

Learning about Learning

Alex M. McAllister (Centre College)

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How do I enable learning?



- Share Truths
- Create Meaningful Challenges
- Inspire Curiosity and Hope
- Ask my students to accomplish more

How do I enable learning?



How do I enable my “audience” to



- Show Up
- Be Actively Engaged
- Learn

“They” are more central to learning than “me” both in and out of class.

LaL Components of My Courses

- 1) “Friendly” Newsletter Syllabus
- 2) Expectations Exercise
- 3) Value Writing Exercise
- 4) TED Talks – growth mindset and more
- 5) Pre-exam questions
- 6) Class Engagement Self-Evaluation
- 7) Post-Exam Metacognitive Reflection
- 8) Thoughts about Studying
- 9) Self-Care
- 10) New Ideas...

1) “Friendly” Newsletter Syllabus

MAT 200: Discrete Math Centre College Spring 2019 Alex M. McAllister

An Invitation

Every course you take in college provides you an opportunity to become a different person. You can learn new ideas, explore different perspectives, challenge yourself, and develop your abilities. You can allow yourself to become more of a person in important ways or, even better, you can actively pursue personal transformation.

For the most part, you are free to enroll in whatever courses you would like to take at Centre College. You do not *have* to take MAT 200 (although, I certainly want you to be here!). I encourage you to reflect mindfully on why you chose to sign up for this class and why MAT 200 counts for various majors and minors. What are your goals for this experience? What do you expect MAT 200 to give you? And, in light of your answers, what are you willing to give? What investment of your time and energy will you make to learn and become more? This intentional approach to MAT 200 will have a profoundly positive effect on your experiences in this class.

Our study of discrete mathematics can change you in many positive ways, if you allow and chase this transformation. Will you join me?

Course Goals

To build a better brain, which means:

- 1) becoming a more self-aware, intentional student with a growth mindset toward learning;
- 2) developing an intuitive and formal understanding of set theory, graph theory, probability, and logic in the context of computing algorithms; and
- 3) becoming more effective at explaining and justifying insights into discrete mathematics.

And, to have fun studying discrete math together!

CENTRE COLLEGE'S MISSION IS TO PREPARE
ALL STUDENTS FOR LIVES OF LEARNING,
LEADERSHIP, AND SERVICE.

What is Discrete Mathematics?

Centre College Catalog

An introduction to the study of discrete mathematical objects and number systems, in contrast to the study of the continuous real number line. The course explores a broad range of topics in this area including relations, logic, techniques of proof, counting techniques, algorithms, graph theory, number systems, Boolean algebra, recurrence relations, and set theory.
Prerequisite: MAT 145 or MAT 170.

What does that mean?

MAT 200 focuses on “discrete” mathematical objects and number systems -- that is, finite processes and sets that can be listed -- in contrast to the infinite processes and continuous real number line that are the basis of the calculus. The ultimate goal is an understanding and description of those aspects of reality that are best explored from the discrete, finite perspective; this is the perspective of the modern computer and humanity continues to push the boundaries of this approach.

<http://web.centre.edu/alexmc/m200s19/>

My Primary Goal

My primary goal is to enable your success in learning mathematics and becoming well-versed in the habits of thought, the means of communication, and the fundamental ideas of discrete mathematics.

I love the ideas in this course. They are beautiful. They rank among the deepest of humanity's insights into reality. They are worthy of your attention. The habits of thought are equally important: grappling with ideas, asking questions, persistently seeking solutions, interpreting results, and thinking carefully. These activities are essential in all of life.

I am here to support you through questions, concerns, confusions, and failures, all on our way to enjoying understanding and success!!

Some Logistics and Thoughts about Questions

Your Professor

- Dr. Alex M. McAllister
- Olin 119
- alex.mcallister@centre.edu
- <http://web.centre.edu/alexmc/>
- (859) 238-5408

Course Materials

Textbook

Discrete Mathematics, 5th Edition
by Dossey, Otto, Spence, and Vanden Eynden
published by Pearson
ISBN-13: 978-0-321-30515-2

If you are interested in learning discrete mathematics, then you will not only want work the exercises at the end of each section, you will also want to spend time reading this book. Many ideas will be discussed during class, but your individual study of this text remains invaluable.

Calculator

A scientific calculator will be provided for exams.

Course Website

All course information, including homework assignments and class handouts will be posted at <http://web.centre.edu/alexmc/m200s19/>. This website will be updated after every class.

Time and Place

- MWF 10:20 - 11:20 AM
- Olin 109

YOU, THE STUDENT, ARE THE CENTER OF THE
LEARNING PROCESS. MY JOB IS TO DESIGN
OPPORTUNITIES THAT ENABLE YOUR LEARNING.
EVERY ASPECT OF THIS COURSE IS CREATED WITH
THIS PRIMARY, FUNDAMENTAL GOAL IN MIND.

Your Questions

When you have questions about the ideas we are studying, please ask me during class, stop by my office to talk with me, call my office, and/or send me an email. Although I enjoy math, I am not here just to have fun. My primary goal is to help you learn and understand discrete mathematics. Your questions are an essential aspect of your learning process and I will help you find answers.

I expect you to spend time talking with your classmates about the ideas from this course. Sometimes mathematics is pursued as a solitary endeavor and investing time in focused, individual study is vital. But just as important is the time you spend working with your colleagues discussing ideas and finding answers to your questions.

Looking at examples, solving exercises, and constructing proofs takes a lot of time and requires a lot of persistence and grit. Learning math requires sustained focus, perseverance, and effort. From the years you have already invested in studying math, you know that some ideas require more effort to learn than others. When you run into something subtle or challenging, I encourage you to be tenaciously persistent as you pursue understanding. And keep in mind the idea of “growth mindset” -- that our abilities are malleable and that with sufficient and thoughtful effort you can become better at math!

