THE
LEARNING SYSTEM

YOUR EVERYDAY
TOOL

JIN YHU

A message from Jun Yuh

I've been in your shoes. I once felt entirely consumed by school, disorganized, and as if I were always falling short of my goals. I felt isolated and misunderstood, especially when seeking guidance from older friends and mentors, who consistently undermined my struggles. The truth is that school has now become harder and more competitive than ever before. Those removed from the current educational environment simply don't understand the increased pressures and stresses of our daily lives as students. However, I understand it.

I spent years researching and applying what I learned to develop a four-stage learning system that has absolutely changed everything. It's allowed me to achieve my best grades ever while spending a fraction of the time. Fast forward, and now I'm a dean's list biomedical engineering student, on the brink of graduating with both my bachelor's and master's degrees simultaneously, concentrating in neuroengineering. Throughout, I've maintained a social life, pursued my fitness passions, created daily content as a hobby, and run a successful business.

Now, my main mission in life is to help all of you who crave the same guidance I wanted growing up. I want to ensure that you have the help I didn't receive, and hopefully, through that support, you can be more successful than me. This book is my way of unlocking your potential as a student, guiding you through every stage—from before class, during class, immediately after class, and finally, your revision. Welcome to your everyday tool, the "Learning System".

JUN YUH

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Introduction to the Book

You finally take the initiative to do well in school, create a study routine that sacrifices any social life or hobbies, work for hours on end, are constantly stressed and filled with anxiety… but all of this is worth that high score you will inevitably attain, right? Only to find yourself with your exam returned and that ugly red ink showing a grade much lower than you'd hope. Ouch.

Of course, your confidence would be shot! How could it not be? Then you approach the next study session with a little bit less vigor and find yourself getting a similar grade. So why study hard in the first place then, right? Why put yourself through all that suffering if your teacher is just going to affirm your deepest fears that school is only meant for those with high IQ's or "good" test-takers?

Since no sane person would want to constantly put themselves through this misery, the only logical solution would be to change the original goal and start spending time doing things that bring you much more joy like hanging out with friends, watching movies, playing sports, pursuing creative outlets, and scrolling on social media.

The problem here though, lies in the fact that you cannot turn off the voice in your head telling you to study because you know it's important for your future, not to mention your parents' disappointment if you were to continue failing. Therefore, this anxiety builds up within you and you can't even be fully present with the things that you love to do.

Although I resonate with these feelings deeply, my goal is to have you use the Learning System and realize something that you didn't know was possible: you can have it all. You can have really great grades, pursue multiple degrees at once, have a social life, still prioritize your mental and physical health, and explore your hobbies.

I believe it all comes down to learning how to learn. If you can make the most out of all four stages—priming, in-class notes, post-class immediate review, and revision—you can excel in your classes while spending a fraction of the time. Then you can fully enjoy everything else that you want to do! Since school refuses to teach you, let me.

Overall Goals of the Book:

- Introduce important learning strategies
- Teach you how to use the Learning System
- Show an example of filled-out pages
- Provide workbook pages for you to fill out daily
- Supplement with additional resources for students

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How This Book Is Structured:

Over the years I've tried so many variations of cadences for my learning system, and undoubtedly, the best method has been to split up my coursework into topics. From my own experience and the thousands of students I've spoken to around the world, each course typically covers a handful of main topics throughout a year. Some schools call these topics "course objectives", but in either case, each topic or course objective is spread across multiple classes. This is because each class is limited to the 60-90 minutes scheduled for it, but the information for the topic is so vast that it requires multiple classes to comprehensively cover the material.

Therefore, you will find each stage of the workbook—priming, in-class notes, post-class immediate review, and revision—is allocated once per topic. You will fill out the stages in the following manner:

- The "Priming" worksheets will be filled out once before any of the classes for a given topic.
- The "In-Class Notes" and "Post-Class Immediate Review" worksheets will be filled out during your first class and then added to during all the subsequent classes that you'll have for a given topic.
- The "Revision" worksheets will be filled out whenever you have it scheduled in your revision timetable. Remember to space out and interleave your revisions. See the "Revision Timetable" section at the back of the book for more information if you need help scheduling your study sessions.

You should be aware that each stage was allocated a very intentional amount of space for its respective workbook pages. For example, the "In-Class Notes" worksheets are limited to a few pages because you should be taking concise yet extremely effective notes. The "Priming" stage will have set you up really well to do this.

If you find yourself constantly needing additional pages, take it as a potential sign that you are writing too much. Remember, learning happens in your brain and not on a piece of paper. Therefore, your writing should not be a transcript of whichever resource you are using to learn.

By having all the stages for every topic organized into one book, you will have created an invaluable resource tailored specifically for you. It's unparalleled because it's filled with cues that YOU have created. It's not some sort of textbook written by an unknown author decades ago, instead it's your own writing and drawings that has helped you to deeply understand a topic. Therefore, when revisiting it months or years later (as knowledge often builds upon itself, especially in university), you can efficiently and effectively review your book to refresh your understanding.

*Additional note: If your teacher doesn't break down the topics for you ahead of time, use your syllabus to create them yourself. Identify what information is being taught in a few of your upcoming classes and create a title for the topic that encompasses all those classes. Do this for the other remaining classes as well until you have a list of topics that are expected to be covered throughout the semester. Bring that list to your teacher and confirm with them if you have created accurate topics. If not, ask for their help to revise the titles.

IMPORTANT BACKGROUND INFORMATION

Physiology:

Before delving into the techniques, I believe it's important that I at least introduce the physiological basis of what is happening when we learn.

First, we begin with sensory inputs which include visual or auditory stimuli that mostly go unnoticed and are subsequently forgotten.

If any attention is given to these inputs, they enter the working memory which is a temporary storage system where information is actively processed. The working memory allows us to hold and manipulate a limited amount of information simultaneously, enabling us to make sense of the inputs. Without further action, the working memory will forget the information within seconds to minutes.

For durable learning to occur, information from working memory needs to be transferred to long-term memory through a process called **encoding**. The long-term memory is able to then store the information for extended periods, ranging from hours to months. In order for the information to return back into the working memory for utilization, it must go through a **retrieval** process.
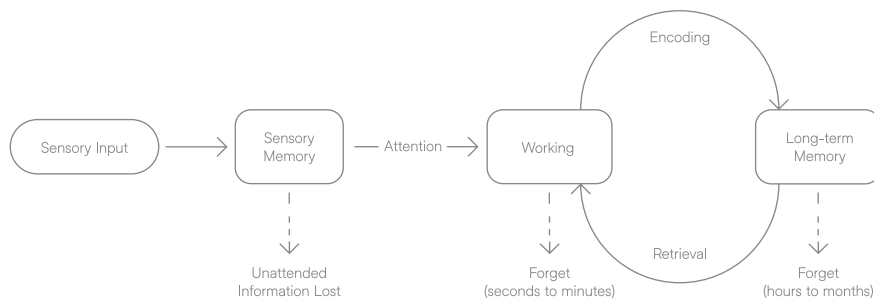
By understanding these cognitive processes, we can employ effective learning strategies that optimize the transfer of information between the working memory and long-term memory, ensuring better retention and recall of the material.

Let's first look at the *type of thought* we should be engaging in when learning new information.

Higher-Order Thinking

Bloom's taxonomy was first introduced to me by my high school social studies teacher who used it to frame his students' perspective on knowledge mastery. This later reappeared in my first year of university when I began researching cognitive science and learned that it serves as a backbone in teacher education and professional development programs. With a lot of practice, the model has become a foundational element of my learning system.

The hierarchy explains that there are tiers of learning outcomes that are identified based on the student's ability to manipulate the information. If the student can engage in thoughts that are higher-order, they will be able to possess a more profound comprehension of the material. This means they can delve into the subject matter beyond surface-level understanding, analyze it critically, solve complex problems, and think creatively, ultimately leading to a richer and more meaningful learning experience.
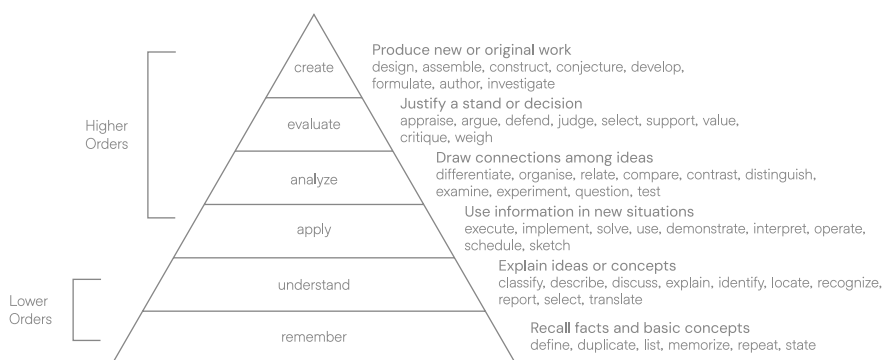
On the other hand, the bottom two layers, "remember" and "understand", are considered to be lower-orders of thinking which usually translates to a student's *inability* to solve complex inferential questions that require the synthesis of knowledge.

In order to more closely examine Bloom's Taxonomy in a practical manner, let's explore a real-life scenario where a student is attempting to master the topic of "photosynthesis" and how each tier of thought translates to a learning outcome.

1. Remember:	The student can regurgitate the equation for photosynthesis. ($6\ CO_2 + 6\ H_2O \longrightarrow C_6H_{12}O_6 + 6\ O_2$)
2. Understand:	The student can explain the roles played by organelles such as chloroplasts and chlorophyll.
3. Apply:	The student can apply their knowledge to predict how changes in temperature might affect the rate of photosynthesis.
4. Analyze:	The student can compare and contrast photosynthesis to other biological processes, like cellular respiration.
5. Evaluate:	The student can prioritize the key factors influencing the rate of photosynthesis, ranking them by their relative importance, such as light intensity, temperature, and carbon dioxide concentration.
6. Create:	The student can design an educational presentation to teach their peers about photosynthesis.

It's easy to imagine how the first two tiers wouldn't prepare the student properly for difficult exam questions, especially considering many teachers use Bloom's Taxonomy to generate their inferential questions in the first place. While remembering facts and understanding concepts can be helpful starting points, assessments, especially in university, often demand higher-order thinking.

A good example of a student that would struggle after secondary school is one that relies solely on cued recall in the form of flashcards for their studying. Flashcards simply require a student to make a connection between a term (cue) and a definition (target) for isolated and decontextualized facts. Therefore, the student may remember and understand the concept, but will fail to **apply**, **analyze**, **evaluate**, and **create** information for the more challenging inferential questions.

This type of student will typically be one that has either average or below average grades, because I GUARANTEE most students engage solely in lower orders of thinking. It's also important to mention that knowledge throughout your education will build on itself. Therefore, having a deeper understanding of the earlier material will set you up for success in later classes.

This principle holds profound significance for students pursuing fields like medicine, engineering, law, and other related disciplines. In these domains, the consequences of failing to recall prior knowledge or having a shallow understanding of a topic can be extremely severe such as death of patients or permanently losing your license to practice.

If you want to be a top student who will also make for an excellent professional, you must consider Bloom's Taxonomy when designing your encoding and retrieval practices for your learning system.

It Starts and Ends With the "Big Picture"

The failure to understand and apply this concept is often the main contributing factor for the downfall of students. They focus so much on understanding every minute detail of a concept before moving onto the next without ever considering how that information is relevant to the overall topic. Usually the consequences are the following:

1. They forget concepts they learned earlier and have to revise them repeatedly.
2. They fail to answer inference-based questions on exams which is the dominant form in higher education.

It's imperative to consider how information is structured within the long-term memory. In most cases, information isn't isolated from one another, instead, there is a highly interconnected web where concepts are grouped and related together in a manner that is relevant to the individual. The more connections the concept is able to have, the better the brain is able to consolidate the information and retrieve it later.

