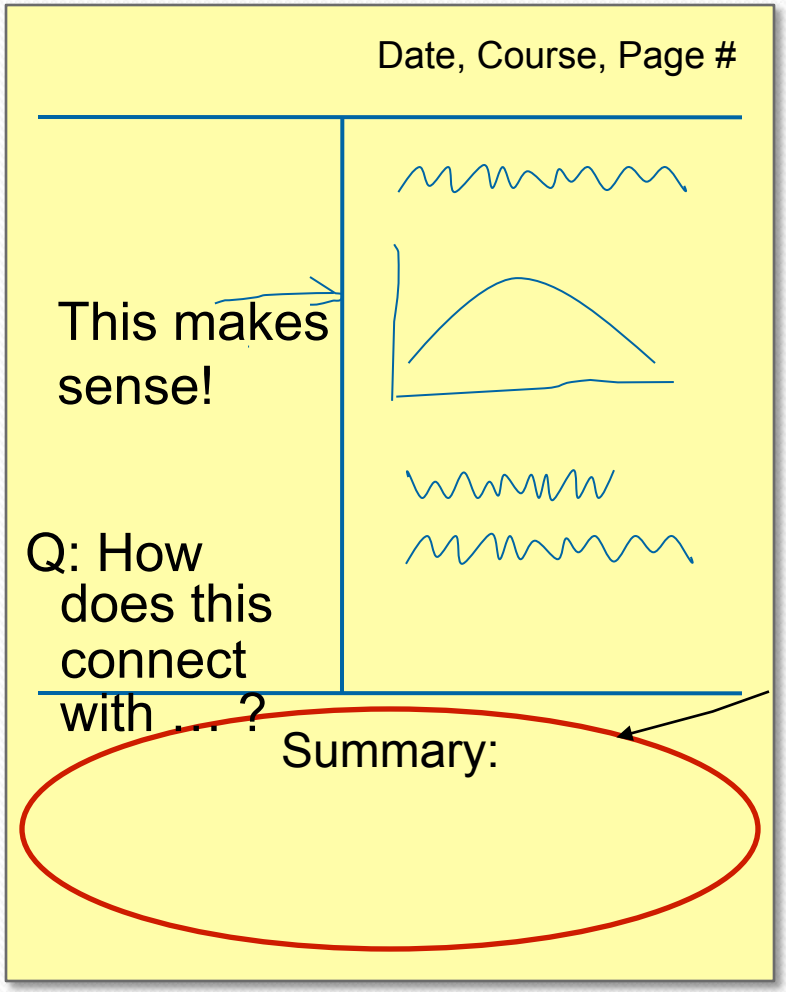
How we Know the SENCER Approach to Learning Works

CBSCI Regional Meeting ~ 2013

Stephen Carroll, PhD

Notes You Can Use

Thoughts & feelings that arise



Notes on what's being presented

Summary Reflections:
ASAP – *before sleeping*

What's worth reviewing & remembering?

For Best Results:
Review Summary within 24 hours

Framing our Problem: Two Visions of Students Today

The 5-Minute University

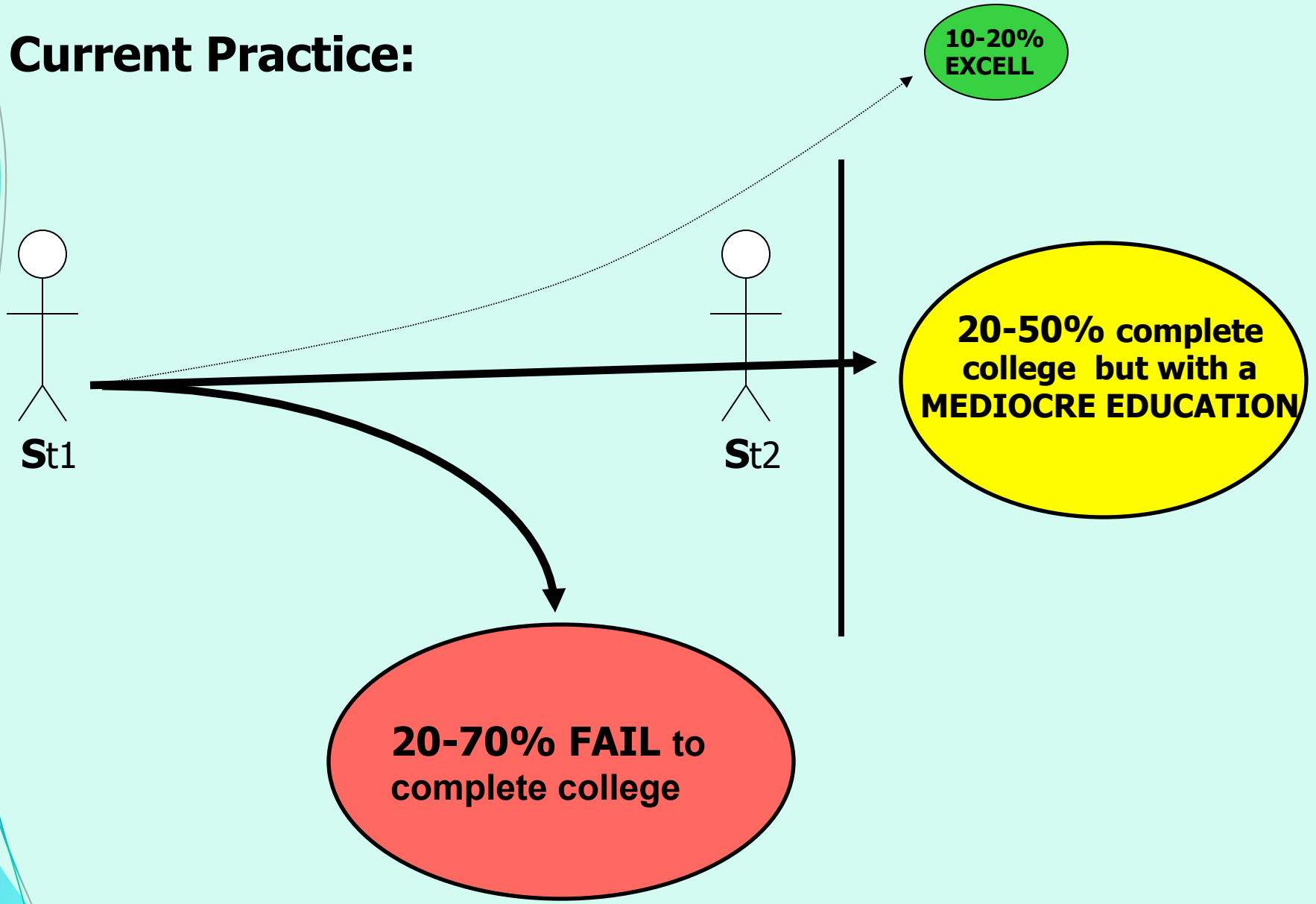
A Vision of Students Today

The Problem:

- **PASSIVE LEARNING** (an oxymoron)
- Habits of learning students developed in high school aim at lower-level thinking skills and encourage passive, dependent learning.
- In college those learning habits don't work well.
- Habits of passive learning create motivation and engagement problems that further erode students' academic performance—and learning.