Learning math is a lot like being on a sports team or part of a band -- players must practice every day. MAT 200 often requires at least two or three hours of studying outside of class for every one hour in class, and sometimes more. *I encourage you to mindfully and intentionally schedule the study time you need to succeed in this course.*

The rewards for investing yourself in this work are tremendous. I am confident that your mathematical abilities will improve every week of this term. And, you will experience a positive change in how you understand ideas and express your insights into our world. And not just in Discrete Mathematics, but in many other aspects of your life and work.

1) “Friendly” Newsletter Syllabus

MAT 200: Discrete Math		Centre College Spring 2019 Alex M. McAllister	
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2) Expectations Exercise

Thoughtfully reflecting on what you looking for from others and yourself as you begin any activity can be incredibly valuable.

We can learn what we are looking for, hoping for, and need, both with respect to ourselves and with respect to others.

Name: _____ /3 pts

LaL #01: EXPECTATIONS (Note: LaL = Learning about Learning)

Thoughtfully reflecting on what you looking for from others and yourself as you begin any activity can be incredibly valuable. We can learn what we are looking for, hoping for, and need, both with respect to ourselves and with respect to others. And we can perhaps distinguish among hopes and needs, and find ways to articulate them to ourselves and to others.

Think about your expectations for this coming term in the context of this mathematics class. Identify at least three expectations you have for each of the following and write two sentences about each. You can include more, but include at least three expectations for each.

Expectations of Yourself

- 1)
- 2) |
- 3)

Expectations of Your Peers

- 1)
- 2)
- 3)

Expectations of Your Professor

- 1)
- 2)
- 3)

Expectation of Self

- Stay up-to-date on homework
- Ask more questions in class
- Review ideas along the way
- Study effectively and arrive prepared
- Ask for help – from professor and peers – and be helpful too
- Attend every class, arrive on time, stay awake
- Do my best and be honest
- Gain a better understanding of the math

Expectation of Peers

- Being engaged in class and come prepared
- Ask questions in class of professor and peers
- Help each other out – be supportive
- Respect each other, especially when mistakes are made – be kind and friendly
- Don't be disruptive and foster a friendly class
- Be honest and genuine
- Be open to other's ideas and work together
- Keep each other motivated – more active

Expectation of Professor

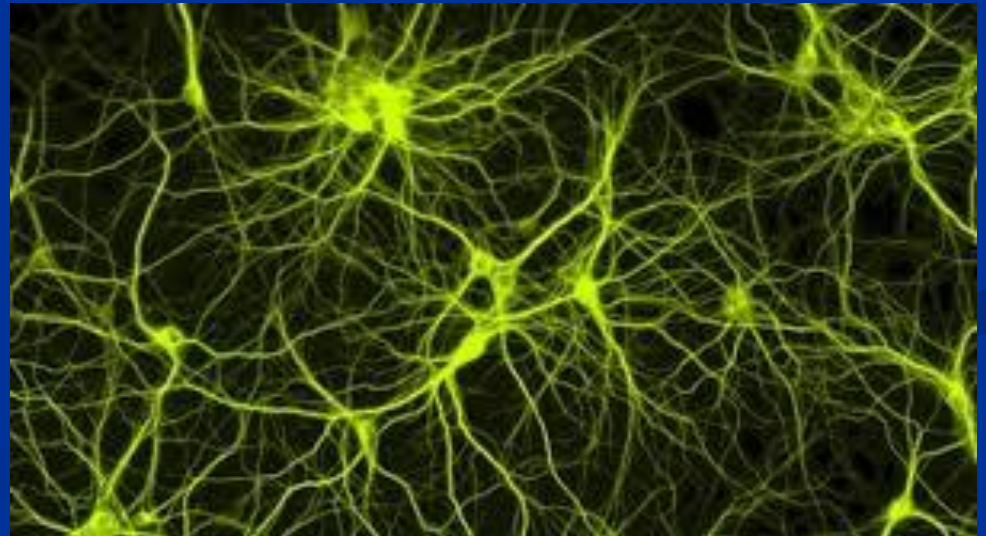
- Be available to help in class and office
- Return work in a timely manner with good feedback and with consistent grading
- Clarity in what we need to know for exams and do for homework
- Offer helpful answers and help us succeed
- Make class fun and interesting, full energy
- Good pacing and workload – not repetitive
- Communicate well and any changes fully

3) Value Writing Exercise

- Strong neural pathways are the key to understanding and recalling ideas.
- Multiple meaningful connections strengthen neural pathways.
- Value Exercise

Image from:

<https://www.extremetech.com/extreme/179223-the-first-real-time-non-invasive-imaging-of-neurons-forming-a-neural-network>



3) Value Writing Exercise

Write about something that is personally important to you. It may or may not have anything to do with “math”.

VALUE Exercise

Write about something that is personally important to you. It may or may not have anything to do with “math”. This could be “friends” or “family” or “sports” or “music” or “health” or “knowledge” or “faith” or something else. Whatever you write will remain confidential and not shared with anyone else, unless you want and choose to do so. This page will not be collected by your professor or anyone else - you can save it, throw it away, share it with someone else, or whatever else you might prefer.

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This could be “friends” or “family” or “sports” or “music” or “health” or “knowledge” or “faith” or something else.

What you write is confidential.

VALUE Exercise

Write about something that is personally important to you. It may or may not have anything to do with “math”. This could be “friends” or “family” or “sports” or “music” or “health” or “knowledge” or “faith” or something else. Whatever you write will remain confidential and not shared with anyone else, unless you want and choose to do so. This page will not be collected by your professor or anyone else - you can save it, throw it away, share it with someone else, or whatever else you might prefer.