As an example, for most of my life, when I thought about the topic of fashion, I immediately considered related groups of information such as the occasion, season, and colors. These would follow a specific flow that was relevant to me when picking out an outfit. First, I would identify which occasion I was dressing up for, then I would ensure the outfit was appropriate for the season, and lastly I would find a color that conveyed my mood that day. A visual representation of this would look something like this:
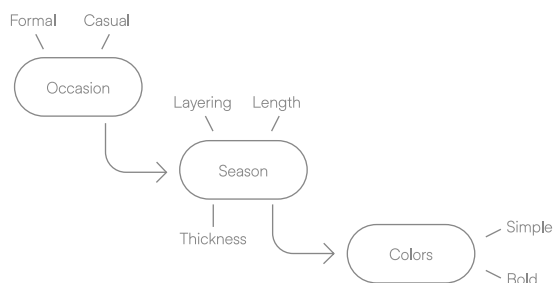
Recently, I've cared more to learn about fashion so I researched and identified a few more important concepts to consider when selecting an outfit such as my personal build, skin tone, and how colors and patterns coordinate with each other. In addition, the more I critically thought about the topic, the more connections I was able to identify. Therefore, new groups and relationships have formed in my understanding of the topic which have helped me select better outfits. My new knowledge flow would look something like this:
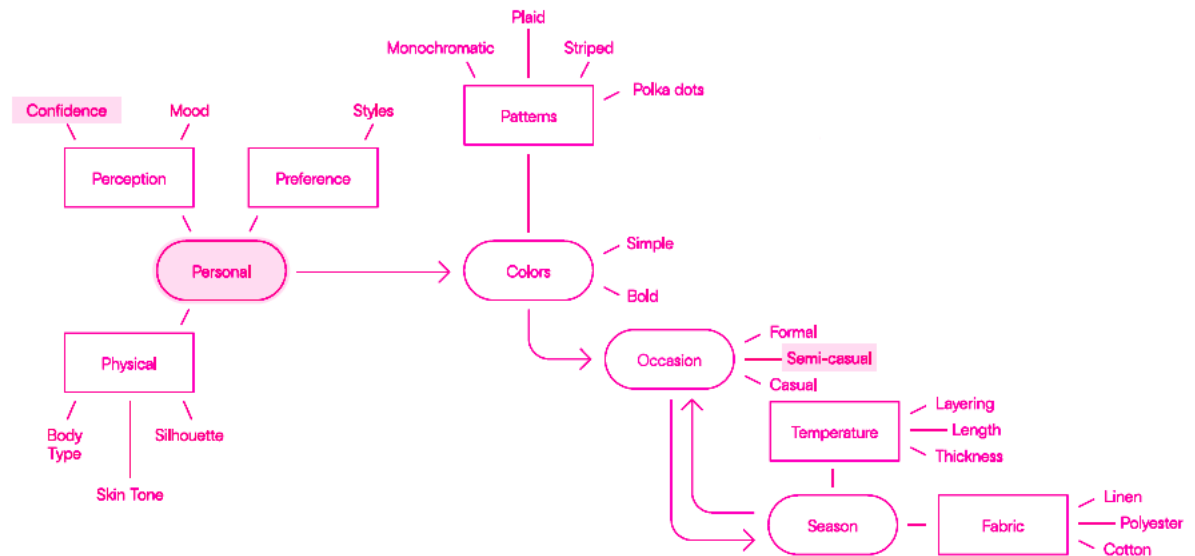
How can we leverage our understanding of the brain's natural desire to form connections in order to better process information and retain it?

Before class, we use the powerful learning strategy of chunking to break down the large amount of information into more manageable groups. Then we relate those groups together in order to form a big picture understanding of the topic. By doing this, you will have created a framework for newly learned details in class to immediately be linked to. Therefore, each piece of information will have many connections to it so our ability to process and retain the information is greatly improved.

Moreover, you will use this big picture understanding to answer inference-based questions on exams. Since you will have learned the material initially in a way that all the information is highly interconnected, you will be able to better synthesize different concepts together to solve those challenging questions.

Spider Web Analogy

When encoding and retrieval practices can be designed to work optimally in tandem, the learning benefits tremendously. A great analogy to consider is a spider creating its web in order to capture prey.

1. The spider establishes the foundation with borders and radial lines for other threads to connect to.

3. It lays down sticky threads that spiral inward from the outer edge towards the center.

2. It reinforces the foundation by adding additional threads.

The result is a perfectly crafted web that enables the spider to not only capture all of the prey that lands within it but also enables the spider to efficiently retrieve its food later.

If you were to ever watch a video of a spider doing this, you would undoubtedly gain a profound appreciation for how intricate and deliberate this process is.

How does this apply to learning?

If you can meticulously design your learning system to behave like the web where it **captures all the new information** into your brain in an organized manner to then be able to **retrieve the information efficiently** when you need it on exams... that would be amazing, right?

1. Establish a framework: Begin by identifying **major groups and relationships** that help you form a clearer "big picture" so that all new knowledge can be connected to it.
2. Visualize knowledge: Reinforce the foundation by visually representing this framework, illustrating the **structure and flow** of your knowledge.
3. Increase relevance: Take a short pretest to further analyze how different concepts **come together** to solve a problem and utilize the **hypercorrection effect** to make information introduced to you in class "stickier".

Having done the work during the priming stage frees up your attention for when you're in class, allowing you to ACTUALLY listen to the teacher while also being able to take notes more effectively and efficiently.

As the teacher speaks, you can capture and immediately organize the information onto your framework, while benefiting from the hypercorrection effect to reinforce the pretest material. Furthermore, this active engagement enables you to create quality questions for review later.

By this point, you would have set yourself up to have really successful active recall revision utilizing the review questions from class, blurting method, Feynman technique, and practice tests. Just a few rounds of these and you can be sure to score at the top of your class.

Defining Active Recall

Active recall involves the deliberate and effortful retrieval of information from memory without referring to the source material. Unlike passive techniques, where students are prone to overestimating their competence, active recall offers an accurate self-assessment of their understanding. Additionally, this technique facilitates higher-order thinking as per Bloom's Taxonomy, including synthesizing, reorganizing, comparing, applying, and contextualizing information.

When students employ active recall, they create meaningful structures in their brains, connecting concepts to form deeper impressions in their memory. Integrating it into a student's learning system can significantly enhance understanding and improve retention. Moreover, this approach closely mirrors typical exam assessments, helping students minimize errors and apply their knowledge effectively under pressure.

Among the numerous revision techniques I've personally employed, active recall has proven to be the most effective in improving my grades while reducing the overall time spent studying. This isn't just my personal experience but has been consistently demonstrated in numerous studies. Instead of delving into every study individually in detail, let's focus on a set of experiments published in 2011 by Karpicke and Blunt.

Examining the Scientific Research for Active Recall
Introduction of Experiments 1 & 2

This study used two separate experiments in order to compare the effectiveness of encoding and retrieval practices on long-term retention. The study aimed to challenge two assumptions regarding human learning:

1. Learning happens mostly through the encoding process.
2. Retrieval can measure how well previous information was embedded into memory but does not produce learning itself.

These two assumptions have kept most education research focused on enhancing the processing that occurs when students encode knowledge. As a result, methods like highlighting, rereading, and summarizing have gained widespread popularity within the field.

Moreover, novel elaborative *encoding* methods were believed to offer additional benefits, leading educators to heavily rely on them. In both experiments, students were instructed to create concept maps as a means to illustrate elaborative encoding.

Experiment 1

Eighty undergraduate students participated in the first experiment where they were separated into the following four separate groups:

1. Study (1x): These participants studied the text in a single study period.
2. Repeated study (4x): These participants studied the text in four consecutive study periods.
3. Concept mapping: These participants studied the text and then created a concept map of the concepts while still viewing the text.
4. Retrieval practice: These participants studied the text and then recalled as much of the information as they could on a free recall test.

* The total amount of learning time was exactly matched in the concept mapping and retrieval practice conditions.

After the study sessions for the four groups, the students predicted the percentage of information that they would retain in one week—this was called their "metacognitive predictions".

Then after one week had passed, the students returned to the lab for testing, where they were presented with two types of questions that required short answer responses. The two types were:

1. Verbatim questions which assess conceptual knowledge stated directly in the text.
2. Inference questions which require students to connect multiple concepts from the text.

These were the results of their test performances along with their metacognitive predictions:
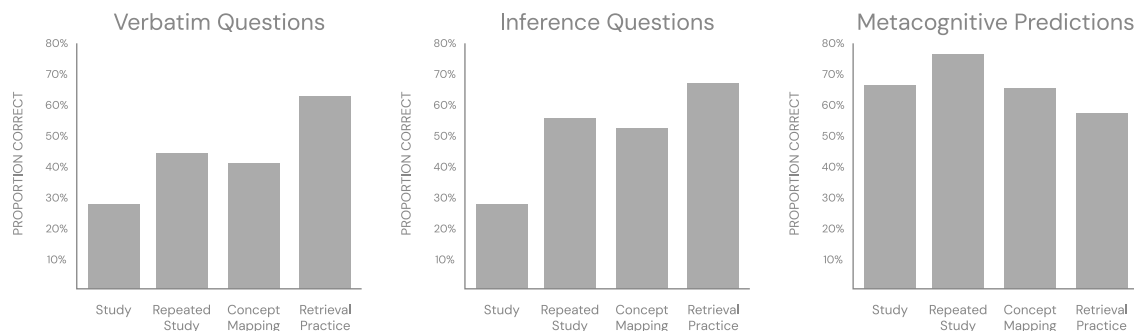
The group that studied once clearly had the worst long-term retention, and there wasn't much difference between the repeated study and concept mapping groups. However, retrieval practice emerged as the clear winner, surpassing all three groups by a significant margin. Collapsed across question types, retrieval practice had a 50% improvement over concept mapping.

Interestingly, the metacognitive predictions were extremely inaccurate. Repeated study was expected to yield the highest long-term retention, while the retrieval practice was expected to fare the worst. Additionally, the perceived effectiveness of studying once and concept mapping was overestimated.

These predictions illustrate the false sense of understanding that arises with various encoding methods. Students may believe that they have fully grasped the content, but in reality, they've only familiarized themselves with the surface-level information without ever identifying gaps of knowledge and truly comprehending its deeper meaning.

Many students often rely on repeated study methods and experience burnout as a result. However, consider the possibility of achieving significantly higher grades on your exams by investing a fraction of the time through the use of active recall. This experiment clearly demonstrates the potential benefits of active recall in improving academic performance.

Experiment 2

These brilliant psychologists weren't done yet. They conducted a second experiment that also considered two types of information structures:

1. Enumeration structures: These refer to texts that describe a list of concepts or items.
2. Sequence structures: These refer to texts that describe an ordered series of events.

There were a total of 120 participants as they studied either with concept mapping or retrieval practice. Similar to Experiment 1, they were brought back to the lab after a week for testing. However this time, there were two forms of testing:

1. Short answer: This test type would closely mimic the retrieval practice study method.
2. Concept map: This test type would closely mimic the concept map study method.

They added this element to the study design to mitigate the potential influence of the similarities between the retrieval practice and the testing scenario in Experiment 1. The aim was to ensure that the observed results were not solely attributed to these similarities.

In theory, if the retrieval practice was indeed superior to the concept mapping as a study method, then there should be similar results with the concept map tests. That is precisely what they saw.

Final Short Answer Test

Sequence Texts

PROPORTION CORRECT

80%
70%
60%
50%
40%
30%
20%
10%

Concept Mapping — Retrieval Practice

Final Concept Map Test

PROPORTION CORRECT

80%
70%
60%
50%
40%
30%
20%
10%

Concept Mapping — Retrieval Practice

Final Short Answer Test

Enumeration Texts

PROPORTION CORRECT

80%
70%
60%
50%
40%
30%
20%
10%

Concept Mapping — Retrieval Practice

Final Concept Map Test

PROPORTION CORRECT

80%
70%
60%
50%
40%
30%
20%
10%

Concept Mapping — Retrieval Practice

The results for enumeration texts showed that retrieval practice outperformed concept mapping on both test types. Similar results occurred for the sequence texts as well. These findings confirmed the results of Experiment 1, indicating that studying with active recall was superior to their elaborative encoding technique.

Due to the remarkable effectiveness of active recall, it is crucial to incorporate it into every aspect of your routine, including before, during, and after class. You'll be amazed at how quickly and drastically it can enhance your comprehension and long-term retention of the material.

Active Recall Applications

Let's break down five highly effective methods of applying active recall that you can adopt immediately.

1   **Pretests**

Proactively identify questions that relate to the upcoming topic using the syllabus, textbook, past papers, and any other pre-class notes given. Narrow your list of questions to just a few of the best ones and give a genuine effort as you answer them.

Remember, new information in your classes usually build upon previously learned material. Therefore, if you have deeply understood the prior topics, you will find that you can navigate the new topic well enough to at least attempt to answer questions. Since you haven't learned all the details of the new topic just yet, it is likely that you will get many of the questions wrong. That is okay as you are trying to benefit from the hypercorrection effect which is the tendency to remember and learn from corrections more effectively than if you were to answer right initially.

As you sit in lecture, you will subconsciously be undergoing the correction process identifying gaps in knowledge or understanding. This will keep you more alert throughout class, enabling you to pick up on subtle yet important links between concepts.

You want to know why those high performing students seem to grasp the lecture information way quicker than you do? It's because it's not their first time actively engaging with the material. Don't let it be your first time either. Take your preparation to a whole new level with your priming stage, which includes your Diagram I and a pretest.

2. In-class active recall questions

Don't overthink this when you are first starting out and just create basic questions that clarify fundamental concepts or definitions. You can simply take the title of a slide and change it into a "What is…" question.

For example, I was learning about electronic filters used in medical devices during my Bio Measurements lecture. One slide had a title that read "Use of Operational Amplifiers'', so my question became, "What is an operational amplifier?".

Once you become more familiar with the process, you should aim to reduce the number of questions and increase the quality of each one. Start asking yourself, "How could this information be tested on an exam?" and look to create questions that facilitate higher-order thinking. "Why" and "how" questions that relate to the big picture of the topic or previously learned concepts are great ways to do this.

Once class is over, you now have a perfect revision guide to implement active recall. Go through all your questions from class and do your best to answer them as in-depth as possible.

For example, if the question was, "What is hydrocephalus?" you would start by answering with the definition but follow up with anything else that you can remember.

"Hydrocephalus is the accumulation of central cerebrospinal fluid within the ventricles of the brain [simple definition].

This can exert dangerous amounts of pressure on the surrounding brain tissue, potentially leading to death and could require an operation for drainage. In some cases, shunts are required to be able to return to a normal life [additional information from recall]."

The goal here is to struggle. It's not necessarily about getting every question correct, but rather working through the retrieval practice to stimulate your brain and optimize for long-term learning.

*Pro tip: try not to write out all your answers to these questions as this can unnecessarily take up a large amount of time. Instead, just go through the process of answering these questions verbally. You could even record your answers with your phone to listen to your responses while commuting between classes or during your down time for further revision.

