

A Quick Study Guide

By Torsten Bernhardt, Department of Biology, McGill University, 2015

The purpose of this guide is to give you a basic grounding in how to study more effectively. This list of techniques includes their strengths and weaknesses as found through research and hopefully includes some that you may not already know. Note that some of them are not very good techniques but are included because they're popular: it's useful to compare several techniques to best choose the ones that work for you.

This is admittedly a fairly quick overview. The names of the techniques are the standard terms used

for them in pedagogy so you should be able to find more detailed information online pretty easily. There are videos, web sites, and downloadable documents (like this one!) with tonnes of ideas out there if you search.

There are three sections to this guide: first some general tips, then a comparison of common study techniques, and finally some memorization techniques. As already mentioned, it's a somewhat superficial guide but there's much more information out there if you look.

General tips

Be a good student

One of the best ways to be a good student is simply to do the work that being a good student requires. Read the textbook before class. Go to class. Don't fall behind in the material. Start working on assignments right away. Spend time working on the material outside of class: that "two hours of studying for every hour of class" that you hear about is actually a good goal. Lectures are only part of learning and most of what you learn will happen outside of the classroom. Being a university student *should* be taking up a good chunk of your time; it's basically your full-time job as an undergraduate, not a minor activity to squeeze in around socializing.

Treat your body well

The importance of sleep can't be overstated. Getting enough sleep has long been known to be key to learning, so make sure you get enough. If you go to bed the world will still be there in the morning. You should also look online for the topic of "sleep hygiene", which aims to improve the quality of your sleep no matter how much of it you actually get.

Eating and keeping physically active are also vital. Good diet and exercise, like sleep, are also important foundations for learning and for living a better life. Finding healthy recipes online isn't difficult, and making meals with other people makes it easier and more fun. Being physically active doesn't necessarily mean training for triathlons. Just walking more and taking the stairs instead of the elevator can make a difference.

Manage your time efficiently

Most people don't manage their time all that well. Look up "time management" on the web for tips on how to do better with the time you've got so you don't

always feel rushed. You have more time in the day than you think, if you use it wisely.

Front load your studying

As with so many things in life it's better to do smaller amounts of work early on than lots of work at the last minute. Pretty much all of these tips and techniques work much better if you're following them throughout the semester and not waiting until the last minute to try them. If you find that you're only reading this as an exam is closing in remember the saying that "The best time to plant a tree was twenty years ago. The next best time is now."

Use all of your resources

It's easy to feel all alone in the class but there are lots of supports that you can call on. The textbook, other students in the class (in person or through the MyCourses discussion boards), tutorials, and office hours (both for instructors and TAs) are resources that relate directly to the course.

There are also many more general resources that you can call on. Look at the general resource page for students (mcgill.ca/students/directory), specifically under "Academic support"; look at this site (www.mcgill.ca/firstyear/undergrad-students), especially (but not only) if you're in your first year at McGill; the Counselling Service has several workshops geared towards making you university experience happier and more productive (www.mcgill.ca/counselling/workshops); look into your departmental student union (like the MBSU for Biology: mbsu.sus.mcgill.ca/); the Advanced Learning Techniques workshop from T-Pulse (www.mcgill.ca/tpulse/l21), and so on.

Wrestle with the ideas

Research shows that it's easier to learn things that one finds interesting. If you only see the topics and concepts in your classes as things to be reluctantly memorized for the exam you're going to have a bad time. You'll have to work harder at studying, not get a good grip on the material, and not enjoy your time as a student as much. So think about the things you're studying while you're outside of class and engage with the ideas; they're actually interesting if you dive in and think about them. Talk about them with other students. Go beyond what the class covers and ask "what if?" questions.

Use metacognition

Metacognition means "knowing about knowing" and is helpful to know what is working for your studying and what isn't. It means planning out what your goals are and working towards them, occasionally evaluating where you are relative to them, and changing what's not working. This is a very important general life skill that can't be adequately covered here. Look the word up online for lots of ideas. One of the great things about the good study techniques in this guide is that they already have a good dose of metacognition built into them.

