



THE
GUIDE TO
**ACADEMIC
SUCCESS**

By
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Disclaimer:

Hi guys! Before we jump into the "Guide to Academic Success" by Jun Yuh, here are a few things you should know:

Jun has poured his personal experience, research, and educational background into this guide. It's important to note that while Jun isn't a licensed professional, his insights are extremely valuable. Just remember, this guide isn't a substitute for professional advice.

Jun has also taken great care to ensure accuracy, but of course, human errors remain a possibility in any circumstance. The thoughts, opinions, and recommendations in this guide are solely his own and may not align with the views of others.

The guide includes references to external sources, which you can check independently for accuracy.

The techniques, tips, and advice in this guide are informative and educational, but results may vary based on individual circumstances. Please be aware that Jun doesn't guarantee specific outcomes.

Jun cannot be held liable for any damages or losses resulting from the use of this guide. By accessing and using the guide, you accept full responsibility for your actions and decisions.

For personalized advice, it's recommended to consult professionals or experts in the relevant fields.

By accessing and using this guide, you acknowledge that you've read and understood this disclaimer. Thanks for joining us on this journey to academic success!

Introduction:

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 revamp 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 finish reading this guide 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 more effectively study with evidence-based techniques, you will not need as much time to excel in classes, and then you can fully enjoy everything else that you want to do. Since school refuses to teach you, let me.

In this guide, we will cover the following topics to get you the most comprehensive understanding of academic success:

- What you are likely doing wrong
- Evidence-based learning techniques
- Productivity hacks
- Personal advice for college students
- Resume writing
- Interview tips

Why Listen to Me?

If you know me, I'm as transparent as it gets so let's look at my credentials together.

High School and College Success:
High school transcript:

STUDENT TRANSCRIPT

Grade 9 2015-2016						Grade 10 2016-2017					
COURSE			GRD	CREDIT		COURSE			GRD	CREDIT	
9000	9TH WELLNESS		A	1.000		9570	ADVENTURE EDUCATION		A	0.500	
7708	COMPUTER GRAPHICS		A	0.500		2411	ALGEBRA II H		A	1.000	
2311	GEOMETRY H		A	1.000		3311	BIOLOGY H		A	1.000	
1102	HISTORICAL INQUIRY H		A	1.000		5740	ENTREPRENEURSHIP		A	0.500	
5509	INTRO TO BUS AND TECH		A	0.500		1202	GLOBAL HISTORY II H		A	1.000	
0120	LANG/LIT/WRIT I H		A	1.000		0220	LANG/LIT/WRIT II H		A	1.000	
3111	PHYSICAL SCIENCE H		A	1.000		5702	PERSONAL & BUS LAW		A	0.500	
4731	SPANISH II H		A	1.000		4751	SPANISH III H		A	1.000	
						5519	SPORTS AND ENT MARKETING		A	0.500	

	GPA 2010-	GPA 2010- (wip)	Unwtg GPA	Att. Crd	Cmp Crd	Crd
GL 09	4.25	4.25	4.00	7.000	7.000	
Career	4.25	4.25	4.00	7.000	7.000	

Absent: 1.0 Tardy: 0

Grade 11 2017-2018						Grade 12 2018-2019					
COURSE			GRD	CREDIT		COURSE			GRD	CREDIT	
1491	AP AMERICAN HIST H		A	1.000		1691	AP ECONOMICS H		A	1.000	
3331	AP BIOLOGY H		A	1.000		0691	AP ENGLISH/LITERATURE H		B+	1.000	
0690	AP ENGLISH/LANGUAGE H		B+	1.000		3712	AP PHYSICS 1		B+	1.000	
3511	CHEMISTRY H		A	1.000		9696	BIOTECHNOLOGY H		A	1.500	
9110	Grad Project Seminar Jr		P	0.000		2712	CALCULUS H		A-	1.000	
9200	HEALTH		A	0.500		9100	GRAD PROJ SEMINAR SR		P	0.800	
5525	MANAGING PERSONAL FINANCE		A	0.500		9840	PHYSICAL EDUCATION		A	0.500	
2611	PRE-CALCULUS H		B	1.000							
4771	SPANISH IV H		A-	1.000							

	GPA 2010-	GPA 2010- (wip)	Unwtg GPA	Att. Crd	Cmp Crd	Crd
GL 11	4.16	4.16	3.71	7.000	7.000	
Career	4.85	4.85	3.90	21.000	21.000	

Absent: 14.5 Tardy: 2

	GPA 2010-	GPA 2010- (wip)	Unwtg GPA	Att. Crd	Cmp Crd	Crd
GL 12	4.14	4.14	3.72	6.800	6.800	
Career	5.24	5.24	3.86	27.800	27.800	

Absent: 17.0 Tardy: 0

Credit Summary										
Arts/Huma	n	Business	Elective	English	Health/PE	Math	Other	Science	Social Studies	World Languages
Credits	0.500	0.500	2.300	4.000	1.500	4.000	3.000	5.000	4.000	3.000
Total 27.800										

Testing Summary	Grade Point Summary
Keystone (Apr 2018)	Cumul 4pt Wt GPA: 5.24
Algebra I Adv	Cumul 4pt UnWt GPA: 3.86
Biology Adv	Cumul 4pt Wt GPA: 5.24 (inc W/P)
Literature Adv	Cumul 4pt UnWt GPA: 3.86 (inc W/P)
	Cumul Credits Attempted: 27.800
	Cumul Credits Earned: 27.800

Signature of Certifying Official: _____

UNOFFICIAL
TRANSCRIPT

Date: _____

Subj No.	Title	Cred	Grade	Pts	R
INSTITUTION CREDIT:					
BIO 122	Cells and Genetics	4.50	A	18.00	
BMES 102	BMES FR Des II	2.00	A+	8.00	
ENGL 103	Composition and Rhetoric III	3.00	A	12.00	
MATH 200	Multivariate Calculus	4.00	B	12.00	
PHYS 102	Fundamentals of Physics II	4.00	A	16.00	
Earned Hrs	GPA-Hrs	QPs	GPA		
17.50	17.50	66.00	3.77		
Dean's List Good Standing					
Fall Quarter 20-21					
In response to COVID-19, optional P/NP and P*/NP* grading was adopted for the Fall Quarter. Biomedical Engineering					
COOP 201	Co-op Experience West Pharmaceutical Services	16.00	DCU	16.00	I
Earned Hrs	GPA-Hrs	QPs	GPA		
0.00	0.00	0.00	0.00		
Good Standing					
Winter Quarter 20-21					
In response to COVID-19, optional P/NP and P*/NP* grading was adopted for the Winter Quarter. Biomedical Engineering					
COOP 201	Co-op Experience West Pharmaceutical Services	16.00	DCU	16.00	I
Earned Hrs	GPA-Hrs	QPs	GPA		
0.00	0.00	0.00	0.00		
Good Standing					
Spring Quarter 20-21					
In response to COVID-19, optional P/NP and P*/NP* grading was adopted for the Spring Quarter. Biomedical Engineering					
BMES 202	Program & Modeling for BME II	3.00	A	12.00	
BCE 201	Electric Circuits	4.00	A	16.00	
ENGR 220	Fundamentals of Materials	4.00	A	16.00	
MATH 201	Linear Algebra	4.00	B	12.00	
MEM 202	Statics	3.00	A+	12.00	
Earned Hrs	GPA-Hrs	QPs	GPA		
18.00	18.00	68.00	3.77		
Dean's List Good Standing					
Summer Quarter 20-21					
Biomedical Engineering					
BIO 218	Principles of Molecular Bio	4.00	A+	16.00	
BMES 241	Mod BMES Des I	2.00	A	8.00	
BMES 338	Biomedical Ethics and Law	3.00	A	12.00	
MATH 210	Differential Equations	4.00	C	8.00	
MEM 238	Dynamics	4.00	A	16.00	
Earned Hrs	GPA-Hrs	QPs	GPA		
17.00	17.00	60.00	3.52		
Good Standing					
Fall Quarter 21-22					
Biomedical Engineering					
COOP 201	Co-op Experience	16.00	DCU	16.00	I

Subj No.	Title	Cred	Grade	Pts	R
INSTITUTION CREDIT:					
Biomedical Engineering					
Fall Quarter 19-20					
BMES 124	BME Freshman Seminar I	2.00	A	8.00	
BMES 201	Program & Modeling for BME I	3.00	B+	9.99	
CHEM 101	General Chemistry I	3.50	A-	12.84	
CTVC 101	Intro to Civic Engagement	1.00	A+	4.00	
ENGL 101	Composition and Rhetoric I	3.00	A	12.00	
MATH 121	Calculus I	4.00	A	16.00	
UNIV R101	The Drexel Experience	1.00	A+	4.00	
Earned Hrs	GPA-Hrs	QPs	GPA		
17.50	17.50	66.83	3.81		
Dean's List Good Standing					
Winter Quarter 19-20					
Biomedical Engineering					
BMES 101	BMES Des I	2.00	A	8.00	
CHEM 102	General Chemistry II	4.50	B+	14.98	
COOP 101	Career Mgmt/Profess Dev	0.00	CR	0.00	
ENGL 102	Composition and Rhetoric II	3.00	A	12.00	
MATH 122	Calculus II	4.00	A	16.00	
PHYS 101	Fundamentals of Physics I	4.00	B+	13.32	
Earned Hrs	GPA-Hrs	QPs	GPA		
17.50	17.50	64.30	3.67		
Dean's List Good Standing					
Spring Quarter 19-20					
In response to COVID-19, optional P/NP and P*/NP* grading was adopted for the Spring Quarter. Biomedical Engineering					

Subj No.	Title	Cred	Grade	Pts	R
TRANSFER CREDIT ACCEPTED BY THE INSTITUTION:					
summer	College Board AP Credit				
HIST 201	US History to 1815	4.00	AP		
Earned Hrs	GPA-Hrs	QPs	GPA		
4.00	0.00	0.00	0.00		