If you find yourself struggling on a particularly difficult question, revisit the lecture slides and identify a thorough answer by looking at the neighboring information. Then, you can write down a simplified version of it for you to refer to later.

3. Blurting method

Blurting is an active recall technique that involves reading a section of a textbook or listening to a lecture and then closing the source and writing down as much of the information as you can remember.

Once completed, you then reopen the textbook or the lecture and compare it with what you have written in order to see which areas your recall was good on, and which areas might need more work.

Let's see this in practice with an example of learning Korean from a textbook:

Step 1: Identify the material you want to cover in your first attempt. Avoid taking on too much information at once, instead elect to break down material into logical chunks. For our example, perhaps we identify vowels as the first concept to cover.

Step 2: Familiarize yourself with the material. Read about the graphemes of Korean vowels, negative and positive nuances, and pronunciations. The goal here is not to remember everything immediately! So don't be discouraged if the information seems really difficult initially.

Step 3: Close the textbook and get out a pen and paper. Begin writing everything that you can remember about the material. You'll be surprised to see that remembering one part of the word can sometimes help you remember a different part of the word or a different word entirely. Therefore, be sure to give yourself enough time to retrieve everything that you can but aim to keep it within a reasonable time frame. I suggest no longer than 15 minutes.

Step 4: Open up the source and revise your initial understanding. Add additional information to fill knowledge gaps and correct inaccurate information.

Step 5: Reiterate steps 2-4. This technique gets better the more you do it, so again, do not be discouraged if you only recall a small portion of the vowel concepts in the first attempt. As you go through the iterations, you will be able to recall more. Also, you'll find yourself naturally starting to remember information in clusters. Putting these ideas on the page closer together and creating linkages between separate ideas, are additional great methods to deepen your understanding of the material.

Blurting is such an effective strategy because of these two reasons:

1. You are actively organizing the information inside your brain and thereby reducing the interference between various memories.
   - For example, you might get confused between two Korean vowels initially, but the blurting method will create distinguishing boundaries between them allowing you to gain a better understanding of their differences and similarities.
2. You are simulating exam conditions. In higher education settings, it is rare to be given simple definition questions with the same cues from your study material. Instead, it is much more likely that you will be given inference-based questions that require you to synthesize new cues, extract all related information from memory, and apply them to solve novel problems.
   - Going through the blurting method prior to your exam, makes it much easier to create these linkages in real time when the pressure is high.

4. Feynman technique

After being able to answer these questions so that you can generally comprehend the information, take it a step further and implement the Feynman technique which involves you teaching the information so that a fifth grader can understand it.

Breaking down a concept into simple terms typically reveals knowledge gaps that you were unaware of initially and gains you a better understanding of the information as you connect ideas to bridge those gaps.

Where you discover holes that cannot be filled with your present knowledge, you should target for future study. Continuing this reiteration a few times will allow you to narrow the scope of your study substantially.

Moreover, being forced to think critically about the underlying principles and applications when simplifying complex concepts encourages higher-order thinking and leads to long-term learning as well.

As you successfully articulate the information, you are providing evidence of your expertise increasing confidence and further reinforcing learning.

Finally, this practice bodes well as you prepare to enter higher learning institutions and ultimately the workforce where you will certainly be expected to present information to others. Many times your audience members will not be subject matter experts whereas you very much could be especially if the information is part of your own findings.

To be successful in these presentations, you must be able to break down complex concepts into its fundamental components while adhering to the interests of the particular audience at hand. Getting into the habit of implementing the Feynman technique now will allow you to tackle this challenge later with more ease.

Pro tip: You don't always need an actual person to do this with. I study almost exclusively alone, so if I wasn't hopping on a call to do this with a friend, I was simply pretending to talk to someone. Go ahead and grab your favorite stuffed animal and explain the concepts to it.

A great part about going through the practice with a person though is that they can point out areas of weakness that you might've overlooked. In order to compensate for this, I would recommend using a video or voice recording that you can replay to critique yourself.

5. Practice Tests

Problem sets are arguably the single greatest resource you could utilize in preparation for an exam. However, they are often misused. It is common to see students simply read a question, make one attempt, check the correct answer, and quickly move onto the next question.

Similar to the passive techniques mentioned before, this creates an illusion of knowing rather than promoting any durable learning.

The appropriate method would be the following:

1. Put away all notes.
2. Read the question.
3. Attempt to answer <u>thoroughly in writing</u> on the exam itself or on a separate blank sheet of paper.

   - In the case of multiple-choice questions, don't solely concern yourself with why an answer is correct. Instead, take another minute to explain why the others are incorrect.

4. If you are stuck initially, give yourself a few more minutes to actively work through the problem creating linkages between related concepts as you would in the blurting method.
5. If you are still stuck, go back to your material from the priming, in-class notes, and post-class immediate review stages in an attempt to retrieve the correct answer from cues you have created.

6. If you remain stuck, then this is when you pull out your lecture or textbook and search for the information utilizing neighboring concepts to thoroughly provide the best answer possible.
7. Check the correct answer and explanation. If your answer choice closely matches, then great! You have successfully revised the material necessary to correctly answer other similar questions and can use your explanation for future revisions.

If your answer choice doesn't match, also great! You have identified gaps of knowledge that you know to cover before the actual exam day.

Either way, the difficult retrieval practice you had just undergone will certainly lend itself to better long-term retention than if you had simply utilized a passive technique.

I understand this process can seem very time consuming and it's likely that you are questioning its sustainability while managing other classes. I would urge you to view this method along with the others that I have mentioned with a wider lens.

Yes, they are more challenging and tedious at first, but you won't need to revisit the material as many times nor for as long each time. Therefore they will actually save you a number of hours, perhaps even days when preparing for your cumulative exams (i.e. midterms and finals).

Pro tip: Ask your teacher for past papers if they aren't already provided. There is nothing more effective in narrowing your scope of study than seeing a previous year's exam for that specific class. Of course, the questions won't be identical, but at the very least they will provide you with valuable clues such as content emphasis, exam structure, and potential mistakes.

If you apply the 7-step revision process outlined above to a past paper, you will be setting yourself up to have tremendous success come exam day.

Additional pro tip: Have at least one session that closely mimics the conditions you'll have during the exam. Anxiety often stems from lacking control, and that applies certainly for test taking. If you have experienced similar conditions prior to exam day, you will be more comfortable and focused on the things that matter. Here are some key elements to consider simulating:

- *Time constraints*
- *Testing environment*
- *Materials allowed*
- *Tools and stationery (i.e. blue pens, calculators, rulers)*
- *Scheduled breaks*

Additional Note

As you begin to read the instructions for each stage of The Learning System and engage in meaningful practice with the prompts given, you will find that the best part about this system is that it can be fully customizable depending on your specific situation. In the case of a very hard class with a lot of important content, you should execute each step thoroughly. On the other hand, in the case of a very easy class with much less important content, like an elective, you can scale down each of the steps significantly and do less iterations when revising.

Just remember that these principles are applicable to all your classes, whether they are in language arts, mathematics, science, social studies, foreign languages, business, or any other subject. Engaging in each of these stages helps you create meaningful structures with the various concepts. Understanding how to chunk information, establish relevant relationships, and apply critical thinking through Bloom's Taxonomy enhances your ability to encode content effectively, while active recall supports more efficient revision.

HOW TO USE
THE SYSTEM

PRIMING: DIAGRAM I

Time to create your "spider web" in order to capture all new information in the future. Before we get into the instructions, remember to engage in higher-order thinking while forming a "big picture" understanding. Refer back to the "Important Background Information" section if you are unclear.

Read the instructions and utilize the prompts in the respective workbook pages to guide you.

Instructions:
1. Check the syllabus to identify the upcoming topic.
2. Gather all your resources with information about the topic. These could be textbooks, presentation slides, or online modules.
3. Skim your resources while making a list of key concepts. These key concepts can be from bolded terms, headings, graphs/images, and repeated words.
4. Research unfamiliar concepts on the list.
5. Compare the concepts together and create groups based on their similarities and differences.
6. Identify how the groups are related to each other. Make those relationships relevant to you by:
   - Connecting the information to your prior knowledge
   - Relating it to your personal experiences or interests
   - Asking questions like "why is this group important?", "how can it be used?", and "how does it affect another group?".
7. Create a diagram that illustrates the groups and relationships.
8. Once you are happy with your diagram, transfer it to the "In-Class Notes: Diagram II" page. As you get more familiar with this, save yourself the time and just immediately create it on that page. We've provided the space here mainly for beginners who want the ability to try out various arrangements of their groups and relationships without worrying about making a mess of their final copy for the priming stage.

PRIMING: PRETEST

Instructions:
1. Identify a few practice problems related to the topic using resources such as textbooks, online modules, YouTube videos, past papers, or any other pre-class notes provided to you.
2. Using Diagram I to guide you, pay close attention to how the various concepts come together in order to solve the questions.
3. Attempt to answer with the best of your knowledge. Even if you have no idea how to solve a problem, write down a preliminary outline of steps that you potentially may need to follow in order to come up with a solution.

The goal here is NOT to get every single one of these questions right because you haven't been exposed to all the information yet. Instead, you are trying to benefit from the hypercorrection effect. This effect refers to the tendency to remember and learn from corrections more effectively than if you were to answer the questions right initially.

As you sit in lecture, you will subconsciously be undergoing the correction process identifying gaps in knowledge or understanding. This will keep you more alert throughout class, enabling you to pick up on subtle yet important links between concepts.

IN-CLASS NOTES: DIAGRAM II

Stop writing down everything the teacher says because:
1. You cannot write as quickly as someone speaks so you will miss important information.
2. It does not require any active engagement and therefore no meaningful learning is actually occurring.

Instead, actually LISTEN to the teacher (80% of your attention) and take concise yet effective notes (20% of your attention). The priming stage has enabled you to do this by laying the groundwork and shifting your focus on the crucial content.

Remember, our brains' ability to deeply understand and then remember a piece of information is greatly improved when there are more relevant connections to it. When you annotate the new information presented in class directly onto your diagram from the priming stage, you automatically establish meaningful linkages between related concepts.

This process ensures that all new pieces of information become relevant, enabling you to quickly and deeply process the information.

Your Attention

80%

20%

■ Your Teacher
■ Notes

Diagram II should have new groups, subgroups, relationships, and illustrations to capture all the new important pieces of information. Anticipate that this version of your diagram will be the messiest and that is okay. Don't waste your time perfecting it now because you will have time to do that during the "Post-Class Immediate Review" stage. Quicky make your annotations, and then return to listening to the teacher with your full attention.

IN-CLASS NOTES: KEY OBSERVATIONS

While in class, you might encounter information that doesn't seamlessly fit into your Diagram II. Instead of getting distracted with finding the perfect arrangement now, simply just note it in your "Key Observations" section. There will be time to effectively organize it later. Additionally, leverage the hypercorrection effect by noting key ideas you initially got wrong in the pretest material. Lastly, reinforce the concepts you answered correctly by making a note of those too.
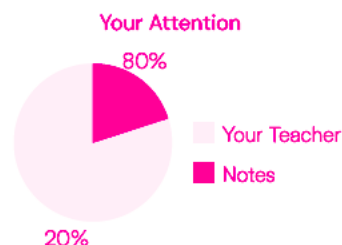
IN-CLASS NOTES: ACTIVE RECALL QUESTIONS

Arguably, the most important part of your in-class notes involves creating a list of active recall questions for you to review later. As per the "Active Recall Applications" section of the book's background information, you can start with simple definition questions. Eventually, you want to reduce the number of questions while increasing the quality of each one. Here are some examples of advanced questions:

- How does this information relate to what we've previously learned?
- Can you provide an example that illustrates this concept?
- Why is this information important?
- What are the potential real-world applications?
- Can you explain the steps/process involved in this phenomenon?
- What are the main variables that influence this outcome?
- How does altering a variable affect the outcome?

Moreover, some teachers do an excellent job of asking important questions throughout their class. This section is a perfect place for you to write down those too.

You shouldn't concern yourself with perfecting any of these questions now. Just jot down their basic form and move onto identifying the next question immediately. It's more important that you don't miss out on any of the information, which can easily happen if you're spending additional time fixing the wording. Make the questions legible and move on.

POST-CLASS IMMEDIATE REVIEW: REFLECTION

Hermann Ebbinghaus, one of the most brilliant psychologists of the late 19th century, developed the concept of the "forgetting curve". Through a series of experiments, later confirmed by modern neuroscience, he demonstrated that humans tend to forget a significant portion of newly learned information in a short time.

By reviewing for just 30 minutes before going to sleep, you can combat the forgetting curve considerably. First, integrate the "Key Observations" onto Diagram II and refine it. Next, clean up your active recall questions and spend some time answering them aloud. Simply verbalizing them or recording with voice memos should be sufficient for our purposes here, but make use of the "Notable Answers" box on the "In Class Notes: Active Recall Questions" page to write down important ones you want to emphasize. This way you can quickly look back on it later if you need to review.

The main objective of this stage is to build an awareness of your strengths and weaknesses up to this point so that you can better target your revision later. Therefore, finish by filling out the reflection prompts in this section.

REVISION: DIAGRAM III

Utilize the checklist provided in this section to construct Diagram III. Engage in higher-order thinking as you reorganize and simplify the groups and relationships. The main objective is to create a resource in which you can immediately process the knowledge that it depicts. By doing this, you will be able to return to it at any time and review all the information in an efficient and meaningful way. You will find that this process requires deliberate effort, so take your time to thoroughly complete each objective. It will be well worth it as you get into the active recall applications.

