Make it Stick

How to be a DOK1 Rock Star

http://bit.ly/makeitstickPD

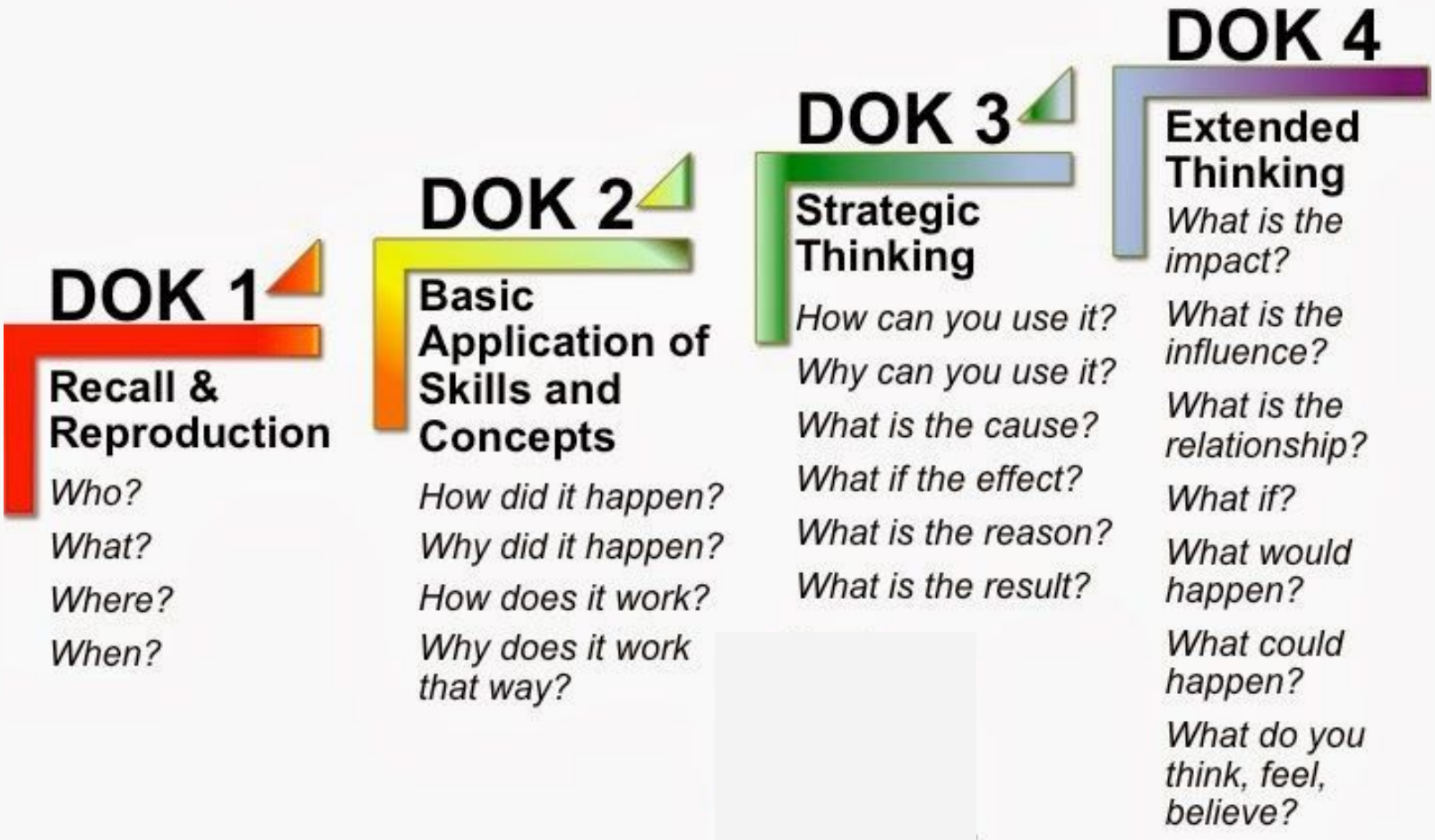
Jennifer West

3/6/20

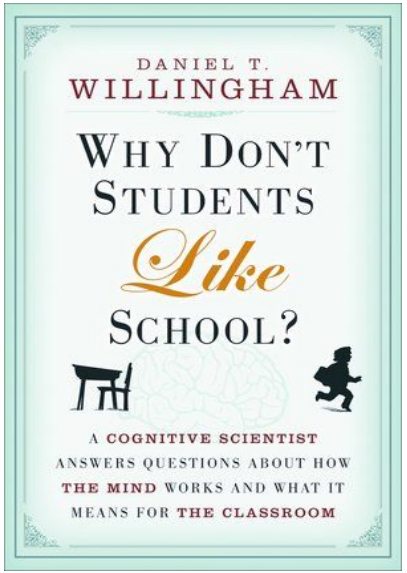
DOK 1 Matters

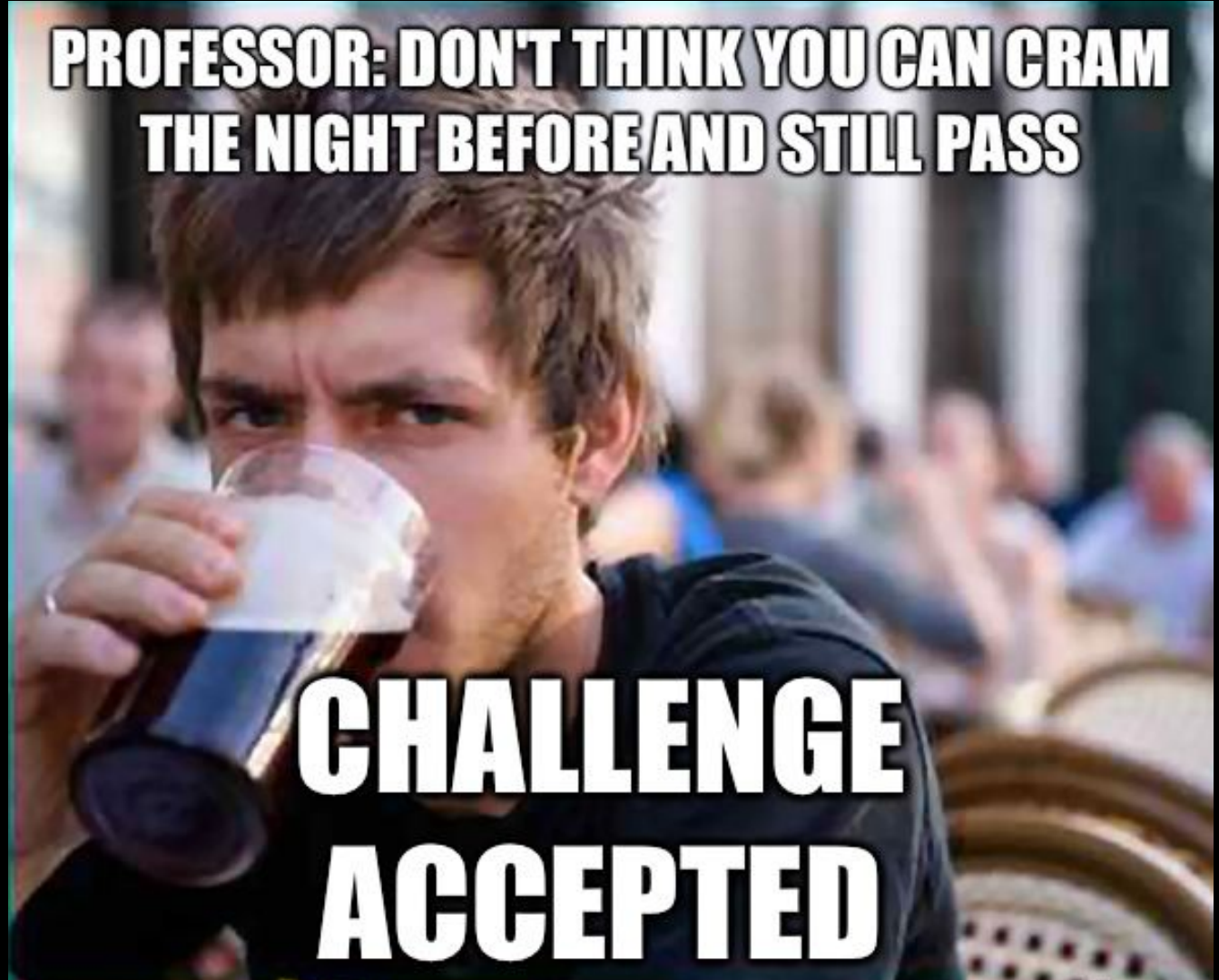
[Learning How to Learn]

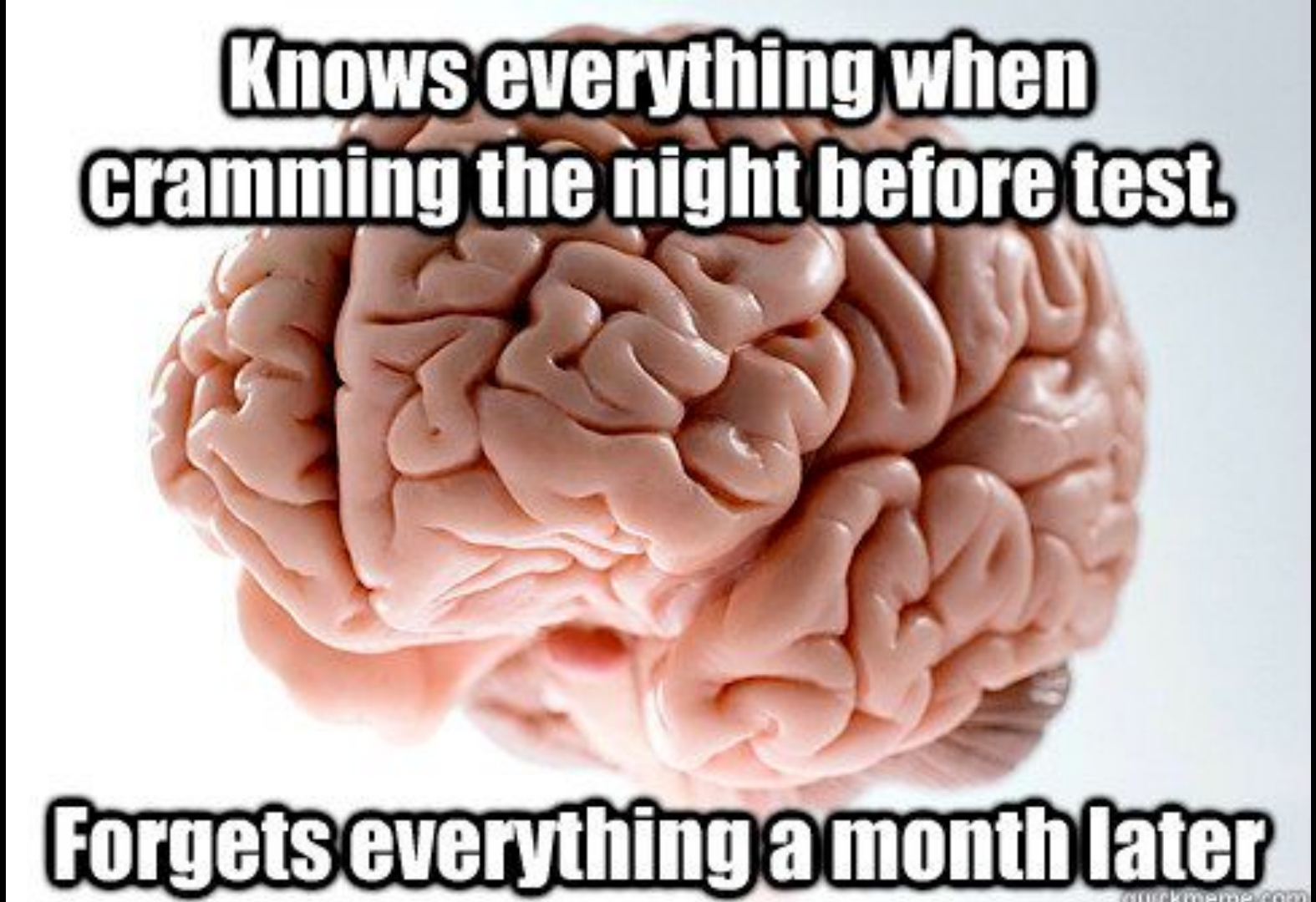
Webb's Depth of Knowledge



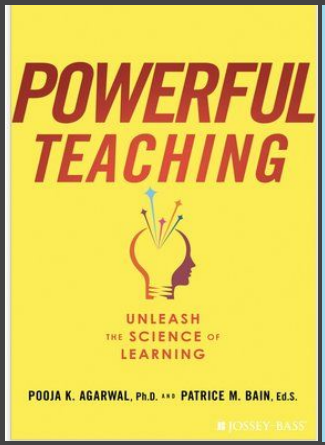
"**It's mostly a myth that you can develop critical thinking skills without a base of factual knowledge**. Reasoning, logic — all of those are interwoven with, and dependent upon, knowing facts. The more factual knowledge you have, the more ability the brain will have to do that higher-level thinking."