Subj No.	Title	Cred	Grade	Pts	R	Subj No.	Title	Cred	Grade	Pts	R		
INSTITUTION CREDIT: GlaxoSmithKline						INSTITUTION CREDIT: BMES 541 Nano/Mol Mech of Bio Materials ENVS 260 Environ Science & Society							
Earned Hrs	GPA-Hrs	QPts	GPA				Earned Hrs	GPA-Hrs	QPts	GPA			
0.00	0.00	0.00	0.00				19.00	19.00	73.33	3.85			
Good Standing						Dean's List Good Standing							
Winter Quarter 21-22 Biomedical Engineering						Spring Quarter 22-23 Biomedical Engineering							
COOP 201	Co-op Experience GlaxoSmithKline	16.00	DCU	16.00	I	BMES 678	Biocomp Modeling & Simulation	3.00	A	12.00			
Earned Hrs	GPA-Hrs	QPts	GPA				COOP 201	Co-op Experience Student Start-Up Co-op	16.00	NP	0.00	I	
0.00	0.00	0.00	0.00				Earned Hrs	GPA-Hrs	QPts	GPA			
Good Standing						3.00 3.00 12.00 4.00							
Spring Quarter 21-22 Biomedical Engineering						Summer Quarter 22-23							
BIO 201	Human Physiology I	4.00	A	16.00		COOP 201	Co-op Experience	16.00	In Prog	Course			
BMES 345	Mechanics of Biolog. Systems	3.00	A	12.00		MATE 230	Fund of Materials II	4.00	In Prog	Course			
BMES 375	Computational Bioengineering	4.00	A-	14.68		Transcript Totals							
BMES 432	Biomed Systems and Signals	3.00	A	12.00		Earned Hrs	GPA Hrs	Points	GPA				
CHEM 253	Thermodynamics & Kinetics	4.00	B+	13.32		TOTAL INSTITUTION	167.50	167.50	628.15	3.75			
Earned Hrs	GPA-Hrs	QPts	GPA				TOTAL TRANSFER	4.00	0.00	0.00	0.00		
18.00	18.00	68.00	3.77				OVERALL	171.50	167.50	628.15	3.75		
Dean's List Good Standing						-----END OF TRANSCRIPT-----							
Summer Quarter 21-22 Biomedical Engineering													
BMES 303	Lab III: Biomed Electronics	2.00	A-	7.34									
BMES 305	Lab V: Musculoskeletal Anat for BME	2.00	A-	7.34									
BMES 310	Biomedical Statistics	4.00	A-	14.68									
BMES 341	Mod BMES Des II	2.00	B+	6.66									
BMES 451	Trans. Phenomena in Living Sys	4.00	A	16.00									
BMES 604	Pharmacogenomics	3.00	A	12.00									
COM 111	Principles of Communication	3.00	A+	12.00									
Earned Hrs	GPA-Hrs	QPts	GPA										
20.00	20.00	76.02	3.80										
Dean's List Good Standing													
Fall Quarter 22-23 Biomedical Engineering													
BIO 462	Biology of Neuron Function	3.00	B	9.00									
BMES 315	Exp Design in Biomed Research	4.00	B+	13.32									
BMES 381	Junior Design Seminar I	2.00	A-	7.34									
BMES 510	Biomedical Statistics	4.00	A	16.00									
BMES 550	Advanced Biocomputational Lang	4.00	A+	16.00									
ENTP 440	Launch It!: Early Stage	3.00	A+	12.00									
Earned Hrs	GPA-Hrs	QPts	GPA										
20.00	20.00	73.66	3.68										
Dean's List Good Standing													
Winter Quarter 22-23 Biomedical Engineering													
BMES 302	Lab II: Biomasurements	2.00	A-	7.34									
BMES 337	Intro: Physio Contl Sys	3.00	B+	9.99									
BMES 382	Junior Design Seminar II	2.00	A	8.00									
BMES 444	Biofluid Mechanics	3.00	A	12.00									
BMES 528	Pediatric Engineering I	3.00	A	12.00									

I've always been a high-performing student that loved the challenge of taking on advanced classes. When I was in high school, that meant exclusively enrolling in honors and AP courses and even a dual enrollment program at a professional biotechnology lab.

In college, that meant choosing one of the most demanding majors—biomedical engineering—with notoriously difficult classes like Calculus 3, Thermodynamics & Kinetics, Transport Phenomena in Living Systems, Nano/Molecular Mechanics of Biological Materials, and Biocomputational Modeling & Simulation.

Furthermore, I've decided to pursue my masters at the same time in biomedical engineering meaning I've had to max out 20 credits each term. Throughout this academic journey, I have also actively engaged in numerous extracurricular activities and assumed various leadership roles within clubs and sports.

I've learned how to study the hard way (and best way in my opinion): putting myself through the most rigorous path possible. The techniques in this guide have passed the test of time and have allowed me to have a lot of success. I now hope to help you do the same.

“Curse of Knowledge“:

Popularized by economist Martin Weber, the phenomenon refers to the cognitive bias where individuals who possess great knowledge or expertise in a particular subject find it difficult to communicate that information effectively to others who lack the same knowledge.

We have all likely experienced this in one form or another. It's the exact reason why those genius professors are so difficult to learn from, why elite athletes become terrible coaches, and why super successful entrepreneurs fail as business mentors.

The gap of knowledge is best bridged by someone who has had more success than the student but is not yet far removed from the day-to-day struggles.

That person is me.

After seeing my grades for the last 8 years, you know I'm certainly not perfect. However, I've been able to navigate very demanding curricula and achieve notable success, including earning a place on the honor roll in high school and the dean's list in university.

Being in the final year of my schooling, I am well-positioned to break down the techniques that have contributed to my success, making them easily understandable for those who may be new to the various concepts.

Multidisciplinary Major:

Biomedical engineering is one of the most versatile majors as students are required to take classes that cover topics in electrical engineering, mechanical engineering, chemical engineering, biology, and computer science. Moreover, I've taken general education courses along with electives in advanced calculus, composition and rhetoric, material science, anatomy, and entrepreneurship.

Therefore, I have personally experienced applying these learning techniques across MANY disciplines and they have served me well in every single course. If you are pursuing a major that involves any of these subjects, I can assure you that they will work for your learning!

Mastering Balance:

I recognized early on that I had great ambition to do more than just school and I wasn't going to let anybody tell me that it wasn't realistic. I wanted to be a great friend, son, boyfriend, scientist, entrepreneur, and creator, all while still being healthy physically, mentally, and spiritually.

I believe I've done just that.

The last four years while pursuing both a bachelors and masters simultaneously, I've received more than 15 internship offers from top pharmaceutical companies, start-ups, and medical device companies.

I've accepted two 6-month positions at West Pharmaceutical Services and at GlaxoSmithKline, where I had the opportunity to develop and manage my own impactful projects. Additionally, I've earned a \$19K scholarship to pursue my entrepreneurial endeavors for another 6 months.

I've still been able to help my dad's contracting business on the weekends, spend time with my friends and beautiful girlfriend, go to the gym regularly, and build social media platforms with over 3M+ followers.

Is it hard work? Yes. Is it more than possible with the correct studying and productivity techniques? Also yes, so let's get right into the rest of the guide now.

What You Are Likely Doing Wrong

You've Fallen into the Numbers Game Trap

Many students have the expectation that the more they study, the better they will perform on an exam. Although this has some merit and can carry students throughout secondary school, it is also one of the biggest causes of burnouts as they pursue higher education.

When students are required to take heavier course loads and more of them simultaneously, they cannot simply increase the number of hours they study. This leaves them unprepared for exams and inevitably results in lower marks than they are accustomed to.

Therefore, it is imperative that students in secondary school don't solely rely on their marks as a metric for success. Instead, it is more important to develop a robust system early on with effective study techniques that will yield long-term benefits when it truly matters.

This system, when developed and executed correctly, will allow the students to be more efficient in their studies (i.e. spend less time getting better grades). Only then can a student excel in all levels of education while still maintaining a healthy balance with their social lives and hobbies.

Your Notes Are Too "Pretty"

I know we all have those friends who pride themselves on having the prettiest notes. They sit down with their pencil cases and go from one highlighter and colored pen to another.

Although this approach could be effective for some, it has been shown in research repeatedly that rereading, highlighting, and other passive techniques typically associated with this approach have very low utility.

Unfortunately, many continue to favor these passive methods because they are pleasing to look at, which is further amplified by viral videos on "studytok" and other social media posts.

Now, perhaps I'm also unintentionally a culprit of this as many of you know me as someone with an aesthetic desk setup. However, ensuring my environment is set up for success does not correlate with the methods of learning I'm applying.

In other words, if you saw what was written on my iPad or typed on my computer, you would see very complex, sometimes messy, and interleaved work. We'll discuss why these methods have greater utility later.

I understand it's fun to take colorful notes, but the reality is, the time it takes to create them is not worth the comprehension that's gained. I suggest reserving this method for the occasional low stress periods of your schooling and look to more efficient methods to apply for the majority of the time.

You Want Studying to be Easy

The Yerkes-Dodson Law states that mild amounts of physiological or mental stress actually improves performance. Therefore, if you are not being adequately challenged with your studying, then it is unlikely that you are optimizing your sessions. With that being said, you certainly shouldn't push to the opposite extreme as excessive stress can negatively impact your performance.

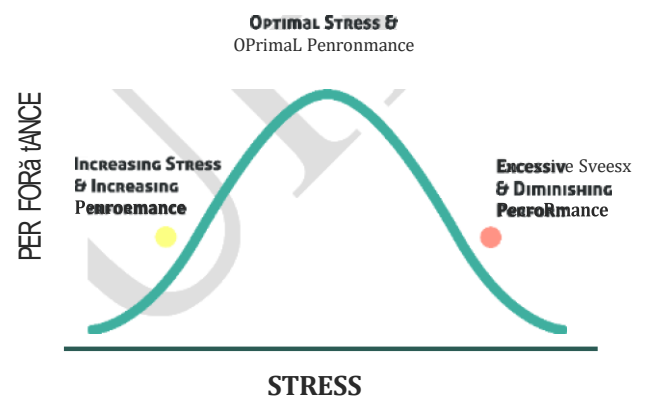
It's important to note that as human beings, we have the capacity to tolerate more stress than we often realize. Moreover, we can increase our tolerance through additional practice. Therefore, it is beneficial to gradually push your boundaries over time to enhance your performance and learning outcomes.

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

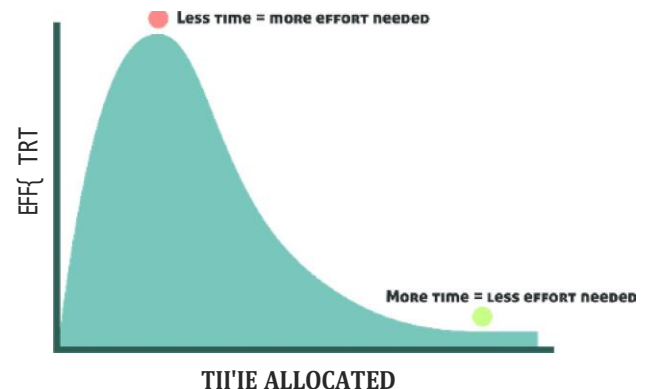
In other words, if you have a task that needs to be done and you give yourself a generous deadline, the task will likely take longer to complete because it will naturally expand to fill the available time. Conversely, if you set a shorter deadline, you are more likely to complete the task within that time frame.

In order to leverage both laws, you want to have more intense yet shorter study sessions. By doing this, you'll still be able to optimize your studying and have more time for the other things you'd like to do!

Yerkes-Dodson Law

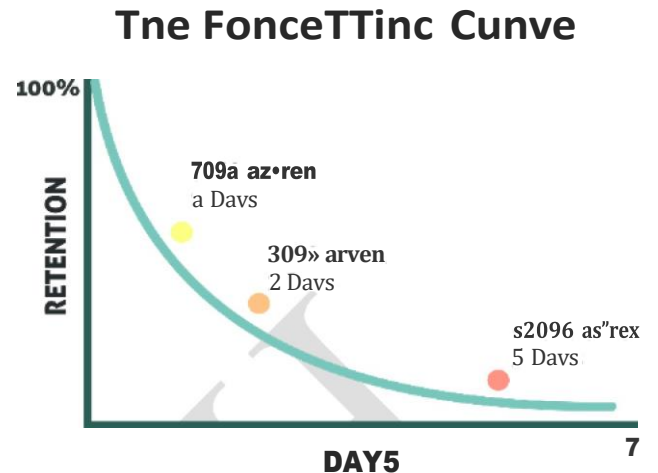


Parkinson's Law



You Are Forgetting About the Forgetting Curve

First proposed by German psychologist Hermann Ebbinghaus in the late 19th century, the concept suggests a significant amount of information learned can be forgotten within a short period. 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.



