

# LEARNING AND THE BRAIN: AN OVERVIEW

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FIRST LITERACY  
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# FRAMING OUR DISCUSSION

- 1. What is learning?**
- 2. How do we know when our students have gained mastery of what they have learned?**
- 3. What does memory have to do with learning?**

# TODAY'S AGENDA

1. **Learning at the neural level**
2. **Forgetting and learning**
3. **Retrieval practice**
4. **Mixing it Up: Interleaving**
5. **Your Implementation**

# OBJECTIVES

**By the end of this session, you will be able to:**

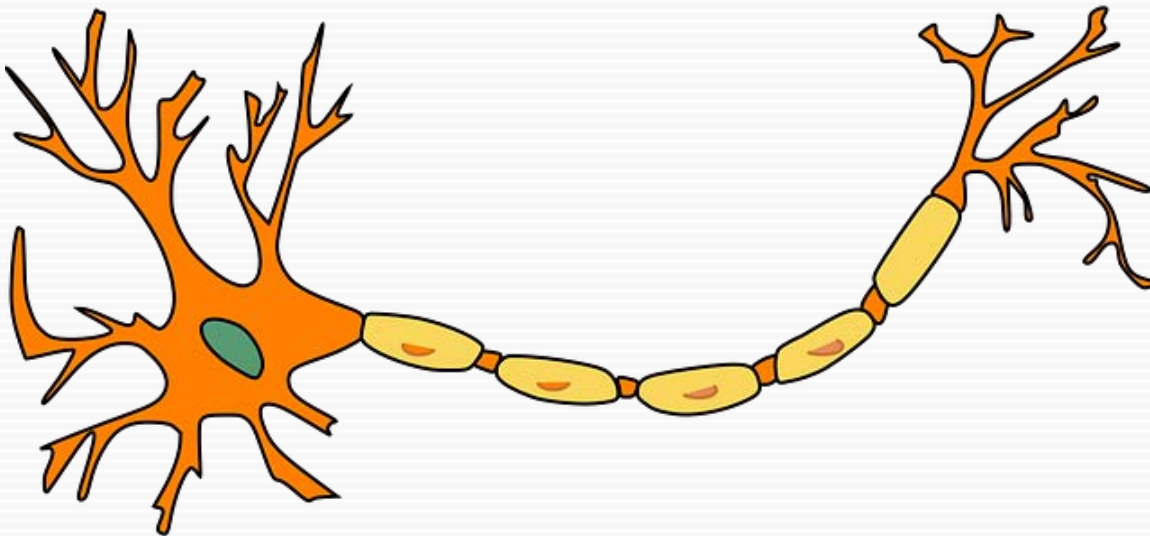
- **Identify principles that support durable and transferable learning.**
- **Name and explain several teaching practices that are effective for student learning.**
- **Identify next steps in your own teaching practice.**

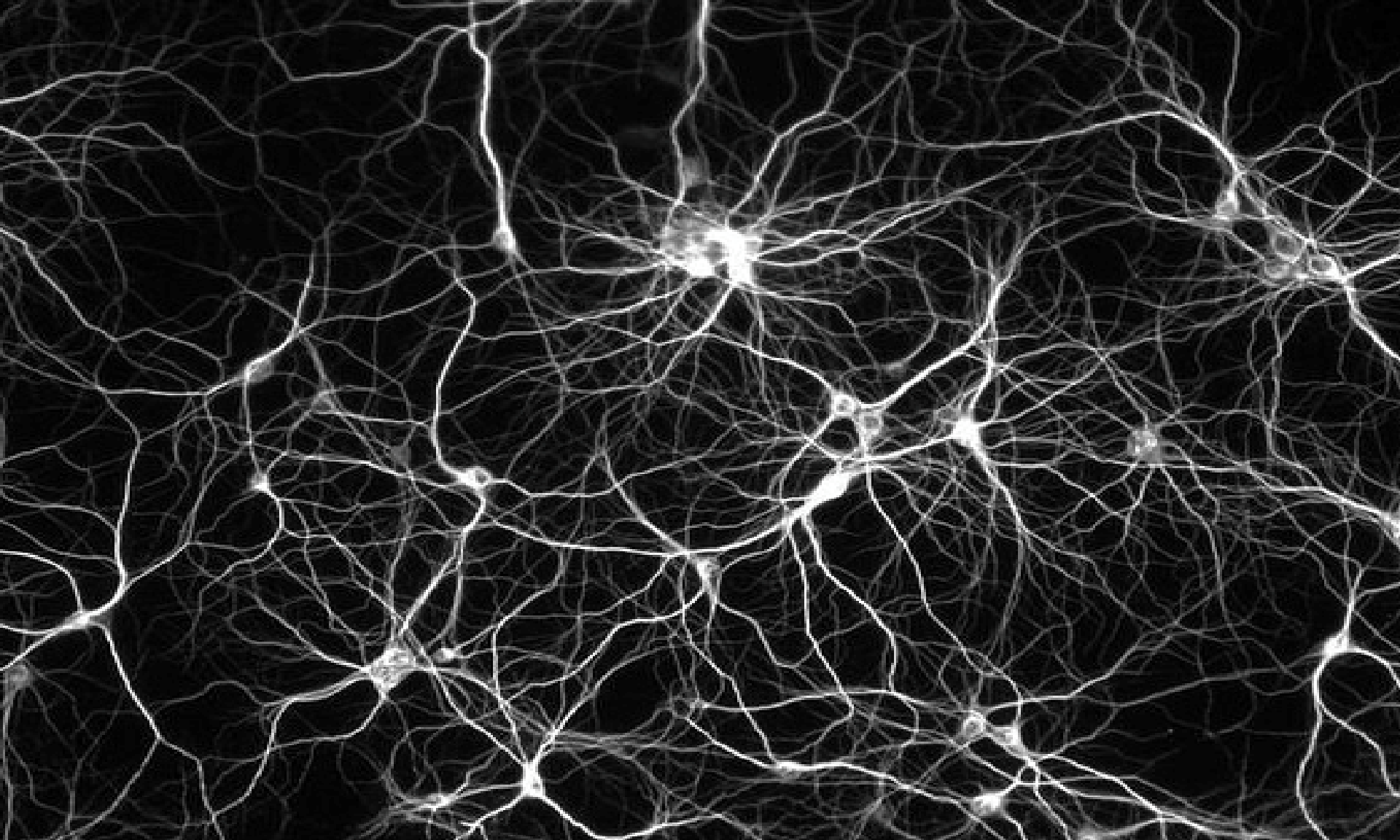
# LEARNING AT THE NEURAL LEVEL

# THE HUMAN BRAIN

**100,000,000,000**

**The number of neurons we have at birth.**





**One neuron can make up to  
10,000 connections through its dendrites.**

Image from Matt Lee on Flickr: <https://www.flickr.com/photos/razorsmile/526249719>