4) TED Talks: growth mindset



TEDxVictoria - Dr. Sean Richardson - Mental Toughness: Think Differently about your World

4) TED Talks: growth mindset



TEDxVictoria - Dr. Sean Richardson - Mental Toughness: Think Differently about your World

LaL #03: TED Talk Name: _____ /3 pts

Watch Sean Richardson's Mental Toughness: Think differently about your world (15:18 minutes long) at <https://www.youtube.com/watch?v=LCPgvTRftZg>.

Write a few sentences in response to each question, and come prepared to share your ideas in class.

(1) State AND explain three ideas or examples from this talk that stand out to you.

-

-

-

(2) How does instant gratification versus delayed gratification play out for you as a student?

(3) Do you perceive ability or effort as the key for you in mathematics? How is the perspective of "growth mindset" relevant for you this term?

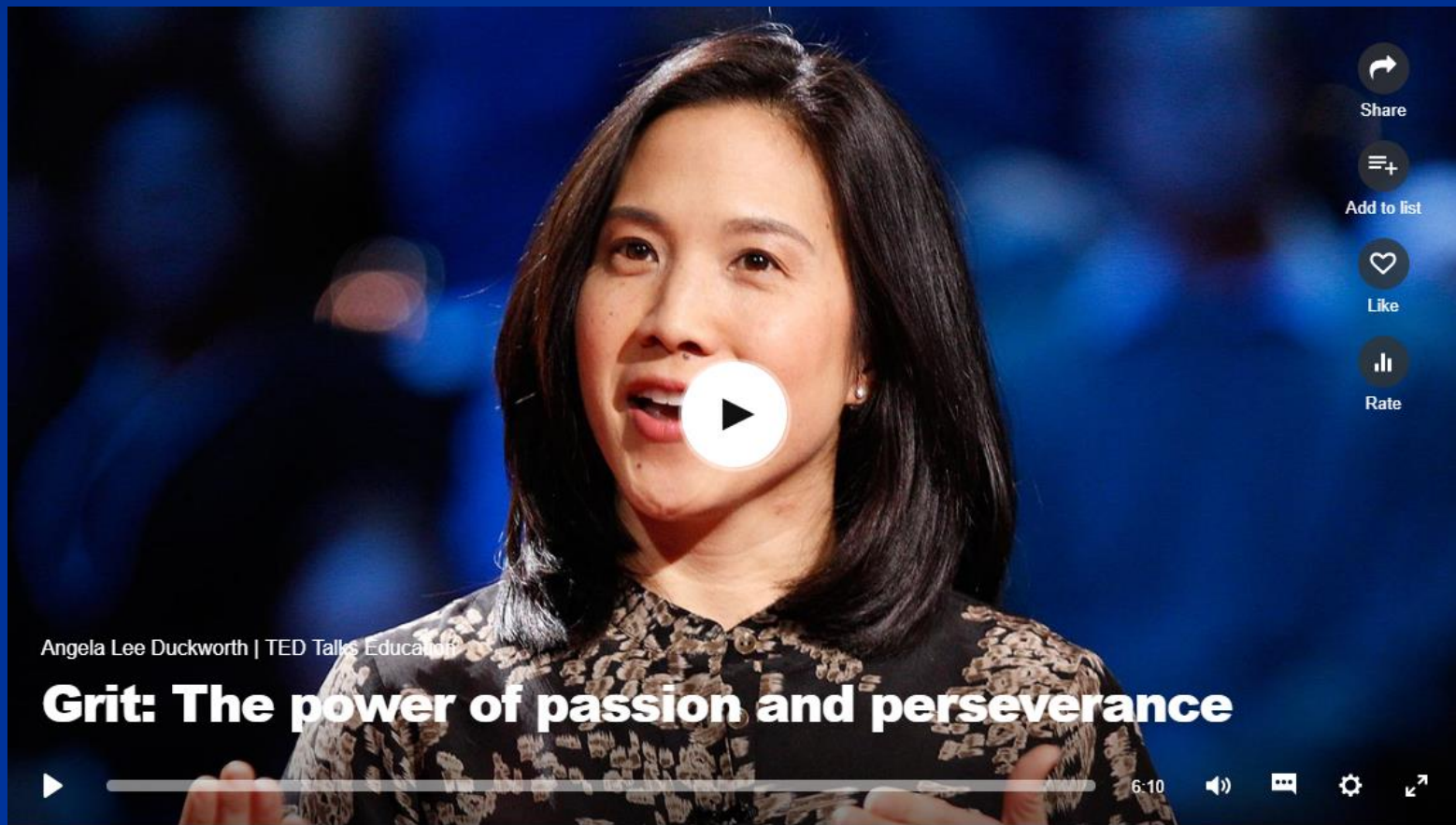
4) TED Talks: growth mindset

- (1) State AND explain three ideas from this talk that stand out to you.
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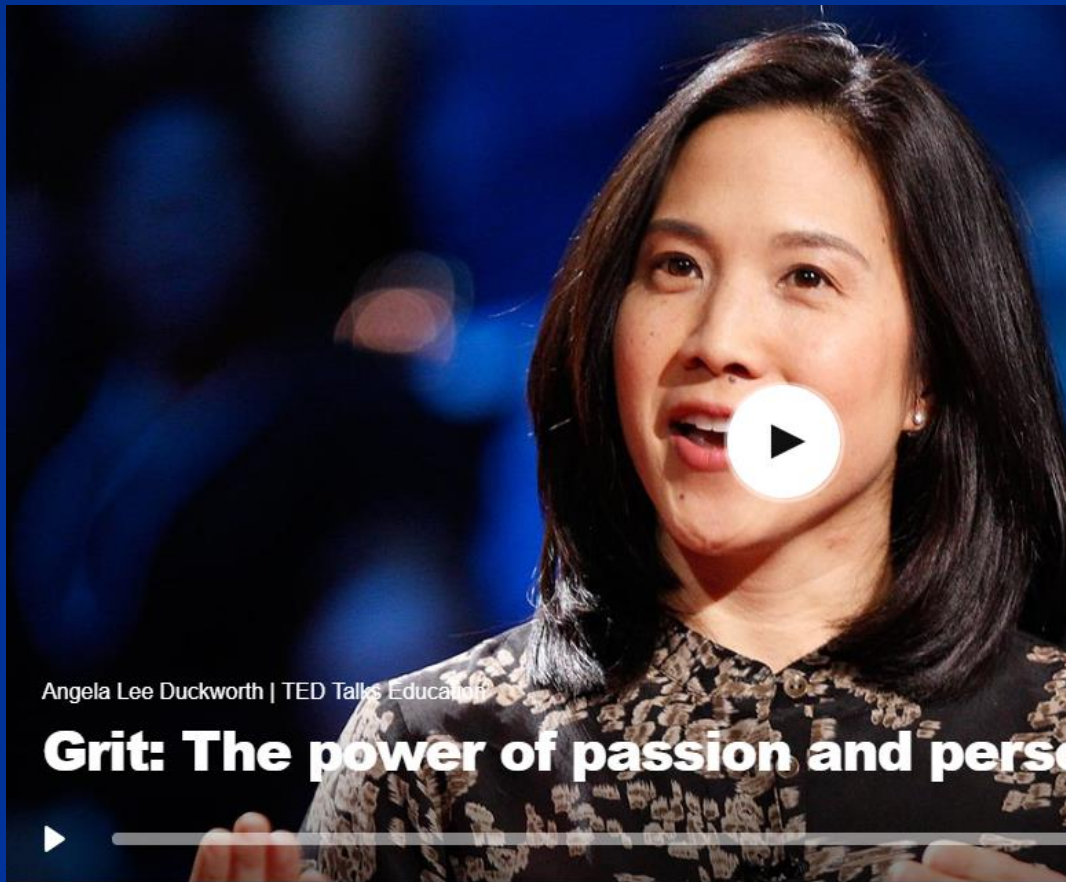
TEDxVictoria - Dr. Sean Richardson - Mental Toughness: Think Differently about your World

(3) Do you perceive ability or effort as the key for you in mathematics? How is the perspective of “growth mindset” relevant for you this term?

