MetaLearning: Leveraging Research on Learning to Improve Student Success

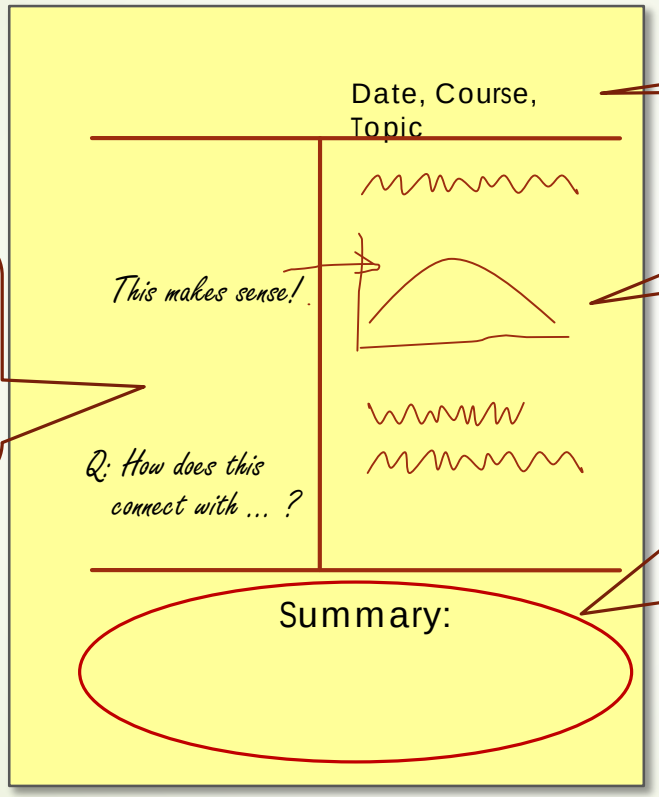
Cal Maritime -- 2018

Stephen Carroll, PhD

The Plan: Steps to Improving Your Success

- Practices that Improve Learning
  - Taking Notes
  - Reading
  - Study Techniques
  - Study Cycle
  - Strategies and Tactics: Exercise, Sleep, etc.
- Theory—Why those practices work
  - Define Learning
  - How Learning Works

Metacognitive Notes



Priming information

Notes on what's being presented

Thoughts, connections & feelings that arise

Summary Reflections:
ASAP – *before sleeping*

What's worth reviewing & remembering?

For Best Results:
Review Summary within 24 hours

Reading Strategies

- Pre-Read
  - Determine context and purpose (motivation)
  - Write ***your*** purpose on a 3x5 card (motivation)
  - Scan the prominent features of the text (priming)
  - Think about what you know now (metacognition)
- Read Critically
  - Focused, attentive reading using 3x5 card(making connections)
  - Two highlighters and a pen (metacog & connections)
  - Reading journal or notebook (metacog & connections)
- Post-Reading
  - Review and reflect [pre-reading and notes] (metacog)
  - Summary before switching gears/before sleep (retain)
  - Review within 24 hours (retain)

Test, Analyze, INtegrate

- Passive review has low correlation with ability to recall what was learned.
- Ability to recall depends on PRACTICE of recall:
  - Test ability to recall frequently for low stakes
  - Analyze successes and failures (seek patterns)
  - Integrate those patterns into learning strategies
- Note the connections to Bloom's higher-order thinking skills (HOTS)

Popular Study Techniques
Which ones are effective?

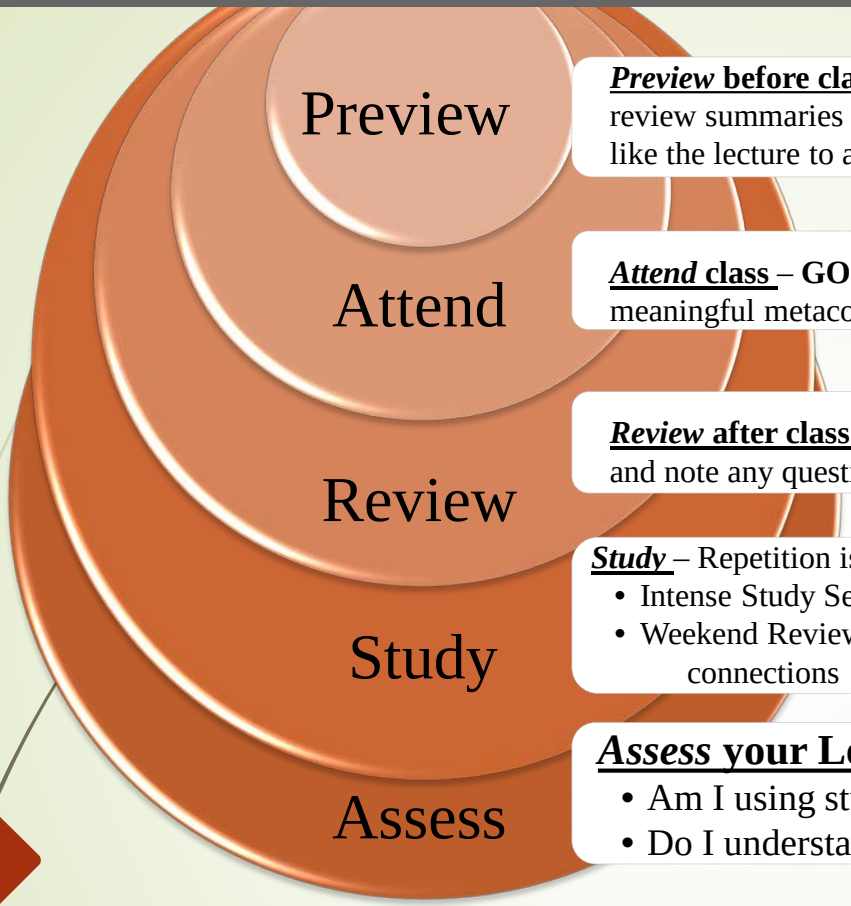
1. Elaborative Interrogation
2. Self-Explanation
3. Summarization
4. Highlighting/underlining
5. Keyword Mnemonic
6. Imagery for text
7. Rereading
8. Practice Testing
9. Distributed Practice
10. Interleaved Practice

Popular Study Techniques

1. Elaborative Interrogation (M)
2. Self-Explanation (M)
3. Summarization (L)
4. Highlighting/underlining (L)
5. Keyword Mnemonic (L)
6. Imagery for text (L)
7. Rereading (L)
8. Practice Testing (H)
9. Distributed Practice (H)
10. Interleaved Practice (M)

Learning Techniques: Promising Directions from Cognitive and Educational Psychology, APS, Psychological Science, (2013) Dunlosky, Rawson, Marsh, Nathan, & Willingham.

The Study Cycle



***Preview* before class** – Skim the chapter, note headings and boldface words, review summaries and chapter objectives, and come up with questions you'd like the lecture to answer for you.

***Attend* class** – **GO TO CLASS!** Answer and ask questions and take meaningful metacognitive notes.

***Review* after class** – As soon after class as possible, read notes, fill in gaps and note any questions. Do this before you sleep.

Study – Repetition is key. Ask questions such as 'why,' 'how,' and 'what if.'

- Intense Study Sessions* - 3-5 short study sessions per day. (Pomodoro)
- Weekend Review – Read notes and material from the week to make connections

***Assess* your Learning** – Periodically perform reality checks

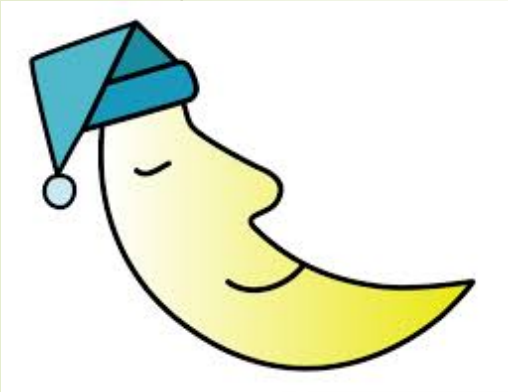
- Am I using study methods that are effective?
- Do I understand the material enough to teach it to others?

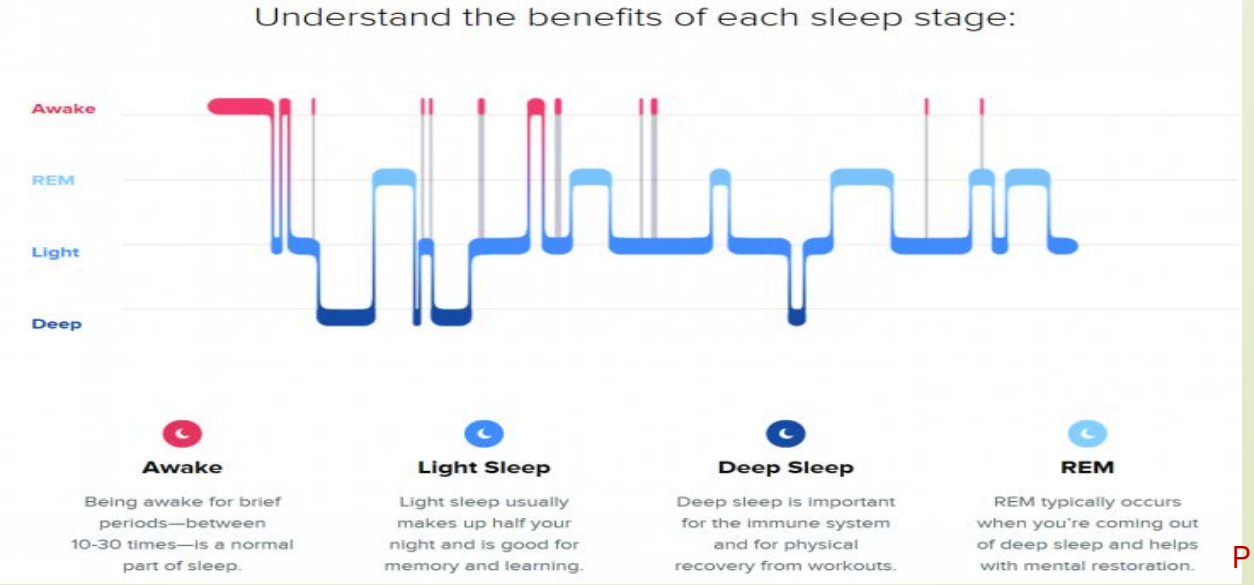
*Intense Study Sessions

1	**Set a Goal**	(1-2 min)	**Decide what you want to accomplish in your study session**
2	**Study with Focus**	(30-50 min)	**Interact with material**- organize, concept map, summarize, process, re-read, fill-in notes, reflect, etc.
3	**Reward Yourself**	(10-15 min)	**Take a break**– call a friend, play a short game, get a snack
4	**Review**	(5 min)	**Go over what you just studied**

