Understanding the Science of Learning to Provide Academic Equity for Students with Disabilities and Multilingual Learners

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Learning Objectives

1. Today we will learn how to use Cognitive Science to boost learning.
2. Today we will learn 3 key ideas within Cognitive Science that are rooted in strengthening memory and posing questions which will help students more effectively retain what they are learning.
3. The first key idea is to Boost Student Memory.
4. The second key idea is Retrieval Practice.
5. The third key idea is Probing Questions.

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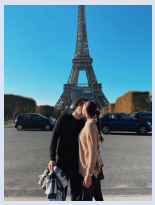
Cassie & Eddy



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Group Attention Signal

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Group Activities Organization

- Create a group of 4-5
- Assign a number starting with 1 to each member of the group
- Who is...

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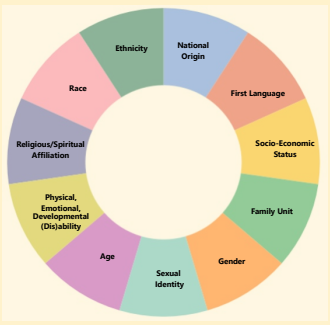
Identity Wheel



Social Identity wheel: Adapted for use by the Spectrum Center and the Program on Intergroup Relations, University of Michigan

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Community agreements help maintain a safe, supportive, and active learning environment.

- Stay engaged
- Expect and accept a lack of closure
- Speak your Truth
- Expect to experience discomfort
- Bring your identity
- Develop and use the language of identity in our discussions
- Bring a willingness to learn and unlearn
- Use First Names

Adapted from Glenn E. Singleton & Curtis Linton, Courageous Conversations about Race: A Field Guide for Achieving Equity in Schools. 2006. pp.58-65. Thousand Oaks, CA: Corwin

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What Is Equity?

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Shelley Moore's 7-10 Split

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What was your AHA moment?

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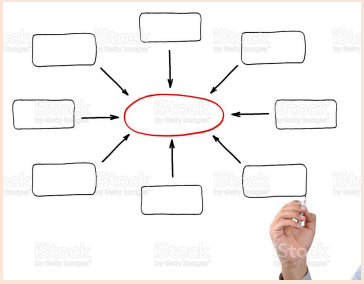
How Do Students Learn?

1. Draw the Brainstorming Diagram onto the large post it paper.
2. In the middle circle write the question "How do students learn?"
3. As a group complete the Brainstorming Diagram.
4. Start with Person #1, write the idea, briefly explain it, go to Person #2, etc.
5. Remember, you must explain why you chose that word to describe how students learn.
6. If you say the same idea, elaborate on the why.
7. Wrap Up – What Law of Learning is it?



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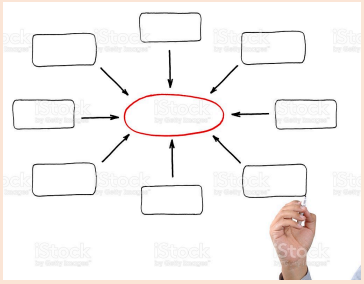
How Do Students Learn?

1. What Law of Learning is it?



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What Is The Science of Learning?

(A basic definition)

- Over the last 20 years the field of Cognitive Science (a.k.a The Science of Learning) has made enormous gains in understanding how students learn.
- Humans are complex beings.
- Our mental processes and behaviors make up our personalities; we are the product or our thoughts, feelings, and actions.
- By studying human behavior and performance, we can learn much about how memory works and how deep learning occurs.
- How we make memories, solve problems and even learn language is part of cognitive psychology.
- **Cognitive psychology takes into consideration how the mind and specific behaviors affect learning. It concerns itself on the journey, not the beginning or the destination itself.**

- **Cognitive psychology is what happens between initial thought and action taken. It is the process of learning, especially what makes that process most effective.**

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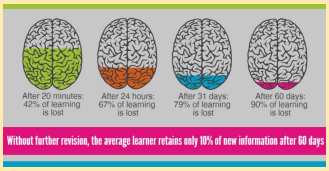
Research on Memory and Learning

- Memories are like spiderwebs, strands of recollection distributed across millions of connected neurons.
- When a student learns something new, the material is encoded across those neural networks, converting the experience into a memory.
- Hermann Ebbinghuas discovered through his landmark research in the field of retention and learning the forgetting curve, a measure of how much we forget over time.
- He discovered **without reinforcement or connections to prior knowledge**, information is quickly forgotten – 56% in 1 hour, 66% after a day, & 75% after 6 days



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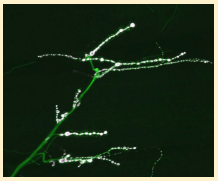
Research on Memory and Learning

- MIT neuroscientists, led by Richard Cho, explained the mechanisms for synaptic strengthening.
- When neurons are frequently fired, synaptic connections are strengthened; the opposite is true for neurons that are rarely fired.
- Known as synaptic plasticity, this explains why some memories persist while others fade away.
- Repeatedly accessing a stored but fading memory—like a rule of geometry or a crucial historical fact—rekindles the neural network that contains the memory and encodes it more deeply.