4) TED Talks: growth mindset



4) TED Talks: growth mindset



LaL #04: TED Talk Name: _____ ____/3 pts

Watch Angela Lee Duckworth's *Grit: The Power of Passion and Perseverance* (6:12 minutes) at https://www.ted.com/talks/angela_lee_duckworth_grit_the_power_of_passion_and_perseverance.

Write a few sentences in response to each question, and come prepared to share your ideas in class.

(1) State AND explain three ideas or examples from this talk that stand out to you.

•

•

•

(2) How might the idea of “growth mindset” be relevant to you as a student in this class or others?

(3) Do you perceive yourself as a “gritty” person? Why or why not?

4) TED Talks: growth mindset

- (1) State AND explain three ideas from this talk that stand out to you.
- (2) How might the idea of “growth mindset” be relevant to you as a student in this class or others?
- (3) Do you perceive yourself as a “gritty” person? Why or why not?

_____/3 pts
perseverance (6:12 minutes)
passion_and_perseverance.
to share your ideas in class.
ad out to you.

Angela Lee Duckworth | TED Talks Education

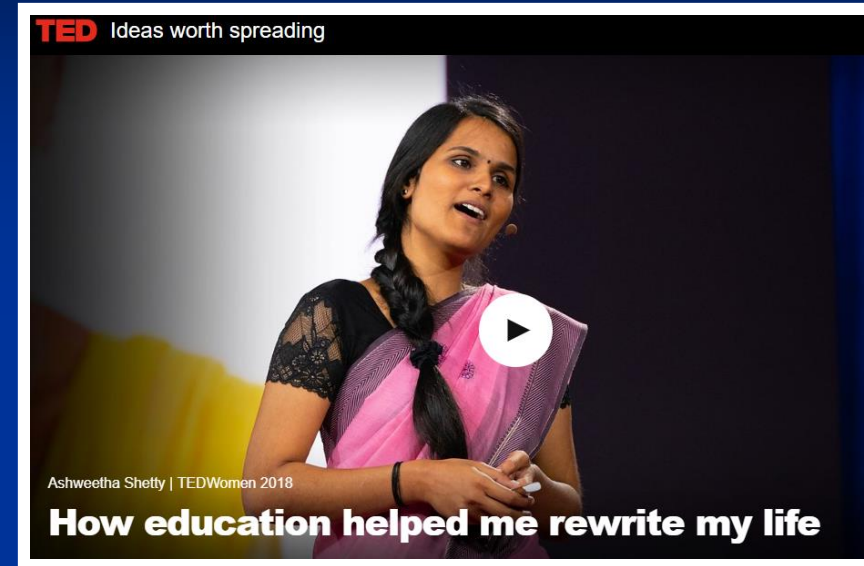
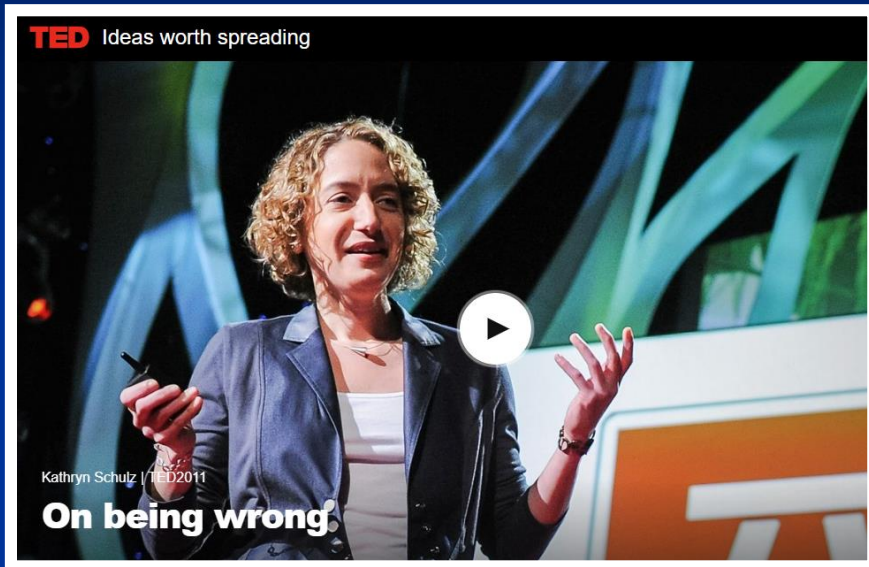
Grit: The power of passion and perseverance