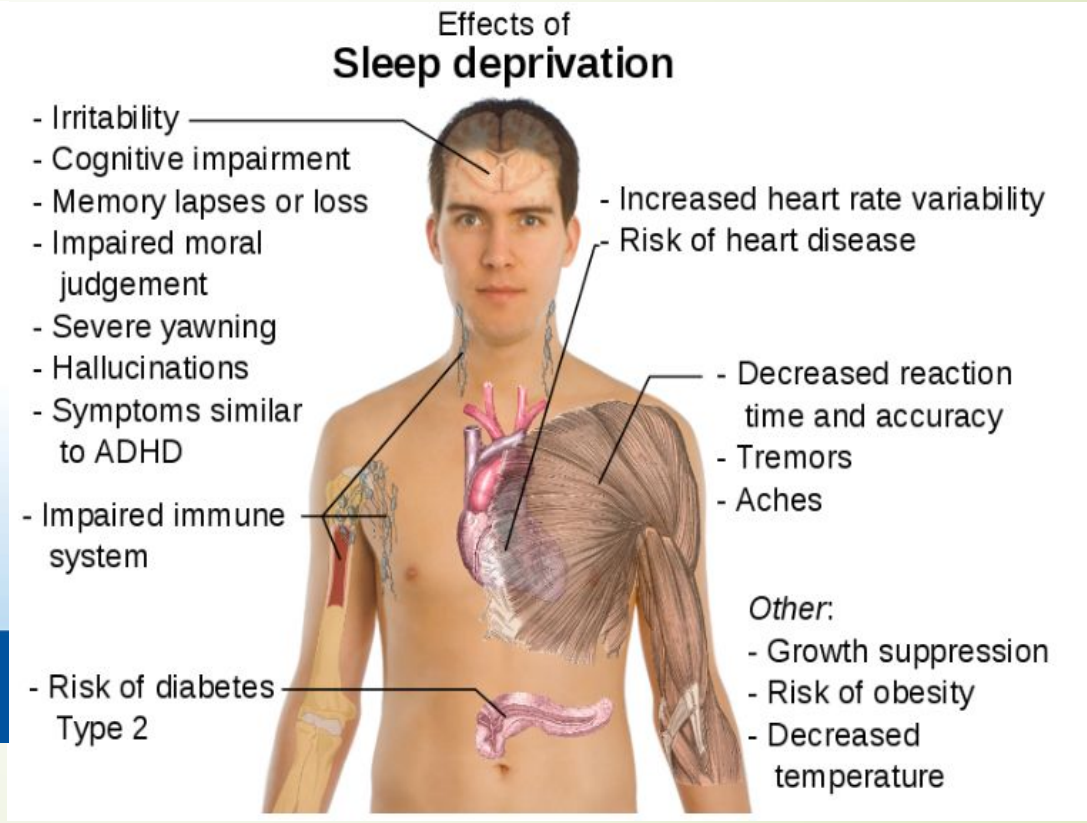
Strategies and Tactics

- Get enough sleep—
  - Young adults need 9-10 hours of sleep for optimum brain performance.
  - You'll perform better on the test if you are well-rested than if you have stayed up most of the night reviewing the material one more time.





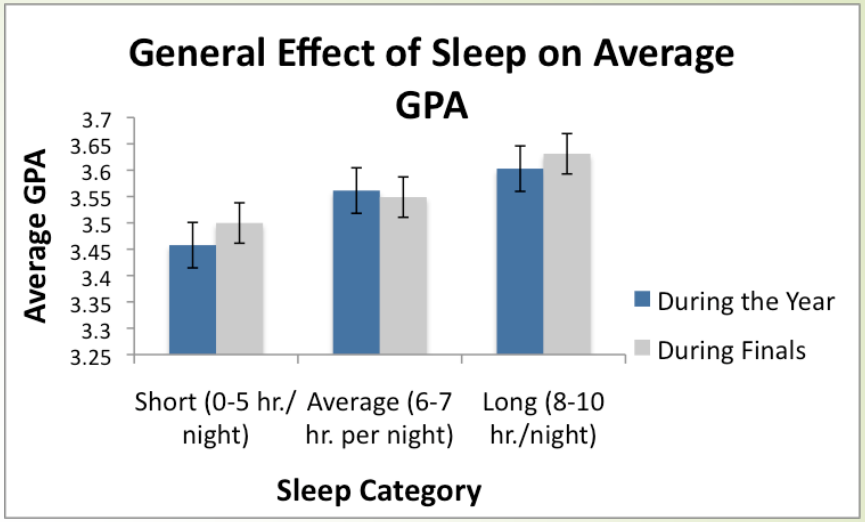
Sleep Deprivation

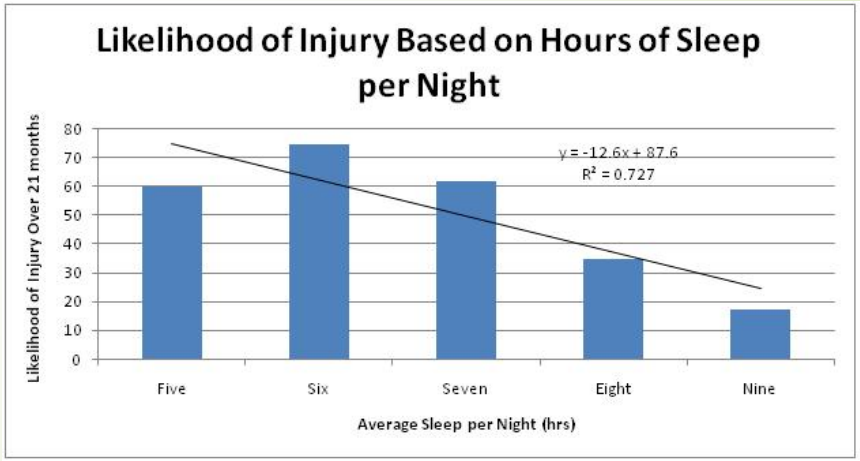


Strategies and Tactics

Manage your Sleep Well: Sleep Cycle: 90 min.

- Minimum of 6 hours for acceptable performance (9-10 hours for young adults).
- Mental performance drops off sharply if you don't get *at least* 6 hours of sleep per night regularly. Without this amount of sleep, you cannot learn: long-chain reasoning, persistence, etc.
- If you must do with less, you want to wake in the REM period at the end of the cycle, not a deep part of the cycle. The less sleep you get, the more important it is when you wake up.





Sleep cycles:
~ 90 minutes/cycle

If you wake up in one of these phases, you'll feel rested and perform well.