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1) NPFXOSK
2) ORANGES

- For readers of English, the second set of letters is more memorable—the more connections neurons have to other neurons, the stronger the memory.
- The seven letters in NPFXOSK appear random and disjointed, while ORANGES benefits from its existing, deeply encoded linguistic context.
- The word *oranges* also invokes sensory memory, from the image of an orange to its smell, and perhaps even conjures other memories of oranges in your kitchen or growing on a tree.
- You remember by layering new memories on the crumbling foundations of older ones.

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Who Remembers This?

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Making Memories

- Most successful when new information is meaningfully linked to already-existing knowledge in our memories.
- The more we process and think about something new, the more enduring and retrievable memories become.

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In Short...

- We engage different types of memory depending on the task.
- Being able to retrieve information stored in long-term memory is an essential part of learning.
- Forgetting is a natural process. Our brains regularly sort through information when we sleep (and while we're awake) to determine what's important to save and what isn't.
- Short-term or working memory
  - Temporary storage with limited capacity
  - The younger the student, the smaller the capacity
- Long-term memory
  - Has unlimited storage capacity
  - Two main categories
    - Explicit – conscious recollection of information, experiences, and concepts
    - Implicit – unconscious memory or performing activities without having to think – EX: Riding a bicycle

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How does understanding the Science of Learning ensure academic equity for SWD & MLL?

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Key Idea #1
5 Teacher Strategies to Boost Student Memory

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Review

1. Use peer-to-peer explanations.
2. Review. Break. Review again.
3. Give frequent practice tests.
4. Try interweaving.
5. Pair text with images.

BOOST RETENTION AND MAKE LEARNING STICK!

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How can you infuse a brain boosting strategy into an IEP or LEP Plan?

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Key Idea #2
Retrieval Practice

- This concept focuses **not** on how we get the information into students' brains but on how students get information **OUT** of their brains.
- Cognitive scientists have discovered that when students struggle to bring information to mind (EX: quizzes), that act of retrieval actually boosts learning itself.
- Memory is strengthened when students attempt to retrieve information – especially when a little forgetting has taken place to the degree that students struggle to recall.

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Retrieval Practice

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Retrieval Practice

- Free recall vs. Cued recall
- Portable
- Assure accuracy
- Shouldn't be graded
- Something available to retrieve
- Value struggle

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20 Ideas for Retrieval Practice

- Flashcards
- Self Quizzing
- Parent Based Quizzing
- Seneca Learning
- Revision Guides/Textbooks
- A Question A Day
- Mindmaps
- Quizlet
- Heads Up/Taboo
- A to Z
- Kahoot
- Homework
- Past papers
- Write their own exam style questions
- Venn Diagrams
- Knowledge organizers
- Wordsearch
- Crossword
- Brain Dump
- Quiz & Trade

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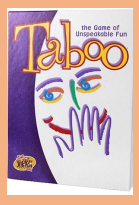

Time to Play Halloween Taboo

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Mini-Quizzes

- Several times per week, teachers will devote five minutes of class time to ask all students three to five questions on content learned previously.
- These no-stakes questions will not be graded but will challenge students to recall what they learned last week, last month, or even earlier in the year.
- It's a deceptively simple strategy, but the mini-quiz structure helps teachers accelerate learning by strengthening students' retrieval of what was previously taught. That will allow more time to move ahead with grade-level content.

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Key Idea #3
Probing Questions

- Barak Rosenshine's research - Ask a large number of questions and check the responses of all students.
- **Questions help students practice new information and connect new material to their prior learning.**
- Research findings have demonstrated students need to practice new materials.
- The teacher's questions and student discussions are a major way of providing this necessary practice.
- The most successful teachers in these studies spent more than half of the class time lecturing, demonstrating, and asking questions.
- Questions allow a teacher to determine how well the materials have been learned and whether there is a need for additional instruction (RETEACH).
- **The most effective teachers also ask students to explain the process they used to answer the question, to explain how the answer was found.**
- Less successful teachers ask fewer questions and almost no process questions.

