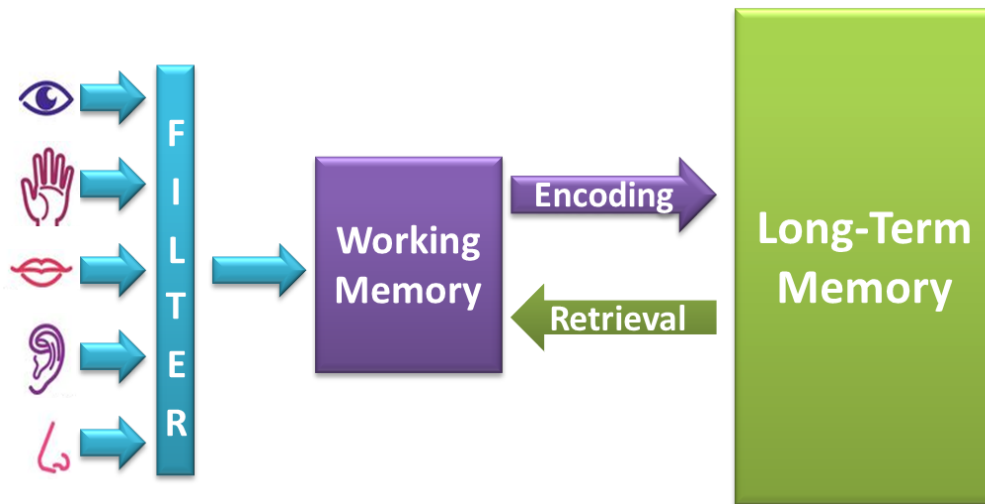


## ANSWERS from Learning Science



### **ATTENTION: Focused attention is necessary, but not sufficient, for long-term memory**

- Intentional learning requires focused attention and clear learning goals
  - Create and share clear learning outcomes
- Attention is limited and decreases over time
  - Take breaks, include activities to reset attention during class
- Multitasking is a myth; task switching yields errors
  - Consider policies to restrict cell phone and laptop use
- Primacy-recency effect
  - Use first and last minutes of class for most important concepts and summaries

### **NOVELTY: The brain seeks novel stimuli and has built-in curiosity**

- Novelty increases motivation and interest; motivation can increase time spent attending and processing
  - Mix up the order and type of activities; include engaging images or videos
- Mystery drives interest, promotes retention and the desire to learn the answer
  - Ask students to predict or guess before giving a demonstration
  - Ask questions before providing answers; use driving questions
  - Avoid giving PowerPoint notes in advance
- Practice should be varied
  - Use a variety of interactive teaching techniques and different types of practice

### **SPACING: Distributed practice (spacing) yields best long-term retention**

- Working memory is limited; long-term memory is unlimited
- Massed practice (cramming) doesn't work well for long-term memory
  - Encourage spaced practice by giving frequent (weekly) assessments
- Mixed practice (interleaving) has demonstrated benefits
  - Consider making assessments cumulative; encourage students to mix practice
  - Return to prior content, make explicit connections with current content
- Practice makes processes automatic, automaticity frees up working memory

- Spacing gaps should include sleep, which helps memory formation and learning
  - Tell students to review notes just before bed

**WHY: Meaning and context help retention**

- We understand new things in the context of what we already know
  - Provide concrete, relatable examples to help understand abstract concepts
  - Put knowledge into the larger context/big picture; why it matters
- Help students put knowledge into larger context, connect items, see relevance
  - Use mind maps/concept maps, flow charts
  - Encourage elaboration—expanding on ideas with additional details and explanation
  - Connect to current events or real-life examples to make it relevant
- We solve new problems better when we understand the underlying principles
  - Encourage students to identify or summarize underlying principles
- Chunking: creates pattern, increases functional capacity of working memory
- Rote memorization: mnemonics (acronyms, pegging, loci, visual link, songs)
- Metamemory (teaching students about memory) improves learning

**EMOTIONS:** Memory formation involves the limbic system, also associated with emotions

- “Affective filter” can impact perception of teacher AND subject matter
  - Share your enthusiasm for the subject matter
  - Get to know your students’ interests and career goals, try to include them
  - Present yourself as a real, approachable person by sharing appropriate, humanizing information
  - Tell relevant stories to make big ideas personal
  - Come to class 5 minutes early and stay 5 minutes late to chat
- Cortisol (stress) is bad for the hippocampus’s optimal functioning
  - Set realistic, clear expectations for assignments and exams to minimize anxiety
- The brain uses up to 25% of the body’s energy: nutrition, hydration, sleep matter
  - Set reasonable deadlines that recognize the need for appropriate sleep

**RETRIEVAL:** Retrieval practice and appropriate application strengthens long-term memory

- Retrieval practice or practice testing is highly effective
  - Make practice tests available
  - Encourage self-quizzing, flash cards
  - Reward additional practice with extra credit
- What you think about is what you remember—the practice must be appropriate to the eventual assessment
  - Use orienting tasks such as prediction, reflection, questions/prompts to guide study
  - Ask students “what are you thinking about when you study?”
- Learning is effortful; there are no shortcuts
  - Tell students that how they study is important; not just how much
  - Rereading, highlighting are common, ineffective practices

## References and Additional Resources

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### Websites

How to Get the Most Out of Studying (a five part video series)

<https://www.youtube.com/watch?v=RH95h36NChI&list=PL85708E6EA236E3DB>

Interactive Techniques (list of over 200 activities compiled by ATLE)

<http://www.usf.edu/atle/teaching/interactive-techniques.aspx>

The Learning Scientists: Six Strategies for Effective Learning (slides and handouts)

<http://www.learningscientists.org/downloadable-materials/>

Student Study Skills: <https://bit.ly/Yee-Study-Skills>