REVISION: BLURTING METHOD

Make use of the groups and relationships you've formed in your Diagram III in order to help you freely recall the information. You'll find remembering certain concepts will help you remember others because you have a clear understanding of how the different pieces fit to form the overall picture of the topic. *Check the "Active Recall Applications" section within "Important Background Information" for detailed instructions.*

REVISION: FEYNMAN TECHNIQUE

Test your knowledge by creating a simplified and accurate story of the topic so that it can be easily understood by a fifth grader. Identify the most important ideas that need to be included and then an appropriate order for them to be explained in. Supplement your story with analogies and examples. *Check the "Active Recall Applications" section within "Important Background Information" for detailed instructions.*

REVISION: PRACTICE TEST

All questions on past papers are usually fair game so it's imperative that you pay close attention to the ones you are weak in. Keep account of these so that you can allocate more time to the topics involved leading up to your exam. By also including the simplified solutions, you will have created a perfect "cheat sheet" for your weaknesses to quickly review right before the exam. *Check the "Active Recall Applications" section within "Important Background Information" for detailed instructions.*

REVISION: ADDITIONAL QUESTIONS

Write down any other important questions that you have collected throughout the four stages. Similar to the "Revision: Practice Tests" section, this list of questions will become a "cheat sheet" for your weaknesses that you can quickly review before your exam.

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

_____

_____

_____

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Topic: _Neural Signals: Action Potentials [topic 4]_

What are the main concepts for this topic?

– Na+ channels   – Tetraethyl Ammonium (TEA)

– K+ channels   – Driving Force

– Tetrodotoxin (TTX)

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

TTX: Neurotoxin that binds to Na+ channels

TEA: Neurotoxin that binds to K+ channels

After comparing the concepts together, what big groups can you form based on their similarities and differences?

TTX
TEA   ] control mechanisms

Na+ channels
K+ channels   ] membrane constituents

Na+ currents
K+ currents   ] parameters

Nernst
Driving Force] membrane potential

How do these groups relate to each other? Use arrows to show the relationships here.

control mechanisms –> membrane constituents
       [turns off certain channels]

           membrane constituents –> membrane potential
                   [controls how ions move]

                   membrane potential –> parameters
                           [visualizing ion movement]

K+ channels

Na+ channels

membrane constituents

control mechanisms

TTX

TEA

membrane potential

Nernst

Driving Force

parameters

K+ current
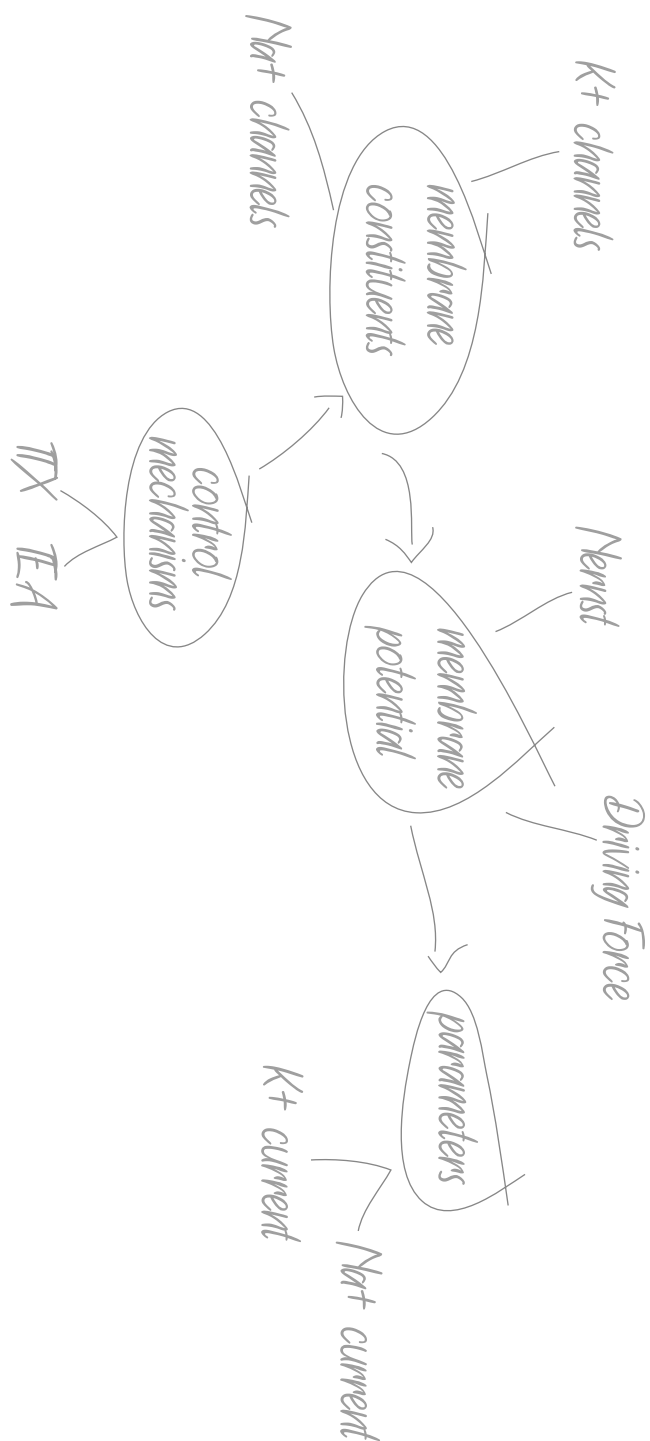
Na+ current

Topic: _Neural Signals: Action Potentials [topic 4]_

Question 1 _How would you isolate Na+ channel?_

Answer	_Use a fluorescent to highlight Na+ channel._		
Comments	_No because highlighting does not prevent other channel from being active. Instead, you must inhibit K+ channel._	Mark	_Incorrect._

Question 2 _How would you isolate K+ channel?_

Answer	_Use a fluorescent to highlight K+ channel._		
Comments	_Must inhibit Na+ channel._	Mark	_Incorrect._

Question 3 _Draw an action potential graph_

Answer			
Comments	_"going up" = depolarizing "going down" = repolarizing_	Mark	_Correct._

Question 4 _What effect do Na+ ions have on membrane current?_

Answer	_Ion going into cell so it's negative._		
Comments		Mark	_Correct._

Question 5 _What effect do Cl- ions have on membrane current?_

Answer	_Ion going into cell so it's negative._		
Comments	_Current is impacted by direction and charge. Behaves similar to K+ current._	Mark	_Incorrect._

Question 6

Answer		
Comments		Mark

Question 7

Answer		
Comments		Mark

Question 8

Answer		
Comments		Mark

Question 9

Answer		
Comments		Mark

Question 10

Answer		
Comments		Mark

Analogy: Salty Banana

membrane constituents

① Na+ channels

② K+ channels

③ Cl– channels

$$E_x = \frac{RT}{ZF} \ln \frac{[x]_o}{[x]_i}$$

Nernst

membrane potential

Driving Force $= V_m - E_x$

control mechanisms

neurotoxins

TTX	TEA

Na+ channel

parameters

voltages [Na+, K+]

K+ current

Cl– current

Na+ current

current

transient

time

current

persistent

time
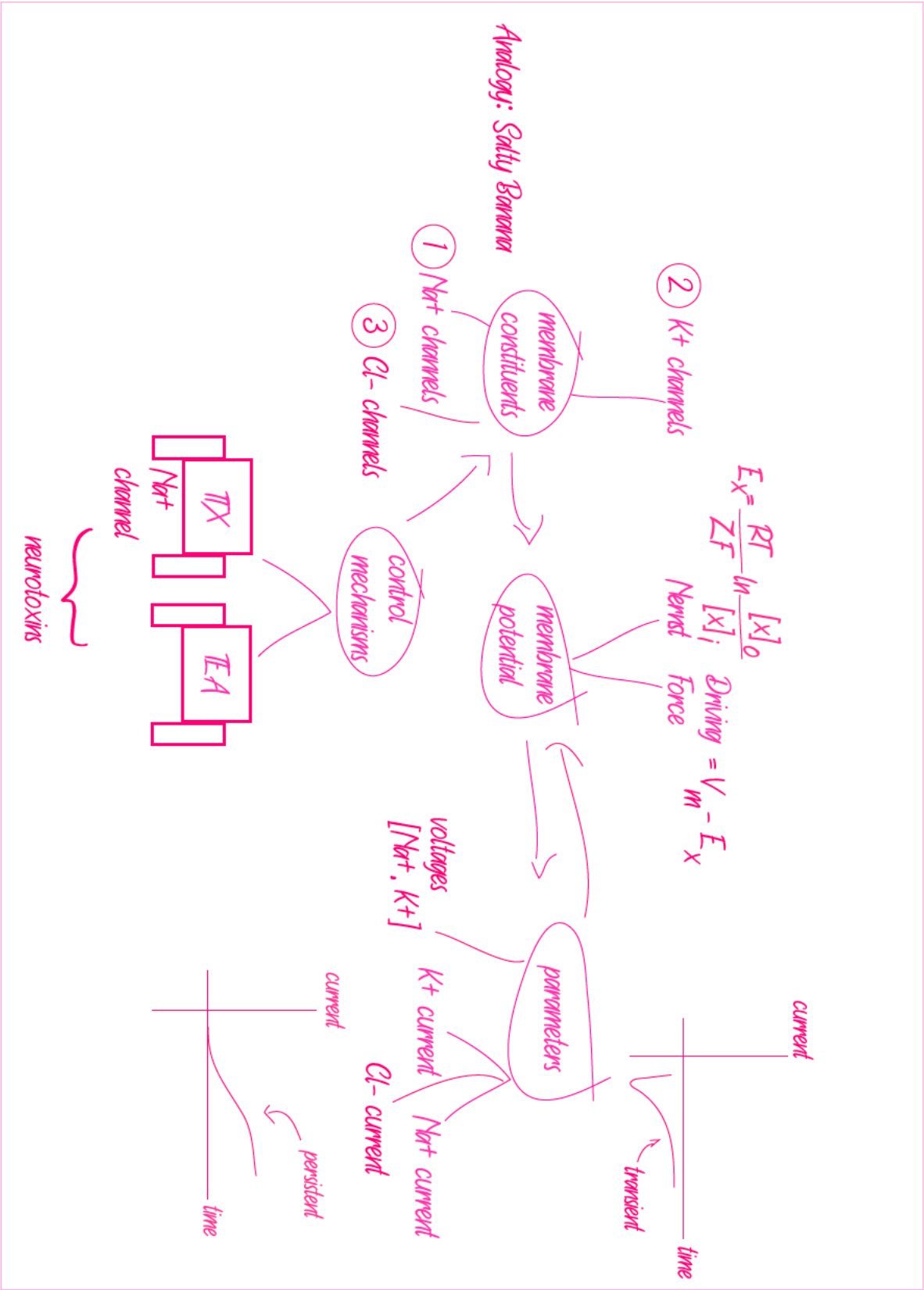
Topic: *Neural Signals: Action Potentials [topic 4]*

Key observations for this topic

- *passive vs active properties*
  - *passive = resistance and capacitors don't change*
  - *active = regenerative*
- *to start, more K+ inside & more Na+ outside*
- *Hodgkin and Huxley: math model for action potential*
- *voltage clamp is used to keep membrane at specific potential by injecting current*

- *K+ current = persistent*
- *Na+ current = transient*

Key ideas that you got wrong on the pretest

- *use TTX to inhibit Na+ channels*
- *use TEA to inhibit K+ channels*
- *current depends on charge too, not just direction*

Key ideas that you got right on the pretest

- *ions going into cell = negative current*
- *ions leaving cell = positive current*
- *action potential graph*

IN-CLASS NOTES: ACTIVE RECALL QUESTIONS

Topic: *Neural Signals: Action Potentials [topic 4]*

Q#	Question	Mark	Q#	Mark
Q1	What determines V_m and i_{ij} relationship without cable?	X	Q14	Mark
Q2	What determines V_m and i_{ij} relationship with cable?	✓	Q15	Mark
Q3	What would happen if neurons try to communicate only through passive conductors?	✓	Q16	Mark
Q4	Why do we need regeneration?	✓	Q17	Mark
Q5	Which current is transient? Why?	X	Q18	Mark
Q6	Which current is persistent? Why?	X	Q19	Mark
Q7	Are Na^+ and K^+ channel conductances constant?	✓	Q20	Mark
Q8	Why does depolarization happen?	✓	Q21	Mark
Q9	What is meant by "repolarization"?	✓	Q22	Mark
Q10	Why does hyperpolarization happen in action potentials?	✓	Q23	Mark
Q11		Mark	Q24	Mark
Q12		Mark	Q25	Mark
Q13		Mark	Q26	Mark

Question #	Notable Answers
1	Radius, R_M, C_M, time constant, length constant
5	Na^+ current = transient, returns to initial value
6	K^+ current = persistent, curve plateaus

Topic: _Neural Signals: Action Potentials [topic 4]_

Which concepts are the most challenging for you so far?

- Nernst
- Driving Force
- Transient & persistent currents

Which concepts do you feel really strong about?

- Starting ion concentrations inside & outside of cell
- Order of channels opening [Na+ –> K+ –> Cl–]
- Neurotoxins as control mechanisms

How are these concepts related to the ones you've previously learned?

Na+ channels | currents }
K+ channels | currents   } all related to
Cl– channels | currents } action potential
                            graph
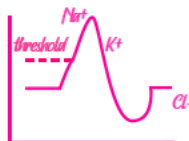
Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

Yes for the most part.
Need to reorganize groups of membrane potential and parameters/form different relationships.