Many students often cram for individual unit tests throughout the semester, relying on binge-watching lectures and rereading textbooks. However, this approach often leads to a shallow understanding of concepts and results in forgetting crucial material when it comes to the cumulative exams at the end of the year.

Using this approach is highly inefficient, as it requires spending significant amounts of time relearning the material. Moreover, you may struggle to retain the information as you progress to higher-level classes, placing you at a significant disadvantage.

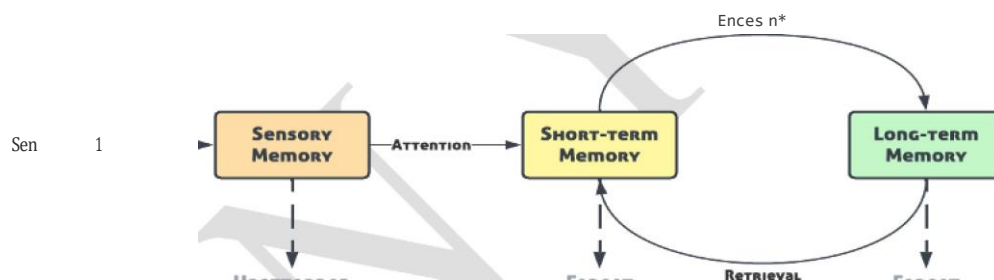
Evidence-Based Learning Techniques

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.

Now let's closely examine four really important principles that will guide our learning system.

Principle One: Active Recall

Defining Active Recall

Active recall involves deliberate and effortful retrieval of information from memory in order to strengthen neural pathways and optimize long-term learning. It is imperative to

distinguish between active or “free” recall from the more ineffective but commonly used *cued* recall method.

An example of cued recall is the use of flashcards as this simply requires a student to make a connection between a term (cue) and a definition (target) for isolated and decontextualized facts. This, like the many passive techniques mentioned before, creates an *illusion of knowing* and often will leave students performing poorly on exams as inference or application-based questions are more prevalent in higher education.

Instead, you should practice the way you would be tested on an exam by synthesizing, reorganizing, comparing, applying, and contextualizing the information through retrieval practice. This approach allows you to create meaningful structure in your brain with links between concepts that create deeper impressions on your memory.

If any of the four principles were more important than the others, it would likely be active recall, as numerous studies have shown its incredible effectiveness across various learning applications. Rather than dedicating the next 20 pages to reviewing each experiment individually, let's focus on a study published in 2011 by Karpicke and Blunt. This study examined multiple important factors through its intelligent design.

Examining the Scientific Research:

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.

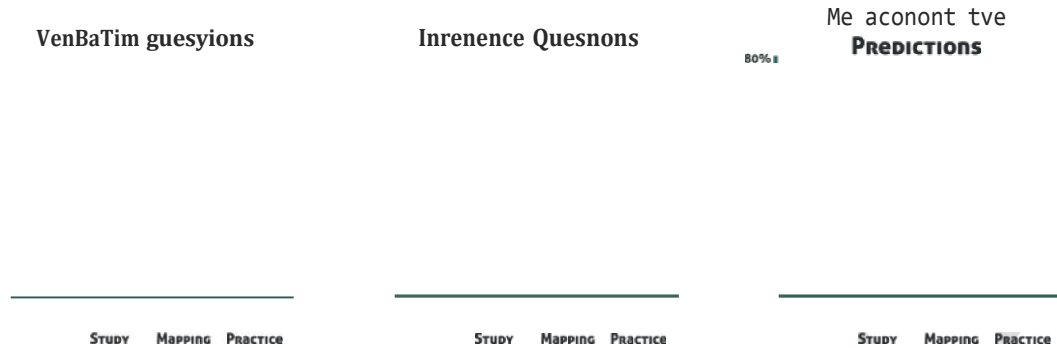
* The total amount of learning time was exactly matched in the concept mapping and retrieval practice conditions.

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 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 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:

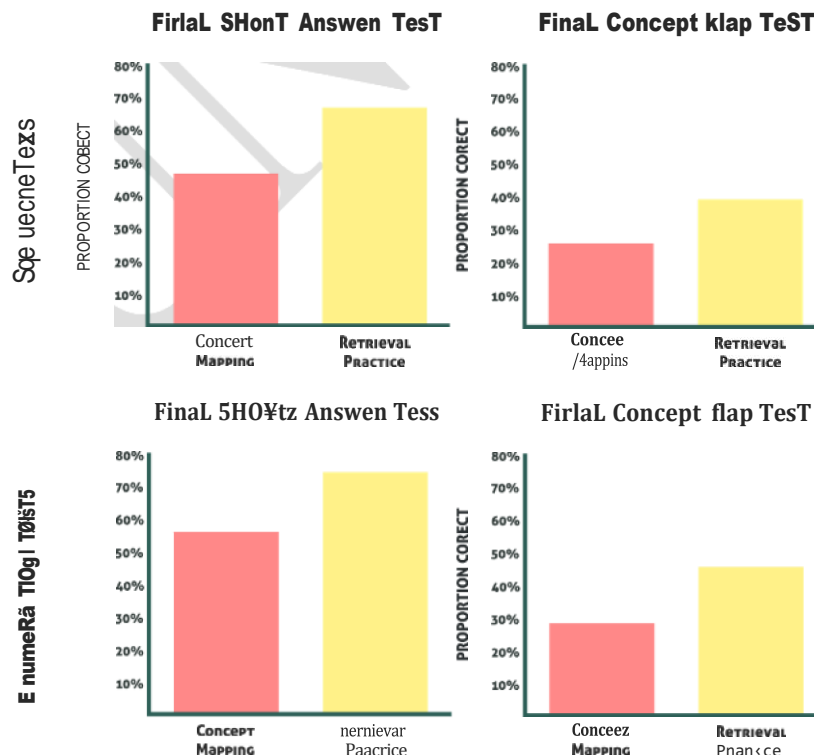
1. Enumeration structures: These refer to texts that describe a list of concepts or items.
2. Sequence structures: These refer to texts that describe an ordered series of events.

There was 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.



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.

Jeffrey D. Karpicke, Janell R. Blunt, Retrieval Practice Predicts More Learning than Elaborative Studying with Concept Mapping. *Science* 331, 772-775 (2014). DOI: 10.1126/science.1199327

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.

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

Applying Active Recall

1. Pretests prior to class

Proactively identify concepts being covered in class the upcoming week using the syllabus, textbook, past papers, and any other pre-class notes given. Search for a few practice problems associated with the concept (no longer than 20 minutes worth), and quiz yourself.

You are meant to set many of these wrong as 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.

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.

2. In-class "notes" (the right way)

Stop simply rewriting everything the professor says. It is so ineffective and ultimately a big waste of your time. Instead, write questions.

Don't overthink this and just start with 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?"

This frame of thinking will allow you to take an additional step into the mind of the teacher, enabling deeper learning.

Here are some potential prompts to implement for your classes:

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

You shouldn't concern yourself with perfecting 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.

**Pro tip: Always utilize lecture objectives w/ieri available as these are free questions that the teacher is directly giving to you. These are usually included in the beginning of presentation, but most students tend to overlook them. Take a second to include the scope now, so that you are able to better ignore the content that does not matter later. This is really important for those that have the type of teachers that like to rhyme (I've had my fair share).*

3. Immediate review of class material

Once class is over, you now have the perfect revision guide to further 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 cerebrospinal fluid within the ventricles of the brain. It can exert pressure on the surrounding brain tissue, potentially leading to death and may require surgery. In some cases, shunts are required to be able to return to a normal level of intracranial pressure."

This can exert pressure on the surrounding brain tissue, potentially leading to death and may require surgery. In some cases, shunts are required to be able to return to a normal level of intracranial pressure."

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.

Next, color code the questions based on your understanding. Leave the question in black if you answered correctly with sufficient detail. Otherwise, change the question to blue if you answered partially or to purple if you couldn't answer at all. You can also make the text a darker shade of blue or purple the less you understand the information!

This is also the time to reformat or rewrite your questions altogether in a manner most effective for future revisions since you were concerned with simply recording their basic form during class.

**Pro tip: try not to write out all your answers for these questions as this can be easily taken away or lost over time. Instead, just go through the questions and answer them 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.*

I have found writing the answers to each of the questions was not worth it because I could always just revisit the lecture slides and be able to find a thorough answer by looking at the neighboring information.

With that being said, there were certain cases when taking a snapshot of a grayli or drawing it out was especially for extremely detailed processes. However, I would always utilize a tool like OneNote (depending on if it was a digital or physical note-taking system) to cover up the cue so that I could initially utter it to recall freely during future revision sessions.

4. Feynman technique

After being able to answer these questions so that Jon can generally comprehend the information, take it a step further and implement the Feynman technique which involves you teaching the information so that a friend 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-level thinking and ultimately 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 process 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 recorder that you can replay to critique yourself).

5. 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 recalled 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.

6. 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 thoroughly in writing 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 the questions you created during and after class in an attempt to retrieve the correct answer with more familiar cues from your studying.
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 studied 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. There is nothing more effective in narrowing your scope of study than seeing a previous year's exam for that specific clues. Generally, the questions aren't identical, but at the very least they will provide you with valuable clues such as content emphasis, exact structure, or 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 on the 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 lack of 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

Principle Two: Spaced Repetition

Defining Spaced Repetition

In an earlier section, we explained that “forgetting about the forgetting curve” is one of the grave mistakes you are likely making. So how do we combat this? Spaced repetition.

No matter how great of a student some of us are, we have all experienced cramming at one point or another. Perhaps you did okay on the exam or maybe you even did well, but how much of that information did you retain afterwards?

In other words, how much did you have to study that material again prior to your finals? Probably a lot. Only to forget that material again immediately after the exam.

This may have gotten you through high school but won't have the same success in university especially in medicine, engineering, law, and other demanding studies as you will be expected to recall information accurately and thoroughly from years prior.

This is a very serious matter as the repercussions of failing to do so in the real world can be as severe as death of patients or permanently losing your license to practice.

Spaced repetition is an evidence-based method that promotes long-term retention and ultimately has you study *less*. Here's how it works:



Without reviewing newly learned information, research suggests you could lose up to 70% of retention in just one day. If you review the material at spaced intervals after the initial learning, then the forgetting curve begins to flatten out and you get significantly 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.

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.

