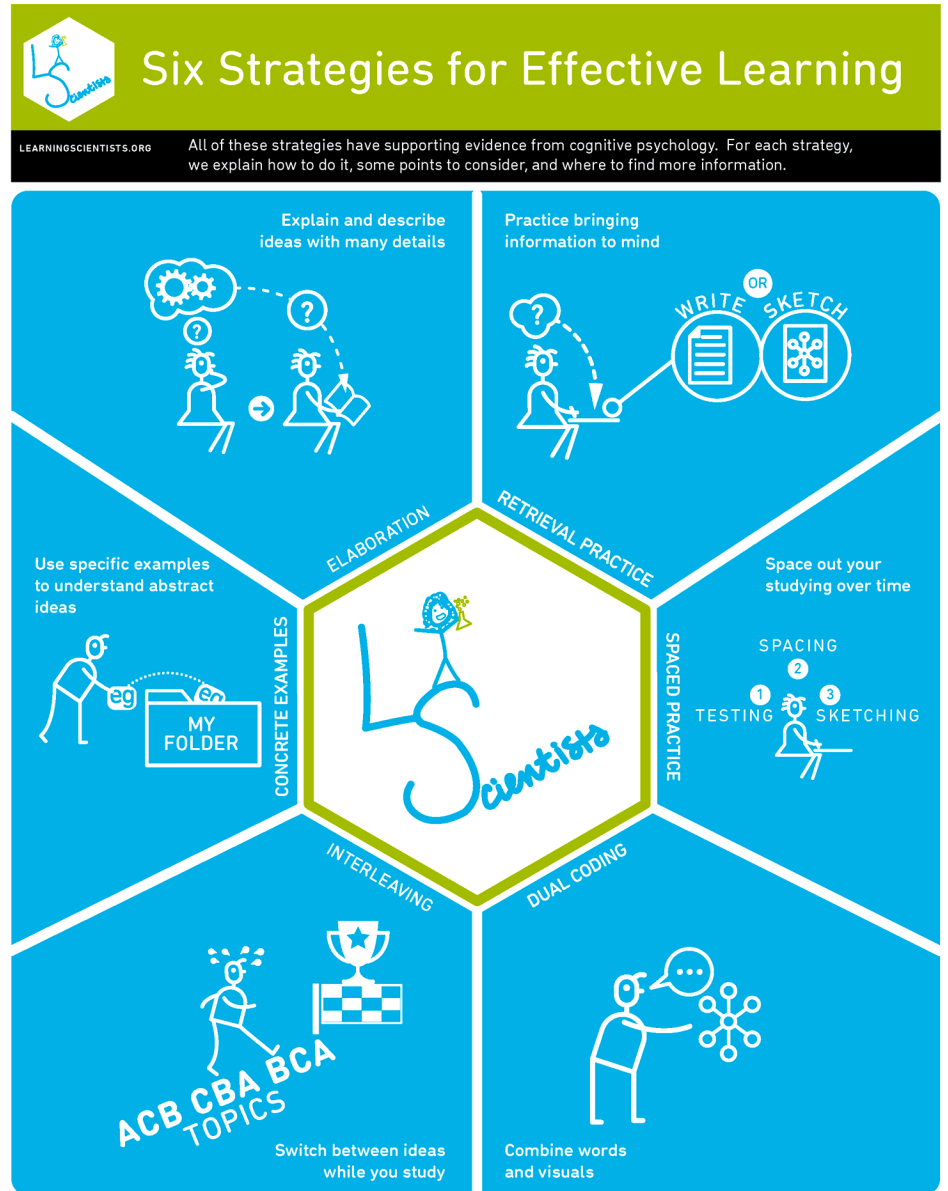


# Six Learning Strategies for Students

From the Science of Learning

- Elaboration
- Retrieval Practice
- Spaced Practice
- Interleaving
- Concrete Examples
- Dual Coding



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Based on a work at <http://www.learningscientists.org>

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Funding provided by the APS Fund for Teaching and Public Understanding of Psychological Science

# 1. Elaboration

Explain and describe ideas with many details



LEARN TO STUDY USING...  
**Elaboration**  
EXPLAIN AND DESCRIBE IDEAS WITH MANY DETAILS

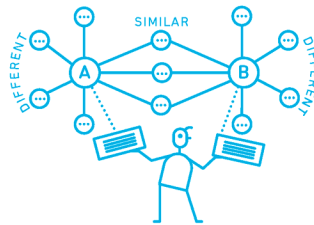
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## HOW TO DO IT

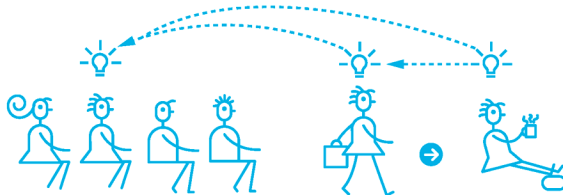
Ask yourself questions while you are studying about how things work and why, and then find the answers in your class materials and discuss them with your classmates.