PROFESSOR: DON'T THINK YOU CAN CRAM
THE NIGHT BEFORE AND STILL PASS
CHALLENGE
ACCEPTED


Knows everything when cramming the night before test.
Forgets everything a month later


UNDERGROUND
MIND THE GAP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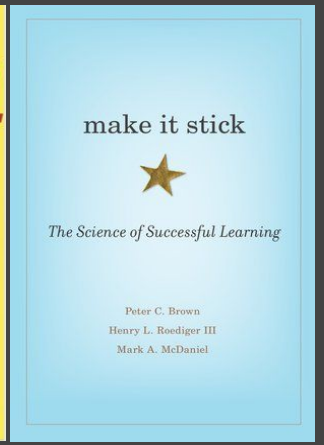
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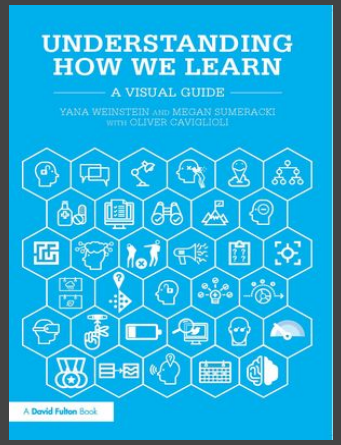
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A VISUAL GUIDE
YANA WEINSTEIN AND MEGAN SUMERACKI WITH OLIVER CAVIGLIOLI
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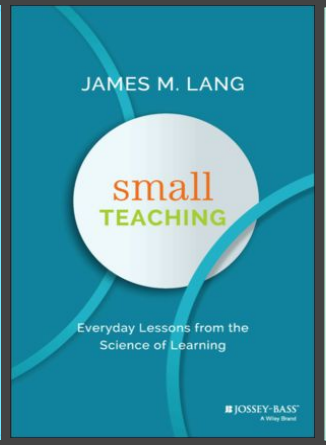
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Everyday Lessons from the Science of Learning
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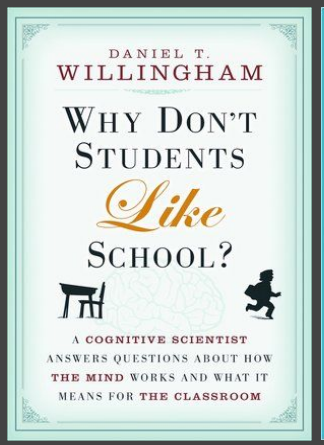
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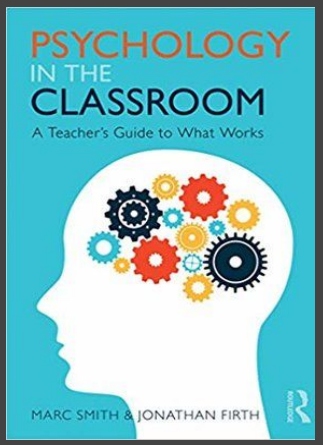
A COGNITIVE SCIENTIST ANSWERS QUESTIONS ABOUT HOW THE MIND WORKS AND WHAT IT MEANS FOR THE CLASSROOM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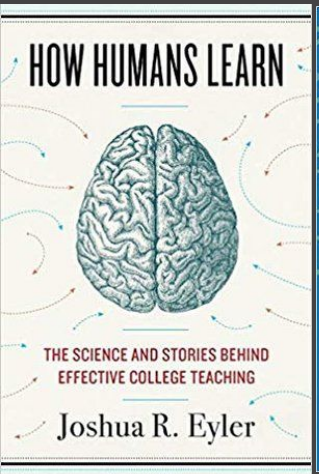
A Teacher's Guide to What Works
MARC SMITH & JONATHAN FIRTH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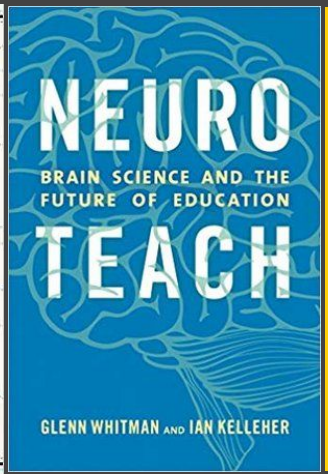
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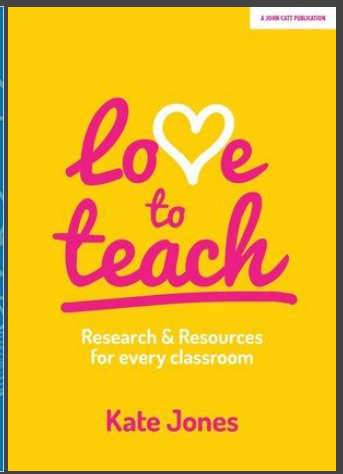
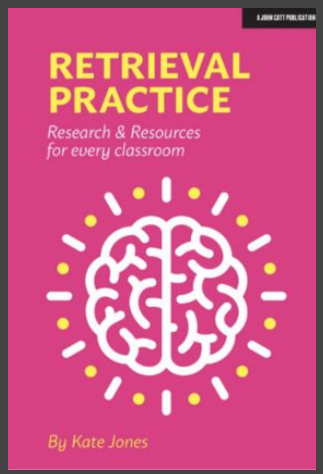
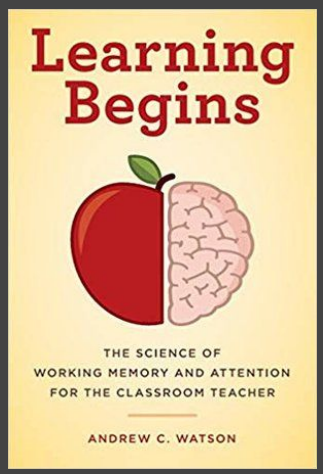
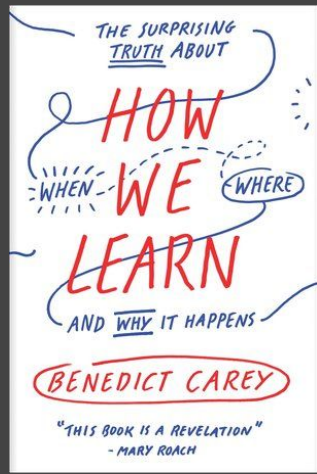
GLENN WHITMAN AND IAN KELLEHER


love to teach
Research & Resources for every classroom
Kate Jones


RETRIEVAL PRACTICE
Research & Resources for every classroom
By Kate Jones


Learning Begins
THE SCIENCE OF WORKING MEMORY AND ATTENTION FOR THE CLASSROOM TEACHER
ANDREW C. WATSON


THE SURPRISING TRUTH ABOUT
HOW WE LEARN
WHEN
WHERE
AND WHY IT HAPPENS
BENEDICT CAREY
"THIS BOOK IS A REVELATION"
- MARY ROACH

www.retrievalpractice.org

Unleash the Science of Learning

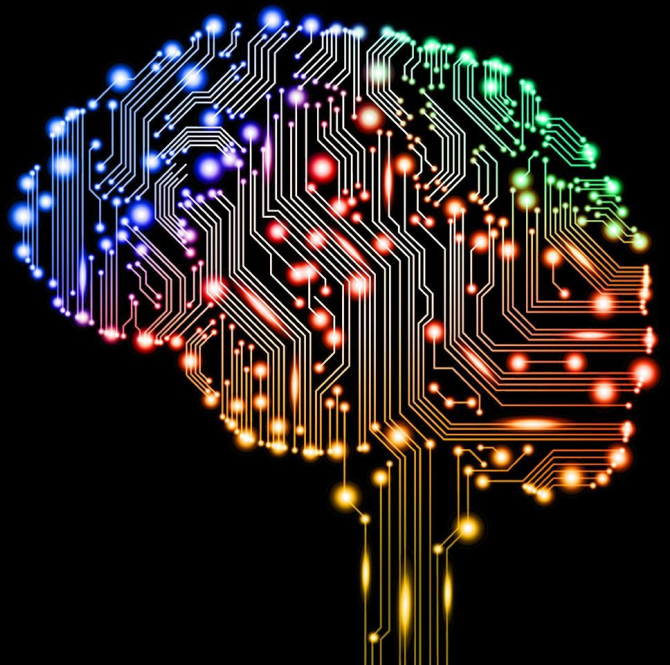
When we think about learning, we typically focus on getting information **into** students' heads. What if, instead, we focus on getting information **out** of students' heads?

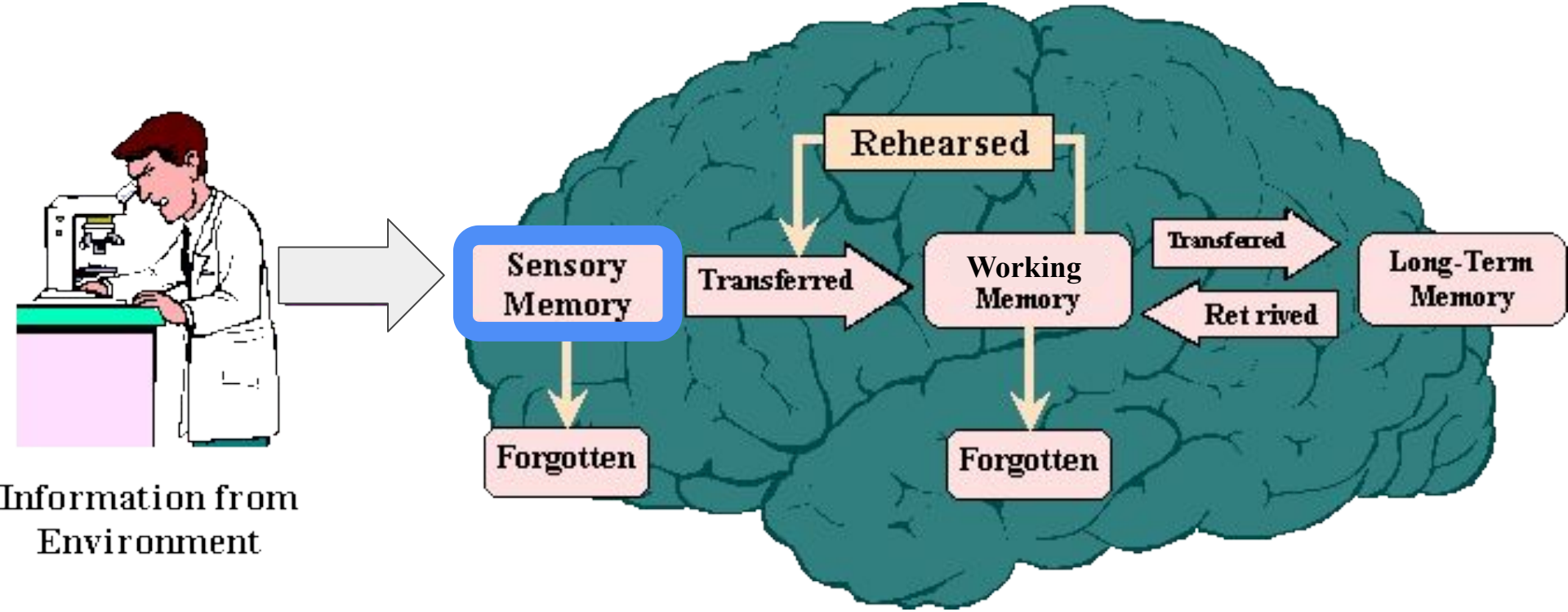
How Memory Works

[How Learning Works]

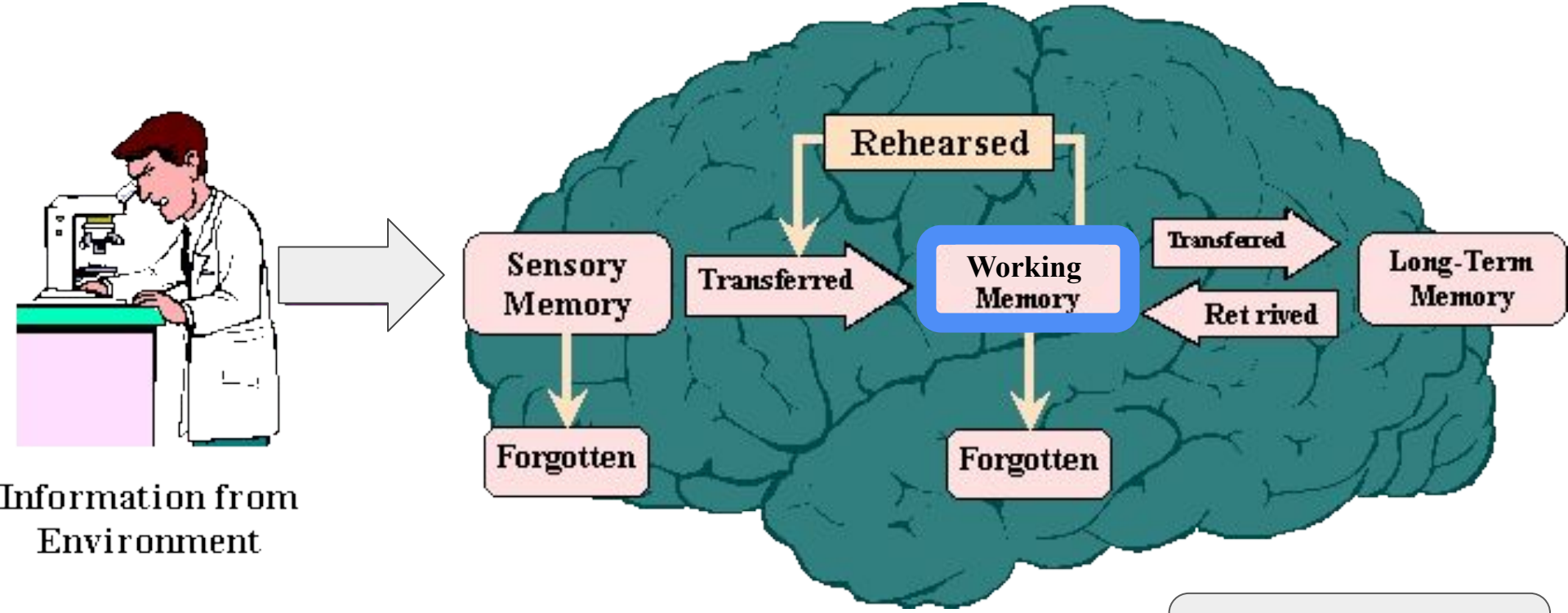
If you want to understand how people learn…

