

Attention

Information enters our brains through sensory receptors that hold onto information for only a short amount of time (less than a second). Right at this very moment, your eyes are reading this text (and glancing at your text messages / TV screen / computer monitor) while your ears are listening to music / YouTube videos / the neighbor's dog / a car alarm. Your skin receptors sense the texture of the desk / bed / sofa and your nose senses lunch / fabric softener / that hottie's amazing fragrance. Oh, and are you eating? Your taste receptors are active too. But your brain is spending most of its energy processing incoming information you **AREN'T EVEN AWARE OF**. Your blood pressure. Your osmotic pressure. Your blood oxygen saturation. Your blood pH. Your hormone levels. On top of ALL of this input, you are trying to do **WHAT? STUDY? Seriously?**

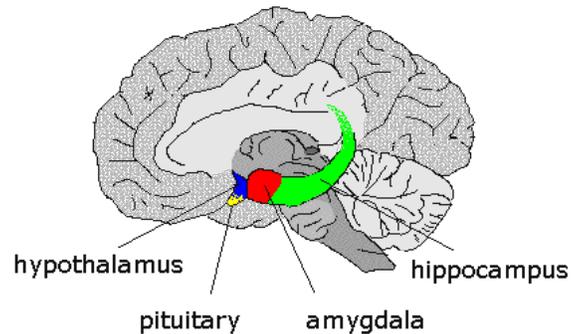


So it's important to acknowledge just how busy our brains are and to **PAY ATTENTION** to your study environment. **HELP** your brain to pay attention to what you **WANT** to pay attention to (*we call this **conscious perception***). To help your brain stay attentive as you study, you must limit distractions as much as possible and make sure you are awake and not hungry (sleepiness and hunger are two of the **BIGGEST** brain distractions). Getting enough exercise and managing stress effectively are very important too. Learning to focus by studying a meditation technique can also be extremely valuable.

Encoding and Storage

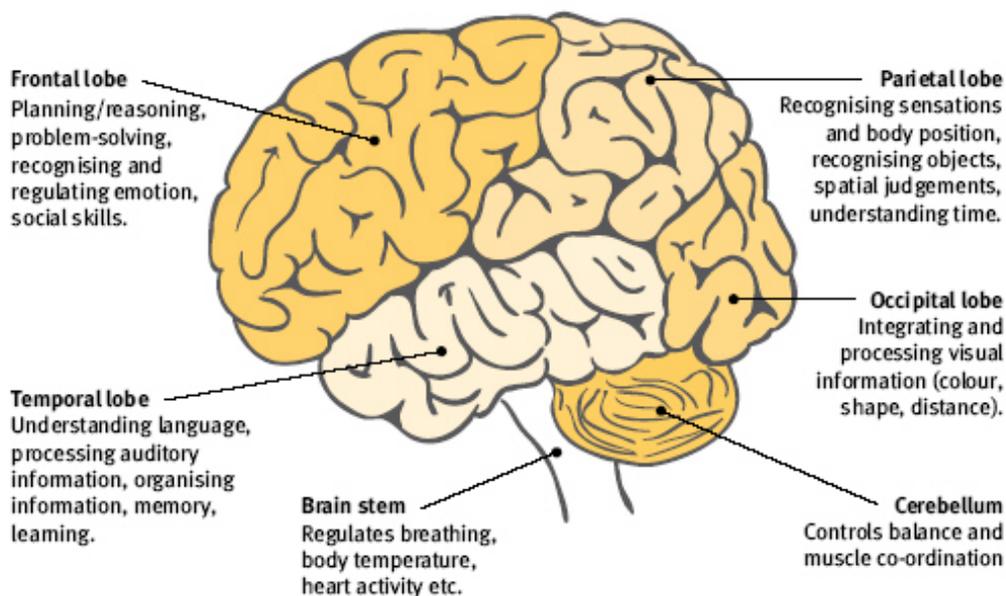
The term *encoding* refers to the conversion of inputs from sensory cells into a format that the brain can work with (for example, light from photoreceptors, sound from mechanoreceptors and taste from chemoreceptors are all converted into action potentials). Once we have encoded information into action potentials, we move that information into either (a) our short-term memory which lasts for only a few seconds (such as a phone number you are trying to remember) or (b) "working" memory which can hold information for longer periods of time, but only if you're actively working with it (such as the numbers from a math problem that you're talking through with a study

group). All of this happens in regions of the brain called the hippocampus and amygdala:



Working memory can only hold information for 10-20 minutes, and after that it is either lost (we don't know how or why) or the memories are marked for long-term distribution and storage elsewhere in the brain.

Long-term memories are partitioned in the brain based on information type - visual information is stored in the occipital lobe, while auditory information is stored in the temporal lobe for example. As you retrieve those memories, your brain puts all the pieces back together for you, so you remember it as a cohesive unit. It's amazing really.



So what you need to understand is that when we say we want to move information into long-term memory, we are really talking about TWO separate issues:

1. STORAGE STRENGTH, which doesn't seem to fade over time. Once information has been sent to the appropriate area of the brain for long-term storage, it stays stored. Storage strength can only increase through repeated recall or use.
2. RETRIEVAL STRENGTH (the ability to access the memory) which does fade - it needs regular maintenance. For most of us, forgetting is an accessibility problem - the memory exists in storage but you can't find it when you need it.