Use the textbook

Textbooks are expensive and too many times they go unread on the bookshelf. Read the appropriate section in the textbook *before* coming to class to get perspective on the topic covered by the instructor and to have the subject explained to you in a different way. Read actively, stopping to think about what you've just read and looking up words and terms you don't know. Use the textbook as a reference while studying when you're unclear about something in your notes. Look at the "elaborative interrogation" and "rereading" techniques below for more information about using textbooks efficiently.

Don't multitask

It's tempting to text your friends while in class. And tweet. And see what's up on Facebook. And watch a couple of funny cat videos. And check on Instagram. And, hopefully, get some notes written down too. Research has shown that multitasking doesn't really exist; it's just switching between tasks and doing them all inefficiently. What's worse, the people who think they're good at multitasking are generally the worst at it. Try to focus on the lecture since you're in the classroom anyway. The same goes for studying

outside of class; watching videos while you study means that you're not studying well.

Write your notes by hand

Writing notes by hand instead of typing on a laptop has been found to help you remember more and understand things at a deeper level, likely due to the slower speed of handwriting. Since you can't write everything down by hand verbatim like you can with a keyboard you have to do some processing of the material right away, which helps you learn better. Taking notes is an art of its own. A good summary page on notetaking can be found at <http://www.csun.edu/~hcpas003/effective.html> and you may want to check out the [Cornell Method](#) as well.

Review your notes right after class

Looking over your notes right after class is a good idea. It lets you fix any mistakes in your notes while the material is still fresh in your mind and also reinforces the information, moving it to long-term memory. This doesn't have to take too long; fifteen minutes is more than enough.

Rewrite your notes

Rewrite your notes, preferably the same day as the class. Compress and expand them as needed, but don't just recopy the first set of notes. What you want to do is make a cleaner, more organized set of notes than the ones you were scrambling to write in class. Rewriting notes, like reviewing them right after class, helps move the information from short-term to long-term memory.

Recognizing vs recalling

One trap that's easy to fall into when studying is confusing recognizing with recalling. Recognizing is like seeing someone at a party and vaguely remembering that you've seen them... somewhere. Recalling, on the other hand, is like seeing someone at a party and remembering their name and where you know them from. Just because the words you're looking at as you study seem familiar (*i.e.* you recognize them) doesn't mean that you actually know the material (*i.e.* you recall it). Put away your notes and test yourself to see if you actually know it. As with metacognition (see above) the better study techniques focus on making you recall the information instead of just recognizing it.

Study techniques

The best technique to use depends on what you're studying; different techniques are better or worse for the sorts of information that you need to remember in different fields. The list below has three categories, from most effective to least, ranked according to research. The techniques within every category are listed alphabetically. You should read through all of them to see their particular quirks and also take a look at the final summary at the very end of the list.

A recurring theme in the better techniques is learning actively instead of expecting information to passively diffuse into you without any work on your part. Don't think you know something just because the term seems familiar when you come across it: if you can't recall it or information about it you don't actually know it very well (see "recognizing vs recalling", above).

One thing to keep in mind is that just because a technique rates poorly below doesn't mean that you won't learn *anything* from it, it just means that there are other techniques that are a better use of your time. If you're convinced that your favourite technique should be ranked higher give another technique a try and compare how it works; research has shown that people are often mistaken in their beliefs of what works best for them when studying.

When you think you've learned something you should obviously move your study focus to other topics that you don't know as well but remember to go back every once in a while and look at the things that have successfully learned so that you don't end up forgetting them again.

In the descriptions below "free recall" means questions that don't give you any hints towards the answer. Examples are short-answer questions, problem-solving questions, and so on. "Recognition" questions, on the other hand, give you hints, such as multiple-choice or fill-in-the-blank questions.

The best three: distributed practice, group studying, and practice testing

Distributed practice

Studying in shorter blocks spaced out over a longer time helps you to learn better than if you studied in a smaller number of long blocks (this is called the spacing effect). One neat thing about this technique is that it's really a metatechnique that layers on top of other techniques: no matter how you actually study, taking breaks between shorter study sessions is good. Combining this with the other generally best techniques is particularly powerful.