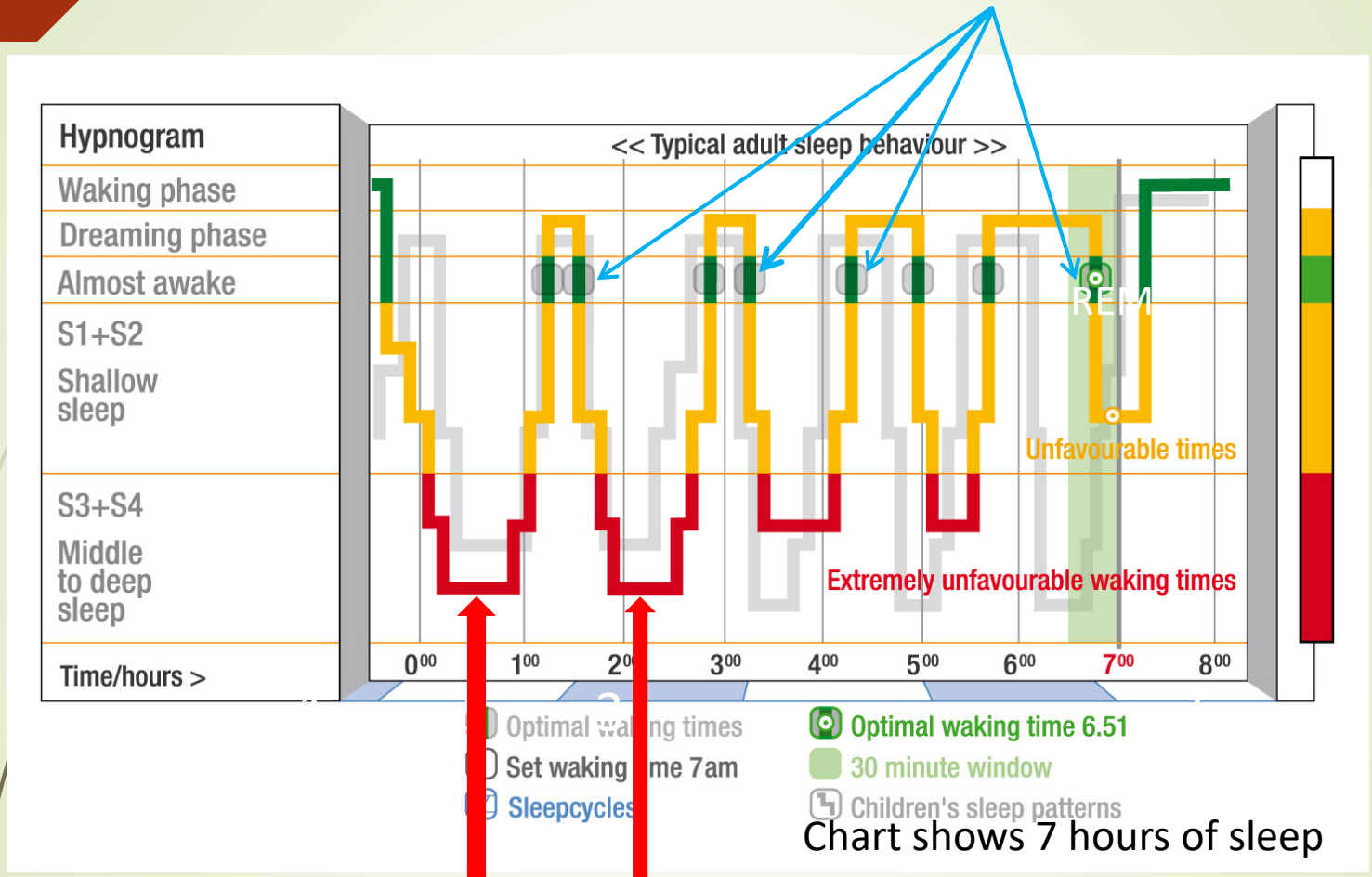
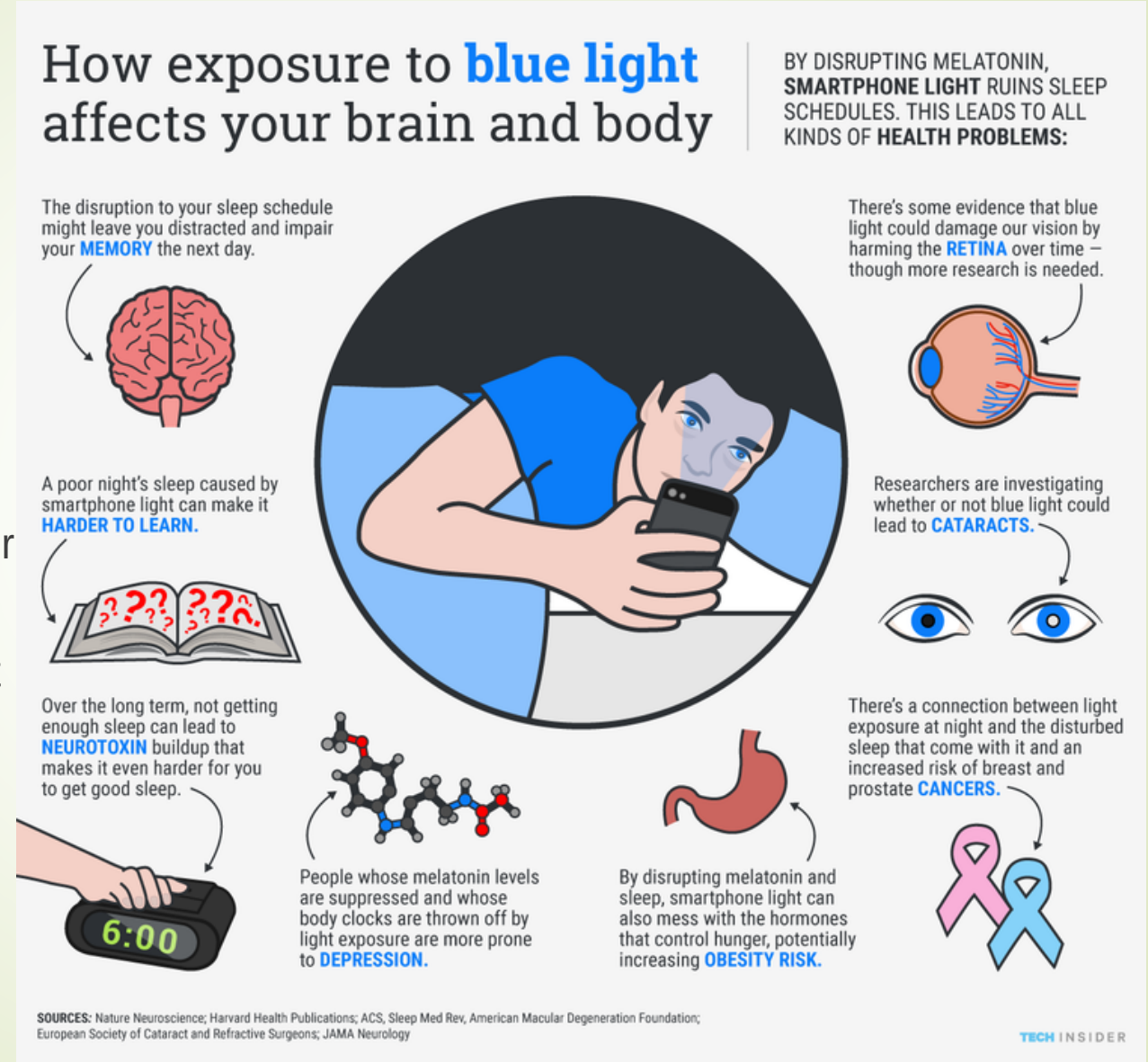


Chart shows 7 hours of sleep

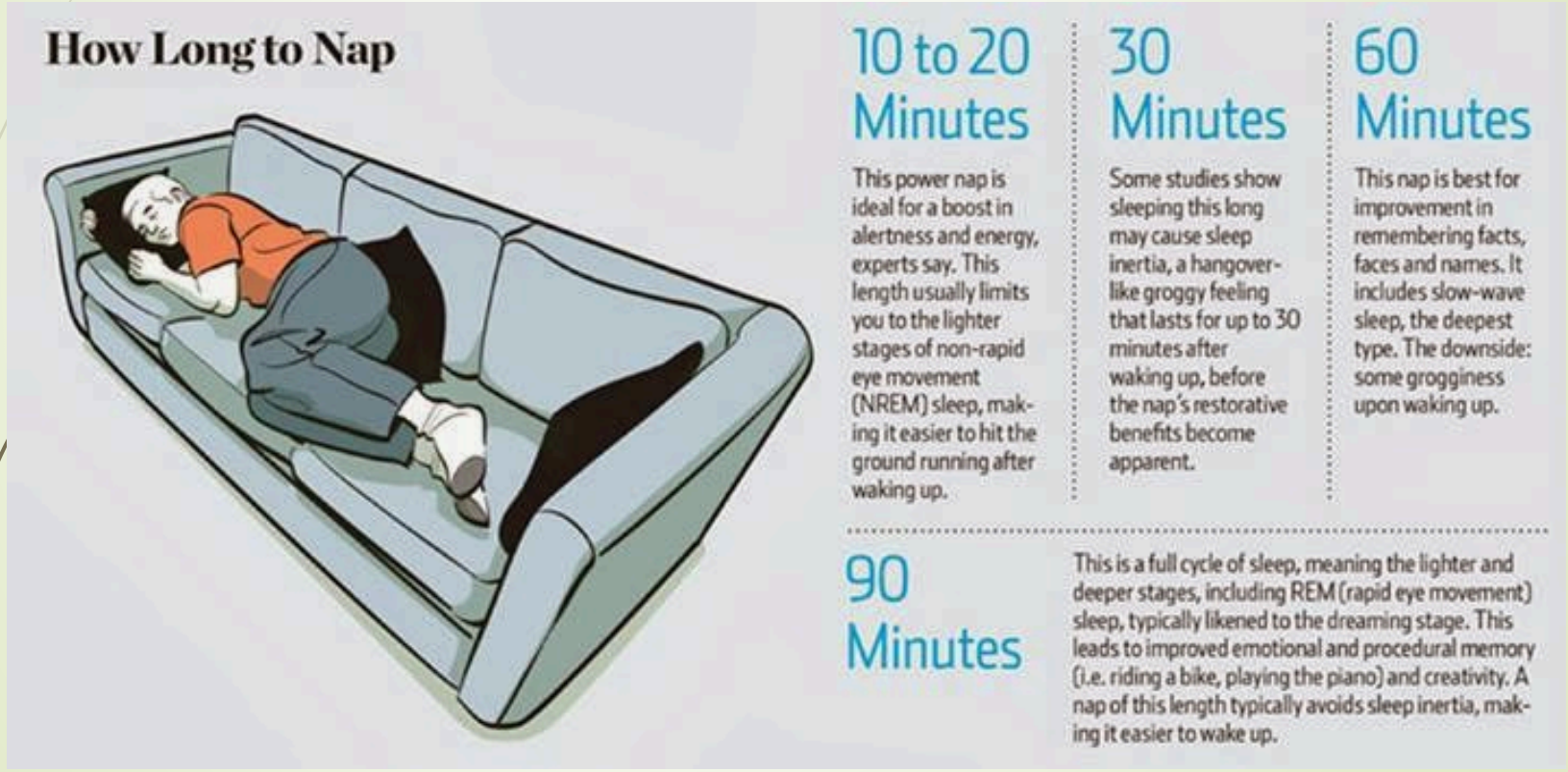
If you wake up in these troughs, you'll be tired and groggy all day. You'll perform significantly less well on cognitive tasks.

Sleep Hygeine

- No caffeine after noon
- Don't study in bed
- No screens one hour before bed (or blue-light screen)
- Go to bed and get up at the same time each day
- Use an app to wake at the right time

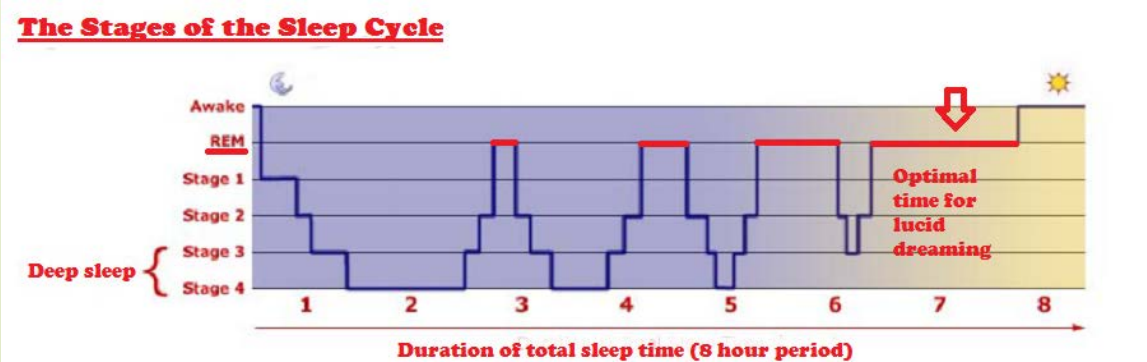


Napping aids memory and cognition



Strategies and Tactics

- Sleep Cycles
  - Plot your cycle so that you know how it works.
  - Your period of maximum fatigue will fall 12 hours after the deepest period of sleep. (Nap!)
  - Use the information-sorting function of sleep to help you solve problems. Focus on the problem you want to solve repeatedly as you fall asleep. Review in the morning. (Keep paper by the bed.)
  - Lucid dreaming can also help you study.
  - Adjust bedtime to the type of test you're taking.