(2) How might the idea of “growth mindset” be relevant to you as a student in this class or others?

(3) Do you perceive yourself as a “gritty” person? Why or why not?

4) TED Talks: and more



5) Pre-Exam Questions

MAT 200 HW #09 due 2/22

To laugh often and much; to win the respect of intelligent people and the affection of children; to earn the approbation of honest critics and to endure the betrayal of false friends. To appreciate beauty; to find the best in others; to leave the world a bit better whether by a healthy child, a garden patch, or a redeemed social condition; to know that even one life has breathed easier because you have lived. This is to have succeeded.

Ralph Waldo Emerson

Cover-Solve-Check Examples

Answer the following:

1. pp 90 Example 2.58 - How many 2-person committees can be chosen from a set of 5 people?
2. pp 100 Example 3.1 - Compute $24 \bmod 7$. Is 98 congruent to 43 mod 11? Is 42 congruent to 5 mod 8? Is 4 congruent to 29 mod 6?
3. pp 103 Example 3.4 - Working in Z_6 , compute $[5]+[3]$ and $[5]x[3]$.

Exercises

Solve the following exercises.

1. 2.5 (pp 83-84): 19, 25.
2. 2.6 (pp 91-93): 1-4, 21-23, 31.
3. 3.1 (pp 105-106): 3, 5, 9, 11, 21, 23, 25, 27, 51.
4. ALSO - write up your answers to "Take (2)" for the four questions on the workshop packet that was given back to you in class.

Reading Questions

Answer the following reading questions.

1. State TWO specific questions you would like to have answered before the exam on Friday.
2. State TWO general questions you would like to have answered before the exam on Friday.
3. Write one question that you think would be a good exam question.

Reading Questions

Answer the following reading questions.

1. State TWO specific questions you would like to have answered before the exam on Friday.
2. State TWO general questions you would like to have answered before the exam on Friday.
3. Write one question that you think would be a good exam question.

6)

SELF-EVALUATION OF CLASS PARTICIPATION Name: _____

	Excellent (8 pts)	Good (6 pts)	Satisfactory (4 pts)	Marginal (2 pts)	Unsatisfactory (0 pts)
ATTENDANCE	attends every class (except for excused absences)	missed at most one class (except for excused absences)	missed at most 2 classes (except for excused absences)	Missed 3-5 classes (except for excused absences)	attends some classes but with many unexcused absences
ARRIVAL TIME	always arrives to class on time	arrived to class late at most once	arrived to class late at most twice	arrived to class late 3-5 times	often does not arrive to class on time
ATTENTIVENESS	always awake and alert during class	almost always awake and alert during class	is usually awake and alert during class	is often not awake or not alert during class	is rarely awake or alert during class
ENGAGEMENT	always fully engaged in class	usually engaged in class	frequently engaged in class	sometimes engaged in class	usually disengaged in class
QUESTIONS	frequently asks relevant questions	often asks relevant questions	sometimes asks relevant questions	asks few questions	asks irrelevant or distracting questions
CONTRIBUTES	contributes frequently	contributes regularly	contributes occasionally	contributes rarely	contributes rarely if ever
COMPLETION of EXERCISES	works all assigned exercises	works almost all assigned exercises	works most assigned exercises	works some assigned exercises	works few, if any, of the assigned exercises
GROUP WORK	always contributes to group activities	often contributes to group activities	sometimes contributes to group activities	rarely contributes to group activities	never contributes or is disruptive to group activities
IN-CLASS TEXTS or EMAILS	I never text nor email during class.		The highest possible grade for a student who reads/sends a text once during class.	The highest possible grade for a student who reads/sends texts twice during class	The highest possible grade for a student who reads/sends texts three or more times during class

Is there anything else you would like to share?

7) Post-Exam #1 Reflection

Metacognitive Reflection on Exam #1 by _____

Reflection #1: How does your grade on the exam match up with how you thought you had done?

Reflection #2: Explain why two specific questions (or parts of questions) went well for you.

- Page _____

- Page _____

Reflection #3: Explain why two specific questions (or parts of questions) did not go well for you.

- Page _____

- Page _____

Reflection #4: Explain two specific actions you will adopt to help the next exam go well.

-

-

Reflection #5: Is there anything I can shift in how this class is running to help make your learning experience better?

7) Post-Exam #1 Reflection

(1) How does your grade on the exam match up with how you thought you had done?

How did you think you had done?

How did it go for you.

How did it not go well for you.

How did the exam go well.

How to help make your learning

7) Post-Exam #1 Reflection

- (1) How does your grade on the exam match up with how you thought you had done?
- (2) Explain why two specific questions (or parts of questions) went well for you.
- (3) Explain why two specific questions (or parts of questions) did not go well for you.

How did you think you did on the exam?

What went well for you?

What did not go well for you?

What did you learn from this exam?

