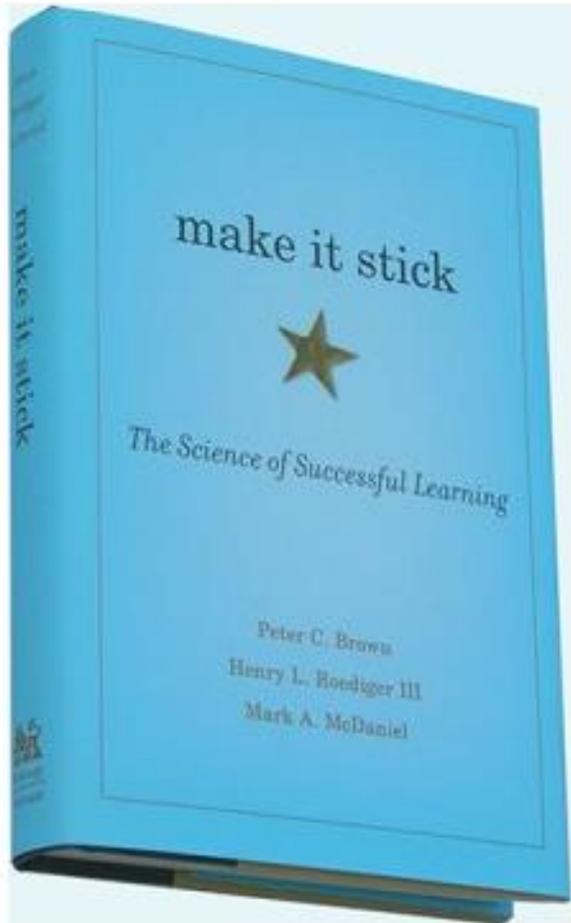


Make it Stick



Claim 1 – Learning is more durable when it is effortful.



- During **encoding**, new information is received by your brain in the form of chemical and electrical charges. These are encoded into memory traces (or mental representations of the patterns you've observed), which are held in your short-term working memory. Most of these memory traces are forgotten.
- During **consolidation**, material is placed in your long-term memory. Your memory traces are reorganized and connected to past experiences and knowledge in your long-term memory to give them meaning. This process strengthens and stabilizes the mental traces.
- During **retrieval**, you fetch material from your long-term memory. This concurrently strengthens the memory traces and reconsolidates them by connecting them to the new learning. Ability to locate can call up this information depends on repeated use and on your establishing retrieval cues that can reactivate these memories.
- When you recall things from short term memory, little benefit occurs. When you recall it after time has lapsed, it strengthens your memory and makes the learning pliable again, leading to its reconsolidation. This helps you to update your memories with new information and reconnect them with new learning.

Tips

1. **Foundation of prior knowledge**

Elaboration can continue indefinitely. This is the process of giving new material meaning by expressing it in new words and linking it to what you already know.

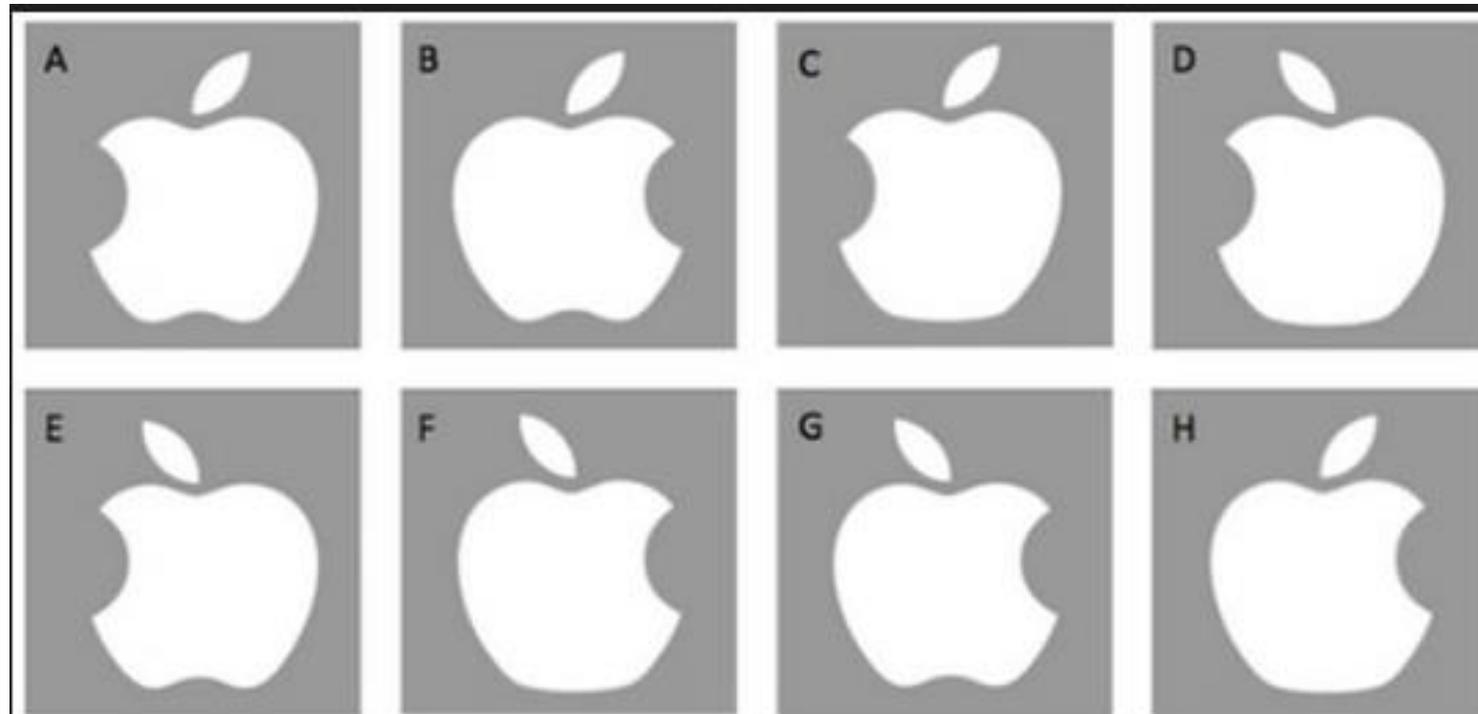
2. **Put the new learning in a larger context**