Strategies and Tactics

- Exercise regularly and early—
  - 45 min of aerobic exercise early in the day is ***the best*** way to increase learning performance
  - Moving blood and oxygen to your brain helps it work more effectively.
  - The chemicals your body makes when you exercise (BDNF) help you make connections more easily.

Strategies and Tactics

Make sure you are properly hydrated and nourished.

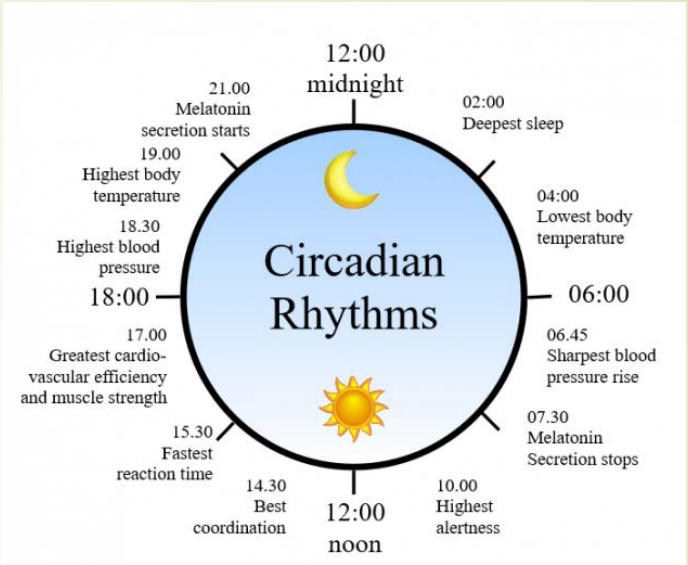
- Water is key. Even modest dehydration decreases your reasoning ability by 20%. (Don't overdo it—over-hydration also adversely affects cognition.)
- If what you eat comes through a car window or if the label lists ingredients with numbers, it isn't food.
- Color your plate: the best brain foods are blueberries, whole grains, oily fish, tomatoes, avocados, broccoli and nuts.
- Hard mental work is equally taxing to the body as hard physical work—you have to nourish it to sustain peak performance.

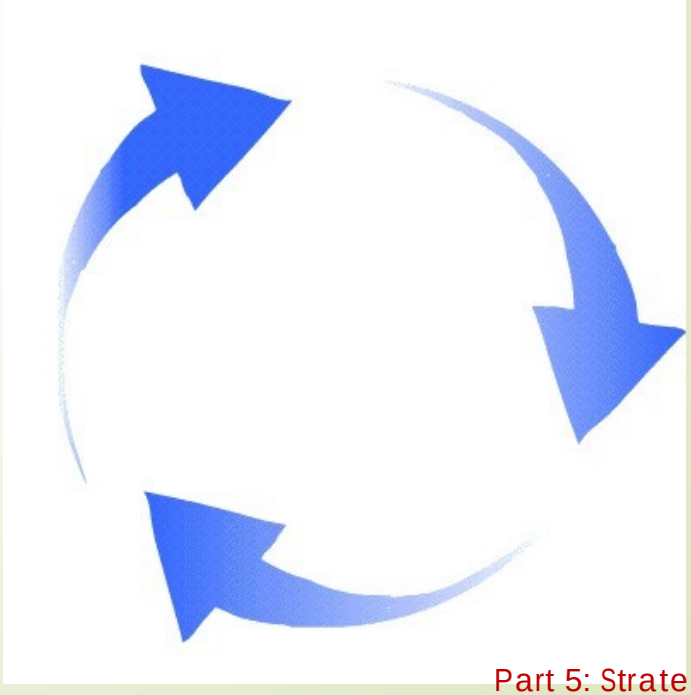
Strategies and Tactics

- Caffeine, Nicotine, Alcohol, and Adderall
  - Caffeine and sugar both inhibit learning and recall, especially in large quantities (>200 mg). When combined in ***small*** quantities, they can provide a boost (equivalent to a walk around the block).
  - Nicotine helps you form new connections only ***if*** you already smoke.
  - Alcohol impairs the brain's ability to form new connections and to recall old ones.
  - Adderall is very dangerous if you don't have ADD.

Strategies and Tactics

- Pay attention to other daily cycles and rhythms—you're more awake and better able to learn at certain times than at others. Arrange your day so that you study during these times.
  - Attention Cycle: Take breaks every 20 minutes so that you remain active and don't go on autopilot. Do something physical and bilateral on your break.
  - Study Cycle: Take a major break every 2 hours. Spend ten minutes on a different kind of task. Make sure you get up and move around. (Put an alarm on your phone to help you remember.)





Strategies and Tactics

- Information Transfer Cycle
  - Summarize materials before you sleep to mark them as important.
  - Review materials within 24 hours to move to long-term

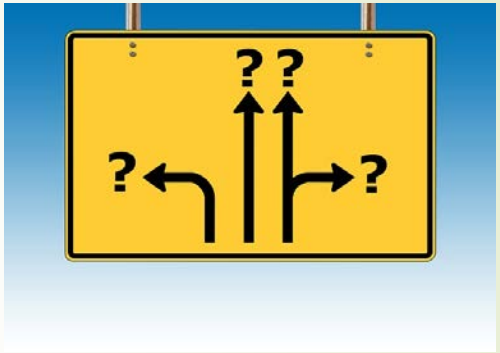
Strategies and Tactics

Make and keep a planner. Most students radically underestimate how long it will take to do things. If you keep track of how long it takes to do things and schedule the right amount of time to do them, it will reduce your anxiety and stress. (Being overwhelmed is stressful and bad for learning; being relaxed and in control makes your learning more effective and enjoyable.)

Definition of Learning

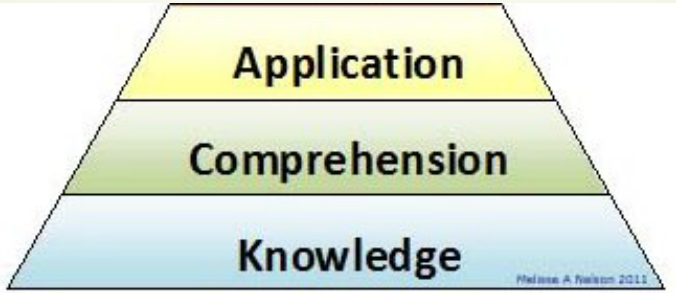
What is learning?

- What does it mean to learn something?
- How can you tell when you've learned something?



Learning is…

- Greater Understanding (50-70%)
- Skill Acquisition (25-35%)
- Total ≈ 90% (Theory-in-use)



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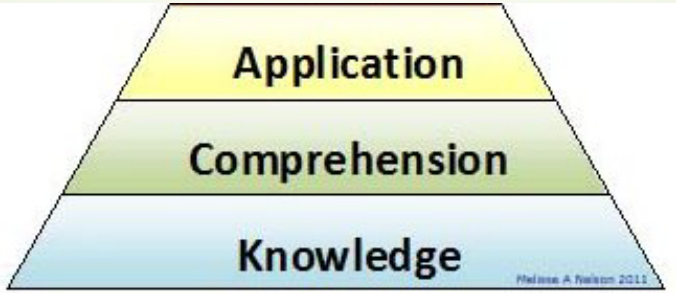
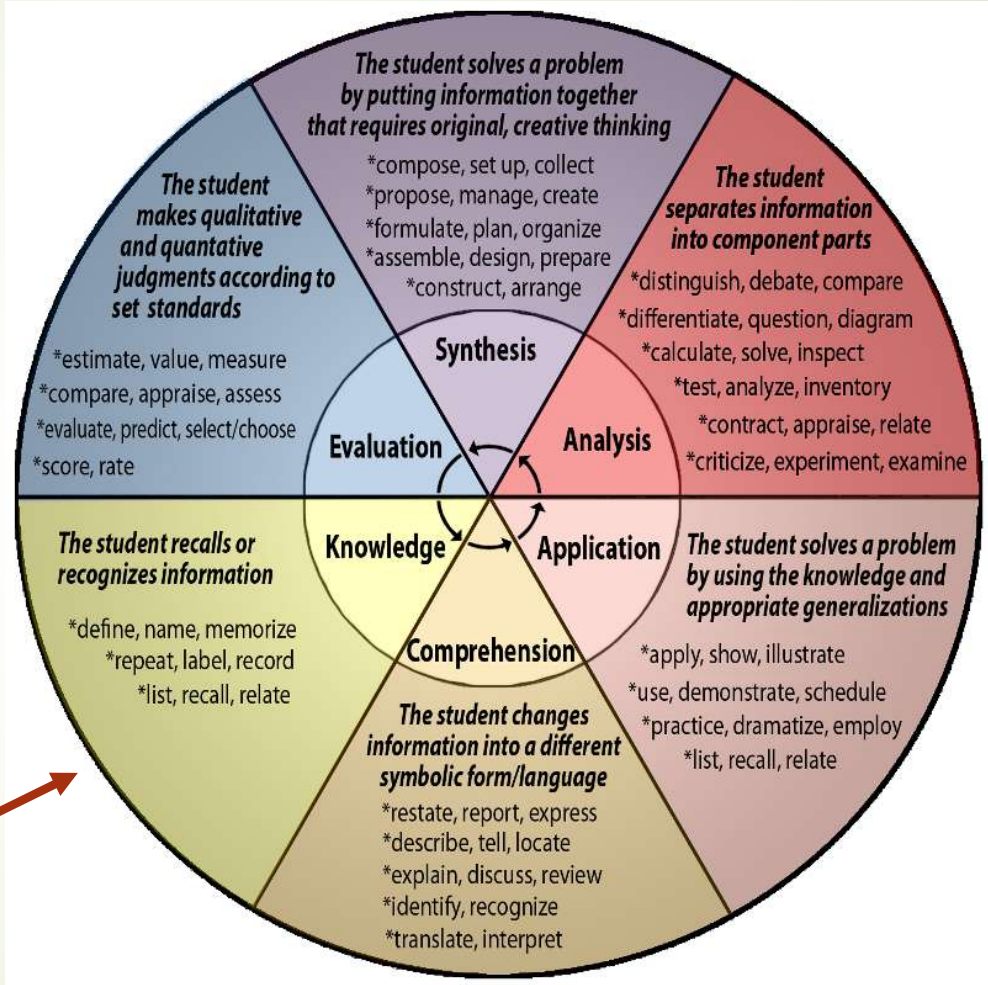
These are lower-order thinking skills on Bloom's taxonomy



Bloom's Taxonomy



Memorizing is the lowest order of learning there is.