Another neat thing about this technique is that since gaps between shorter study sessions are better, you can be more efficient by spending less time overall studying! This is a really concrete example of "studying smarter, not harder".

One popular timing for distributed practice is the Pomodoro Technique: study for 25 minutes, followed by a five-minute break. Repeat this for four iterations (two hours total), then take a break that's 15-30 minutes long. Then start from the beginning.

Cramming – everyone's favourite desperation technique – is the exact opposite of this. Cramming (studying for one long stretch right before the test without a break or with only very short breaks) is definitely better than nothing, but you'll forget the information soon. It's also bad at doing much of anything beyond straight memorization; questions that require you to make connections between things won't be easy at all. So go ahead and cram the night before the exam if you haven't studied yet, but remember that you really will soon forget what you've crammed and have to relearn it again (and again, and again...).

Group studying

Over thirty years of research has shown that collaboration helps you to learn better, so think about setting up a study group. There are many reasons to spend some of your study time with other people. To some extent they're like gym buddies: knowing that other people expect you to show up and prepare beforehand is a great incentive to do just that. You'll come across new perspectives on the material and learn new study skills. Teaching other people things is an effective way to learn them better and deeper yourself (as Isocrates put it, "To teach is to learn twice"). It's also harder to skim over problems and just assume you know the answer when your friends are waiting for you to come up with a concrete answer (see "recognizing vs recalling" above). Finally, studying in a group is a good way to work out how well you're keeping up other students in the class as the course goes on. Tutorials and conferences can often effectively be group study sessions.

Here's a page on setting up a study group: www.how-to-study.com/study-skills-articles/study-groups.asp. Pay particular attention to the sections on how to keep it running and avoiding possible pitfalls.

Practice testing

As painful as taking exams is, it's been known for over a hundred years that testing improves learning. It's not just a way for instructors to see how much you've

learned, it is in itself a way to learn. This technique is no-stakes testing outside of class. It doesn't only literally mean doing old exams, it's anything that requires you to come up with answers. Flash cards and practice problems in textbooks are effective forms of practice testing. What tests you do while studying don't have to be in the same format as the actual exam you'll eventually take to work.

You can add practice testing to group studying (above) by having a mock test where everyone comes to the group study session with a couple of questions and a prize contribution (chocolate is generally popular) – everyone takes the test with the pot going to the person with the best score.

This is an excellent general technique, though it works slightly better for free recall (where you have to come up with the entire answer on your own) than for fill-in-the-blank or tests like multiple choice. More practice testing is of course better, but there are eventually diminishing returns.

Four good techniques: concept maps, elaborative interrogation, interleaved practice, and self-explanation

Concept maps

Concept maps are drawings that connect concepts to each other and identify the relationships between them. A simple example can be found at www.nature.com/nrm/journal/v7/n4/images/nrm1856-f2.jpg. Making concept maps is a good way to work out how things are connected and to tie them together conceptually but they're also good for learning facts. Studying from someone else's map is okay but creating one yourself is much better, and working on them collaboratively is better yet. You can draw them by hand or use a free program like CMap (cmap.ihmc.us/) – the CMap site has a fair number of resources about concept maps too.

Elaborative interrogation

It's sometimes useful to just ask "why?" – just ask any three-year old! – and this technique is based on coming up for explanations of why a statement is true. Slightly more complex variations of this technique include asking why a statement is true while another similar statement isn't or why a statement is true for a particular context but not for others.

This shouldn't take long, maybe fifteen seconds per fact, and it's best if you do it fairly often: a few times per page in a textbook or your notes, say. When you come across a factual statement cover up the text and come up with the reason why that statement is true. You can also go into more depth and ask "why?" for any facts that you came up with in your

explanation of the first "why?". Elaborative interrogation works well for facts, integrating knowledge, and for concepts that are related to each other.