Consequences of Passive, Dependent Learning

Current Practice:

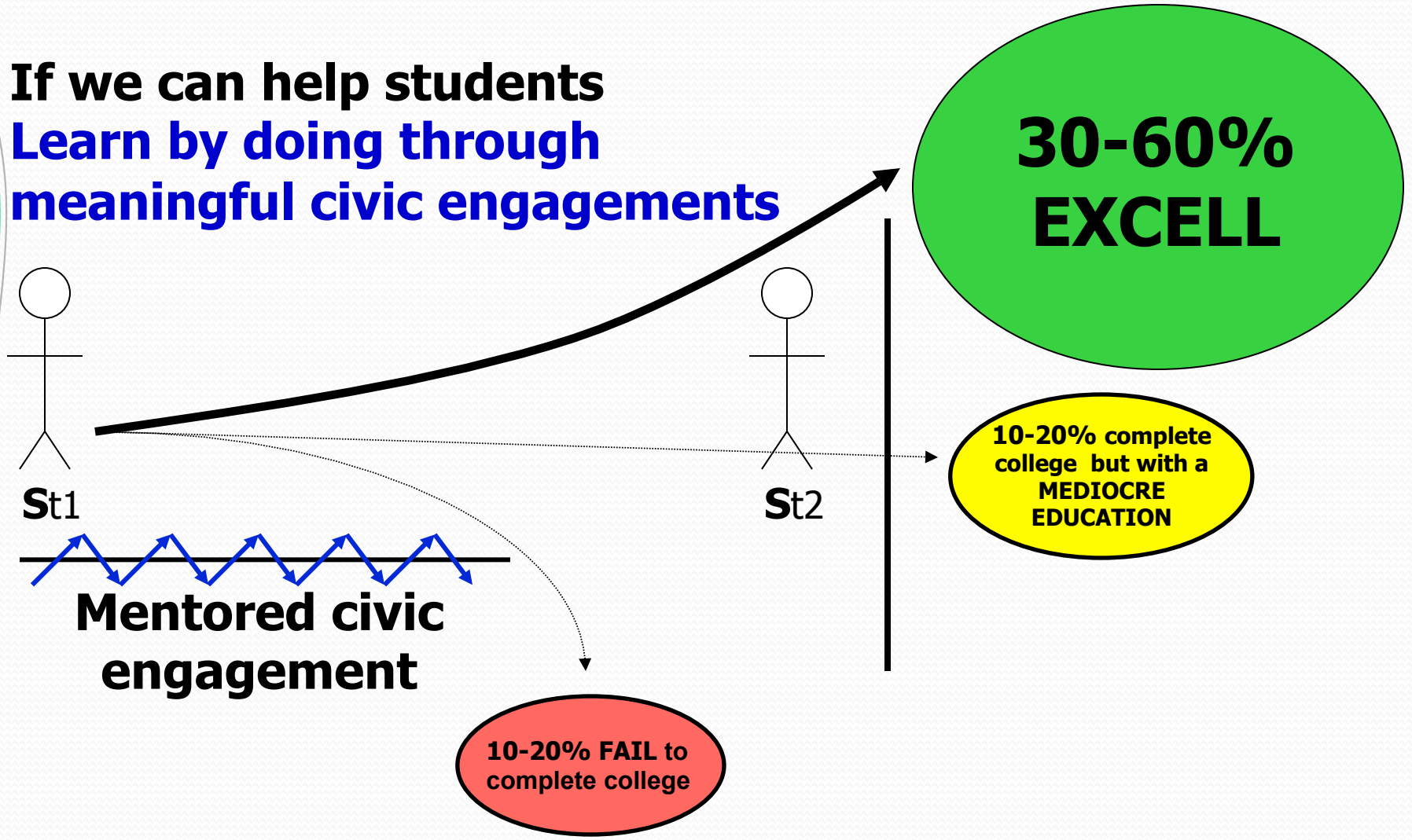


One Solution: Civic Engagement

- Teach students ***how to learn actively***—to learn by doing
  - Show them how to learn by themselves, for themselves
  - Improve learning and academic performance
  - Increase students' motivation and engagement
  - Make them more successful inside and outside class

One Solution: Civic Engagement

If we can help students
Learn by doing through meaningful civic engagements



Objectives for Today

- Investigate our own epistemologies of learning
- Learn a few basic principles of how learning works
- Consider civic engagement as a

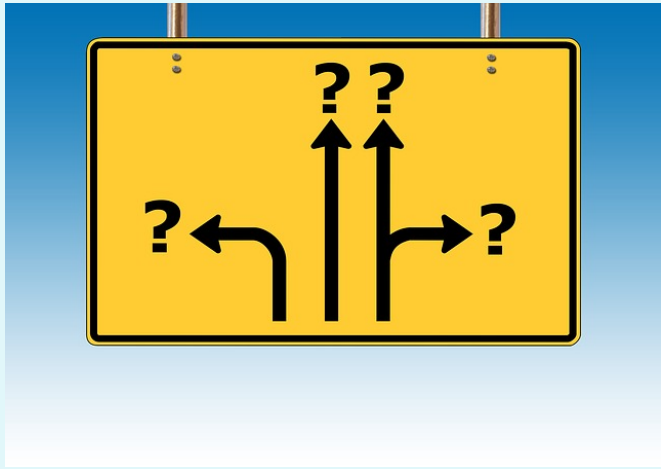
  learning accelerator

- Motivate you to develop civic engagement-based learning objectives and pedagogy

Epistemology of Learning

What is learning?

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



Typical Answers - Understanding

- Knowing something
- Understanding something
- Being able to teach something
- Getting it
- Eureka!
- Making a connection to something new
- Insight
- Discovery
- Enlightenment
- Knowing that (vs. knowing how)
- Memorizing
- Being able to recall
- Remembering something
- Understanding the principles
- Seeing the logic
- Being able to extrapolate
- Seeing how it works
- Epiphany

Typical Answers - Skills

- Being able to do something
- Knowing how
- Facility
- Doing it
- Mastering a procedure or process
- Increasing level of proficiency
- Following correct procedures
- Being able to use what I know
- Being able to apply something in a new situation
- Acquiring the knack of something
- Gains in craftsmanship
- Getting better at something

Typical Answers - Affective

- Learning to like something
- Getting engaged
- Being inspired
- Being motivated
- Finding joy
- Wanting to do more
- Wanting to practice
- Looking for chances to use what I know
- Learning to love something
- Learning to see the beauty or complexity or artistry in something
- Learning to appreciate something
- Gaining confidence
- Becoming more interested in something

Typical Answers – Habits/ Integrations

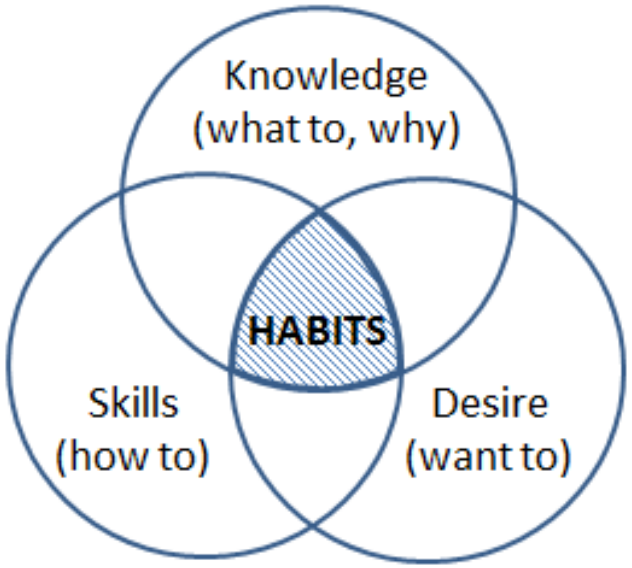
- Integrating what I know into my life
- Being able to do something without paying a lot of attention
- Doing things automatically
- Using what I know as a matter of course
- Knowing when to use what I've learned
- Ability to improvise based on what I already know

Epistemology of Learning

Facilitating *durable learning* depends on changing students' attitudes in ways that motivate them to form new habits of using what you have taught them.