….start with the brain



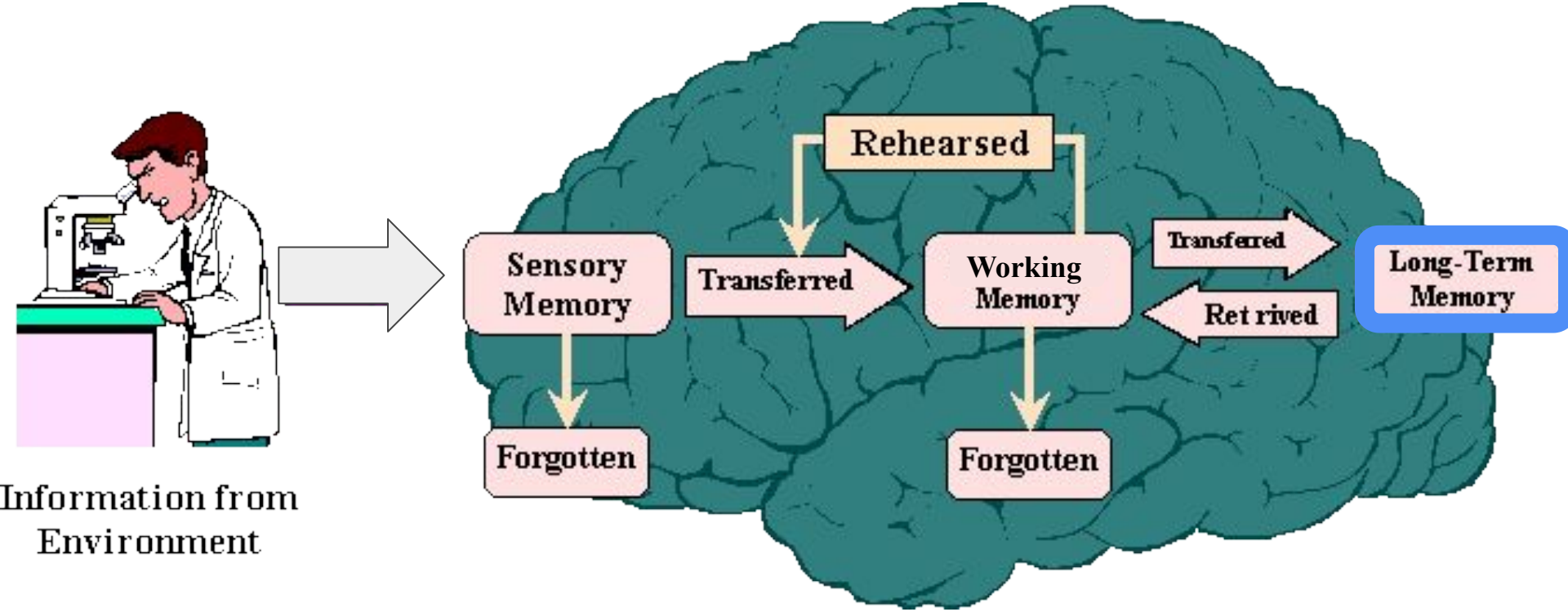


Sensory Memory lasts a few seconds; 99% of input immediately discarded; the 1% we **choose to pay attention** to is encoded into working memory

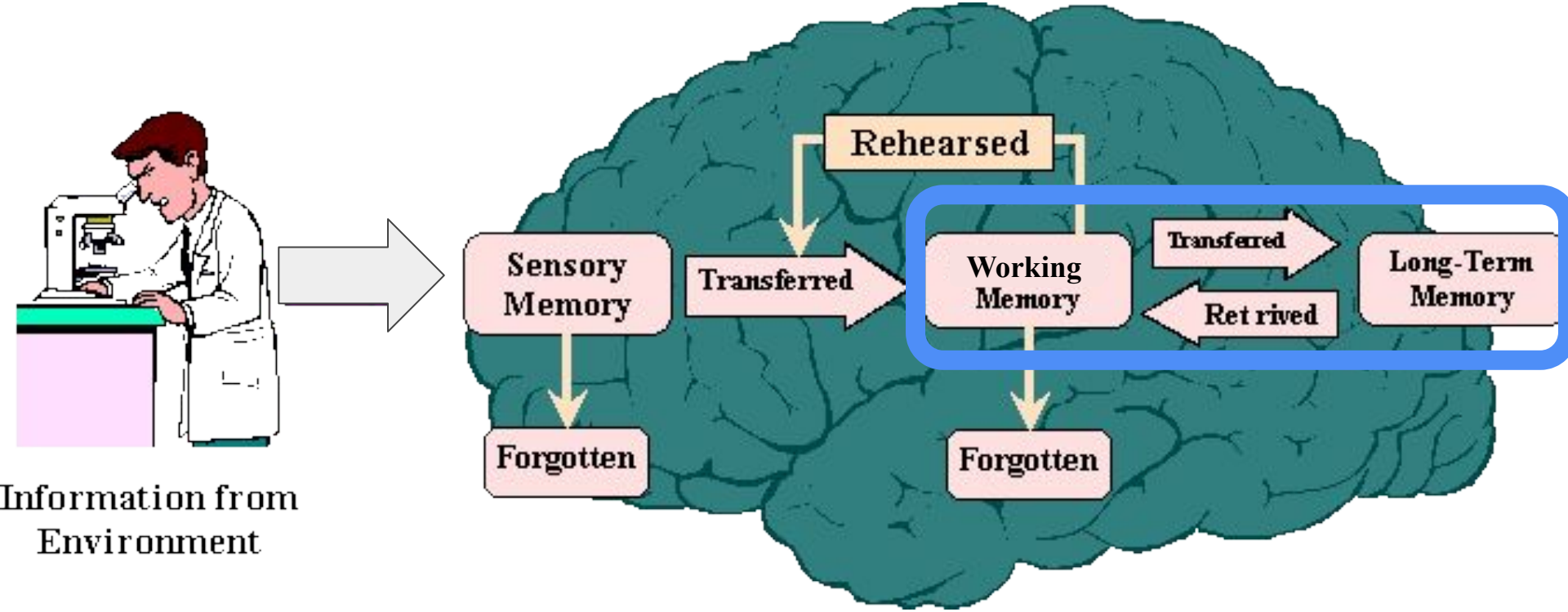


Cognitive Overload Theory

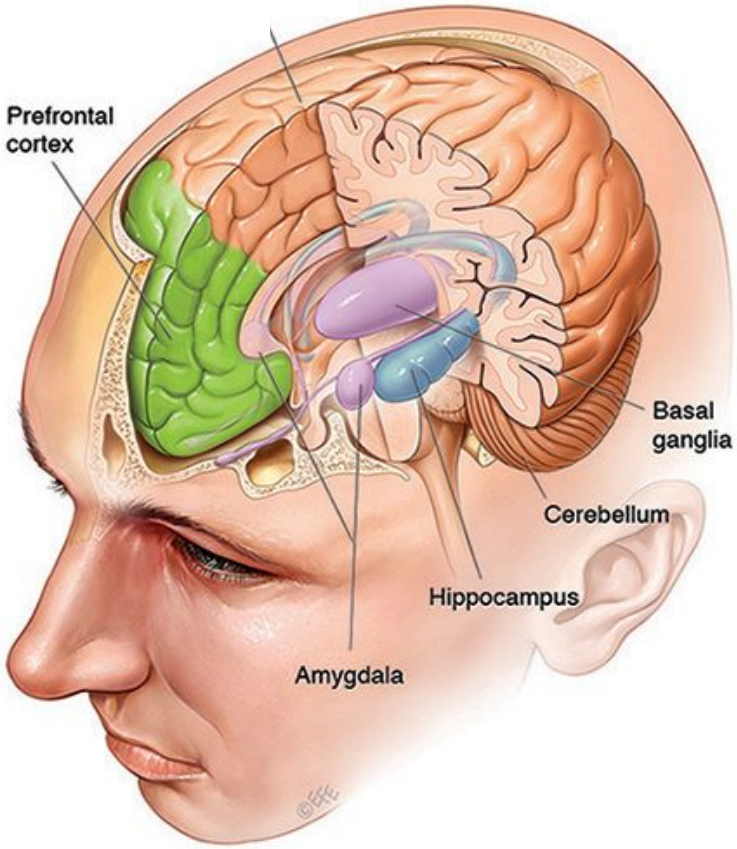
Working Memory can hold and manipulate **5-9 chunks** of info simultaneously for 20 seconds; **up to 20 min** with enough mindless repetition or cramming



Long-Term Memory can store an **unlimited amount** of info for an **infinite period of time**; must connect to existing stored knowledge & be **periodically activated** to be retained



Learning is the act of transferring knowledge and skills from working memory into long-term memory so it can be retrieved and applied when needed



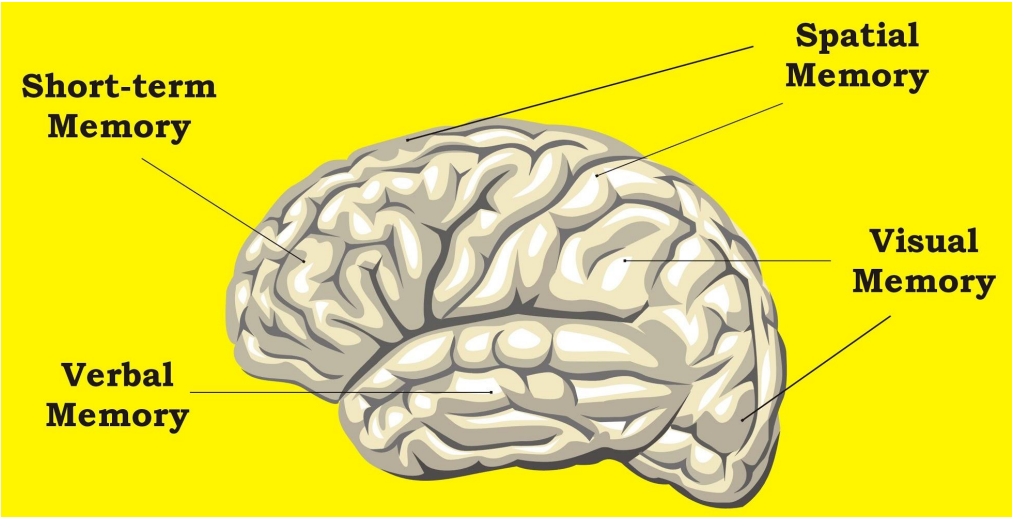
Prefrontal Cortex: working memory

Hippocampus: declarative

Amygdala: emotional

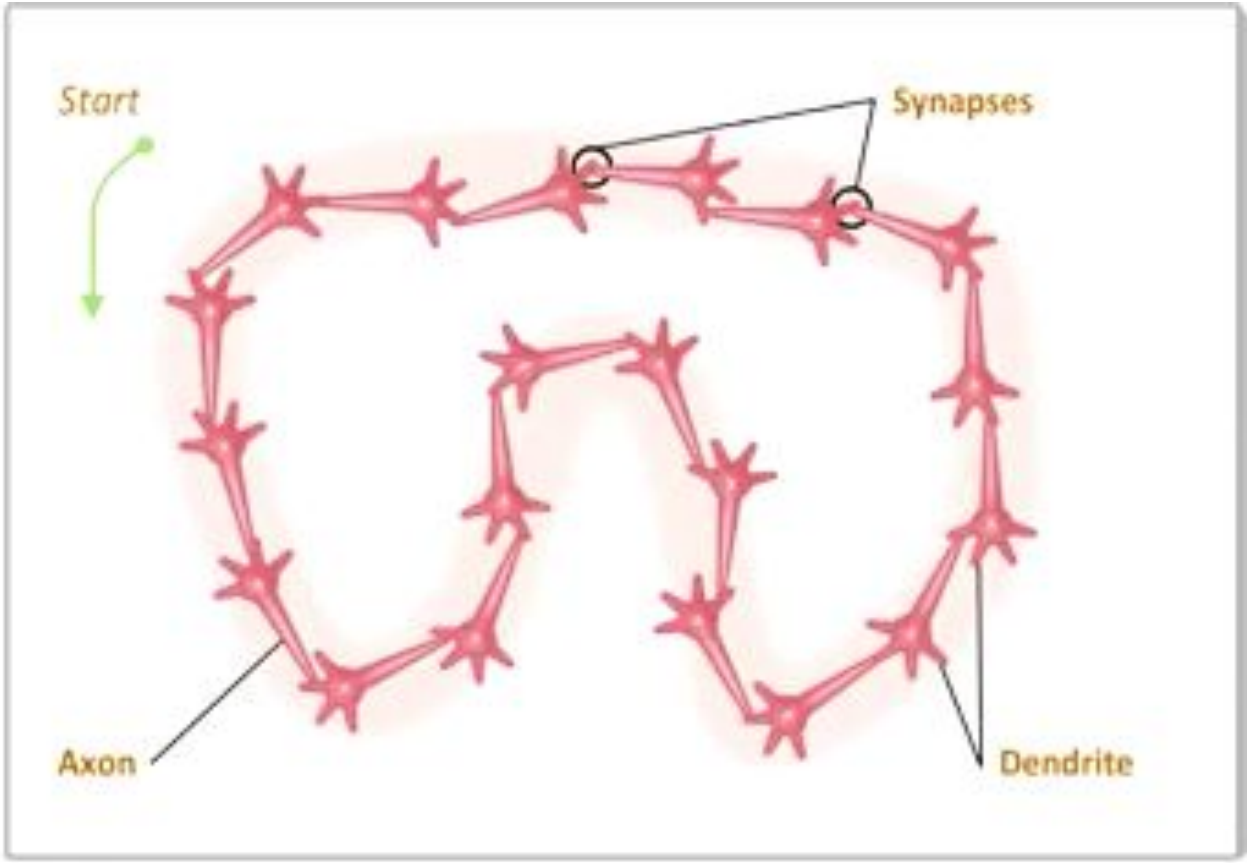
Cerebellum & Basal Ganglia: procedural

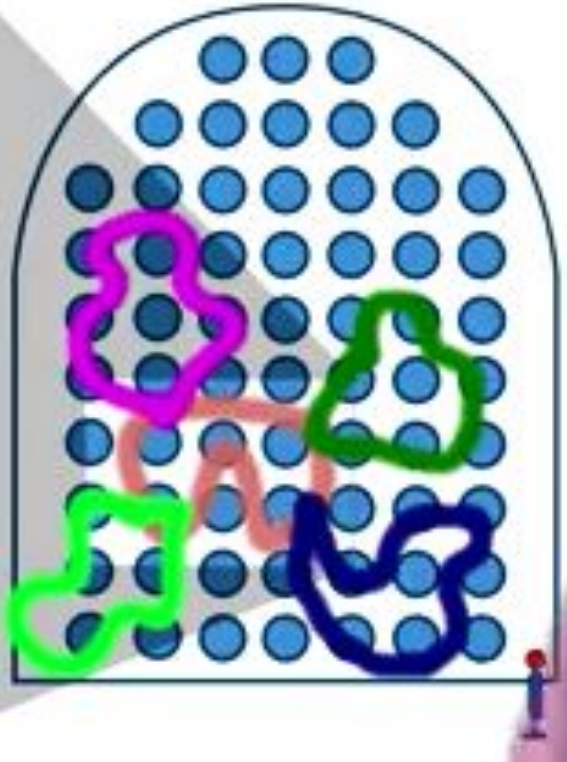
Cortex: long term storage (by type)