Interleaved practice

Instead of focusing on just one class topic for a block of time you can also study different but related topics in that block, so you're not studying only topic A one week, topic B, the next, and topic C the week after that, making your studying over the weeks look like this: AAABBBCCC. This is called block study. By continuing to go back to the older topics (so your studying looks more like ABCABCABC) you'll learn more. If you try this technique, be aware that you'll typically do worse in practice testing compared to block testing, but you'll do better in the actual exam.

Interleaving different topics at the same time reinforces the connections between them and helps you decide which type of solution to use to solve a problem. It works well for topics like classical mechanics, where there is a relatively small number of possible equations to choose from, but is of little help if the possible options are extremely large (e.g. vocabulary in a foreign language).

Self-explanation

This technique is based around explaining to yourself why you came up with the answer you did or why you did something the way that you did. Your justifications should go into depth about why you made those particular choices as opposed to other ones. You may come up with a better way to have done it, helping you in the future.

Self-explanation works for an impressive list of question types; after all, it's always useful to work out why you answered any question the way that you did! Be sure that you come up with a good rationale for your decision *before* you look up any explanation that's given; it's easy to look at an explanation that's been provided and assume that you could have gotten there while not actually doing the work, which weakens this technique.

Four weak techniques: highlighting, imagery use, rereading, and summarization

Highlighting (and underlining)

This is an extremely common practice, where you highlight or underline key phrases or ideas in your textbook or notes so that they stand out and are easier to memorize. While lots of bright yellow on the page looks dramatic and productive it's not actually a very good technique, despite its popularity. Studies

have found that there's no real overall difference on exams between people who highlight and those who don't: highlighters do slightly better on the highlighted material and worse on the rest. This doesn't mean that you can get away with underlining *everything*... the important text has to stand out from the background! Not only does highlighting give no overall improvement but research suggests that isolating facts it may make it more difficult to make connections between them.

Imagery use

Visualizing what you're reading does seem to help in remembering what it is that you've read, but research is inconsistent in terms of just how much it helps and whether it's worth it overall. It may be better if you're read to than if you read the text yourself. It's definitely better for "real" things that can be imagined than for abstract concepts and it's better for facts than for inferences or applications. This technique works best for low-level learning (e.g. memorization, as opposed to more complex things like analyzing or evaluating) and isn't terribly impressive in any case.

Rereading

This is probably the single most commonly-used technique on the list. Rereading something one additional time will give you the best return for the time you spend; additional rereads don't add much more learning. This isn't to say that textbooks are useless after you've read them twice; they're still valuable resources.

Rereading works best for tests in which you have to come up with the information yourself (free recall), like short-answer questions. It's not as good for tests where the answer is explicitly stated, like multiple-choice questions. Whether or not it helps with actually understanding the material is unclear from the research so far. Rereading does work, but it's not as useful as many of the techniques listed above.

Memorization

Most of the good techniques covered above work best for learning concepts but there are also times that you simply need to memorize. Here are some mnemonics (something that helps you remember) that are better than just rote memorization. A theme that runs through these techniques is making connections between things. More dramatic imagery makes stronger connections, so use lots of colour, light, movement, emotion, symbols, and humour for the image-using techniques. Using more senses while going over the material also helps you to remember,

Summarization

Summarizing things in your own words can help, certainly more than writing down verbatim what someone else said. This works well for figuring out how well you know the subject and is better for tests where you have to produce information than when you have to pick out information, like multiple-choice tests. It's a good way to check out how aware you are of what you know (metacognition). Unfortunately, summarization isn't as good as the other study techniques listed above. Concept maps (see above) are somewhat similar but much better for learning. Note that writing your notes in class by hand (as mentioned above) is still a good idea; that's a note-taking technique, while this is a study technique.

A summary of what each technique is best at (in alphabetical order, not order of usefulness)

Concept maps: Good for working out connections between things and seeing the big picture.

Distributed practice: Good for everything.

Elaborative interrogation: Good for factual information, higher-level thinking and integration, inferences, concept relatedness. Not so good for problem-solving tests.