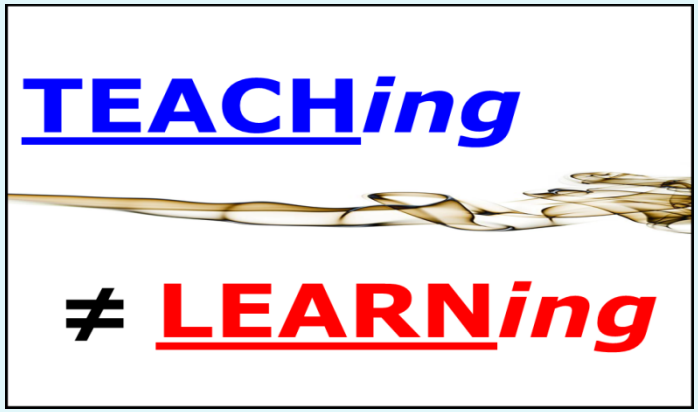
Learning is Forming New Habits

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



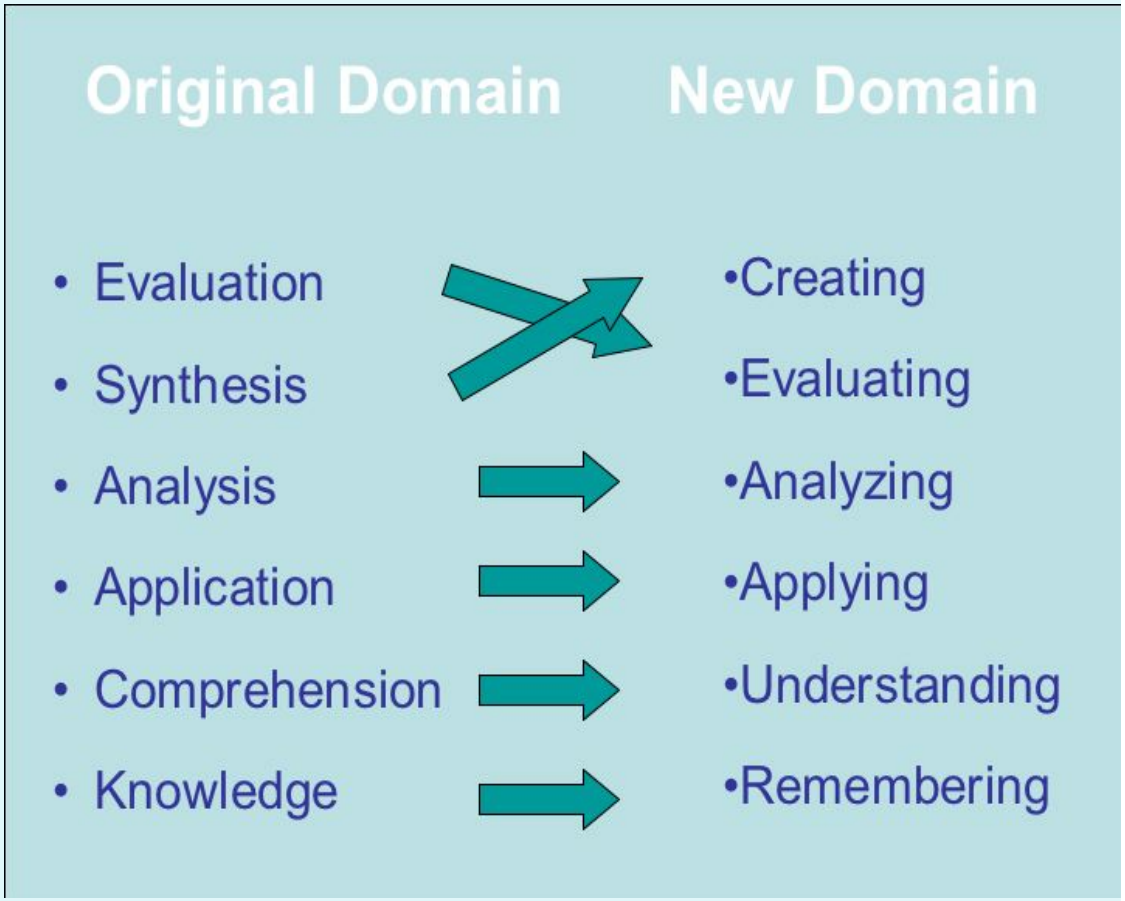
Epistemology of Learning

How we define *learning* affects how we teach and shapes how students learn in our classes far more than how we define teaching or what we say about our goals.



Try this Experiment

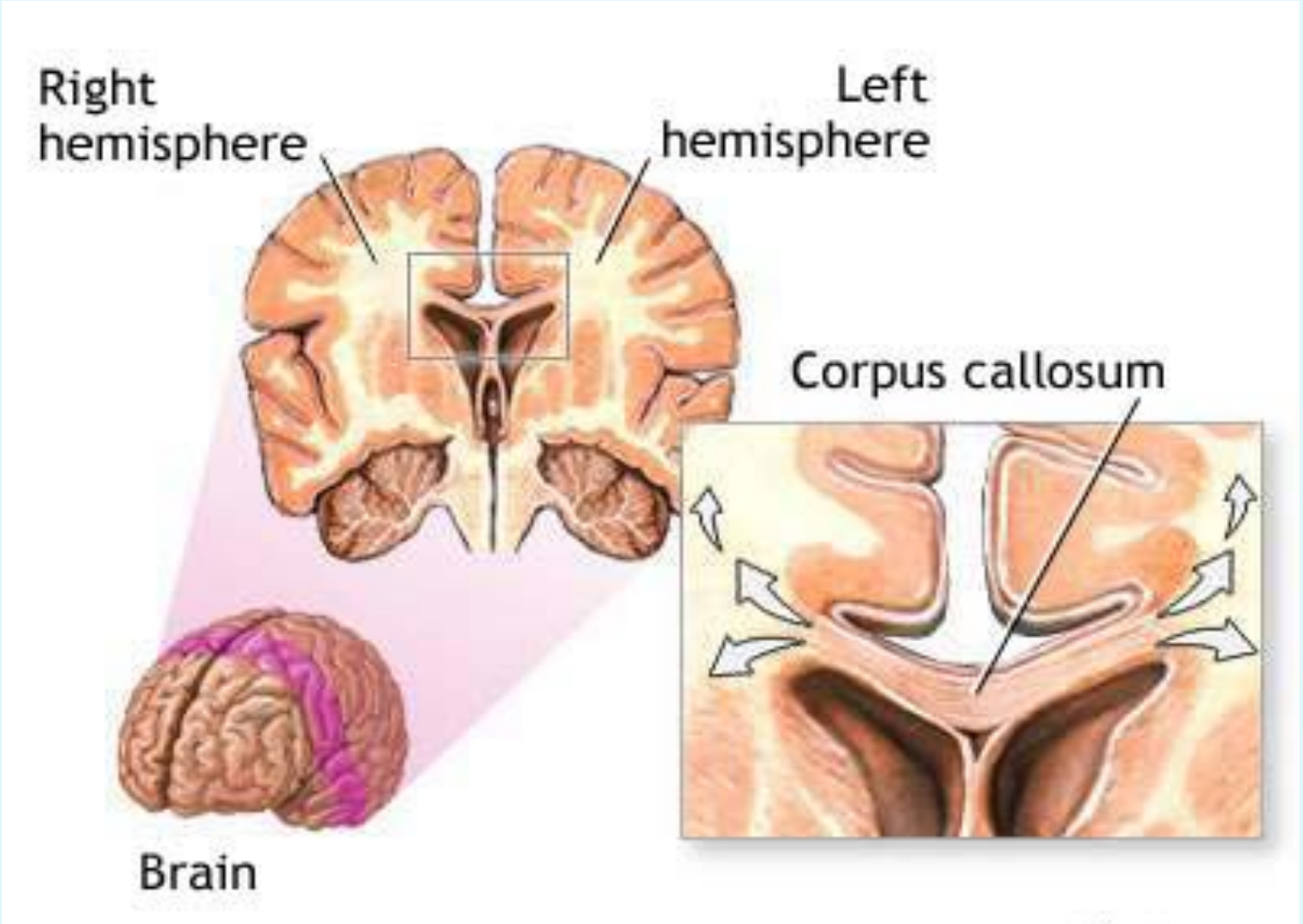
Rank your course learning objectives using Bloom's Taxonomy: What do you want your students to be able to do at the end of your course?



Try this Experiment

- Then ask your students to use a list of verbs correlated with that taxonomy to evaluate where your teaching focuses.
- If what they say doesn't match what you intend, your teaching isn't aligned with your learning objectives.