What can you do to help make your learning

7) Post-Exam #1 Reflection

- (1) How does your grade on the exam match up with how you thought you had done?
- (2) Explain why two specific questions (or parts of questions) went well for you.
- (3) Explain why two specific questions (or parts of questions) did not go well for you.
- (4) Explain two specific actions you will adopt to help the next exam go well.
- (5) Is there anything I can shift in how this class is running to help your learning?

...thought you had done?

...went well for you.

...did not go well for you.

...t exam go well.

...o help make your learning

7) Post-Exam #2 Reflection

- (1) How does your grade on the exam match up with how you thought you had done?
- (2) Explain why two specific questions (or parts of questions) went well for you.
- (3) Explain why two specific questions (or parts of questions) did not go well for you.
- (4) Discuss one change you made in how you work in this class since the last exam and how it affected the exam.
- (5) Explain two specific actions you will adopt to help the next exam go well.

...thought you had done?

...went well for you.

...did not go well for you.

...t exam go well.

...o help make your learning

8) Thoughts about Studying

- What are two ideas you really like on this handout?
- What is one idea you think I should modify before I share this with a next class?

Some Thoughts and Ideas about Studying

The rule-of-thumb for study time in college is 2.5-3 hours on your own for every 1 hour of class.

- Why? When you studied math in high school, you invested about 180 hours of in-class time during the course of the school year. That's about the amount of time it takes to develop a good understanding and strong neural pathways. We have 36 hours in class. In college, you are responsible for making enough study time on your own outside of class to fill in the gap.
- What if I finish my homework in an hour? The general guide refers to "study" time, not "homework" time. If you finish the homework in less than three hours, you still need to fill in the remaining time on your own.

Here are some ways to study and achieve success in this and your other classes.

- Read through your notes and retry the examples without looking at the solutions. You have an answer key in your notes to check your understanding. You can follow this same approach with the examples in the book.
- Attend every study session. You can choose to make these "mandatory" for yourself, just like attending class. If you haven't started your homework yet, you can begin your work there. If you've finished your homework, check out any questions you are uncertain about with the tutor. Or just go and listen to the answers to other people's questions. The study sessions are intentionally scheduled the night before the homework is due in class for your benefit.
- Create flashcards with definitions and formulas as they come up. And practice with them every day - this practice will strengthen your math neural pathways a great deal.
- Look at the feedback on your quizzes. The day you get a quiz back, make sure you know a correct solution and confirm it with me, our tutor, and/or your friends.
- While doing your homework, mark the exercises that seem harder to you. Go back and work a couple more exercises right around those. They will be similar and give you more practice.

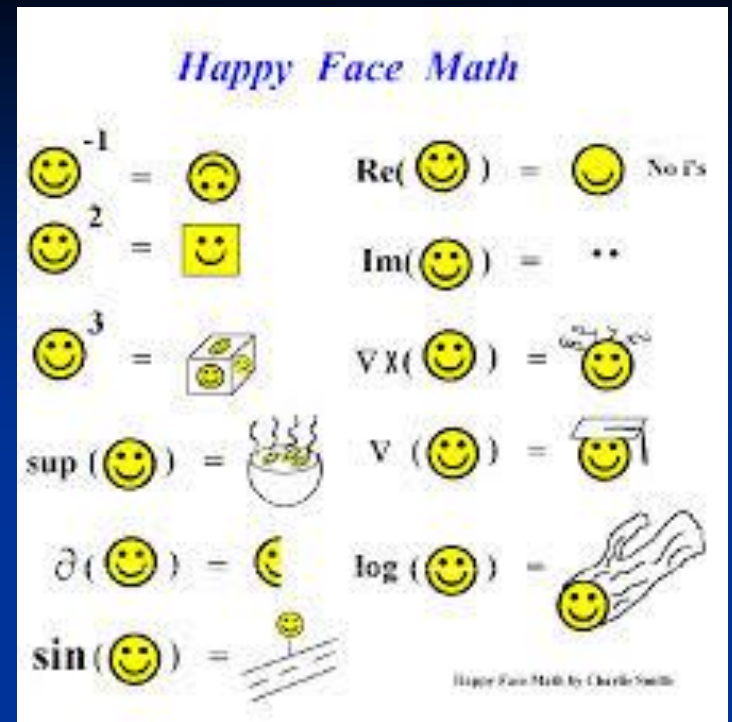
Study when your brain is fresh. If you start studying at midnight, then by 2 AM your brain will not be fresh. You won't think as clearly, and your hippocampus will shut down, which keeps you from making memories. Make the time during the day to study, rather than take a nap. Your brain will be fresher and you won't have to stay up until 2 or 3 AM studying.

Think about your study space. Are you an auditory learner? Turn off your music and find a quiet space. Are you a visual learner? Find a space that is not full of visual distractions. Some folks can work in their room. Other people find another place on campus to study and make their room a work free zone. Find a study place that will enable you to effectively and efficiently learn.

