

Powerful Teaching: Unleash the science of learning



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@RetrieveLearn @PoojaAgarwal

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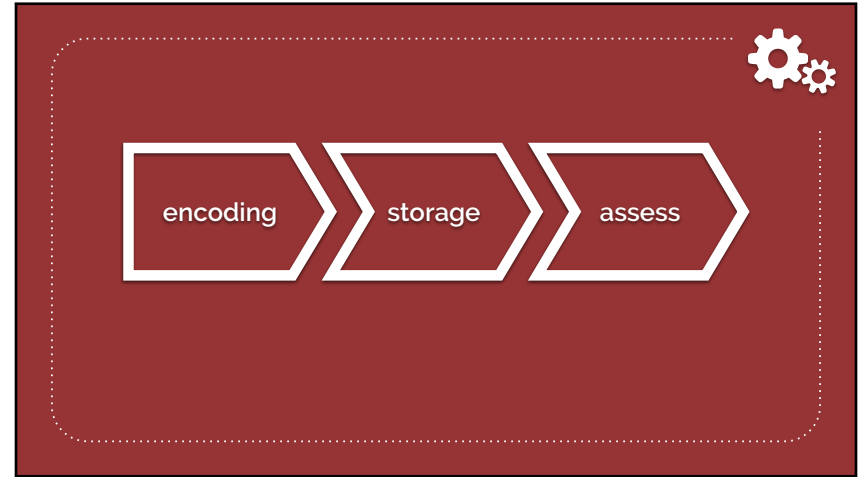


How many bones in the human body?



retrievalpractice.org/wellesley





We focus on getting information **IN**.

Let's focus on getting information **OUT**.

Retrieval Practice

- Bringing information to mind
- We learn when we retrieve!
- Transforms long-term learning



Unleash the Science of Learning

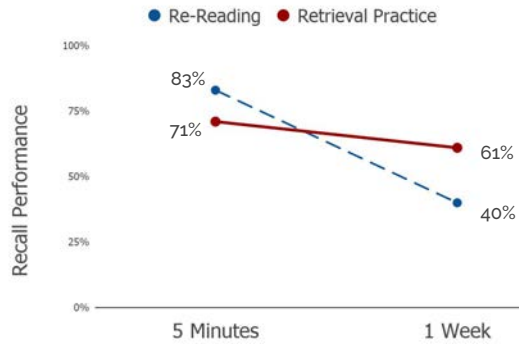
- Foundation: Retrieval Practice
- Spacing, Interleaving, Feedback
- We already do this!
- Practical classroom strategies



The Basics

Retrieval Practice vs. Re-Reading

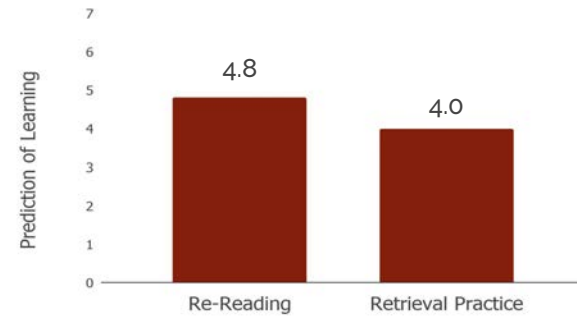




Roediger & Karpicke (2006)



How much will you remember in one week?



Roediger & Karpicke (2006)



In the Classroom

Including fire alarms and snow days!



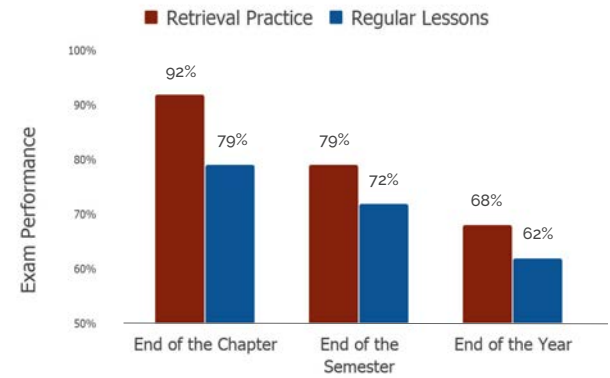
10+ years of research
(ages 11-17)