# NEURAL PATHWAYS DEVELOP



Newborn



1 Month



9 Months



2 Years



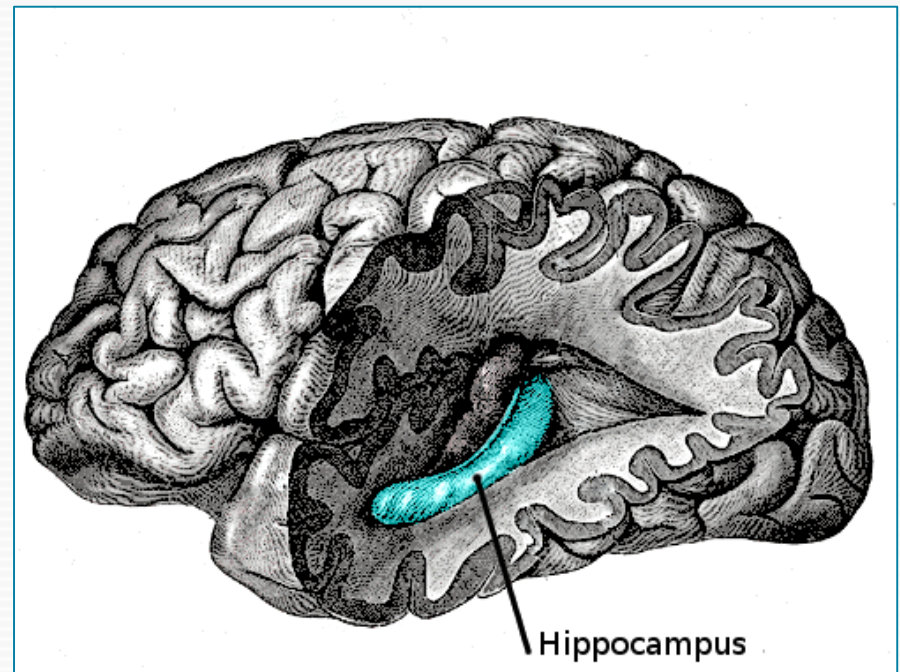
Adult



# A PUZZLE

When you navigate you use the **hippocampus**.

*Why do London taxi drivers have a larger hippocampus than London bus drivers?*



Maguire, Woollett, & Spiers, 2006

## PRINCIPLE 1

*Learning \_\_\_\_\_  
your brain.*

# RECAP: THE HUMAN BRAIN

True or False?

**Learning happens when neurons make new connections.**

True or False?

**Neural connections are permanent.**

True or False?

**Some neural connections become stronger than others.**

True or False?

**The more connections a memory has,  
the more durable the memory is.**

True or False

**Our brains change over our lifetimes.**

## PRINCIPLE 2

*Learning is about  
making \_\_\_\_\_.*



**Write 2 ideas we discussed in Part 1.**



**Write one question you have.**



**EXIT TICKET**

STRETCH!



"Of course I never forget. I've got a lifetime supply of post-it notes."

# FORGETTING AND LEARNING

# THE FORGETTING CURVE



- **In 1885, Hermann Ebbinghaus discovered that information is lost very quickly after it is learned.**

# THE FORGETTING CURVE



*Without any reinforcement or connections to prior knowledge, information is quickly forgotten—roughly 56 % in one hour, 66 % after a day, and 75 % after six days.*