People who learn to extract the key ideas from new material and organise them into a mental model and connect that to prior knowledge show an advantage in learning complex mastery.

3. Trying to come up with an answer rather than having it presented to you, or trying to solve a problem before being given the solution, leads to better learning and longer retention of the correct answer, even if your attempted response is wrong, **so long as the corrective feedback is provided.**

Claim 2 – We are poor judges of when we are learning well and when we aren't.





Claim 3 – Gains achieved during mass practice and repetitive exposure are transitory. Mix up your practice!

IF YOU'RE
READING
THIS **AGAIN** IT'S
TOO LATE



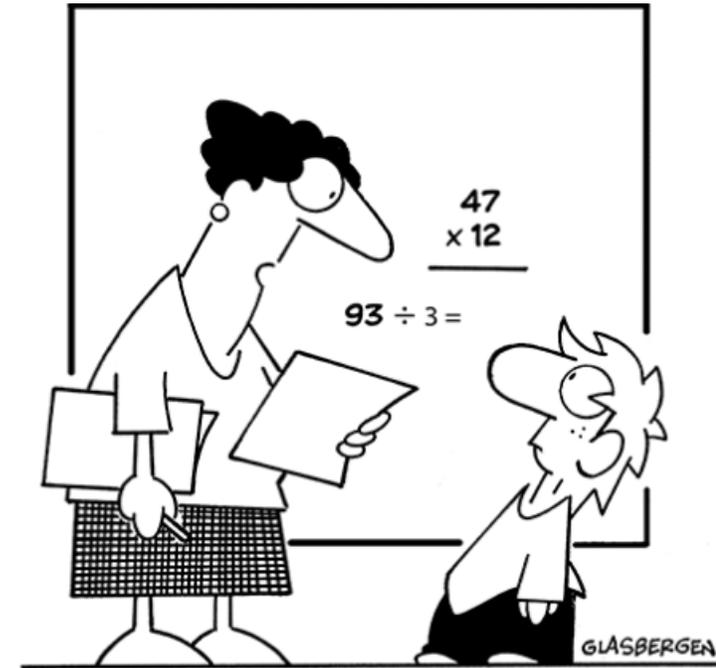
1. Space out the practice

If you get rusty between sessions, retrieval is harder but the effort produces longer lasting learning and enables more versatile application.

2. Interleave practice of two different subjects or skills, e.g. clunkers.

One group worked on practice problems that were clustered by type, e.g. 4 problems for calculating the volume of a wedge, then 4 problems for a spheroid, then 4 for a cone, etc.), the other were given them in a mixed up order. The students who worked on the problems in clusters got 89% correct, compared to 60% when mixed up. But, one week later, the cluster group averaged 20% and the interleaved averaged 63%. The mixing boosted performance by 215%.

