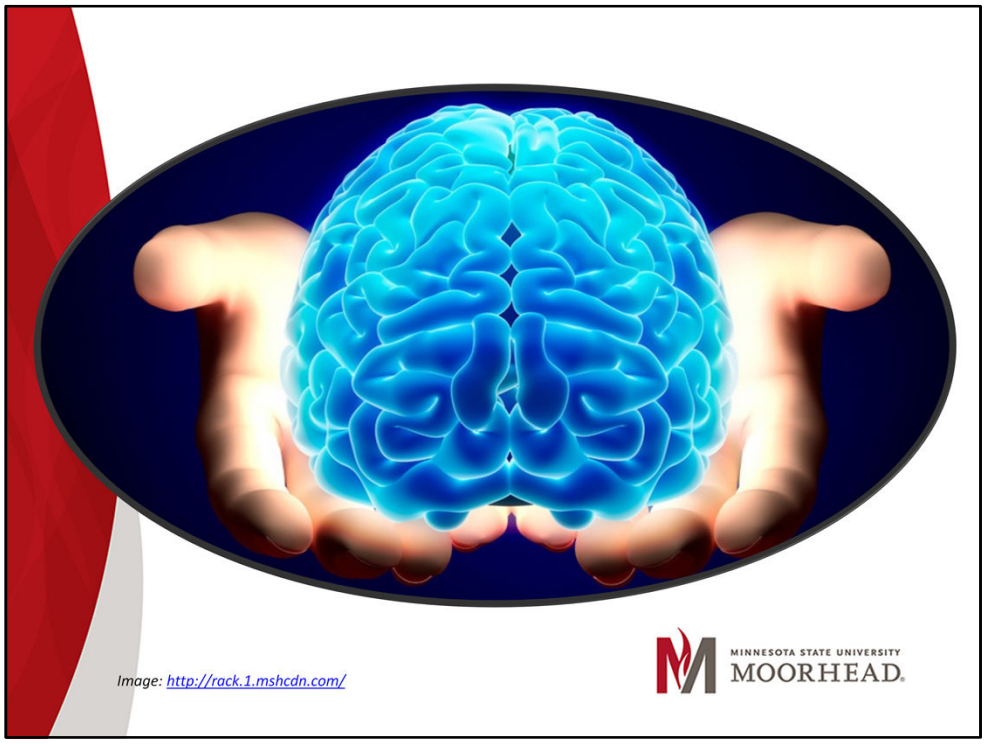
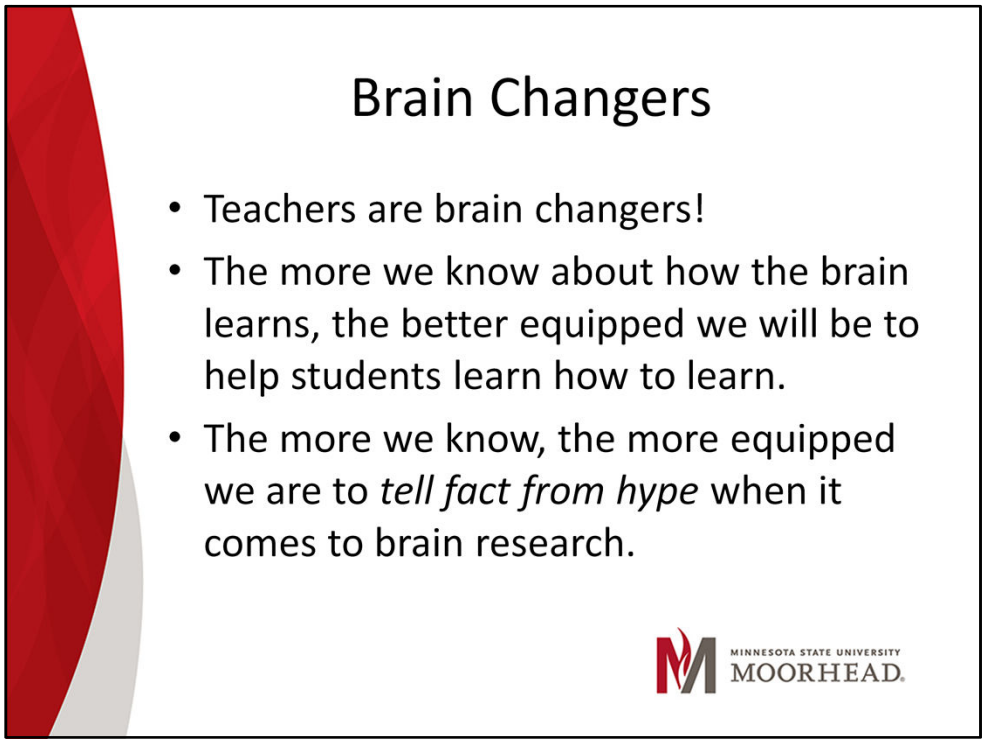
Brain research and its interpretation. Is the research valid?



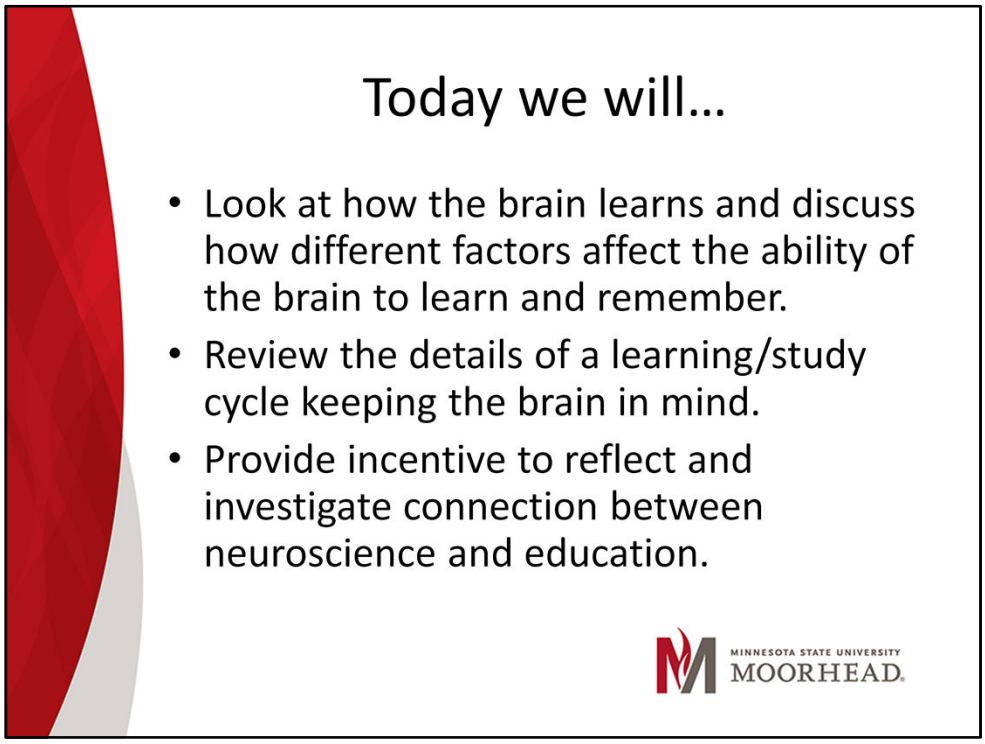
Educational neuroscience

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

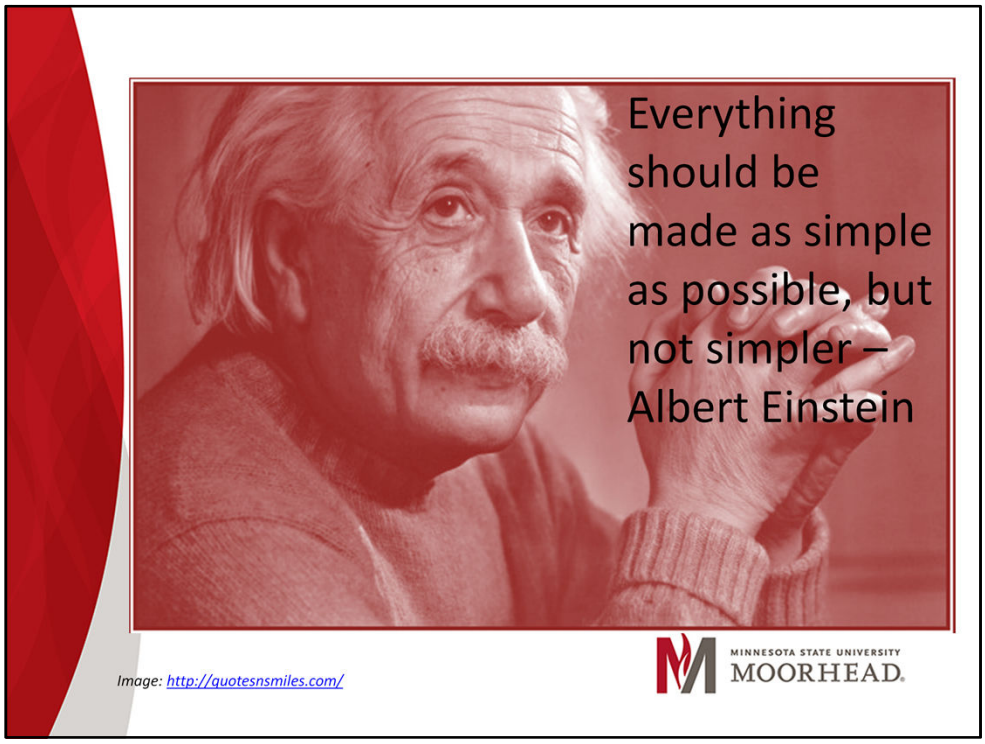


Knowing how the human brain seems to process information and learn can help teachers plan lessons that students are more likely to understand and remember. The more we know about how we learn, the more we can be in control of our learning…metacognition.

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)

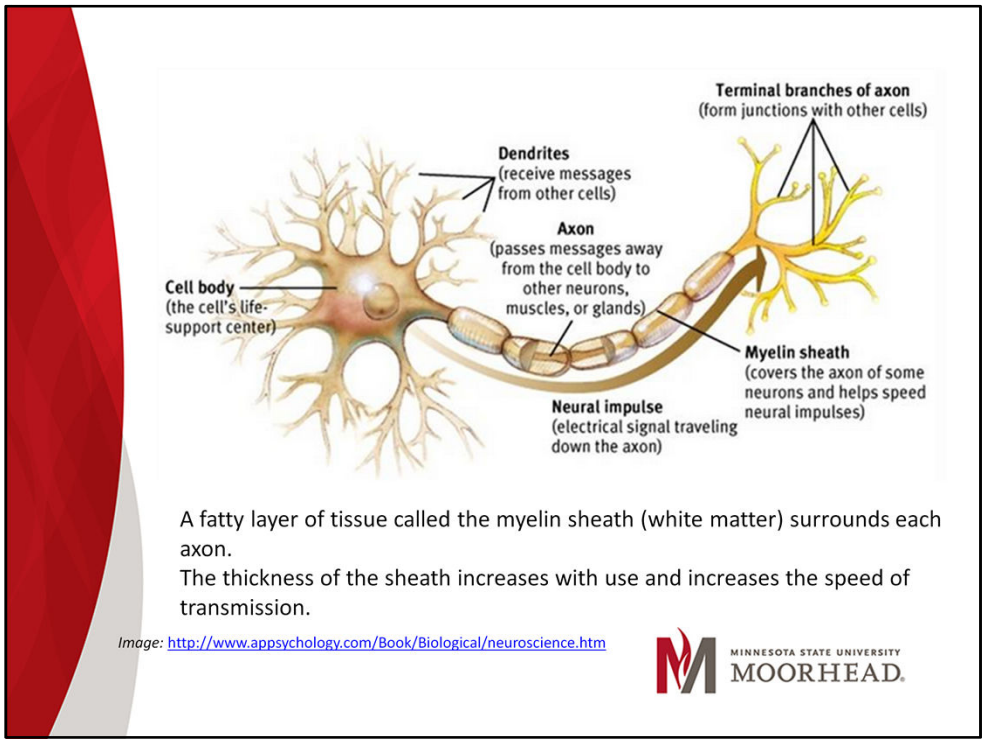


As scientific understanding of learning includes understanding about learning processes, learning environments, teaching, sociocultural processes, and the many other factors that contribute to learning. Research on all of these topics, both in the field and in laboratories, provides the fundamental knowledge 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 fatty layer of tissue called the myelin sheath (white matter) surrounds each axon.
The thickness of the sheath increases with use and increases the speed of transmission.