*James Zull, 2002*

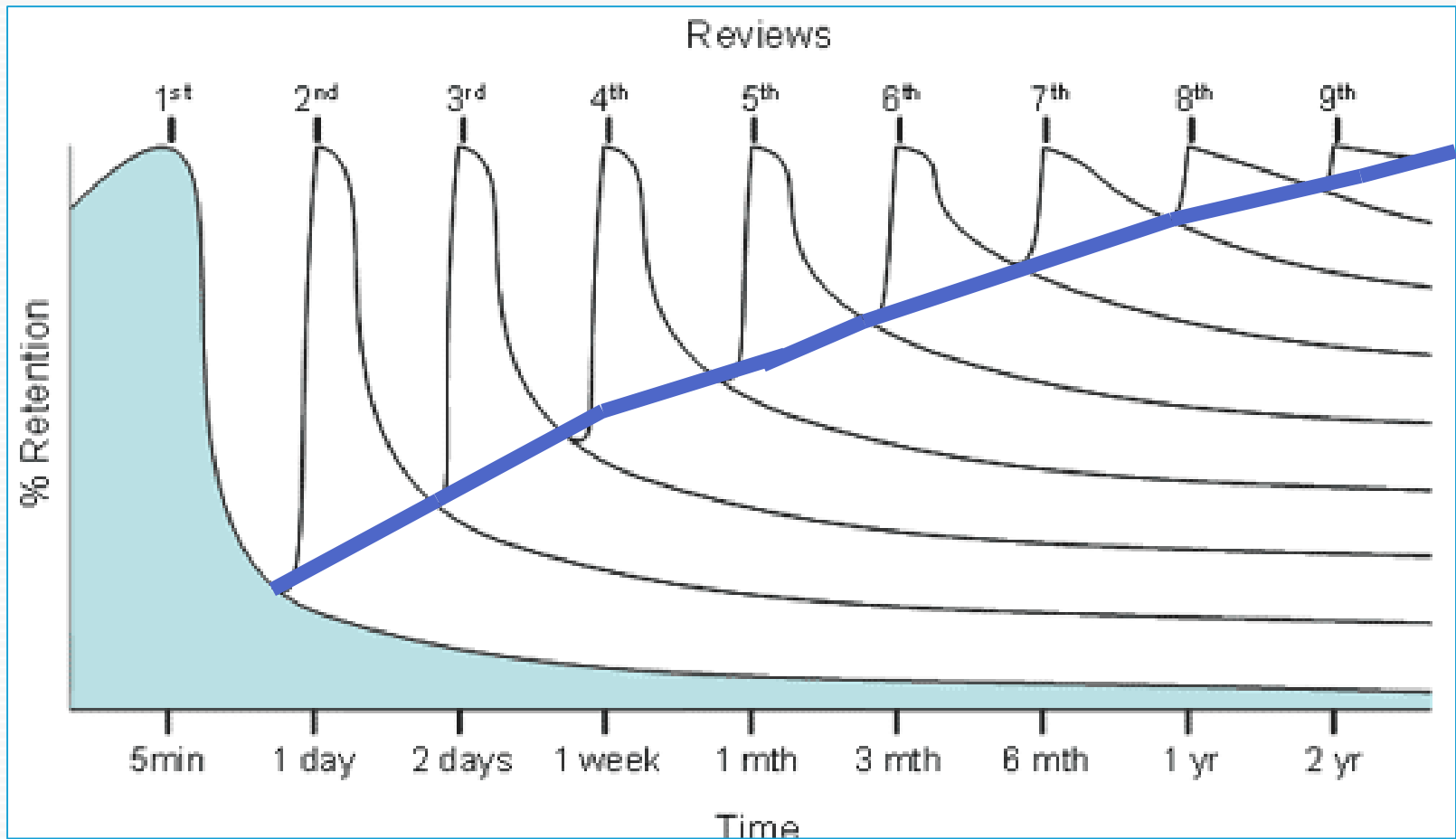
**True or False?**

By 5:00 today, you will have forgotten more than half of what you heard in this session.

## PRINCIPLE 3

*Forgetting is \_\_\_\_\_.*

# THE FORGETTING CURVE & THE LEARNING CURVE





- 1. What is the forgetting curve?  
Can you give an example of it  
in your own life?**
  
- 2. What is the learning curve?  
Can you give an example it in  
your own life?**

**GIVE AN EXAMPLE**

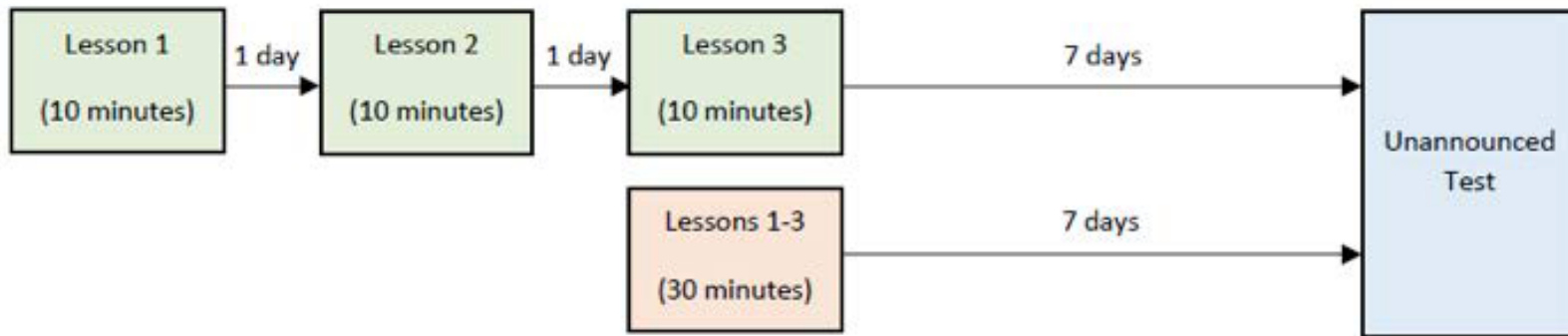


# WHAT KIND OF REPETITION?

## True or False?

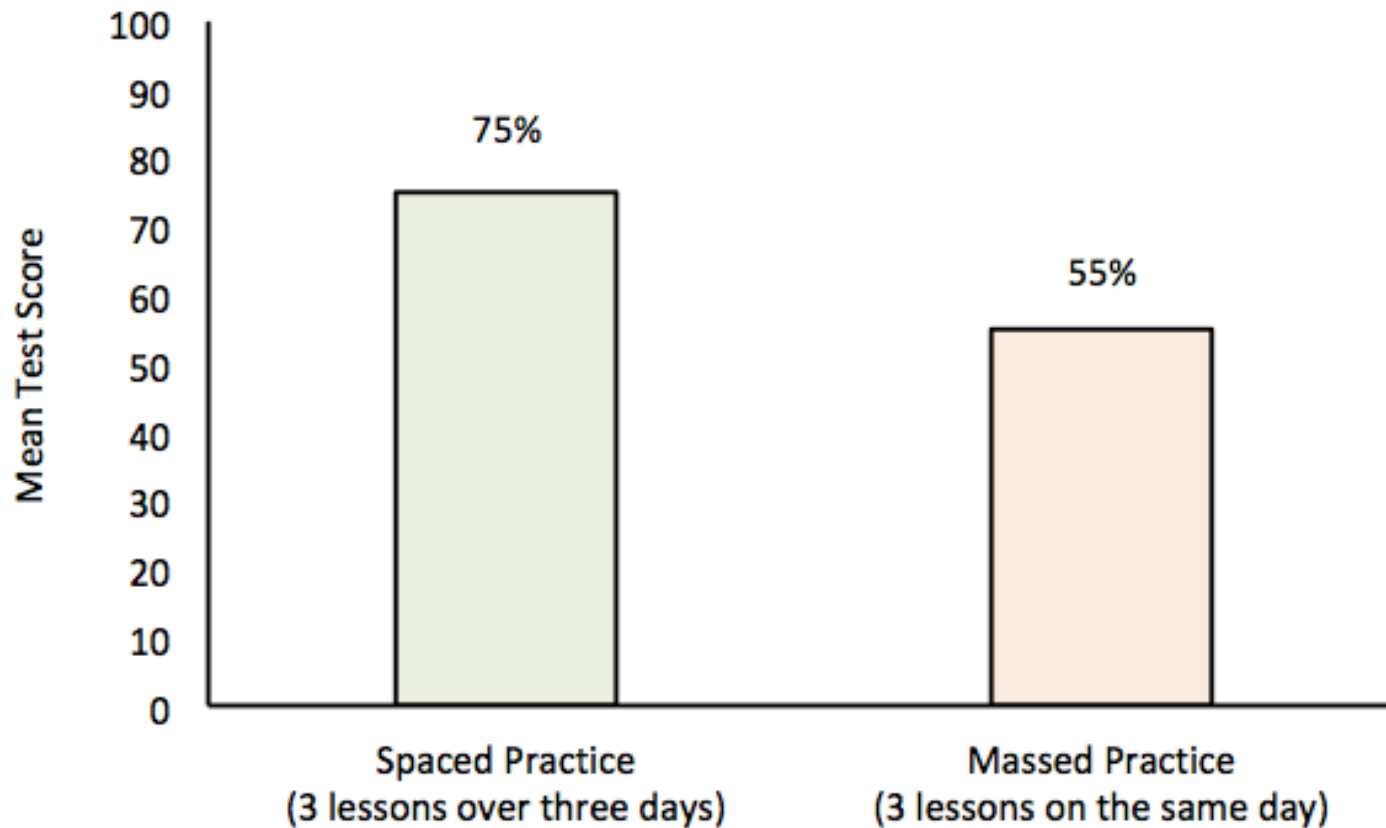
- 1. You remember better when you practice one point and master it, before you move on to practicing the next point.**
- 2. You memorize something faster when you practice it at intervals.**
- 3. You remember more when you use the same prompts and the same context each time you practice something.**

