MedStudy[®]

Study WISE

BRAIN HACKING TECHNIQUES TO STUDY STRONG FOR MEDICAL STUDENTS



MedStudy

Studying Wisely

MedStudy's reason for existence is to make learning medicine easier for you. And when we say "learning medicine," we mean **truly** learning medicine—both **understanding** the concepts and processes and also storing this information into readily accessible **long-term memory**.

Many of the current well-known methods of learning have been passed down through generations of educators. We use them ourselves and teach them to our children. Educators still teach them. But based on what we now know about how the brain processes memories and on the results of many empiric and randomized controlled trials of specific learning techniques, we can conclude that our most used and taught study techniques are not optimal, not helpful at all, or are even counterproductive. There are much better learning techniques available.

We'll go through all of this and then explain how we've incorporated the best learning concepts, techniques, and processes into our Study Strong System—built from the ground up exclusively for medical students.

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The Challenge

You're in medical school. Congratulations! But...Yikes! You're in medical school! This is a bit scary because of all the unknowns. Most students enter medical school without a good idea of how they'll approach the required studying and pretty unequipped to deal with the uncertainties that await them. There has been no set of books specifically for medical school, and students have been left on their own to find the best material that supplements the lectures. Sometimes there are lecture notes of variable quality. Many students purchase various tomes written for medical specialists or use postgraduate and college textbooks for some subjects, but then find that only about 5% of the content directly applies to their studies. Some buy various help-books filled with outlines of what is most important to learn but find them impossible to assimilate. Many buy Q&As for the USMLE Step exams and then cram to pass these tests. This uncertainty brings a tremendous amount of stress that negatively impacts the medical school experience.

This StudyWise guide introduces you to the brain and learning research results that apply universally to learning and how we at MedStudy have used these as the guiding principles in the development of the Medical Student Study Strong System.

MedStudy aims to bring more coherence to your medical learning, making it more deeply satisfying with much less stress and much more true long-term learning.

This StudyWise guide for Medical Students has 3 parts:

- 1. What we currently know about how the brain makes long-term memories
- 2. The best evidence-based learning techniques
- 3. How we have incorporated the best of these brain-hacking techniques into what we call the MedStudy Method

Let's jump right in!

A NOTE ON EXPERTISE

As you learn and repeatedly recall medical facts, concepts, processes, and relationships, you eventually obtain a level of access to those memories that is immediate. All the associated thinking is fluid and quick—not delayed by looking information up or attempting to recall it. At this point you have achieved "expertise" in that area. Attaining expertise in a medical specialty is a gradual and piecemeal process. You first learn the facts, concepts, and connections that are most common in your practice and those that are very dangerous to the patient if you don't fully understand them. Next, you master the less common ones. Finally, you learn the relatively rare ones.

Everybody has expertise in some areas. Think of driving a car. You do this almost without conscious thought, even though the process is full of fast, complex calculations and judgments with life and death consequences. Similarly, all docs have expertise in some area of medicine. The level of expertise may be only 2% for a medical student or 20% for a resident. It is probably 60% or higher if you're in practice.

What are we aiming for? Physicians working at the expert level have immediate access to much of the medical knowledge of their specialty, and many of the mental processes that go on in their minds become automated with time, even complex problem solving. This is called "automated thinking." These mental processes are mostly nonverbal. The expert tends to think in patterns and bases decisions on where the current patient presentation fits in with matching patterns. Hence, an expert physician's care becomes quick and accurate, no matter how complicated the case.

Using focused study materials and optimal study methods accelerates your progress toward the goal of becoming a top student and ultimately, an expert physician. MedStudy's Study Strong System has been conceived and built specifically to fill this need.

What We Know: How Memory Works

Types of Memory

There are 2 types of long-term memory and each is important in learning:

- 1. Episodic memory: Memory of events
- 2. Semantic memory: Memory of facts and concepts

Episodic memory is the memory of events, and forming these memories is the way **all** information is initially coded into our brains. An episodic memory is rich in content with the "who, what, where, when, why, and how" of the event. They include associated emotions and what level of importance that event had in our lives.

Semantic memory is that of facts, concepts, and processes. Any fact. Any concept. Any process. Names of medications, diagnostic criteria for a disease, treatment protocols, names of colors, heck, why the sky is blue.

A key point about semantic memory is that each semantic memory trace is formed from episodic memories. You can't intentionally program facts, concepts, or processes into your semantic memory. Semantic memories form automatically—they are initially **derived** and then further **strengthened** during the process of consolidating multiple episodic memories that include the **same** information. As episodic memories are encoded and consolidated, there is a continuously ongoing background process in which the same information within those different events is encoded into a completely separate semantic memory network. So, by scheduling learning events (readings, Q&As, lectures) that repeat must-know information, you will strengthen these semantic memories and their associations.