Image: http://www.appsychology.com/Book/Biological/neuroscience.htm

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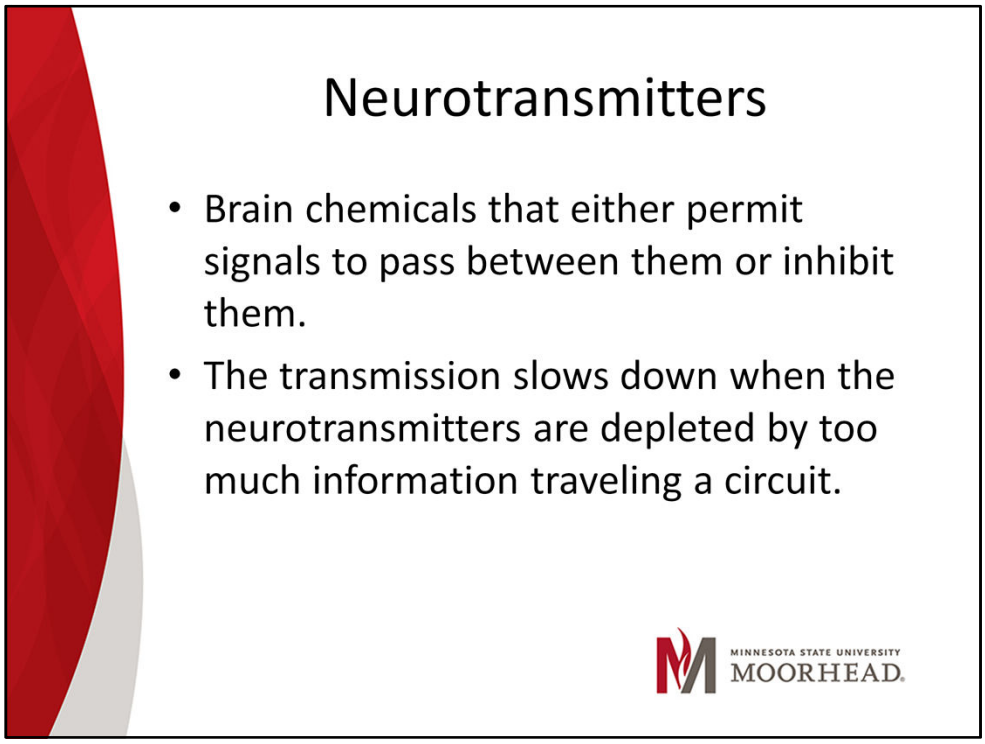
A neuron can transmit between 250 and 2500 impulses per second. Its possible to have up to one quadrillion (1 x 10^15) synaptic connections in one brain. So as we practice, … we trigger a pattern of electrical signals through our neurons. Over time, that triggers the glial cell duo to myelinate those 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



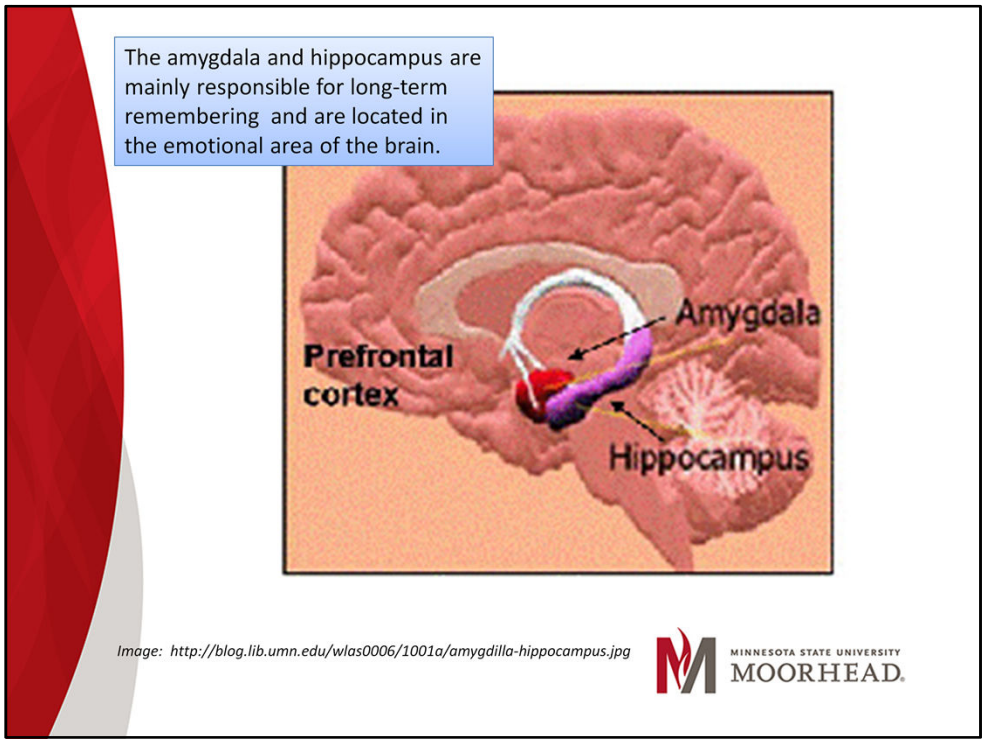
INHIBITORY : does not stimulate the brain
Serotonin: necessary for a stable mood and to balance excessive excitatory neurotransmitters.
Gaba: sent to attempt to balance excitatory overfiring.
Dopamine: can be both. Helps with depressions and focus.

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).



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)

Mathematical thinking is a perfect example of the higher-order thinking that is unique to the prefrontal cortex. The executive functions of the PFC – including personal responsibility, emotional response control, planning, prioritizing, organization, creative problem solving, critical analysis, judgment, prediction, and self-motivation … (Willis, 2010)

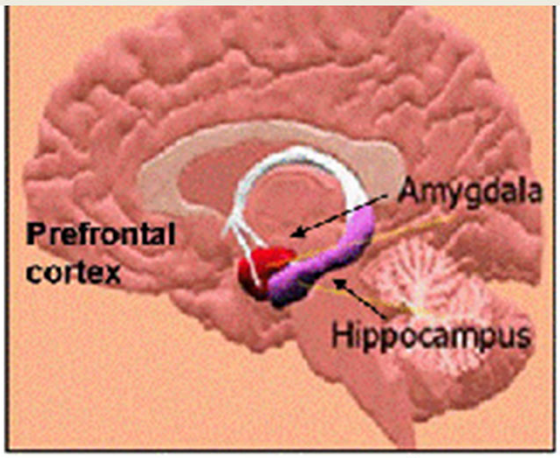


Image: http://blog.lib.umn.edu/wlas0006/1001a/amygdilla-hippocampus.jpg

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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.

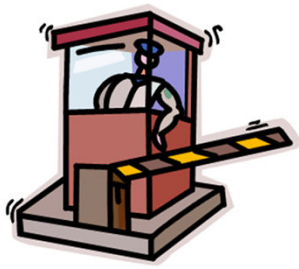
The prefrontal cortex is the front part of the frontal lobe.

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

Amygdala

- Sensory receptor areas of the brain must travel through the amygdala to get to the prefrontal cortex.
- When the amygdala is in a state of stress, new information coming through the sensory intake areas of the brain cannot pass through the amygdala to gain access to the memory circuits.



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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.

https://s-media...

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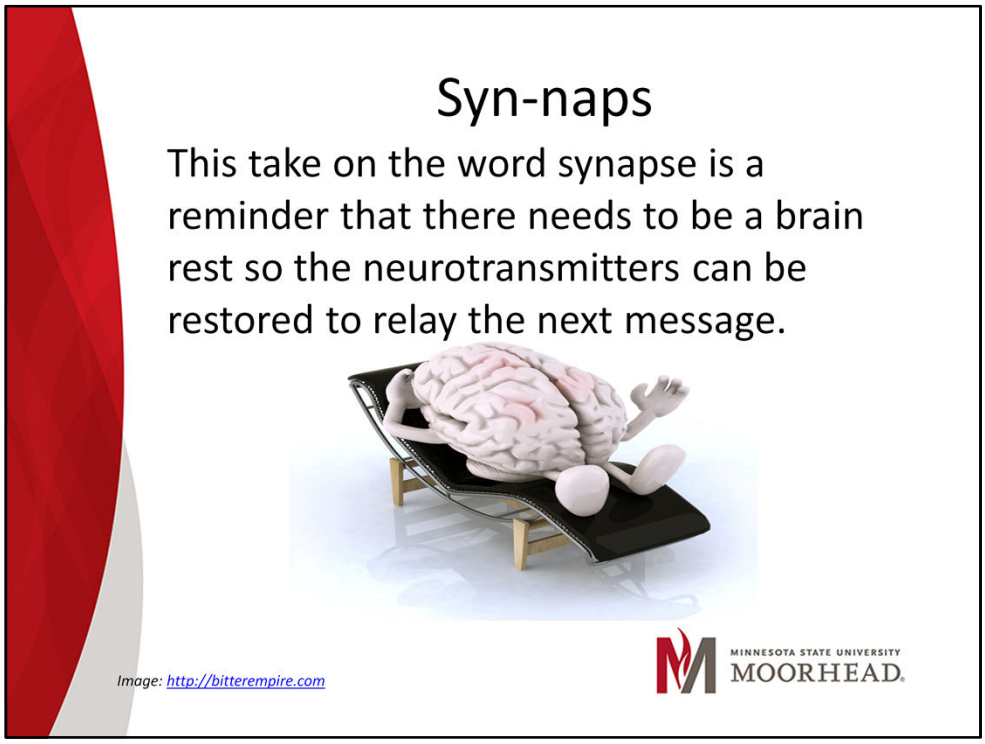
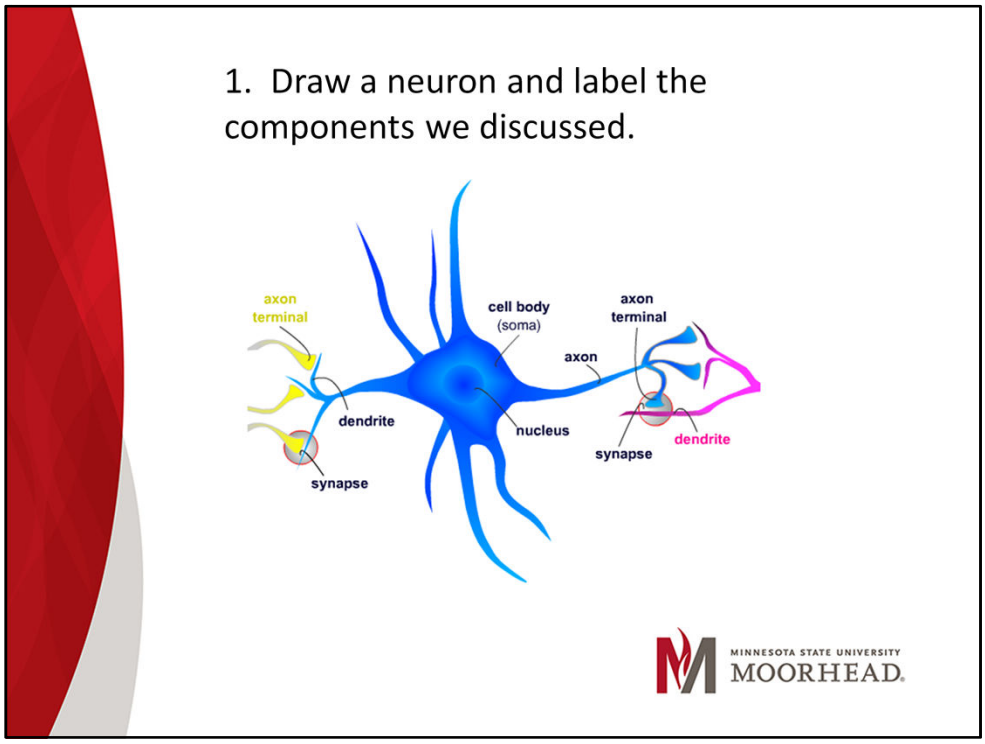
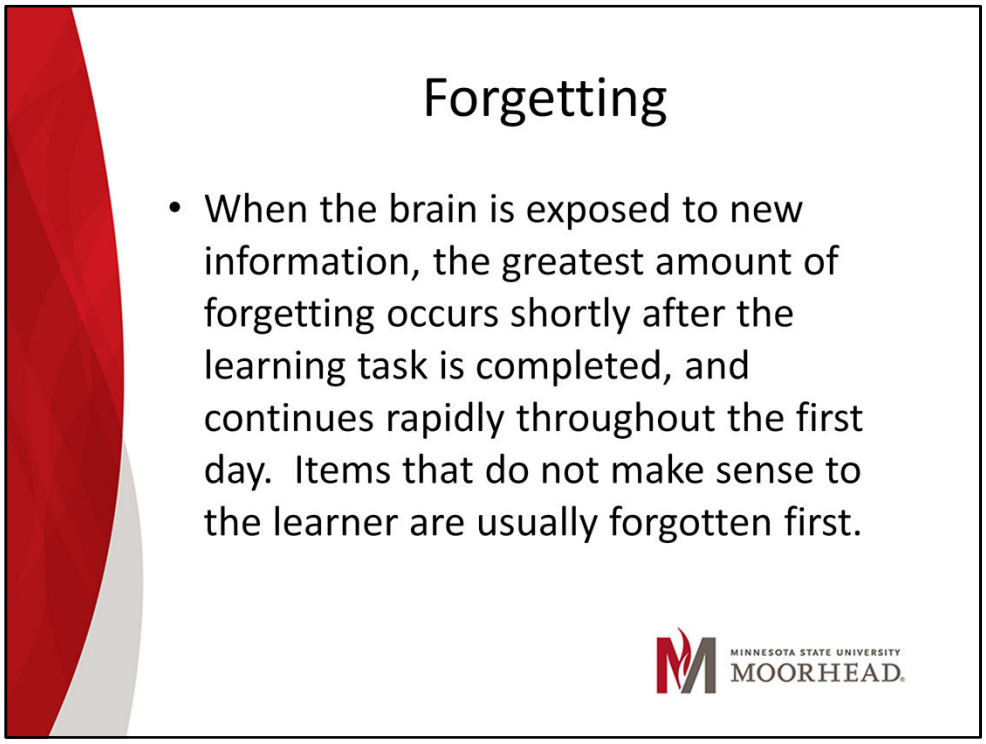


Daily lesson: Introduce some new material, practice, repeat. Example: practice worksheet.
Syn-naps are brain breaks that restore neurotransmitters depleted when the same neural circuit is used for extended periods. They help the amygdala from getting overstressed. The newly learned material has the opportunity 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)



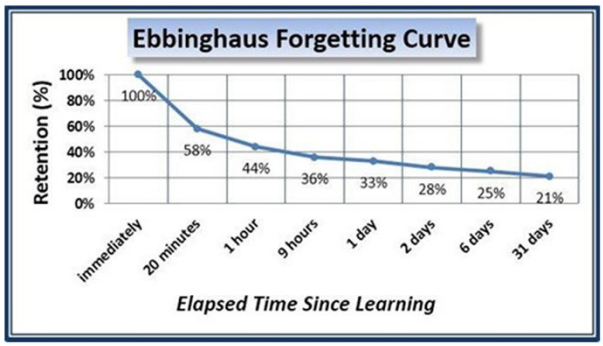
Chunking. It is possible to increase the number of items within the functional capacity of working memory through a process called chunking. Keep the number of items in a lesson objective within the capacity limits of students, and they are likely to remember more of what they learned. Less is more!



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

$$R = e^{(-t/S)}$$

Where **R** is memory retention, **S** is the relative strength of memory and **t** is time.