# HIGH SCHOOL FRENCH VOCABULARY



Bloom & Shuell,

# SPACED REPETITION VS. MASSED REPETITION



**1. Why doesn't cramming work?**

**2. Why does spaced practice work?**

**INFO GAP**

BREAK  
TIME!

# RETRIEVAL PRACTICE



# TWO ASPECTS OF MEMORY

- 1. Memory Storage**
- 2. Memory Retrieval**

# LEARNING IS A TWO-WAY STREET



# WHAT IS THE MOST EFFECTIVE WAY TO STUDY?

**3**

**Reread the text and your notes.**

**1**

**Close books and write what you remember.**

**2**

**Write a summary from your notes.**

# REVIEW VS. RETRIEVE

**Group A** read a passage and then recalled their learning by writing on a blank piece of paper.

**Group B** spent read a passage and the spent twenty minutes studying the passage.

*How much did they remember?*

	<b>A</b>	<b>B</b>
5 minutes later:	75%	81%
7 days later:	56%	42%

Roediger and Karpicke (2006)

# REVIEW VS. RETRIEVE

When you **review** material, you are recognizing material that looks familiar.

When you **retrieve** material, you are remembering it. Recall (or retrieval) strengthens your memory.

## PRINCIPLE 5

Use it or lose it.

# RETRIEVAL ACTIVITIES

**Total Recall**

**Last Class Recall**

**Pre-test**

**Recall with a picture**

**Vocabulary recall**

**Stand & Talk**

**Exit Ticket**

## Remember your Learning!



1. Read.



2. Read again.



3. Close the book.



4. Write what you remember.



5. Open the book.



6. Check your work

# TOTAL RECALL



# RETRIEVAL ACTIVITY

## Last Class Recall

- **At the start of class, ask students:**

*What did you learn last class? (New words?  
New grammar? )*

# RETRIEVAL ACTIVITY

## Pre/Post Test

**Before you introduce new material, give a short pre-test.**

- True/False.
- Multiple choice.
- Open questions: who, what, where, when, why, how.

**Repeat the test after students learn the material.**

# RETRIEVAL ACTIVITY

## Recall with a Picture



# RETRIEVAL ACTIVITY

## Vocabulary Recall with TTT

- **Call out a category and ask learners to write a list of words that fit the category.**

**Memory:**

**The Brain:**

# RETRIEVAL ACTIVITY

## Stand & Talk

- **Between activities, students stand up and turn to talk to a partner about what they are learning.**
- **Teacher supplies questions.**
  - Why do humans forget so quickly?
  - What is retrieval practice? Why is it important?
  - What is spaced practice? Why is it important?

# RETRIEVAL ACTIVITY

## Exit Ticket

- **At end of class, students write down a response to a teacher prompt. They hand to teacher as they exit room.**
- **Example prompts:**
  - “What are three new words you learned today?”*
  - “What is something you learned today? What is something you want to practice more?”*

**Read the list of retrieval activities.**

**★ Draw a star next to any you'd like to adapt to your context.**

**? Write question mark next to anything that is not clear to you.**

**MARK THE MARGINS**

IT UP MIX!



## PRINCIPLE 6

Recycle old learning.

# INTERLEAVED PRACTICE

## Question Cards

Write questions students have learned how to answer. For example:

- ***What is the forgetting curve?***
- ***What is “interleaving”?***
- ***Why do humans forget so quickly?***

Write 1 question per card. Use the cards to practice at intervals.