PROMPTS FOR REORGANIZING

☑ Is your diagram nonlinear?

☑ Have you considered other groups, subgroups, and relationships?

☑ Are the groups and relationships structured so that they make sense to you intuitively?

☑ Do your arrows depict accurate cause and effect relationships?

☑ Have you organized your groups on the page so that your arrows don't overlap?

☑ Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☑ Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic: *Neural Signals: Action Potentials [topic 4]*

PROMPTS FOR SIMPLIFYING

☑ Is all the information in the diagram crucial?

☑ Are you able to identify which pieces of information are most important?

☑ Can you justify why certain pieces of information are more important than others?

☑ Have you considered bigger groups that could further generalize ideas that are less important?

☑ Have you created enough subgroups to make the information easily digestable?

☑ Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

☑ Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

$$E_x = \frac{RT}{ZF} \ln \frac{[x]o}{[x]i}$$

Nernst

Driving Force $= V_m - E_x$

resting membrane potential

salt

Red

Analogy-Salty banana

leak channels

① Na+

sodium potassium pump

③

② K+

voltage-gated channels

membrane constituents

control mechanisms

TX / Na+ channel

TEA / K+ channel

} neurotoxins

ion transport

parameters

voltages

currents

Na+ = Cl-

K+ current

membrane potential

+30
0
-55
-70

① Na+ Vgc

② K+ Vgc

③ Sodium Potassium Pump

All or nothing

time

I transient

time

I persistent

time

Topic: *Neural Signals: Action Potentials [topic 4]*

Which groups are the most important to recall?

Iteration #	Groups
1	voltage-gated channels, ion transport, parameters
2	voltage-gated channels, parameters
3	parameters, resting membrane potential

Which relationships are the most important to recall?

Iteration #	Relationships
1	voltage-gated ion channels → parameters, ion transport
2	voltage-gated ion channels → parameters, ion transport control mechanisms -> membrane constituents
3	voltage-gated ion channels -> parameters

After completing, where were the knowledge gaps?

Iteration #	Knowledge gaps
1	• which ions are responsible for which part of action potential graph • function of neurotoxins • resting potential voltage value
2	transient vs persistent current curves
3	None

Keep track of your progress here after each iteration.

Iteration #	% Recall	Comments
1	40%	start with voltage-gated channels
2	75%	transient = K+ persistent = Na+, Cl-
3	95%	None

Topic: *Neural Signals: Action Potentials [topic 4]*

What are the main ideas?	
Attempt #	Crucial ideas that must be included
1	Resting state, depolarization, repolarization, hyperpolarization, ion channels, voltages, currents
2	– transient vs persistent currents – negatively charged proteins inside of the cell

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline
1	resting –> channels –> ion movement –> voltage & currents –> control mechanisms
2	resting state –> leak channels –> sodium potassium pump –> voltage-gated channels –> ion movement –> voltage & current –> control mechanisms

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples
1	– neurons are like batteries with positive and negative ends – salty banana –> Na^+, Cl^- outside and K^+ inside
2	– channels are like revolving doors – all or nothing is like flipping a light switch on or off (no in-between)

After completing, where were the knowledge gaps?	
Attempt #	Weak points
1	– why transient vs persistent? – why is cell more negative on the inside at resting state?

Topic: *Neural Signals: Action Potentials [topic 4]*

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution
How do you isolate the sodium current? What does the sodium current look like when you step the voltage from resting to more depolarized potentials?	– Neurotoxins – Transient current – Persistent current	TEA binds to and inhibits the K+ channels so that you can isolate the Na+ channels. Na+ currents are transient so they return to zero.
How do voltage-gated sodium, potassium, calcium, and other ion channels contribute to the initiation, propagation, and termination of action potentials?	– Selectivity – Conductance – Gating	Sodium channels initiate the depolarization phase, potassium channels contribute to repolarization, and calcium channels can affect synaptic transmission and intracellular signaling.

Topic: _Neural Signals: Action Potentials [topic 4]_

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution
How do subthreshold potentials influence the generation and modulation of action potentials?	– EPSPs – IPSPs – Integration	They integrate synaptic inputs and modulate membrane potential but do not elicit action potentials on their own.
Describe the impact of myelination on action potential propagation.	– Insulation – Nodes	Myelin insulates axons, enabling saltatory conduction where action potentials "jump" between nodes of Ranvier. Faster by ↑ capacitance and ↓ resistance.
Discuss the application of optogenetics in dissecting neural circuits and manipulating specific neuronal populations.	– Excitation – Neuronal targeting – Photosensitivity	Optogenetics uses light-sensitive proteins to control neuronal activity. Provides insight into neural circuits and behaviors.

WORKBOOK PAGES
FOR YOU TO FILL IN

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic:

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1		Mark	Q14		Mark
Q2		Mark	Q15		Mark
Q3		Mark	Q16		Mark
Q4		Mark	Q17		Mark
Q5		Mark	Q18		Mark
Q6		Mark	Q19		Mark
Q7		Mark	Q20		Mark
Q8		Mark	Q21		Mark
Q9		Mark	Q22		Mark
Q10		Mark	Q23		Mark
Q11		Mark	Q24		Mark
Q12		Mark	Q25		Mark
Q13		Mark	Q26		Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

PROMPTS FOR REORGANIZING

☐   Is your diagram nonlinear?

☐   Have you considered other groups, subgroups, and relationships?

☐   Are the groups and relationships structured so that they make sense to you intuitively?

☐   Do your arrows depict accurate cause and effect relationships?

☐   Have you organized your groups on the page so that your arrows don't overlap?

☐   Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☐   Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic: _____

☐   Is all the information in the diagram crucial?

☐   Are you able to identify which pieces of information are most important?

☐   Can you justify why certain pieces of information are more important than others?

☐   Have you considered bigger groups that could further generalize ideas that are less important?

☐   Have you created enough subgroups to make the information easily digestable?

☐   Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

☐   Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

Topic:

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

_____

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_____

_____

Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic: _____

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1		Mark

Q2		Mark

Q3		Mark

Q4		Mark

Q5		Mark

Q6		Mark

Q7		Mark

Q8		Mark

Q9		Mark

Q10		Mark

Q11		Mark

Q12		Mark

Q13		Mark

Q14		Mark

Q15		Mark

Q16		Mark

Q17		Mark

Q18		Mark

Q19		Mark

Q20		Mark

Q21		Mark

Q22		Mark

Q23		Mark

Q24		Mark

Q25		Mark

Q26		Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

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☐   Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic: _____

☐   Is all the information in the diagram crucial?

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☐   Can you justify why certain pieces of information are more important than others?

☐   Have you considered bigger groups that could further generalize ideas that are less important?

☐   Have you created enough subgroups to make the information easily digestable?

☐   Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

☐   Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

Topic:

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS   _____

TOPIC   _____

DATE STARTED _____

DATE ENDED   _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic:

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

IN–CLASS NOTES: KEY OBSERVATIONS

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

IN-CLASS NOTES: ACTIVE RECALL QUESTIONS

Topic: _____

Q1	Mark		Q14	Mark
Q2	Mark		Q15	Mark
Q3	Mark		Q16	Mark
Q4	Mark		Q17	Mark
Q5	Mark		Q18	Mark
Q6	Mark		Q19	Mark
Q7	Mark		Q20	Mark
Q8	Mark		Q21	Mark
Q9	Mark		Q22	Mark
Q10	Mark		Q23	Mark
Q11	Mark		Q24	Mark
Q12	Mark		Q25	Mark
Q13	Mark		Q26	Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

PROMPTS FOR REORGANIZING

☐ Is your diagram nonlinear?

☐ Have you considered other groups, subgroups, and relationships?

☐ Are the groups and relationships structured so that they make sense to you intuitively?

☐ Do your arrows depict accurate cause and effect relationships?

☐ Have you organized your groups on the page so that your arrows don't overlap?

☐ Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☐ Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic: _____

☐   Is all the information in the diagram crucial?

☐   Are you able to identify which pieces of information are most important?

☐   Can you justify why certain pieces of information are more important than others?

☐   Have you considered bigger groups that could further generalize ideas that are less important?

☐   Have you created enough subgroups to make the information easily digestable?

☐   Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

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Topic:

REVISION: BLURTING METHOD

Topic: _____

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Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic:

Topic:

Question 1

Answer	
Comments	Mark

Question 2

Answer	
Comments	Mark

Question 3

Answer	
Comments	Mark

Question 4

Answer	
Comments	Mark

Question 5

Answer	
Comments	Mark

Question 6

Answer	
Comments	Mark

Question 7

Answer	
Comments	Mark

Question 8

Answer	
Comments	Mark

Question 9

Answer	
Comments	Mark

Question 10

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1	Mark

Q2	Mark

Q3	Mark

Q4	Mark

Q5	Mark

Q6	Mark

Q7	Mark

Q8	Mark

Q9	Mark

Q10	Mark

Q11	Mark

Q12	Mark

Q13	Mark

Q14	Mark

Q15	Mark

Q16	Mark

Q17	Mark

Q18	Mark

Q19	Mark

Q20	Mark

Q21	Mark

Q22	Mark

Q23	Mark

Q24	Mark

Q25	Mark

Q26	Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

PROMPTS FOR REORGANIZING

☐   Is your diagram nonlinear?

☐   Have you considered other groups, subgroups, and relationships?

☐   Are the groups and relationships structured so that they make sense to you intuitively?

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☐   Have you organized your groups on the page so that your arrows don't overlap?

☐   Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☐   Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic: _____

☐   Is all the information in the diagram crucial?

☐   Are you able to identify which pieces of information are most important?

☐   Can you justify why certain pieces of information are more important than others?

☐   Have you considered bigger groups that could further generalize ideas that are less important?

☐   Have you created enough subgroups to make the information easily digestable?

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Topic: _____

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic:

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1	Mark

Q2	Mark

Q3	Mark

Q4	Mark

Q5	Mark

Q6	Mark

Q7	Mark

Q8	Mark

Q9	Mark

Q10	Mark

Q11	Mark

Q12	Mark

Q13	Mark

Q14	Mark

Q15	Mark

Q16	Mark

Q17	Mark

Q18	Mark

Q19	Mark

Q20	Mark

Q21	Mark

Q22	Mark

Q23	Mark

Q24	Mark

Q25	Mark

Q26	Mark

Question #	Notable Answers

POST–CLASS IMMEDIATE REVIEW: REFLECTION

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

PROMPTS FOR REORGANIZING

☐ Is your diagram nonlinear?

☐ Have you considered other groups, subgroups, and relationships?

☐ Are the groups and relationships structured so that they make sense to you intuitively?

☐ Do your arrows depict accurate cause and effect relationships?

☐ Have you organized your groups on the page so that your arrows don't overlap?

☐ Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☐ Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic: _____

☐ Is all the information in the diagram crucial?

☐ Are you able to identify which pieces of information are most important?

☐ Can you justify why certain pieces of information are more important than others?

☐ Have you considered bigger groups that could further generalize ideas that are less important?

☐ Have you created enough subgroups to make the information easily digestable?

☐ Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

☐ Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

Topic: _____

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic: _____

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic:

Q1	Mark	Q14	Mark
Q2	Mark	Q15	Mark
Q3	Mark	Q16	Mark
Q4	Mark	Q17	Mark
Q5	Mark	Q18	Mark
Q6	Mark	Q19	Mark
Q7	Mark	Q20	Mark
Q8	Mark	Q21	Mark
Q9	Mark	Q22	Mark
Q10	Mark	Q23	Mark
Q11	Mark	Q24	Mark
Q12	Mark	Q25	Mark
Q13	Mark	Q26	Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

REVISION: DIAGRAM III

PROMPTS FOR REORGANIZING

☐   Is your diagram nonlinear?

☐   Have you considered other groups, subgroups, and relationships?

☐   Are the groups and relationships structured so that they make sense to you intuitively?

☐   Do your arrows depict accurate cause and effect relationships?

☐   Have you organized your groups on the page so that your arrows don't overlap?

☐   Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☐   Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic:

☐ Is all the information in the diagram crucial?

☐ Are you able to identify which pieces of information are most important?

☐ Can you justify why certain pieces of information are more important than others?

☐ Have you considered bigger groups that could further generalize ideas that are less important?

☐ Have you created enough subgroups to make the information easily digestable?

☐ Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

☐ Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

Topic:

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic:

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

IN-CLASS NOTES: KEY OBSERVATIONS

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

IN-CLASS NOTES: ACTIVE RECALL QUESTIONS

Topic: _____

Q1	Mark	Q14	Mark
Q2	Mark	Q15	Mark
Q3	Mark	Q16	Mark
Q4	Mark	Q17	Mark
Q5	Mark	Q18	Mark
Q6	Mark	Q19	Mark
Q7	Mark	Q20	Mark
Q8	Mark	Q21	Mark
Q9	Mark	Q22	Mark
Q10	Mark	Q23	Mark
Q11	Mark	Q24	Mark
Q12	Mark	Q25	Mark
Q13	Mark	Q26	Mark

Question #	Notable Answers

POST–CLASS IMMEDIATE REVIEW: REFLECTION

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

PROMPTS FOR REORGANIZING

☐ Is your diagram nonlinear?

☐ Have you considered other groups, subgroups, and relationships?

☐ Are the groups and relationships structured so that they make sense to you intuitively?

☐ Do your arrows depict accurate cause and effect relationships?

☐ Have you organized your groups on the page so that your arrows don't overlap?

☐ Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☐ Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic: _____

☐   Is all the information in the diagram crucial?