Evaluating the Scientific Research:

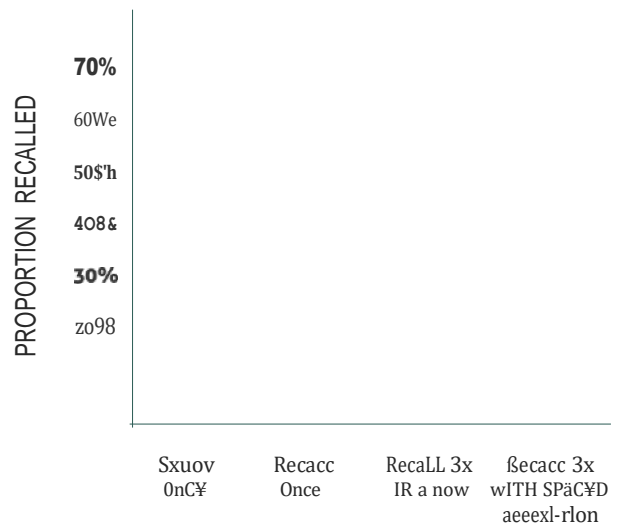
Scientists Karpicke and Bauernschmidt performed a study investigating recall of a new language using various study techniques. The findings were incredibly interesting.

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. This finding supports the previous section, highlighting the effectiveness of active recall as a study method.

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%).

Effects of Various Techniques on Retention



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.

Kai {aicke JD, Ba uern.scli nritlt A. S{aacetl retrieval: HbS(flute spacing enhance.s leai ning i'cgai'd Icsc of rclative .spacing. J Exp Psychl of L.carn Mem Cogn. 2011 Sep;37(5):1 2S0-7. doi: 10.1037/a0023436. PMID: 21574747.

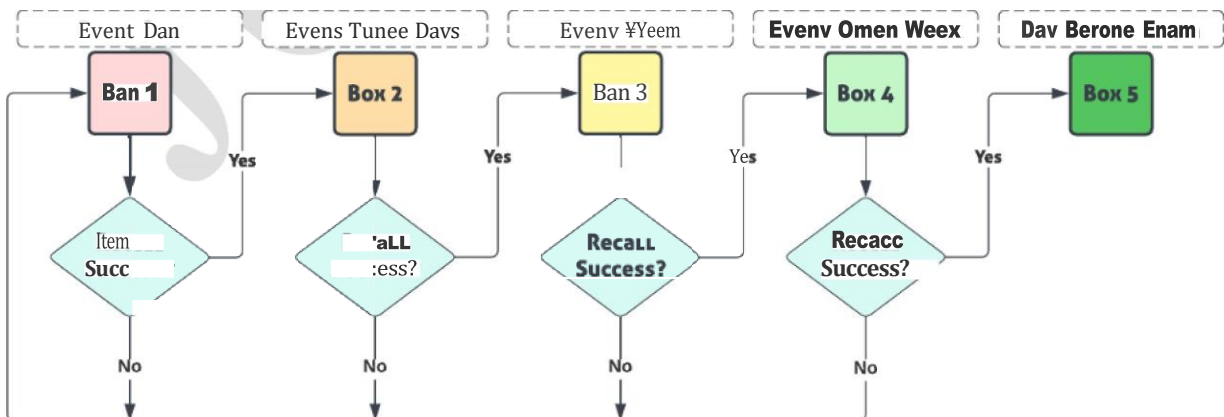
Applying Spaced Repetition

1. Leitner system

One of the first methods to integrate spaced repetition was the Leitner system which still proves to be very popular amongst students today. This method was originally done with shoeboxes and notecards but has since been more commonly implemented using digital note taking softwares. Either approach works perfectly fine.

The boxes can be labeled indicating *when to revise* concepts in the following manner:

- Box 1: "Every Day"
- Box 2: "Every Three Days"
- Box 3: "Every Week"
- Box 4: "Every Other Week"
- Box 5: "Day Before Exam"



After the boxes are created, identify all the topics that will be covered on the exam and place them in the first box. If you decide on physical boxes, then use notecards to write the concepts, and if you decide on virtual boxes, then use bullet points. These notecards or bullet points should also include various active recall questions derived from problem sets, past papers, in-class notes, etc.

Then take turns going through each concept answering the questions thoroughly. If you successfully recall a concept, then move that flashcard or bullet to the subsequent box. If you fail to recall the concept, then move it back to Box 1.

This method ensures that you have shorter spaced intervals between study sessions for unfamiliar material and longer spaced intervals between study sessions for familiar material.

There are many reasons to like the Leitner system but perhaps none more important than its customizability. As learning paces are subject to vary based on the individual, the labels can be changed out for shorter or longer intervals. Moreover, the individual can elect to move back only one or two boxes in the case they fail to recall rather than all the way to the beginning.

2. End of day review

The first two years of college were filled with experimentation as I tried various combinations of evidence-based methods that I discovered while reading books and scientific publications.

I understood it would take time for me to optimize a system that would work for all the various subjects in biomedical engineering that were not necessarily covered in the readings.

However, the *end of day review* method was one that I immediately adopted after learning about Ebbinghaus's forgetting curve and till this day remains a vital component of my learning system.

This application is a lot more intuitive than the others and does not require a learning curve to implement, so I would highly suggest you integrate this method right away.

I understand the feeling of wanting to shut down your computer, close your textbook, and put away all your notes after covering the last topic. However, I strongly encourage you to take advantage of the spacing effect by dedicating another 20 minutes before going to bed to practice retrieving all the newly learned information.

The forgetting curve demonstrates that up to 70% of information can be forgotten within 24 hours. However, based on my own experience, I've found that dedicating

just a little additional time to review at the end of the day can significantly reduce that percentage.

At this point, you should have a list of topics and questions, therefore treat them as you would in the blurring method and look to recall any related information.

The goal here isn't necessarily to answer all the questions correctly. It's about leveraging the spacing effect and ensuring that the information you do recall is encoded more deeply into your long-term memory.

By putting in just an extra 20 minutes, you can reap important benefits later by significantly reducing the amount of revision needed in subsequent study sessions.

3. **Prospective revision timetable**

Revision timetables, also known as study schedules, can be implemented in two ways.

The first one we will cover is the more popular “prospective” method, which involves creating a revision plan prior to any studying, usually at least 6 weeks before an exam.

To execute this effectively, get out either a paper or digital spreadsheet and in the first column include the dates you have available for studying.

Then in the subsequent column you will fill in topics based on your class's syllabus with a common spacing method being to double the days between sessions.

For example, if we were looking at my Mechanics of Biological Systems class I would schedule the first day of studying for 3-D Hooke's Law and then revisit it on the second day, fourth day, eighth day, 16th day, and so forth leading up to the exam.

This method is excellent for providing a structured framework that helps you manage your time effectively and ensures balanced coverage of the topics utilizing spaced repetition.

Moreover, students often find themselves procrastinating because they are unsure about what to study each day. This method helps alleviate hesitation by pre-determining the topics to be covered, providing a clear direction for their study sessions.

For those that need additional help with procrastination, it may be beneficial to further break down the days into hours. This would require you to make headers for both the rows and columns labeling them times and days respectively. Look below for an example.

	A	B	C	D	E	F	G	H
1		19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun
2	6:00	Topics based on syllabus go here						
3	7:00							
4	9:00							
7	12:00							
8	13:00							
9	14:00							
10	15:00							
11	16:00							
12	17:00							
13	18:00							
14	19:00							
15	20:00							

By breaking the days down to every hour, you are also able to have more control over how you allocate your time across multiple subjects. This can prove especially useful in higher education, where you typically have a larger number of classes.

4. Retrospective revision timetable

The more uncommon approach to revision timetables is the “retrospective” method which involves evaluating your performance from past sessions and adapting the schedule to your weaknesses.

Essentially this is the opposite of the prospective method so when you set up your spreadsheet, this time you will include your topics in the first column. Then the subsequent columns will consist of the dates that you studied them which will be highlighted in a specific color identifying your ability to recall the information that day.

Personally, I use green when my knowledge is sufficient, yellow when my knowledge is adequate, and red when my knowledge is poor. Additionally, I'll use various shades of those colors for a more nuanced assessment of knowledge recall. For example, a darker green means I understand the concept better than a lighter green.

To choose what to study on a particular day, you will need to consider two important questions:

1. How long has it been since I've studied it last?
 - Prioritize concepts that have not been studied recently.
2. What color is the concept highlighted in?
 - Prioritize concepts in red first and then yellow.

This ensures that the concepts you are unfamiliar with are covered more often than those that you are familiar with. The goal by exam day is to have all the concepts highlighted in green.

Look below for an example:

	A	B	C	D	-	F	G	H	I	J
1 Crystallographic Planes				1&May	2&May	1-Jul	10-Jun	16-Jun		
2 Elastic Deformation					15-May	1&May	26-May	2-Jun	10-Jun	
3 Dislocations		1-May	3-May	6-May	12-May	20-May	4-Jun			
4 Strengthening in metals		10-May		15-May	23-May	2&May	3-Jun	10-Jun	16-Jun	
5 Fracture		13-May	15-May	20-May	24-May	25-May	5-Jun	12-Jun	15-Jun	
6 Fatigue & creep		1-May			6-Jun	16-Jun				
Composites & thermal properties		1&May	21-May	25-May	6-Jun	10-Jun	15-Jun	1&Jun		
8 Phase diagrams & transformations		18-May	24-May		2-Jun	8-Jun	13-Jun	16-Jun		

**Pro tip: When you highlight a date in red or yellow, identify a few key questions missed and include them directly into your spreadsheet. When you come across the correct answer in a literature study session, put it next to the question. Executing this up to exam day will provide you a systematic guide that can be quickly referenced for review on past weaknesses.*

5. Spaced repetition algorithms

There are many softwares out there that have spaced repetition algorithms programmed into them such as Anki and Supermemo which replicate flashcards digitally. They assess your knowledge and then show the flashcards that were answered incorrectly more often.

The great added benefit is that these softwares track progression for you and allow you to study remotely with their mobile apps.

I would like to emphasize once again that while flashcard softwares effectively incorporate spaced repetition, they often lack the elements of synthesis, reorganization, comparison, application, and contextualization that are involved in free recall.

Therefore, use them as supplemental tools to your retrieval practice, rather than as a replacement for it.

Principle Three: Interleaved Practice

Defining Interleaved Practice

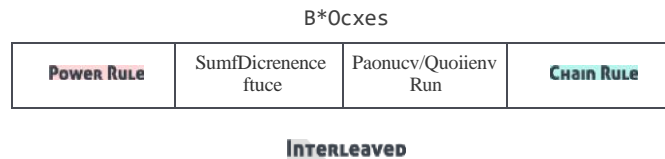
Let's first look at its more popular counterpart—blocked practice—using a calculus example. If you were learning derivatives, a common approach to studying would be something similar to the following:

- 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 to revision 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 necessitate 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 principle to your studies, you have a much better chance at solving these problems more effectively when it counts on an exam.

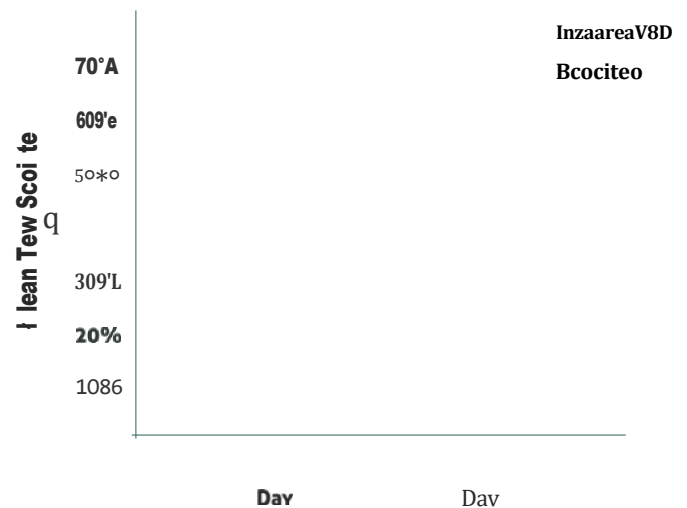
Examining the **Scientific** Research:

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.