As you elaborate, make connections between different ideas to explain how they work together. Take two ideas and think of ways they are similar and different.



Describe how the ideas you are studying apply to your own experiences or memories. As you go through your day, make connections to the ideas you are learning in class.



## HOLD ON!



Make sure the way you are explaining and describing an idea is accurate. Don't overextend the elaborations, and always check your class materials or ask your teacher.



Work your way up so that you can describe and explain without looking at your class materials.

## RESEARCH


Read more about  
[elaboration](#)  
as a study strategy

McDaniel, M. A., & Donnelly, C. M. (1996). Learning with analogy and elaborative interrogation. *Journal of Educational Psychology*, 88, 508-519.

Wong, B. Y. L. (1985). Self-questioning instructional research: A review. *Review of Educational Research*, 55, 227-268.

# 6. Dual Coding

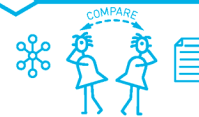
Combine words and visuals



LEARN TO STUDY USING...  
**Dual Coding**  
COMBINE WORDS AND VISUALS

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## HOW TO DO IT



Look at your class materials and find visuals. Look over the visuals and compare to the words.



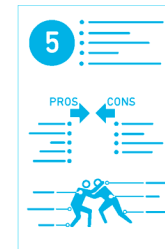
Look at visuals, and explain in your own words what they mean.



Take information that you are trying to learn, and draw visuals to go along with it.

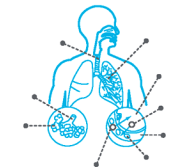
## HOLD ON!

### INFOGRAPHIC



Try to come up with different ways to represent the information visually, for example an infographic, a timeline, a cartoon strip, or a diagram of parts that work together.

### CARTOON STRIP



DIAGRAM

### TIMELINE

EVENT 1	EVENT 2	EVENT 3	EVENT 4	EVENT 5
2012	2013	2014	2015	2016



GRAPHIC ORGANIZER

Work your way up to drawing what you know from memory.



## RESEARCH

Read more about  
[dual coding](#)  
as a study strategy

Mayer, R. E., & Anderson, R. B. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. *Journal of Educational Psychology*, 4, 444-452.

# 3. Concrete Examples

Use specific examples to understand abstract ideas



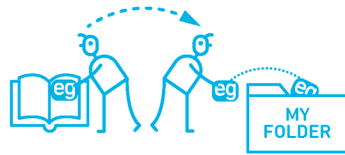
## LEARN TO STUDY USING... Concrete Examples

USE SPECIFIC EXAMPLES TO UNDERSTAND ABSTRACT IDEAS

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### HOW TO DO IT

Collect examples your teacher has used, and look in your class materials for as many examples as you can find.



Make the link between the idea you are studying and each example, so that you understand how the example applies to the idea.



Share examples with friends, and explain them to each other for added benefits.



### HOLD ON!



You may find examples on the internet that are not used appropriately. Make sure your examples are correct - check with your teacher.



Ultimately, creating your own relevant examples will be the most helpful for learning.

### RESEARCH

Read more about  
concrete examples  
as a study strategy

Rawson, K. A., Thomas, R. C., & Jacoby, L. L. (2014). The power of examples: Illustrative examples enhance conceptual learning of declarative concepts. *Educational Psychology Review*, 27, 483-504.

# 4. Spaced Practice

Space your studying over time



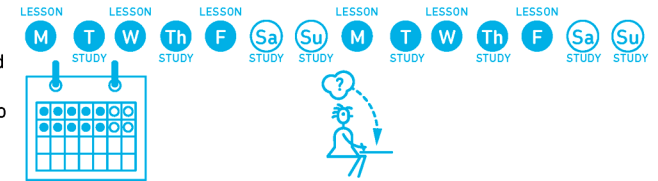
## LEARN TO STUDY USING... Spaced Practice