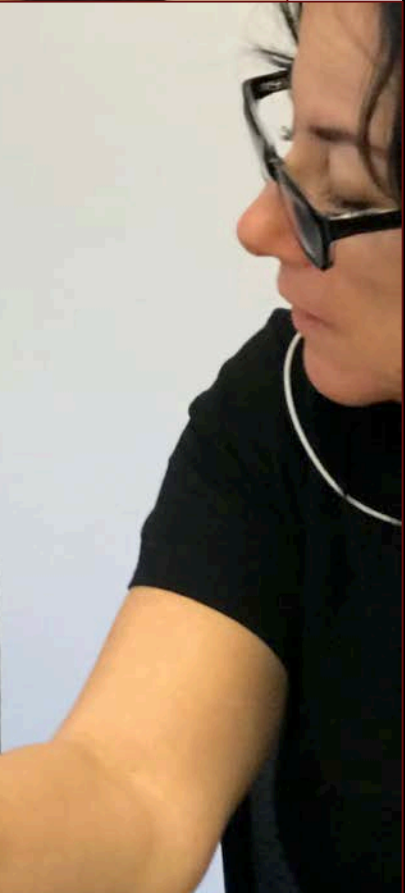
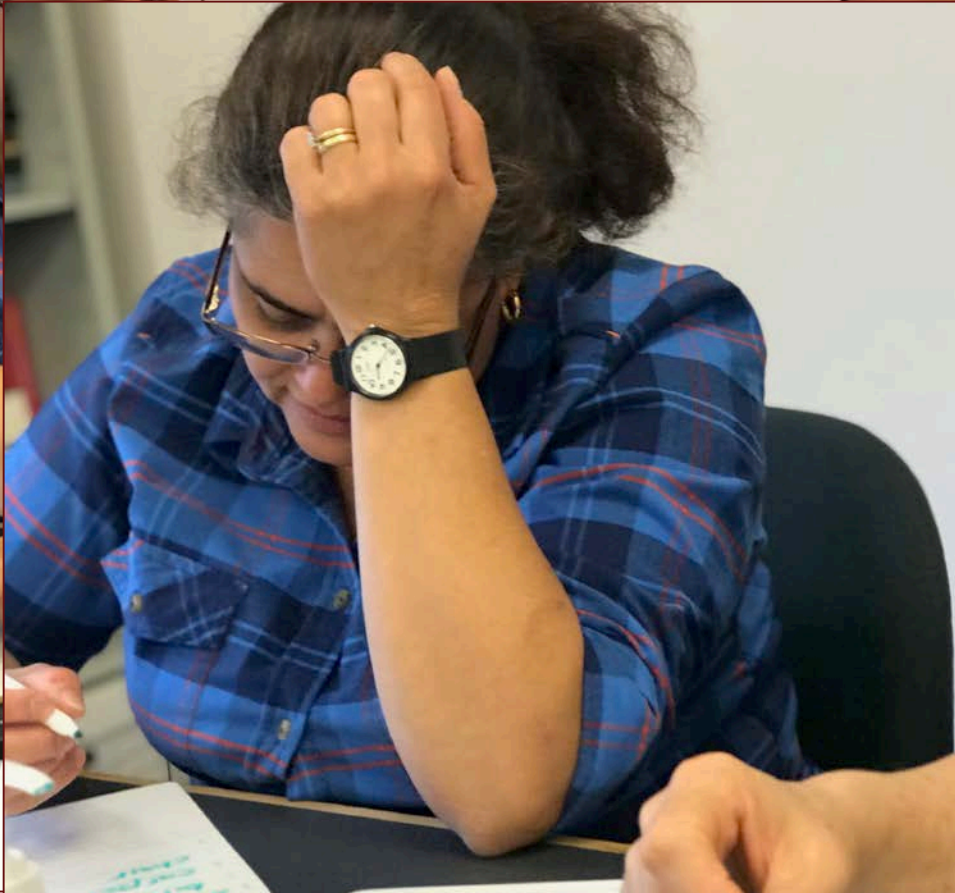
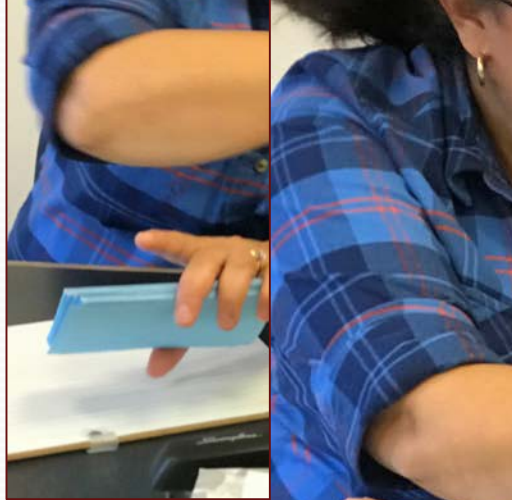
# INTERLEAVED PRACTICE

## Vocabulary Flashcards

1. **Students write new vocabulary on flashcards.**
2. **Students quiz one another with the flashcards.**

**What is [word]?**

**How do you spell  
[word]?**



# INTERLEAVED PRACTICE

## Vocabulary Flashcards

**Students sort cards according to categories.**

**Which words  
relate to [topic]?**

**Which words are  
verbs? nouns? both?**

# INTERLEAVED PRACTICE

Compare and Contrast Topics

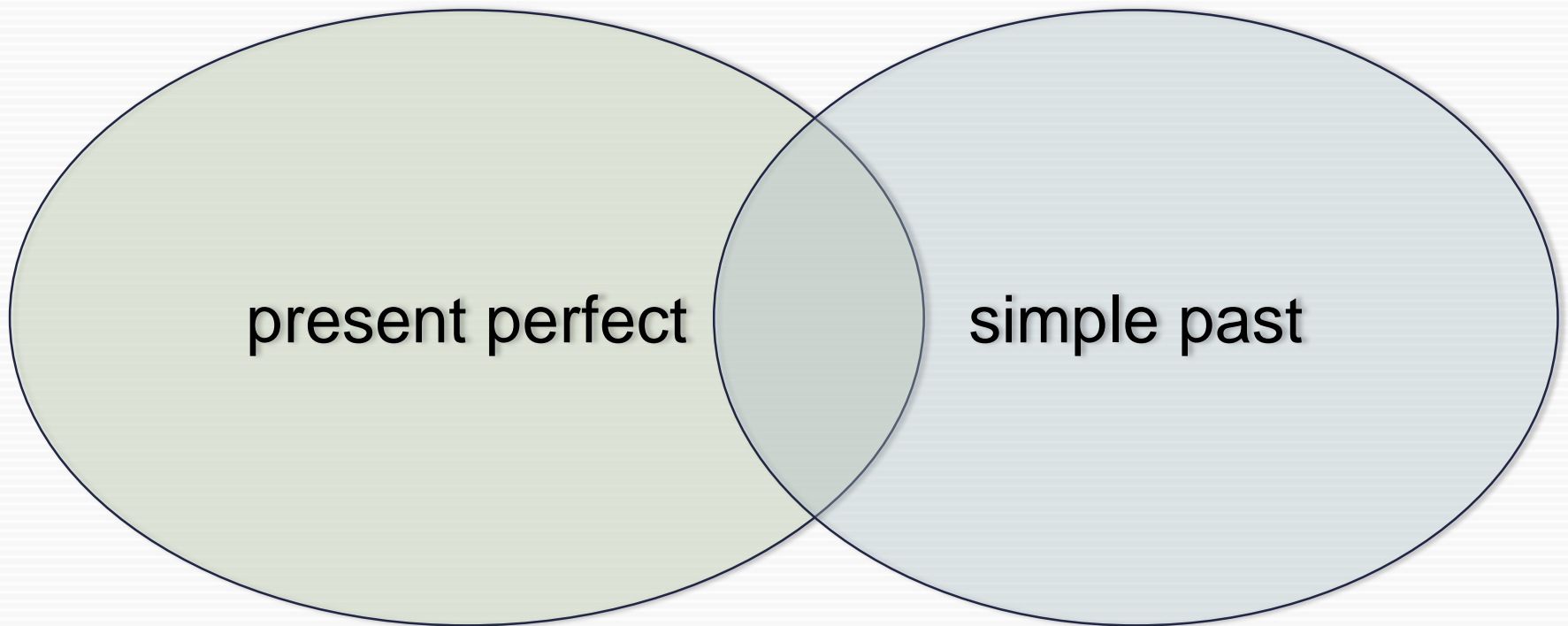


Martin Luther King

Abraham Lincoln

# INTERLEAVED PRACTICE

Compare and Contrast Structures





What are three classroom activities to recycle old learning?