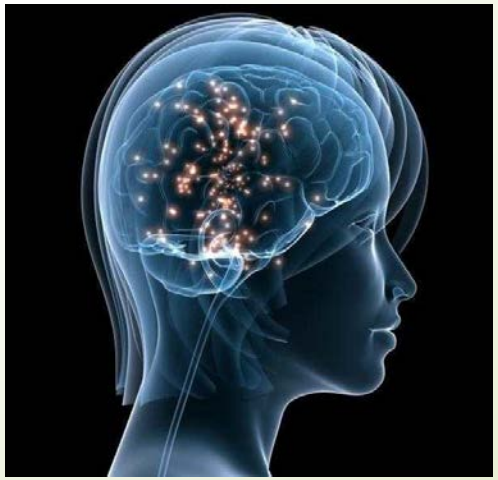
Learning is…

- Affective change (5-15%)
- Habit formation/integration (>5%)

Learning is…

- …a relatively durable change in behavior caused by experience.
- …a change in the neuron patterns in the brain.

(Goldberg, 2009)



A Teacher's Definition of Learning

- Learning is the ability to use information after significant period of disuse… ***and***
- The ability to use the information to solve problems that arise in a context different (if only slightly) from the context in which the information was originally taught. (Robert Bjork, *Memories and Metamemories, 1994)*

Habit makes Character

- We *are* what we repeatedly do. Excellence, then, is not an act, but a *habit*.
- Good habits formed at youth make all the difference.

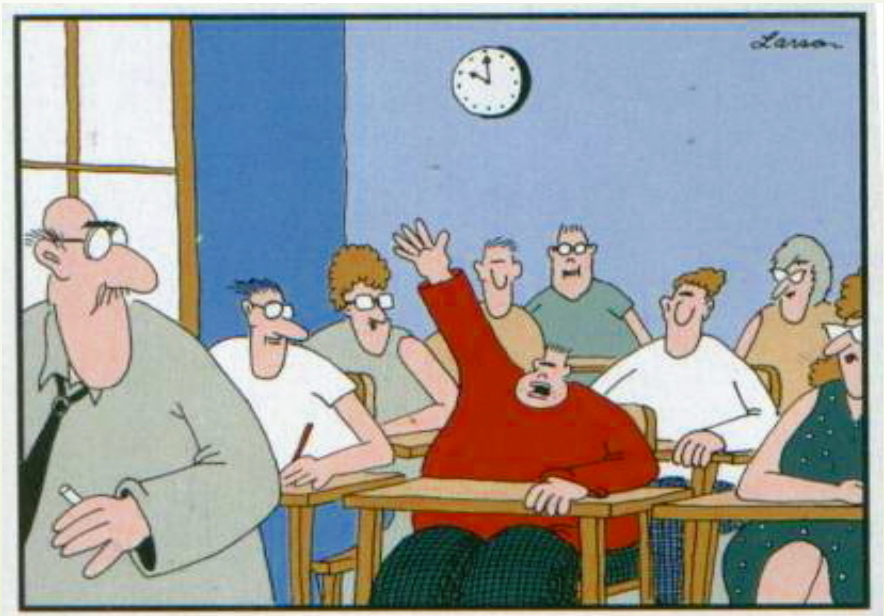
~Aristotle

- Character is simply habit long continued.

~Plutarch

Definition of Learning

Our existing definitions of learning lead to cramming and forgetting—and failure.

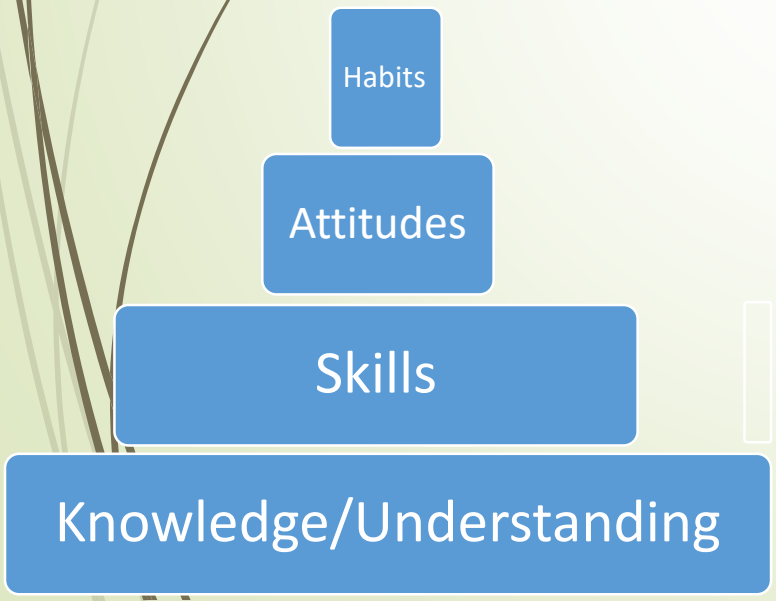


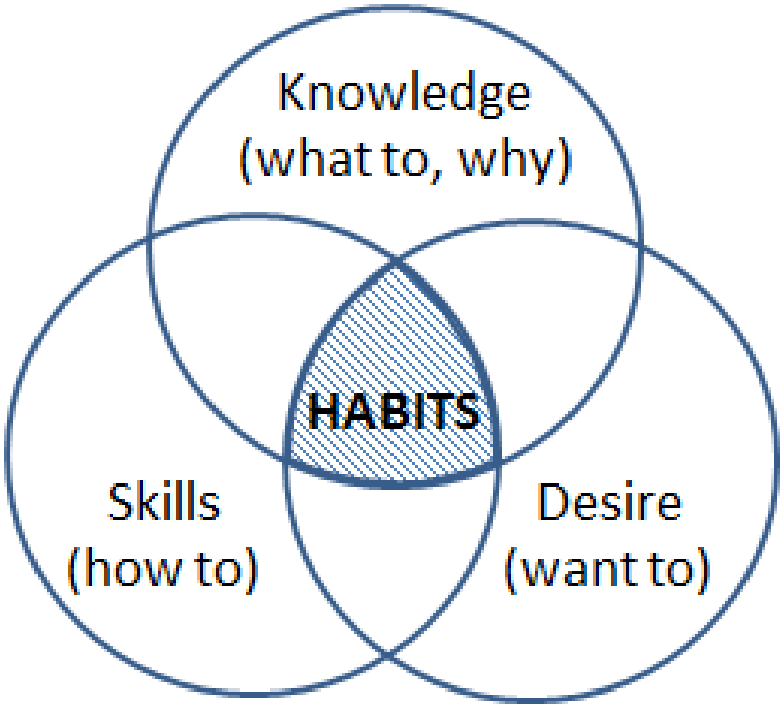
Definition of Learning

Facilitating *durable learning* depends on changing attitudes and forming new habits. (You only keep what you value and use regularly.)

Learning is Forming New Habits

- Fueled by attitudes and desires (emotion)
- Supported by skills and understanding

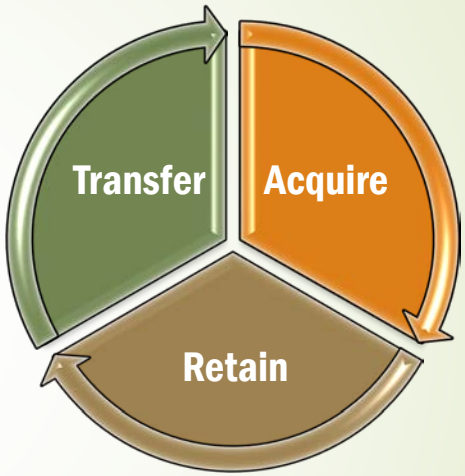




Stephen R. Covey, *The 7 Habits of Highly Effective People*

Step 3: The ART of Learning

- **A** Acquire new material
- **R** Retain new material
- **T** Transfer use of new material