1,500+ students

Raised grades: C to A

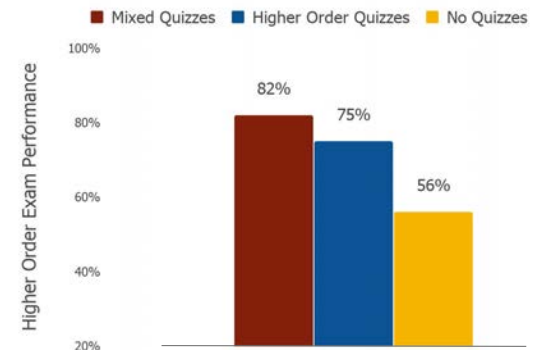
Agarwal et al. (2012)

Retrieval practice
vs.
Business as usual



McDaniel et al. (2011)

Higher order retrieval
vs.
Basic retrieval
vs.
Business as usual



Agarwal (2018)

Complex higher order learning

Agarwal (2018)

Transfer of knowledge

McDaniel et al. (2013)

Multiple-choice vs. short answer

McDermott et al. (2014)

Optimal quiz spacing

McDaniel et al. (2011)

Feedback and metacognition

Agarwal et al. (2009)

Open-book quizzes

Agarwal et al. (in prep)

Collaborative retrieval

Agarwal et al. (in prep)

Reducing test anxiety

Agarwal et al. (2014)

Online quizzes

Roediger et al. (2011)



Figure 1.2
INDUCTIVE REASONING: FROM OBSERVATIONS TO GENERAL PRINCIPLES
 The inductive process starts with observations. For example, if all swans you observe are white, you might conclude that all swans are white. This is an inductive process because you are moving from specific observations to a general conclusion. In science, inductive reasoning is used to generate hypotheses. For example, if you observe that plants grow better in sunlight than in shade, you might hypothesize that plants need sunlight to grow.

Figure 1.3
HYPOTHESIS TESTING: FROM GENERAL PRINCIPLES TO SPECIFIC OBSERVATIONS
 The deductive process starts with a general principle or hypothesis. For example, if you hypothesize that all swans are white, you would expect to see only white swans. If you observe a black swan, this would disprove your hypothesis. In science, hypothesis testing is used to evaluate the validity of a hypothesis. For example, if you hypothesize that plants need sunlight to grow, you would expect to see that plants in sunlight grow better than plants in shade.

Retrieval strategies



- Free recall ("Brain Dump")
- Two Things
- Retrieve-taking



Retrieval in Action



Paper and pencil!

Blackboard & Canvas

Think-pair-share

Clickers or Plickers

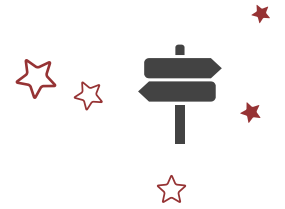
Weekly mini-quizzes

FlipGrid

**What is your
least favorite
ice cream flavor?**



Retrieval Guidelines



Low or no stakes

The more, the better

Keep it closed-book

Retrieval *saves* time!

**How many
bones in the
human body?**



“Power Ups”

Spacing, Interleaving, & Feedback



Dunlosky et al. (2013). *PSP*

Spacing

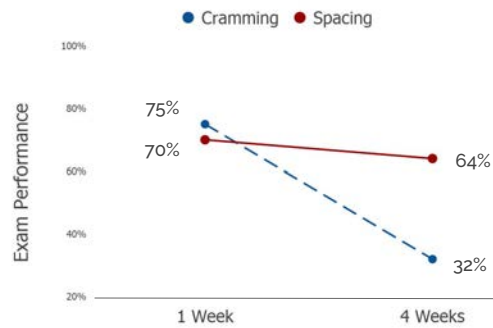
- Space retrieval over time
- Forgetting is a good thing



McDaniel et al. (2011)



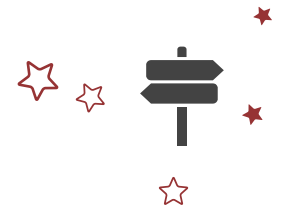
Cram it in
VS.
Space it out



Rohrer & Taylor (2006)



Spacing Guidelines



Ask about past content

The more, the better

Try a "hybrid" approach

"Blast from the past"

“

What did you learn today?

vs.

