**Handout**
Simple Strategies Video Podcasts (VODCASTS)
Episode 1
November 3, 2021

Teaching and Learning in Harmony With our Brain

Google's Learning Myth:

If you can Google it there is no need to teach/asses it. We need to debunk this myth: foundational knowledge is essential. As cognitive psychologist Daniel Willingham argues, you can't think creatively about information unless you have information in your head to think about.
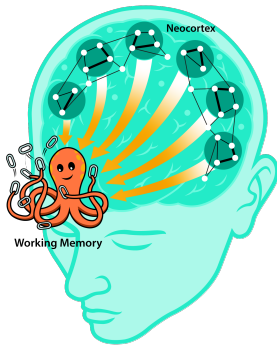
Memory and learning:

We have two types of memory: long-term and working memory. Long-term memory is where the neural connections are built. When neural links are consolidated, they can store ideas that we can access months, or even years, later.

Long-term memory is stored in the Neocortex[1]

Working memory is one of the brain's executive functions. It has limited capacity and can only hold information temporarily. On average, working memory can hold up to *four* pieces of information at a time. When working memory is trying to juggle too many pieces of information at once, we experience cognitive load.
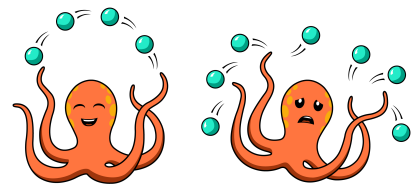
Working memory overload [1]

To retain information in our long-term memory, we need to strengthen existing neural connections. We strengthen our neural links every time we recall information stored in long-term memory. As described by Doyle and Zakrajsek (2019):

> *Establishing new connections is like blazing a trail through a thick forest, which is a great deal of work. But every time a trail is used it becomes more established and easier and faster to follow (p. 9)*
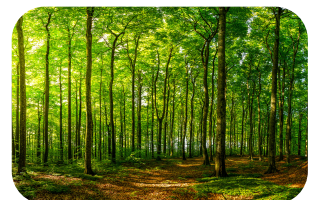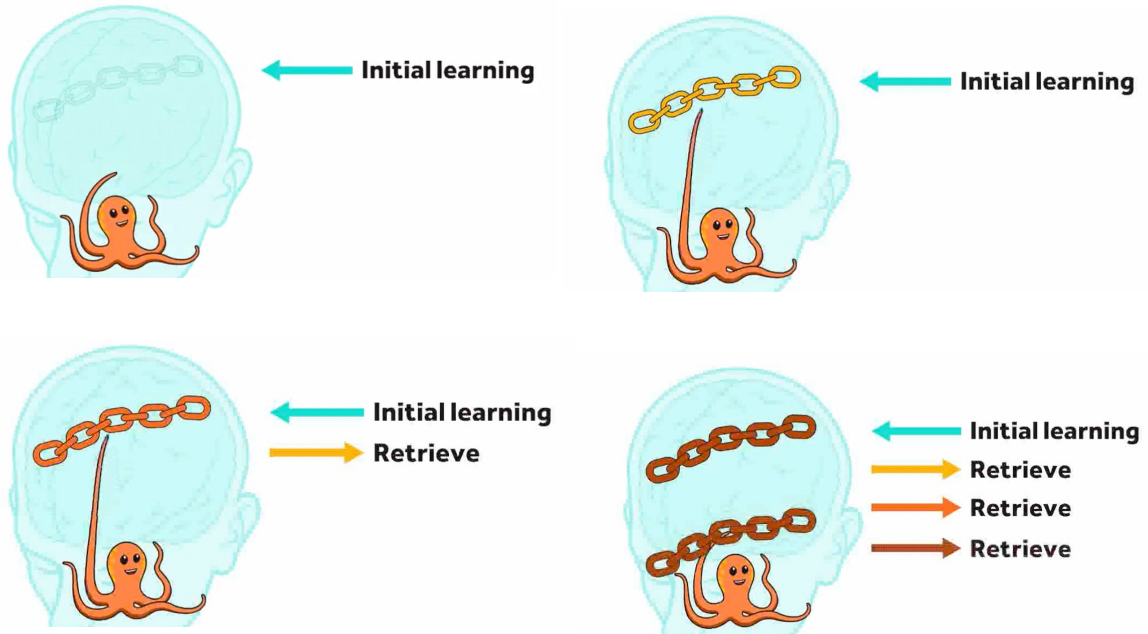
1. Oakley, B., Rogowsky, B., & Sejnowski, T. J. (2021). *Uncommon sense teaching: Practical insights in brain science to help students learn* [MOOC]. Coursera. https://www.coursera.org/learn/uncommon-sense-teaching/

Retrieval, Spacing and Interleaving Practices

How do we get students to remember information? In their excellent book Powerful Teaching- Unleash the Science of Learning[2], Agarwal and Bain (2019) describe retrieval, spacing, and interleaving as follows:

Retrieval practice boosts learning by pulling information out of students' minds, rather than cramming information into students' minds.