Speaking of associations, your semantic memories are the elements of the semantic network, which is basically **all** your factual and conceptual knowledge. The network can be thought of as nodes representing the facts, concepts, and processes, with all related nodes connected by their strength of association. Just as it is important to build solid nodes it is equally important to build strong interconnections between the nodes. You do this by contrasting and comparing similar information.

Again, based on the dependent relationship of semantic memory to episodic memory, you can see that solidly learning a fact or concept requires experiencing multiple events that explain or contain that fact or concept. This is a **key** study principle!

Okay, let's look at how memories are made and how they can be strengthened.

The Memory Process

There are 3 stages of the memory process:

- 1. Encoding
- 2. Consolidation
- 3. Retrieval

When you experience an event, all the information is funneled to the hippocampus and converted into a neural code that can be stored and accessed, first as working short-term memory and later as distributed long-term memory. As mentioned above, this episodic memory contains all relevant information of the event, the "who, what, when,



why, and where," the emotions, the sensations, and the personal importance of the event. This hippocampal processing is called **encoding**, and there are a few factors that can influence it.

Stronger encoding occurs with:

• General factors

- Good health—physical and mental. Eat well, sleep well, exercise routinely.
- Strong motivation to learn

• Event factors

- Increased personal importance of the event
- Novel associated sensory input—new or different sights, sounds, smells, etc.—adds robustness to a memory, even if it is not the main focus of the event.
- An interesting storyline within the event
- Strong emotion engendered by the event

• Study techniques

- Practicing recall of the study material while previewing, studying, and reviewing it
- Interleaving study content (combining nonrelated topics; see page 21)
- Writing your own questions and making concept maps while studying

Weaker encoding results from, basically, the reverse of the above factors: lack of attention or motivation, physical or psychological stress, poor sleep, and use of various psychoactive drugs.

For hours to days after the encoding, the new memory code gets converted into long-term storage by undergoing a completely automatic process called **consolidation**. During this process, elements of the new memory are associated with similar previously stored memory elements. Although the consolidation process is automatic, it can be disrupted by many of the same factors just mentioned that cause weak encoding, especially poor sleep, physical or psychological stress, and use of psychoactive drugs. **Retrieval** is the process of recalling a memory. Recalling the memory is an end in itself, but every time retrieval occurs, another round of the memory storage process occurs—the memory, along with any new information, is **reencoded** and then automatically **reconsolidated** over hours to days. Each round of recall, reencoding, and reconsolidation results in a memory that is more robust, better defined, more durable, and more easily recalled. This is the **golden key** study principle!

Memory Storage and Retrieval Strengths

We tend to worry about whether our puny brains can hold all the information we want to remember. However, the storage capacity of the brain is virtually unlimited; what we are trying to add is merely a drop in a swimming pool. So, capacity is not a problem. Accessibility is the problem. And this is fixable!

A stored memory has 2 intertwined components of strength:

- 1. Storage strength (durability)
- 2. Retrieval strength (ease of recall)

Storage strength is how durable a memory is. A learning session that is not repeated produces a memory with low storage strength. But each time the information is recalled, reconsidered, reencoded, and reconsolidated, the memory is made more durable. An odd finding is that, even when the memory is not recalled, storage strength of a memory appears to stay the same over time—so storage strength can increase with recall, but it doesn't really decrease.

All the information you once learned but are now unable to dredge up is still there (good storage strength). Why can't you remember it? It is because you have lost *access* to those memories. The **retrieval strength** is low. Retrieval strength, unlike storage strength, does always decrease with time, but it is increased in exactly the same way that storage strength is—by recalling the information. In the same way that retrieval makes the memory more durable, it also makes the memory more easily recalled. And this is *key*: Repeated retrieval of a memory progressively spaced out over weeks to months can make that memory easily recalled for years. Purposefully repeating the process of recalling previously-learned information is called **retrieval practice**, and doing retrieval practice on the same material multiple times with progressively longer periods between is called **spaced retrieval**. In the following text, "**strength**" is used to reflect both storage and retrieval strengths.

Using the above information, you have the basis for how to go about building a powerful and accessible mental knowledge base:

- Use retrieval practice to strengthen the memories.
- Incorporate the factors for stronger encoding and consolidation into your learning and retrieval practice.

Now we'll use the combined results from many studies evaluating learning methods to expose 6 learning myths and explain the 2 learning truths (only 2!). The learning truths will sound familiar as they are based on the 2 items in the above list! Then we'll go over the MedStudy Method, which will make perfect sense.



A 2015 Salk Institute study found that the brain's storage capacity may be around a quadrillion bytes.