- 1. Question Cards**
- 2. Vocabulary Cards**
- 3. Compare and Contrast**

**RECALL**

**1. Chose one activity you want to think about more.**

1. Question Cards
2. Vocabulary Cards
3. Compare and Contrast

**2. How would you use it in your own context?**

**3. Share your ideas.**

**SELECT A TOPIC**

# TOTAL RECALL LEARNING PRINCIPLES

- 1. Learning changes your brain.**
- 2. Learning is about making connections.**
- 3. Forgetting is natural.**
- 4. Learning requires repetition.**
- 5. Use it or lose it.**
- 6. Recycle old learning.**

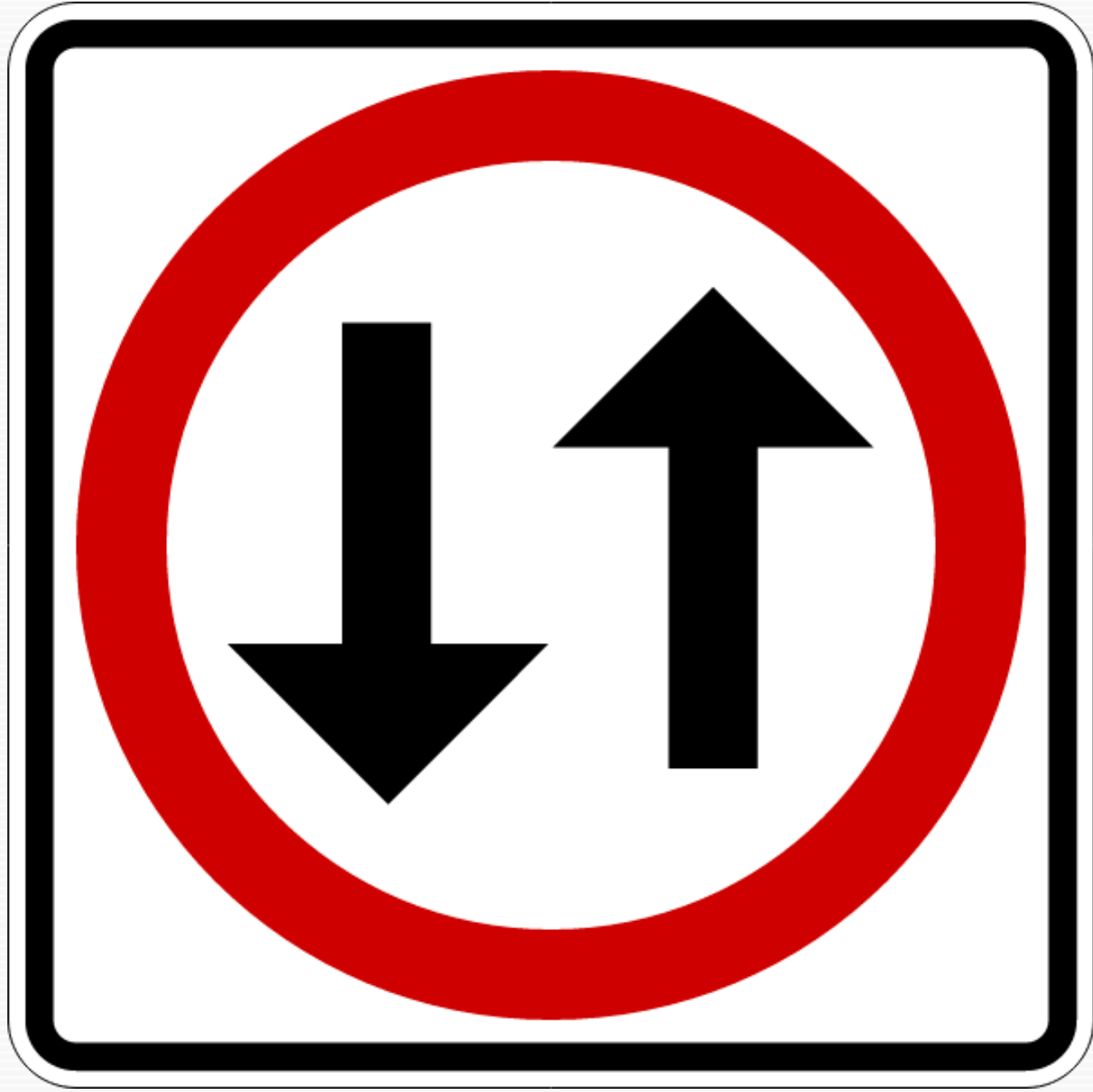
- 1. Review the activities in your handout.**
- 2. Review your notes.**
- 3. Do the goal implementation sheet.**