The forgetting curve demonstrates the decline of memory retention in time – how information is lost over a period when there is no attempt to retain it.

https://www.trainingindustry.com/wiki/entries/forgetting-curve.aspx

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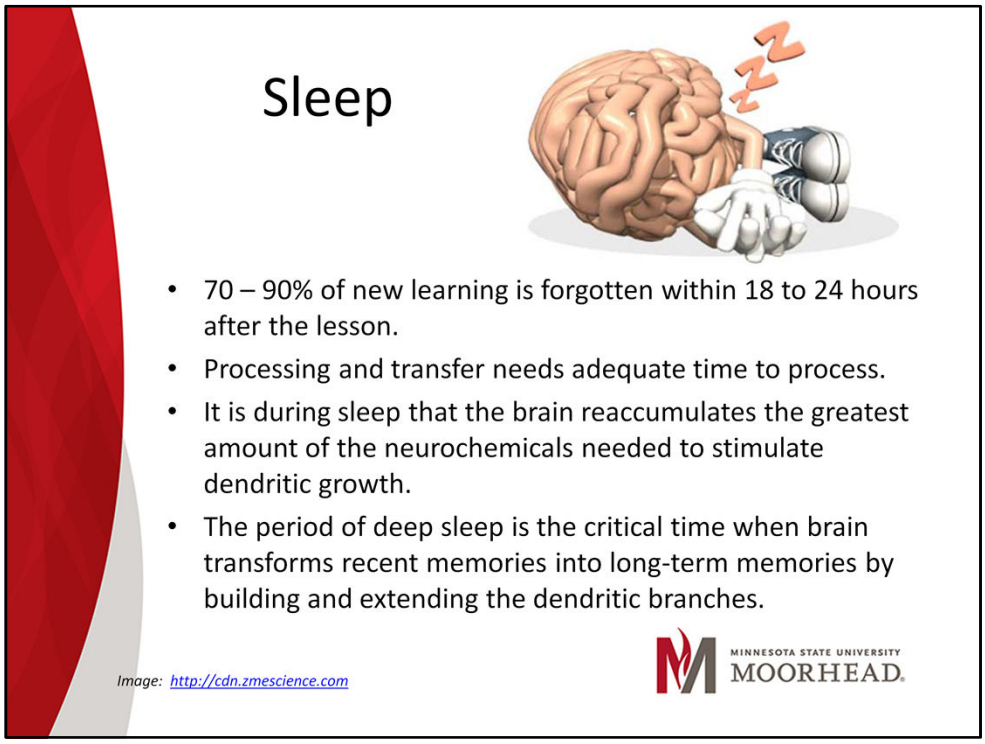
Philosopher Hermann Ebbinghaus conducted experiments on his own memory, where he memorized a set of 3-letter nonsense syllables and then tested himself at intervals to see how much he could remember. This was the resulting data, showing that after only about 3 days, he forgot 75% of what he learned.



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.

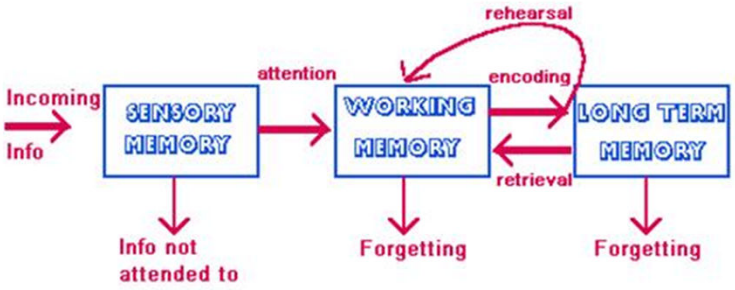


Image: http://healthpsych.psy.vanderbilt.edu/alcoholMemory_files/image007.jpg

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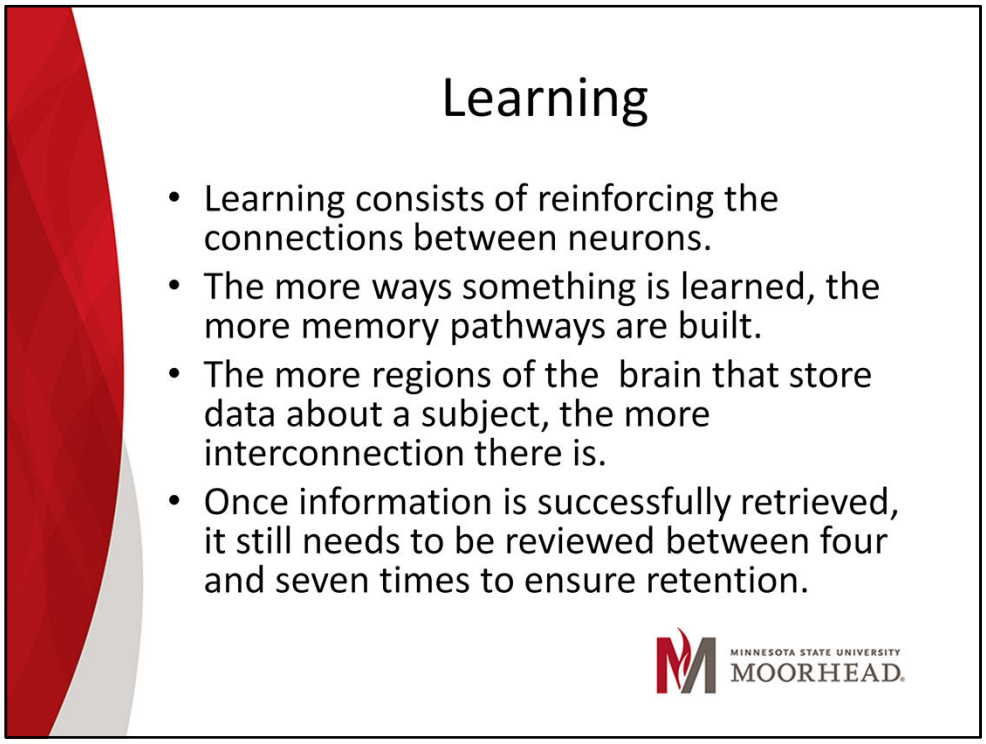
Share neuroscience information with your students.

Four brain lessons beginning the second week of the semester.

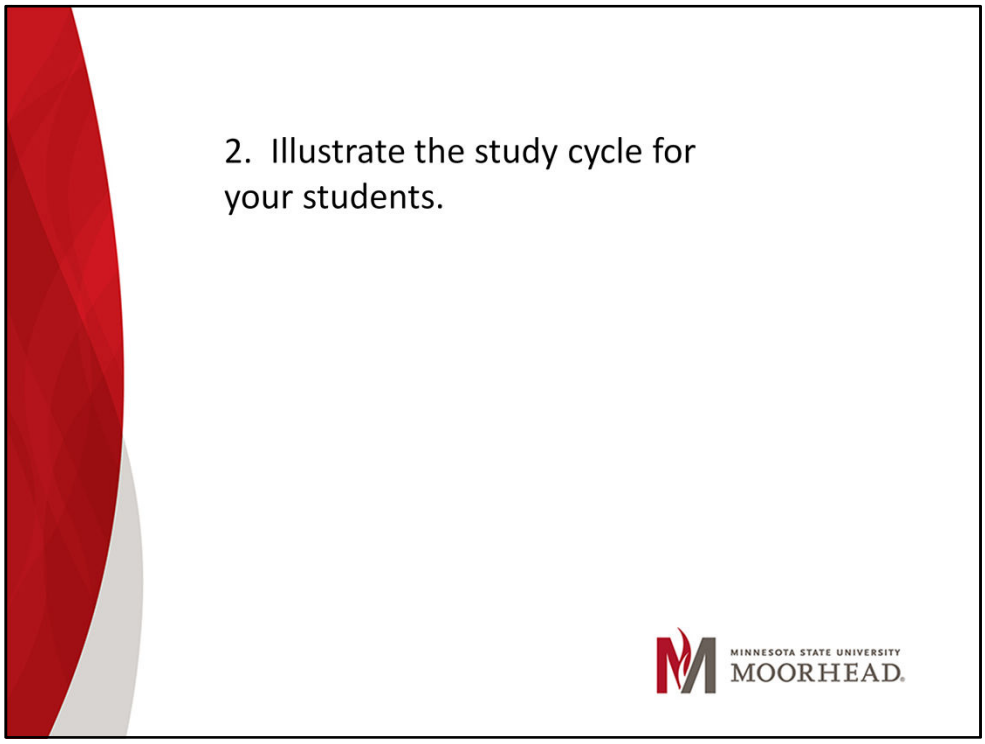


Students need to monitor their learning and actively evaluate their strategies and their current levels of understanding.

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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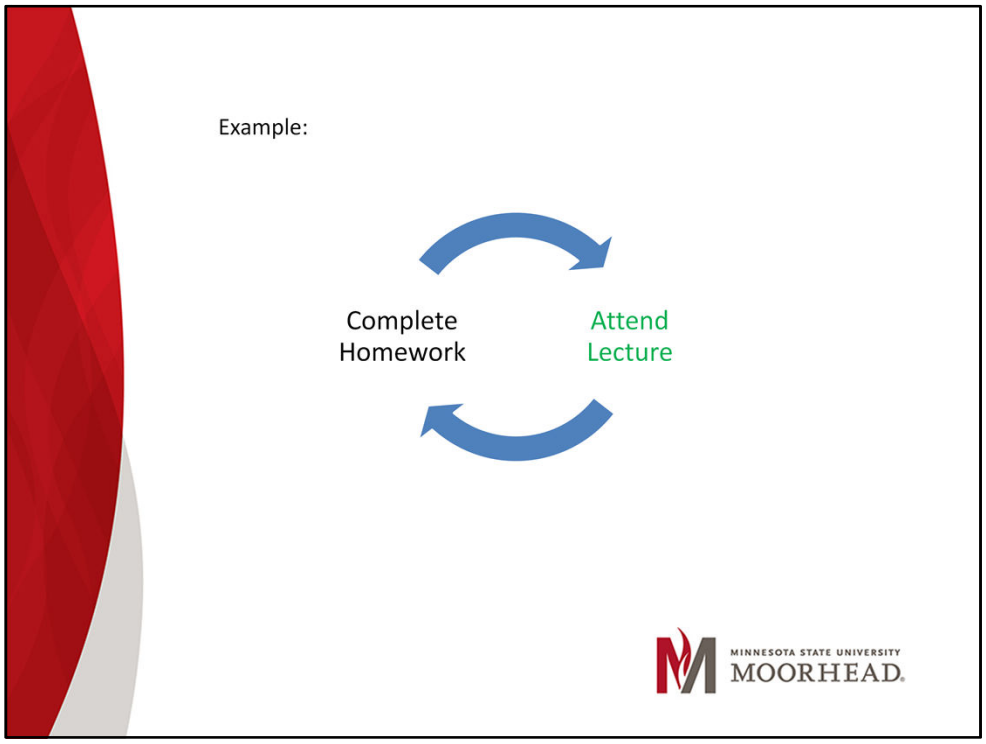
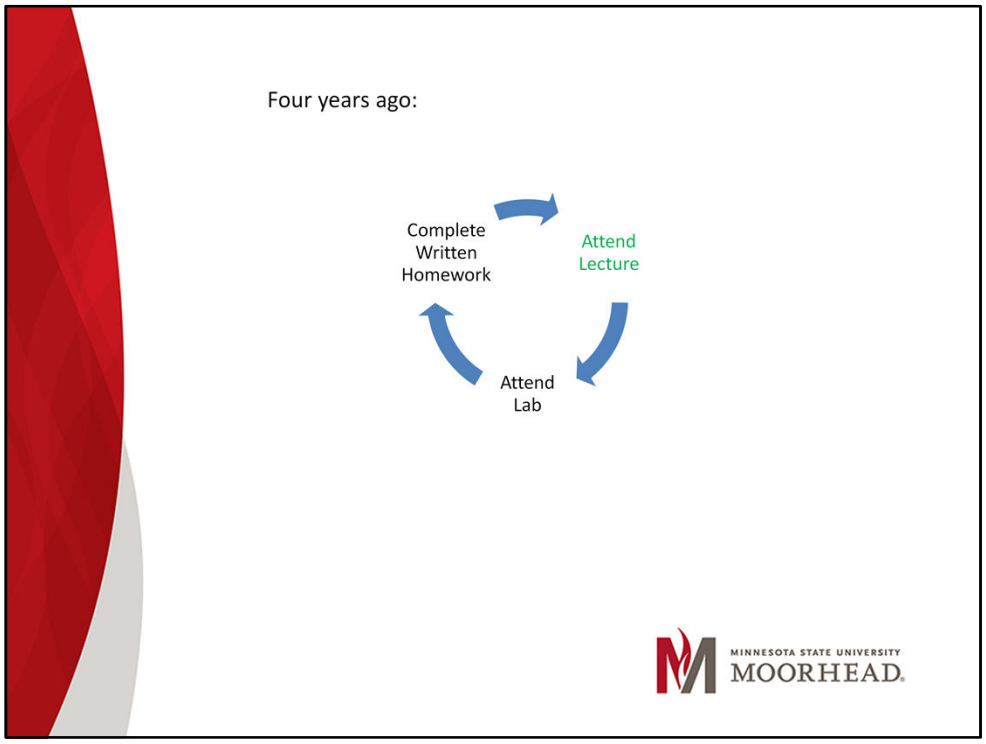