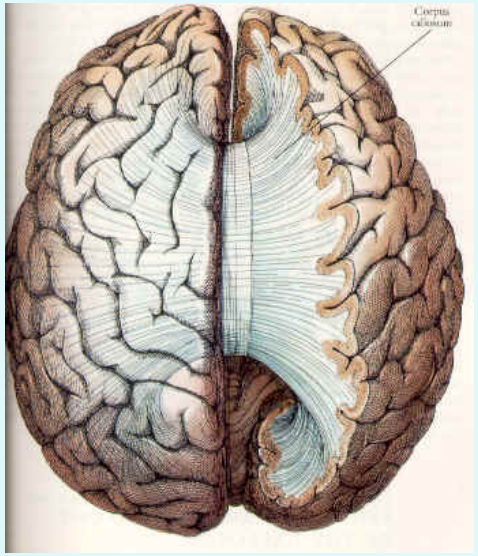
A Cross-lateral Neurobic



Cross-lateral Activity

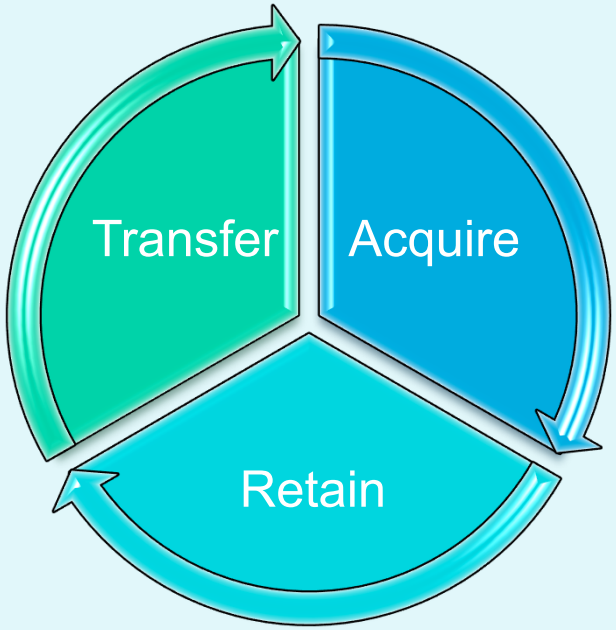
Cross-lateral activity opens up the corpus callosum

- Gets more of your brain involved
- Balances the load
- Aids memory
- Makes learning easier



The ART of Learning

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

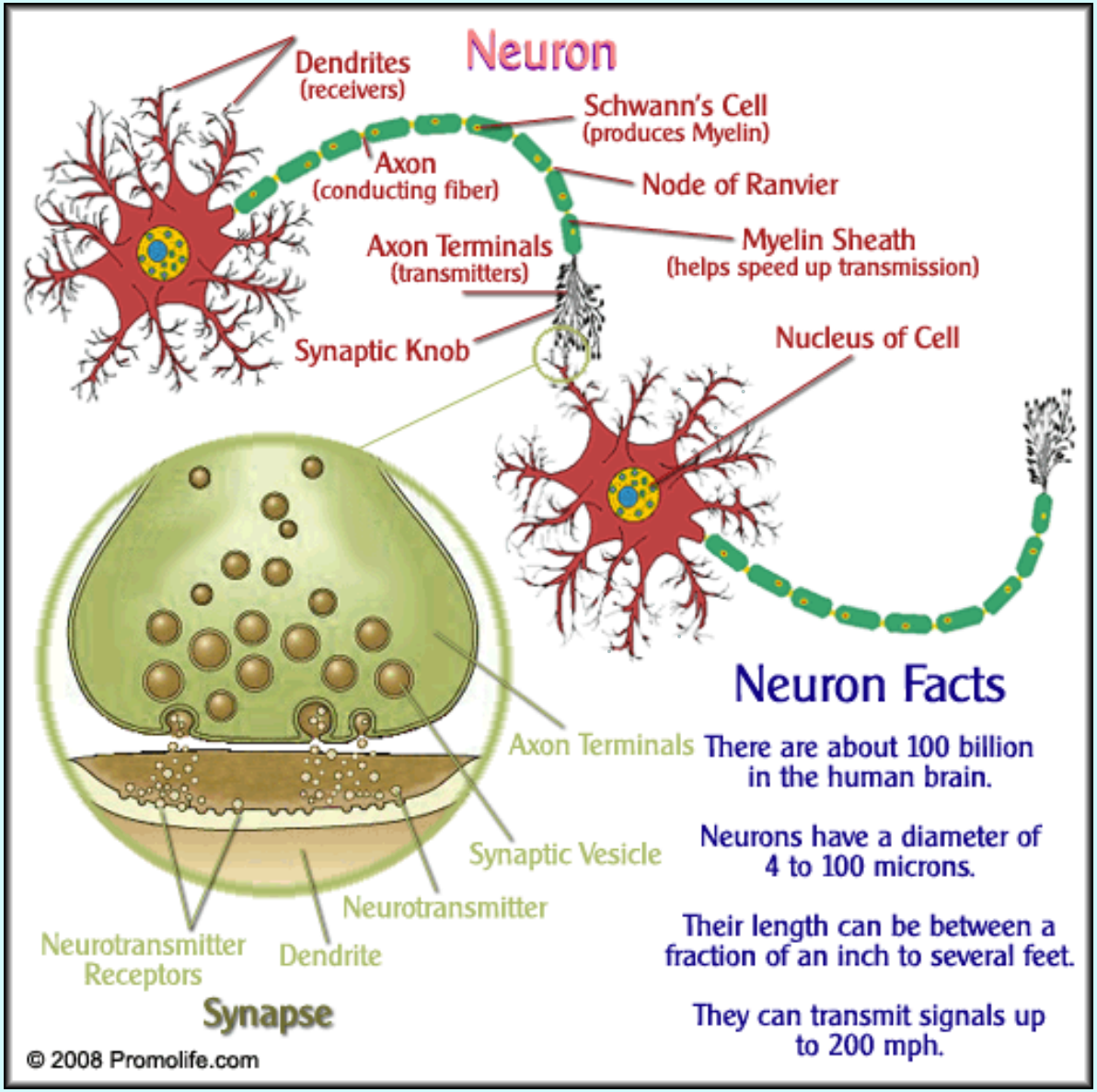


The ART of Learning.

The A in ART is for **Acquisition**

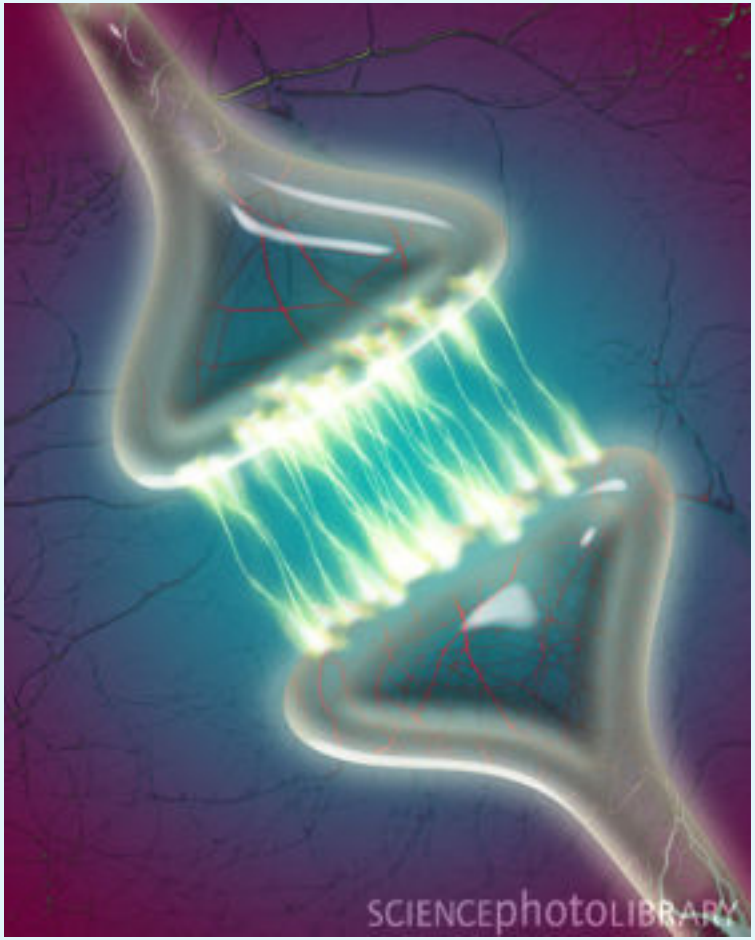
Mnemonic:

