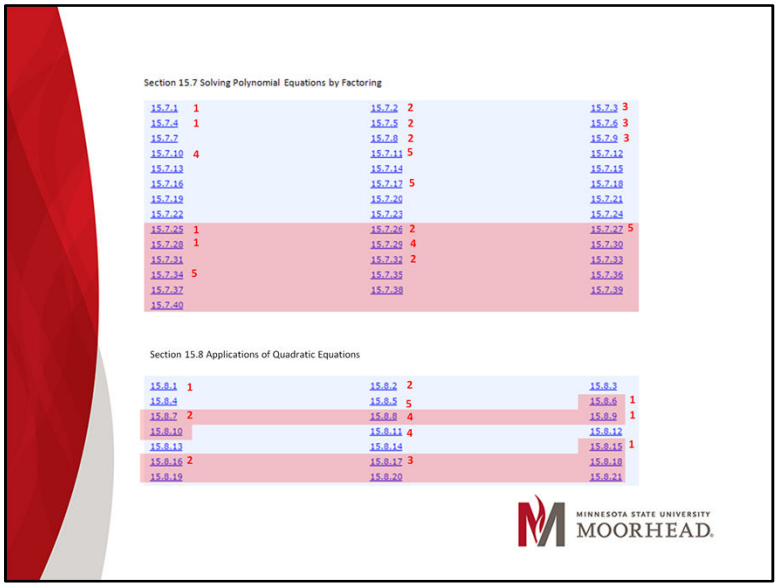


Topic 1: 20 problems
Blocked, or mass, practice



29 problems
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

Interleaving Homework

CHAPTER 2. Linear Equations and Inequalities in One Variable	
Section 1. The Addition and Multiplication Properties of Equality	
1. Identify linear equations in one variable.	1, 2, 3, 4, 5, 6
2. Determine if a given value is a solution to an equation.	7, 8, 9, 10, 11, 12
3. Solve linear equations using the addition property of equality.	13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25
4. Solve linear equations using the multiplication property of equality.	26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36
5. Solve linear equations using both properties of equality.	37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52
Section 2. Solving Linear Equations in One Variable	
1. Solve linear equations containing non-simplified expressions.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
2. Solve linear equations containing fractions.	19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32
3. Solve linear equations containing decimals; apply a general strategy	33, 34, 35, 36, 37, 38, 39, 40
4. Identify contradictions and identities	41, 42, 43, 44, 45, 46, 47, 48
5. Use linear equations to solve application problems.	49, 50, 51

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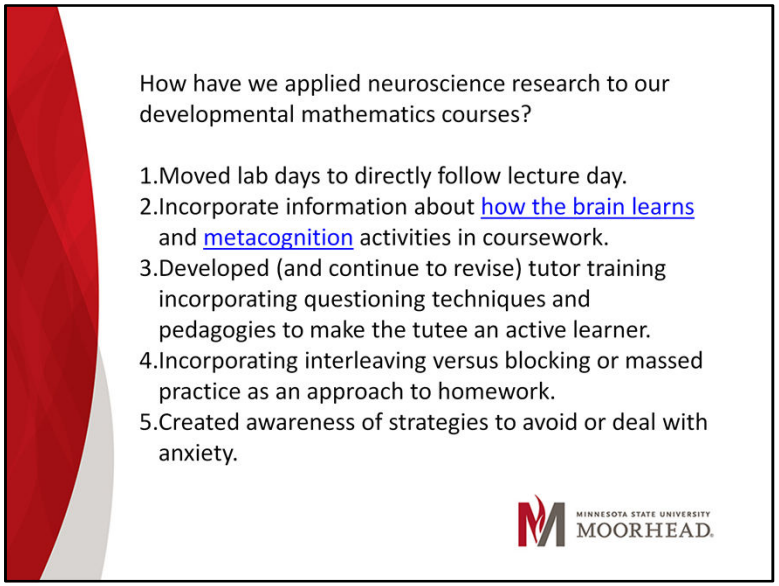