4. Draw Cycle

Old cycle vs. new cycle



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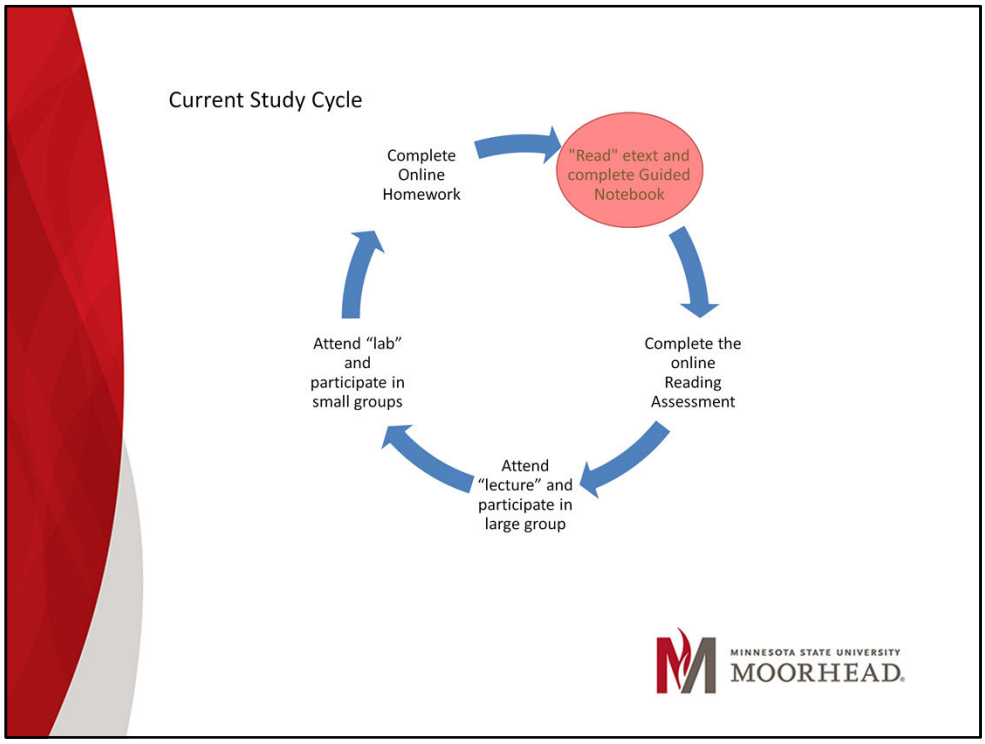
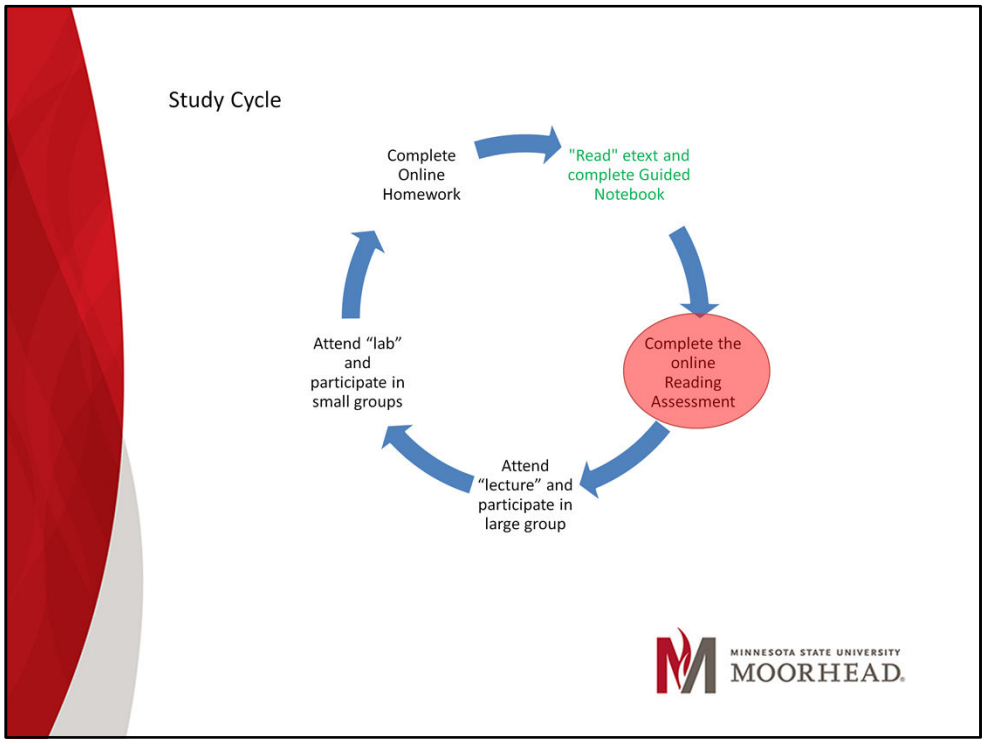


The study cycle may be familiar to many, but why does it work? How does each step of the study cycle figure in to the learning process and what it happening in the brain?

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



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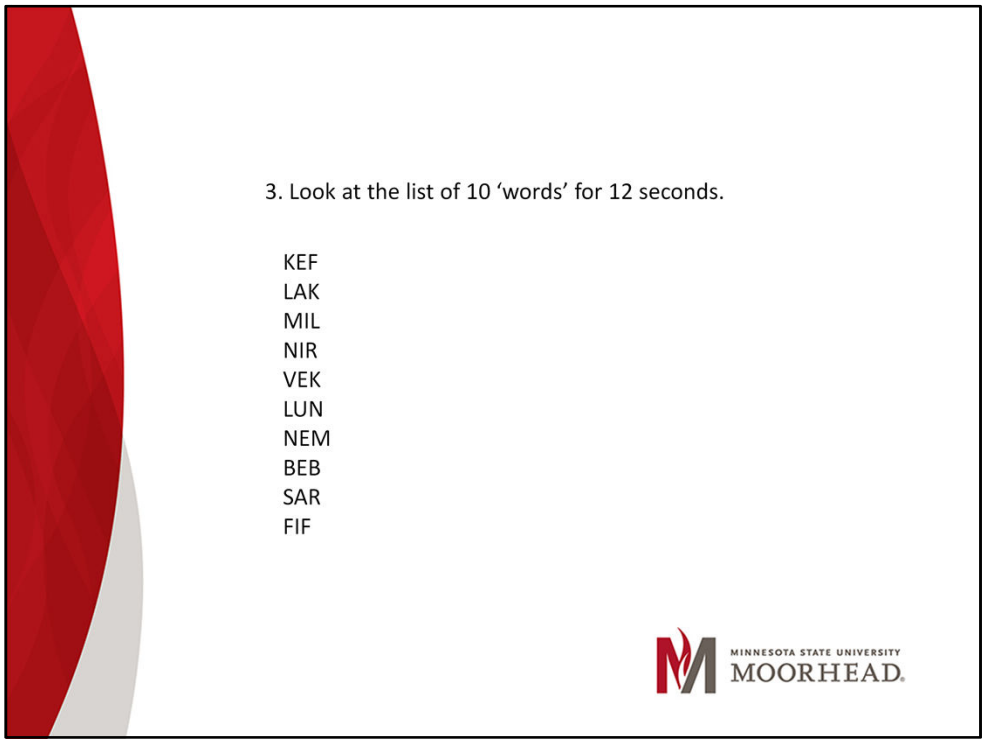
3. Look at the list of 10 'words' for 12 seconds.
KEF
LAK
MIL
NIR
VEK
LUN
NEM
BEB
SAR
FIF
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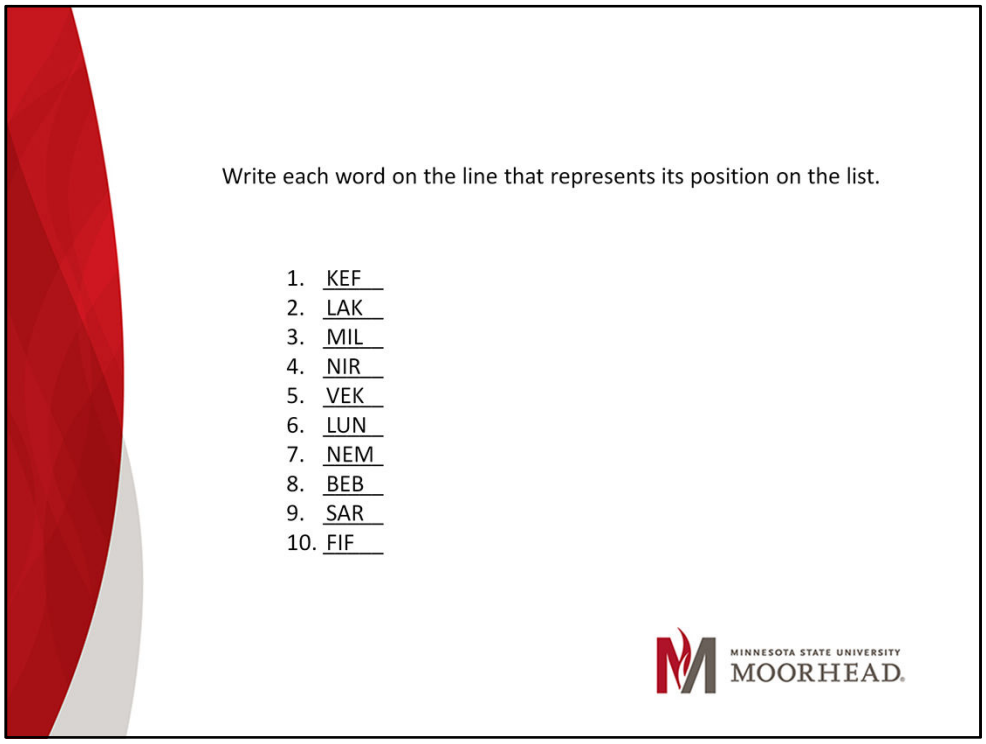
2.



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

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.

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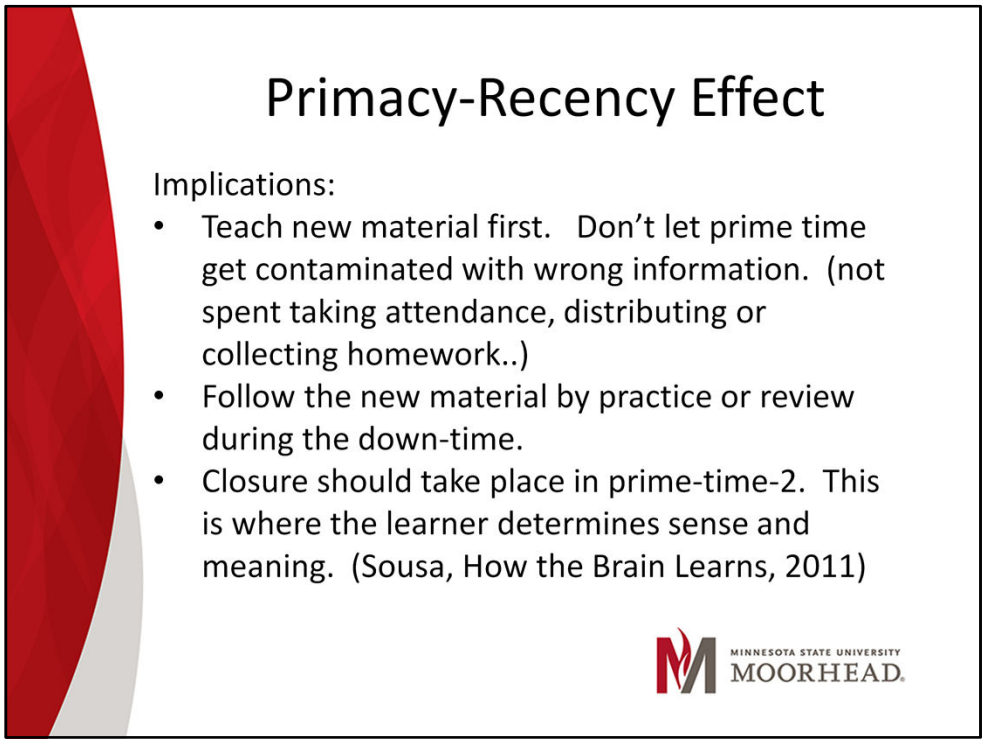
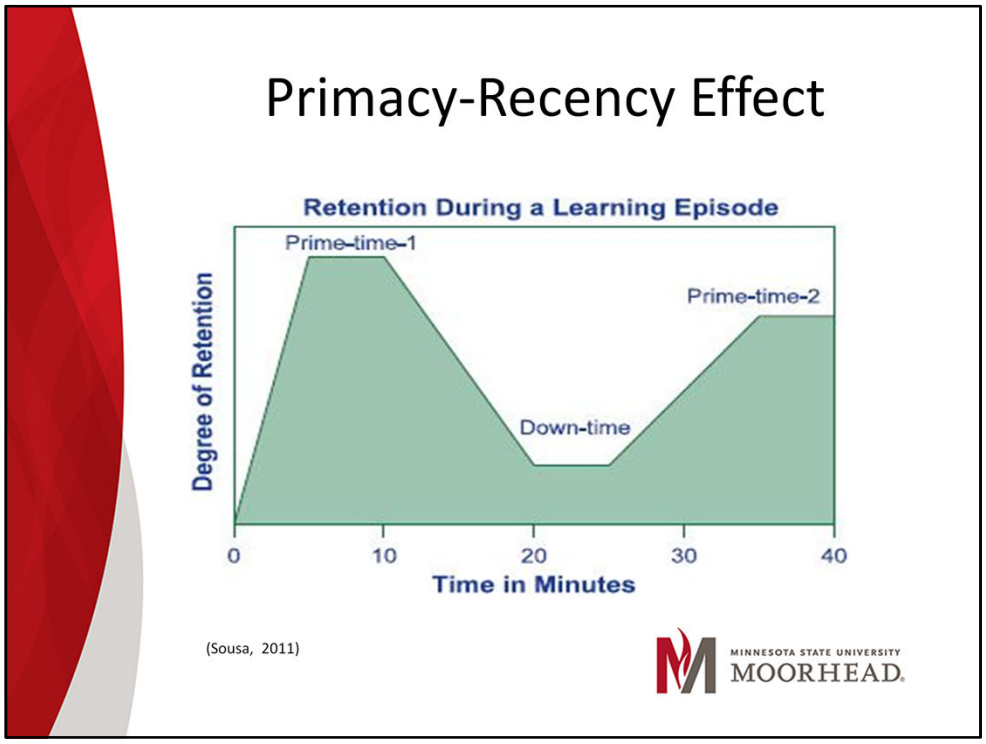


More attention occurs when lessons are shorter and meaningful. (Sousa, How the Brain Learns, 2011)