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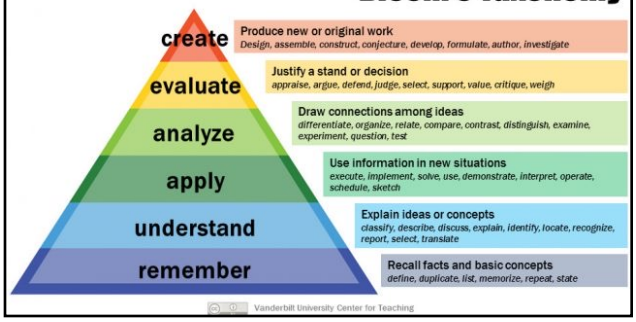
Bloom's Taxonomy



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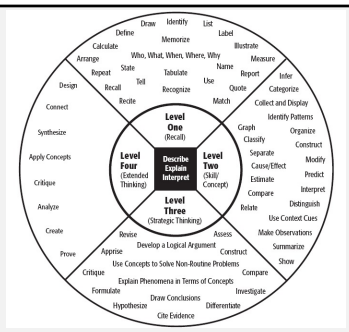

Webb's Depth of Knowledge

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fldoe.org

2.1.3. Cognitive Complexity/Depth of Knowledge

Statewide assessment items are classified using a model with origins in the works of Dr. Norman Webb[1] on depth of knowledge (DOK). With this system, items are classified on the cognitive demand inherent in the test item, not on assumptions about the student's approach to the item. The three categories—referred to as *DOK Level 1*, *DOK Level 2*, and *DOK Level 3* for FSA assessments, and low complexity, moderate complexity, and high complexity for NGSSS assessments—form an ordered description of the cognitive demands an item makes on a student. Items at the low level of complexity require a simple skill, such as locating details in a text or solving a one-step problem. At the moderate level, an item can ask the student to summarize a passage or retrieve information from a graph and use it to solve a problem. At the high level, an item may require a student to analyze cause-and-effect relationships or justify a solution to a problem. The distinctions made in item complexity are intended to provide a balance across the tasks administered at each grade level. The range of the percentage of points in each complexity level is listed for each assessment in the test blueprints and in the tables below and on the following page.

Table 1: FSA Percentage of Points by Depth of Knowledge Level

Grade/Subject	DOK Level 1	DOK Level 2	DOK Level 3
Grades 3–10 ELA	10%–20%	60%–80%	10%–20%
Grades 3–8 Mathematics	10%–20%	60%–80%	10%–20%
Algebra 1 and Geometry	10%–20%	60%–80%	10%–20%

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Classroom Examples

Tell the answer to a neighbor.	Write the answer on a card and hold it up.	Raise their hands if they know the answer (thereby allowing the teacher to check the entire class).	Raise their hand if they agree with the answer that someone else has given.	**Sample questions:**	*How are _____ and _____ alike?*
What is the main idea of _____?	*What are the strengths and weaknesses of _____?*	*In what way is _____ related to _____?*	*Compare _____ and _____ with regard to _____.*	*What do you think causes _____?*	*How does _____ tie in with what we have learned before?*
	Which one is the best _____, and why?	*What are some possible solutions for the problem of _____?*	*Do you agree or disagree with this statement: _____?*	*What do you still not understand about _____?*	

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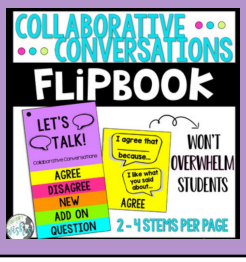
Collaborative Conversation Starters
Flip Book Activity
(Discourse – B.E.S.T. Standards)



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Is it important to understand the Science of Learning when planning instruction for SWDs and MLLs?

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Wait Time

- Wait time is the time teachers give after posing a question, and there is an additional, lesser known wait time after students respond that is actually more important (Wait Time 2).
- Wait time allows students to think about answers. All students and not just the one or few that are called on.
- Research on the outcomes of wait time by Mary Budd Rowe says that if teachers increase the wait time after posing a question and after students respond, there are encouraging improvements.
- Waiting an additional three seconds or more can enhance students' "use of language and logic as well as in student and teacher attitudes and expectations" according to Rowe's studies.
- Studies also found that waiting after students first respond (Wait Time 2) increased the length and quality of their responses.
- Students provided more information and elaborated on their thoughts. Wait time slows down thinking, allowing students to process and dig deeper into content.