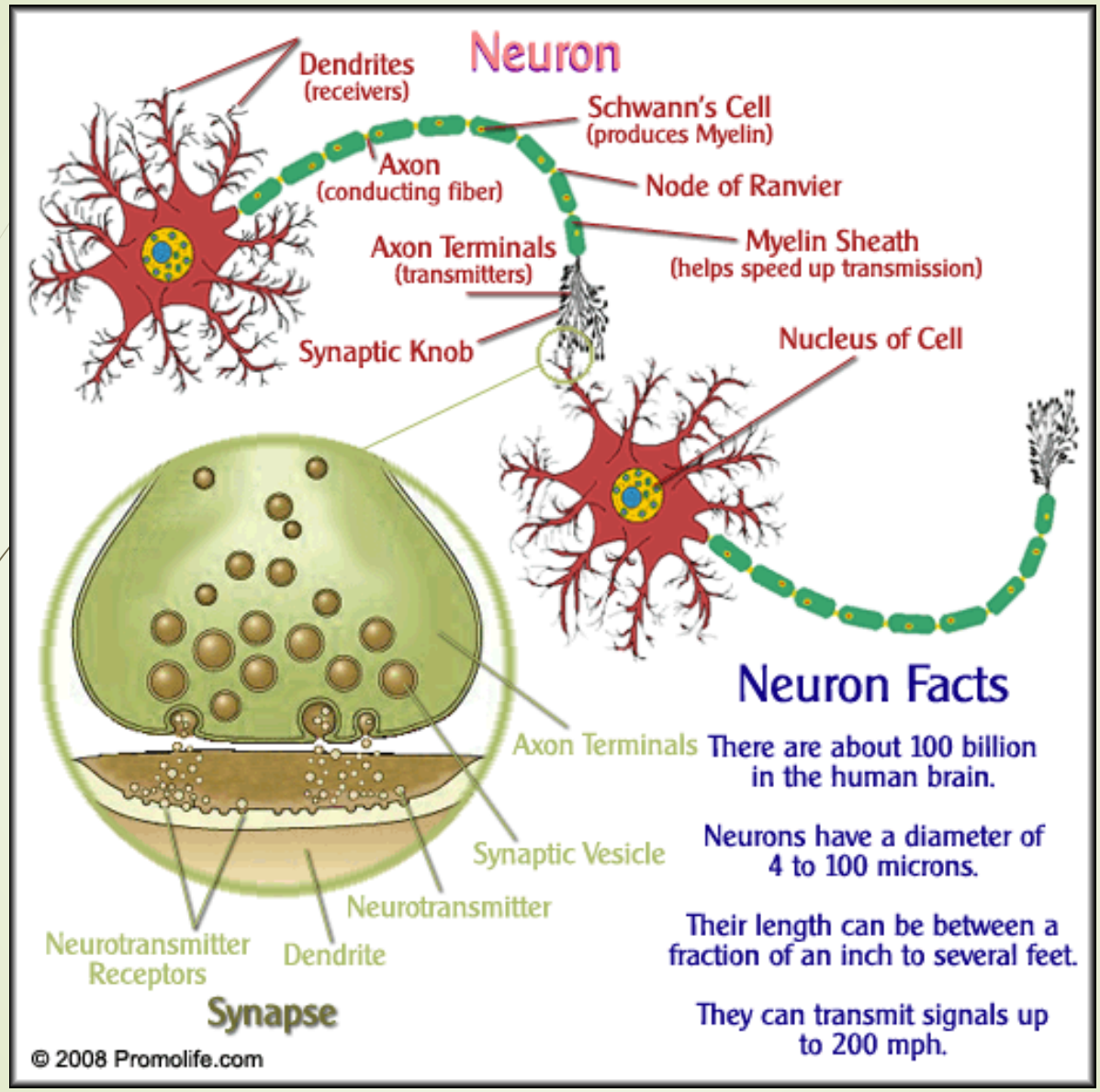


The ART of Learning.

The **A** in ART is for **Acquisition**

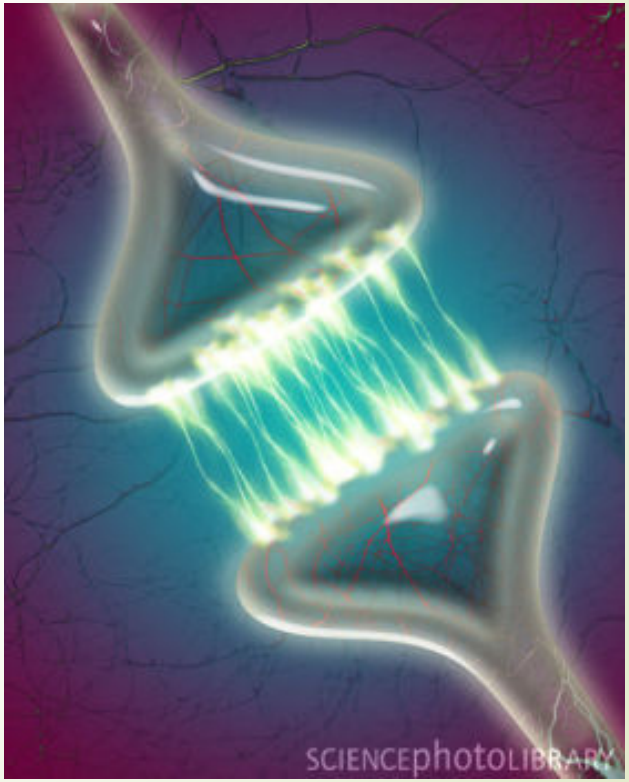
Mnemonic:

Actively
Build
Connections


Neuron
Dendrites
(receivers)
Schwann's Cell
(produces Myelin)
Axon
(conducting fiber)
Node of Ranvier
Axon Terminals
(transmitters)
Myelin Sheath
(helps speed up transmission)
Synaptic Knob
Nucleus of Cell
Neuron Facts
There are about 100 billion in the human brain.
Neurons have a diameter of 4 to 100 microns.
Their length can be between a fraction of an inch to several feet.
They can transmit signals up to 200 mph.
Axon Terminals
Synaptic Vesicle
Neurotransmitter
Neurotransmitter Receptors
Dendrite
Synapse
© 2008 Promolife.com

#1 Learning IS Making Connections

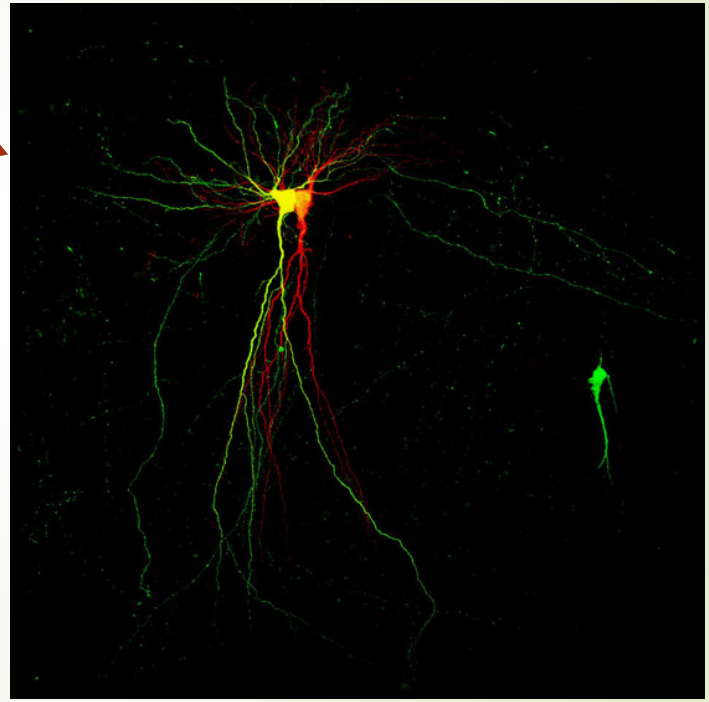
Learning ONLY happens when it is active and intentional.



Staying fully engaged is vital—you only learn when you are paying attention actively

Learning IS making connections: Neurons that fire together wire together

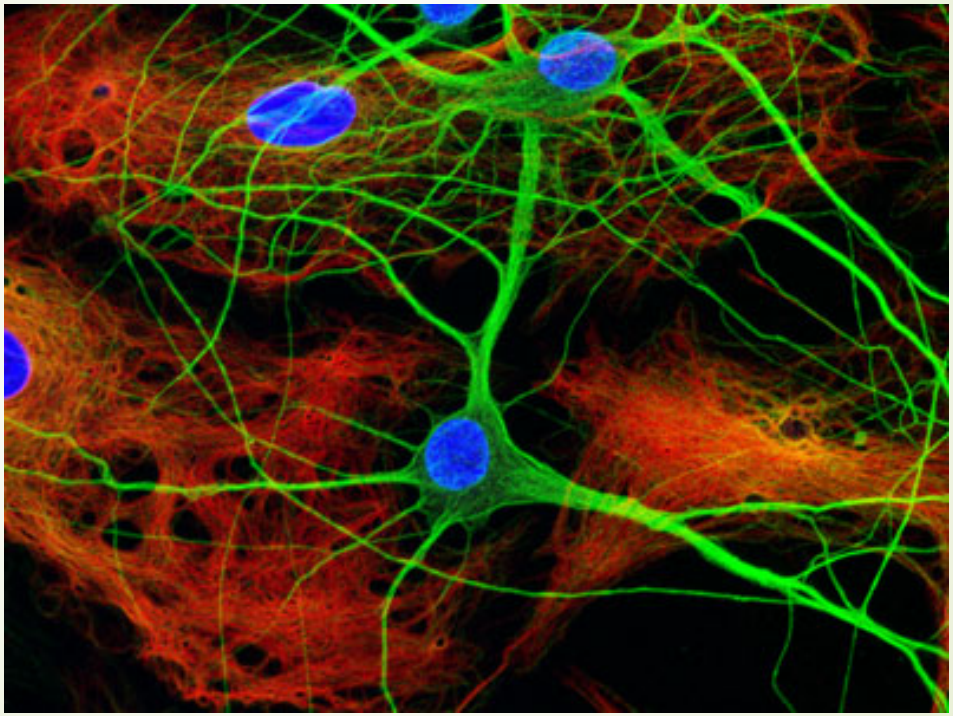
2 pyramidal neurons forming a synapse



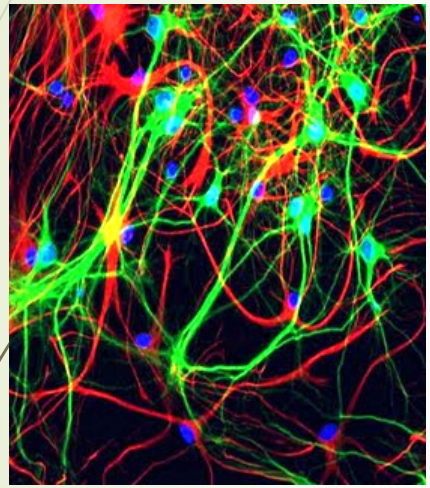
Focus on connecting new information to old (not on uptake of content).