Effectiveness 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.

Blum, 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>

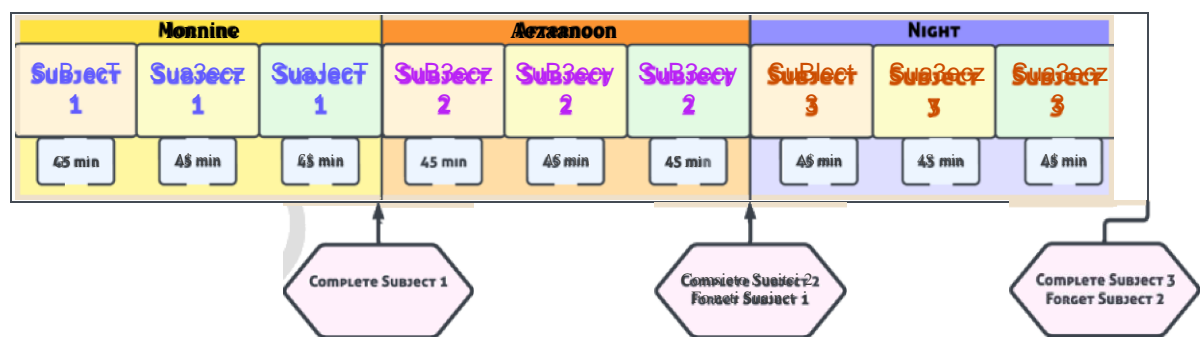
Applying interleaved Practice

1. Switching subjects/topics

Let's imagine a scenario in which you have allocated a little under 7 hours to study three subjects in a single day.

One 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:

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.



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 in our revision schedules. One way to do this would be with the following approach:

Noanino						NIGHT		
SuB«ecz 1	SuBaecT 2	SuBzecz 3	SuB ecu 1	SuByecT 2	SuBzecz 3	SuB3ecT 1	SuB3ecz 1	SuB3ecz 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.

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.

2. Switching modes

How do you study for multiple subjects? Well, the answer may surprise you.

If you follow the active recall applications, you will be exposed to the following four modes of learning regularly: pretests, lectures, after-class reviews, and homeworks. I understand it may be intuitive to schedule all four modes on the same day because the concepts will be fresh in your mind, and you'll have an easier time getting through the work.

For example, you may take a math pretest, attend a math class, review the math class's material, and do the math homework all within the span of several hours. However, there are two main issues with this method and are most likely the reasons why you are studying way more than you need to.

The first issue being that it is *too* easy. When a concept has been recently taught to you, it does not take much cognitive effort to apply that knowledge soon after. Hence, you may complete the work with less trouble, but the information likely will not be stored in your long-term memory effectively.

Once it's time for an exam, you will need to heavily review the material again in order to achieve the level of comprehension necessary to perform well, especially on inference questions.

The second issue being that you'll forget the information before you next revisit the material. Once you enter higher education, you won't have the same classes each day, meaning that it could be days, maybe even a week, before you have the class again.

If you were to only practice with the material the same day you have class, the forgetting curve suggests you will not retain any significant amount of knowledge. Therefore, you may feel behind in each of your subsequent classes and grow frustrated when you realize you have to relearn most of the information come exam time.

Interleaving modes of learning becomes a great alternative approach to resolve both of these issues. See the following schedule for a very basic example:

Day 1	Day 2	Day 3	Day 4	Day 5
PHYSIOLOGY CLASS Pretest	MECHANICS PRETEST	COMPUTATIONAL PRETEST	SIGNALS PRETEST	THERMODYNAMICS PRETEST
PHYSIOLOGY CLASS Lecture	Mechanics Lecture	COMPUTATIONAL Lecture	SIGNALS Lecture	THERMODYNAMICS Lecture
PHYSIOLOGY CLASS Review	Mechanics Class Review	COMPUTATIONAL CLASS Review	Signals Class Review	THERMODYNAMICS Class Review
THERMODYNAMICS HOMEWORK (Day 6)	PHYSIOLOGY HOMEWORK	Mechanics HOMEWORK	COMPUTATIONAL HOMEWORK	SIGNALS HOMEWORK

You can certainly break up the review and homework sessions and spread them out across multiple days for more advanced interleaving. Additionally, having multiple classes each day will further enhance the complexity. Forcing your brain to switch not only between subjects but also between modes of learning requires a lot of cognitive effort and, therefore, will result in better encoding of the information.

Moreover, spacing out your revision of concepts will enhance long-term retention. This approach reduces the need for extensive revision when preparing for exams, allowing you to allocate more time to areas that require additional focus.

In essence, by rearranging the modes of learning, you initially dedicate the same amount of time but significantly reduce the additional preparation required before exams.

Not only is this approach much more efficient, but it also enhances your ability to recall information after the exam and as you enter more advanced classes. Since these classes build upon past knowledge, utilizing this application will give you a significant advantage.

3. Ideal time for switching

A common question with interleaving is *when* to switch between topics. Simply put, if you were to study for 6 hours straight on a singular topic, you wouldn't attain the benefits of interleaving. Conversely, if you were to study for only 6 minutes before moving on to the next topic, you wouldn't be able to get into a proper flow state.

The optimal time to switch will depend on the individual and I encourage you to experiment in order to discover one that works for you. However, I recognize the desire for a starting point, so based on my personal experience, I will provide you with a range to consider for your testing.

The infamous Pomodoro technique which has helped millions of students like you for decades encourages 25 minutes of focused work. Although some students will increase that duration to get into a *flow state*, rarely do students ever decrease it. Therefore, 25 minutes seems to be a reasonable lower limit to experiment with.

Moreover, our bodies operate on 90-minute ultradian rhythms, which are observed in a multitude of physiological processes such as the sleep cycle, hormone release, brain activity, and the body's natural rest-activity patterns. These processes have all been shown to be connected with memory consolidation. Therefore, 90 minutes seems to be a reasonable upper limit to experiment with.

Try durations within these two bounds and decide on your optimal time to switch.

Principle Four: Optimized Breaks

Defining Optimized Breaks

If I were learning how to shoot a basketball, the particular parts of my brain involved in hand-eye coordination, depth perception, and balance would be engaged. The more I 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 my 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 rewire 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 guide.

The more interesting research centers around the use of naps and non-sleep deep rest protocols following periods of deep focus. These practices have been shown to activate the replay of neurons, similar to the neural replays observed during 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.

Applying Optimized Breaks

1. Naps / non-sleep deep rest

Ever since I was young, my dad worked odd hours. Whether that was as a contractor or truck driver, waking up at 3 AM was not outside the norm. This meant, however, he got extremely tired by early afternoon, and in order to resolve this issue, he would take power naps lasting no longer than 30 minutes. Till this day, he stands by them.

Unfortunately, during secondary school, I had classes until 3 PM, followed immediately by sports and clubs, which left no room for power naps. However, this changed for me in my first year at university where my class schedule provided a window of opportunity midday, and I took full advantage.

The power naps immediately became a part of my daily routine as I could sense the benefits that my dad had always talked about. I had a lot more mental clarity and energy heading into my late afternoon classes and was able to still be productive afterwards by going to the gym.

You can imagine how upset I was when my second year's schedule didn't allow for this. I began feeling the ramifications with afternoon crashes, especially when I was drinking caffeine in the morning.

After two months of unproductive afternoons and nights, I decided to look into the scientific literature for an answer. I was happy to find studies that affirmed the benefits of naps but was even happier to see that research was done on a viable alternative.

A non-sleep deep rest protocol is where you practice controlling your breath while simultaneously shifting your perception on which sensations to focus on. In doing so, you can enter states of deep relaxation without needing to fully go to sleep.

There are an ample number of YouTube tutorials that guide you through these sessions that can be anywhere between 10 to 45 minutes long.

As my second year was entirely remote due to quarantine mandates, I was able to go into my basement midday where it was quiet and listen to one of these guided meditations.

This required more of a learning curve than power naps, because surprisingly trying to sit still and practice breathing without getting distracted for any longer than 5 minutes is actually very difficult.

Once applied effectively, the benefits were eerily similar to those that I felt after those naps in my first year. This became another addition to my daily routine because it allowed me to focus deeply on my work late into the afternoon and gave me the energy to train at night.

This became a lot more difficult to do when I returned to campus my third year because finding any quiet places outside of specific areas of the library was difficult. Although I'm usually confident, the idea of sitting there with my eyes closed going through these breathing practices in front of people didn't thrill me.

That is when I went back to researching and discovered numerous recently published studies on what truly proved to be a game changer: gap effects.

2. Gap effects

Studies have shown that incorporating random pauses during work sessions, where you allow your brain to idle for about 10 seconds, can reactivate the same neural circuits that were engaged during the practice. What's fascinating is that these neural replays occur at an accelerated pace, possibly up to 20 times faster than normal!

Essentially, this means you can achieve more repetitions without exerting any extra effort. When I learned about this phenomenon, I was intrigued and decided to implement it into my deep work sessions. I found an online buzzer that would randomly sound off, and each time it went off, I intentionally let my brain idle for a few seconds.

I certainly had to tote the line between taking too many of these 10 second breaks and not taking enough of them. If I were to take them only once a session, I wouldn't attain the benefits of enhanced learning. Conversely, if I were to take them too frequently, such as every 10 seconds, it would become highly distracting and counterproductive. Moreover, there isn't a consensus on the optimal duration for these micro-rests, so I encourage you to experiment and find what works best for you.

After much practice, I truly believe that this method was one of the final pieces to my study system as it's increased both the speed and depth of my learning. While it didn't immediately boost my energy like the nap or deep rest protocol, it enabled me to work for extended periods.

This was mainly due to the physical benefits it offered, such as releasing muscle tension and reducing stress. I've even implemented gap effects during exams whenever I found myself feeling immense pressure. This practice provided immediate relief and granted me a sense of clarity.

Actually Putting Together the Perfect Study System

I will now outline how to apply each of the four principles we've just covered as you look to study more effectively moving forward.

1. Review your syllabi and identify the important topics of study for all your classes.
2. Create a basic **prospective revision timetable** for the term integrating **spaced repetition** and **interleaving**.
3. Apply **active recall** before class, during class, immediately after class, and also during your study sessions. Experiment with all the techniques provided in the "Applying Active Recall" section and optimize to your learning preferences.
4. Prioritize breaks with **gap effects** during study sessions.
5. Prioritize breaks with **naps / non-sleep deep rest** after study sessions.
6. Record your progress after each session and create a **retrospective revision timetable** that allocates additional time for difficult topics while reducing time allocated to easier topics.

If you've never studied this way before, I warn you that it will take time to perfectly adopt this study system. It is totally normal to stumble and to tweak along the way, but please provide yourself enough time to experiment fully.