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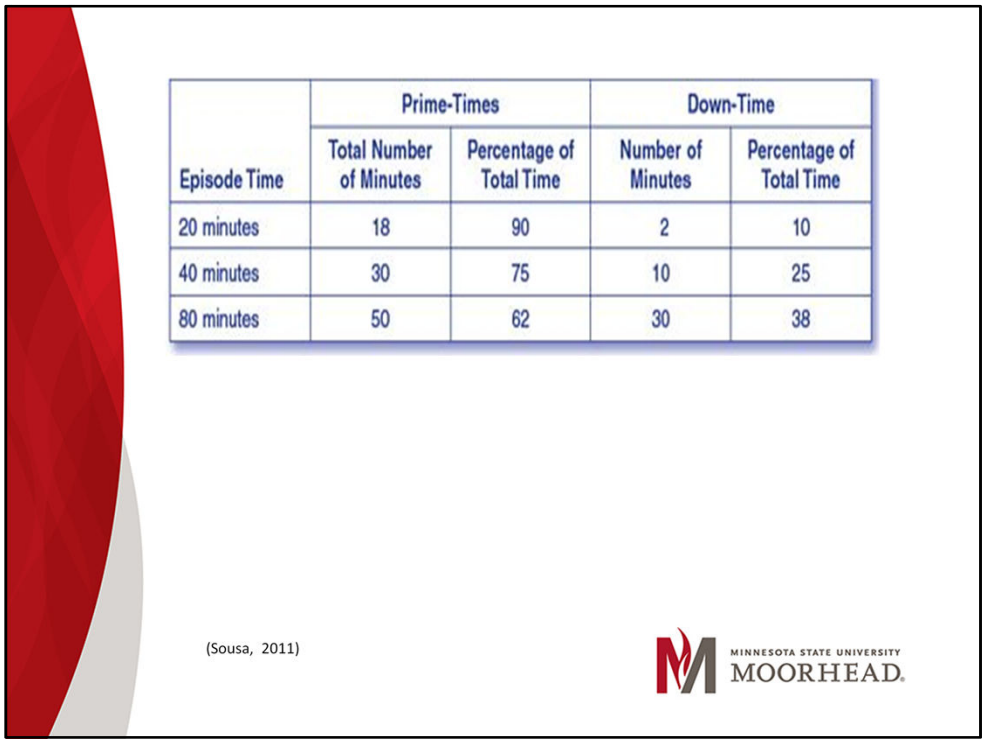
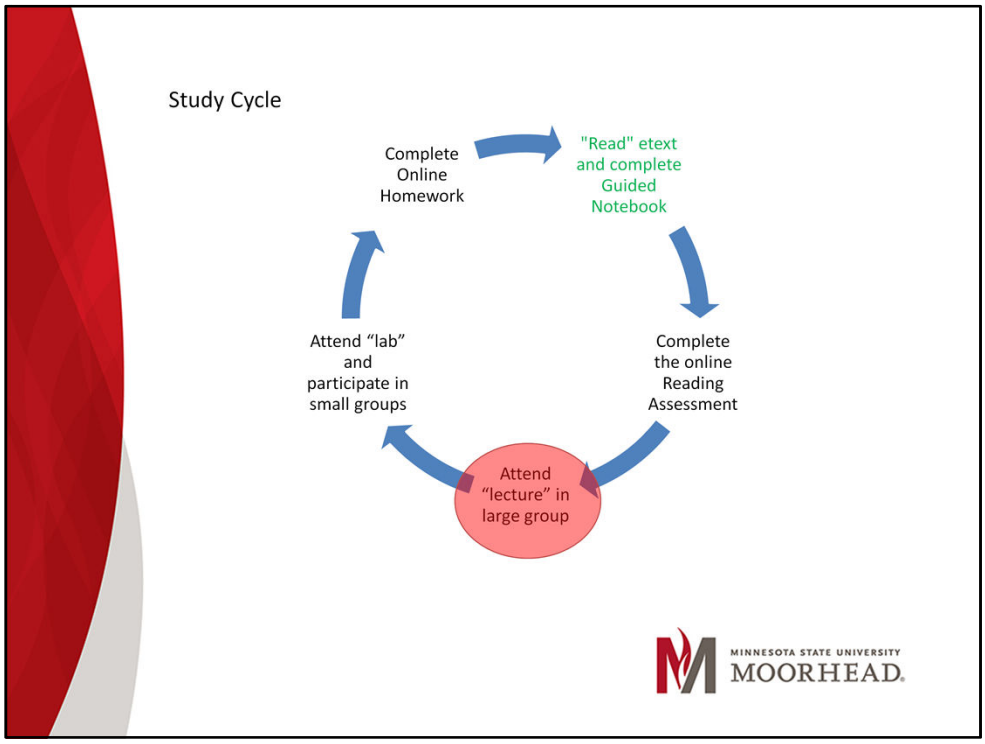


Although classes are 50 minutes, we can think of it as 2 twenty minute 'episodes' with 5 minutes at the beginning and 5 minutes at the end for additional tasks.



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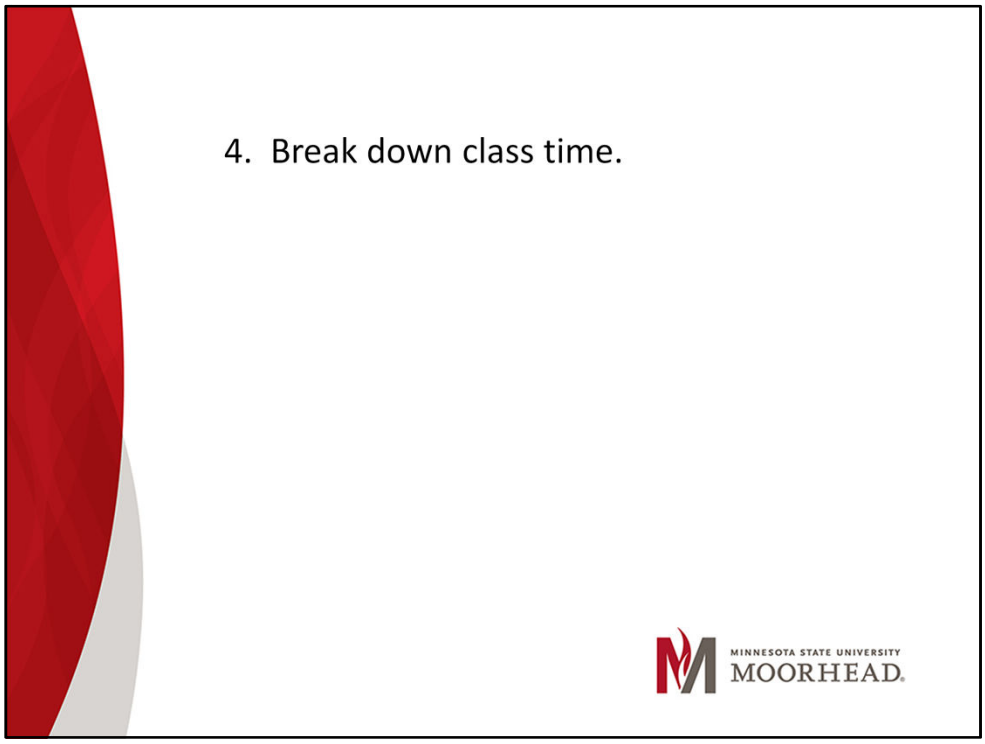

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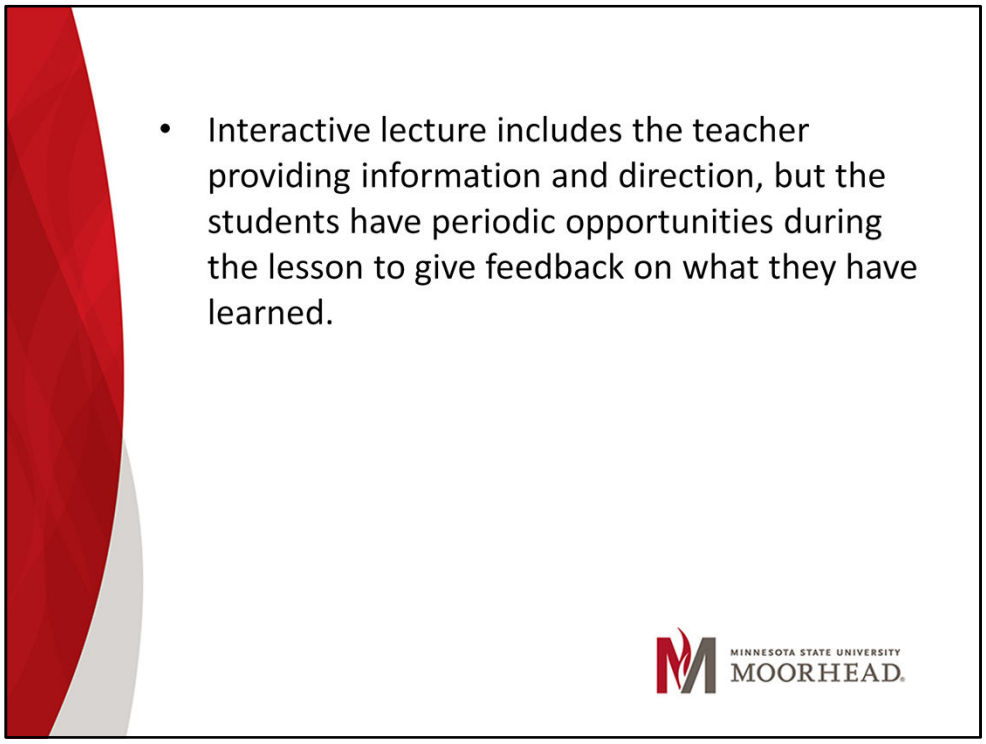
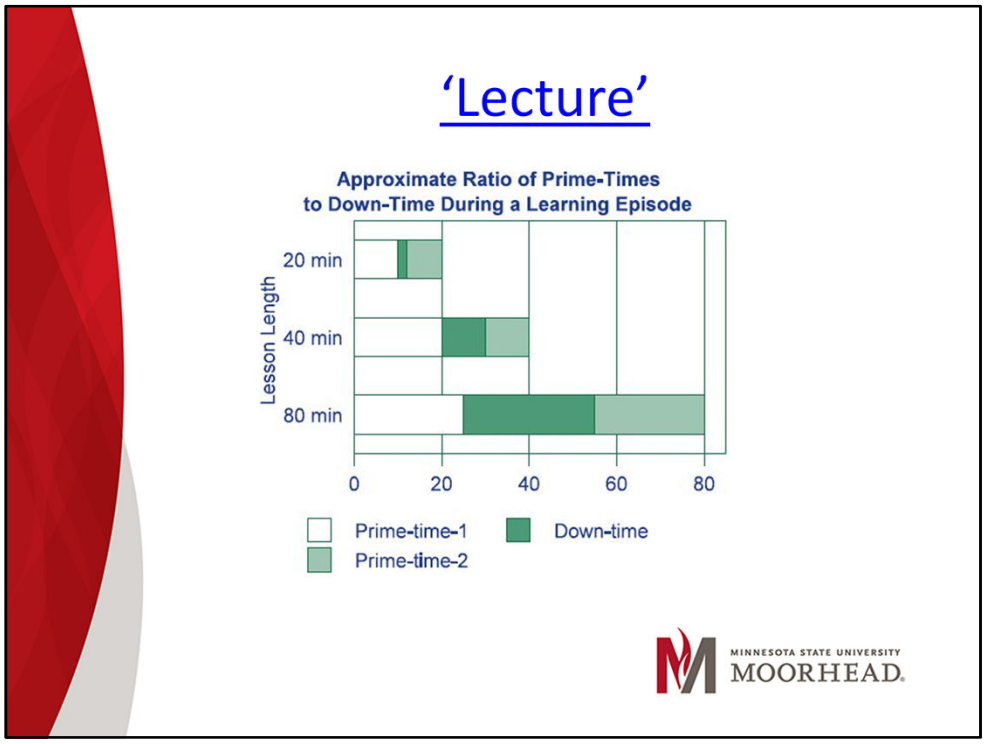
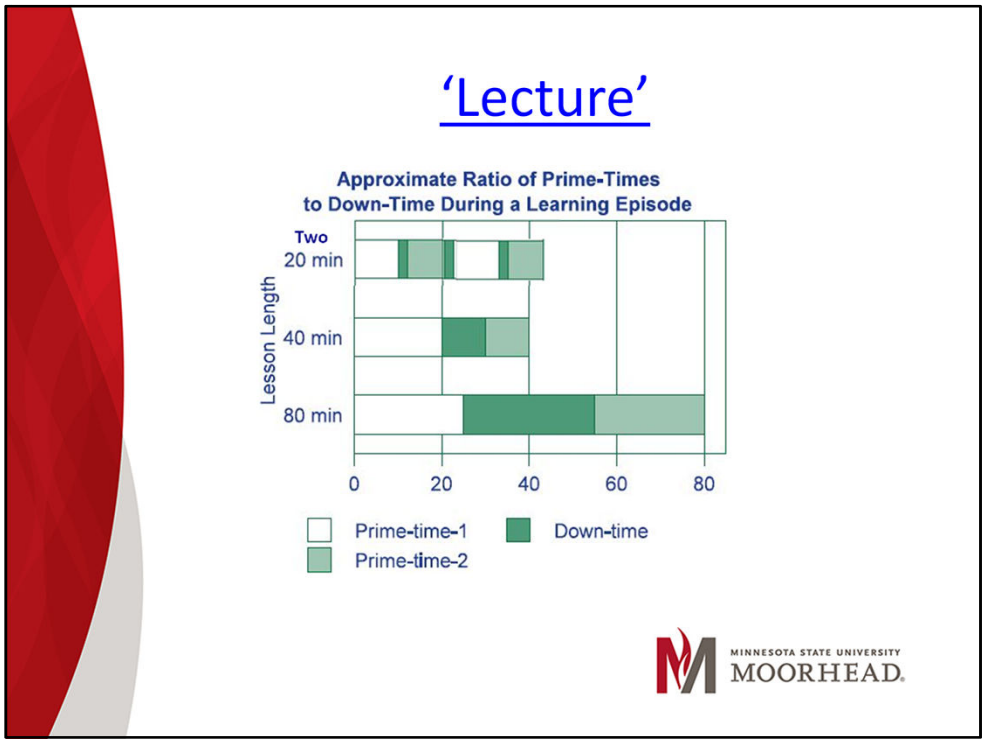