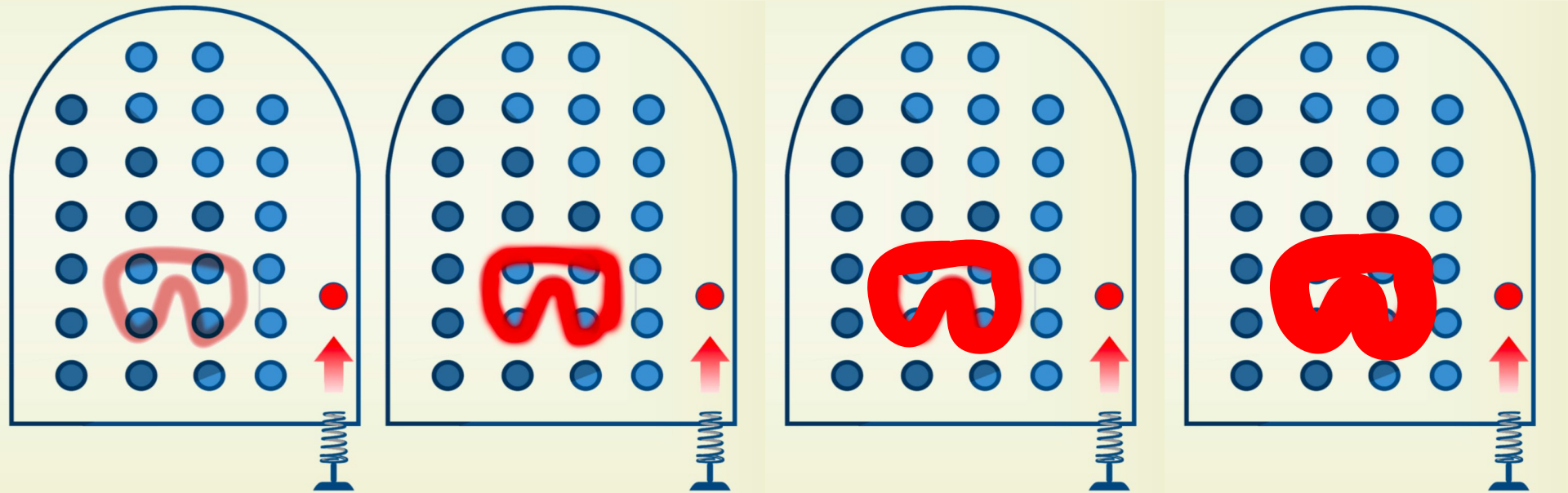
Info moved from long-term storage to working memory when needed

“Neurons that fire together, wire together."

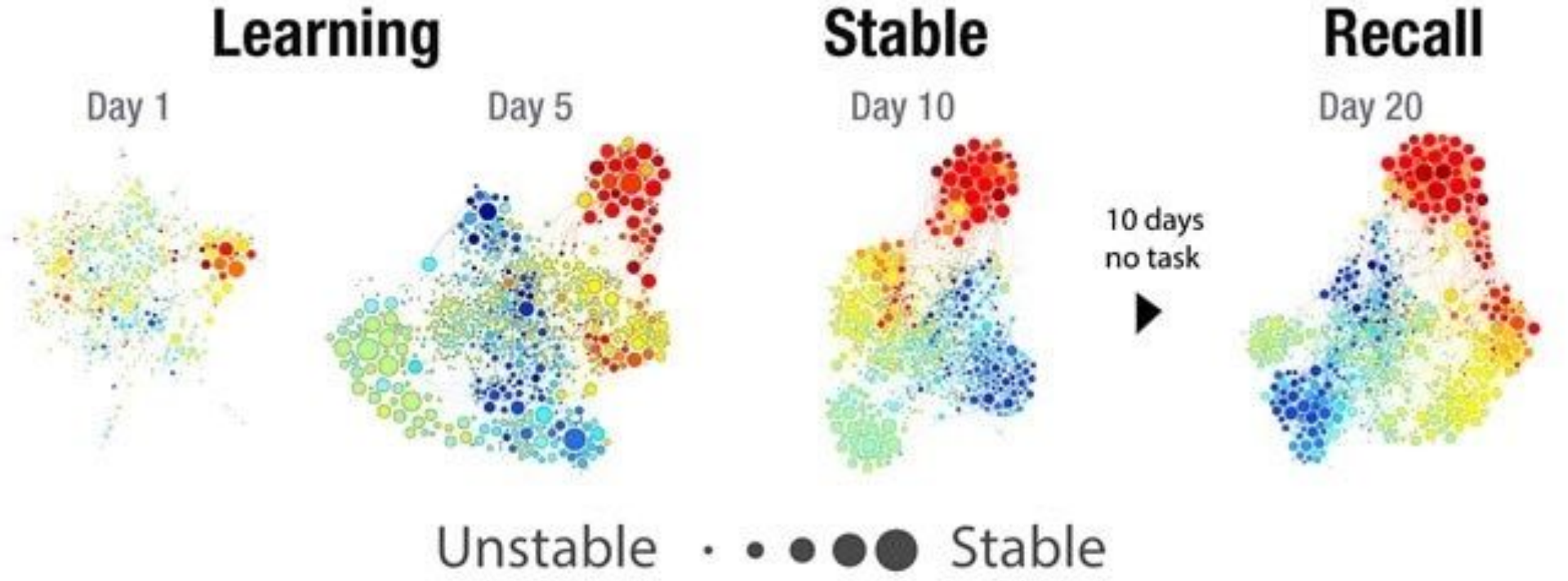




New memory traces are fragile, but can be strengthened by repeated activation of the neural network that contains them.

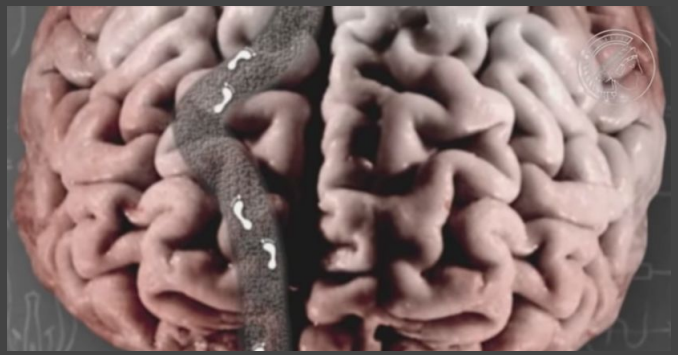


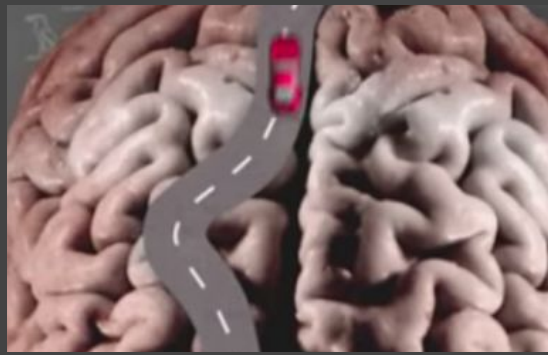
How Neurons Form and Solidify Memory

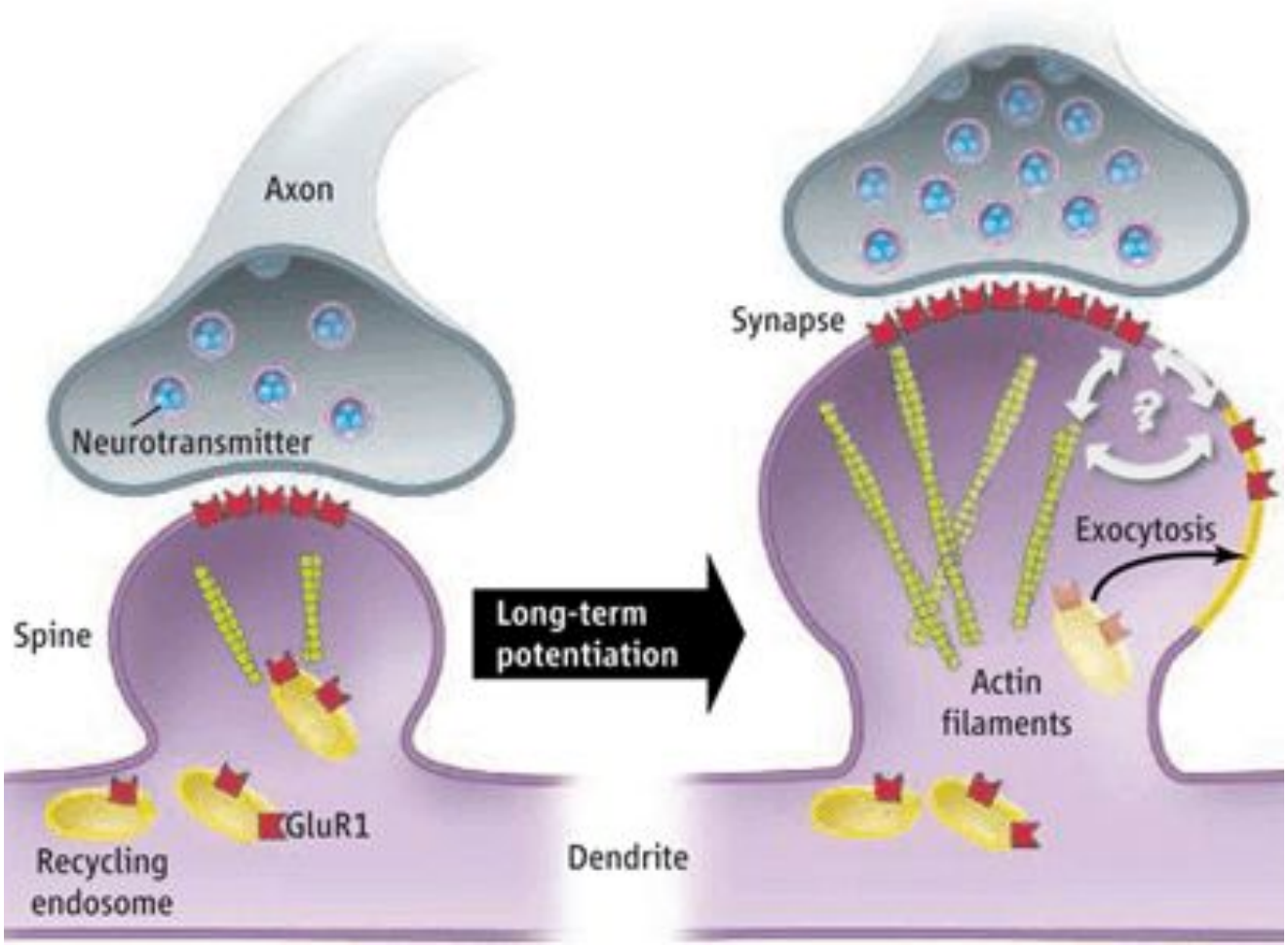


Synaptic Plasticity

the ability of a synapse to **physically change**
and become **more efficient** at conducting impulses
as a result of learning