6 Common Learning Myths

- Read and reread the material; highlight and rehighlight it until you know it.
- Study one topic at a time. Move on to the next topic once you've mastered the first one.
- Study at the same time and place each day, in a location free of distractions.
- Find your learning style and study accordingly.
- Use practice questions to confirm your mastery after extensive study.



What We Know: Myths and Truths

Learning Myths

Over the last 50+ years, a tremendous amount of work has been done rigorously testing study techniques to determine which ones result in better learning. This has been empiric testing—testing each method against a control group. All the results I present here have been confirmed by many studies.

Correct the Myths

Self-correction is an important step in learning. Better learning occurs when the student has an active role and corrects their own errors rather than simply being told the right answer. Well, let's take a big step back and see if you can apply this concept to fixing the way you've been learning in the first place! Here we present 6 commonly used and taught techniques of studying that turn out to be not optimal and maybe even counterproductive.

Learning Myth 1:

Read and reread the study material; highlight and rehighlight it until you know it.

This is the method most of us have used for studying throughout our schooling. When you read and reread, highlight and rehighlight, and underline and reunderline material, you feel that you are learning the material better and better. Once you understand it all, you think you don't need to study it again. But you are being tricked by what is now known as the "**fluency illusion**," the very powerful but utterly false sense that you have a much greater grasp of the material than you do—simply because the information has become more and more familiar. In fact, rereading, rehighlighting, and reunderlining have been proven to not improve test scores at all—no matter how many times you do it! Instead, see Learning Truth 1 on page 13.

Learning Myth 2:

Study one topic at a time. Move on to the next topic once you've mastered the first one.

This technique *seems* intuitively logical and sound. It is still being used in most schools. Study one concept or set of related material before moving on to the next. Well, counterintuitive as it may seem, studies show that there is a better way to learn—essentially by mixing up the topics. See more on this in Learning Truth 2 on page 15.

Learning Myth 3:

Study at the same time and place each day, in a location free of distractions.

This is almost as hallowed a tradition as Learning Myth 1. Students have spent countless hours studying in the same, boring room because they were erroneously told it would help them focus and learn more. What works better? See Learning Truth 2 on page 15.

Fluency Illusion

Just because you are familiar with material doesn't mean you can accurately recall it. An fMRI study (Ryals et al., 2012) found evidence that familiarity and recall are not the same. They are processed in two separate parts of the brain: Recall is moderated in the hippocampus while familiarity involves anterior parts of the parahippocampal region, or MTL cortex. Subjects who found items familiar knew they had seen them before, but they couldn't tell you where or when. To accurately and reliably recall information, you must practice recalling it over progressively longer intervals of time.

Learning Myth 4:

Find your learning style and study accordingly.

Evidence from many studies shows *no* support for the idea that you learn better if you study according to your learning preferences (visual, aural, verbal, physical, logical, social, solitary, etc.). This is an insidiously pervasive myth that is still believed by the majority of teachers—in higher and lower education. Many teachers arrange their assignments around the different learning preferences of their students.

Rather, studies show, again and again, that **spaced retrieval** is the most effective way to lock the study material into long-term memory, regardless of anyone's favored learning style. This is explained in Learning Truth 1 on page 13.

Learning Myth 5:

Use practice questions to confirm your mastery after extensive study.

Okay, this myth is partially true. For instance, quizzes that cover an area you have studied extensively are a good means of self-assessment of your current knowledge of that area. But Q&As do so much more! They are the ideal presentation of facts, concepts, and processes during all stages of studying—assessing your knowledge of a topic, previewing the material, studying it, and as a means of processing the material into long-term memory. We'll discuss this in Learning Truth 1 on page 13 and in the MedStudy Method.

Learning Myth 6:

Cram before exams.

This is a tried-and-true test prep method that we've all depended on when we've realized that we weren't ready for an impending exam. There may be some short-term benefit in cramming, such as passing the exam. The overarching problem, however, is that most of what you crammed is—pfttt!—gone, shortly after the exam. It is much better to learn the material in a way that makes the information immediately accessible whenever you need it, even long after the exam. The fix is in Learning Truth 1 on page 13.

Learning Truths

The following details the techniques that are most useful for effective learning. I categorize these various techniques into 2 essential learning truths. The first learning truth is all about using and practicing **recall**. The second is a bit longer because it digs into the many ways to strengthen **encoding** during your study periods.

Learning Truth 1:

Recall, recall, recall.

As studies have proven, practicing recall of facts, concepts, and processes is the **sole** way to convert that information into durable, easily recalled long-term memories. We tend to do this naturally as we gain proficiency in any area of endeavor, from hobbies to our profession. We frequently rewind and replay new information, fitting it in to what we already know. The more you practice recall, the better your results. By including structured recall sessions during your daily practice and studies, you can more easily and efficiently learn new information.

