



What's the Brain Do With All That Math?

Carolyn Williamson
Virginia Advanced Study Strategies
and
The Carmel School

Why don't they remember?



Who is to blame?

The college professor said, "Such rawness in a student is a shame. Lack of preparation in high school is to blame."

Said the high school teacher, "Good heavens, that boy's a fool. The fault, of course, is with the middle school."

The middle school teacher said, "From stupidity may I be spared. They sent him so unprepared."

The primary teacher huffed, "Kindergarten blockheads all. They call that preparation? Why it's worse than none at all."

The kindergarten teacher said, "Such lack of training never did I see. What kind of woman must that mother be?"

The mother said, "Poor helpless child. He's not to blame. His father's people were all the same."

Said the father at the end of the line, "I doubt the rascal's even mine."

-anonymous, 101 "Answers" for new Teachers and their Mentors, page 81

Lexicons

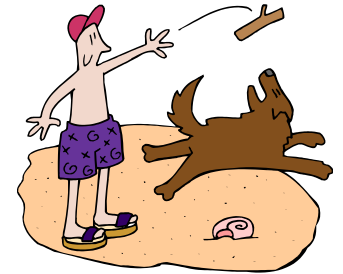
- Lexicons are knowledge stores
- Lexicons can vary in size
- Lexicons can vary in amount of info stored
- Lexicons can vary in terms of accessibility
- Lexicons can vary in terms of emotional tone and intensity



Memory Stages

- Past: Lexicon storage

- If it is stored, then it can be retrieved



- Present: Figure out what to do with new information



- Future: Take working memory in present and extend it into future time



The NOW

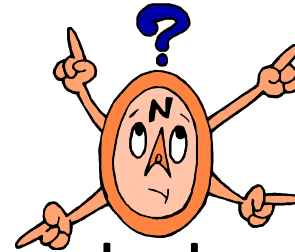
- Initial registration of information requires access of previously stored information
- Students must travel to their lexicons

It can be scary in there....



Now and Then

- Initial registration in the “now” requires access to knowledge stores (lexicons)
- If students do not have an organizational structure, **they can't find it when they need it**
- Inaccessibility of previous knowledge is a barrier to learning
- Students must call upon prior knowledge to make connections



3 Types of Memory

- Short Term Memory
 - Retention for a few seconds or minute
- Working Memory
 - “Desktop” for retrieval of memory for immediate use. When working memory is no longer needed it is partially or totally forgotten.
- Long Term Memory
 - The brain produces new proteins when items from working memory are moved to long term memory

What appear to be memory problems are really difficulties with processing information



Memory is

EVERYWHERE

- Memory is not stored in a single location in the brain
- As experience enters the brain it is deconstructed and distributed all over the cortex
 - Semantic Memory: Hippocampus
 - Episodic Memory: Hippocampus
 - Procedural Memory: Cerebellum
 - Automatic Memory: Cerebellum
 - Emotional Memory: Amygdala

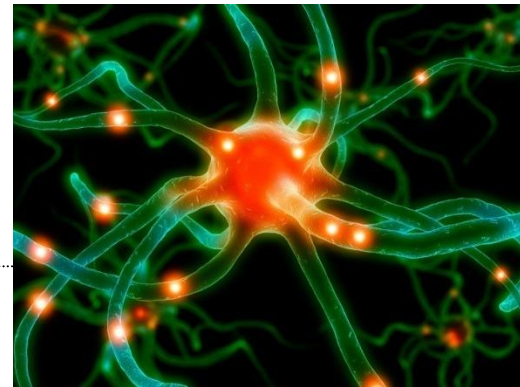


The Transition from....

- Active Working Memory
 - Repeat/Rehearse
 - Strong Context



- Long Term Storage
 - Lexicons can vary in size, accessibility, frequency of use
 - Ease of retrieval = frequency of use
 - Frequency of use builds pathways



MAKING MEMORIES

Repeat and Rehearse can be tricky for the digital generation who are immersed in multimedia and acclimated to multitasking

With repeated exposure, novel experiences become routine

The key is to find meaningful and different applications of math to maintain interest

Determine how much practice is needed and then do no more

Seven Steps in the Memory and Learning Cycle*

- **Reach**
- **Reflect**
- **Recode**
- **Reinforce**
- **Rehearse**
- **Review**
- **Retrieve**

*Marilee Springer

What We Remember...

