How the Brain Learns to Learn

Session handout · *Grades 6–12* | Caroline Miller, EdD

Three brain ideas, three classroom moves

Each idea carries an evidence tag: **Strong evidence** (replicated, often across many studies), **Promising** (solid but limited), **Debated**, or **My interpretation** (my read on what it means for your classroom).

Brain idea	What the research says	Classroom move
1 · Memory	**Strong evidence.** One week later, students who studied once and then tested themselves three times recalled 61% of a passage. Students who studied four times recalled 40% (Roediger & Karpicke, 2006). Across 50 classroom experiments with 5,374 students, 57% of effects were medium or large benefits of retrieval practice (Agarwal et al., 2021).	**Retrieve before you review.** Quiz first, then check notes. Space short retrieval moments across days and weeks.
2 · Stress	**Strong evidence.** Even mild, uncontrollable stress can quickly weaken prefrontal function. In human studies, acute stress impaired working memory and flexible thinking (Arnsten, 2009; Shields et al., 2016).	**Reduce what's uncontrollable.** My interpretation: remove surprise formats, unclear criteria, no way to recover, and racing the clock.
3 · Self-regulated learning	Self-regulated learning (SRL) is a cycle: forethought, performance, self-reflection. Reflection feeds the next plan (Zimmerman, 2002).	**Put the thinking back on students.** Instead of "Don't forget, test on Friday," try "What's your plan for Friday, and how will you know you're ready?"

The confidence trap: students who reread were the most confident and remembered the least. Rereading builds fluency, and fluency feels like learning (Roediger & Karpicke, 2006, Experiment 2).

Space It planner

STRONG EVIDENCE for spacing; the schedule below is an example, not a research formula. There's no single perfect gap. Come back when the material is still familiar but no longer fresh (Carpenter, Pan & Butler, 2022; Dunlosky et al., 2013).

Pick a unit you'll teach soon. Instead of one review day, plan three short retrieval moments (2 to 5 minutes each) spread out after it.

Unit: _____

Moment	When	What students will retrieve	How (brain dump, quiz, mixed questions)
1	A few days after the lesson		
2	A week or two later		

Moment	When	What students will retrieve	How (brain dump, quiz, mixed questions)
3	Mixed into a later unit's quiz		

Swap a routine: pick one review that relies on rereading and make students retrieve first, then check.

Before	After
Review day: students reread the study guide.	Blank-page brain dump, then check notes and fill gaps in a second color.
Your routine:	Your swap:

Where the cycle breaks, and what to try

A note on sources: much of my self-regulated learning (SRL) work comes from, or was inspired by, Timothy J. Cleary's research and his book *The Self-Regulated Learning Guide* (2018). If these tools help you, his book is the best next read.

Self-regulated learning runs in three phases (Zimmerman, 2002; applied to classrooms in Cleary, 2018): **before** (forethought: set goals, plan strategies), **during** (performance: use strategies, self-monitor), and **after** (self-reflection: judge results, explain causes).

The research below is mostly correlational and from college-age students. Use it as a lens, not a diagnosis. The moves are my interpretation, informed by Cleary (2018), not tested protocols.

Breakdown	Where it breaks	What the research says	Try this
Avoidance: "I don't really get it, so I'll do it tonight."	Before: motivation	**Promising, correlational.** Disliking the task, low confidence, and impulsiveness were among the strongest predictors of procrastination. Students also read effort as a sign they aren't learning (Steel, 2007; Kirk-Johnson et al., 2019).	Shrink the first step to five minutes. Say out loud that hard means learning.
Disorganization: starts three subjects, finishes none	During: monitoring	**Promising, inference.** Keeping track draws on working memory and self-control, which are still developing and sensitive to stress and poor sleep (Diamond, 2013).	One task visible at a time, a checklist, and a midpoint check-in.
Time estimation: "The research paper will take one night."	Before: planning	**Strong evidence, adults and long projects.** Students predicted 33.9 days to finish a thesis. It took 55.5, longer than their worst-case guess of 48.6 (Buehler, Griffin & Ross, 1994).	Ask, "How long did the last one take you?" Then break it into dated steps.

For all three: after the result, ask what the strategy did, not what the student is.

Put the thinking back on students. Write one thing you say every week, then rewrite it so students do the planning, monitoring, or reflecting.

What I say now	My rewrite
"Don't forget, test on Friday."	"What's your plan for Friday, and how will you know you're ready?"

Key sources

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For the full reference list, email cmiller@efficacylabconsult.com.