5. Points of interest to be investigated or implemented.

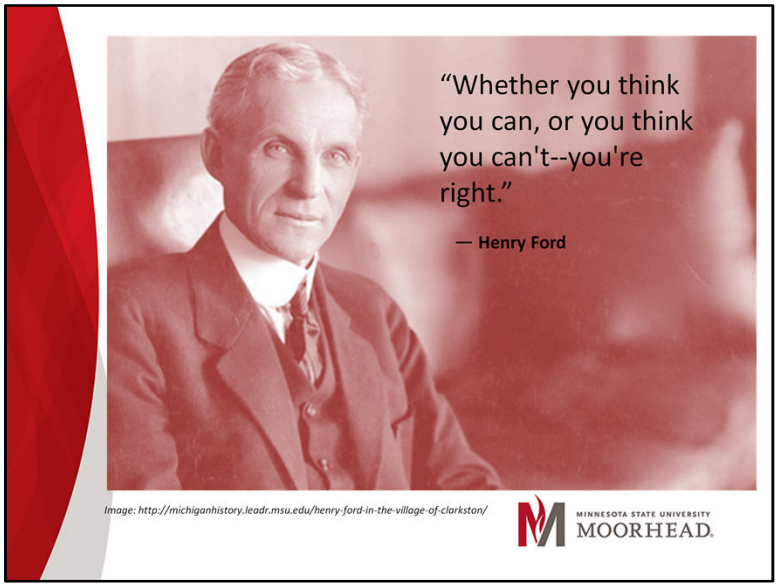

Image: http://michiganhistory.leadr.msu.edu/henry-ford-in-the-village-of-clarkston/

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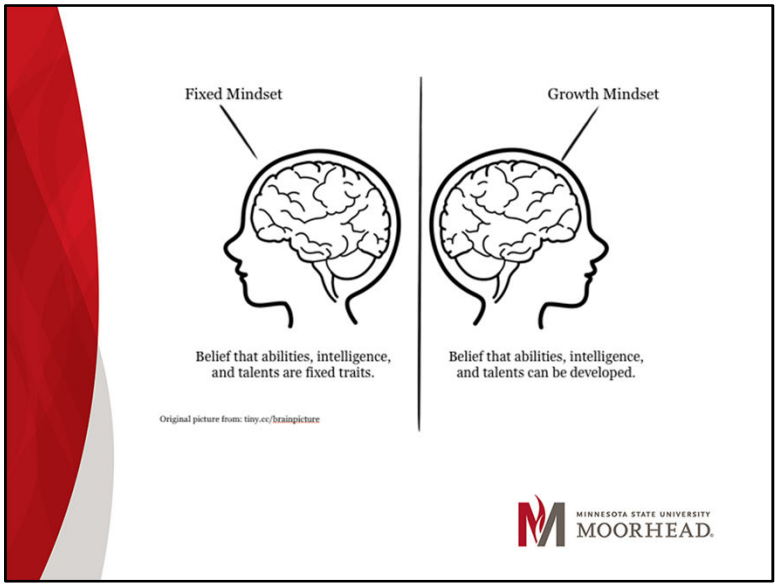
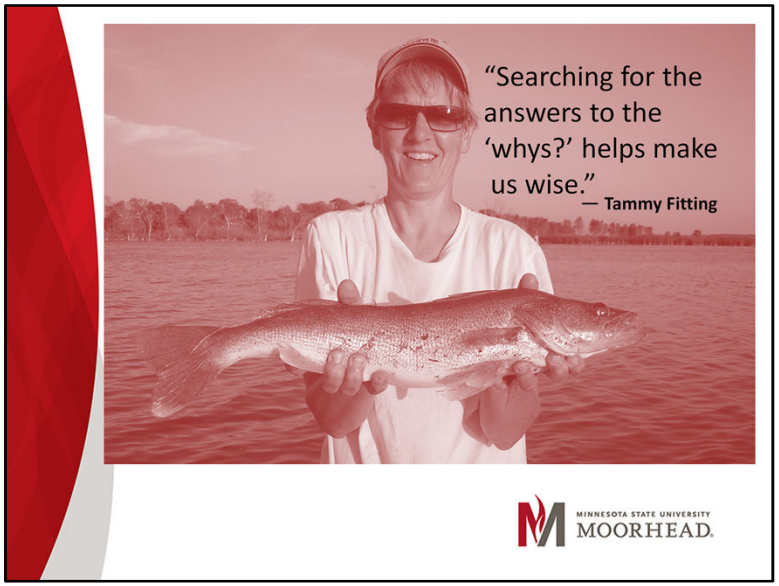