BEFORE ACTIVATION

AFTER ACTIVATION

Repeated signals sent between networked neurons →

More **neurotransmitters**

More **receptors**

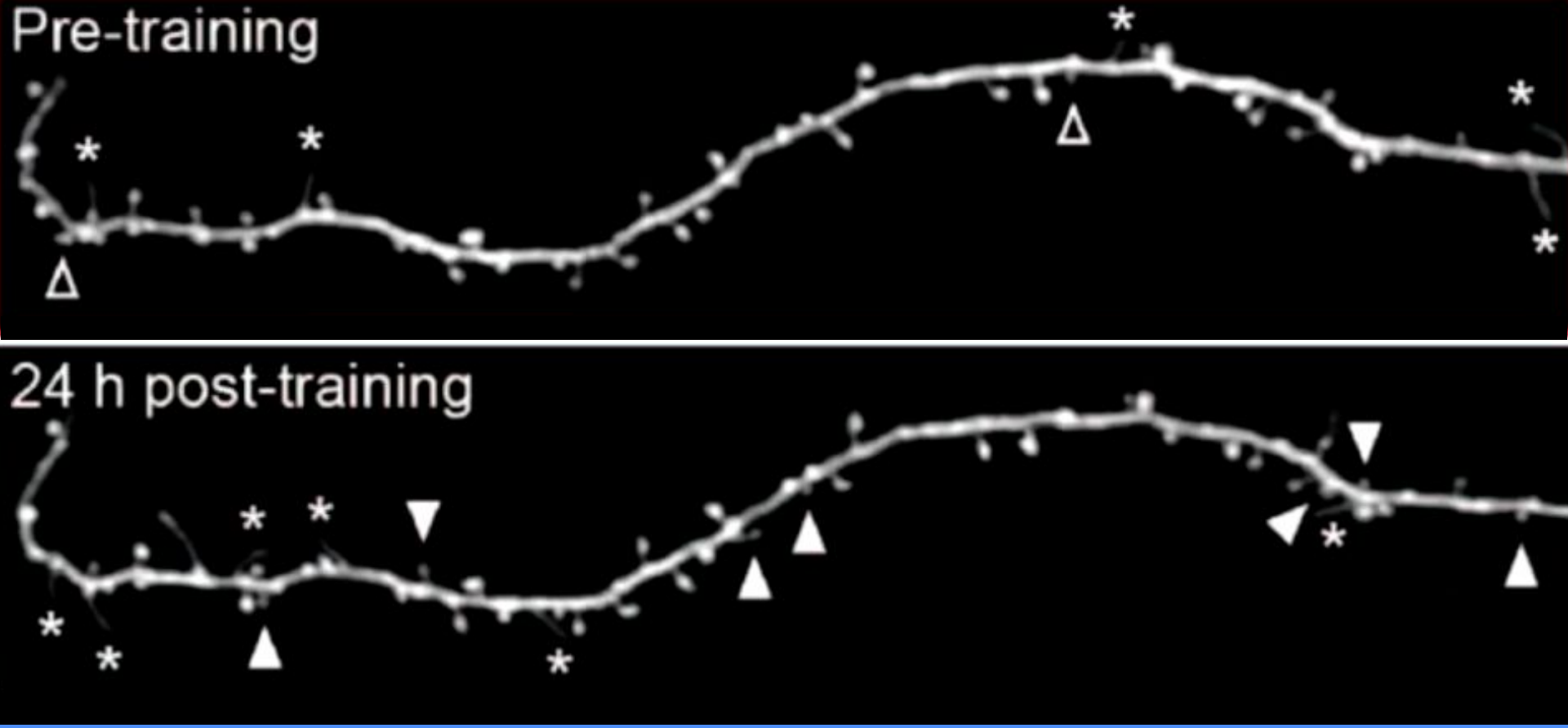
More **proteins**

Larger, thicker **dendrites**

Stronger **synapses**

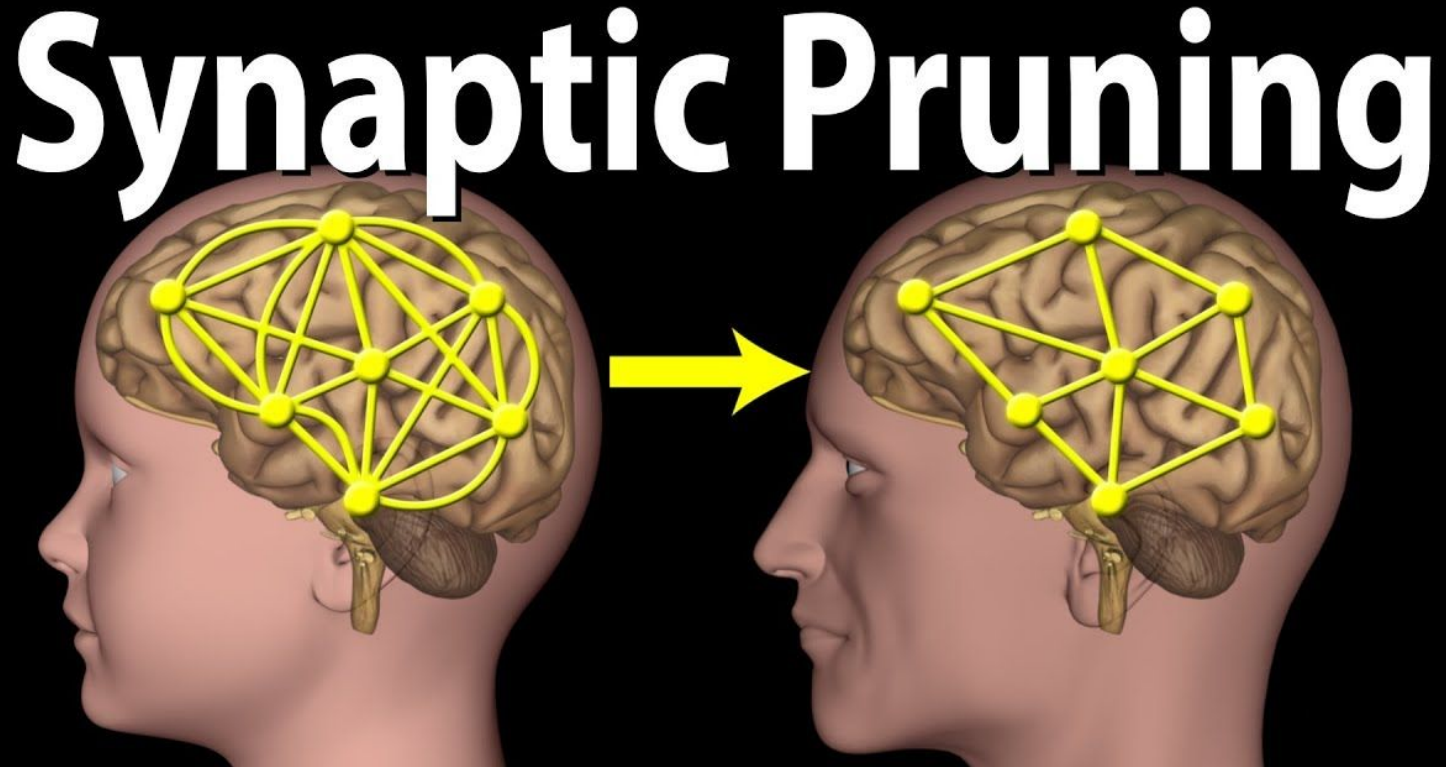
More efficient **impulse transmission**

More recall → faster, easier recall



We can actually see these physical changes happening!

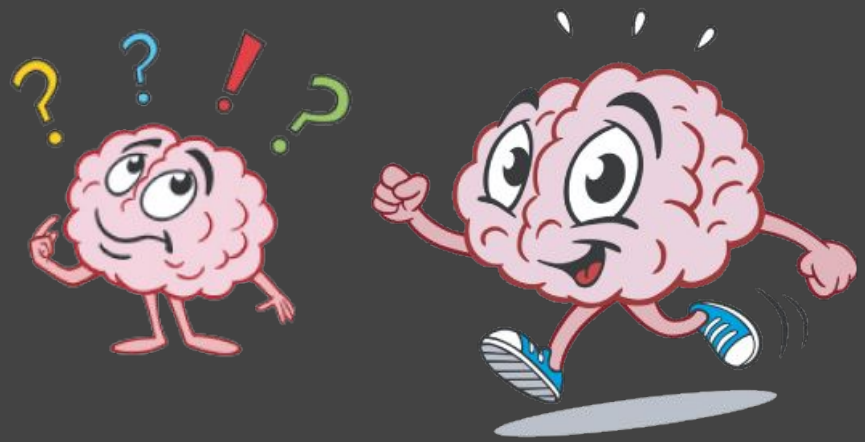
Neural networks, which represent chunks of learned information, are “use it or lose it”



4 Keys to Making it Stick

Neural networks are made **physically stronger** through repeated activation using **retrieval practice**

Retrieval practice is the act of **unassisted recall** (bringing previously learned info to mind)



WHERE THERE IS NO **STRUGGLE**, THERE IS NO **STRENGTH**.

Retrieval practice is even more powerful when you build in **desirable difficulties** such as **spacing and interleaving**

Retrieval Practice

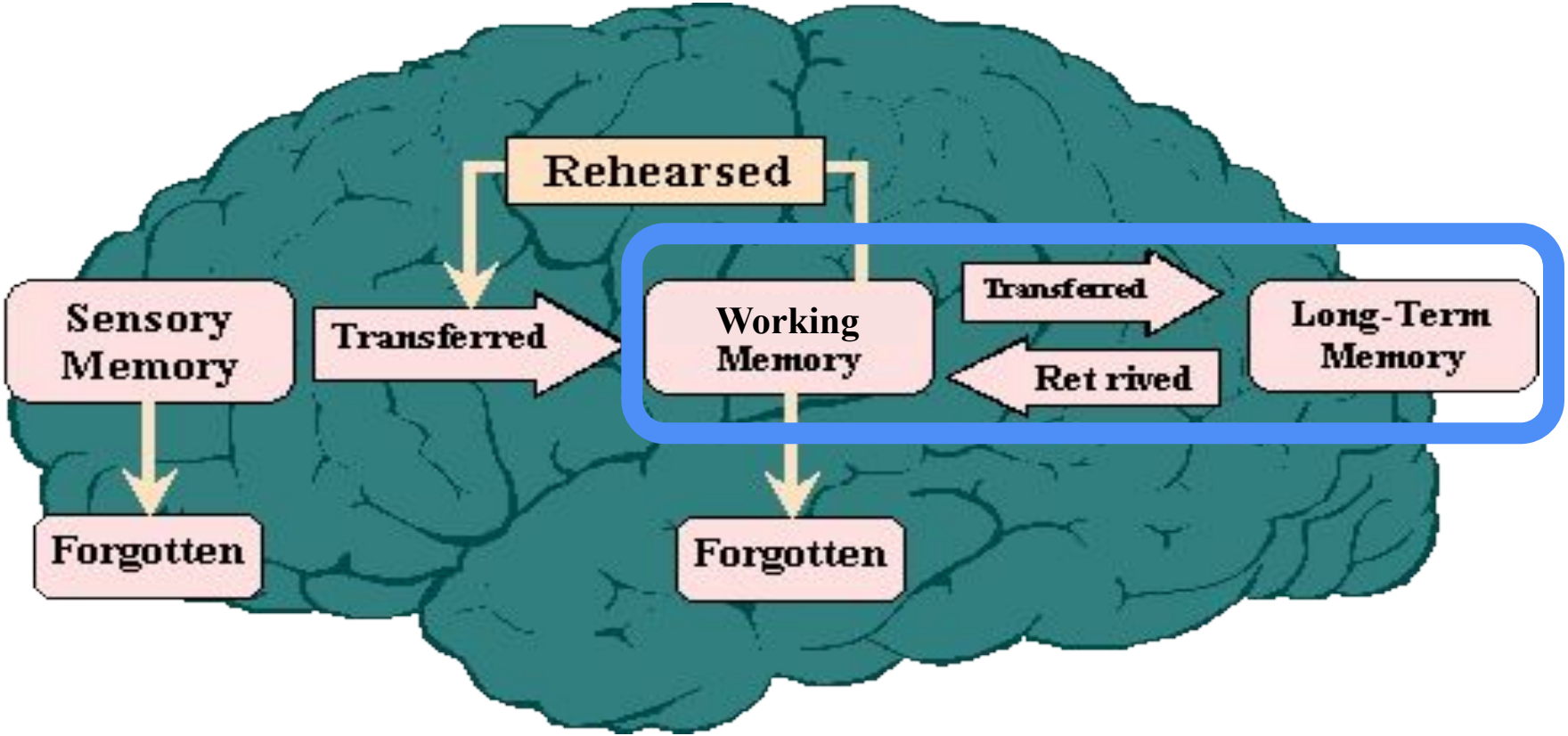
Spacing

Interleaving

Feedback

Retrieval Practice

unassisted recall



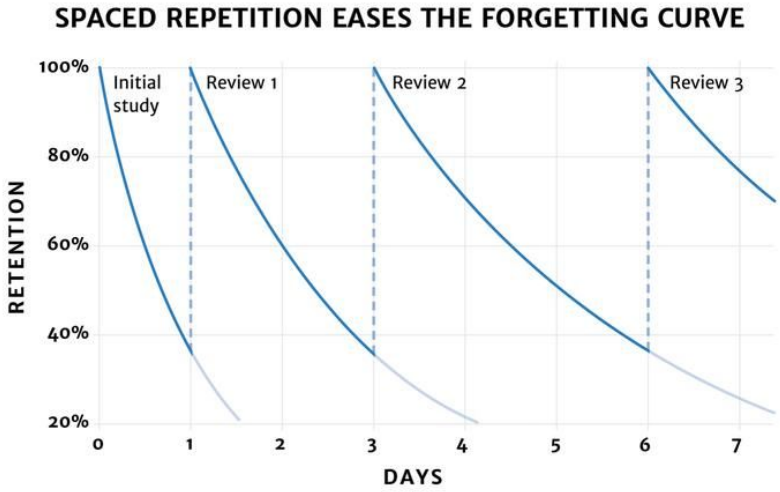
Spacing

Using shorter, more frequent retrieval practice sessions

- 1 hr on 5 days → better retention than 5 hrs on 1 day

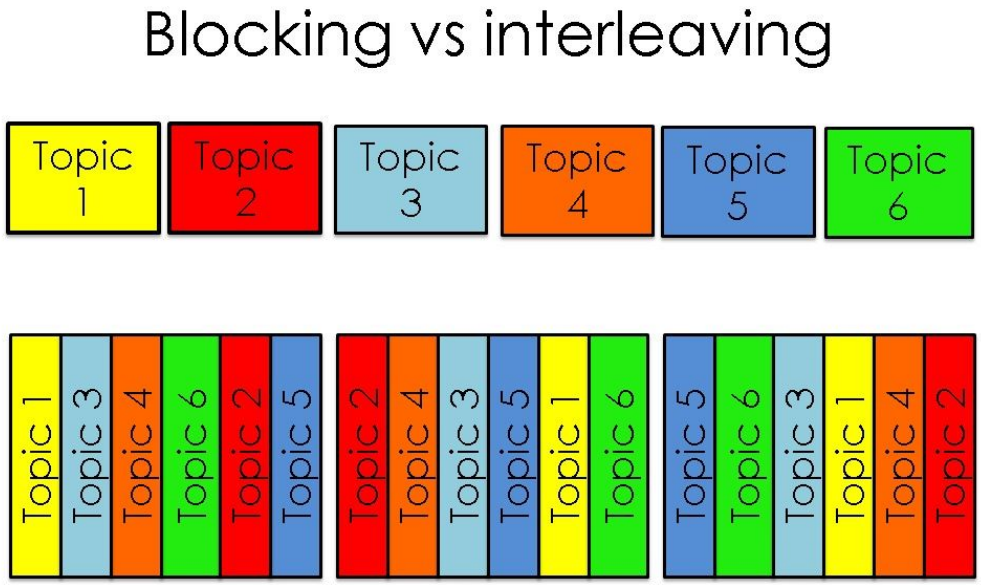
Gradually increase time between retrieval sessions