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
Axon Terminals
Synaptic Vesicle
Neurotransmitter
Neurotransmitter
Receptors
Dendrite
Synapse
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.
© 2008 Promolife.com

Learning IS Making Connections

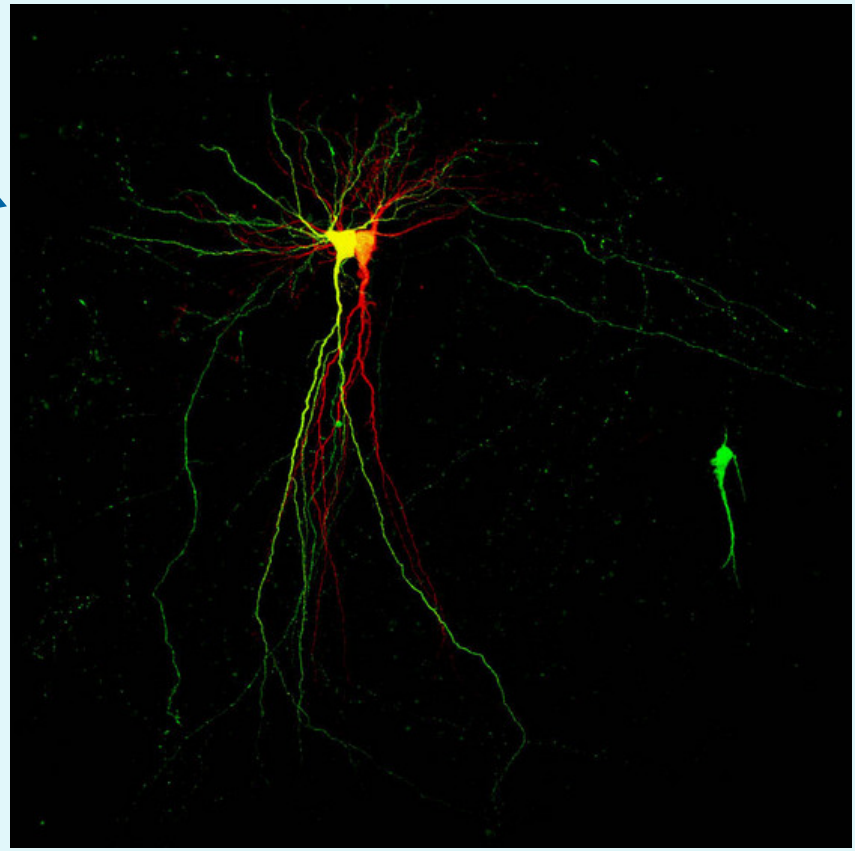
Learning ONLY happens when it is active and intentional, so keeping students engaged is vital



Learning is making connections:

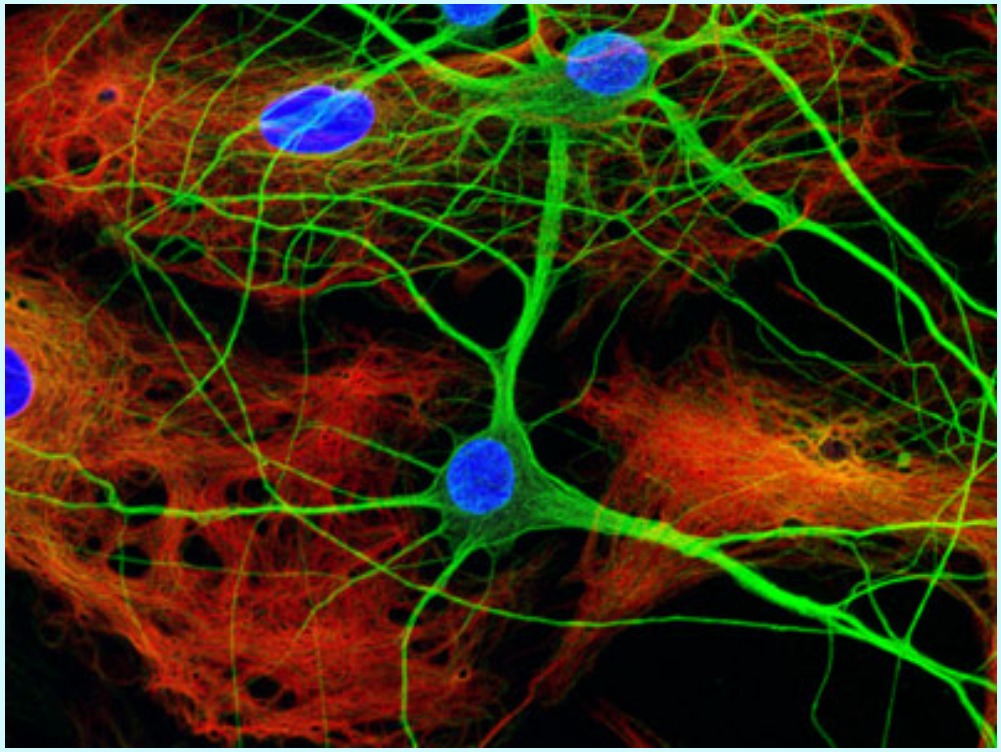
Neurons that fire together wire together

2 pyramidal neurons forming a synapse

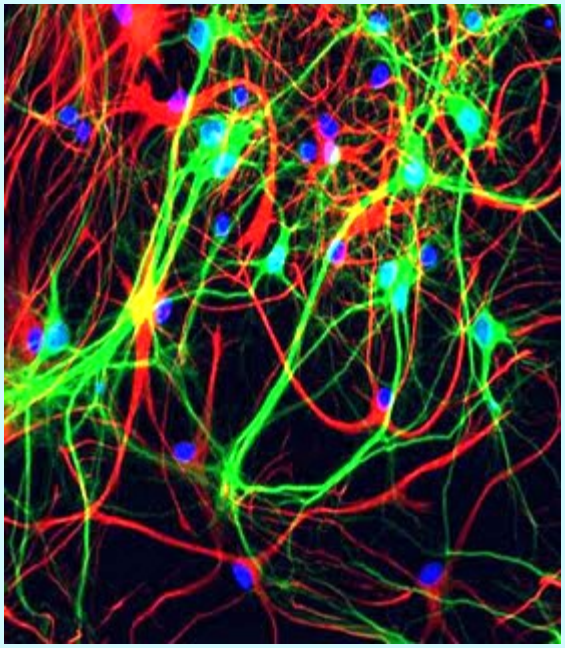


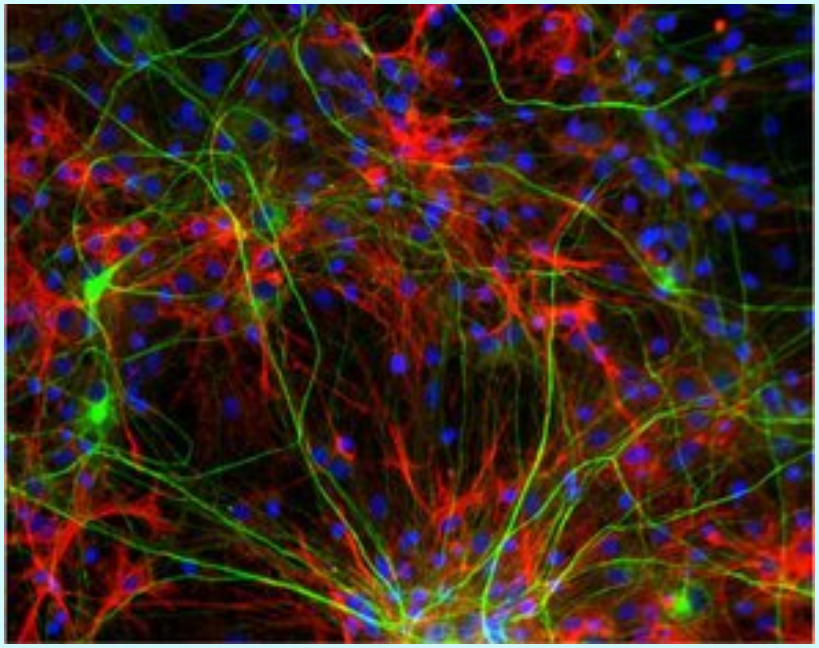
Focus teaching on helping students connect new information to old (not on uptake of content)