There is a specific way you must engage with the recall process for it to be effective. You can't just spend a few seconds trying to recall the information and say, "Nope, don't remember much" and then jump back into reading about that topic. This will drop you right back into your soft and fuzzy illusion-of-fluency world where you are not really learning anything. Rather, even if you don't remember anything at first, strive to dredge up all the information you can that is related to the topic. This is termed "**effortful recall**," and the more effort you put into recalling the facts or concepts, the stronger your memory becomes when it is reencoded and reconsolidated with new information.

Purposefully repeating the recall of previously learned information is called **retrieval practice**. This process has been studied extensively, and the best way to practice retrieval is with **spaced retrieval**. Spaced retrieval is when you practice recalling a topic multiple times—with a progressively longer time between each session. Each session results in memories of that topic that are even more durable and even more easily accessible. The review session itself is best set up with structured content that reliably quizzes you about the same information with each session.

Look at the graph titled 20% Forgetting Curve. You can see that the time to forget 20% (i.e., retain 80%) of the information becomes longer and longer as time goes by. Similar results occur even if you wait until you've forgotten 60% or even 80% of the info. Because there is so much medical information you are trying to make easily accessible, I recommend you spread out the retrieval sessions. After the initial study session, practice recall on the topics in 2 days, 10 days, 4 weeks, and 4 months (or whatever progressive spacing fits best for you). And always follow the cardinal rule: Recall as much as you possibly can before looking up the answer!

Your ultimate goal may be to become an expert physician who is truly fluent with all relevant medical facts, concepts, and processes. Making retrieval practice a second-nature part of your clinical work will allow you to continually grow your knowledge base and level of expertise. Using it in your learning years and practice years boils down to simply following the most important rule: Always recall as much as you possibly can before looking up the answer.

20% Forgetting Curve



This reflects the finding of increased memory durability after each successive study session with the same content.

Learning Truth 2:

Use techniques and behaviors that strengthen encoding.

We outlined these factors earlier. Now, let's delve into them a bit. You'll see that there are many factors that affect encoding. But it's all important!

Optimize physical and mental health.

On the physical side, watch what you eat, get plenty of sleep, and exercise regularly. (Yes, your mother was right!)

- **Eat a sensible diet.** Avoid a diet high in carbs; it adds an increased risk of weight gain, diabetes, and heart disease—and the ups and downs in blood sugar interfere with concentration.
- Sufficient sleep is crucial for decreasing stress and for optimizing the encoding and consolidation processes. Aim for 7–8 hours per night. Minimize alcohol ingestion at bedtime—it disrupts normal sleep cycles by decreasing your amount of REM sleep and by decreasing deep sleep (a.k.a. Stage 3 sleep, slow-wave sleep, delta-wave sleep), which is the restorative part of the sleep cycle thought to be important for memory consolidation.
- Get at least 30 minutes of exercise 5 days a week. This results in decreased stress, anxiety, depression, and better deep sleep. Did you know that regular aerobic exercise not only improves short-term memory but also increases the size of the hippocampus?
- **Manage stress.** This is a key necessity! Maintaining physical health with the above recommendations is a great starting point. Balance your work with relaxation and play. Place mental boundaries around work time, study time, and family time. Don't let these distinct activities interfere with each other.
- **Meditate.** Meditation is being studied and, although there is a lot of hype associated with various practices, there are not many sound clinical trials yet. A few good trials on mindfulness meditation, however, do show a benefit for stress reduction

and for decreasing anxiety and depression. Regular meditation practice also appears to help with maintaining focus and staying on task.

• Address learning disabilities. Many physicians have a learning disability that they have never recognized. If you've had trouble with reading, calculating, learning, or testing, get a thorough learning disability assessment. For it to be useful, the assessment must evaluate for both specific learning disorders and psychological issues. A good starting point for more information is the Learning Disabilities Association of America at LDAamerica.org/adults.

SLEEP ON IT: HOW SLEEP HELPS YOU CONSOLIDATE KNOWLEDGE

Everyone knows it's important to get a good night's sleep *before* learning something new. But did you know sleep is just as important—maybe even more so—*after* learning? That's because a vital part of learning—consolidation—happens while you sleep.

Neuroscientists haven't yet pinned down the mechanisms involved, but consolidation appears to entail an interchange between the hippocampus and the neocortex, two parts of the brain particularly active during sleep.

Recent studies have focused on EEG activity that takes place during NREM (non-REM) or slow-wave sleep. Additional studies have also brought to light the importance of REM sleep—the dream cycle—in knowledge integration.

The bottom line? When it comes to consolidation and learning, there is no part of the sleep cycle that's expendable. How well you "sleep on" what you've just learned directly impacts how well you will recall the information later.