- We remember **BEST** that which comes FIRST
- We remember **SECOND BEST** that which comes LAST
- We remember **LEAST** that which comes JUST PAST THE MIDDLE



Layering the Curriculum

Foster higher level thinking skills by connecting new learning to prior knowledge

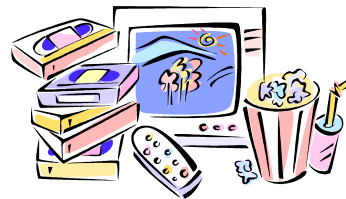
1. Primetime 1

- First twenty minutes
- Avoid management tasks
- Do you really want to start with homework?

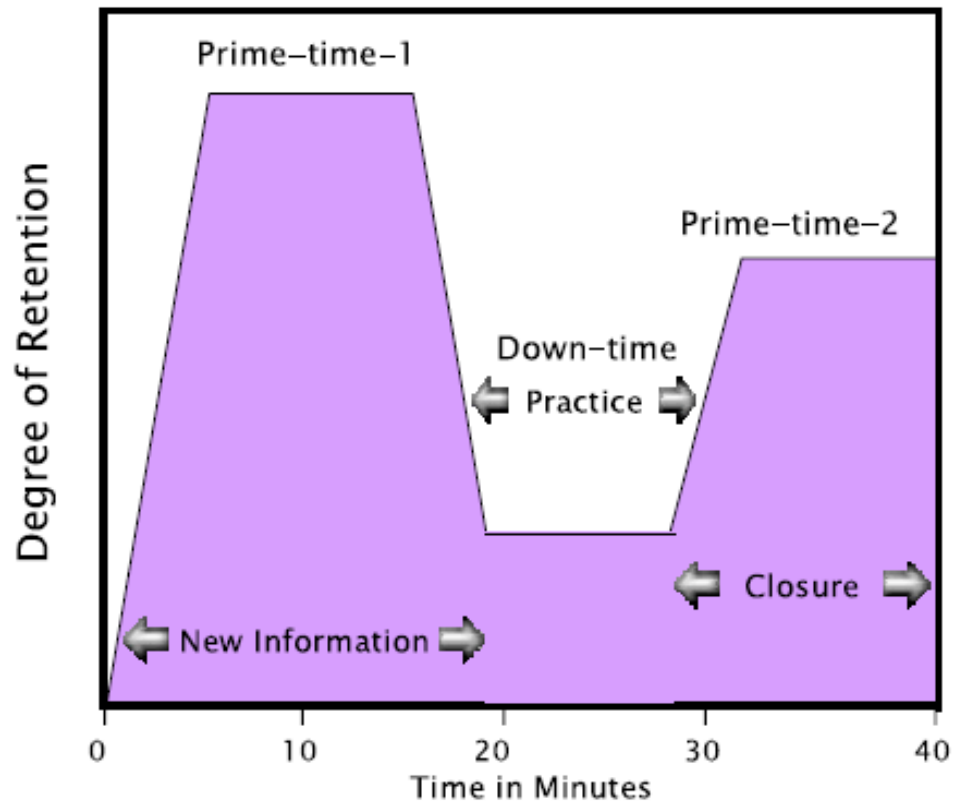


2. Primetime 2

- Closure
- Last chance to attach meaning and make sense of new learning

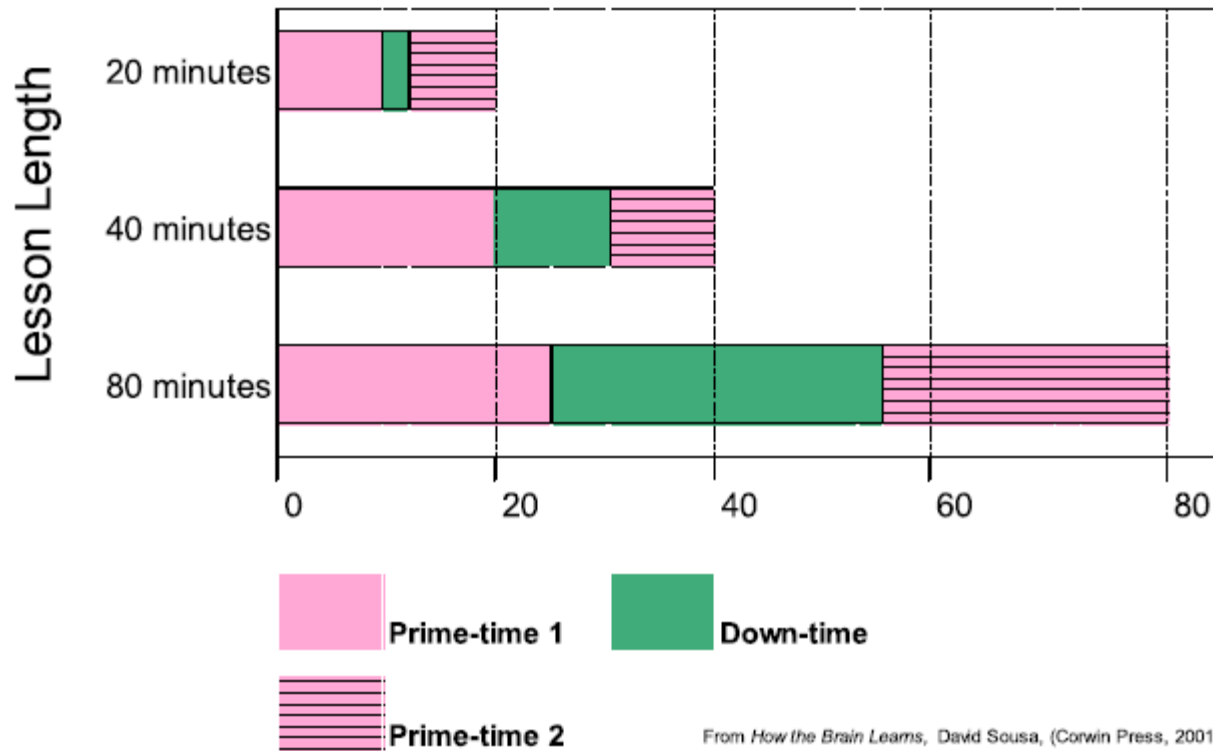


Retention During a Learning Episode



From *How the Brain Learns*, David Sousa, (Corwin Press, 2001)

Approximate Ratio of Prime-Times to Down-Time During Learning Episode



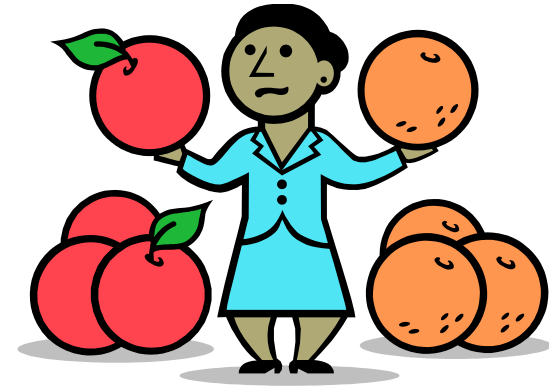
From *How the Brain Learns*, David Sousa, (Corwin Press, 2001)



- Between Primetime 1 and Primetime 2 **should** be a time where students are given the opportunity to move information from working memory to short term memory