Ideas are patterns of neural firing



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





Focus teaching on patterns and meaning, not on facts and information

Learning IS Making Connections

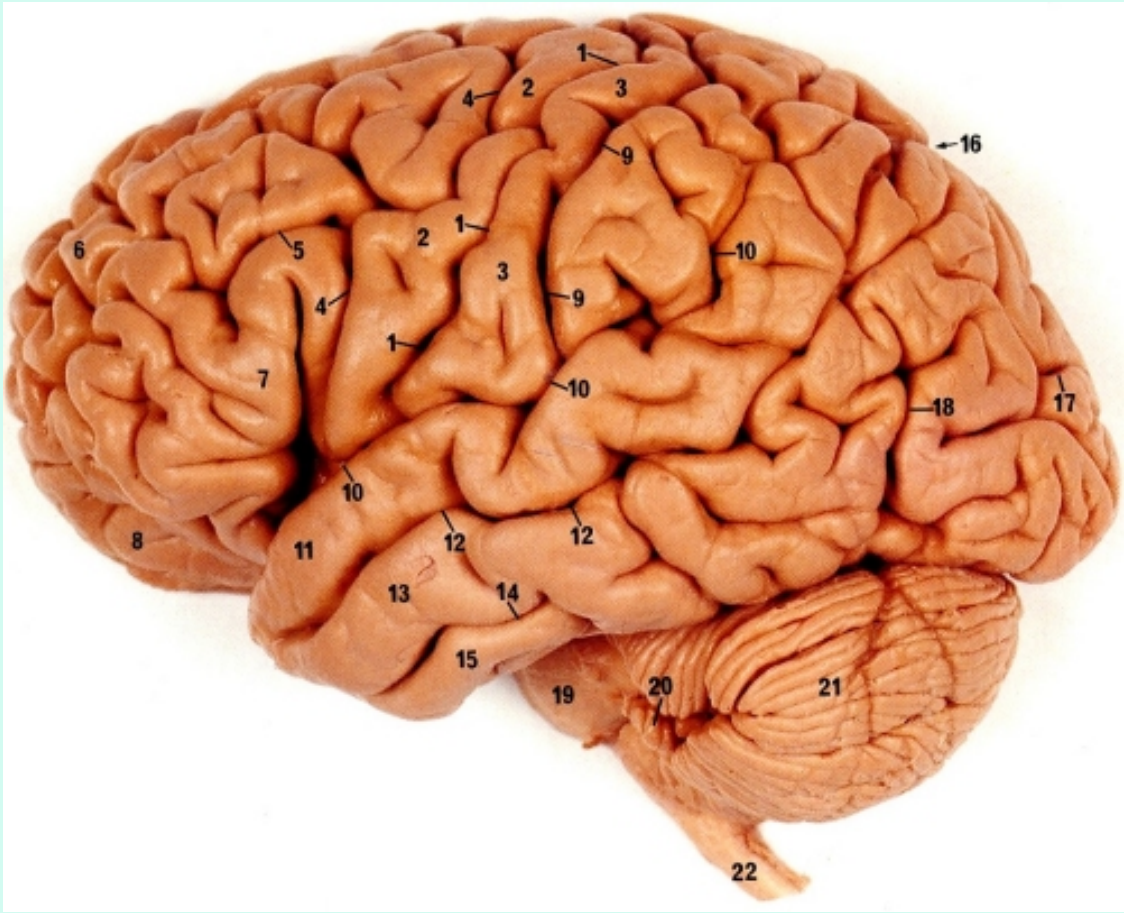
- Learning has the physical and metaphorical structure of an analogy.
- Therefore we must teach analogically, not *de novo.*
- “Nothing we learn can stand in isolation; we can sustain new learning only to the degree we can relate it to what we already know.” (Sci Am Mind, July 2010.)

Focus on helping students make connections between what they know and what they are trying to learn

Learning Changes the Brain

A Basic Brain—not very fold-ey

A Better Brain—more fold-ey



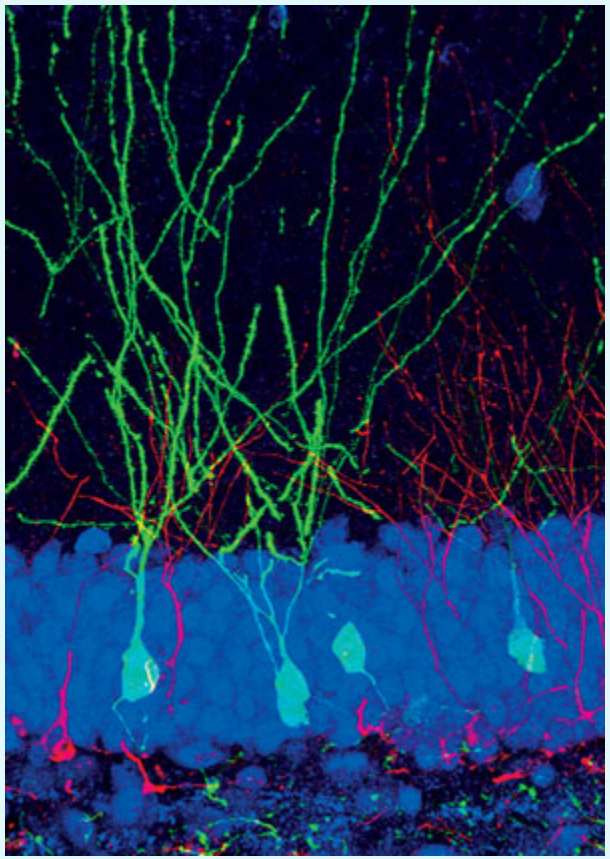
Make sure that relevant learning happens every day in every class session