Maintain a strong motivation to learn.

To reach a goal requiring significant mental effort over a long time, you must have commitment. Commitment is, basically, persisting in efforts to attain a goal until it is achieved. To succeed, your degree of commitment must match the mental and physical effort required to reach the goal. Motivation, in the engineering world, is the process of getting an object moving. A certain amount of force is required to accelerate an object from standstill to a set velocity against a set amount of frictional force. In learning, motivation powers your commitment and provides you with the enthusiasm, focus, determination, and persistence to reach your goal. How can you boost motivation and decrease factors that interfere with it?

Here are the 4 main influencers of motivation:

- 1. **Value** what you are doing and why you are doing it. You want to be a physician. Picture yourself as a highly-competent med school graduate. Your med school was glad to have had you there, and the residency program of your choice is glad to see you coming.
- 2. **Self-efficacy:** Realize that you can do this. Put yourself in a "growth" mindset rather than a "fixed" mindset. These mindsets determine how you handle challenges and setbacks:
 - a. Fixed mindset is learning behavior based on the belief that intelligence is innate, fixed, and static. You are either smart or not smart. Period. And that intelligence and talent alone are responsible for success. People with a fixed mindset fear failing at a task or challenge because doing so will "prove" that they are not so intelligent after all. A setback is felt as a confirmation of inability, and "failures" are felt as just that—with profound negative emotion. People with fixed mindsets tend to stick with what they find easy to do and with what they already know. They tend to not take on challenges they might fail at.

b. **Growth mindset** is the belief that learning and intelligence grow with experience, effort, and persistence. And that the amount of effort put into overcoming a challenge has a direct effect on success. Setbacks are simply learning nuggets, and "failures" are big learning experiences—important steppingstones on the path to success. This belief allows people to take on big challenges without fear of failure.

The funny thing about these mindsets is that they are a selffulfilling prophecy: Your actions will follow whichever mindset you adopt! These mindsets are shorthand for core beliefs that guide critical decisions in peoples' lives and prevent them from, or allow them to, take on challenges. But they are not immutable. These beliefs are habitual ways of thinking that can be changed with a little thought—consistently applied. It is important to realize that a growth mindset is possible and that choosing it helps you achieve the big (and little) goals in your life.

- 3. **Solution-oriented behaviors** focus on problem solving and getting things done, rather than attributing your lack of productivity to another person or thing. Example: "I don't have enough time." Hey, don't even think that, much less dwell on it. Simply figure out what you must do to get the necessary time, given that you've committed to the task.
- 4. **Outlook:** Keep a positive outlook. Remember that you are an awesome, future expert doc with amazing grit. At least, starting now you are!

Vary your surroundings while studying.

Don't think that because you are in a new environment or because there are a few distractions around that you can't learn effectively. It's just the opposite!

It has been a surprising and counterintuitive finding from the learning research that encoding improves when studying in varying surroundings and with mild distractions. We can make sense of this when we consider what is prioritized in the encoding of an episodic memory.

As we've covered previously, episodic memory, which is the source of all semantic memory, is event-based. We more strongly encode information that is considered more important, and that allows the processing to be very efficient. The importance attached to elements of an event is derived from previous experience and from hard-coded, brain-based processing. The brain tends to attach more importance to *differences* in our surroundings than to the surroundings themselves. Our brains habituate to elements in our surroundings that don't change with time and essentially cancel them out. In novel environments, we have much stronger event-related memories. Remember the first time you went to a foreign country, the first time you camped out in the mountains, or the first time aliens probed you in that weird room? (Just making sure you're paying attention!) The point is, unique experiences stand out.

On the other hand, studying day-after-day in a bland, small, white room with no distractions adds no importance to the memories generated there; it decreases encoding strength because you're bored to death with the place!

During your study sessions, focus solely on the study material. You will find that the differences in the environment and the mild distractions are perfectly ignorable. The point of these factors is to enrich the encoding, not to actually distract you!

Add interesting stories to your study material.

We love stories. Stories are a series of events, and our episodic memory mechanisms are most at home cataloging and encoding events. Again, the "who, what, where, why, and when" of an event is encoded along with its importance. Memory experts often use stories to give themselves seemingly amazing powers of recall. They can take a very long list of items and make up a funny story that has these items in the same sequence as they appear in the list. They can then repeat the items forward or backward or start from any item on the list. Here are a couple of examples showing how we can use stories during studying:

1. When doing spaced retrieval practice with Q&As: An

exam-style multiple choice Q&A starts with the telling of a story. It helps with the encoding if you put yourself in this story and "experience" the scenario. For example, you can imagine the patient in the question stem is one of your patients or, perhaps, a close relative. If you choose the wrong answer, play out in your mind how this story ends (tragically—with weeping and with friends and colleagues looking out of the corner of their eyes at you), but then, after learning the correct answer, reimagine it with the correct ending (happy—with all friends and colleagues dang proud to know you). Perhaps you then imagine explaining the reasoning of the correct answer to one of your amazed colleagues. Make it an interesting story with an ultimately happy ending.