- Some forgetting → more struggle → more strength



Interleaving

- **Mixing up closely related topics**
- Requires discrimination between similar strategies/facts
- Feels harder, but works better than chunking (after initial instruction)



	Problem	1. Choose Strategy	2. Execute Strategy
A	A bug flies 48 m east and then 14 m north. How far is the bug from where it started?	Pythagorean Theorem	$\sqrt{48^2+14^2}=50$
B	A bug flies 48 m east and then 14 m west. How far is the bug from where it started?	Number line arithmetic	$48-14=34$
C	Find the length of the line segment with endpoints (1, 1) and (5, 4).	Pythagorean Theorem	$\sqrt{3^2+4^2}=5$
D	Find the slope of the line that passes through the points (1, 1) and (5, 4).	$\text{slope}=\frac{\text{rise}}{\text{run}}$	$\frac{4-1}{5-1}=\frac{3}{4}$

Problem		1. Choose Strategy	2. Execute Strategy
Simplify.	$8x^5 \cdot 4x^2$	Add exponents	$32x^{5+2} = 32x^7$
Simplify.	$\frac{8x^5}{4x^2}$	Subtract exponents	$2x^{5-2} = 2x^3$
Simplify.	$(2x^5)^2$	Multiply exponents	$2^2x^{5\cdot 2} = 4x^{10}$

Feedback-Driven Metacognition

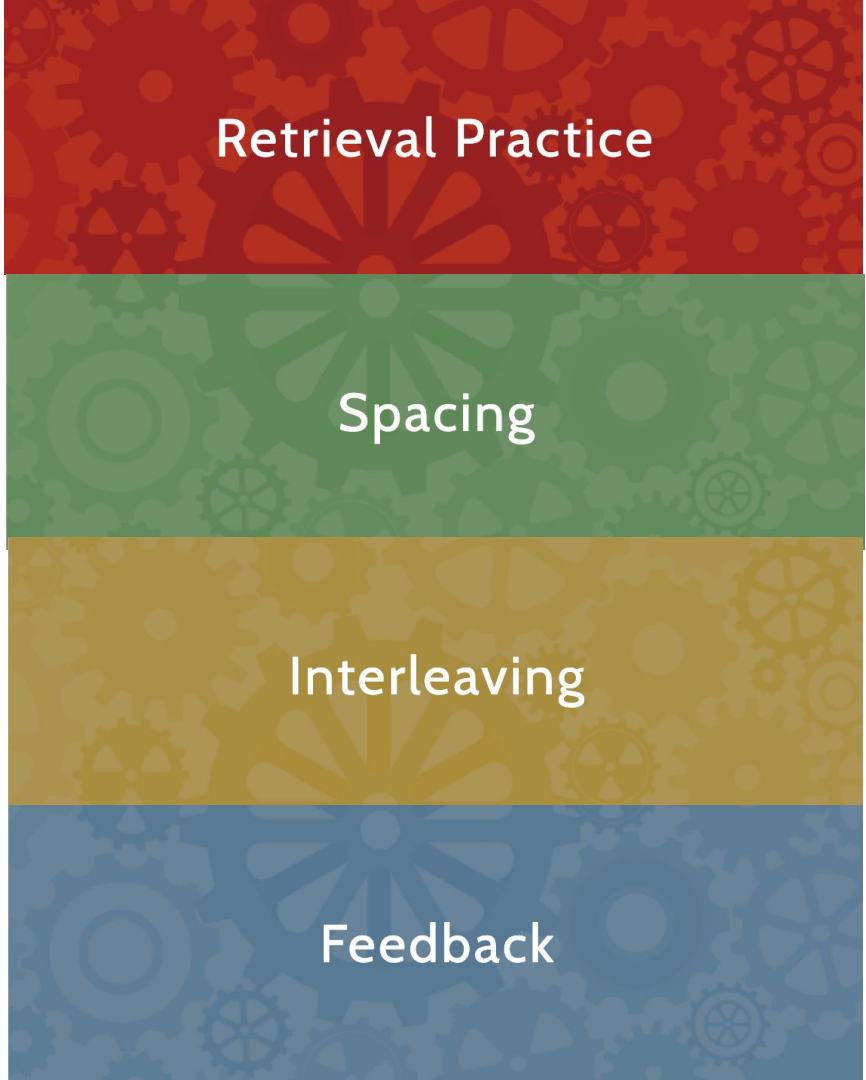
- **Correct or incorrect?**
- **If incorrect, why?**
- **Where are my gaps?**
- Better understanding of content
- Better awareness of their personal level of mastery

Classroom Strategies

[Big Ideas]

Strategy Criteria

- ➔ Fast
- ➔ Flexible
- ➔ Low or no prep
- ➔ No grading
- ➔ No anxiety
- ➔ Incorporates all 4 keys



Recall must be **unassisted** for retrieval practice to work

frequent

LOW-STAKES OR NO-STAKES TESTING IS KEY TO OPTIMIZING LEARNING.

ROBERT BJORK
ON THE TEACHING IN HIGHER ED PODCAST #072

Classroom Strategies

[First 5 / Mid-Lesson]

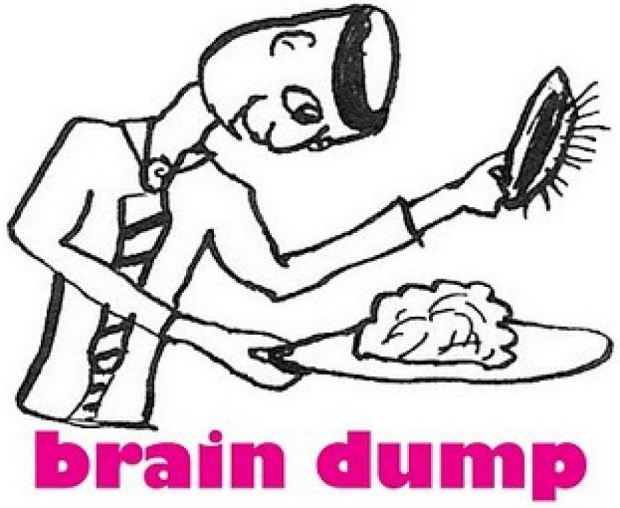
Brain Dumps

Pause your lesson.

Ask students to write down everything they can remember from the lesson so far (or from a previous lesson).

- Be specific with your prompt
- Give a time limit
- Have students compare their brain dump to their partner's, add missing items

Continue the lesson.



Two Things

At any point during a lesson, stop and have students write down two things about a specific prompt:

- What are two things you learned so far today about...?
- What are two things you learned yesterday (or last week) about...?
- What are two things you'd like to learn more about?
- What are two ways today's topic relates to previous topics?

2-Column Quizzes

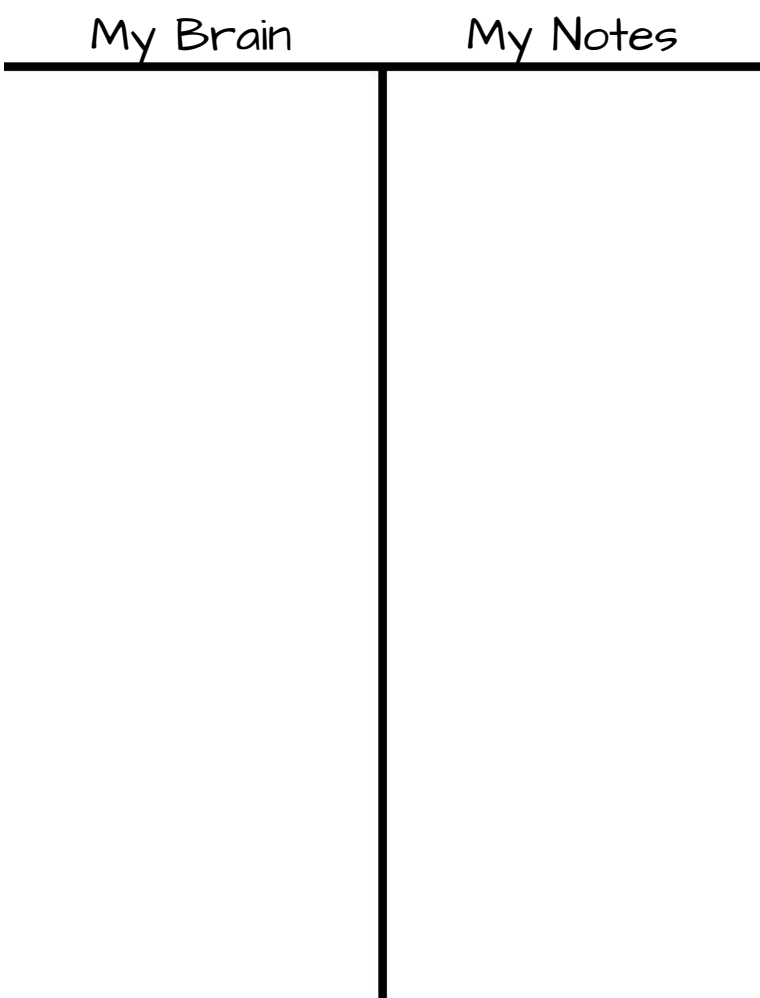
Students set up paper

Teacher gives questions/prompt

Students write answers from memory on the left

Give permission to open book/notes

On the right, students add to or modify left side answers



2-Color Quizzes

Students set up paper

Teacher gives questions/prompt

Students respond from memory

Teacher gives correct answers, explains, surveys class

Students fix incorrect answers using a different color pen

3/2/2020

3/3/2020

1.
2.
3.
4.
5.

3/4/2020

1.
2.
3.
4.
5.

Oral Quizzes

Students work in small groups to learn parts or processes

Students signal when ready by putting “red cups up”

Teacher quizzes each student verbally on vocab, concepts, applications

If they pass, group is cleared to move on

Classroom Strategies

[Test Review]

Beat the Clock / Carousel Brain Dump

Divide class into groups of 3-5.

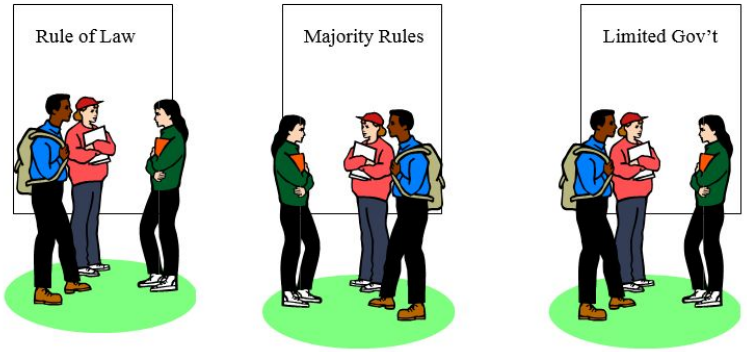
Place poster paper or large whiteboards around the room. Write a topic on each one.

Send groups to stations.

Give students 30 sec to write everything they know about that topic.

Call for groups to rotate.

Repeat until all groups have been to all stations.



Big Basket Quizzes

Put all the questions from daily quizzes throughout the week AND questions from previous weeks into a big basket (one question per slip of paper).

Randomly choose 10 questions and have students write down their responses (without notes). Give correct answers and discuss.

Put the 10 questions back in the big basket and choose another 10 questions randomly for the next class period.

Fishbowl Game

Write past and current topics on slips of paper and put them in a fishbowl or hat, or use a digital list where topics are numbered.

Have a student draw a slip or choose a number randomly.

Have all students think-write-pair-share before giving the answer & choosing the next topic.

Fishbowl Game - Lightning Round

Write past and current topics on slips of paper and put them in a fishbowl or hat, or use a digital list where topics are numbered.

Have one student call out 10 concepts from the list at random for a specified period of time, with brief pauses between prompts.

Have all students retrieve (without notes) and write down their answers.

At the end of the round, give answers.

Dice Game

Teacher prepares a handout with a list of similar vocab words, math problems, related concepts. etc.

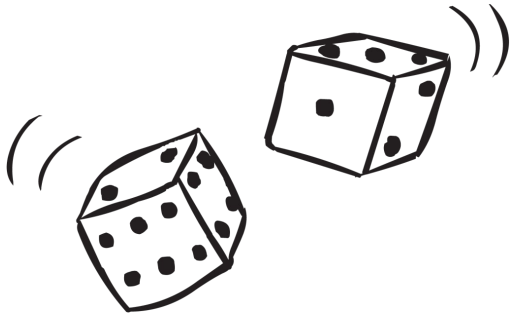
Students form small groups

One student rolls a die (or dice if >6 items on the list)

The student who rolls, retrieves (responds to the prompt with the corresponding number on the list)

The other students provide feedback

A new student is chosen to roll the dice.