Group studying: Good for everything.

Highlighting: Good for facts, not so good for concepts.

Imagery use: Good for things that can be imagined. Not so good for abstract things or concepts.

Interleaved practice: Good for choosing options for problem-solving.

Practice testing: Good for free recall, not as powerful for filling in blanks or recognition.

Rereading: Good for facts, not so good for problem-solving.

Self-explanation: Good for everything.

Summarization: Good for free recall, not so good for recognition.

so write it down, say it out loud, and so on.

Connections

As stated above, making connections helps you to remember things, no matter how silly those connections may be. I once had a TA named Gavin who was a little odd and studied loons (the bird family Gaviidae). I still remember that loons are in the Gaviidae because Gavin was a bit loony.

One particular type of mnemonic is the acrostic, where you make a phrase or sentence out of a list of things by keeping the first letters the same, as in

“King Philip Came Over For Good Spaghetti” for the different taxonomic levels: Kingdom Phylum Class Order Family Genus Species.

These sorts of connections are good for long-term memorization.

Mnemonic pegs

You can memorize using fixed “pegs” that you attach things to. One good sort of peg is numbers; make rhyming pairs like “one-sun” and “two-shoe” and then imagine the first thing you want to memorize as being up in the sky like the sun, sunrays warmly beaming down on you. The second thing can be walking down the street wearing shoes made of what you’re trying to memorize. Make the “pegs” dynamic so they’re easier to remember.

Similar to this is the loci technique. Imagine your walk to school and imagine the things you want to remember at particular locations on the way. When you need to recall the items go through the walk in your head and encounter the items.

You can also link things together (the mnemonic link technique) without any sort of framing device like numbers. Need to remember carrots, bread, and apples when you go shopping? Think of a loaf of bread with a carrot run through it, the carrot balanced on its point on the apple and the whole thing wobbling slightly. Having the items touching, moving, being on top of each other, and so on – again, making connections – helps you to remember them.

These techniques are better for short- and medium-term memorization. If you start memorizing things that you keep coming across you’ll eventually memorize them permanently anyway.

Rhymes and songs

We’re a musical species and tend to remember

rhymes and songs. The alphabet song is how we teach children to memorize 26 arbitrary sounds in order, after all. Need to memorize the structures of all twenty amino acids for organic chemistry? Make a twenty-line rhyming song with one line per amino acid! This doesn’t have to tell you everything about the amino acid – something like “proline is a funny fellow” is a good enough line to help you remember its odd structure.

Rhymes and songs are good for long-term memorization.

Keyword mnemonic: not that great

A keyword mnemonic is an image that you use to help you remember something. For example you can imagine a *dentist* holding up a giant tooth to help you remember that the French word for “tooth” is “dent”. It’s better for things that are easy to visualize than more abstract topics. Although it works in the short term studies show this technique can be detrimental to long-term learning, as what exactly in the image is referred to can be forgotten or the wrong thing can be remembered. It can also take a lot of time relative to other techniques; try something else first.

Bonus: chunking

There’s the saying that people can remember seven things at one time, plus or minus two. That may be true but each of those things can also be a group (“chunk”) of other things. This process of chunkifying – an admittedly ugly word! – lets you sneak more things into your head. For instance, memorizing ten digits at once often leads to mistakes but chunking the numbers into a phone number, such as (212) 664-7665, make it easier to remember properly.

Conclusion

All these techniques are like any sort of exercise: you’ll need to try them out, see which ones work best for you, and perfect how you use them. Use metacognition to tweak things so they work best for you.

There is no one ultimate study technique except to be able to flow between all the good techniques fluidly and make use of different ones in different

circumstances to maximize your learning.

In addition to knowing what techniques work for you there is also the need for discipline, so that you regularly work on them. Having a list of good study techniques will only lead to better learning if you practice!

Study well and good luck!

Creative Commons notice

This document is covered by an attribution-non-commercial-sharealike 2.5 licence. The full licence can be found at <http://creativecommons.org/licenses/by-nc-sa/2.5/ca/legalcode.en>.