2. When drawing a concept map: Concept maps are great for breaking down difficult concepts and processes into manageable pieces. These maps show relationships between associated facts that make up the concept and even other concepts. We can think of it as a representation of our semantic network for that concept. One thing studies have shown about concept maps is that they must be generated by you. You can't copy one off the internet and find it very useful. Concept maps can look like anything. They are often a funny picture or items with lines drawn between them. Most of the power of the concept map is the thought that goes into creating it. You are clarifying associations and comparing and contrasting similar items. However, because the way we learn is with our episodic memory, it is very difficult to remember a static concept map (even if you made it yourself!). Instead, bring a story into the concept map, turning the concept map into an event-hacking the brain to remember it better.

Concept Map



Learn more about concept maps at medstudy.com/method/concept-maps.

Put some emotion into your studies!

Intense emotion can powerfully enhance encoding, sometimes making an event unforgettable. This can be good, but in the case of mental or physical trauma, it can be debilitating. We are probably familiar with using the sheer terror of not passing a test to cram better. But we really don't want to make this our go-to study method! Moderate emotion also enhances encoding, and we can use this effect to enrich the stories we create while studying (see "Add interesting stories to your study material" on page 19). The more personal the emotion you experience with your stories, the better you will encode the event.

Interleave the content.

Interleaving is combining multiple topics into the same study session. For example, you can have a Pulmonary Preview | Review Question spaced retrieval session combined with initial reading of topics in Cardiology and Infectious Disease.

Now, this study technique is pretty dang nonintuitive and may sound a

bit crazy. And even when you do it, it may feel like you are not getting much learning done. But!...this has been **proven** to enhance not only the encoding but also the cognitive processing involved with learning.

Why does interleaving work?

- **Increased attention:** Once you start studying this way, you will see that you remain fresher and have better focus throughout the study session.
- **Practicing recall:** Bouncing back and forth between topics can be thought of as a mini retrieval practice. The more often you recall knowledge, the better your grasp of it and the stronger your memory of it.
- **Contrast and compare:** Mixing concepts forces you to contrast and compare similar information in different topics, thereby building new and stronger connections to and between concepts and developing a more robust understanding of each. You don't get this benefit from studying one topic at a time.
- Active learning: Interleaving is active learning—as opposed to traditional, passive learning; you are actively engaged in the learning process rather than merely being a passive receptacle. You are constantly thinking about what you are doing and are directing all your own efforts. This helps you maintain focus and deepens your learning. As you might guess, active learning meshes very well with growth mindset.

Whew! There certainly are many factors that help optimize your study sessions!

Let's see how combining the elements from the 2 Learning Truths and what is now known about how memories are made works in the MedStudy Method.

The MedStudy Method

The MedStudy Method adds a powerful little method to the madness of solidly learning all the medical knowledge you need to know. Your immediate need may be to study for the various med school exams, with an ultimate goal of gaining expert-level fluidity of the facts, concepts, and processes.

Take a serious look at your current state of medical knowledge through the looking glass of your brain's semantic network nodes (of tightly related information). Most of us have some pretty big and shiny (durable and accessible) nodes and some pretty big, wide-open interconnections between these larger nodes (i.e., lots of contrasting/ comparing info). These are areas we are very familiar with. But when we consider the level of knowledge we wish we had, the picture gets dreary and we also see the many small, tarnished nodes with few or tiny interconnections and many we don't have access to (we just know we learned that info sometime in the past). By simply using the MedStudy Method in your self-directed studies, you'll get moving toward having these nodes bright and shiny with big, strong connectors—and keeping them that way.

Many of us go into high-stress, freak-out mode when we study because we focus on the terrible need to pass this or that exam. The MedStudy Method allows you to put a calm, sustained, and repeated focus on the study material that is sure to achieve this same goal and, in addition, make that same information readily accessible in long-term memory. So, no need to worry; trust the method, and you can put your valuable energy into the optimum learning processes rather than wasting it on freakouts, procrastinations, and brain paralysis.

So how do you go about planning this journey through medical school? Well, to plan a long journey over land you consider many factors, such as how much time you have available for travel, means of travel, route of travel, and what luggage to take. Similarly, on this journey for knowledge, you don't just jump right in; you need to plan:

- 1. How to study most effectively
- 2. What to study
- 3. How to sequence and execute your journey

So, I'll present the MedStudy Method in these same 3 steps. Let's go through them one by one. Note that the first one, How to study – PSSr, the optimal learning sequence, can be applied universally—to learning projects in any field of study.