3. Varied practice e.g. anagram example, bean bags

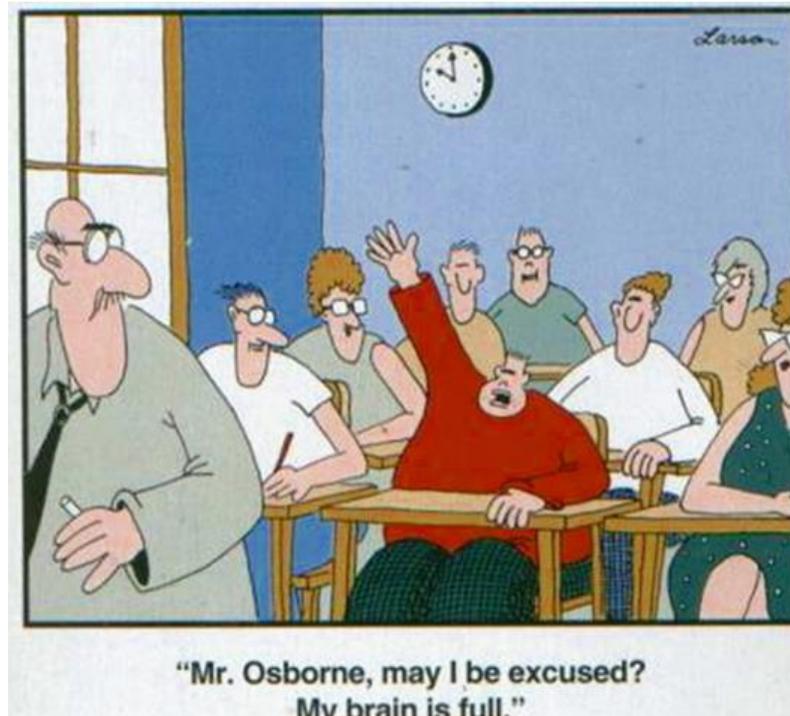


“Yes, love is the answer...but not on a math test.”

Claim 4 – Trying to solve a problem before being taught the solution leads to better learning, even when errors are made in the attempt.



Claim 5 – Practice at retrieving new knowledge or skill from memory is a potent tool for learning and durable retention.



Active retrieval is powerful – think of it as a tool for practicing retrieval of memory.

Testing has two effects:

1. It tells you what your child doesn't know.
2. Recalling causes consolidation, strengthening connections and making it easier to recall later.

To be most effective, retrieval must be repeated.

Feedback is crucial.

X Re-reading text and mass practice

Appear to give fluency but doesn't

✓ Retrieval practice

Recalling facts, concepts or events is most effective. This helps the neural pathways that make up a body of learning get stronger, when the memory is retried and the learning is practiced. Periodic practice arrests forgetting, strengthens retrieval routes and is essential for hanging onto knowledge you want to gain.

✓ Spaced Practice – embedding new learning requires consolidation, which takes time. Rapid fire practice leans on short term memory.

✓ Interleaved practice (*mixing practice up with other things*)

THE RESEARCH SUGGESTS

PRACTICE RETRIEVAL

- Make an effort to recall concepts from memory.
- Reflect on what you've learned from time to time.
- Test immediately after a lecture.
- Test at spaced intervals.
- Delay feedback.



MIX UP PRACTICE

- Space out practice.
- Interleave learning with other learning.
- Vary practice.
- Beware the familiarity trap.
- "Learn from experience" by spacing, interleaving, and varying practice.

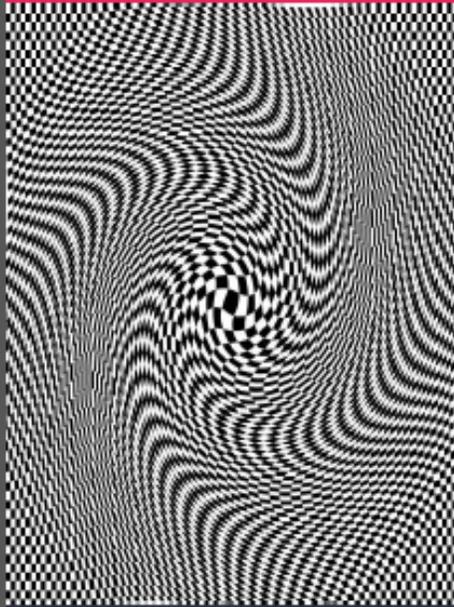


EMBRACE DIFFICULTIES

- Know that learning is a three step process.
- Call on prior knowledge.
- Use information to keep retrieval routes strong.
- Establish retrieval cues.
- Let concepts get rusty.

AVOID ILLUSIONS OF KNOWING

- Cultivate analysis.
- Know that memory is distorted.
- Beware imagination inflation.
- Calibrate your judgment.



GET BEYOND YOUR LEARNING STYLES

- Be the one in charge.
- Embrace the notion of successful intelligence.
- Adopt active learning strategies.
- Distill the underlying principles.

INCREASE YOUR ABILITIES

- Trust the brain's mutability.
- Maintain a growth mindset.
- Practice deliberately.
- Use memory cues.
- Self-discipline and persist.

Bad times have scientific value. These are occasions a good learner would not miss.

~ Ralph Waldo Emerson