☐   Are you able to identify which pieces of information are most important?

☐   Can you justify why certain pieces of information are more important than others?

☐   Have you considered bigger groups that could further generalize ideas that are less important?

☐   Have you created enough subgroups to make the information easily digestable?

☐   Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

☐   Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

Topic:

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
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Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic:

Topic:

IN–CLASS NOTES: KEY OBSERVATIONS

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1	Mark	Q14	Mark
Q2	Mark	Q15	Mark
Q3	Mark	Q16	Mark
Q4	Mark	Q17	Mark
Q5	Mark	Q18	Mark
Q6	Mark	Q19	Mark
Q7	Mark	Q20	Mark
Q8	Mark	Q21	Mark
Q9	Mark	Q22	Mark
Q10	Mark	Q23	Mark
Q11	Mark	Q24	Mark
Q12	Mark	Q25	Mark
Q13	Mark	Q26	Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

REVISION: DIAGRAM III

PROMPTS FOR REORGANIZING

☐   Is your diagram nonlinear?

☐   Have you considered other groups, subgroups, and relationships?

☐   Are the groups and relationships structured so that they make sense to you intuitively?

☐   Do your arrows depict accurate cause and effect relationships?

☐   Have you organized your groups on the page so that your arrows don't overlap?

☐   Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☐   Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic:

☐   Is all the information in the diagram crucial?

☐   Are you able to identify which pieces of information are most important?

☐   Can you justify why certain pieces of information are more important than others?

☐   Have you considered bigger groups that could further generalize ideas that are less important?

☐   Have you created enough subgroups to make the information easily digestable?

☐   Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

☐   Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

Topic:

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic:

PRIMING: PRETEST

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

IN–CLASS NOTES: KEY OBSERVATIONS

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic:

Q1		Mark

Q2		Mark

Q3		Mark

Q4		Mark

Q5		Mark

Q6		Mark

Q7		Mark

Q8		Mark

Q9		Mark

Q10		Mark

Q11		Mark

Q12		Mark

Q13		Mark

Q14		Mark

Q15		Mark

Q16		Mark

Q17		Mark

Q18		Mark

Q19		Mark

Q20		Mark

Q21		Mark

Q22		Mark

Q23		Mark

Q24		Mark

Q25		Mark

Q26		Mark

Question #	Notable Answers

POST–CLASS IMMEDIATE REVIEW: REFLECTION

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

PROMPTS FOR REORGANIZING

☐   Is your diagram nonlinear?

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☐   Are the groups and relationships structured so that they make sense to you intuitively?

☐   Do your arrows depict accurate cause and effect relationships?

☐   Have you organized your groups on the page so that your arrows don't overlap?

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Topic:

- [ ] Is all the information in the diagram crucial?

- [ ] Are you able to identify which pieces of information are most important?

- [ ] Can you justify why certain pieces of information are more important than others?

- [ ] Have you considered bigger groups that could further generalize ideas that are less important?

- [ ] Have you created enough subgroups to make the information easily digestable?

- [ ] Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

- [ ] Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

Topic:

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

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Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic:

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

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Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1	Mark	Q14	Mark
Q2	Mark	Q15	Mark
Q3	Mark	Q16	Mark
Q4	Mark	Q17	Mark
Q5	Mark	Q18	Mark
Q6	Mark	Q19	Mark
Q7	Mark	Q20	Mark
Q8	Mark	Q21	Mark
Q9	Mark	Q22	Mark
Q10	Mark	Q23	Mark
Q11	Mark	Q24	Mark
Q12	Mark	Q25	Mark
Q13	Mark	Q26	Mark

Question #	Notable Answers

POST–CLASS IMMEDIATE REVIEW: REFLECTION

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

PROMPTS FOR REORGANIZING

☐ Is your diagram nonlinear?

☐ Have you considered other groups, subgroups, and relationships?

☐ Are the groups and relationships structured so that they make sense to you intuitively?

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☐ Have you organized your groups on the page so that your arrows don't overlap?

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☐ Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic: _____

☐   Is all the information in the diagram crucial?

☐   Are you able to identify which pieces of information are most important?

☐   Can you justify why certain pieces of information are more important than others?

☐   Have you considered bigger groups that could further generalize ideas that are less important?

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Topic:

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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PRIMING: DEVELOP DIAGRAM I

Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

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Topic:

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1		Mark		Q14		Mark
Q2		Mark		Q15		Mark
Q3		Mark		Q16		Mark
Q4		Mark		Q17		Mark
Q5		Mark		Q18		Mark
Q6		Mark		Q19		Mark
Q7		Mark		Q20		Mark
Q8		Mark		Q21		Mark
Q9		Mark		Q22		Mark
Q10		Mark		Q23		Mark
Q11		Mark		Q24		Mark
Q12		Mark		Q25		Mark
Q13		Mark		Q26		Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

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Topic:

REVISION: BLURTING METHOD

Topic: _____

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Iteration #	Relationships

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Iteration #	Knowledge gaps

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Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

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Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

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Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

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Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

IN-CLASS NOTES: ACTIVE RECALL QUESTIONS

Topic: _____

Q1	Mark		Q14	Mark
Q2	Mark		Q15	Mark
Q3	Mark		Q16	Mark
Q4	Mark		Q17	Mark
Q5	Mark		Q18	Mark
Q6	Mark		Q19	Mark
Q7	Mark		Q20	Mark
Q8	Mark		Q21	Mark
Q9	Mark		Q22	Mark
Q10	Mark		Q23	Mark
Q11	Mark		Q24	Mark
Q12	Mark		Q25	Mark
Q13	Mark		Q26	Mark

Question #	Notable Answers

Topic: _____

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Topic: _____

PROMPTS FOR SIMPLIFYING

☐   Is all the information in the diagram crucial?

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☐   Have you considered bigger groups that could further generalize ideas that are less important?

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Topic:

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
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REVISION: FEYNMAN TECHNIQUE

Topic: _____

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Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

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CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

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Topic:

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Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

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Answer	
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Answer	
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Topic:

Topic: _____

Key observations for this topic

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Key ideas that you got right on the pretest

Topic:

Q1	Mark	Q14	Mark
Q2	Mark	Q15	Mark
Q3	Mark	Q16	Mark
Q4	Mark	Q17	Mark
Q5	Mark	Q18	Mark
Q6	Mark	Q19	Mark
Q7	Mark	Q20	Mark
Q8	Mark	Q21	Mark
Q9	Mark	Q22	Mark
Q10	Mark	Q23	Mark
Q11	Mark	Q24	Mark
Q12	Mark	Q25	Mark
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Question #	Notable Answers

POST–CLASS IMMEDIATE REVIEW: REFLECTION

Topic: _____

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REVISION: BLURTING METHOD

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REVISION: FEYNMAN TECHNIQUE

Topic: _____

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Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

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CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

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Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

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Question 6 _____

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Question 7 _____

Answer	
Comments	Mark

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Answer	
Comments	Mark

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Answer	
Comments	Mark

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Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1		Mark

Q2		Mark

Q3		Mark

Q4		Mark

Q5		Mark

Q6		Mark

Q7		Mark

Q8		Mark

Q9		Mark

Q10		Mark

Q11		Mark

Q12		Mark

Q13		Mark

Q14		Mark

Q15		Mark

Q16		Mark

Q17		Mark

Q18		Mark

Q19		Mark

Q20		Mark

Q21		Mark

Q22		Mark

Q23		Mark

Q24		Mark

Q25		Mark

Q26		Mark

Question #	Notable Answers

POST–CLASS IMMEDIATE REVIEW: REFLECTION

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Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

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CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

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Topic:

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
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Question 5 _____

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Comments	Mark

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Question 7 _____

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Comments	Mark

Question 8 _____

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Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

IN–CLASS NOTES: KEY OBSERVATIONS

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

IN-CLASS NOTES: ACTIVE RECALL QUESTIONS

Topic: _____

Q1	Mark	Q14	Mark
Q2	Mark	Q15	Mark
Q3	Mark	Q16	Mark
Q4	Mark	Q17	Mark
Q5	Mark	Q18	Mark
Q6	Mark	Q19	Mark
Q7	Mark	Q20	Mark
Q8	Mark	Q21	Mark
Q9	Mark	Q22	Mark
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Topic:

REVISION: BLURTING METHOD

Topic: _____

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REVISION: FEYNMAN TECHNIQUE

Topic: _____

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Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

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CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

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Topic:

Topic:

Question 1

Answer

Comments	Mark

Question 2

Answer

Comments	Mark

Question 3

Answer

Comments	Mark

Question 4

Answer

Comments	Mark

Question 5

Answer

Comments	Mark

Question 6

Answer

Comments	Mark

Question 7

Answer

Comments	Mark

Question 8

Answer

Comments	Mark

Question 9

Answer

Comments	Mark

Question 10

Answer

Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

IN–CLASS NOTES: ACTIVE RECALL QUESTIONS

Topic: _____

Q1	Mark	Q14	Mark
Q2	Mark	Q15	Mark
Q3	Mark	Q16	Mark
Q4	Mark	Q17	Mark
Q5	Mark	Q18	Mark
Q6	Mark	Q19	Mark
Q7	Mark	Q20	Mark
Q8	Mark	Q21	Mark
Q9	Mark	Q22	Mark
Q10	Mark	Q23	Mark
Q11	Mark	Q24	Mark
Q12	Mark	Q25	Mark
Q13	Mark	Q26	Mark

Question #	Notable Answers

POST–CLASS IMMEDIATE REVIEW: REFLECTION

Topic: _____

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REVISION: BLURTING METHOD

Topic: _____

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REVISION: FEYNMAN TECHNIQUE

Topic: _____

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Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

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Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

PRIMING: DEVELOP DIAGRAM I

Topic: _____

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Topic:

PRIMING: PRETEST

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

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Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

IN–CLASS NOTES: ACTIVE RECALL QUESTIONS

Topic: _____

Q1		Mark

Q2		Mark

Q3		Mark

Q4		Mark

Q5		Mark

Q6		Mark

Q7		Mark

Q8		Mark

Q9		Mark

Q10		Mark

Q11		Mark

Q12		Mark

Q13		Mark

Q14		Mark

Q15		Mark

Q16		Mark

Q17		Mark

Q18		Mark

Q19		Mark

Q20		Mark

Q21		Mark

Q22		Mark

Q23		Mark

Q24		Mark

Q25		Mark

Q26		Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

Which concepts do you feel really strong about?

How are these concepts related to the ones you've previously learned?

Does your diagram help form a clear picture of the topic? If not, how can you rearrange the groups and relationships to do so?

☐   Is your diagram nonlinear?

☐   Have you considered other groups, subgroups, and relationships?

☐   Are the groups and relationships structured so that they make sense to you intuitively?

☐   Do your arrows depict accurate cause and effect relationships?

☐   Have you organized your groups on the page so that your arrows don't overlap?

☐   Are the groups and relationships personal to you? (i.e. not just copied from your textbook)

☐   Is this diagram organized in a manner that would help you easily teach the topic to another person?

Topic:

☐ Is all the information in the diagram crucial?

☐ Are you able to identify which pieces of information are most important?

☐ Can you justify why certain pieces of information are more important than others?

☐ Have you considered bigger groups that could further generalize ideas that are less important?

☐ Have you created enough subgroups to make the information easily digestable?

☐ Did you use any creative way of emphasizing key ideas? I.e. thicker lines, bolded words, highlighting, illustrations, increasing size, different colors, etc.

☐ Will you be able to return to this diagram in the future and quickly understand the logic it portrays?

Topic:

REVISION: BLURTING METHOD

Topic: _____

Which groups are the most important to recall?	
Iteration #	Groups

Which relationships are the most important to recall?	
Iteration #	Relationships

After completing, where were the knowledge gaps?	
Iteration #	Knowledge gaps

Keep track of your progress here after each iteration.		
Iteration #	% Recall	Comments

REVISION: FEYNMAN TECHNIQUE

Topic: _____

What are the main ideas?	
Attempt #	Crucial ideas that must be included

Identify an appropriate order for explanation [use arrows →]	
Attempt #	Storyline

Identify analogies/examples you could use to make the information easier to understand.	
Attempt #	Analogies or examples

After completing, where were the knowledge gaps?	
Attempt #	Weak points

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

Topic: _____

Question I'm struggling with	Key ideas that helped me understand	Simplified correct solution

CLASS _____

TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

_____

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Topic: _____

What are the main concepts for this topic?

Which words from the list of main concepts are unfamiliar? Research and provide simplified definitions.

After comparing the concepts together, what big groups can you form based on their similarities and differences?

How do these groups relate to each other? Use arrows to show the relationships here.

Topic: _____

Topic:

Question 1

Answer

Comments	Mark

Question 2

Answer

Comments	Mark

Question 3

Answer

Comments	Mark

Question 4

Answer

Comments	Mark

Question 5

Answer

Comments	Mark

Question 6

Answer

Comments	Mark

Question 7

Answer

Comments	Mark

Question 8

Answer

Comments	Mark

Question 9

Answer

Comments	Mark

Question 10

Answer

Comments	Mark

Topic:

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

IN-CLASS NOTES: ACTIVE RECALL QUESTIONS

Topic: _____

Q1	Mark	Q14	Mark
Q2	Mark	Q15	Mark
Q3	Mark	Q16	Mark
Q4	Mark	Q17	Mark
Q5	Mark	Q18	Mark
Q6	Mark	Q19	Mark
Q7	Mark	Q20	Mark
Q8	Mark	Q21	Mark
Q9	Mark	Q22	Mark
Q10	Mark	Q23	Mark
Q11	Mark	Q24	Mark
Q12	Mark	Q25	Mark
Q13	Mark	Q26	Mark

Question #	Notable Answers

Topic: _____

Which concepts are the most challenging for you so far?