What did you learn **yesterday**?



Interleaving

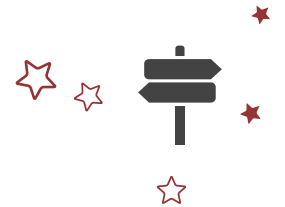
- Mix up content
- Improves discrimination
- Remember the middle!



Taylor & Rohrer (2010)



Interleaving Guidelines



Mix similar topics

Try a “hybrid” approach

Think of a fruit salad!

Dice or fishbowl games

“

Avoid

“plugging and chugging”

Feedback

- Reinforces knowledge
- Reveals illusions of learning
- Errors are a good thing!

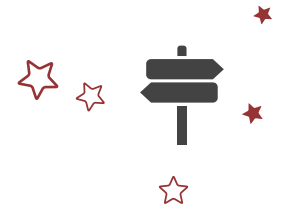


Agarwal et al. (2009)

1. Melbourne
2. Canberra
3. Sydney



Feedback Guidelines



Immediate or delayed
After retrieval

Correct/incorrect is good
Elaborative is best

“

Know what you know
and
Know what you **don't** know

Challenge Learning

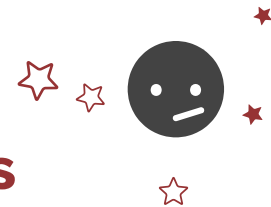


These strategies are “desirable difficulties”
Flexible for all students and all content areas
You can combine them, too!



But I studied for hours!

Ineffective study strategies



Re-reading Highlighting & Underlining
Note taking Flashcards (sometimes...)

“

Learning that's easy is like writing in sand.
Here today and gone tomorrow.



@RetrieveLearn
#makeitstick

Make it Stick: The Science of Successful Learning
by Brown, Roediger, & McDaniel (2014)



Start small

- Tweak what you're already doing
- No extra prep, grading, or class time
- Save time in the long run



Pooja's Classroom

- NO papers
- NO midterm exam
- NO final exam
- NO high stakes



Pooja's Classroom

- Weekly retrieval practice (2% each)
- FlipGrid assignments
- Group projects
- Participation



Retrieval practices are the bomb.

Retrieval practices once a week! ♥

Love that we have nothing for a final!

Best thing ever!

Retrieve!

One strategy you can use
tomorrow?



Now what?



Let's continue!



- Effective classroom strategies, activities, technology
- Building a supportive class culture
- Boosting student study strategies
- More research!



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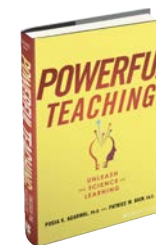


Coming soon!



retrievalpractice.org

Available this spring!



Powerful Teaching: Unleash the Science of Learning
(Spring 2019, Wiley/Jossey-Bass)

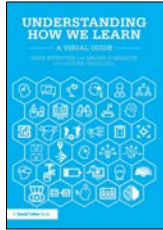
retrievalpractice.org/powerfulteaching



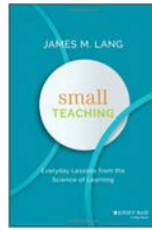
Recommended books!



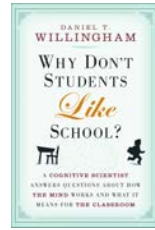
#makeitstick



@AceThatTest



@LangOnCourse



@DTWillingham

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Follow our collaborators!



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How many bones in the human body?



Let's transform learning by getting information out.

retrievalpractice.org/wellesley

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@RetrieveLearn @PoojaAgarwal