

Handout: How to study/How to Learn

Studying/Learning strategies

1. Study as if you will have to teach the material. Constantly ask yourself “why?” and “what if?” questions.
2. **Reading strategy.** Skim a chapter before reading it. Look at section headings, charts, graphs, review questions, summary. Determine what is important. Create questions while reading that you should be able to answer afterwards.
3. **Use recall.** Read a page, look away, and recall main ideas. Retrieval practice is far more effective than simply rereading. Try to explain a concept in your own words. Rereading is not effective- it gives you the illusion you understand. Highlighting your text is not effective.
4. **Test yourself.** Be able to solve a problem without looking at the solution. Glancing at a solution is not effective. Any activities that involve testing yourself- that is, activities that require you to retrieve or generate information- will make your learning both more durable and flexible. Simulate exams.
5. **Space your repetition** by studying the subject some each day. Cramming is not effective. Test yourself more often on things you are not good at.
6. **Interleave different types of problems;** i.e., switch between different types of problems.
7. Try the **Pomodoro technique:** use a timer (or the Forest App) and work for 25 minutes un-interrupted .
8. **Take breaks.** Do not study more than 60 minutes without a break. When stuck on a problem, stop, do something else. When you come back to it later, it will be easier to solve.
9. One's brain uses both focused and diffuse modes for learning. Activate the diffuse mode by exercise or sleep. Learning usually requires times when you're not consciously working on the problem
10. Early in the day is the best time to study. Do the hardest thing early in the day.
11. Find multiple isolated places (i.e., places without distractions) to study. Do not study in the same location every time.
12. **Get enough sleep and exercise regularly.** Regular exercise can improve both memory and learning ability.
13. **Work with others,** but make sure a study session is focused on studying.
14. Take advantage of office hours.
15. Turn off email, cell phones, Facebook, etc.. Don't try to multitask-it does not work.

Bloom's taxonomy (You want to be at the higher levels -analyzing, evaluating, creating)

creating: come up with your own ideas about solving different types of problems or designing different processes

evaluating-you can look at two processes posed by others and determine which is likely to be correct, efficient, or desirable

analyzing-you can take concept and break it down into its component concepts

applying-you can use the information to solve problems you've never seen before

understanding-you can paraphrase the material and explain it to your eight-year-old nephew by creating analogies and examples.

remembering- you memorized definitions or equations, but you cannot put that information into your own words

Strategies for Taking Exams

Read through the entire exam first.

Set time limits for each question.

Try a hard problem first, if stuck after a few minutes, do an easy problem. Repeat.

Check your work.

Units of measure are your friends; match units on both sides of the equation

Time management

Record all deadlines in a calendar.

Use a weekly to-do list -plan your week at beginning of week.

Make up a daily to-do list the night before; schedule specific time periods for each item.

Add new to-do items or deadlines to right side of daily to-do list. Transfer these to calendar or to-do list in evening.

Strategies for success

Sit in the front of the class.

Be an active participant.

Multitasking does not work.

Software

Microsoft OneNote (use shared notebooks instead of email)

Dropbox

Dragon Naturally Speaking dictation software

Memorization

Anke is free software that uses online flash cards and spaced repetition (www.ankisrs.net)

Learning is creating relationship between known and unknown.

Exaggerate-bigger, smaller, with humor

Energize action, visit, colorful, illogical

Bring info to life with imagination

Create links

More details on studying strategies

Three keystone strategies:

1. *Practice retrieving new learning from memory* (self-quizzing). When reading, pause periodically to ask yourself questions without looking in the text: What are the key ideas?
What terms or ideas are new?
How do I define them?
How do I relate the ideas to what I already know?
Set aside time each week throughout the semester to quiz yourself on the material in a course of the current week's work and material covered in prior weeks. The harder it is for you to recall new learning from memory, the greater the benefit of doing so. Self-quizzing is far more effective learning than additional rereading. Rereading creates illusions of knowing, but these are not reliable indicators of mastery of the material.
Practice testing had the most evidence supporting its benefits for learning across context and over time. It shows significant advantages over re-study
Practice testing: enhance retention by triggering elaborative retrieval processes.
Repeated practice testing works best when spaced.
In contrast, highlighting and rereading were found to have low utility in benefitting learning outcomes.
2. *Space out your retrieval practice (distributed practice)*- studying information more than once, but leave time between sessions. New material in a text may need to be revisited within a day after first reading. Then perhaps again in several days or week. Space retrieval practice by interleaving the study of two or more topics. It's a mistake to believe that you can burn something into memory by sheer repetition. Distributed practice testing is better than distributed study. Spacing with longer lags better than spacing with shorter lags.
3. *Interleave* the study of different problem types- study more than one type of problem at a time so that you alternate between different problem. This also improves your ability to discriminate between types of problems.

Other Effective Study Strategies

Elaboration is a process of finding additional layers of meaning in new material. Generate an explanation for why an explicitly stated fact or concept is correct. For example, relating material to something you already know, explaining to someone else in your words, or explaining how it relates to life outside of class. This can be discovering a metaphor or visual image for the new material. Elaborations should be self-generated rather than provided.

Generation is an attempt to answer questions or solve a problem before being shown the answer or solution. For example, before reading the new class material, try to explain the key ideas you expect to find in new material and how you expect they relate to your prior knowledge. Then read to see if you're correct.

Reflection is a combination of retrieval practice and elaboration. This means taking a few minutes to review what has been learned in a recent class and asking yourself questions. What went well? What could have gone better? What other knowledge or experience as it remind you of? What might you need to learn for better mastery, or what strategies might use the next time to get better results?