1. How to Study – **PSSr**, the Optimal Learning Sequence

In the previous chapters, we went through the brain science of memory and the best evidence-based study techniques. Here, we combine and distill all of this into the best universal study method. This works no matter what it is you are learning and attempting to transfer into long-term memory. PSSr stands for the 3 phases of learning used in the MedStudy method: **Preview**, **Study**, and **Spaced retrieval**—PSSr—err, think PaSSer, *not* PiSSer ;-). Below, I cover the very specific techniques used in each phase. This PSSr approach is an optimization of the way we naturally learn and works with *any* study material.

PHASE 1: PREVIEW

Relax and see what you can remember. At this stage, you're only doing a brain prep for the next day's **study unit(s)** (see page 26). This is a low-stress exercise in which you simply look at the topics and attempt to recall everything you know about them; you're not trying to learn new information.

Because this is a **pre**view exercise, don't seek the answers. *Only* go over the questions and *only* see what you can dredge up with a little pondering (i.e., effortful recall). Be careful! You might interpret this exercise as a serious "assessment of knowledge" and judge yourself harshly if you don't know much at this point. Rather, welcome this for





PREVIEW

The day before you dig into the study material, recall everything you can about it using the Preview | Review questions as prompts.



STUDY

Read through your material carefully, seeking understanding. Don't memorize!



SPACED RETRIEVAL

Again, using the Preview | Review questions as prompts, practice recall of the same study material over progressively longer intervals. This moves your study material into easily accessible long-term memory!

REFRESH 📿

Go back through the study material as needed to refresh your understanding.

what it really is—a low-stress, simple process proven to make your brain "sticky" for what you're about to learn the next day.

PHASE 2: STUDY

Seek understanding. This is where you actually study the material in a textbook, attend the lecture, or watch the video. Make this a low-stress exercise also. You are not supposed to know the material yet nor are you supposed to know it at the end of this study period. During this phase, you are satisfying your curiosity and simply aiming for an *understanding* of the facts, concepts, and processes.

If you are studying material that doesn't have associated quizzes, make up your own Q&As, flashcards, and concept maps that cover key information and help you understand it. You can then use these same study aids during all future review sessions of that material.

PHASE 3: SPACED RETRIEVAL (RECALL, RECALL, RECALL)

Okay, now we get serious about moving the study unit material into long-term memory. This phase is all about putting Learning Truth 1 to work (recall, recall, recall).

The Study Unit

In the MedStudy Method, a "**study unit**" is the study material you plan to address during one study session or set of sessions. Generally, a study unit should not be more than you can cover within a day or two and should be tightly related material—so use the major topics as your study units. The best place to source your study units from is the table of contents of a book or the subtitles in a video product. For example, in the MedStudy Core, source your study units from the major topics in the table of contents.

In memory network terms, a study unit can be thought of as a node in the semantic network of the brain. Study time devoted to a particular study unit is strengthening that node and improving accessibility to it. Similarly, when you contrast and compare similar information in different nodal areas, such as when doing multiple choice Q&As, you are strengthening the connections between these nodal areas. After the initial study session, go over the same study unit in 2 days, 10 days, 4 weeks, and 4 months (or whatever progressively longer spacing best fits your schedule). As always, continually practice recall and dredge up all you can remember after reading a question but *before* reading the answer or explanation. As you move through each session on a particular study unit, you'll find that the time spent becomes less. Eventually, you fly through the spaced retrieval sessions of the earlier material. Be very dedicated with this phase of learning! Spaced retrieval using this very particular way of practicing recall is the *only* way to reliably shuttle this information into long-term memory.

Each of these review sessions of the study unit must be set up with structured content that reliably quizzes you about the same need-toknow information. Use Q&As, review questions, and/or flashcards that are already part of the study unit, or the ones you make on your own. And include any concept maps you made on that study unit.

Remember that these sessions are about practicing recall of the information. Be careful! Don't get trapped into rereading and rehighlighting the study unit (no matter how badly you want to! {Fluency illusion!}).



Example: How to identify a **study unit** in the MedStudy Medical Student Core. From the major topics in the Student Core Table of Contents—look for the bold entries that aren't indented.

Refresh

During your recall sessions, go back to the study unit material as needed to maintain your understanding of the material.

2. What to Study

When you are studying a large, complex subject, you want your learning material to be closely aligned to what you need to know. But throughout the history of medicine, a major lacking in medical school education programs has been not having good study materials. Students have had to piece together their own sources and make do with an assortment of class notes, 3rd party outlines, Q&A booklets, and what they could find on the internet. The MedStudy Medical Student Study Strong Program contains the only comprehensive set of medical school learning materials that is written exclusively for med students and is focused only on the topics taught in medical school. I'll give a brief introduction to these now and you can find out more at **medstudy.com/medstudent**.