Learning Increases Brain Plasticity

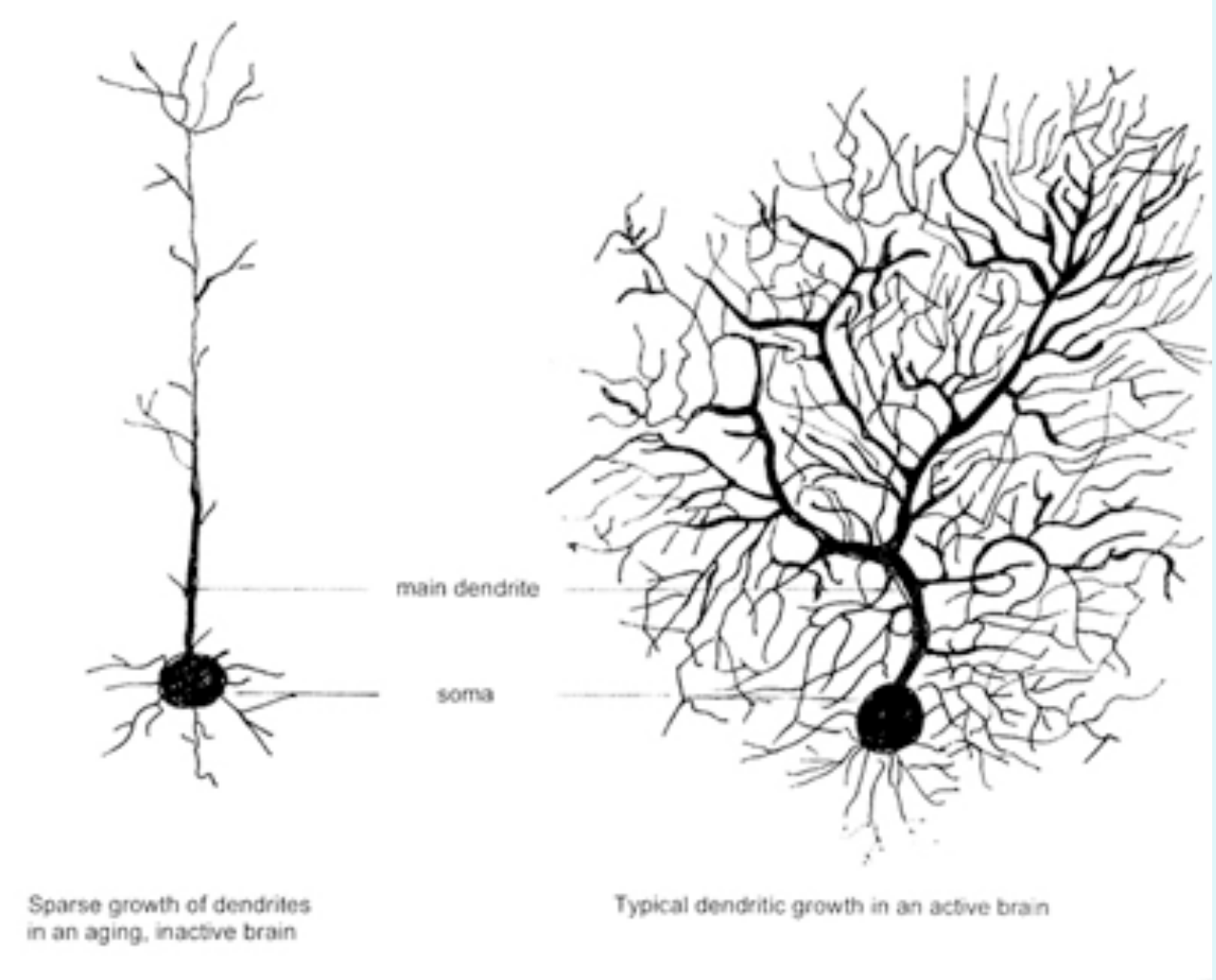
- Therefore we need our students to regularly experience sustained, challenging learning tasks
- The more they learn, the better learners they will become
- Analogy: Like building muscle or learning a foreign language (use it or lose it/working makes it stronger)

Learning Hard Stuff Grows Your Brain

New Brain Cells Forming



Learning Builds and Maintains Healthy Neurons



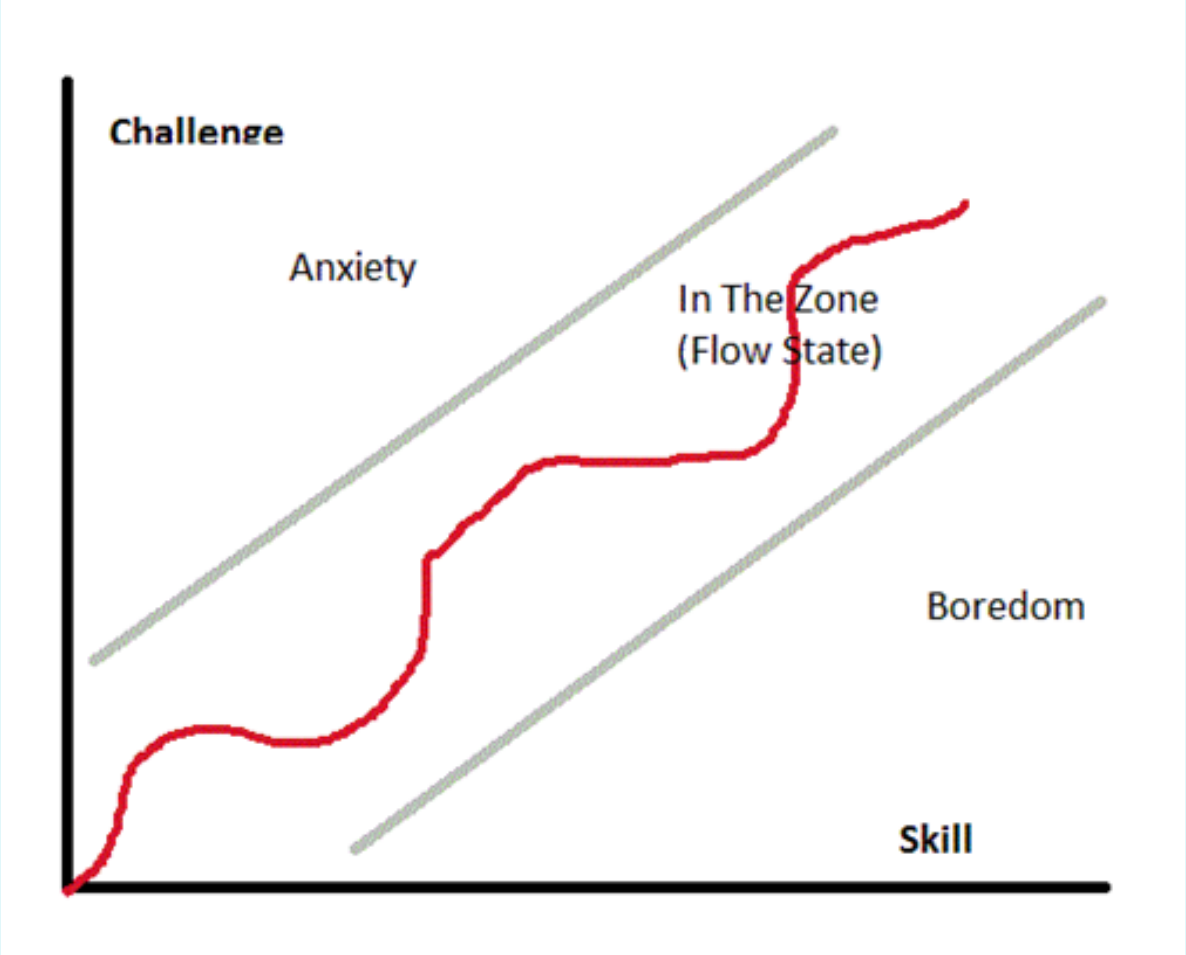
Vary students learning tasks so they practice multiple modes of learning

Learning works best when it is difficult

- Therefore, we must teach our students 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

Make sure that students are constantly challenged—but not overwhelmed

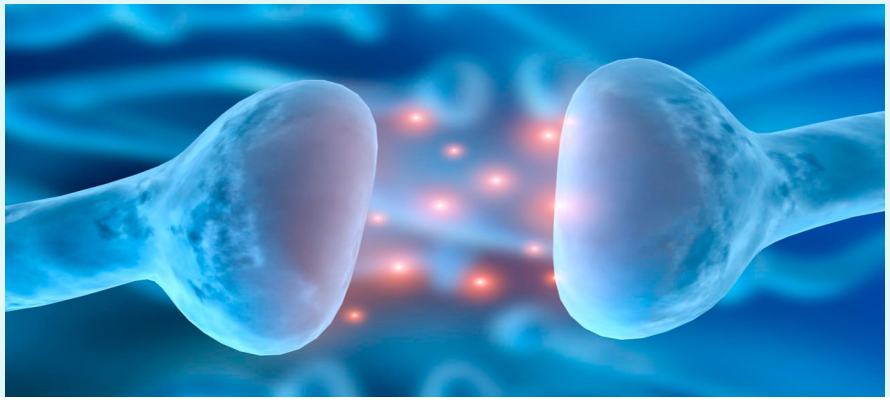
Difficulty Increases Engagement



Based on *Flow*, by Mihaly Csikszentmihalyi (2002)

Key Factors Shaping Acquisition

- Learning IS making connections
- Learning has the structure of an analogy: this is why analogies, metaphors, models, and mnemonics are so effective
- It is ALWAYS active and almost always intentional: it only happens when we are paying attention
- Positive engagement, motivation and emotions increase uptake