Spaced practice boosts learning by spreading lessons and retrieval opportunities out over time, so learning is not crammed all at once.

Strengthening neural links through spaced practices*

Interleaving boosts learning by mixing closely related topics and encouraging the discrimination between similarities and differences.

Strengthening neural links through interleaving practices1

1. Oakley, B., Rogowsky, B., & Sejnowski, T. J. (2021). *Uncommon sense teaching: Practical insights in brain science to help students learn* [MOOC]. Coursera. https://www.coursera.org/learn/uncommon-sense-teaching/
2. Agarwal, P. K., & Bain, P. M. (2019). *Powerful teaching: Unleash the science of learning*. John Wiley & Sons. p. 14.

Strategies and Activities to Enhance Retrieval, Spacing and Interleaving Practices
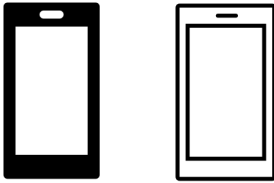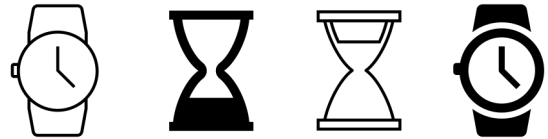
Strategy 1: Prediction

What it is:

Activities that force students to make a prediction or to provide an answer to a question they have not been taught.

Activities

Polling

Pre- and post-quizzes

How it works:

https://www.mcgill.ca/tls/instructors/strategies/misconceptions

Technologies:

https://deptkb.mcgill.ca/display/TLK/Create+Polls+with+Polling+@+McGill

Why it works:

By making predictions, students search for any information they might have that relates to the subject matter that can help them make an educated prediction. As explained by Roediger and coauthors in *Make it Stick: The Science of Successful Learning*, "Unsuccessful attempts to solve a problem encourage deep processing of the answer when it is later supplied, creating fertile ground for its encoding, in a way that simply reading the answer cannot" (McDaniel, Brown, & Roediger 2014, p. 88). Lang's (2016) analogy to this activity is that "the ground is fertile because the learner's brain has now activated several connections between the question and other possible contexts, and when the answer arrives, in the soil it takes hold more quickly and firmly because of the link between the answer and those other contexts" (p.51).
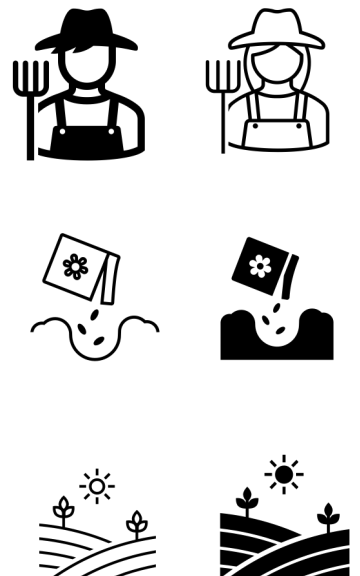
Strategy 2: Free recall, Synthesis and Reflection

What it is:

Short, easy to implement activities where students are asked to take class time (usually 5 minutes or less) to write down everything they remember of the lesson so far.

Activities

One-minute paper/free write

How it works:

https://www.mcgill.ca/tls/instructors/strategies/synthesis-and-reflection

Two Things

How it works

Take a moment during your lesson and ask students to write down **Two Things** about a specific prompt[2] :

- ❖ What are two things you learned so far today?
- ❖ What are two things you learned last week?
- ❖ What are your two takeaways from this unit?
- ❖ What are two examples from your own life that relate to today's lesson?

Technologies:

https://deptkb.mcgill.ca/display/TLK/Use+the+Discussions+Tool+for+Student+Journals+in+myCourses

Why it works:

By pausing your lecture time, students' working memory stops "inputting" information into their long-term memory and instead will work on retrieving the information that was just stored in their long-term memory. Remember: every time students go back and forth between working memory and long-term memory, the neural paths are strengthened, making recall of information easier over time.
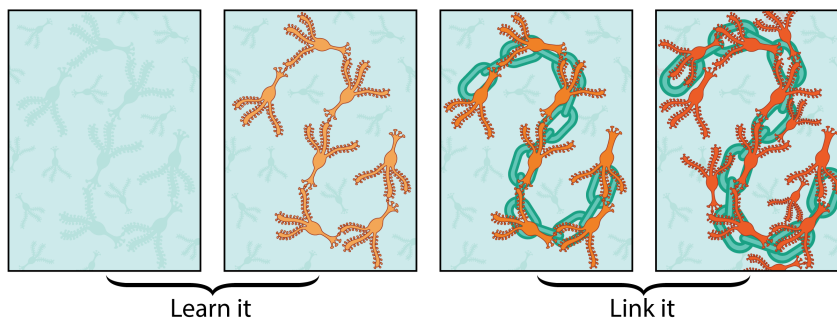
Learn it   Link it