Calibration the act of aligning your judgments of what you know and don't know with objective feedback so as to avoid the illusions of mastery. Quizzes and practice tests can be used, but this means writing out the answer to each question. Treat practice test as actual test, and check your answers.

Important Ideas (from *Make it Stick* by Brown, Roediger, McDaniel)

- Some kinds of difficulties during learning help to make the learning stronger and better remembered.
- When learning is easy, it is often superficial and soon forgotten.
- Not all of our intellectual abilities are hardwired. When learning is effortful, it changes the brain, making new connections increasing intellectual ability.
- You learn better when you wrestle with new problems before being shown the solution, rather than the other way around.
- To achieve excellence in any sphere, you must strive to surpass your current level of ability.
- Striving by its nature, often results in setbacks, and setbacks often provide essential information needed to adjust strategies to achieve mastery.

References

These four books provide valuable insights into better ways to study and learn.

College Smart: How to Succeed in College Using the Science of Learning, by Nicholas C. Soderstrom with Sam McMillian, Lasting Learning Press, 2016. I highly recommend this book. It is short but explains clearly the approaches to use to study/learn better.

A Mind for Numbers: How to Excel at Math and Science by Barbara Oakley, Penguin, New

York, New York, 2014. I highly recommend reading this book. A Coursea course based on this book is: <https://www.coursera.org/learn/learning-how-to-learn/>

How We Learn: The Surprising Truth about When and Where and Why it Happens, by Benfict Carey, Random House (2015).

Make it stick: the science of successful learning, by Peter C. Brown, Henry L. Reodiger III, and Mark A. McDaniel, Belknap Press (2014).

Screencasts on learning strategies on LearnChemE.com

How to study using screencasts (<https://www.youtube.com/watch?v=ZMBjHm9gkwk>)

How to study 1 (<https://www.youtube.com/watch?v=MMHih0RSt3s>)

How to study 2 (<https://www.youtube.com/watch?v=Uebdd3ewMxg>)

How to study 3 (<https://www.youtube.com/watch?v=8LTPt2izYxo>)

How to Study 3 animated (<https://youtu.be/lyzdjxnKfiM>)

How to Study: Top 6 Effective Strategies; <https://www.youtube.com/watch?v=CPxSzxyIRCI>

Resources on time management, text anxiety, textbook reading, organization, how to study engineering, test-taking tips, etc.

www.HowToStudy.org

Oregon State University Learning Corner <http://success.oregonstate.edu/learning>: videos on test-taking, procrastation, reducing anxiety, studying, note-taking, etc.

Learning to Learn series at University of Arizona

<http://academicaffairs.arizona.edu/learning2learn>

Excellent book that describes techniques to improve memory

Unlimited memory: How to use advanced learning strategies to learn faster, remember more and be more productive, by Kevin Horsley, TCK Publishing (2016).

Using time effectively is critical for success in college.

Getting Things Done: The Art of Stress-Free Productivity by David Allen. Penguin Press (2003). *This is the best book I have seen on time management; I have read it at least three times.*

Deep Work: Rules for Focused Success in a Distracted World, by Cal Newport, Hachette Book Group, New York (2016). Very good book on using your time effectively.

This excellent book presents techniques used by successful students

How to Become a Straight-A Student: The Unconventional Strategies Real College Students Use to Score High While Studying Less, by Cal Newport, Broadway Books, New York (2007) \$11.

This book present methods to learn language based on the literature and the experience of

someone who speaks seven languages.

Fluent Forever: How to Learn Any Language Fast and Never Forget It, by Gabriel Wyner, Harmony Books, New York (2014).

An App to help concentrate <https://www.forestapp.cc/en/>

Additional references

A. Dunlosky, K.A. Rawson, K.J. Marsh, M.J. Nathan, D.T. Willingham, Improving Students' Learning With Effective Learning Techniques: Promising Directions From Cognitive and Educational Psychology, *Psychological Science in the Public Interest* 14, 4-58 (2013)

10 Steps to Earning Awesome Grades (While Studying Less) by Thomas Frank (2015), This book is good and the kindle version is only \$0.99.

Teach Students How to Learn: Strategies You Can Incorporate Any Course to Improve Student Metacognition, Study Skills, and Motivation, by S.Y. McGuire and S. McGuire (2015), Stylus Publishing, Virginia

The ABCs of How We Learn: 26 Scientifically Proven Approaches, How They Work, and When to Use Them, Daniel L. Schwartz, Jessica M. Tsang, Kristen P. Blair, W.W. Norton, New York (2016).

Brain Rules: 12 Principles for Surviving and Thriving at Work, Home, and School, John Medina, Pear Press, Seattle, WA (2008)

Online resources

Growth mindset lesson plan: <https://www.khanacademy.org/educator/reference-for-coaches/how-to/a/growth-mindset-lesson-plan> . Students with a growth mindset have higher levels of success than those with a fixed mindset

Bjork Learning and Forgetting Lab <http://bjorklab.psych.ucla.edu/research.html>

Forget What You Know About Good Study Habits, New York Times, http://www.nytimes.com/2010/09/07/health/views/07mind.html?_r=2&ref=health

Applying Cognitive Psychology to Enhance Educational Practice: <http://bjorklab.psych.ucla.edu/research.html>

Why Multi-Tasking is Worse than Marijuana For Your IQ
<http://www.forbes.com/sites/vanessaloder/2014/06/11/why-multi-tasking-is-worse-than-marijuana-for-your-iq/#2cbf2c484e51>