SPACE OUT YOUR STUDYING OVER TIME

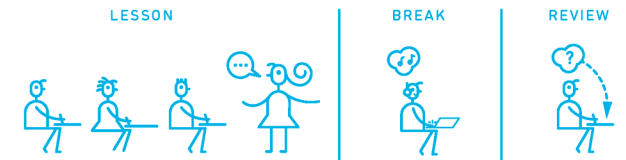
LEARNINGSIENTISTS.ORG

### HOW TO DO IT

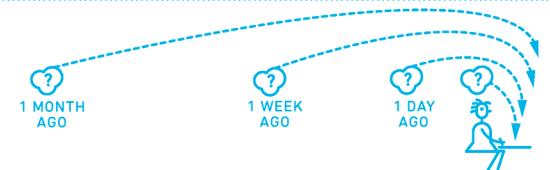
Start planning early for exams, and set aside a little bit of time every day. Five hours spread out over two weeks is better than the same five hours all at once.



Review information from each class, but not immediately after class.



After you review information from the most recent class, make sure to go back and study important older information.



### HOLD ON!

TESTING 1  
SPACING 2  
SKETCHING 3



When you sit down to study, make sure you are using effective study strategies rather than just re-reading your class notes.

This may seem difficult and you may forget some information from day to day, but this is actually a good thing! This forces you to retrieve information from memory (see Retrieval Practice poster).



Create small spaces (a few days) and do a little bit over time, so that it adds up!

### RESEARCH

Read more about  
spaced practice  
as a study strategy

Benjamin, A. S., & Tullis, J. (2010). What makes distributed practice effective? *Cognitive Psychology*, 61, 228-247.

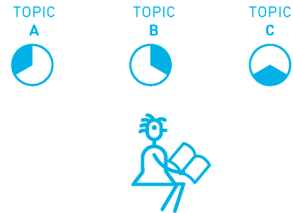
# 5. Interleaving

## Switch between ideas while you study

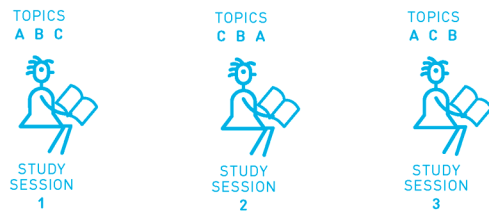


### HOW TO DO IT

Switch between ideas during a study session. Don't study one idea for too long.



Go back over the ideas again in different orders to strengthen your understanding.



Make links between different ideas as you switch between them.



### HOLD ON!



While it's good to switch between ideas, don't switch too often, or spend too little time on any one idea; you need to make sure you understand them.



Interleaving will feel harder than studying the same thing for a long time. But don't worry - this is actually helpful to your learning!

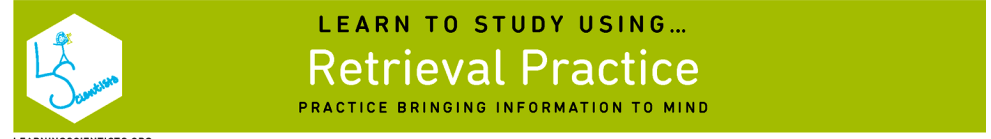
### RESEARCH

Read more about interleaving as a study strategy

Rohrer, D. (2012). Interleaving helps students distinguish among similar concepts. *Educational Psychology Review*, 24, 355-367.

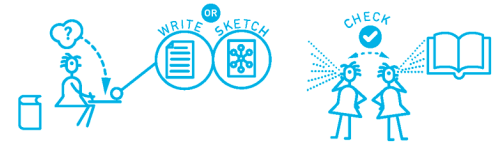
# 2. Retrieval Practice

## Practice bringing information to mind



### HOW TO DO IT

Put away your class materials, and write or sketch everything you know. Be as thorough as possible. Then, check your class materials for accuracy and important points you missed.



Take as many practice tests as you can get your hands on. If you don't have ready-made tests, try making your own and trading with a friend who has done the same.



You can also make flashcards. Just make sure you practice recalling the information on them, and go beyond definitions by thinking of links between ideas.



### HOLD ON!



Retrieval practice works best when you go back to check your class materials for accuracy afterward.



Retrieval is hard! If you're struggling, identify the things you've missed from your class materials, and work your way up to recalling it on your own with the class materials closed.



Don't only recall words and definitions. Make sure to recall main ideas, how things are related or different from one another, and new examples.

### RESEARCH

Read more about retrieval practice as a study strategy

Roediger, H. L., Putnam, A. L., & Smith, M. A. (2011). Ten benefits of testing and their applications to educational practice. In J. Mestre & B. Ross (Eds.), *Psychology of learning and motivation: Cognition in education*, [pp. 1-36]. Oxford: Elsevier.