Every one of these principles are based in research and their applications have been shown to work for millions of students across the world. I have personally never worked with a student that has not been able to benefit from this study system when applied correctly.

Therefore, if you feel tempted to give up, I urge you to revisit the "Evidence-Based Learning Techniques" section of this guide and persist in trying out new approaches, whether it's by experimenting with different combinations or durations. It is highly likely that you will find your optimal system sooner or later!

Productivity Tips

Leverage 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 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 guide, which is 7:15 AM. Recognizing that my peak focus occurs between 6-8 AM, I am intentionally using this time to write the guide 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.

Second Brain

Founded by productivity expert Tiago Forte, the second brain is an external, centralized, digital repository for all the things you learn. He explains that the average individual consumes the equivalent of 174 newspapers of information per day. For people of younger generations like you and me, it is likely that this number is significantly more with our use of social media.

Having access to an abundance of information should be incredibly advantageous, however, without proper organization of both old and new knowledge, our brains become overloaded, and productivity suffers.

Every time I introduce the second brain, I get students who believe the method is common sense, already have a note taking system in place, and are ready to tune me out. If this is you, I hope you give me another minute to explain the likely differences between your current framework and this one.

- 1) The second brain method facilitates many modes of collection in real time that can then be integrated into a singular ecosystem. Whether it's a voice recording, a photo, or a web article, you can capture the information on the go, ensuring valuable content is never lost.
- 2) After the information is put into the system, the second brain method offers robust organization and retrieval capabilities with the use of tags, links, and metadata, enabling easier access to your knowledge repository.
- 3) By automatically grouping similar information together, the system facilitates the cross-pollination of ideas and the discovery of patterns that might have otherwise been overlooked, ultimately leading to the generation of novel solutions.

There are an ample number of digital note taking platforms available that will help you take your note taking system to the next level, but some of my favorites that I would recommend are Evernote and Notability.

Benefits for productivity

If you've ever had a job in industry or another professional setting, you know that building on past work is not only acceptable but encouraged in most cases. Being able to borrow creativity from multiple sources and then adding your own unique elements is much more efficient than starting from scratch.

Similarly, the second brain system behaves as your own personal library of knowledge ready to be further expanded upon, so you never have to start with a blank page.

We just spent a good portion of the "Evidence-Based Learning Techniques" section explaining that our brains are not very good at storing information without deliberately repeating revisions. Although a proper study plan allows us to do this with important

school topics, it is much harder to do this for ideas we randomly encounter throughout the day.

Therefore, getting in the habit of capturing ideas into our second brain system ensures we never lose valuable information and frees up space in our brains to generate new ideas.

Let's take a look at an example

A few months ago, one of my cousins was learning how to play the goalkeeper position in soccer. Having played at a high level for my entire childhood, I went out to his training session and assisted with coaching.

He was struggling with how to approach breakaways, and I tried to teach him while detailing my previous game experiences. However, I had a difficult time simplifying the techniques in a manner he could understand. Therefore, after 60 minutes of coaching, he had no improvement and his confidence was noticeably hurt.

When we had gotten home, I remembered learning that skill through a YouTube channel which actually served as a phenomenal resource throughout my playing days. I got very excited and ran to my computer to try rediscovering the channel only to be met by unfamiliar creators in the search results.

At that moment, I desperately wished I had created my second brain in high school, because it would have served well in my cousin's player development.

In other words, we never know when we will need to recall old information. In addition, it is very difficult to reenter the beginner mindset, especially after having worked on a skill for years. If I had included the links to the videos along with my feelings, thoughts, weaknesses, and questions, I could have better coached my cousin.

Please try creating your second brain now because you'll be thanking yourself later.

Time Blocking

This time management method involves proactively dividing your day into blocks of time where you have a specific task or a group of tasks scheduled. Usually these blocks span across the entire day as you aim to maximize every hour.

Due to its growing popularity, there are an ample number of calendar softwares that streamline this process available for free. These softwares also include mobile features so that you can access your schedule and revise it at any point conveniently.

I really do believe time blocking is essential for anyone juggling multiple responsibilities such as school, a job, relationships, hobbies, training, and a social life (which I know is most of you).

You can use either monthly, weekly, or daily revisions for time blocking, however, I believe the most effective method is to use all three in the following manner:

1. Create a general monthly outline of recurring tasks, i.e. classes.
2. Schedule weekly tasks if you have commitments that extend across multiple days.
3. Revise daily as needed if new tasks are introduced or you need more time for a particular task.

We know that work expands to fill the time allocated for its completion, according to Parkinson's Law. Therefore, without any deadlines or constraints, your productivity is likely to suffer.

Time blocking creates urgency as you understand you must finish the work in the time allotted in order to move on to subsequent tasks. You would be surprised how much work you can get done in a single deep work session, especially using all the evidence-based learning methods we just talked about.

Another benefit to time blocking is that it reduces 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 hourly plan, it helps you transition smoothly from one task to another without second-guessing. These reasons make time blocking an excellent method for procrastinators to adopt.

A common misconception is that time blocking 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.

Another piece of advice I'll offer you is to get in the habit of timing yourself while doing any task. It is very common to underestimate how long you'll need when preplanning which can be detrimental to the subsequent blocks. This can negatively impact your morale

as you start to question your productivity when in reality you just didn't allocate a realistic amount of time to complete a task.

To address this, start a timer before each activity and keep a record. This practice helps you become more mindful of the duration required for each block in the future, ensuring more accurate planning and increased productivity.

5 Minute Rule

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

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 for 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.

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.

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 (similar to the concept of time blocking). 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!

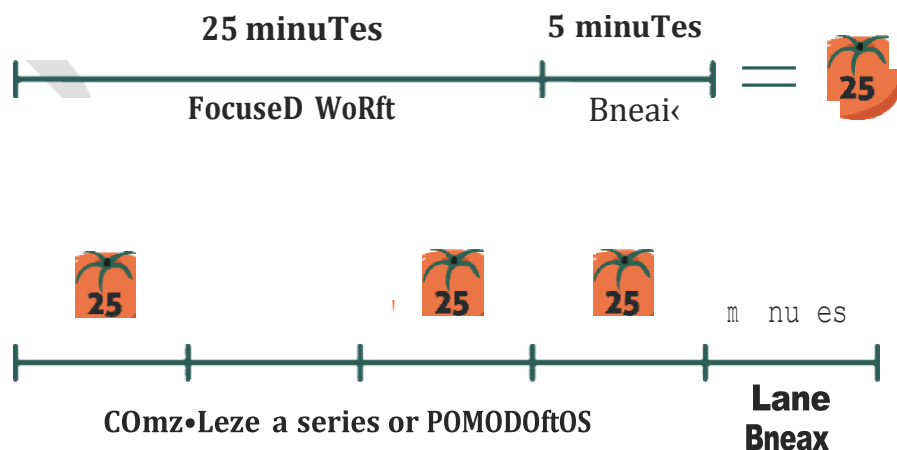
I typically use this method in the mornings when my alarm clock goes off. Instead of snoozing, I simply roll over, count down from three, and get up. This practice can serve as a powerful subconscious tool when turned into a habit.

Pomodoro Technique

One of the most widely used productivity hacks on our list 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 ultimately 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 *o flow state* consistently for each pomodoro. I suggest that you experiment with the intervals and find one that fits your natural rhythm.

Night Alarm Clock

I won't delve into all the physiological reasons to prioritize getting good sleep, as that could be an entire guide on its own. I assume many of you have already learned the basics in your science classes, which hopefully was enough to convince you.

However, I do want to emphasize that in all my different biomedical engineering classes, both at the undergraduate and graduate level, the topic of sleep consistently comes up. This recurring emphasis from experts in the field should speak volumes about its importance.

Even with our best efforts, we've all experienced situations where we lose track of time at night and before we know it it's 3 am. Then we have trouble waking up in time the next morning because we're too tired, which ruins any positive momentum we had built.

Two night alarms employed regularly can prevent all of that.

The first alarm serves as a reminder to close out work tasks, wrap up late-night conversations, or finish watching movies, signaling that it's time to prepare for bed. Then you should begin to wind down and transition into your nighttime routine.

The second alarm is specifically set to remind you to switch off or put away all electronic devices, such as lights, computers, iPads, and phones. This step is essential as it helps create an environment conducive to sleep by reducing exposure to the stimulating effects of electronic screens.

By incorporating night alarms into your routine, you can ensure that you allocate sufficient time for winding down and disengaging from electronic distractions, ultimately promoting a more quality sleep experience.

Stacking Micro Wins

Often, we set lofty goals that demand immense discipline and consistency, which can be challenging to maintain. As a result, many of us, lacking that level of development at a young age, struggle to follow through and end up damaging our confidence.

However, a simple change in approach can have significant results. Instead of tackling overwhelming objectives directly, break them down into smaller, more manageable micro-goals. Make these micro-goals incredibly small to the extent that they feel easy to achieve.

By adopting this strategy, you will find yourself accomplishing many more of these goals which will build positive momentum and increase your confidence as you have proven you can achieve what you commit to.

Stay focused and consistently stack these micro-wins over time, and eventually, you will glance up and realize you are closer than ever to those massive goals you had initially set.

Mindfulness Practice

I would argue that individuals who lead highly productive lives often possess a heightened sense of intentionality. By simply being more aware of your thoughts, you can actively shape the life you desire. This level of mindfulness allows you to be fully present in your work, relationships, and hobbies, ensuring that your decisions align with your core values, beliefs, and goals.

In a world filled with constant distractions, you must be careful to avoid inadvertently adopting a lifestyle that contradicts your desired path. To aid in this process, I encourage you to start each morning with a brief meditation session followed by writing down your intentions for the day. This practice provides an opportunity to differentiate between meaningful experiences and distractions.

By incorporating this practice at the beginning of your day, you can make conscious decisions and effectively allocate your resources when distractions become more prevalent later on.

Personal Advice for Students

Develop a Network

For those incoming college freshmen, the best advice I can offer is to take advantage of your first two weeks by beginning to network in your classes. I promise you this will make your life so much easier for the next four years.

Every single other freshman will want the exact same thing as you: friends. Unfortunately, this cannot be said for upperclassmen who already have their groups figured out. Therefore, take the initiative now after every single class to exchange phone numbers with the people sitting next to you.

Simply say something along the lines of:

"This class is going to be a huge help to all of us. Would you guys wait to introduce yourselves to everyone in the class? We can help each other in the future."

Then collect everyone's number and create the group chat. Then prompt everyone to text their names so each individual's contact is identified.

After you do this at least once, then you can add the following sentence the next time you ask for a different class:

"I already have some contacts of people from ____ class, so I can connect all of us if we have other overlaps in our schedules."

I made this a habit for every new class, and it is single handedly the most important thing I did during freshman year because it created a massive network of peers who were readily available. Each individual possesses their own unique strengths and having a friend knowledgeable in a subject available to answer your clarifying questions can save a ton of time. It can be the difference between waiting 5 minutes for a response from them and waiting several days for a response from a professor.

Moreover, due to the curse of knowledge, sometimes professors are unable to teach the material to a beginner effectively. By having peers that are only slightly ahead of you in expertise, you may be taught by them in a way that's easier to comprehend.