In 2006, 81,499 students in grades 9 – 12 from 26 states participated in a survey of student engagement and reasons for dropping out. Only 27 percent said they would consider dropping out because the work was too difficult. The majority said the reason they would consider it was because it was boring, 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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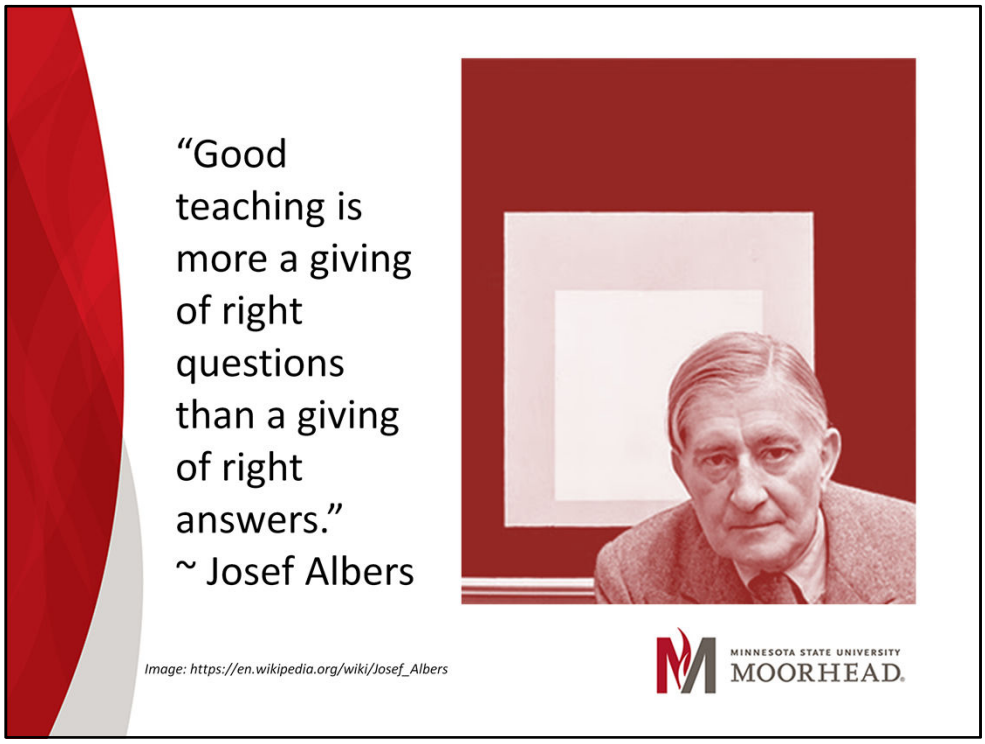
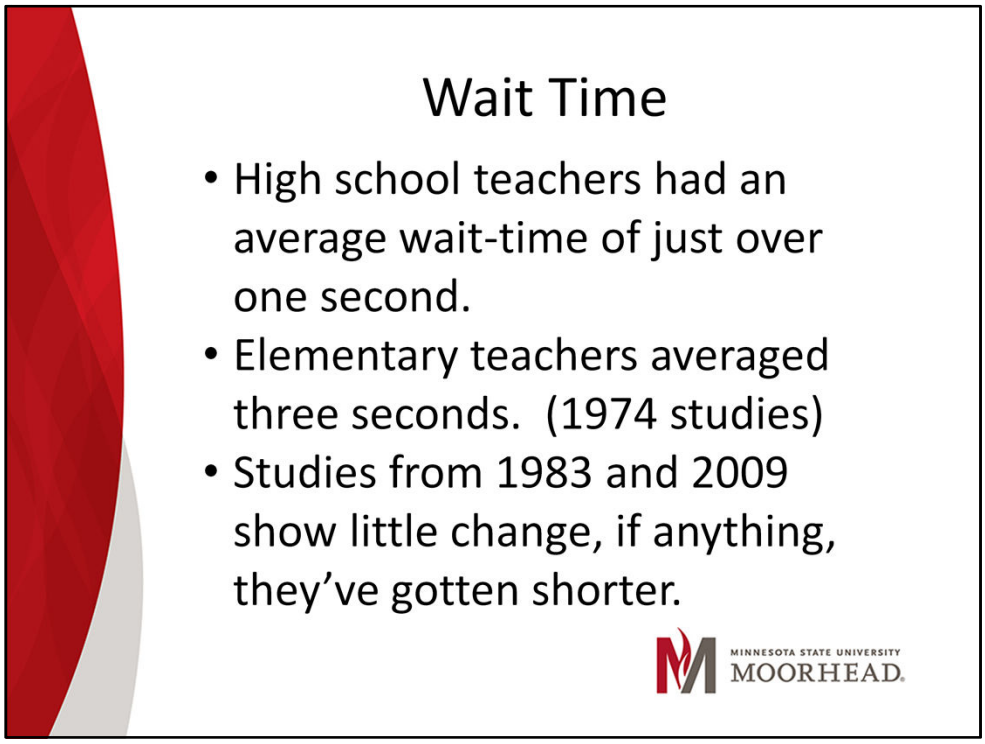


Socratic vs. Didactic

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

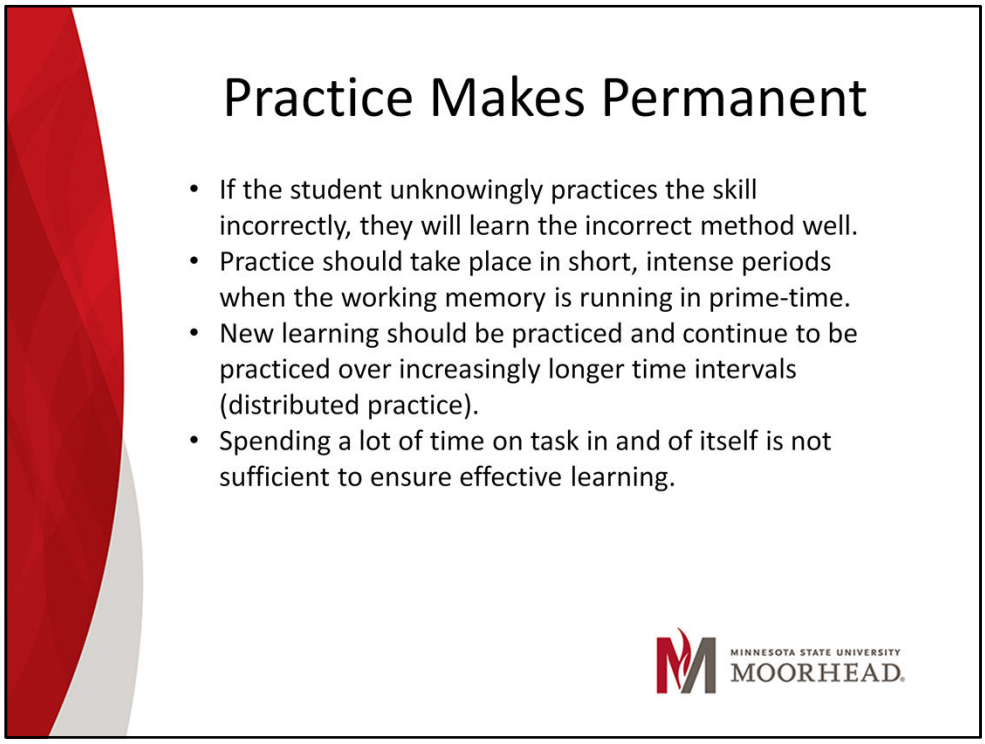
- Utilize Socratic tutoring style versus didactic tutoring style (both can be effective)
- When a student explains their thinking out loud it enhances their learning. (Socratic versus Didactic Tutoring, 2001)
- Both can use open ended questions. In socratic, the tutee does more of the talking.

6pq tutoring



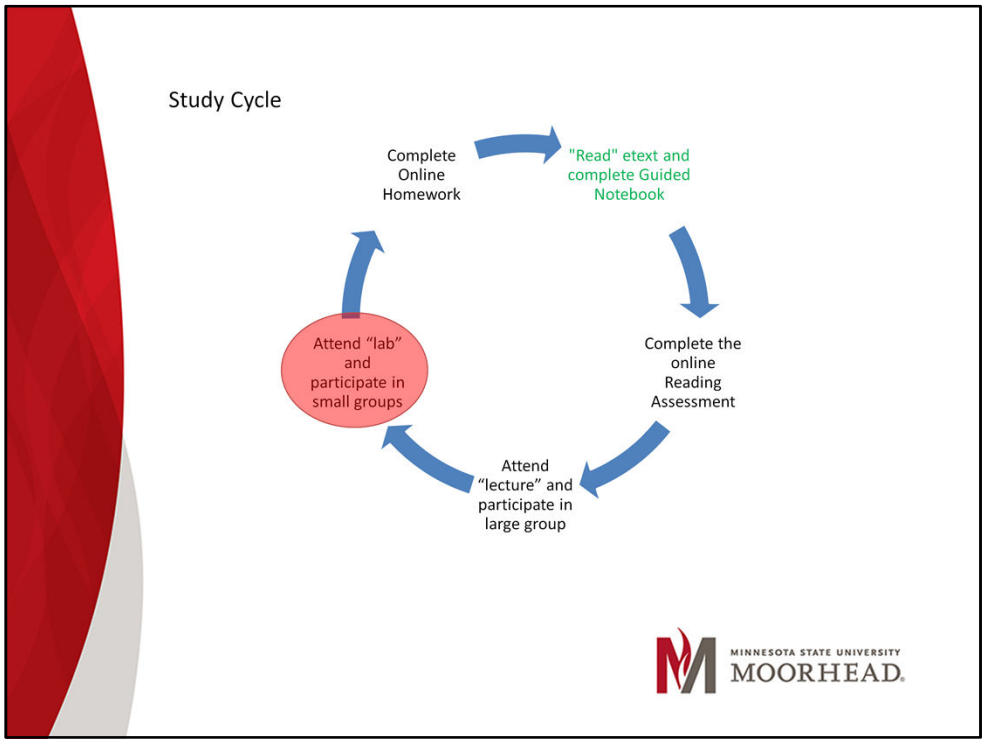
Extend the wait-time to at least five seconds or more:

- 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



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)



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

"Lab"

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

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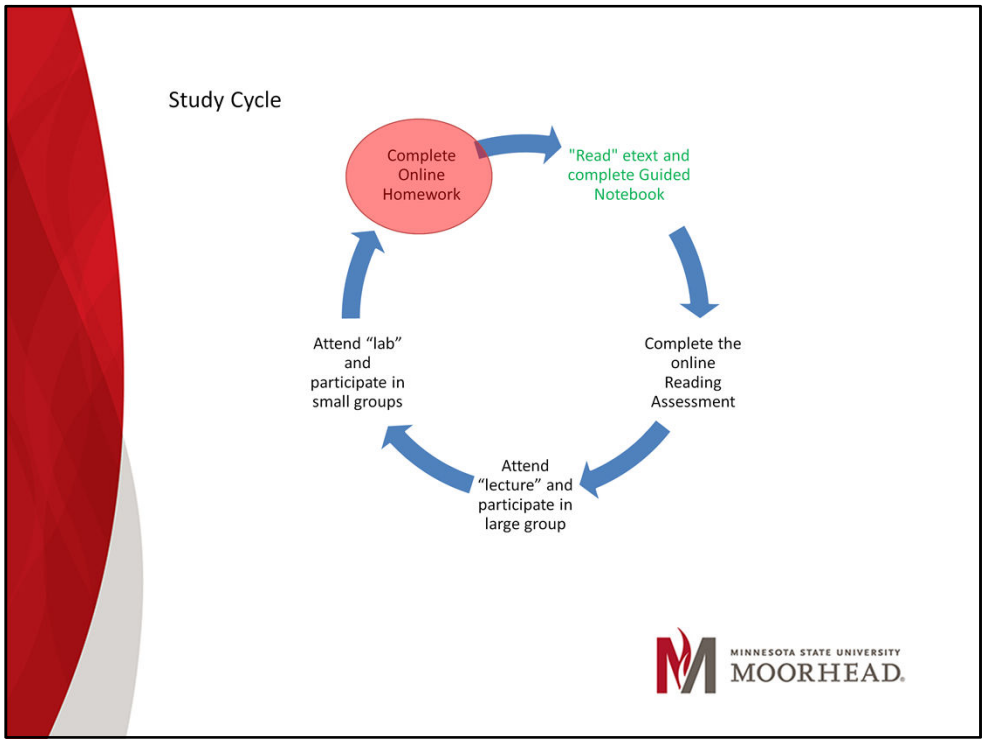
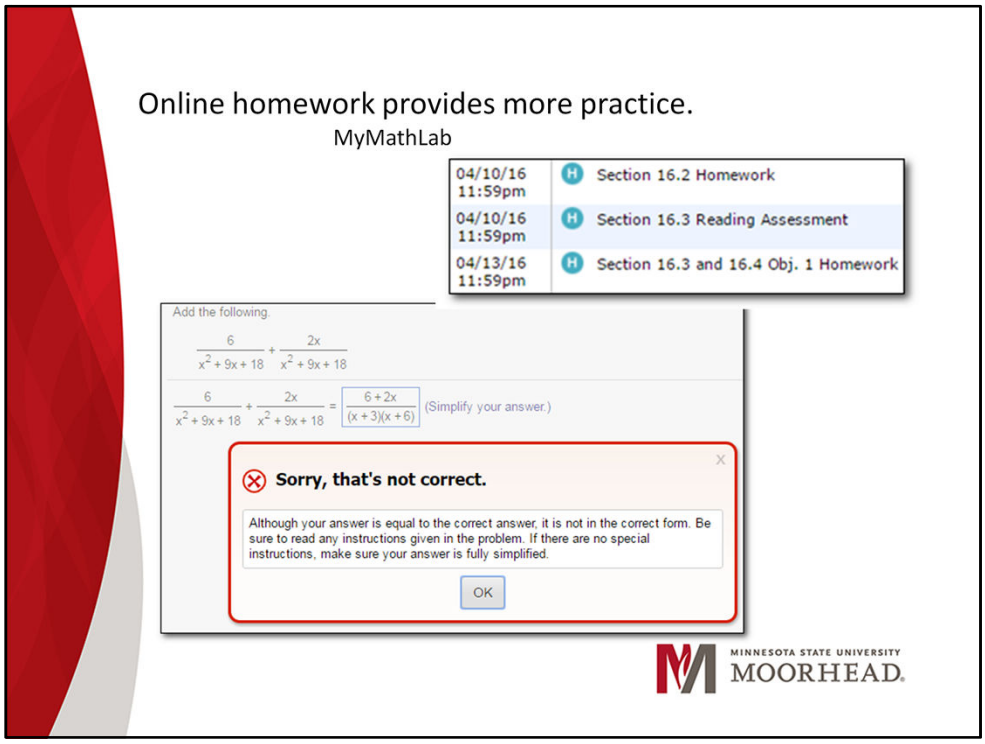


The study cycle may be familiar to many, but why does it work? How does each step of the study cycle figure in to the learning process and what it happening in the brain?