**GOAL  
IMPLEMENTATION**

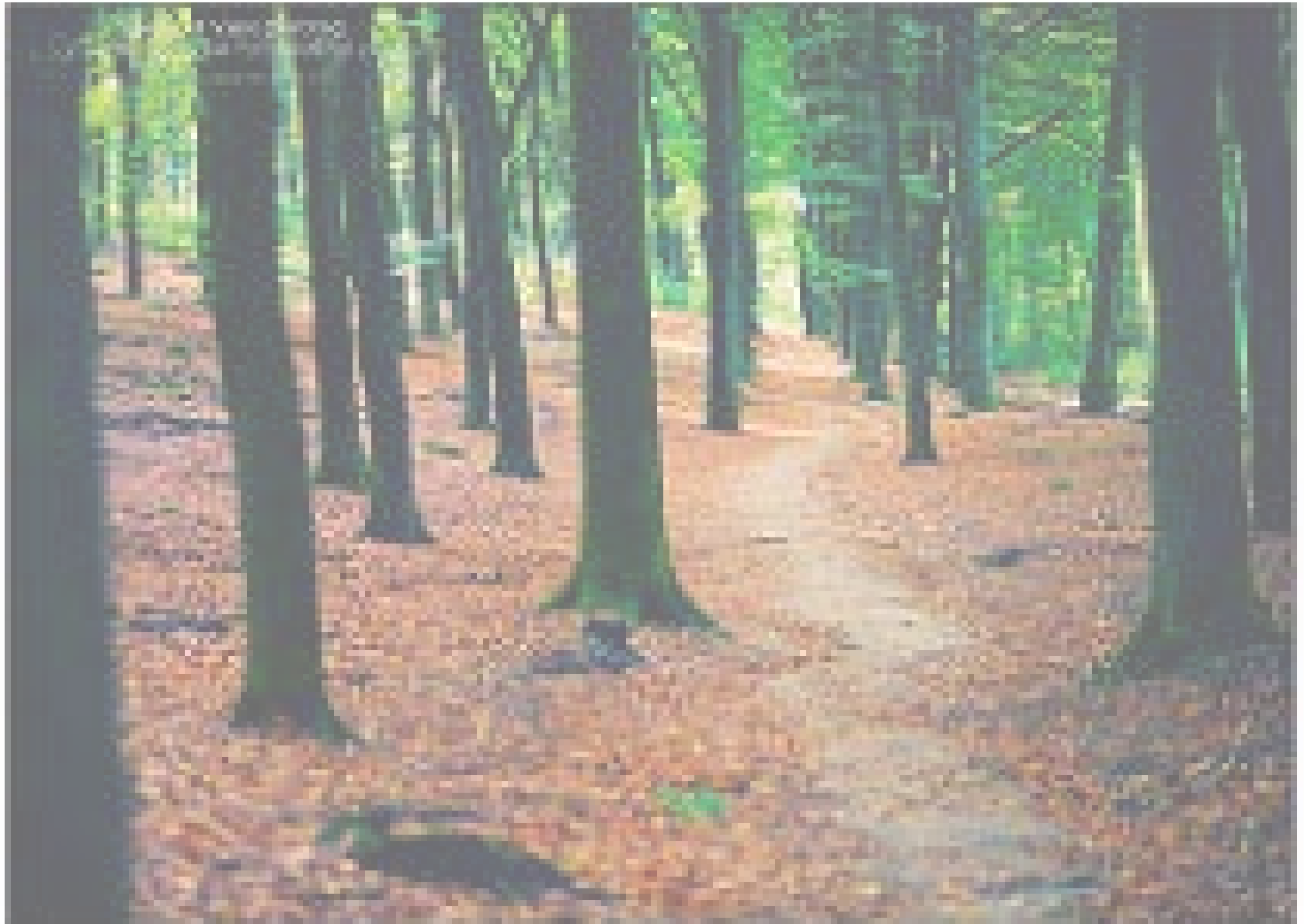
# THANK YOU!

SARAH LYNN

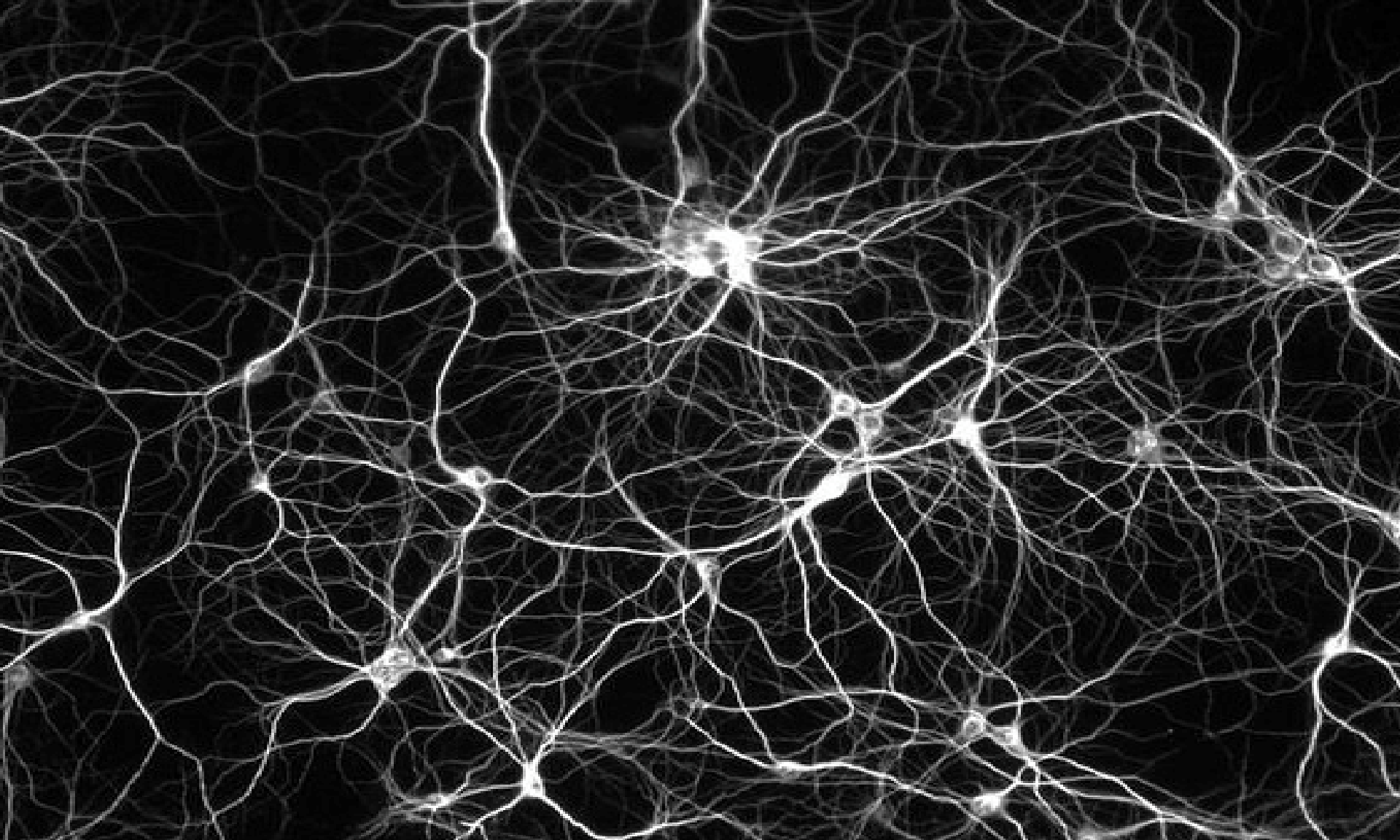
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10,000 connections through its dendrites.**