I believe it goes without saying, but you should always add more value to the network than take away. Attend every lecture, stay organized, and keep up to date with deadlines, so that you can be the first to offer help to a student who needs it. When you are generous with your time and knowledge, it is much more likely that the behavior will be reciprocated in the future when you need it.

Lastly, get to know your school's faculty early on. This certainly includes your professors and teaching assistants, but also begin exploring research opportunities and work experiences that are offered by other faculty members throughout your university.

It's unlikely that you'll be offered a position immediately because freshmen usually don't have the necessary credentials but reach out anyways and ask for a tour of their facility or a short meeting to discuss their work. Trust me, professors love to show off when given an opportunity so it's likely they'll agree.

After you make those initial connections, follow up with them with a short email checking in on their work every term. You will be so much more likely to get a position with them in the future and that experience is invaluable for your resume.

Develop a High Value Skill

I was the typical high-achieving student in high school. I consistently earned good grades, took many AP classes, participated in a dual enrollment program at a local college, engaged in many clubs, and played sports every year. I thought these credentials were paving the way for a great college experience and ultimately a fulfilling and high-paying job.

Once I entered college, I realized I only had a part of the full picture. I immediately fell behind those individuals who had the foresight to develop a high value skill that complimented their academic credentials.

These were the individuals that immediately secured lab positions, expanded their network, earned scholarships, and started companies. They went on to leverage those experiences for incredible internship opportunities, further widening the gap between them and their peers.

So what actually makes a skill *high value** Here are some important criteria to consider:

1. Market demand: Do employers or clients actually want it?
2. Transferability: Can it be leveraged in different roles and industries?
3. Specialized knowledge: Does it require a barrier of entry so that someone can't easily replicate it?
4. Future relevance: Does it align with the way our society is headed?
5. High earning potential: Do experts of the skill often command high salaries?

Here are a few example skills that fit all 5 criteria:

- Programming and software development
- Cloud computing
- Data analysis
- Sales and marketing
- Graphic design and UI/UX design
- Content creation

There are many more that you can explore with a quick google search, so I encourage you to take a look at every opportunity before honing in on one.

Once you've identified which skill you want to develop, browse through the hundreds of courses available online and select a free one that is geared towards beginners. You can always pay for upgraded services in the future, but you should at least get some experience before committing to a paid service.

If you are in secondary school, I would encourage you to still take advanced classes and get involved in extracurriculars but be more mindful of how you are spending your time. I would argue that spending a few hours each week developing one of the aforementioned skills would be a greater return on your investment compared to a third or fourth AP class. Remember, the only way you can leverage the skill in the future is if you are at least proficient at it, so it will require a significant amount of time to practice.

If you are already in college, I would immediately schedule an appointment with an academic advisor and review your plan of study for the remaining terms. Ensure that you are only taking required classes along with electives that align with the high-value skill you want to explore. Spend your time outside of school practicing and even challenge yourself to make money if possible providing services. When you have some skin in the game, it can really motivate you to deepen your learning.

Embrace the Difficulty

School teaches you invaluable soft skills as much as it teaches you technical skills. In order to get the most out of your education, you need to approach it with the correct mindset.

One of the changes you can immediately enact is shifting your perspective on difficult classes. We all have subjects we are weak in, but that's a good thing. Embrace those subjects, knowing it's not solely the marks that matter, but the resilience you are building that matters. Challenge yourself to gradually improve throughout the term by exploring new resources and study techniques.

When you combine the resilience you develop while doing things you don't want to do with a future opportunity that you genuinely like, you'll become a **powerhouse**. Therefore, treat your education now as an opportunity to prepare for that moment.

If you instead decide to complain and accept a grade without trying, then it's likely you will apply that mindset to the difficult obstacles that inevitably come along with great opportunities.

Moreover, resilience improves the more experience you have, so don't shy away from taking difficult classes that are out of your comfort zone. Push your boundaries with learning and have confidence that you'll put in the work to figure things out.

Build Good Habits

When you enter college, you will have a lot more freedom than ever before. That's when your habits really become apparent and can dictate the experience you have for the next four years. Therefore, it is important to start developing good ones while you're still in secondary school and benefit from the structured environment. Here are some examples that I believe will serve you well in the future:

- Establishing a healthy sleep routine
- Relying on effective study techniques
- Practicing regular exercise
- Cooking healthy foods
- Developing time management skills
- Maintaining a clean room
- Going out alone

It's important to note that breaking any habits can be very challenging. Therefore, it is essential to be aware of the bad habits too in order to avoid them. Here are a few habits that I would strongly advise against:

- Skipping lectures
- Cramming for exams
- Only staying indoors
- Lacking balance
- Failing to seek help/feedback
- Heavily depending on others
- Oversleeping

Resume Writing

You can be an exceptional student but if you don't have internship experience while in school, you are at a serious disadvantage when competing for job opportunities that are paid upon graduation for three main reasons.

1. The market continues to grow more competitive as online resources have made it easier for students to obtain degrees and certificates. Therefore, graduating from a university alone may no longer be sufficient to secure a quality job.
2. It is imperative that you've understood your likes and dislikes with a job. It's one thing to read about it, but it's another to experience it every day, and you want to be sure you are satisfied before applying for a long-term role.
3. You'll lack a professional network to write letters of recommendation that can gain you a competitive edge over the other candidates.

Therefore, it is crucial to prioritize seeking out internships with a similar level of focus as you have for your studies.

The first step is to develop a comprehensive resume that captures the attention of potential employers. This process can be very overwhelming for those who are new to it, but don't worry, as I'll break down the key points in this section.

During my last two internships, I've been connected to several hiring managers and they've all reiterated the importance of these four basic resume writing principles:

- Focus on impact using measurable metrics
- Include keywords regarding job description and soft skills
- Keep it concise and tailored with the reviewer in mind
- Include a comprehensive LinkedIn profile

I'll address each one of them and also include my own resume at the end as an example for all of you to see. It's not perfect, but hopefully it serves as a good resource.

Focus on Impact Using Measurable Metrics

It is very common for students to seek internships in different fields in order to explore and discover their preferences. However, students tend to struggle with leveraging these experiences for different positions in the future. By quantifying your impact, hiring managers across different departments and industries are able to quickly understand within the appropriate context.

Moreover, using numbers and percentages will immediately stand out compared to other resumes that simply summarize achievements in text. This approach showcases your ability to deliver tangible results and make a meaningful impact in your work.

For example, during my previous internship, I utilized automated platforms to efficiently handle and simultaneously test a large number of lead compounds. However, simply mentioning this experience on my resume may not leave a lasting impression on an employer unfamiliar with the early drug discovery process. Instead, a more impactful statement would be:

"L' thanceel drii,q protiret clesi,qn 3-J'olcl across n11 phases of'pharm aceutical clevekiyment hy effi'ieii tly utiliziii q uutomatecl ylutformns to execute stlluhility, stuhility, und ›artitloii coeJficien screens."

By delving deeper into the impact of my contributions and quantifying it as a "3-fold improvement," I provide concrete evidence of my accomplishments and create context that showcases the value I brought to the organization at large. Therefore, the hiring manager is able to better understand how my skills could transfer to the position they're offering, ultimately making me a more desirable candidate.

Include Keywords Regarding Job Description and Soft Skills

Many companies use an Applicant Tracking System (ATS) that automates the screening process. Therefore, it is important to first make your resume readable by avoiding columns, pictures, graphs, charts, and tables, and instead electing for clear section headings, paragraphs, and bullet points.

Additionally, you must use keywords that the ATS is likely to search for based on the job description. A good first step is to copy the entire job description and paste it into any text analyzer online in order to identify the most recurring word or phrases. Then naturally integrate them into your experience or skills section in order to demonstrate those desired qualities.

It is very common to find resumes that have an abundance of *technical* skills but fall short in highlighting essential *soft* skills. The hiring managers I've spoken to suspect it's due to templates prioritizing technical skills while neglecting the necessary space for emphasizing soft skills.

Failing to include keywords regarding soft skills relevant to your position can be detrimental as it is likely that the ATS will screen for these as well. A quick google search will help you identify appropriate and effective soft skills that your employer is likely to seek. Again, you can include these into your experiences or create a separate skills section.

Keep It Concise and Tailored with the Reviewer in Mind

Most recruiters typically spend just a few minutes reviewing resumes, so it's crucial you make yours concise. For a majority of students, unless there are exceptional

circumstances, a resume should be kept within a single page. More specifically, the recommended word count seems to be a range of 475-600 words.

If you find yourself over this limit, then it is likely you are including unnecessary details such as outdated skills, unrelated work experience, or irrelevant personal details. Use the word count feature on your software or any other available ones online for free to keep track as you write.

It is important to always remember that you are using your resume to advertise your skills for a specific job, and therefore, ensure you are tailoring the experiences and skills appropriately. Sometimes that means replacing, reordering, or perhaps removing items altogether, leading to the existence of multiple versions of your resume.

I understand tailoring your resume can be time-consuming, and you will be tempted to just send the same resume out in mass. However, I promise you the extra time invested will be more than worth it.

Over the past two years, I have applied to more than 50 internships, tailoring each application to some extent. As a result of my efforts, I have been fortunate to receive more internship offers than the majority of biomed students at my university.

Include a Comprehensive LinkedIn Profile

Recently, I gained valuable insight into the hiring process from a previous employer. They described a scenario where they were selecting candidates for interviews and faced a decision between a few finalists. To help them choose, they considered information from a candidate's LinkedIn profile related to a small business venture.

The candidate had sold candles during her first year of university and shared images of her hosting pop-up shops at various locations, along with regular updates on revenue milestones.

Although this experience wasn't included on her resume (likely because she assumed it was unrelated), the hiring manager recognized it demonstrated initiative, project management, self-motivation, and problem-solving, which were all skills transferable to the position.

Employers have to allocate many resources to bring on a new hire such as time, finances, training, and management. Therefore, they will exhaust all available resources, and a LinkedIn profile serves as an invaluable supplement to a resume. It allows for greater flexibility in showcasing a diverse range of experiences, interests, skills, and professional networks.

Moreover, a LinkedIn profile offers the employer valuable insights into the candidate's personality, which is vital when assessing their fit within the team. In other

words, while a candidate may be exceptionally talented, the hire may not be worth potentially damaging the workplace culture. If their profile contains any inappropriate content, the employer may use it as a reason to exclude them from further consideration.

Additionally, a LinkedIn profile can help identify shared interests between candidates and employers, creating opportunities for connection and standing out. For example, imagine you have a strong passion for rock climbing, so you actively engage with various rock-climbing companies on LinkedIn and share videos showcasing your skills. In such a case, it is highly probable that an employer who shares the same enthusiasm for rock climbing will take notice of your profile.

I certainly recognize that my LinkedIn is an area of weakness because its importance only came to my attention recently. However, I will be sure to improve my profile before applying for my next job. In the meantime, be sure to make yours better than mine!