Strengthening neural links through retrieval practices[1]

1. Oakley, B., Rogowsky, B., & Sejnowski, T. J. (2021). *Uncommon sense teaching: Practical insights in brain science to help students learn* [MOOC]. Coursera. https://www.coursera.org/learn/uncommon-sense-teaching/
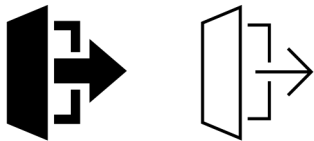2. Powerful Teaching, 2019. p. 62

Strategy 3: Closing questions

What it is:
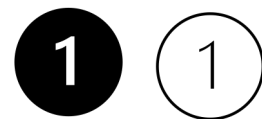Questions at the end of a class/module asking students to revisit information introduced, discussed and/or practiced during the session.

Activities

Exit cards

One-sentence summary

How it works
https://www.mcgill.ca/tls/instructors/strategies/synthesis-and-reflection

Technologies:
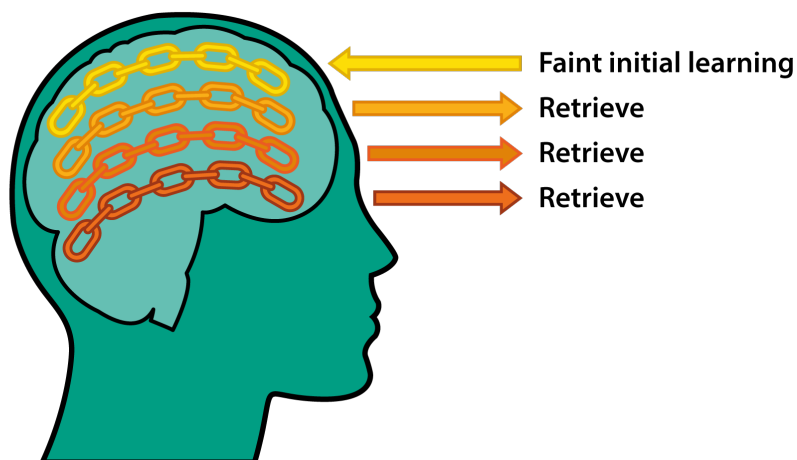https://deptkb.mcgill.ca/display/TLK/Create+Discussions+in+myCourses

Why it works:
The principals of closing questions are the same as those explained in strategy 2 (free recall, synthesis and reflection): neural links are strengthened when activated, and they are activated when information is recalled from long-term memory to working memory.

Faint initial learning

Retrieve

Retrieve

Retrieve

Strengthening neural links through retrieval practices[1]

1. Oakley, B., Rogowsky, B., & Sejnowski, T. J. (2021). *Uncommon sense teaching: Practical insights in brain science to help students learn* [MOOC]. Coursera. https://www.coursera.org/learn/uncommon-sense-teaching/

Resources

Books

Agarwal, P. K., & Bain, P. M. (2019). *Powerful teaching: Unleash the science of learning*. John Wiley & Sons.

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., & Norman, M. K. (2010). *How learning works: Seven research-based principles for smart teaching*. John Wiley & Sons.

Doyle, T., & Zakrajsek, T. D. (2018). *The new science of learning: How to learn in harmony with your brain*. Stylus Publishing, LLC.

Lang, J. M. (2021). *Small teaching: Everyday lessons from the science of learning*. John Wiley & Sons.

McDaniel, M. A., Brown, P. C., & Roediger III, H. L. (2014). Make It Stick The Science of Successful Learning. *Cambridge, MA Harvard Univ Pr*.

Oakley, B., Rogowsky, B., & Sejnowski, T. J. (2021). *Uncommon sense teaching: Practical insights in brain science to help students learn*. Penguin.

Willingham, D. T. (2009). Why students don't like school. *San Francisco, CA: Jossey*.

Online resources

Agarwal, P. (2021). *Unleash the Science of Learning.* Retrieval Practice. https://www.retrievalpractice.org

Oakley, B., Rogowsky, B., & Sejnowski, T. J. (2021). *Uncommon sense teaching: Practical insights in brain science to help students learn* [MOOC]. Coursera. https://www.coursera.org/learn/uncommon-sense-teaching/