- If no meaning is attached then 99% of the learning is lost in 24 hours
- Retention requires the learners to “**hook learning**” to something in their brains

Similarities and Differences

- Brains store using similarities
- Brains retrieve using differences
- If concepts have more **similarities** than **differences**, the **similarities** will overwhelm the **differences** resulting in the same retrieval cues being attached to both concepts.



Lesson Design: Similarities

- List similarities and differences between subjects
- If the number of **similarities is greater** than differences, confusion is likely
- Teach a related concept to give the first concept time to be consolidated (12-14 hours)
- Teach the second similar concept later

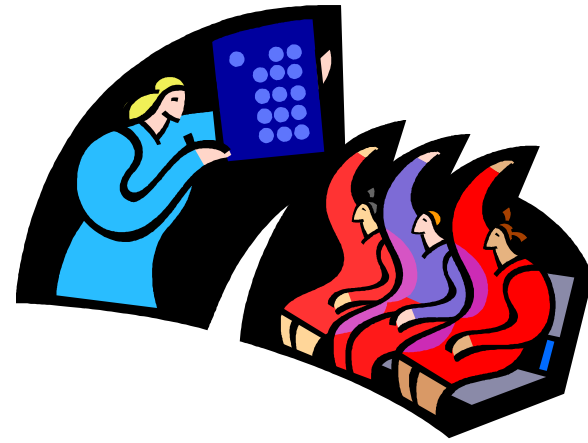


Lesson Design: Differences

- Start by teaching differences first
- Focusing on and practicing the differences gives learners the warnings and cues they need to identify them correctly in the future.