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REVISION: BLURTING METHOD

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TOPIC _____

DATE STARTED _____

DATE ENDED _____

REMINDERS:

_____

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Topic:

Topic: _____

Question 1 _____

Answer	
Comments	Mark

Question 2 _____

Answer	
Comments	Mark

Question 3 _____

Answer	
Comments	Mark

Question 4 _____

Answer	
Comments	Mark

Question 5 _____

Answer	
Comments	Mark

Question 6 _____

Answer	
Comments	Mark

Question 7 _____

Answer	
Comments	Mark

Question 8 _____

Answer	
Comments	Mark

Question 9 _____

Answer	
Comments	Mark

Question 10 _____

Answer	
Comments	Mark

Topic:

IN–CLASS NOTES: KEY OBSERVATIONS

Topic: _____

Key observations for this topic

Key ideas that you got wrong on the pretest

Key ideas that you got right on the pretest

Topic: _____

Q1		Mark	Q14		Mark
Q2		Mark	Q15		Mark
Q3		Mark	Q16		Mark
Q4		Mark	Q17		Mark
Q5		Mark	Q18		Mark
Q6		Mark	Q19		Mark
Q7		Mark	Q20		Mark
Q8		Mark	Q21		Mark
Q9		Mark	Q22		Mark
Q10		Mark	Q23		Mark
Q11		Mark	Q24		Mark
Q12		Mark	Q25		Mark
Q13		Mark	Q26		Mark

Question #	Notable Answers

Topic: _____

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TOPIC _____

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Q3	Mark		Q16	Mark
Q4	Mark		Q17	Mark
Q5	Mark		Q18	Mark
Q6	Mark		Q19	Mark
Q7	Mark		Q20	Mark
Q8	Mark		Q21	Mark
Q9	Mark		Q22	Mark
Q10	Mark		Q23	Mark
Q11	Mark		Q24	Mark
Q12	Mark		Q25	Mark
Q13	Mark		Q26	Mark

Question #	Notable Answers

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Topic: _____

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RESOURCES

Revision Timetable

Why You Should Be Creating Revision Timetables

Parkinson's Law

Parkinson's Law states that work naturally expands to fill the time available for its completion. In other words, it suggests that the amount of time allocated for a task directly influences how long it will take to complete it.

Parkinson's Law

Therefore, if you fail to be specific with when to do a task and give yourself too generous a deadline, it's likely that you will procrastinate and actually use up all that time. On the other hand, if you were to create hard (but of course realistic) deadlines for yourself using a revision timetable, you will be much more likely to complete the task in an efficient manner.

Reducing Decision Fatigue

We as human beings make thousands of decisions each day, and it's in those moments of contemplation that we waste cognitive energy. If we hesitate for long enough, our bodies will persuade our minds to make decisions that keep us comfortable. That is why we tend to skip workouts and procrastinate on tasks.

By proactively scheduling your days, you can optimize your time and eliminate the internal struggle between your mind and body. When you have a detailed plan, it helps you transition smoothly from one task to another without second-guessing and ultimately makes for a much more efficient process.

Being Present in Every Moment

A common misconception is that scheduling is only good for workaholics. This could not be further from the truth. Consider how often you spend time with friends or take a day off to relax and recharge, only to wake up the next day feeling none of the intended benefits.

This happens because our minds tend to wander to unfinished tasks or obligations, preventing us from being fully present in the moment. This behavior brings about feelings of anxiety and guilt that waste your cognitive energy, not recharge it.

Therefore, when you pre-plan your schedule, include time for rest and play. In doing so, you allow yourself to be fully present during every part of your life. You can dedicate your attention to work when it's work time, indulge in rest when it's time to relax, and fully embrace play when it's playtime. This is the recipe to longevity.

How You Should Create Revision Timetables

Spaced Repetition

First proposed by German psychologist Hermann Ebbinghaus in the late 19th century, the "Forgetting Curve" suggests a significant amount of information learned is usually forgotten within a very short period. More specifically, Ebbinghaus used the curve to demonstrate that the rate of forgetting is greatest shortly after learning, then slows down over time. This trend has since been validated by modern neuroscience in several published papers.

The Forgetting Curve
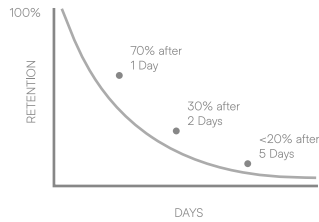
This behavior is actually thought to be beneficial to the human brain, because otherwise it would be subjected to overload as it's constantly exposed to so much information. By forgetting prior information that is unimportant or irrelevant, the brain is able to free up space to take in new information.

Therefore, if you keep forgetting content for your exams, it's not because you are "stupid", but instead you are simply experiencing a natural human behavior. So how do we combat this? Well, we have already explained how to make information more relevant with The Learning System, but spaced repetition is also an EXTREMELY important technique that must be incorporated into your revision timetables.

Without reviewing newly learned information, research suggests you could lose up to 70% of retention in just one day as seen in the previous graph. However, if you review the material at spaced intervals after the initial learning, then the forgetting curve begins to flatten out and you ultimately get better long-term retention.

Now the goal here is to review the material at the right time.

There is a phenomenon in cognitive psychology called "desirable difficulty" that suggests the harder your brain has to work to retrieve information, the stronger it gets encoded into your long-term memory.

Therefore, in order to optimize spaced repetition, you should revise the material just as your brain forgets some of the knowledge. The extra brain power required to retrieve the slightly lost information will promote durable learning.

Spaced Repetition
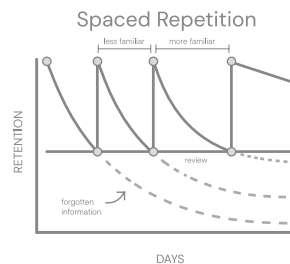
Practically, this means you will have shorter spaced intervals between study sessions early on while the material is still new, and then wider spaced intervals later when the material is more familiar. For example, you may study a concept today, tomorrow, five days later, two weeks later, and then a month later.

Moreover, the amount of studying in the subsequent sessions should decrease significantly as your baseline knowledge will be much higher than if you had allowed yourself to fully forget the information.

Examining the Scientific Research for Spaced Repetition:

Scientists Karpicke and Bauernschmidt performed a study investigating recall of a new language using various study techniques.

Effects of Various Techniques on Retention
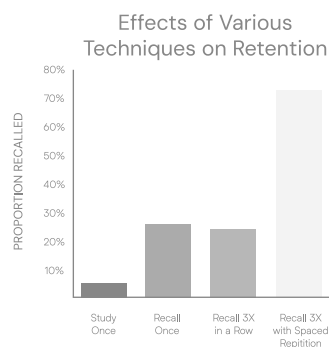
The results showed that studying the words only once resulted in very poor retention (1%), while subsequently recalling the words once and three times in a row showed significantly enhanced long-term retention.

Upon looking deeper at the results, recalling the words three times in a row produced **no advantage** beyond recalling the words once (26% vs. 25%). However, introducing spacing between the three repeated recalls significantly improved retention.

Different intervals for spaced repetition were studied, and all of them resulted in greater retention compared to not using spaced repetition. Among the intervals studied, repetitions every 30 words led to the highest final retention (75%).

It's important to note here that the subjects who utilized spaced repetition studied for the same total amount of time as the "Recalling 3x in a Row" group. Therefore, these findings suggest that utilizing spaced repetition can optimize recall performance without increasing the total time of studying.

Moreover, as students are able to better retain the information the first time around when employing spaced repetition, they are unlikely to require as much revision before cumulative exams. As a result, the overall amount of studying is **significantly** reduced.

Karpicke JD, Bauernschmidt A. Spaced retrieval: absolute spacing enhances learning regardless of relative spacing. J Exp Psychol Learn Mem Cogn. 2011 Sep;37(5):1250-7. doi: 10.1037/a0023436. PMID: 21574747.

Interleaving

Interleaving is a revision technique in which students mix, or interleave multiple topics or subjects while studying to improve their learning process.

Before diving into its benefits, let's first look at its more popular counterpart—blocked practice—using a calculus example. If you were learning derivatives, a common approach to studying would be something similar to the following:

- First hour = power rule
- Second hour = sum/difference rule
- Third hour = product/quotient rule
- Fourth hour = chain rule

Students tend to revise a topic extensively before moving on to the next because that is how they are first introduced in their classes. Although you generally do want to start with blocked practice to familiarize yourself, you should be quickly adopting interleaved practice for your studying.

Therefore the more appropriate approach would be to randomize and mix the practice questions and then complete them.

For a visual representation of the differences between the two techniques see the illustration below:
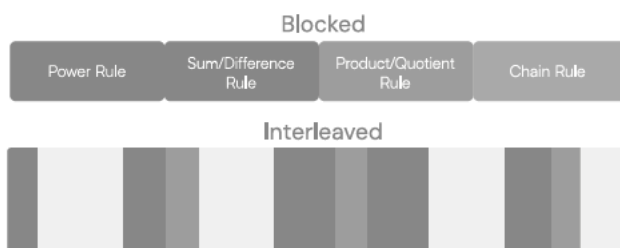
Interleaving has been shown in research to be the more effective approach for several reasons, with the first advantage stemming from the principle of spaced repetition that we discussed in the previous section.

By spacing out your practice, you can revisit the information just as your brain starts to forget it, which ultimately promotes long-term retention. In contrast, the traditional blocked practice would require extensive review of the material just before an exam, as a significant portion of the information, particularly from the earlier blocks, would have been forgotten.

Another advantage of interleaving is that it improves your ability to discern between concepts which enhances memory consolidation. Instead of storing the information as isolated and decontextualized facts, you are creating stronger linkages between concepts. By experiencing different topics in close proximity, you become more skilled at identifying differences and similarities, fostering a deeper understanding of the material.

A third advantage is that interleaving mimics the conditions of real-world applications. For example, if I was creating a mathematical model utilizing derivatives, I would not be exposed to each of the rules separately. Instead, it would be much more likely that I would be exposed to a barrage of combinations. Then it would be my responsibility as a biomedical engineer to differentiate them and apply my knowledge in order to sort through the material and create a working model.

Moreover, this is certainly the case for exams as well. Especially in higher education, it is likely that you will be exposed to inference questions where a scenario would be explained, and you have to apply the techniques without being guided on a particular order. It will be your responsibility to then retrieve the appropriate rules when necessary for each step in order to come up with an appropriate answer.

If you had applied the interleaving technique to your studies, you have a much better chance at solving these problems more effectively when it counts on an exam.

Examining the Scientific Research for Interleaving:

This study compared the effectiveness of interleaved practice vs. blocked practice in helping students master math problems.

The researchers took a group of students and split them up into two groups. One group was given practice problems in the same order as they were presented in the textbook, and the other group had the exact same problems but in a mixed order. Both groups of students were given the same amount of time to complete their respective problems.

The researchers then tested the students 1 and 30 days after the initial study session to see if interleaving the practice problems had any effects on long-term retention. The results showed that the students who revised with interleaved practice performed significantly better on both tests than those who used blocked practice.

Effects of Interleaved and Blocked Practice
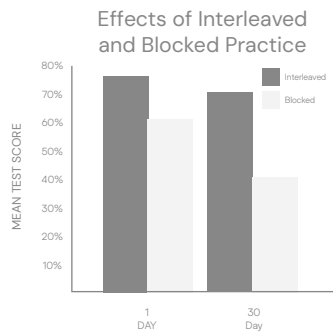
This finding suggests that interleaved practice can enhance long-term retention, making it a superior study technique to the traditional blocked practice.

I hope the realization that simply rearranging the order of your homework questions can boost your grade by more than 30% makes it clear that incorporating this practice into your study routine is a wise choice.

Blunt, J. M., & Clements, D. H. (2012). Interleaved practice in mathematics: A method of distributed practice. Journal of Educational Psychology, 104(3), 733—745. https://doi.org/10.1037/a0027454

Applying Interleaved Practice

I've found that this method is not as intuitive for most students as some of the others, so therefore let's look at a specific example of applying interleaved practice when creating a revision timetable.

Imagine a scenario in which you have allocated a little under 7 hours to study three topics in a single day.

I would first break down the total time into 45-minute blocks as that is usually long enough to enter a flow state[1] and short enough to not be bogged down by too many distractions. Most people would approach their studying in the following manner.

[1] *Flow state, also known as being "in the zone", refers to a heightened state of concentration and engagement, where individuals feel a deep sense of control and lose track of time. In this state, individuals often perform at their best, feeling a sense of effortless action.*

Morning			Afternoon			Night		
Topic 1	Topic 1	Topic 1	Topic 2	Topic 2	Topic 2	Topic 3	Topic 3	Topic 3
45 min	45 min	45 min	45 min	45 min	45 min	45 min	45 min	45 min

Complete Topic 1

Complete Topic 2
Forget Topic 1

Complete Topic 3
Forget Topic 2

People often intuitively engage in blocked practice because it can provide a perceived sense of mastery and familiarity. Whereas we now know research suggests otherwise, and therefore it is imperative to integrate the principle of interleaving. One way to do this would be with the following approach:

Morning			Afternoon			Night		
Topic 1	Topic 2	Topic 3	Topic 1	Topic 2	Topic 3	Topic 1	Topic 2	Topic 3
45 min	45 min	45 min	45 min	45 min	45 min	45 min	45 min	45 min

When executed this way, you're able to actively engage with each topic over the course of the entire day and also create linkages between topics, ultimately promoting better memory consolidation. Also, it's important to recall the concept of desirable difficulty here because interleaving is certainly not as easy nor as comfortable as blocked practice but be assured that the extra brain power required to implement this method will enable you to learn more effectively the first time around.