Image from Matt Lee on Flickr: <https://www.flickr.com/photos/razorsmile/526249719>





**Newborn**



**1 Month**



**9 Months**



**2 Years**



**Adult**

*"Neurons that  
fire  
together,  
wire  
together."*

Donald Hebb, 1949

STAND & TALK

**“Each time we rebuild the neural network, the skill or concept becomes more stable and automatic. The highest level of skill or understanding results from repeatedly experiencing this *building-rebuilding* cycle over time (years), moving through a sequence of increasingly complex levels. That movement is not linear and steady; it is dynamic and messy.”**

**“Brains and Schools: A Mismatch” by Alden Blodget**

# NEUROGENESIS

**When we have healthy brain habits,  
we can grow **700** new neurons  
a day!**

True or False?

**Only young people grow new brain cells.**

# RECAP:

True or False?

**The best way to memorize something is to practice it single-mindedly until you burn it into your memory.**

True or False?

**Varying the way you practice material  
confuses your memory.**

True or False?

**Rereading a passage is an excellent way to get information into long-term memory.**



True or False?

**We begin to forget new information days after we hear it.**

# TEACHING TO MASTERY?

## **Group 1: Massed Practice**

**Instruction on a topic and then practice the topic.**

Instruction on A. Then practice A.

Instruction on B. Then practice B. . . . .etc.

## **Group 2: Interleaved Practice**

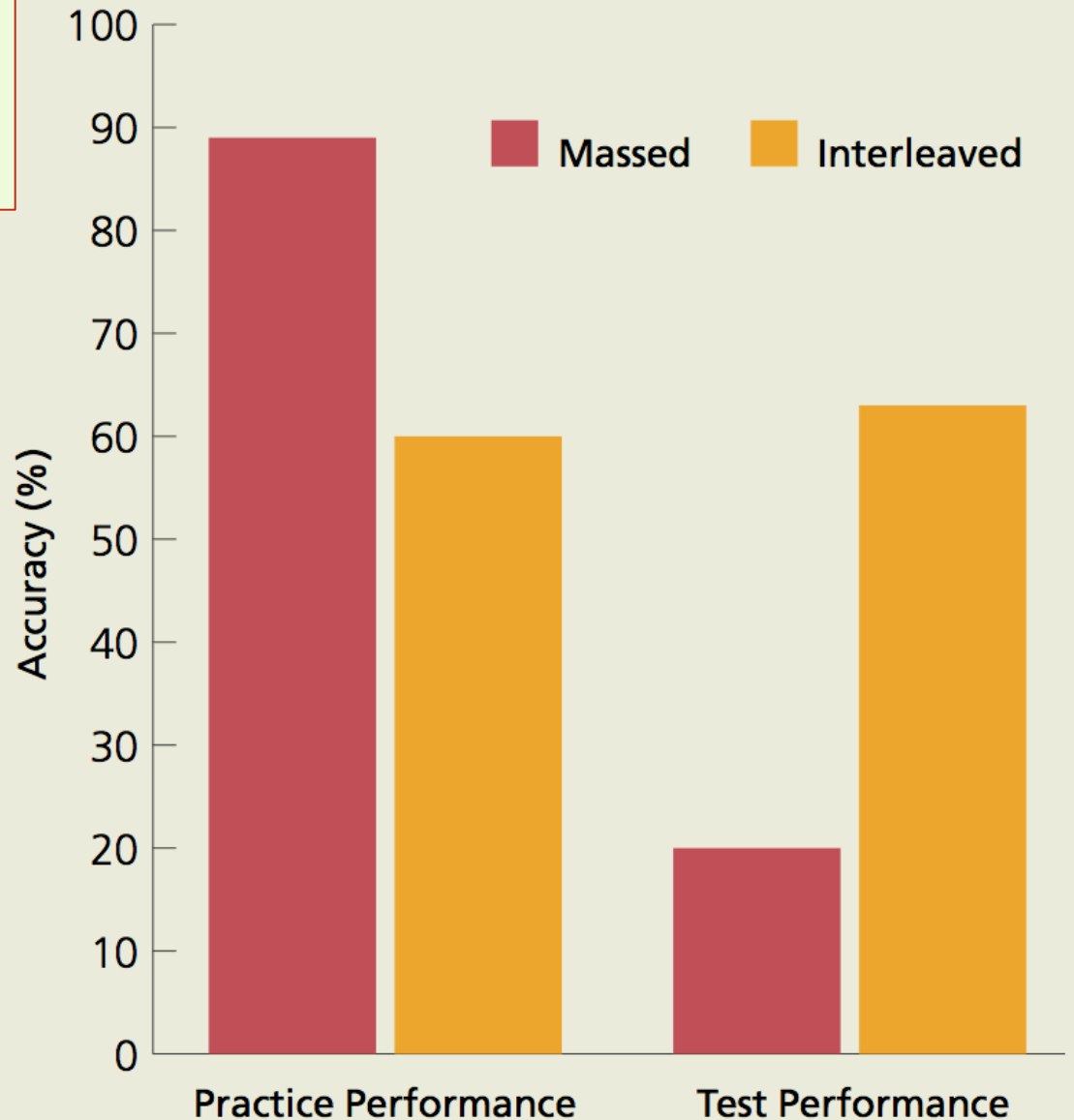
**Rotating instruction and practice.**

Instruction on A, B, C, D. Then practice A, C, D, B.

Dunloskey (2013)

## Strengthening the Student Toolbox: Study Strategies to Boost Learning

John Dunlosky, *American Educator*, 2013.



Accuracy at solving problems during practice session and on the delayed criterion test.