**Pro tip: Customize your LinkedIn URL to help with Search engine optimization (SEO) purposes and make it cleaner for your resume. Navigate to your home page and select "Edit profile" & "URL". Then underneath the "Current LinkedIn URL" section, select the "Edit" icon and edit the text field to your name or a business name if appropriate.*

My Own Resume

Jun Yuh

EDUCATION

Cumulative GPA: 3.75
Biomedical Engineering

EXPERIENCE

GLAXOSMITHKLINE

High Throughput Experimentation Scientist (Co-Op)

- Proficient user of automation, both hardware and software components, including the use of Freeslate CM3, along with the OSR chemical reactor module, Metier Toledo Quantum, ChemSpeed Flex Swile, Hamilton and Andru' Alliance robotic platforms
- Enhanced drug product design fold across all phases of pharmaceutical development by efficiently utilizing automated platforms to execute solubility, stability, and partition coefficient screens
 - o Designed automation protocols using L'ncfaiiied Labs LEA Library Studio and Automation Studio
- + Increased throughput by integrating analytical instrumentation such as HPLC with laboratory automation
- o Collaborated with cross-functional teams to create rapid analytical assays, maximizing data output while upholding high analytical quality standards
- e Analyzed, organized, and presented data using Spotfire visualization tools

WEST PHARMACEUTICAL SERVICES

Container Systems R&D Scientist (Co-Op)

- e Pioneered the development of a customizable long-lasting fill fluid that could be tailored to mimic a wide range of drug aseems
 - o Authored, designed, and executed an aging study that enabled the team to optimize fill fluid constituent selection
 - o Drove innovation and optimization of in-house microbial growth detection methods over UV-Vis scans, viscosity, and extrusion force testing
 - o Completed the comprehensive functional characterization of the fill fluid in West's container systems leading to generation of extensive data packages
- Developed standardized methods to mix fill fluid variants, increasing efficiency in the stability testing methods
- e Executed cartridge tensile and compression testing using an Instron to verify specification requirements were met
- Drafted and executed protocols and non-conformance reports

YU JIN REMODELING INC.

Administrative Assistant

- Standardized work documents for estimated, agreement forms, schedules, and employee payouts to increase workflow efficiency
- Leveraged a wide-ranging work portfolio to attract new customers and set competitive rates
- » Broadened customer base 4-fold by transforming the company's communication from solely Korean to English
- » Developed trusted partnerships with material companies, increasing confidence in supply quality and delivery speed

TECHNICAL CAREER CENTER

Biotechnology Student

- During the 9-month dual enrollment program, gained key theoretical and practical biotechnology laboratory knowledge. Improved student engagement by bridging the gap between education and technical skills via development of practical challenge activities for students.

RELEVANT COURSEWORK

- » Biomedical Statistics
- Experimental Design in Biomed Research
- e Biology of Neuron Funktion
- Thermodynamics
- Pharmacogenomics
- Biofluid Mechanics
- » Differential Equations
- e Biomed Systems and Signals
- Biocomp Modeling & Simulation

Skills: ROSIE Minitab, TIRCO Spineflex, Electronic Laboratory Notebook, ChemStation, Hamilton, Basic Python, Basic MATLAB, Instron, Viscometa, HPLC, High-Throughput Experimentation

ACTIVITIES

- College and High School Tutor, 2020-2023
- Marketing Agency Pounder, 2022-2023
- Social Media Coach, 2023
- Missionary Team Board Member, 2017-2022
- Fitness Trainer, 2020-2022
- Mini-THON Coordinator/Manager, 2018-2021

Interview Tips

Congratulations on writing an exceptional resume that has caught the eyes of many employers. However, as you proceed, you'll quickly realize that there is an additional crucial step awaiting you: the interview process.

Strong Introduction

It's actually rather difficult to fully capture the immense power of a strong introduction through mere explanation. Perhaps some examples will serve better to illustrate the point.

Imagine you are at a party, and you see a person well-groomed with tailored clothing who then confidently introduces themselves. It is likely you will be intrigued by the individual and proceed to keep an eye on them throughout the night. A first impression in an interview serves a similar purpose to immediately engage the interviewer.

There is more to a strong introduction though, and I believe that a basketball analogy can best illustrate this point.

During my childhood years of playing basketball, I excelled more as a defender than as an offensive player. Therefore, I was often tasked with guarding the opposing team's best player, and one of the key strategies would be to dictate their rhythm of play. If a good player could speed up or slow down whenever they wanted to, there's pretty much nothing you can do defending them because all of their subsequent moves will catch you off guard.

However, if from the jump you can dictate their pace by pressing on or sagging off strategically, you can command the exchanges between you two. As you start to have success, your confidence builds and you have a much better chance at stopping the talented offensive player throughout the game.

Similarly, when you can get out ahead of an interview and have a strong introduction, you can command the pace of the conversation and instill confidence early. If you do not have a compelling introduction prepared, you likely will speed up, stutter, and forget important pieces of information that will leave you nervous for the following difficult questions.

A strong introduction that I used to get my most recent internship at GlaxoSmithKline was the following:

"My name is Jun Yuh. I'm a fourth-year honoree student at Drexel University, where I am currently enrolled in Drexel's BS/MS program. I have a strong interest in neuroscience, due to my grandmother's Alzheimer's diagnosis, and my goal is to pursue a Ph.D. in the field of cognitive neuroscience, with a focus on the role of the hippocampus in memory. I am particularly interested in the role of the hippocampus in memory, and I am currently working on a research project that will explore the role of the hippocampus in memory. I am currently working on a research project that will explore the role of the hippocampus in memory."

My first internship was at West Pharmaceutical Services where I played an important role in developing the Cleveland office. I will highlight that I managed the development of various projects in our software. I have to utilize the research and analytical skills that I've developed to develop your automation team with high throughput for early drug discovery.

I could not be more thrilled about this opportunity. I hope to be a part of this great initiative. Thank you for your time today."

I've rehearsed that opening statement hundreds of times to the point it could naturally flow while simultaneously having a big smile on my face and keeping eye contact.

Even in the rare cases that they forget to ask for your introduction, you can say something along the lines of:

"Before I answer any of the questions, I would love it if you would permit me the opportunity to introduce myself as I want to ensure you know exactly what type of candidate you are getting in me. Would that be okay?"

This would be another great way to command the interview from the start. Either way, drafting up your introduction and rehearsing it many times before an interview will serve you exceptionally well.

Strong Closing

Just as a strong introduction is important to initially engage the interviewer, a strong closing is important to give a good final impression that the interviewer can remember you by. Here are some important things to do as you close:

- Express gratitude: Thank the interviewer for their time and consideration.
- Reiterate interest: Emphasize your continued interest in the position.
- Highlight fit: Quickly summarize your key qualifications and how they align with important aspects of the role that the interviewer mentioned.
- Ask about next steps: Inquire about the hiring process timeline and if there is anything you can do to aid them moving forward.
- Collect emails: It is imperative you send a "thank you" note along with any follow up questions within 24-hours in order to further your relationship.
- Final statement: End with a positive statement such as, "I look forward to hearing from you soon and hopefully exploring methods to serve the company together."

Never Just Tell, Always SHOW

Behavioral interview questions where they assess how you have responded to situations in the past are extremely common. These questions aim to evaluate your past

behavior as an indicator of your future fit for a role. Usually these questions begin with one of the following statements:

- “Describe a situation where...”
- “Can you give an example of when...”
- “Tell me about a time when...”

Even when the question isn't framed this way, it is always helpful to provide a story showing your skills and experience rather than simply just telling them. For example, if the interviewer asked me, “What is your biggest strength?”, instead of saying that I'm a “great problem solver”, the following answer (which I've used previously) would be more effective:

“I've encountered a commonality that is my expertise once as an engineer it's that something always goes wrong when you least expect it. Additionally, these situations were frustratingly unclear sometimes even overwhelming at first, but I've learned that as an engineer, it is my responsibility to address these issues in stride and identify a solution.”

During my first internship, we were doing break loose and extension force testing on syringes using an Instron, but we didn't have a fixture that could hold the syringe in our desired position.

We looked to order a new part, but the shipping time would have required us to push back our schedule another week. However, since there were so many teams involved in this project, I took it upon myself to identify a solution in the meantime.

contacted various teams and got a hold of an individual who was familiar with CAT modeling until 3D printing. I scheduled a meeting where I showed him a drawing of what I was looking to create with the appropriate dimensions. Not only did he agree to create the model and print it, but he also allowed me to sit with him while he did it.

Therefore, we were able to get a functional holder to conduct testing without disrupting our schedule, and I was able to utilize the skills I learned to conduct the project successfully in the end.”

In this way, I was able to show that I'm a problem-solver through practical experience. Moreover, I was able to highlight other strengths such as effective communication, strong sense of accountability, willingness to learn, and even basic modeling.

This is an excellent way of standing out from other candidates because it's likely many of them are simply telling the interviewers about their skills.

Come Prepared with Questions

I know it may seem more effective to act as though you've understood everything about the position, but never say “no” when they ask if you have any questions. In doing so, you show a lack of interest in pursuing the position further.

My mentor would always say that if the interview ends earlier than the scheduled time, then it probably means they don't care enough about you to offer you a job. Conversely, if the interview goes longer than the scheduled time, then it probably means they are very interested in you and will likely offer you a job.

In my experience of interviewing, this has been true a majority of the time. A perfect way to extend the interview is by asking thought-provoking questions. You should ask ones that you thought of during the interview, but always come prepared with a handful of questions so you are never without any. Consider asking some of the following:

- If we were to sit down together 6 months from now, what would you need to see happen in order for you to be happy with your decision to hire me?
- Do you have any reservations about considering me for this role?
- Is there anything on my resume that is of concern that I can clarify for you while we are here?
- What do the day-to-day responsibilities look like in this role?
- How does this role interact with other teams?
- Which competencies does a successful person in this role typically have?

Please remember that an interview should flow like a conversation so if any of their answers provide you an opportunity to further highlight your skills or to elaborate on your experiences, please **feel** free to **interject** and do so!

Moreover, just as it is important for you to impress the interviewer with your questions, take the time to genuinely assess their answers. This is the time to interview them because you want to be sure that the role is a good fit for you.

There is nothing worse than you getting so worked up about a new job, and then actually going through the day-to-day and hating it. Do your due diligence with these questions!

Research the Company Beforehand

By the time of the interview, you should have reviewed the job description plenty of times, but also do further research utilizing resources such as the company's website, LinkedIn, Glassdoor, and Indeed.

It is imperative that you highlight your skills and experiences that align with the company's goals and direction for the future. If you include remarks or ask questions about

ongoing projects, it will showcase to the interviewer that you came prepared, separating you from other candidates.

One really great method would be to connect with current or previous employees through LinkedIn and gain as much insight about the company from them. It is not always easy to discover information regarding a company—especially a smaller one. By asking an individual who has experienced the company on a daily basis, you will have important details that will aid in your responses during the interview.

Closing Remarks

We all have so many responsibilities as students, and this guide hopefully showed you exactly how to have success in every single one of them by:

1. Learning effective and efficient learning strategies in order to free up time to pursue other endeavors
2. Implementing productivity techniques to optimize your time and accomplish more
3. Following my personal advice in order to get ahead of your peers
4. Utilizing resume writing and interview tips to help you secure your dream internships

To you reading right now, I believe in you. You are powerful beyond measure and will do incredible things in your future. Have faith, keep working smart, and I will see you at the top.