The content in the Medical Student Study Strong System has 2 components:

- 1. Medical Student Core
- 2. Step 1 and Step 2 QBank+

Medical Student Core is a 20 volume set of books for *all* of medical school. It was written and edited by an amazing set of physician educators who have brought all the must-know information in medical school together in one place. The tone of the writing is casual and encouraging and there are clear explanations and supportive tables, images, and beautiful illustrations. Sections typically begin with a review of the relevant basic science (anatomy and physiology) and then smoothly progress onto clinical topics.

Preview | Review Questions start off each major topic and are based on the most exam-relevant info. Answers to these questions are highlighted in the text, and appear in the same sequence as the questions. The Core is in print and mobile-friendly digital formats, and you get both.

Step 1 and Step 2 QBank+ with more than 3,000 USMLE-format multiple choice questions created by expert physician educators to address the most testable concepts of the topics listed in the USMLE Exam Content Outlines.

Clear explanations detail why the correct answer is correct, and why the incorrect answers are incorrect. Remember, this comparing and contrasting of similar information in different topics enhances your understanding of each topic. Using the memory network nodes illustration, you are enlarging and strengthening the interconnections between nearby memory nodes.

All the medical knowledge in the Q&As is tightly integrated with that in the Core. With a single click, you can easily move from questions in your Qbank+ to associated digital Core topics. And vice versa. Great for refreshing your understanding as you proceed through the spaced retrieval (Sr) phase.

3. How to Sequence and Execute Your Journey—Introducing Your Personal Trainer

We found that it would be a full-time job to keep up with all the complex calendaring of many study units when you fully implement a system that first requires that you preview the study unit, then study it, and then move the study unit into long-term memory using spaced retrieval sessions with progressively longer times between sessions. Whew! So we decided to do that for you!

We basically took all of the **PSSr** learning phases and what we know of how the brain processes memory—everything we've talked about in this StudyWise guide—added the latest in learning engineering best practices, and funneled all of it, in the form of many elegant algorithms, into the digital brain of the all-new **Personal Trainer**. You essentially get your very own friendly and encouraging Personal Trainer. It takes you through the **topics in the Student Core**, using both the topic's Preview | Review questions—along with the extracted answers—and the associated **QBank+ Q&As**.

Your Personal Trainer follows you throughout the entire medical school journey, setting up weekly assignments based on the your goals and timeline. If your study pace changes, the calendaring is instantly recalculated. Your Personal Trainer also keeps real-time track of all the work you've done no matter if your study pace has changed. Once a study unit goes into spaced retrieval phase, it will stay there and keep reappearing despite other schedule changes—ensuring the steady transfer of that info into your long-term memory. If you forget something, the Personal Trainer will bring that study unit up more often a few times and then return it to spaced retrieval phase once you indicate that you've relearned it.

Personal Trainer uses the **Study Board** to set up your weekly assignments, to follow your progress, and to communicate with you. *You* use the Study Board as a portal with a selective viewing of your study products—only showing what you need to complete that week. You can do all of your studying from this board! The Personal Trainer will give you access to the digital Core and the QBank+ as needed.

The Study board has 3 main areas—each presenting the study material for 1 of the 3 PSSr phases of learning. There is the Study area on the left, the Spaced retrieval area in the center, and the area on the right is where you Preview the next day's study units. There are free trials of the Musculoskeletal System volume along with associated QBank+ questions and Personal Trainer at medstudy.com/medstudent.

Quick Tips for Staying Motivated

Getting prepared for an important exam and just keeping up with your school requirements takes an investment of time and attention. The theory of operant conditioning says that when a certain behavior is followed by a pleasant outcome, we are more likely to repeat the behavior. You can use this effect to help maintain your commitment and focus on your studies. **When you have achieved a significant goal or milestone, give yourself a reward.** It should be something that you find very pleasant. Maybe eating at your favorite restaurant, an afternoon off, a movie night, or a morning sleeping in. You know what external rewards motivate you best.

Don't ignore the good feelings (internal rewards) generated by your study efforts. In the long run, internal rewards have been shown to be even more motivating than external rewards. These internal rewards might include a feeling of satisfaction with finally learning a tough topic, the feeling of absorption with your studies, and the sense of accomplishment that you are progressing well along a long path. **Persist with your studies and you will find that you can keep up with them simply because it feels good to keep up with them!**

And be sure to have a celebration when you complete a major goal! You, along with everyone who has supported you along the way, deserve it!

The End

(or, maybe a fresh start)

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