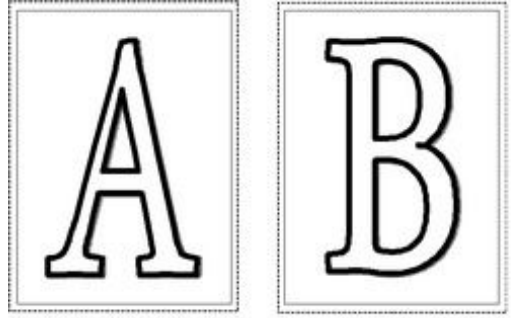


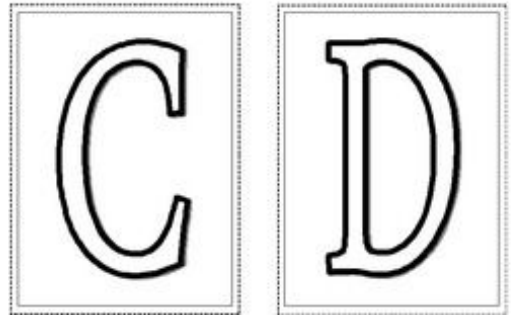
Hold-Ups

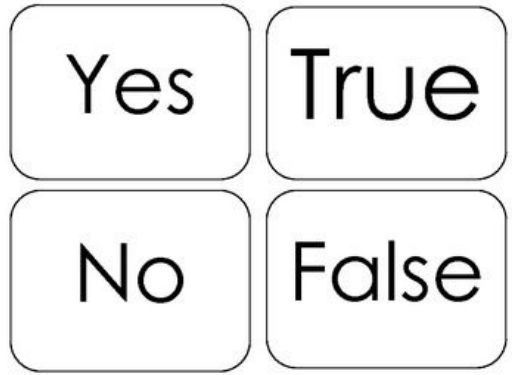
Teacher projects multiple choice or true/false question

Students respond by holding up a card (without consulting notes)

Teacher reveals the correct answer, explains, asks follow-up questions







Test Review Circles

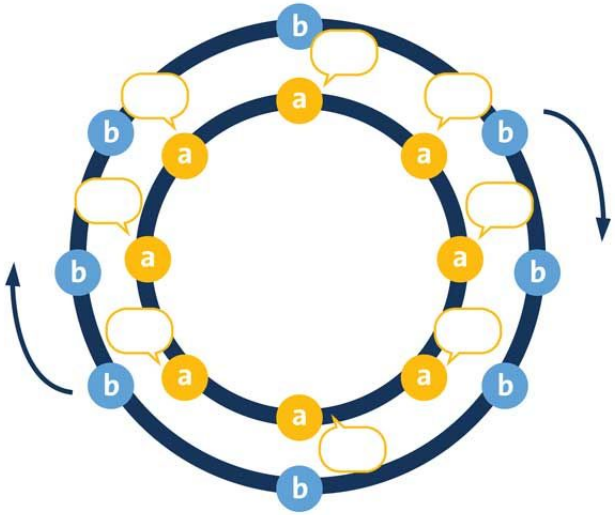
Level 2 & 3 questions projected

Inner circle responds first

Outer circle contributes when inner circle is done

Switch roles and repeat with next question

Partners High 5, say thank you. Then outer circle rotates, introduces themselves to new partner.



Retrieval Tic-Tac-Toe

Project tic-tac-toe board

Split class into 2 teams

Students write question on index card, give to team rep

Team A rep stands at front, chooses and asks question

Team B answers; places X or O if correct

Switch & repeat

Retrieval Grids

Teacher creates table with prompts for retrieval practice (handout)

Each column = similar topic, different spacing

Students complete on their own, w/out notes

Teacher gives correct answers (or students look up)

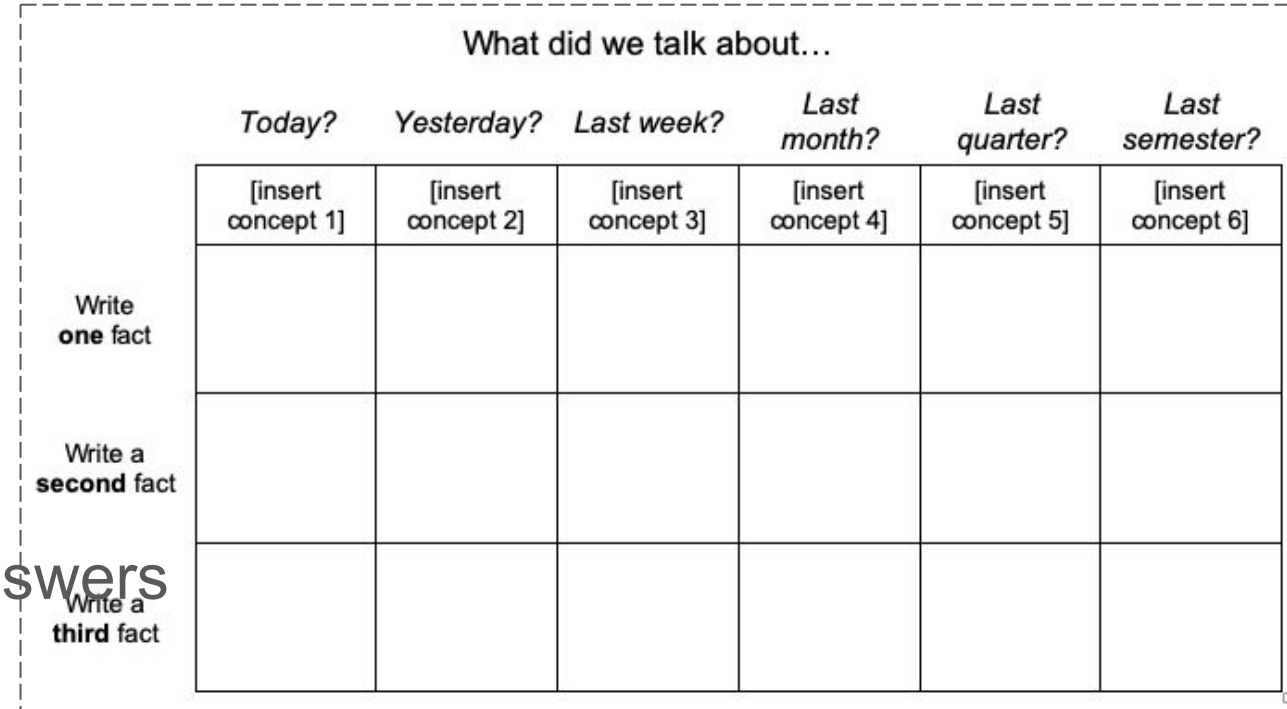
Power Tickets

Teacher gives a blank copy of the power ticket to each student, announces topics

Students write 3 facts about each topic

Students compare responses w/a partner, adds facts

Teacher reviews answers



What did we talk about…

	Today?	*Yesterday?*	*Last week?*	*Last month?*	*Last quarter?*	*Last semester?*
	[insert concept 1]	[insert concept 2]	[insert concept 3]	[insert concept 4]	[insert concept 5]	[insert concept 6]
Write **one** fact						
Write a **second** fact						
Write a **third** fact						

Flashcards Done Right

Retrieve

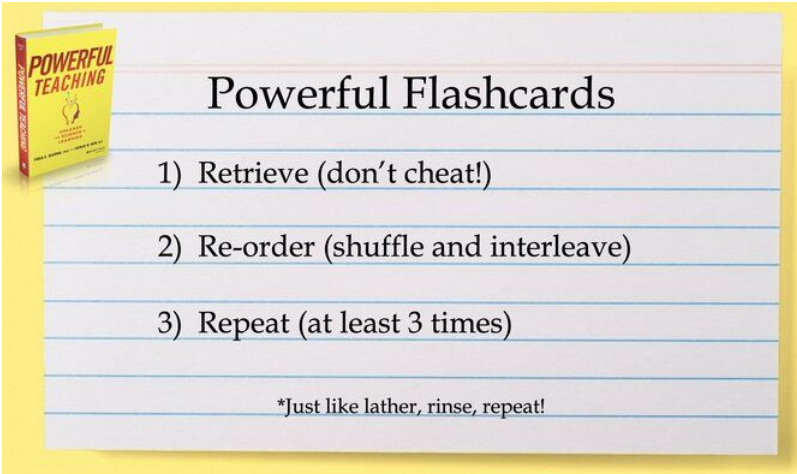
- Look at the prompt and say the answer it out loud *before* flipping the card over instead of thinking “of course I know it” and flipping the card over prematurely.

Re-order

- Shuffle the card deck each time you go through.

Repeat

- Keep cards in the deck until you’ve correctly retrieved it 3x.



Flash Forward

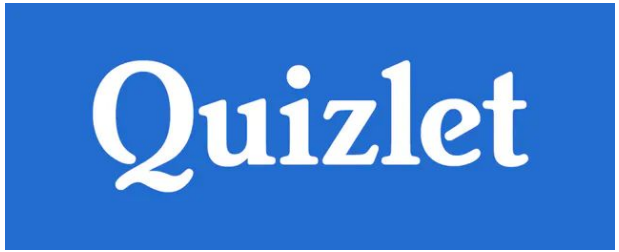
Ask your students, "If you could remember one thing about [insert topic/unit/course name] 10 years from now, what would it be and why?"

Collect responses on a written entry or exit ticket, via FlipGrid in 30 seconds or less, or during think-pair-share.

Classroom Strategies

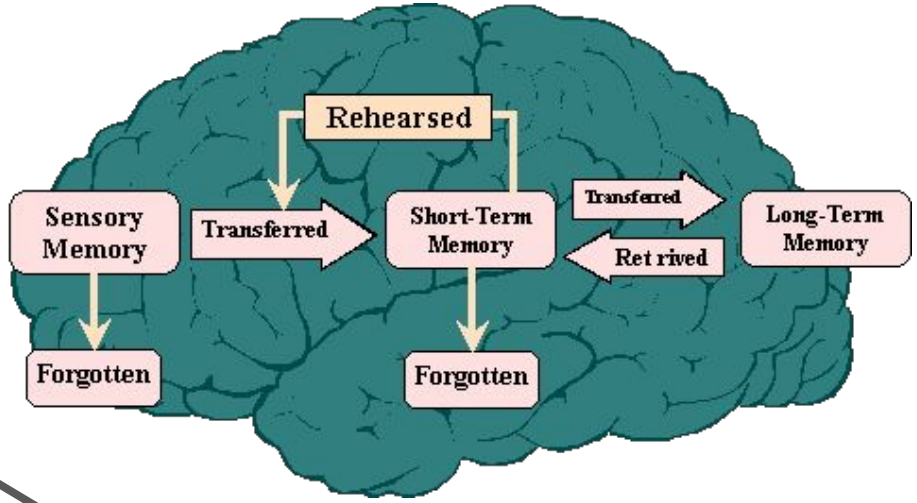
[High Tech/High Prep]

Tech Tools for Retrieval Practice



Leverage the Power of Canvas!

- Dual coding
- Retrieval practice
- Spaced repetition
- Interleaving
- Explain & elaborate
- Teach it to learn it
- Embrace errors



Canvas makes it especially easy to give kids opportunities to do these

Randomization = Major Game Changer

Details | Questions | Mastery Paths

Group Pick 2 questions, 1.0 pts per question

Questions will be pulled from the bank: **AP U02 L1 The Nature of Science**

Group Pick 2 questions, 1.0 pts per question

Questions will be pulled from the bank: **AP U02 L2 The Nature of Physics**

Group Pick 5 questions, 1.0 pts per question

Questions will be pulled from the bank: **AP U02 L5a Significant Figures Counting**

Group Pick 5 questions, 1.0 pts per question

Questions will be pulled from the bank: **AP U02 L5b Rounding and Scientific Notation**

Quick & Easy Creation of Randomized Practice/Quizzes/Tests

Every student, every attempt → completely different test, not just the same questions in a new order

Daily Study Sets

- Unit 1 Study Set #1
  Closed | Due Aug 24 at 11:59pm | 10 pts | 10 Questions
- Unit 1 Study Set #2
  Closed | Due Aug 26 at 11:59pm | 10 pts | 10 Questions
- Unit 1 Study Set #3
  Closed | Due Aug 27 at 11:59pm | 10 pts | 10 Questions
- Unit 1 Study Set #4
  Closed | Due Aug 27 at 11:59pm | 10 pts | 10 Questions
- Unit 1 Study Set #5
  Closed | Due Aug 28 at 11:59pm | 10 pts | 10 Questions
- Unit 1 Study Set #6
  Closed | Due Aug 28 at 11:59pm | 10 pts | 10 Questions
- Unit 1 Test Review Study Set #1
  Closed | Due Sep 21 at 11:59pm | 10 pts | 50 Questions
- Unit 1 Test Review Study Set #2
  Closed | Due Sep 23 at 11:59pm | 10 pts | 50 Questions
- Unit 1 Test Review Study Set #3
  Closed | Due Sep 24 at 11:59pm | 10 pts | 50 Questions

Practice by Topic Sets

- 1.1 Practice by Topic - Defining A&P
  5 pts | 5 Questions
- 1.2 Practice by Topic - Body Planes & Sections
  5 pts | 5 Questions
- 1.3 Practice by Topic - Body Cavities & Abdominopelvic Regions
  5 pts | 5 Questions
- 1.4 Practice by Topic - Directional Terms
  5 pts | 5 Questions
- 1.5 Practice by Topic - Essential Latin for A&P
  5 pts | 5 Questions
- 1.5 Practice by Topic - Regional Terms
  5 pts | 5 Questions
- 1.7 Practice by Topic - Body System Functions
  5 pts | 5 Questions
- 1.7 Practice by Topic - Body System Structures
  5 pts | 5 Questions
- 1.7 Practice by Topic - Fetal Pig Dissection
  5 pts | 5 Questions
- 1.8 Practice by Topic - Homeostasis & Feedback Loops
  5 pts | 5 Questions

Study Sets: 1 x 20 ≠ 2 x 10

Student	Attempt	Time	Score
Acuna, Avery	4	finished in 34 minutes	8
Allen, Brooke	4	finished in 3 minutes	9.0
Anderson, Tiffany	1	finished in 6 minutes	9.0
anguiano, aaliyah	--		
Anguiano, Isaiah	3	finished in 22 minutes	8.0
Arevalo, Rosa A	5	finished in 20 minutes	10.0
Arredondo, Raelyn	3	finished in 4 minutes	5.0

1 set current info / 1 set throwback

Practice By Topic

Easy Differentiated Instruction!