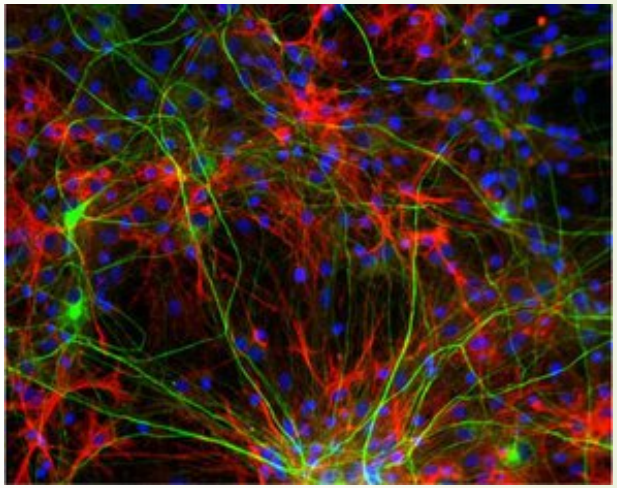
Analogies and mnemonics are the best way to learn!

Ideas are patterns of neural firing



More complex ideas are more complex patterns—made up of smaller patterns



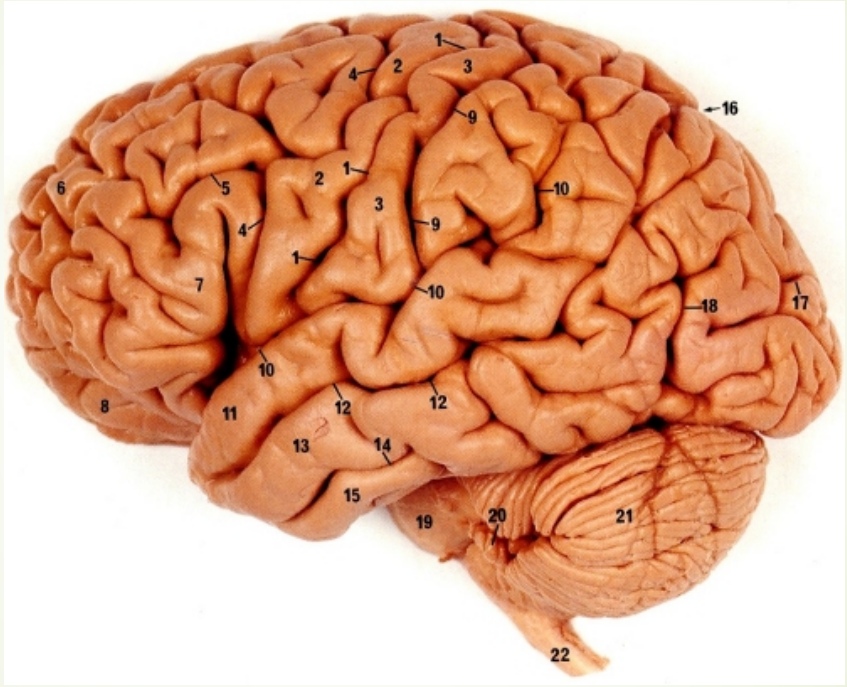


Focus on patterns and meaning, not on facts and information

#2 Learning Changes the Brain

A Basic Brain—not very fold-ey

A Better Brain—more fold-ey



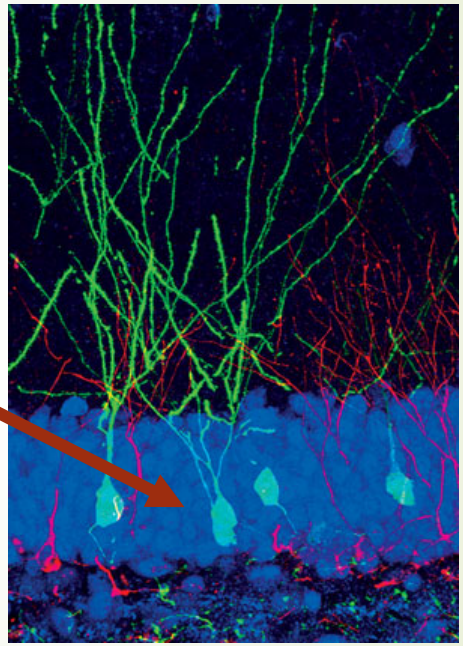
Make sure you learn something relevant every day
in every class session (to increase strength and plasticity)

Learning Increases Brain Plasticity

- Therefore we need to regularly experience sustained, challenging learning tasks
- The more we learn, the better learners we become
- Analogy: Learning is like building muscle or learning a foreign language (use it or lose it/working makes it stronger)

#3 Learning Hard Stuff Grows Your Brain

New Brain Cells Forming



Prefer the difficult path over the easy one: you'll learn more and feel better.

Learning works best when it is difficult

- Therefore, we must to seek challenge
- Always prefer the difficult over the routine or the easy
- Optimal learning occurs in “flow state”—midway between boredom and anxiety
- Analogy: crosswords and sudokus

Rekindle your love of learning by figuring out optimal levels of challenge

Step 3: The ART of Learning

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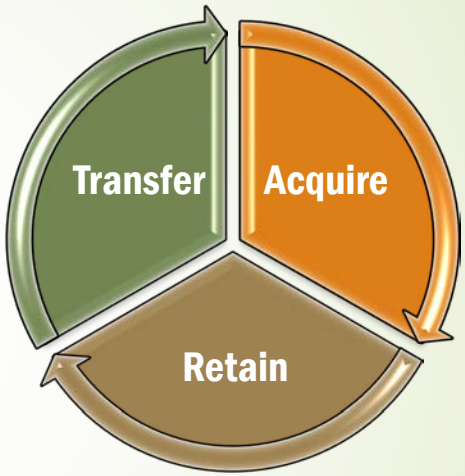


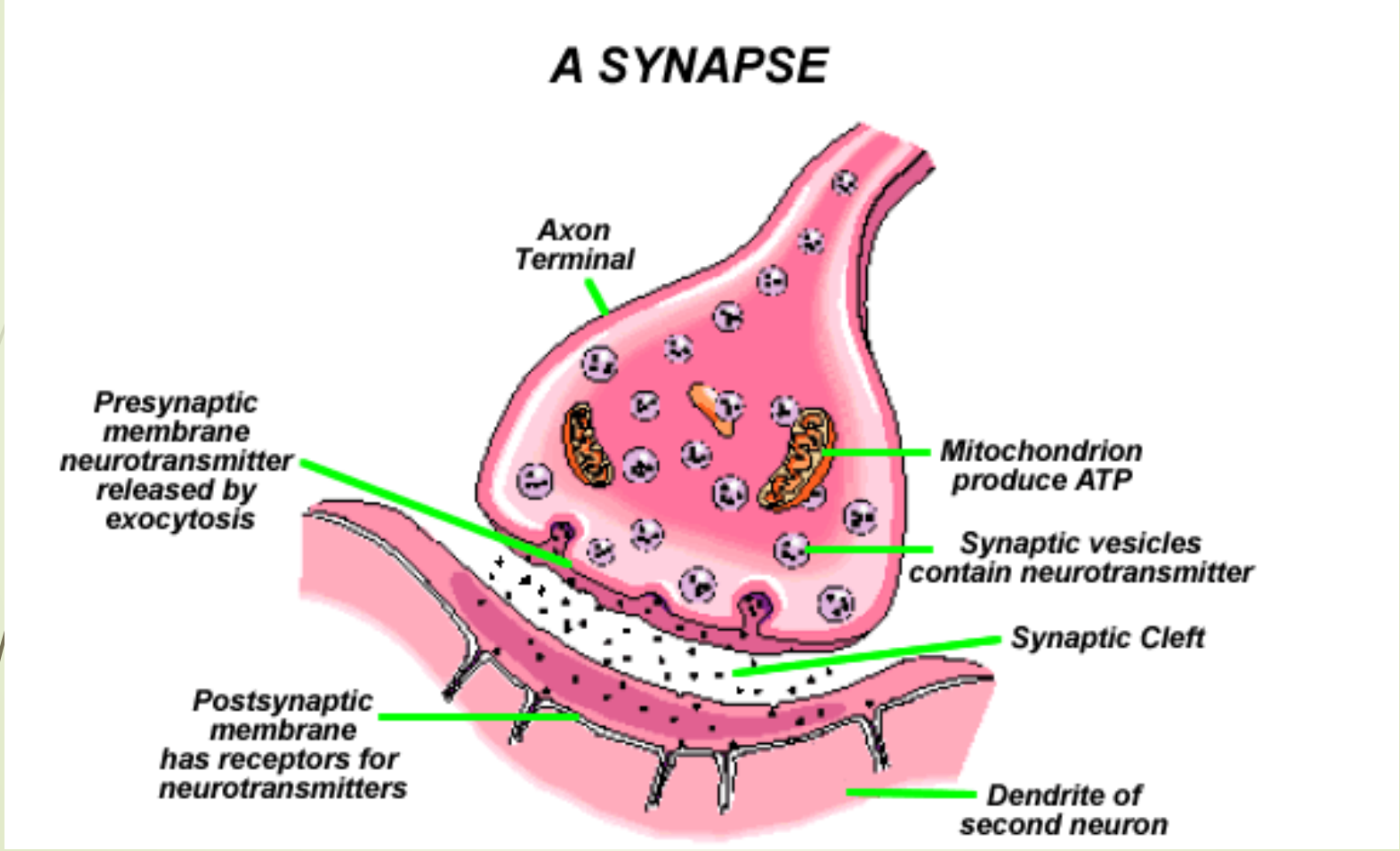
The ART of Learning

The R in ART is for RETAIN (Acronym)

- Repetition,
- Emotion,

- Test,
- Analyze,
- INtegrate.