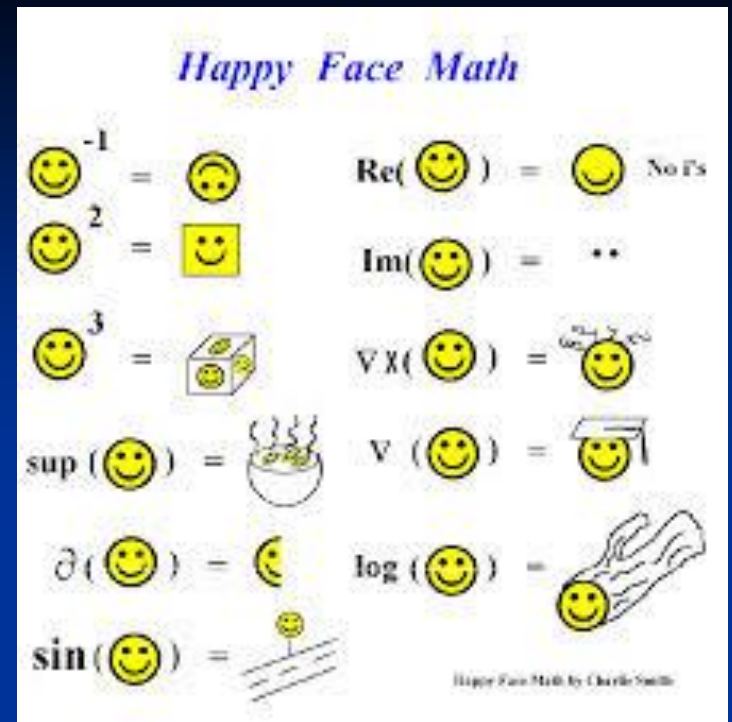
Form a study group. You can learn a lot on your own, but you can also learn a lot with others. If you're stuck, ask a friend your question and talk through the solution, rather than throwing yourself up against something you don't understand for an hour. At the same time, if your study group is socializing more than studying, well, it might be time to recalibrate or find another study group.

This might be a hard one. Turn off your cell phone and other electronic devices for at least 30 minutes at a time while you are studying, and remove them from view. Frequently switching your attention from what you are studying to something else makes you less efficient and often incapable of learning. The human mind can only hold seven things in its active working memory at a time. As you know, it sometimes takes seven ideas to solve a single math question. Help yourself succeed by turning off your phone and computer for pre-designated chunks of time while you study.

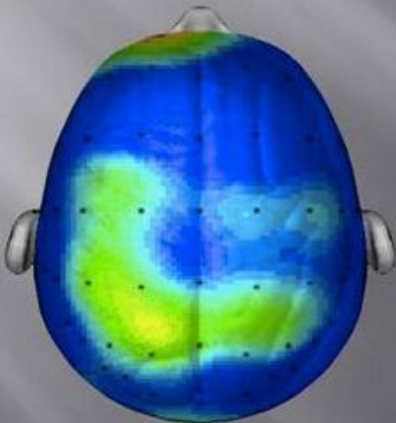
9) Self-Care



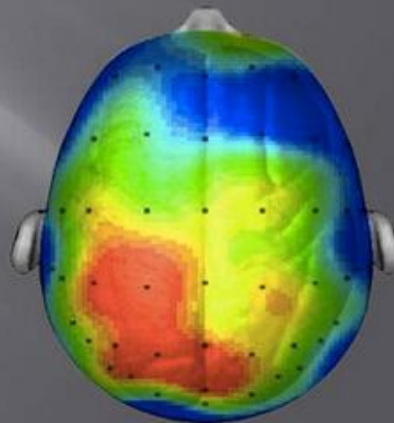
9) Self-Care



BRAIN AFTER SITTING QUIETLY



BRAIN AFTER 20 MINUTE WALK



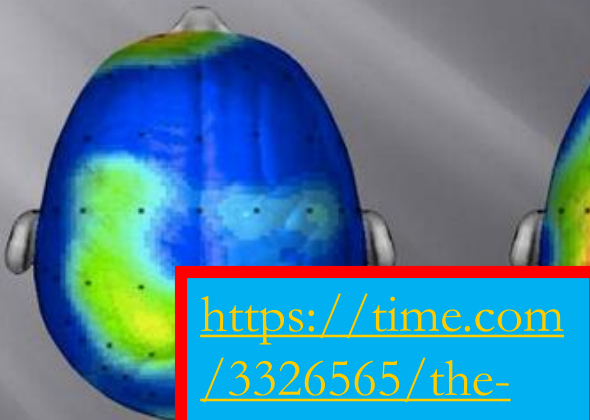
Research/scan compliments of Dr. Chuck Hillman University of Illinois

9) Self-Care



BRAIN AFTER SITTING QUIETLY

BRAIN AFTER WALKING

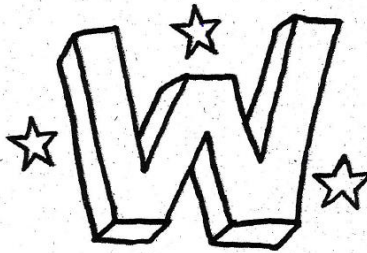


Research/scan c

<https://time.com/3326565/the-power-of-sleep/>

HEALTH | SLEEP

THE POWER OF SLEEP BY ALICE PARK



WHEN OUR HEADS HIT THE PILLOW EVERY NIGHT, we tend to think we're surrendering. Not just to exhaustion, though there is that. We're also surrendering our mind, taking leave of our focus on sensory cues, like noise and smell and blinking lights. It's as if we're powering ourselves down like we do the electronics at our bedside—going idle for a while, only to spring back into action when the alarm blasts hours later.

That's what we think is happening. But as scientists are now revealing, that couldn't be further from the truth.

In fact, when the lights go out, our brains start working—but in an altogether different way than when we're awake. At night, a legion of neurons springs into action, and like any well-trained platoon, the cells work in perfect synchrony, pulsing with electrical signals that wash over the brain with a soothing, hypnotic flow. Meanwhile, data processors sort through the reams of information that flooded the brain all day at a pace too overwhelming to handle in real time. The brain also runs checks on itself to ensure that the exquisite balance of hormones, enzymes and proteins isn't too far off-kilter. And all the while, cleaners follow in close pursuit to sweep out the toxic detritus that the brain doesn't need and which can cause ill

Happy Face Math

$$\begin{aligned} \text{😊}^{-1} &= \text{😞} \\ \text{😊}^2 &= \text{😊} \end{aligned}$$

$$\text{Re}(\text{😊}) = \text{😊} \quad \text{No i's}$$

$$\text{Im}(\text{😊}) = \dots$$

New Research Shows A Good Night's Rest isn't a luxury—it's critical for your brain and for your health.