What Can Teachers Do?



- Help students to emotionally prepare for learning by creating relaxed, positive emotional states.
- Teach students about information processing by modeling new strategies
- Help students be in the “now” and cue them about what lexicons are likely to be needed for processing
- Cue students about upcoming need to extend information beyond the “now”

You are the scientist!



Your experience, with research and
practice, is evidence.

Making it Stick

MAKING IT STICK

Rigor

- Does not mean harder
- Effective use of questions
- Incorporation of symbols previously encountered
- Rule of Four: verbal, algebraic, tabular, graphical
- Build in ongoing scaffolding to support students' connections

Relationships

Relevance

- Makes connections within context of the problem
- Solving problems from prior course with new learning
- Relevance makes rigor possible, but relationships are key in determining relevance

LAYING THE FOUNDATION: PRE AP TRAINING

Determining a Rigorous Lesson

When all else fails, ask the students

One research study found that the best way to determine the level of rigor as well as the extent there was evidence of the 3 R's; Rigor, Relevance and Relationships, was to ask students these 7 Questions:



7 Questions on the three R's

1. What is the **purpose** of this lesson?
2. Why is this **important to learn**?
3. In what ways **am I challenged** to think in this lesson?
4. How will I **apply, assess, or communicate** what I have learned?
5. How will I **know how good my work** is and how can I improve it?
6. **Do I feel respected** by the **other students** in the class?
7. **Do I feel respected** by the **teacher**?



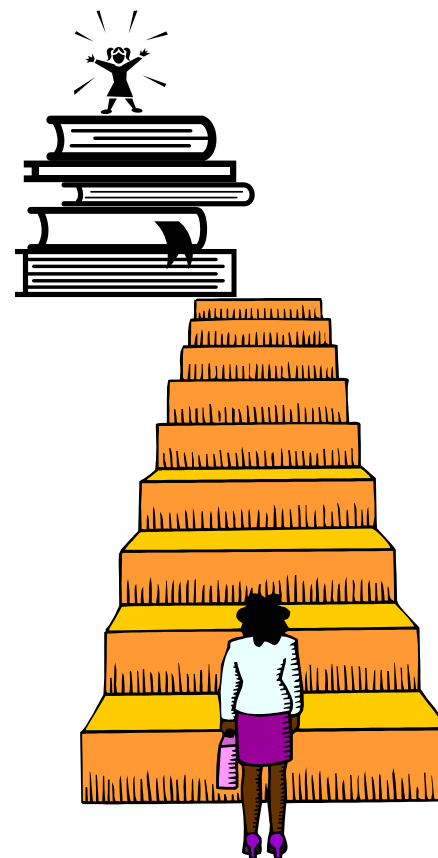
New Beginnings

You are not alone!

- **Collaborate within each subject and between subjects**
- **Articulate vertical alignment of core courses**
- **Meet regularly to share success and use disappointment as a catalyst to revisit and revise**

Every year is a journey....

- For Teachers and Students



Acknowledgements

- Dr. Robert Greenleaf, *Brain Based Teaching*, 2005
- Dr. George McCloskey, *Memory, Learning and Production*, 2007
- Dr. George McCloskey, *Executive Functions*, 2009
- David Sousa, *How the Brain Learns Mathematics*, 2008
- David Sousa, *How the Brain Learns*, 2001
- *Attributes of Digital Learners*, The 21st Century Fluency Project, www.21stcenturyfluency.com
- Patricia Wolfe, *Brain Matters*
- Education Week, 1/11/06, www.schoolchange.org
- "Layered Curriculum is a registered trademark developed by and registered to Kathie F. Nunley. Additional information is available at <http://help4teachers.com>."