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- **The learning experiences within day-to-day class time remain the single most efficient and important opportunity to meet student academic needs.**
- When it comes to instruction, it's helpful for teachers to understand
  - The different types of memory
  - When and how to engage them
  - How to instruct students in such a way that they can move new information from their working memory to long-term memory.
- Key Idea #1
  - Boost Memory
- Key Idea #2
  - Retrieval Practice
- Key Idea #3
  - Probing Questions

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- Lesson planning and the development of learning environments should take all students into account.
- Unfortunately, this doesn't always happen.
- Through her analogy, Shelly Moore provides a solid explanation of what we should plan for and teach to all students.
- 7-10 Split

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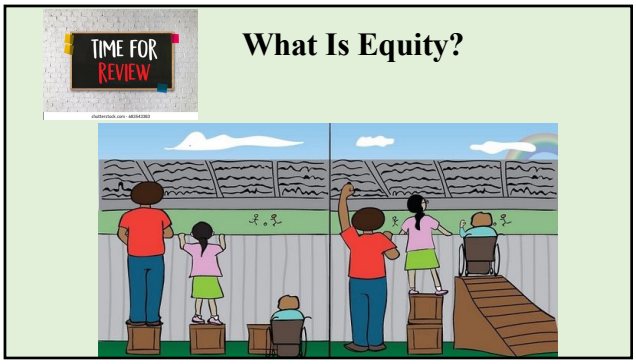
TIME FOR REVIEW
What Is Equity?

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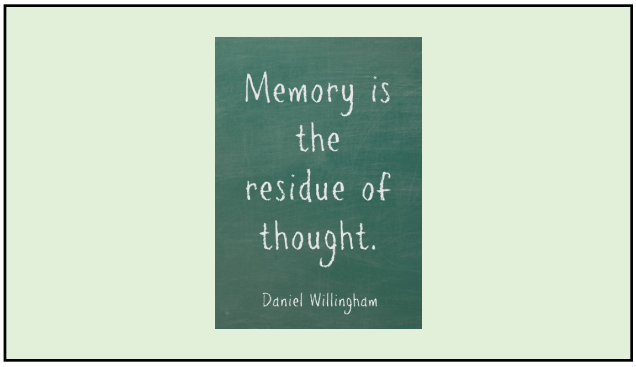
Memory is the residue of thought.
Daniel Willingham

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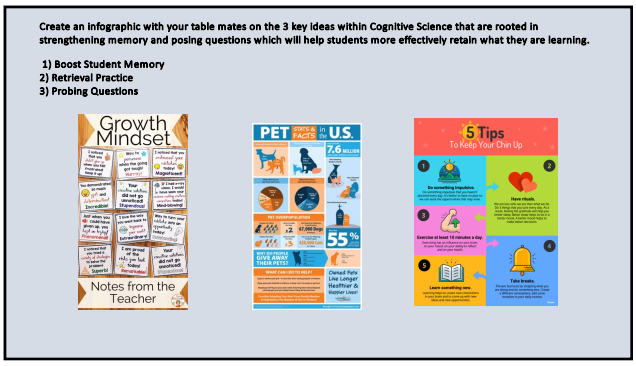
Create an infographic with your table mates on the 3 key ideas within Cognitive Science that are rooted in strengthening memory and posing questions which will help students more effectively retain what they are learning.
1) Boost Student Memory
2) Retrieval Practice
3) Probing Questions
Growth Mindset
Notes from the Teacher
PET
55%
5 Tips
To Keep Your Chin Up

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How will you take this information back to your schools?

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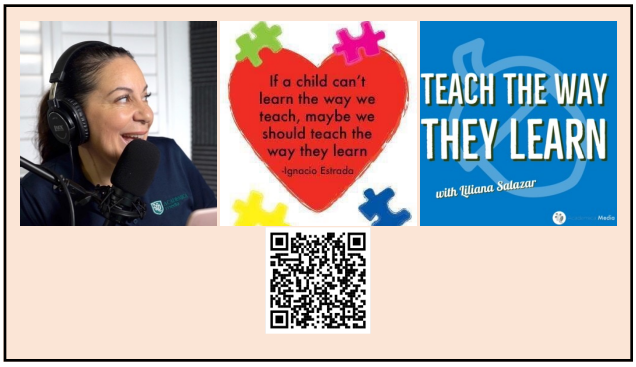
If a child can't learn the way we teach, maybe we should teach the way they learn
-Ignacio Estrada
TEACH THE WAY THEY LEARN
with Liliana Salazar

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