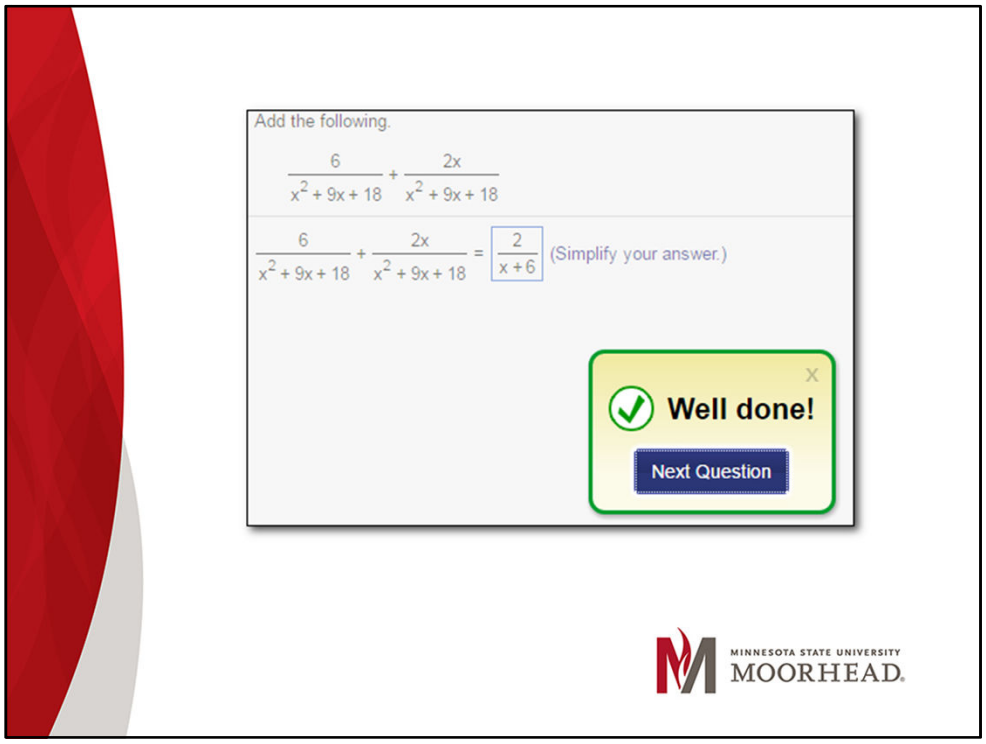
3. Lecture: Draw or outline how the time is spent in one class period.



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.

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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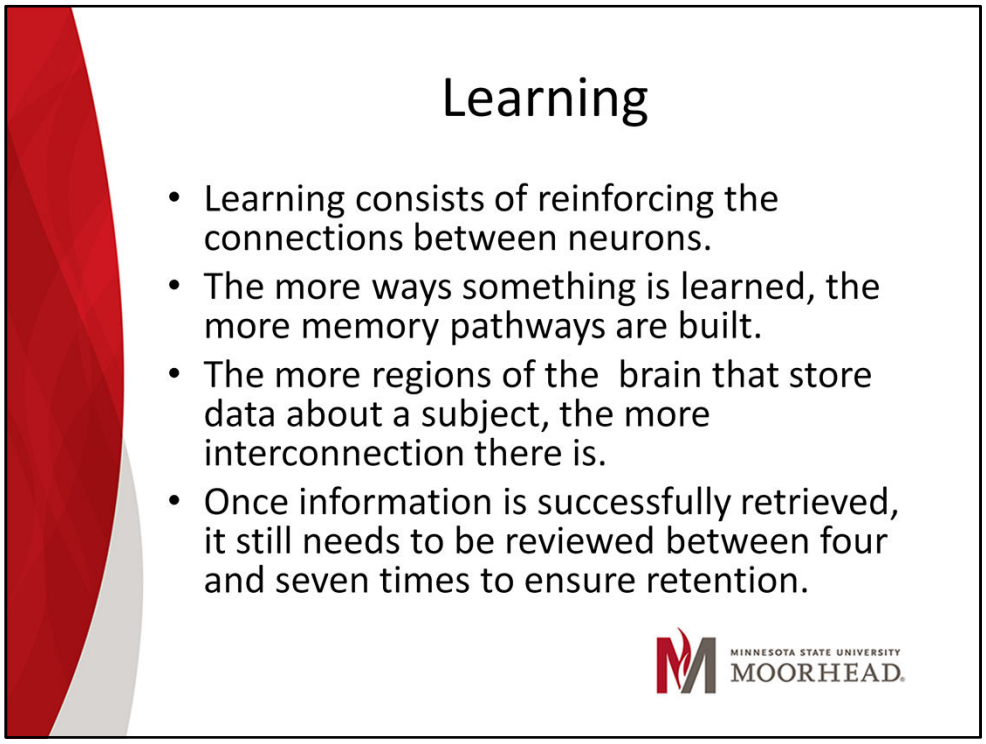

Students need to monitor their learning and actively evaluate their strategies and their current levels of understanding.

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)

http://2.bp.blogspot.com

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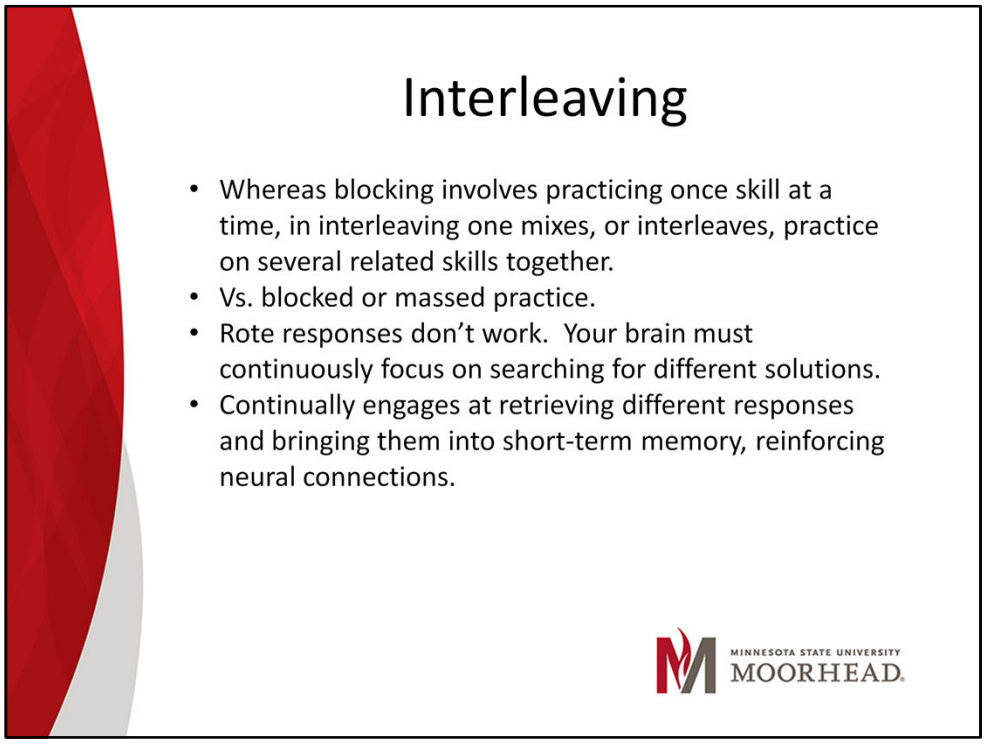
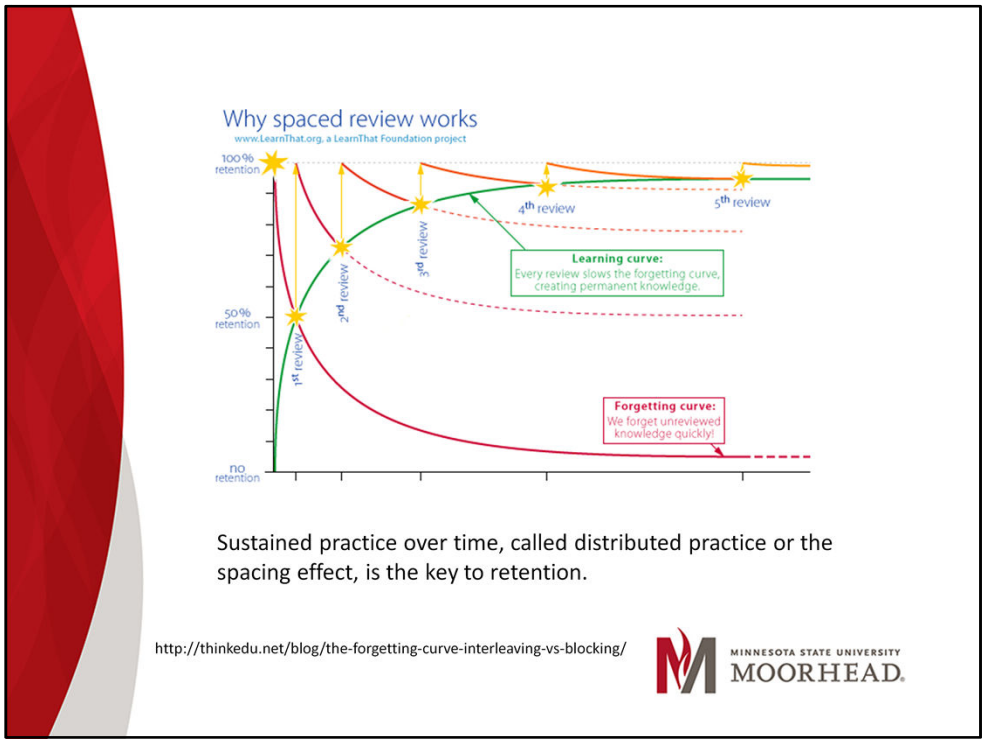
What is our definition of smart?



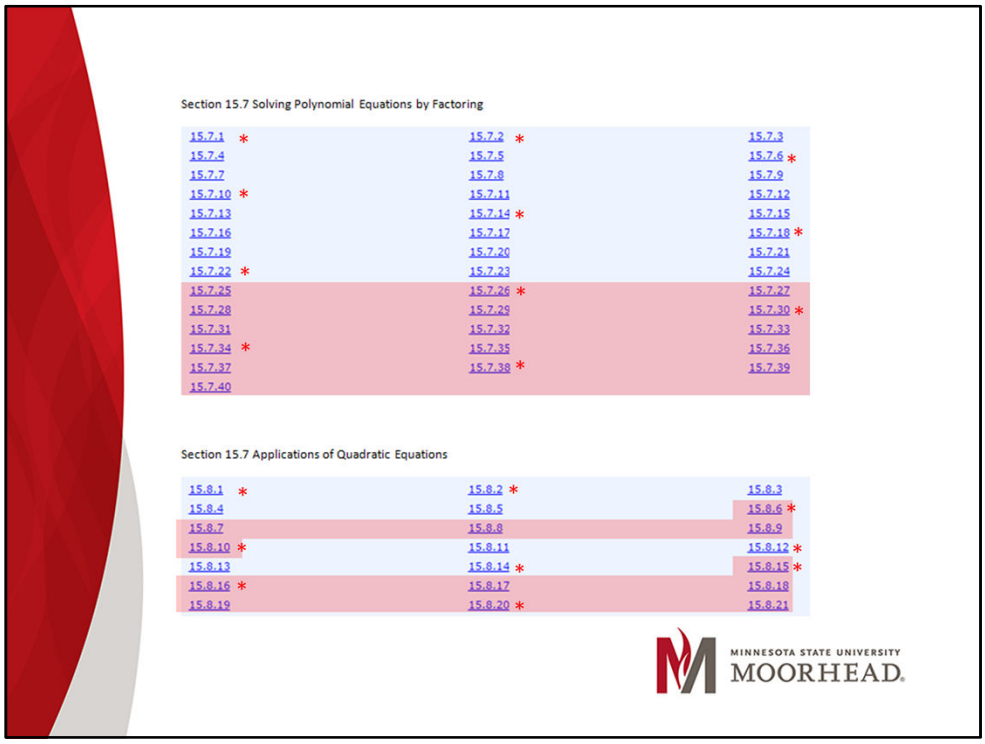
Did it 35 years ago…Saxon text
The spacing effect was first described by Hermann Ebbinghaus in 1885.

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

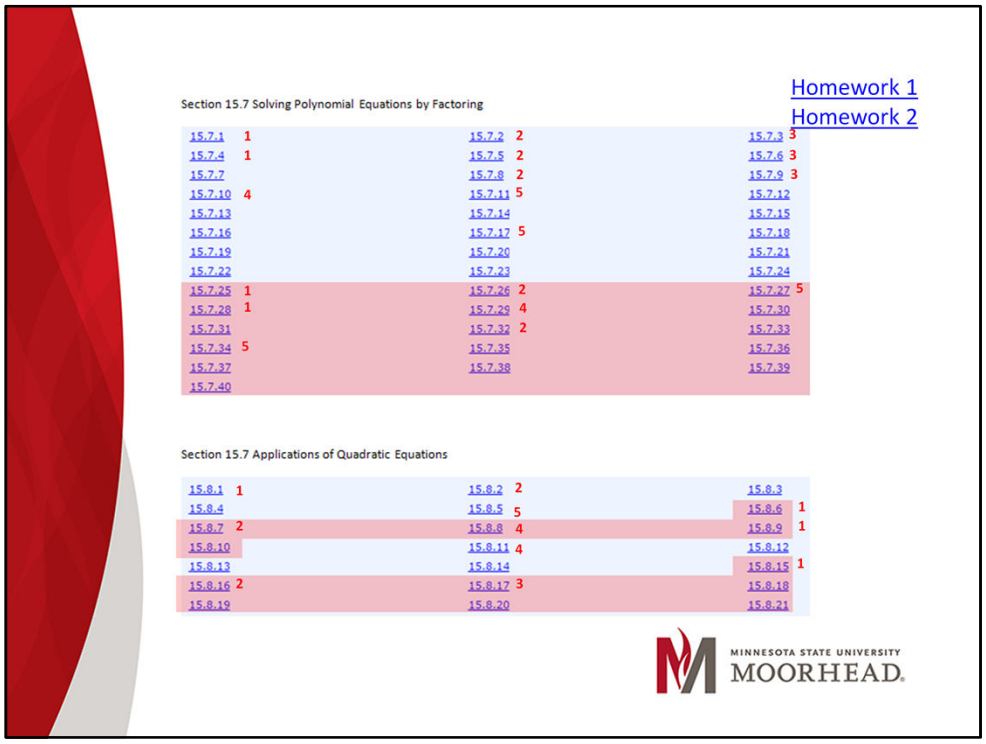
Block practice allows a student to get into a groove and get a false sense that they understand it.
Saxon has used interleaving for years.