ACTIVITIES to IMPROVE STORAGE AND RETRIEVAL

Repetition. "Rehearsal" and "repetition" are both terms that refer to the act of practicing your recall of information, but beware... simply re-reading the textbook or your notes is NOT an effective study strategy! In fact, it's one of the poorest study methods you can employ. Unfortunately, it's the most popular study method. Admit it - you do it. And it feels like studying, right? And it doesn't work? WTF?!?!

Here's the thing... you can memorize text verbatim without having ANY IDEA what it means or how to use it. I can't tell you the number of students who have come into my office claiming they have been studying material for DAYS AND DAYS and they still didn't pass the exam. We sit down and talk about their study habits and 9 times out of 10, we discover that while they can often recite material from the textbook word for word, when I ask them questions about the material, they give me the deer-in-the-headlights look. "WHAT?" some of them ask me, "I have to UNDERSTAND it?"

Recitation gives you a FALSE sense of MASTERY.



You must do more than recite. Quizzing yourself using flashcards, working the practice problems and re-phrasing the text in your own words are examples of effective repetition-based recall practice.

Elaboration. Elaboration is the process of connecting new information with prior information and looking for relationships between various pieces of information. You can elaborate by thinking of examples of concepts, explaining a concept to someone else, applying knowledge to a case study or creating a summary based on your notes.

Making Connections: Organizational Schemas. Our brains are natural pattern-seekers; the brain is constantly trying to take in new information and attach it to things we already know. Your brain will find it easier to remember information if you make associations or connections with it; these associations create a structure of knowledge for information which is easier to remember than random facts. Creating your own study guides, making a concept map, and comparing and contrasting ideas are examples of study techniques that fall into the category of organizational schemas. Making analogies is another great way to organize new information by incorporating it with material your brain is already familiar with - I do this constantly in my YouTube videos and it's one of the things my viewers appreciate the most... but you can do this yourself! (Actually, research shows it's more effective if you make the analogies yourself because it's YOUR brain you want to integrate with, not someone else's, right?)

Multiple modes. When you're studying, you can create stronger memories if you engage your visual, auditory, and kinesthetic senses. Information stored using more than one "sensory mode" will be easier for you to remember and recall later (remember, everything gets separated during storage and re-assembled during recall, so the more storage sites you have, the more likely recall will be). So don't just read - read and take notes or read aloud. Don't just listen to the lecture you recorded, listen and then pause the recording to verbally summarize what was just said. Read, write, draw, talk, build, listen, try to make a skit about sliding filament theory with pipe cleaners - ENGAGE your BRAIN as much as possible!

Improve Retrieval with Spaced Repetition

Pierce J. Howard writes in *The Owner's Manual for the Brain*:

“Work involving higher mental functions, such as analysis and synthesis, needs to be spaced out to allow new neural connections to solidify. New learning drives out old learning when insufficient time intervenes.”

Think of this like a building a brick wall; if you work too quickly and stack the bricks up too high before the lower ones solidify, your wall isn't going to be strong. Spacing your learning allows the “mental mortar” time to dry. You've got to **WORK IT over time to KEEP IT.**



Here's something amazing... forgetting is the very thing that discourages students the most, and it seems to be THE THING that is most important! In the book *How We Learn*, Benedict Carey explains:

“Some ‘breakdown’ must occur for us to strengthen learning when we revisit the material. Without a little forgetting, you get no benefit from further study. It is what allows learning to build, like an exercised muscle.”

Forgetting and then ‘re-learning’ information is one of the best ways to strengthen retrieval strength.



For this reason, shorter study sessions spaced out over time are FAR more effective than fewer, longer study sessions, even if the longer study sessions actually involve more study time.



Study for less time but over a longer PERIOD OF TIME.

How you space out your study sessions depends on how long you have until your exam, and there are varying theories on this, but one of the best is the Leitner System, which you use with flashcards, old-school style. If that isn't your thing, you can use technology and apps that can help you with spaced repetition - here are some that my students use (I'll penguin-mark my two personal favorites):

- SuperMemo
- Flashcards Deluxe
- Memrise
- NimbleNotes
- Mnemosyne
- Eidetic
- Anki 
- TinyCards 

In Summary:

- Keep your body healthy (regular sleep, good food, stress management and exercise) so your brain can focus on what you want it to learn, rather than having to attend to physical imbalances resulting from poor lifestyle choices.
- Help your brain to be attentive by limiting distractions during study times.
- Study material using as many modes as possible.
- Do NOT just re-read and recite... it's a waste of your time.
- You must USE and APPLY the knowledge - RETRIEVAL is most important.
- Space out study sessions over time (retrieval practice after forgetting is best).
- Always review previous material as you study new material and focus on connections as you build knowledge.
- Don't be hard on yourself - focused practice is a skill like any other and it takes time to build up stamina.

As always, I hope that was helpful! Good luck!



The Penguin Prof