Which is why, after long treating rest as a good-if-you-can-get-it obligation, scientists are making the case that it matters much more than we think. They're not alone in sounding the alarm. With up to 70 million of us not getting a good night's sleep on a regular basis, the Centers for Disease Control and Prevention considers insufficient sleep a public-health epidemic. In fact, experts argue, sleep is emerging as so potent a factor in better health that we need a societal shift—and policies to support it—to make sleep a nonnegotiable priority.

THE CONSEQUENCES OF SKIPPING

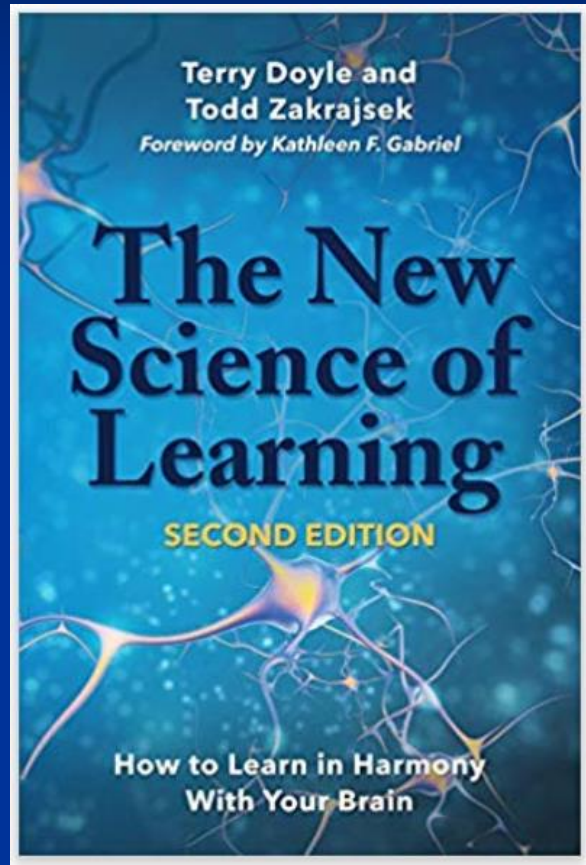
DESPITE HOW GREAT WE FEEL AFTER A NIGHT'S rest—and putting aside what we now know about sleep's importance—we stubbornly refuse to swallow our medicine, pushing off bedtime and thinking that feeling a little drowsy during the day is an annoying but harmless consequence. It's not. Nearly 40% of adults have nodded off unintentionally during the day in the past month, and 5% have done so while driving. Insomnia or interrupted sleep nearly doubles the chances that workers will call in sick. And half of Americans say their uneven sleep makes it harder to concentrate on tasks.

Those poor sleep habits are trickling down to the next generation: 45% of teens don't sleep the recommended nine hours on school nights, leading 25% of them to report falling asleep in class at least once a week, according to a National Sleep Foundation survey. It's a serious enough problem that the American Academy of Pediatrics recently endorsed the idea of starting middle and high schools later to allow for more adolescent shut-eye.

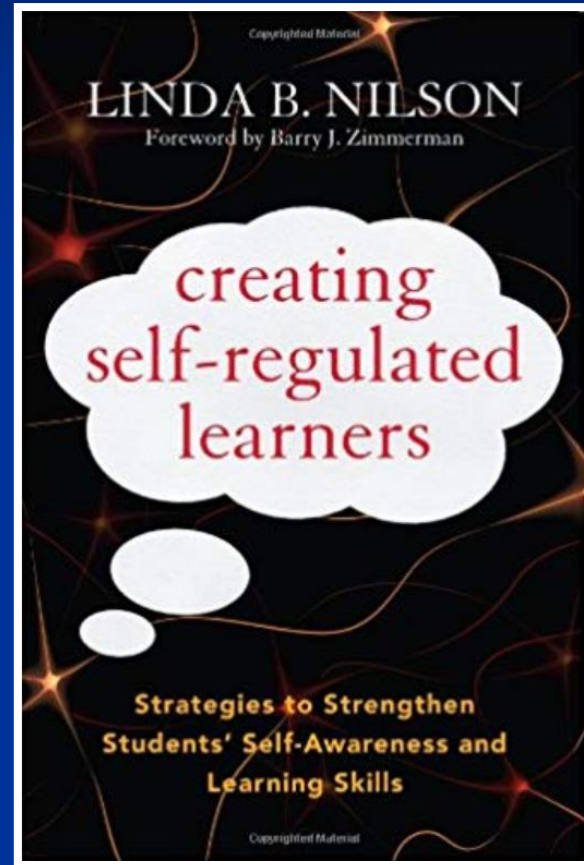
SLEEP DEPRIVATION COMES WITH CONSEQUENCES THAT ARE 'SCARY, REALLY SCARY.'

—Mary Carskadon, professor of psychiatry and human behavior at Brown University

10) New Ideas...



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Student Thoughts about LaL

- The focus on improving us as math students, learners in general, and just as individuals was something I found incredible and greatly appreciated.
- The learning about learning exercises were very helpful and kept me thinking about how I can improve my learning.

Student Thoughts about LaL

- I loved the positive reinforcement after the exams. Feeling like I did poorly on an exam, but then having a TED Talk to cheer me back up and regain faith kept me going throughout this semester.

Student Thoughts about LaL

- I loved the positive reinforcement after the exams. Feeling like I did poorly on an exam, but then having a TED Talk to cheer me back up and regain faith kept me going throughout this semester.
- He gave us Love of Learning (LoL) assignments which I loved. He wants us to love learning, not only in his class but in all. He wants us to reflect on our mistakes and learn from them and become a better student.

Thanks!!

Questions?

Learning about Learning

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