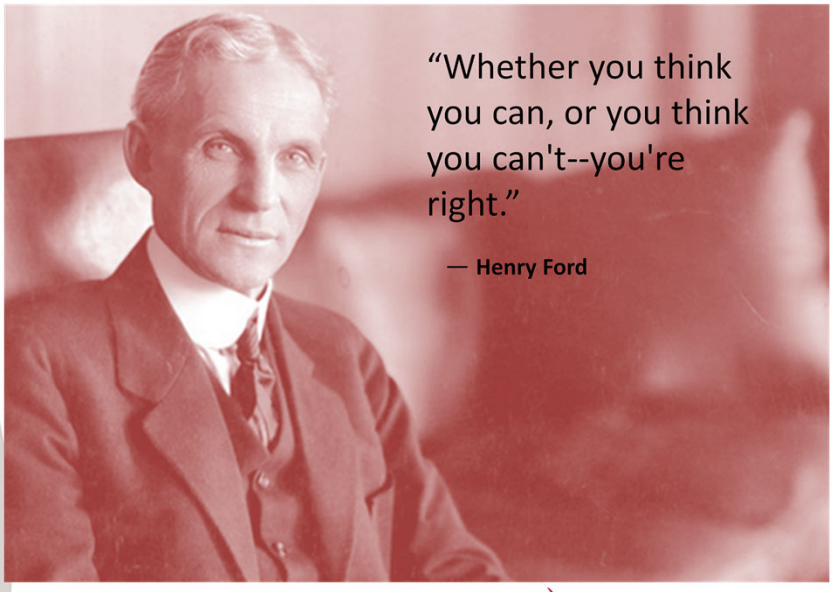
Spiral curriculum, where critical information and skills are reviewed at regular intervals within and over several grade levels.



Topic 1: 20 problems
Blocked, or mass, practice



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



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

— **Henry Ford**

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

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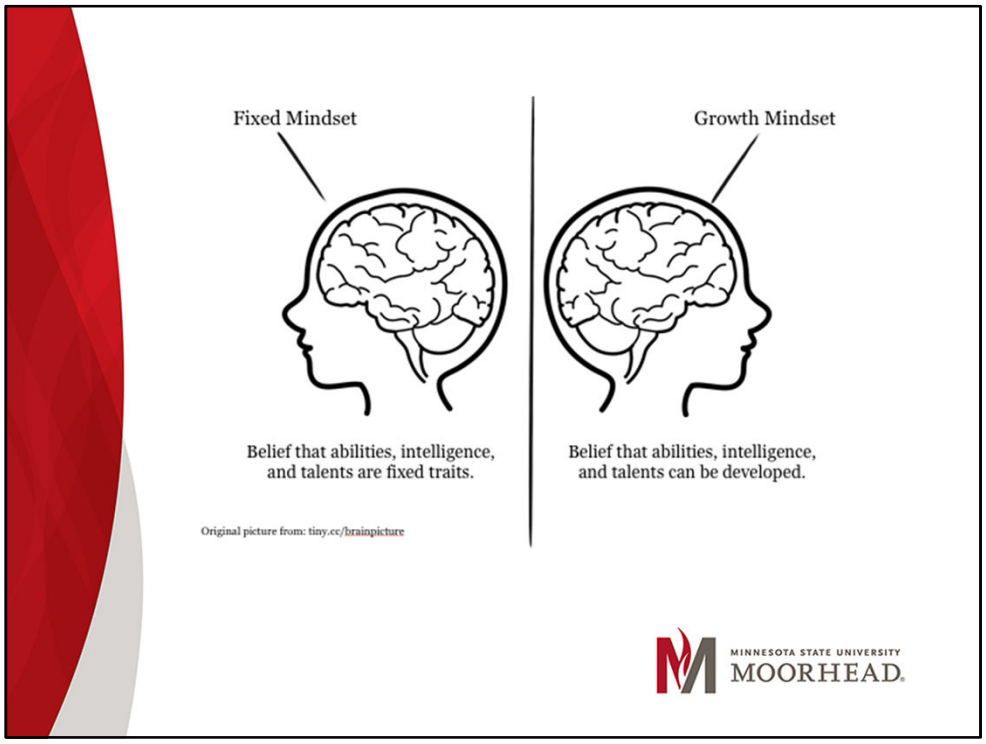
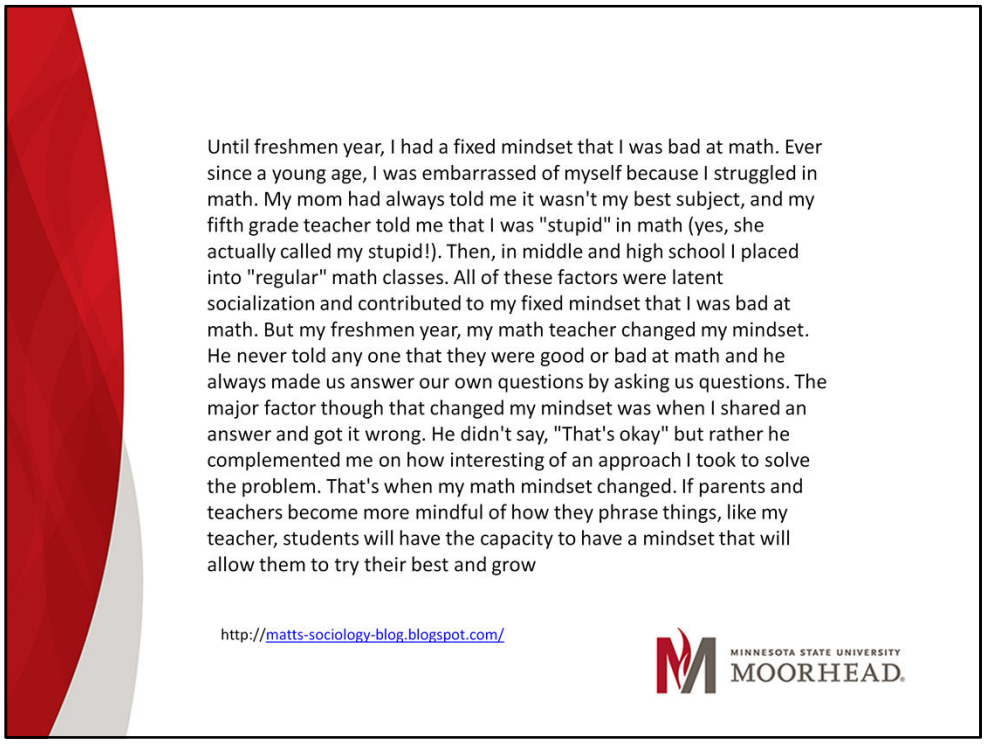
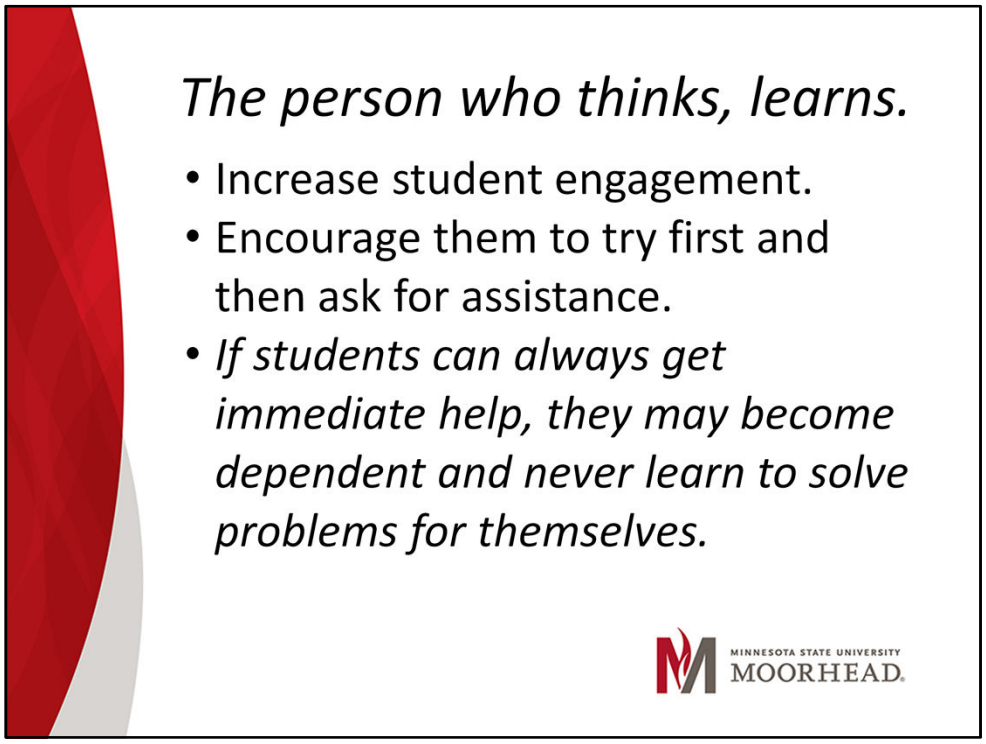


Mindset plays a key role in student's persistence and view of one's capabilities. Carol Dweck



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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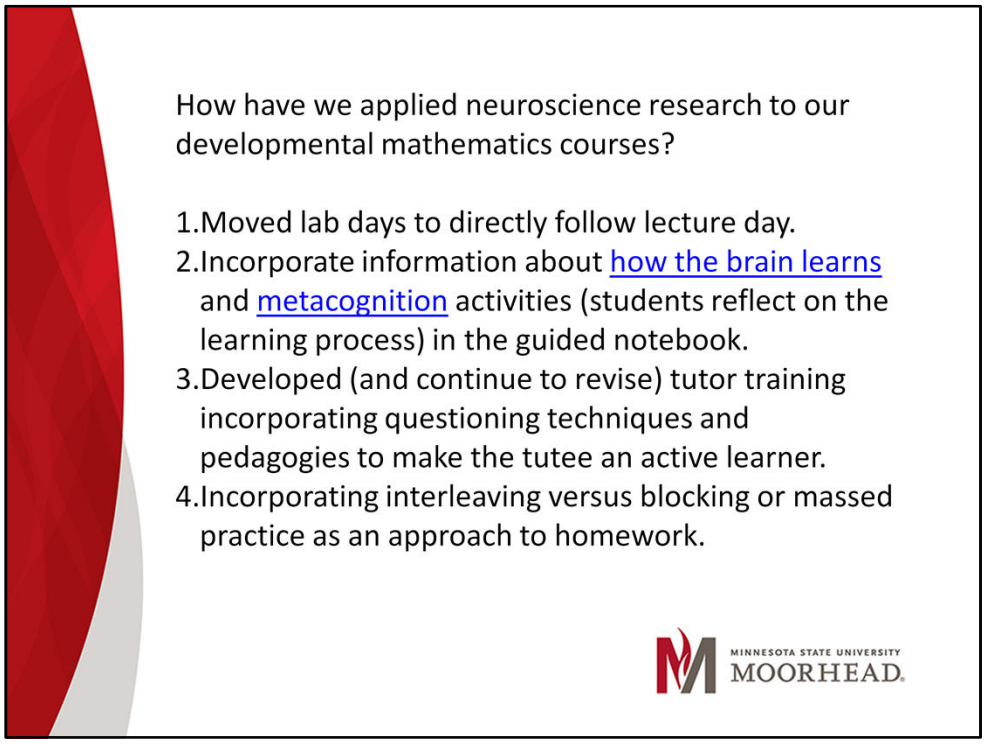

5. Points of interest to be investigated or implemented.

Sources

- Brown, P. C., Roediger, H., & McDaneil, M. (2014). *Make It Stick: The Science of Successful Learning*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press.
- Cherry, K. (2014). About Education. Retrieved November 25, 2014, from What is Memory Consolidation?: http://psychology.about.com/od/memory/g/memory-consolidation.htm
- Dweck, C. (2006). Mindset: The New Psychology of Success. New York: The Random House Publishing Goup
- Green Sleep. (n.d.). Green Sleep. Retrieved November 25, 2014, from The Importance of Deep Sleep and REM sleep: http://www.greensleep.com/Europe/Great-Brittain/EN/seg-belang-diepe-slaap.asp
- Harvard University. (2015). Mind, Brain, and Education. Retrieved 3 20, 2015, from Harvard, Graduate School of Education: http://www.gse.harvard.edu/masters/mbe
- Johnson, K. (2014, January 16). Amygdala Hijack & Emotional Intelligence. Retrieved November 29, 2014, from https://www.youtube.com/watch?v=Lr-T6NAV5V4
- National Research Council. (2000). How People Learn: Brain, Mind, Experience and School. Washington, D.C.: National Academy Press.
- Neuroscience. (n.d.). Retrieved October 25, 2014, from appsychology.com: http://www.appsychology.com/Book/Biological/neuroscience.htm
- NINDS. (2014, July 25). Brain Basics: Understanding Sleep. Retrieved November 25, 2014, from National Institute of Neurological Disorders: http://www.ninds.nih.gov/disorders/brain_basics/understanding_sleep.htm

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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.