Retention is controlled by Repetition and Chemistry



Repetition

- Review before sleep to encode memories
- Review within 24 hours to solidify learning
- Make review a regular part of classroom activity
  - Daily review at start of class
  - Daily summaries at end of class
- Review summaries offline on a regular basis
- **Classroom mantras**

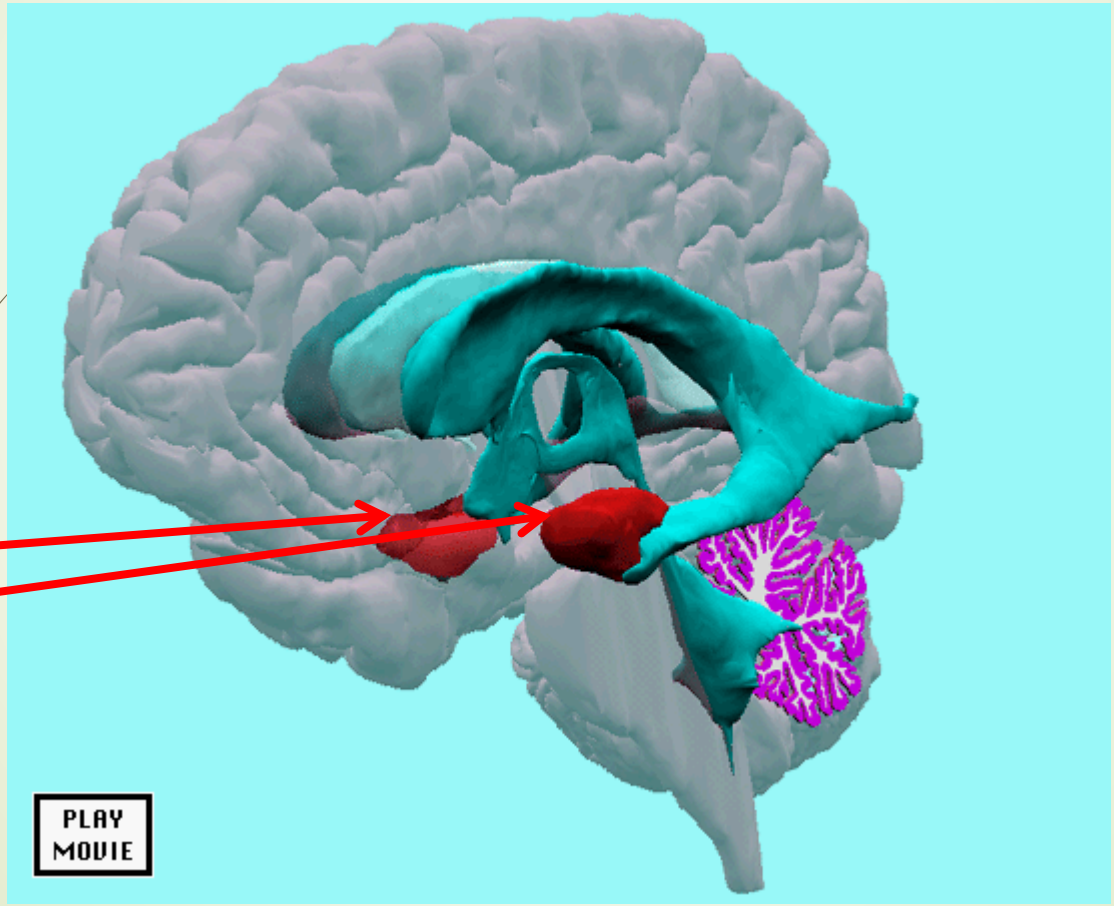
Repeated review is ***necessary*** for habit formation and transfer (it's also the best way to study)

Emotion

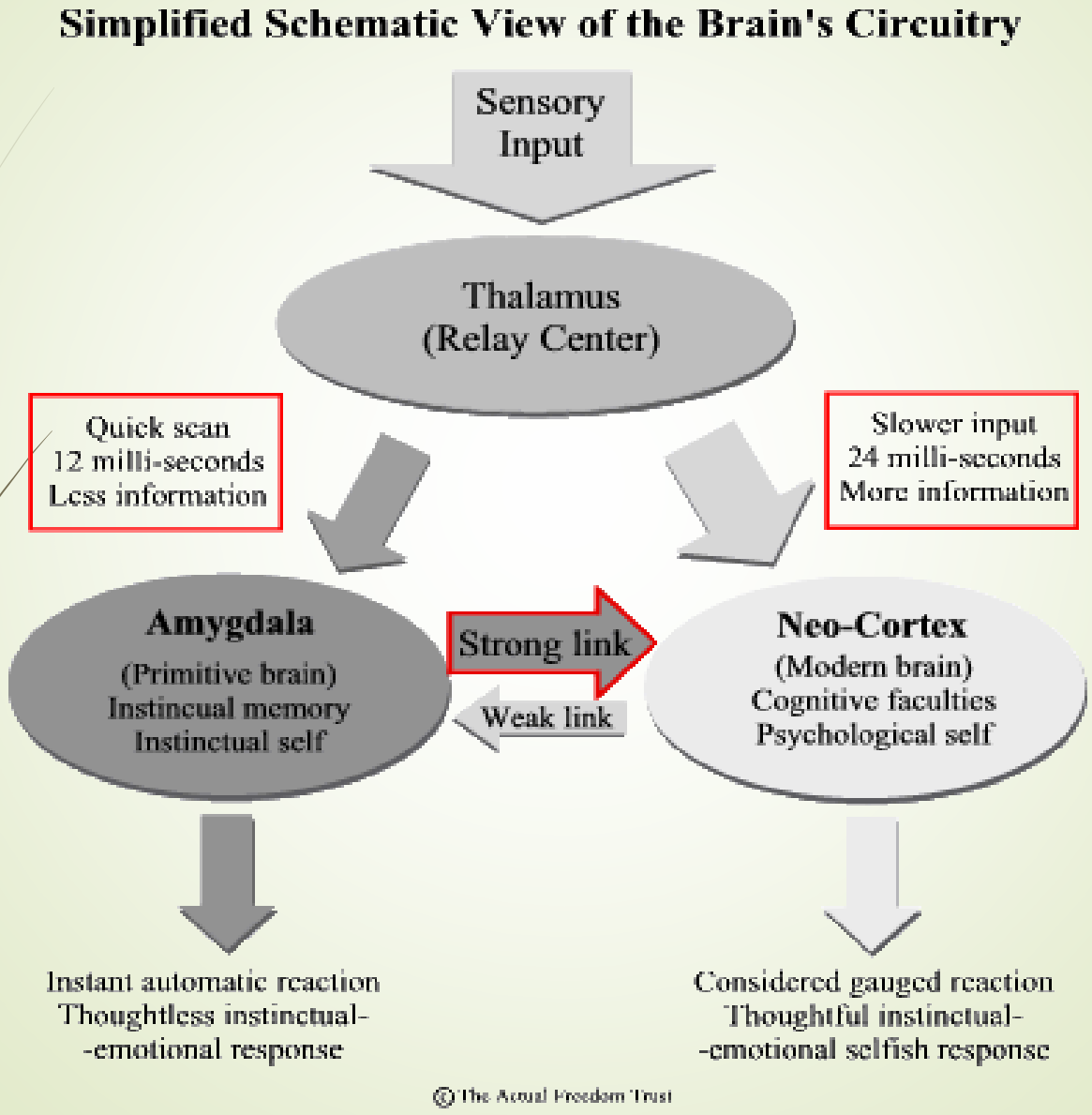
- Most powerful determinant of memory
  - Emotions control connection-formation (acquisition)
  - And ability to recall what was learned
- Negative emotions (especially fear and stress) block the ability to learn and to recall
- Positive emotions enhance engagement, motivation and retention of what was learned

Manage your emotions to create an environment conducive to learning

Emotion and chemistry: Your amygdalas



Emotion: Fear response



The Power of Emotions

VS.

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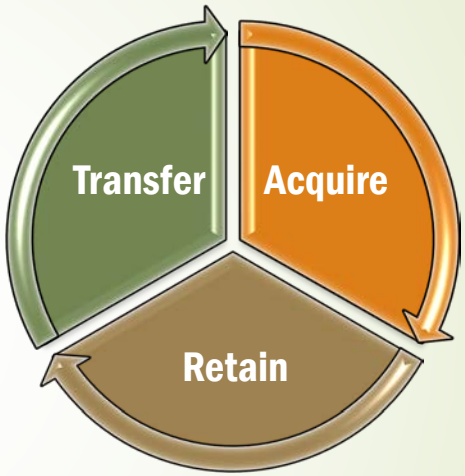


The ART of Learning

T is for Transfer (Bus transfer, job transfer)

Transfer applies what you know in a new context or to a new type of problem

Teaching for Transfer

- Transfer depends on pattern recognition and changing set
- It is the most difficult part of learning

  … and the least practiced!
- Students need to practice as much as possible

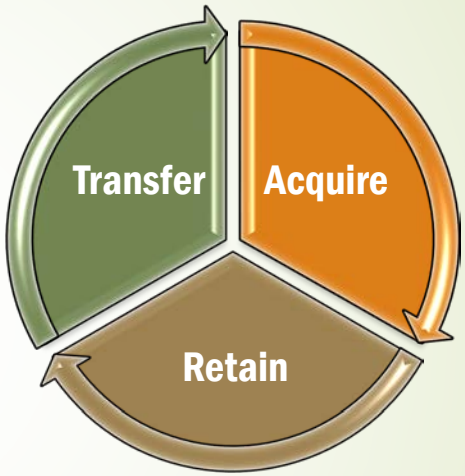
Practice transfer explicitly and consciously—in class and out

The ART of Learning: Habits of Transfer

- Pattern recognition
- Lateral thinking
- Looking for analogies, metaphors
- Classroom mantras

Step 3: The ART of Learning

- **A** Acquire new material
- **R** Retain new material
- **T** Transfer use of new material



Write your summaries

3-5 sentences

in 2 minutes

Evidence MetaLearning Works

	Control	Metalearners (Jr)	Metalearners (Sr)
Dean's List (top 10% of class)	10%	40%	45%
Honor societies	X		3.2X
Campus Leadership positions	X	2.7X	

Thank You!

Write your summaries

3-5 sentences

in 2 minutes

Scarroll@scu.edu

Thank You!

Write your summaries:
(What did you learn?)
3-5 sentences
in 3-5 minutes

scarroll@scu.edu