Furthermore, if the topics are closely related enough, you can also randomly mix practice questions from all three topics and solve them within the same study session. The added complexity of this application becomes especially powerful when you are testing the depth of your comprehension with material learned earlier in the day.

Morning			Afternoon			Night		
Topic 1	Topic 2	Topic 3	Topic 1	Topic 2	Topic 3	Topic 1	Topic 2	Topic 3
45 min	45 min	45 min	45 min	45 min	45 min	45 min	45 min	45 min

This schedule would do an excellent job of utilizing interleaving in all stages of the revision throughout the day, while also increasing the difficulty at the end in order to further optimize the benefits. If executed correctly, this schedule will leave you with an enhanced ability to discern between topics and have you be extremely prepared for exams when the topics will undoubtedly be scattered across the various questions.

Lastly, consider interleaving the modes of learning as well. Each time you revisit a topic, try a different form of revision to benefit from the various perspectives. You have already been introduced to diagrams, pretests, and active recall applications like reviewing the questions from class, blurting method, Feynman technique, and practice tests. They all have their own unique advantages, so interleaving them can enhance the complexity, boost motivation, and make for a more well-rounded revision approach.

The way you decide to incorporate interleaving into your revision timetable is a matter of experience level and personal preference. What matters most is that you actually integrate it.

Taking Breaks to Facilitate Learning

If you were learning how to shoot a basketball, the particular parts of your brain involved in hand-eye coordination, depth perception, and balance would be engaged. The more you actively focus on the practice, the more a neurotransmitter called acetylcholine is generated.

One of acetylcholine's functions is to mark the neurons in those engaged parts of your brain as potentially strengthening later. However, the actual rewiring of those neurons happens in states of deep relaxation. Typically, this will happen while you're asleep the night after you learn.

This is partly why all-nighters before exams are incredibly inefficient. When you cram, acetylcholine is generated and marks those neurons, however, you are unable to optimize the rewiring of those connections which is necessary for memory consolidation.

Therefore, you likely will struggle with questions on the exam that require critical thinking, and immediately forget the information once you disengage your focus after the exam.

However, the importance of sleeping at night seems to be intuitive for most students, so I won't focus too much on that for this section.

The more interesting research centers around the use of naps and non-sleep deep rest (NSDR) protocols following periods of deep focus. These practices have been shown to activate the replay of neurons, similar to the neural replays observed during a full night's sleep. Additionally, incorporating random micro gaps within deep focus sessions has demonstrated the ability to induce accelerated neural replays.

The activation of neural replays through these three applications provides opportunities for the brain to reinforce and strengthen the connections between neurons, facilitating the encoding of information into long-term memory. Ultimately, the optimization of these breaks can lead to more efficient learning and increase the effectiveness of your study sessions.

Therefore, never skip out on integrating breaks into your revision timetable. Not only do you get the recovery benefits, but the science definitely shows that there are significant learning advantages too.

REVISION TIMETABLE

Remember to include spaced repetition, interleaving, and breaks into your schedules. You will first create your timetable ahead of any studying so that you have a specific game plan moving forward. However, make sure to make edits to your schedule if you find yourself struggling in certain areas. Dedicate more time for those challenging topics while subsequently reducing the time spent on topics you feel confident with in order to accommodate accordingly.

EXAMPLE

date: / /

time	monday	tuesday	wednesday	thursday	friday	saturday	sunday
6-9 AM	Study Neural Signals Topics 1, 2, 3	Prime Psychology Topics 3, 4	Study Social ENP Topics 3, 5	Review Neural Signals Topics 2, 3 & Prime Topic 4	Study Social ENP 3, 4		Study BMES ENP Topics 2, 3
9-11 AM	Gym	Boxing	Classes	Gym	Classes	Breakfast with Dad	Church
11-2 PM	Classes	Study Medical Sciences Topics 2, 3	Classes	Review Medical Sciences Topic 2 & Prime Topic 4	Classes	Prime Neural Signals Topics 5, 6	Friends
2-5 PM	Prime Biomechanics Topic 2	Nap	Prime BMES ENP Topic 4	Nap	Relax	Prime Medical Sciences Topic 5	Prime Psychology Topic 5
5-8 PM	Dinner with Friends	Classes	Gym with Alec	Classes	Flag Football	NSDR	Gym with John
8-11 PM	Classes	Classes	Study Biomechanics Topic 1, 2	Classes	Movie Night	Study Neural Signals Topics 1, 3	

Notes: Allocate 45 min to each topic with 5-10 min breaks in between. Include more NSDR when time permits.

REVISION TIMETABLE

Try for yourself!

time	monday	tuesday	wednesday	thursday	friday	saturday	sunday

date: / /

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time	monday	tuesday	wednesday	thursday	friday	saturday	sunday

date: / /

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time	monday	tuesday	wednesday	thursday	friday	saturday	sunday

date: /   /

Notes

time	monday	tuesday	wednesday	thursday	friday	saturday	sunday

date: / /

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PREVENTING PROCRASTINATION

When we procrastinate, rarely is it because the task is overwhelming in and of itself. Instead, it's often a result of our natural tendency to overthink and fixate on the details when introduced to a new task. If we do this for long enough, we artificially create complexity which induces feelings of anxiety and fear.

Therefore, we are inclined to push that task off to a later time, but we never actually forget about it. Rather it sits there subconsciously gnawing away at our sanity, and then we begin to have feelings of guilt. This creates an unhealthy and repetitive pattern because usually we are introduced to a new task before even getting started on the prior one.

When trying to prevent procrastination, you should look for strategies that decrease the initial friction and make it easier for you to get started. You will find that beginning a task is the hardest part, and once you do, it is likely that you will dismantle some of the perceived complexities and eventually enter a flow state. As a result, the subsequent blocks of studying are much easier to complete.

By adopting this strategy, you will accomplish more which will build positive momentum and increase your confidence as you have proven you can achieve what you commit to.

Let's now look at my three favorite techniques that help me prevent procrastination.

5 Minute Rule

This method is one of the best remedies to procrastination that I've ever come across.

The 5 minute rule reduces the initial friction when getting started because you commit to only 5 minutes of working on a task before deciding whether to continue. I have found 8 out of 10 times that I will complete the entire task, because I've entered a flow state and began dismantling some of the artificial complexities.

Even if you choose to not continue, that is okay. Take some time to do something else and try implementing the 5 minute rule again later. It is likely that you will eventually be able to continue working past the first 5 minute bout.

For the first few years of university, I brought along with me a sand timer everywhere I went. I would take it out when I needed to focus because it didn't require me to use my computer or phone which were filled with distractions. It was really a game changer as it served two purposes.

The first, more important, one being that it would allow me to apply the 5 minute rule, but it also became a great place to focus my attention when my brain would begin to wander. Instead of looking at my surroundings where I could easily be distracted further, I would just stare at the timer and see the sand grains dwindle. Once that became boring—which happened usually quickly—I turned to the next best option which was returning back to work.

Pomodoro Technique

One of the most widely used productivity techniques used by students is the Pomodoro Technique. This method involves breaking work into intervals of 25 minutes, followed by short breaks of 5 minutes. After completing a series of pomodoros, a longer break of 30 minutes is taken.

Similar to the 5 Minute Rule, this method aids in overcoming procrastination by making the task more manageable. It's significantly easier to grasp working for 25 minutes instead of several hours straight.

Typically, getting started is the most challenging part, and once you've completed a few pomodoros, the subsequent ones become much easier. Therefore, you'll likely find yourself motivated to continue and quickly make significant progress.
I personally use a revised version of the Pomodoro Technique which has 45-minute intervals instead of the traditional 25 minutes. I find that the increase of time allows me to properly enter a flow state consistently for each pomodoro. I suggest that you experiment with the intervals and find one that fits your natural rhythm.
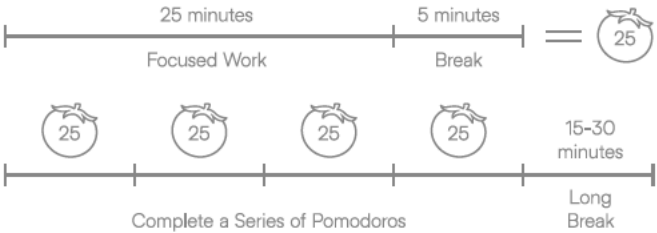
321 Method

The 321 method is an extremely simple yet highly effective technique for combating procrastination. It has you count down from 3 whenever you lack the desire to begin a task. As you are focused on the counting, you momentarily free yourself from the internal struggle between your mind and body. When you reach 1, you immediately act on the task at hand, eliminating any room for second-guessing and making it easier to overcome the initial resistance.

The more common approach to this method is counting up from 1 to 3, but I often found myself extending the countdown. If I extended it for too long, I would find myself right back in the midst of the internal struggle, continuing to procrastinate. By reversing the order and removing any additional numbers to count down to, I have found it to work better for me!

I typically use this method in the mornings when my alarm clock goes off. Instead of snoozing, I simply roll over, count down from three, and get up. This practice can serve as a powerful subconscious tool when turned into a habit.

CAN'T FOCUS?

Try leveraging your peak productivity window.

Everyone has their own natural rhythms throughout the day, and it's important to plan work according to your corresponding energy levels. Some may find themselves to be most focused in the mornings, and others may experience a burst of energy in the afternoon or at night.

Whichever describes you best, it is important that you leverage your peak productivity window by completing the tasks that require the most focus and energy during that time.

Most likely you won't have multiple peaks throughout the day, so ensure the windows are only reserved for deep work sessions. Come prepared, eliminate distractions, and find a suitable environment in order to take full advantage of these limited opportunities.

As an example, let's consider the current time here while I write this book, which is 7:15 AM. Recognizing that my peak focus occurs between 6-8 AM, I am intentionally using this time to write the book because it's the most demanding task today.

Additionally, I have taken proactive measures to enhance my productivity such as carefully planning the sections I will be writing, leaving my phone in a different room, and cleaning my workspace. By implementing these strategies, I am giving myself the best opportunity to fully leverage the heightened focused period and achieve optimal results.

After 8 AM, I will take a break, eat breakfast, and workout. Then once I return to the office, I will have less demanding tasks to complete such as responding to emails and taking a short pretest for my Biosimulation class in the afternoon.

By deliberately aligning my schedule with my natural energy levels, I'm able to produce quality work efficiently.

If you are unsure of your peak productivity window, I would encourage you to spend a week tracking your energy levels, monitoring both natural fluctuations and external factors that influence your focus.

Then the following week, experiment with various time frames that align with the patterns you have identified. You may have to go through multiple reiterations before finding your window, but it will be more than worth it.

DON'T HAVE MOTIVATION?

"Never let your mood dictate what you do. You have to take action first because movement changes your mood." - Mel Robbins

Motivation is amazing when you have it, but you shouldn't rely on it because it's temporary.

Instead, find ways to get yourself moving with a simple routine that will build positive momentum. This book should become a foundational element of your daily life as a student which will aid in taking actionable steps during all stages of the learning process.

With any new initiative comes challenges, and using this book will be no different. It's up to you to take on the difficulties head on and persevere until it's become a habit because it will be well worth it, especially when your motivation is low.

Moreover, do everything you can to reduce the initial friction for all the parts of your routine.

You want to stop wasting time scrolling in the morning? Don't leave your phone where you can reach it in bed.

You want to do your journaling? Have your book opened up already on your desk.

You want to go to the gym? Lay out your workout clothes the night before.

By embracing a routine and making it a part of your daily life, you can overcome the ebb and flow of motivation, ensuring consistent progress towards your goals as a student. Remember, it's the small, consistent micro-wins that lead to lasting success.

HOW TO HANDLE FAILURE

You were wrong? You messed up? You got rejected? Good.

You are one step closer to finding your correct solution. No one's path is linear and you are exactly where you are supposed to be on yours.

Fail your way to success by identifying what you did well and continue building upon them and also identifying what you did not so well and continue improving on them.

Don't be afraid to seek support from your friends, family, mentors, or a support network as they can offer guidance, encouragement, and a fresh perspective.

The only time a failure actually becomes a defeat is if you give up. Don't let that be you.

HOW TO READ TEXTBOOKS

How many times do you find yourself rereading the same passage over and over again because you don't understand the content? Then by the time you are able to move onto the next section, it's already been an hour and you are very behind on your readings. Ultimately, the entire experience becomes miserable and you never want to do it again.

It doesn't have to be that way.

First, understand that the author did not consider your specific background before writing the textbook. Instead they had to decide on an organization that they felt was best for the general audience. If you think about it, the author themselves most likely didn't learn the information in that particular order, right?

Just because information is presented to you in a certain order, it does not mean that it is the best order that YOU should read it. Instead, skim through until you reach a concept that is relevant to you. Take the time to understand it and then proceed to the next piece of information that is relevant. You'll find that the neighboring content becomes increasingly easier to understand.

Then return back to the text that you skipped. Since it's the second time going through it and you've started identifying the big picture with the concepts you already understand, you'll find more relevance with the remaining text.

If you still cannot understand certain concepts, simply look for a different resource that explains it from a new perspective such as a YouTube video.

This is a much more efficient AND enjoyable method of learning from your textbooks.

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