Mindset plays a key role in student's persistence and view of one's capabilities. Carol Dweck


"Searching for the answers to the 'whys?' helps make us wise."
— Tammy Fitting
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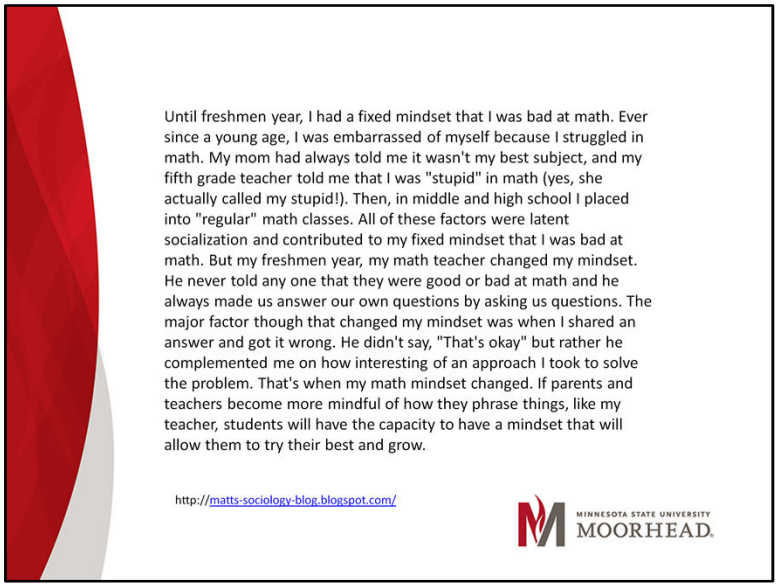
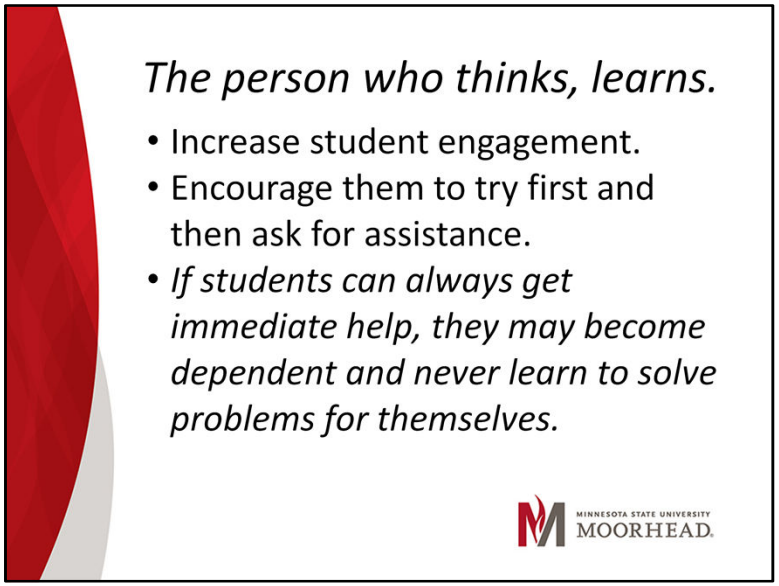


http://matts-sociology-blog.blogspot.com/2011/10/mathematical-mindset.html
The Serendipity of Sociology



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)

- 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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A couple of good resources for going beyond the study cycle for students facing the hurdles of frustration and anxiety.

Oakley, Barbara. (2014) *A Mind for Numbers: How to Excel at Math and Science (Even if you Flunked Algebra).* Penguin Group (USA)

Prittman and Karle. (2015) *Rewire Your Anxious Brain*, New Harbiner Publications, Inc.

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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.