3.2 Practice by Topic

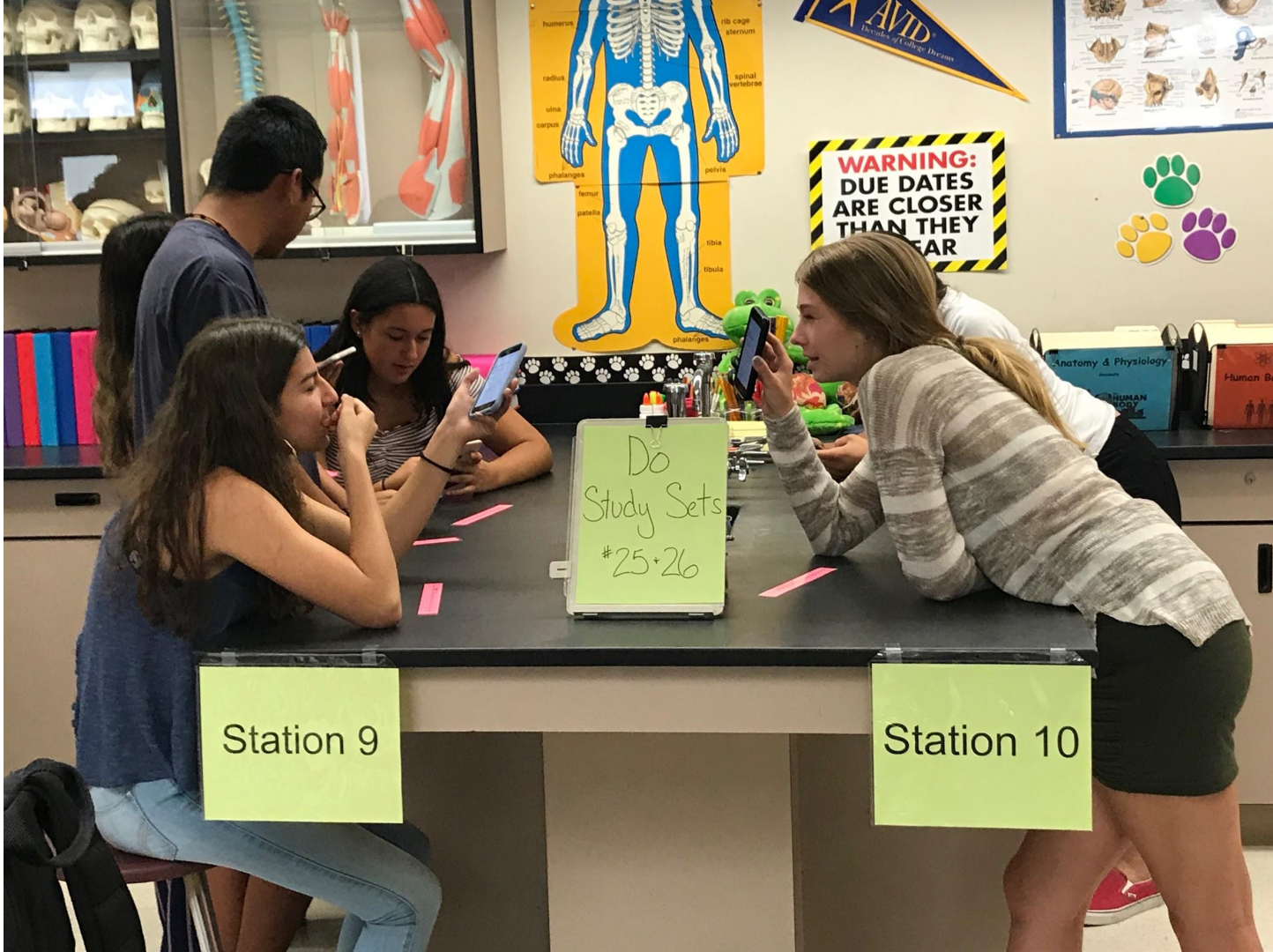
- 3.2 Practice by Topic - Gross Anatomy of Bone
- 3.2 Practice by Topic - Microanatomy of Bone

Ungraded quiz
5-questions
Open always
Single topic

@ Home
Level 1-2
(Study Sets)

@ School
Level 2-4

Explain
Elaborate
Predict
Analyze
Integrate
Evaluate
Apply



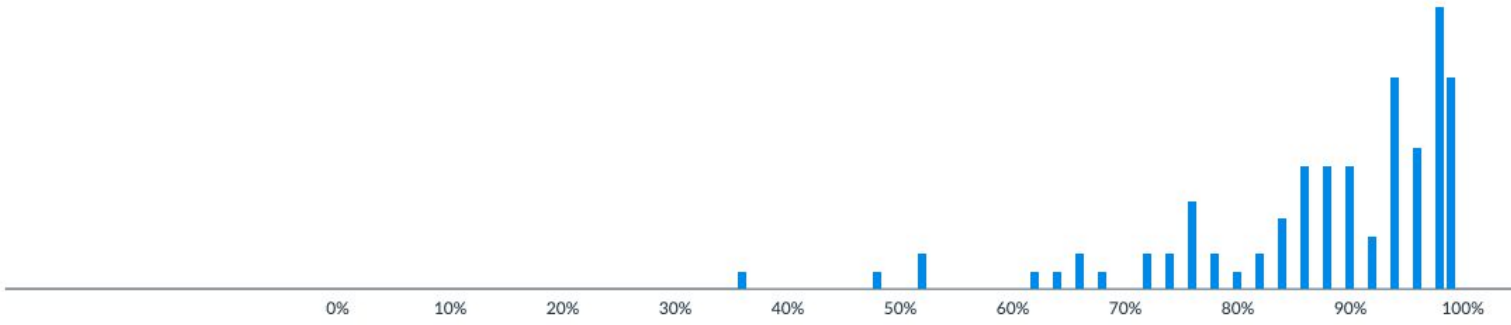
Results

Study Set Test (Level 1-2)

Short Answer Test (Level 2-4)

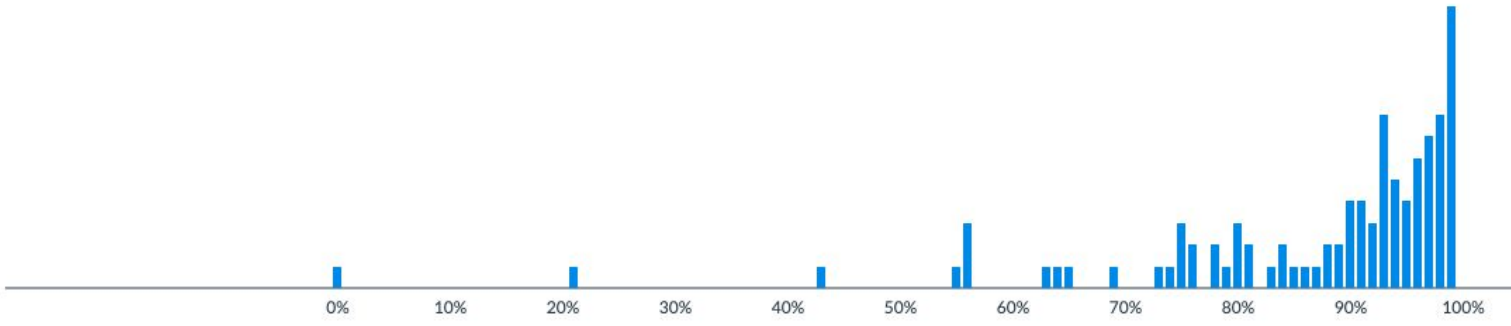
1.3-1.4 Study Set Test - Body Sys & Homeostasis

100%	36%	88%	6.34	17:19
High Score	Low Score	Mean Score	Standard Deviation	Mean Elapsed Time



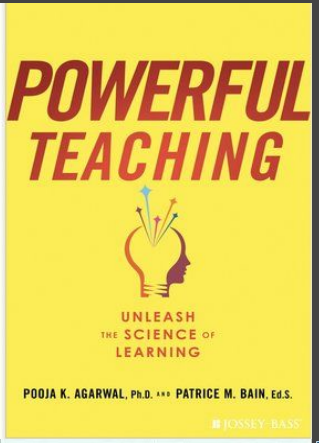
1.3-1.4 Short Answer Test - Body Sys & Homeostasis

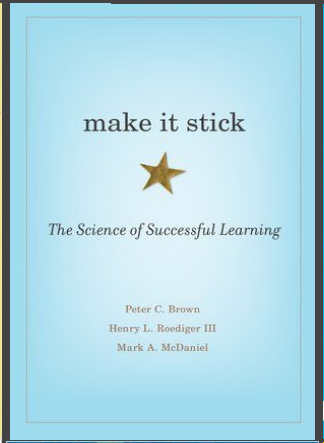
100%	0%	87%	16.388	37:58
High Score	Low Score	Mean Score	Standard Deviation	Mean Elapsed Time

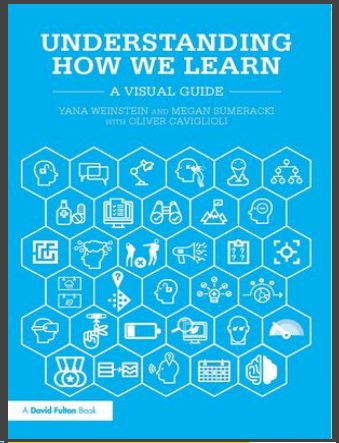


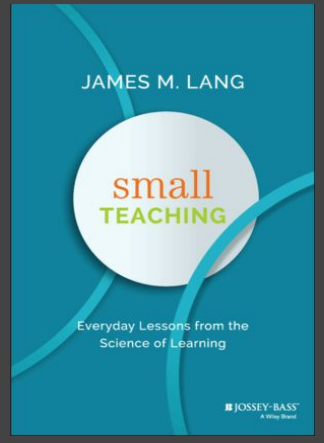
Resources

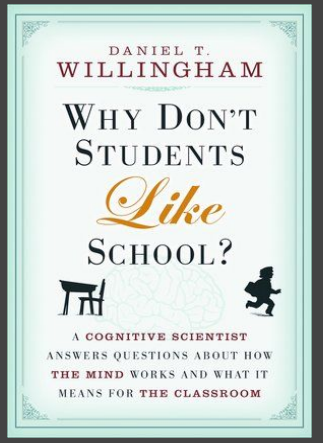
For Teachers

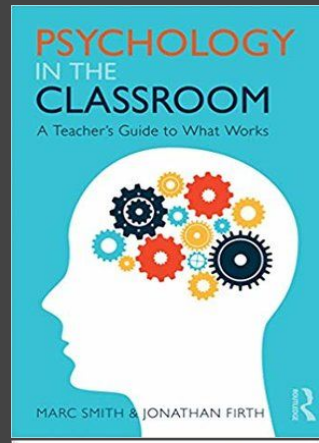


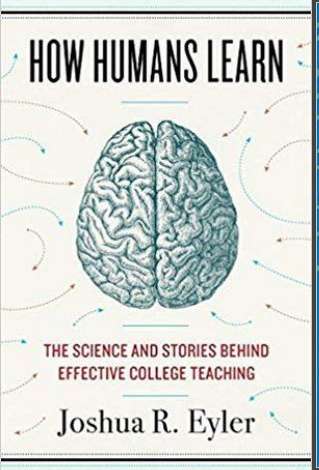


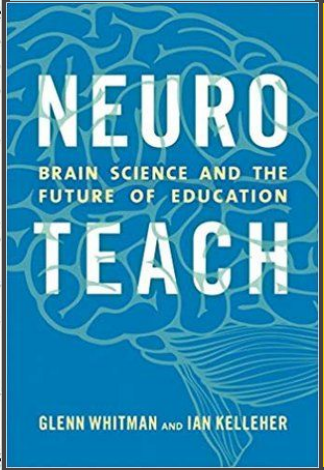


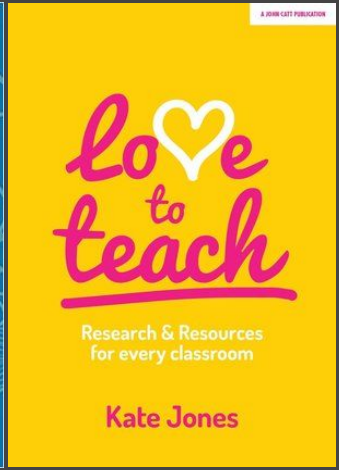


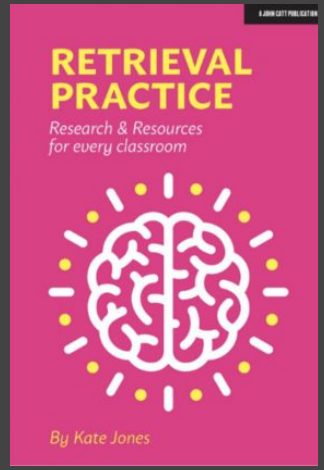


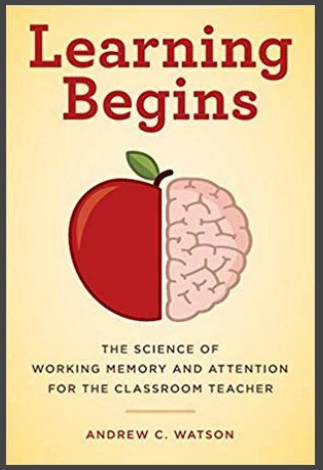


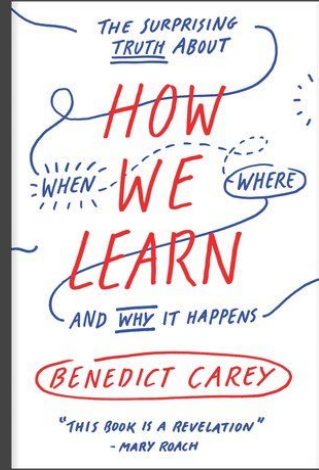












For Students

Books

College Smart: How to Succeed in College Using the Science of Learning
How to Learn: Effective Study and Revision Methods for Any Course
A Guide to Effective Studying and Learning: Practical Strategies from the Science of Learning
Understanding How We Learn: A Visual Guide
Make it Stick: The Science of Successful Learning (download our free resources!)

Blogs

The Learning Scientists, particularly their blogs on note-taking with laptops vs. handwriting, studying while listening to music, flashcards, and FAQs

Downloads

Five Popular Study Strategies: Their Pitfalls & Optimal Implementations
Optimizing Learning in College: Tips From Cognitive Psychology
What Works and What Doesn't in Scientific American

Videos & Podcasts

Podcast by NPR Life Kit: How to Succeed at College
Podcast episodes by the Learning Scientists
Our YouTube playlist of study strategy videos


thank
you