Civic Engagement and Acquisition

Learning by doing facilitates acquisition because it:

- is always active and intentional and immersive
- helps students connect what they know to what they are doing and learning
- helps students see the value and meaning of what they are learning (engagement and affective change)
- ensures relevant learning happens every day; it requires constant effort and provides always-appropriate challenge
- enriches the learning environment and the variety of learning tasks

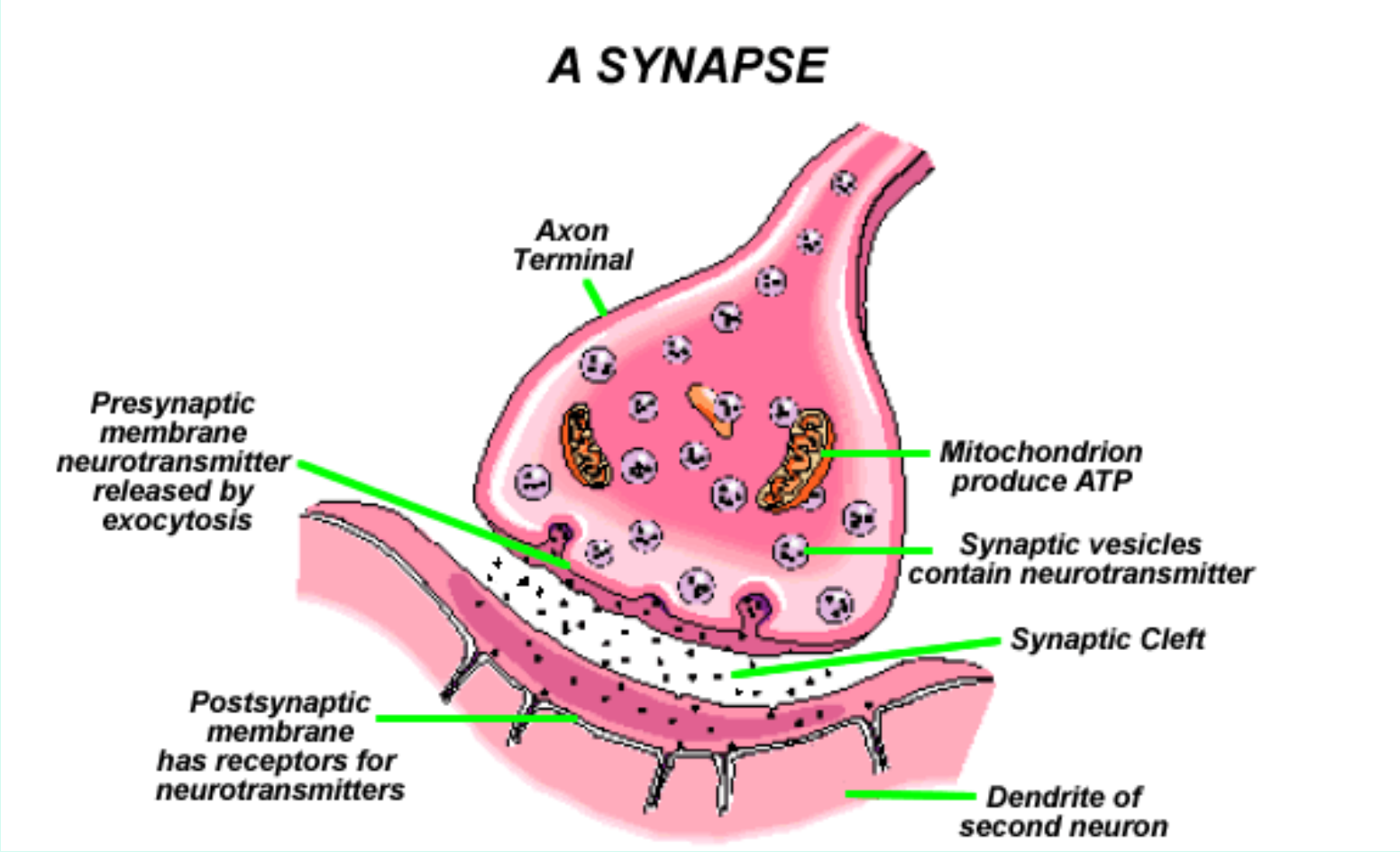
The ART of Learning

R is for RETAIN (Acronym)

- Repetition,
- Emotion,

- Test,
- Analyze,
- INtegrate.

Retention is controlled by Repetition and Chemistry



Repetition

- Repetition grooves the neural pathways
- Review before sleep to encode memories
- Review within 24 hours to move to long-term memory
- Make review a regular part of classroom activity
  - Daily review at start of class
  - Daily summaries at end of class
- Repeated low-stakes testing and distributed study are the best ways to learn

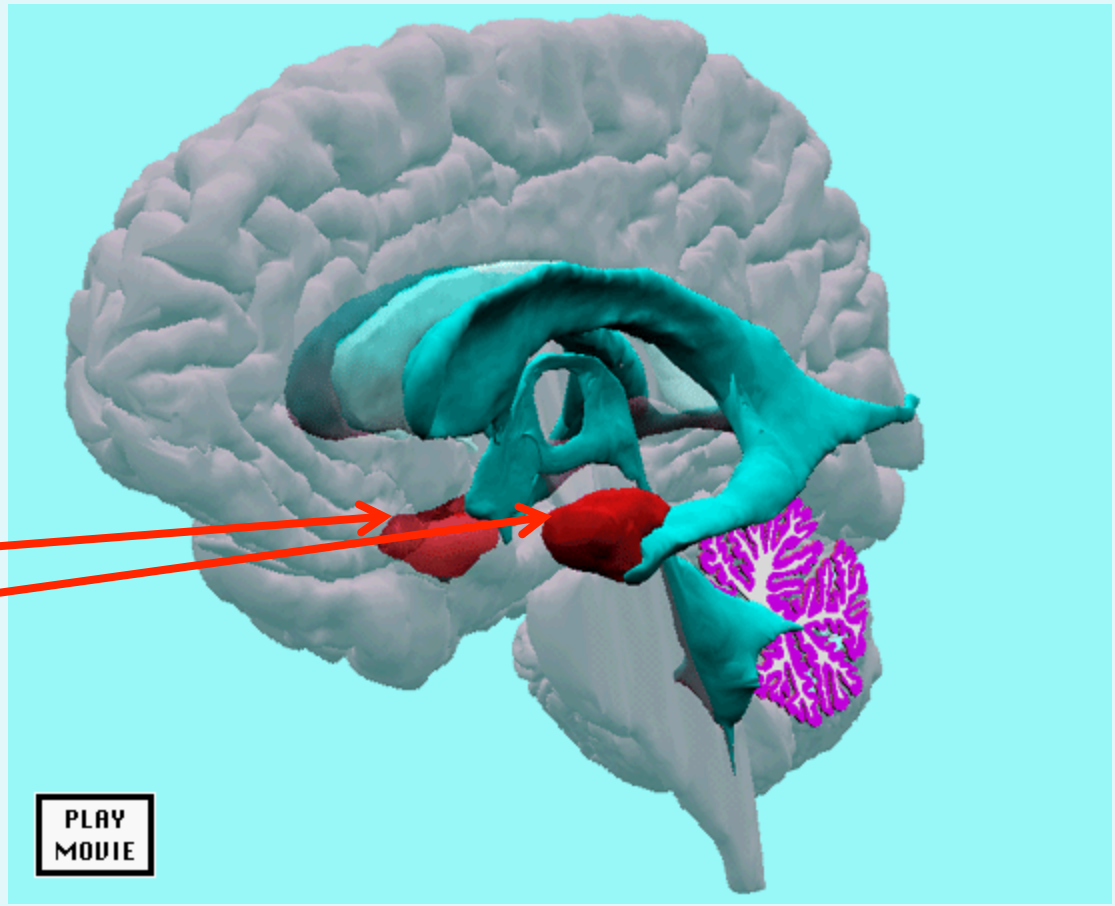
Repeated review is ***necessary*** for habit formation and transfer (it's also the best way to study)

Emotion

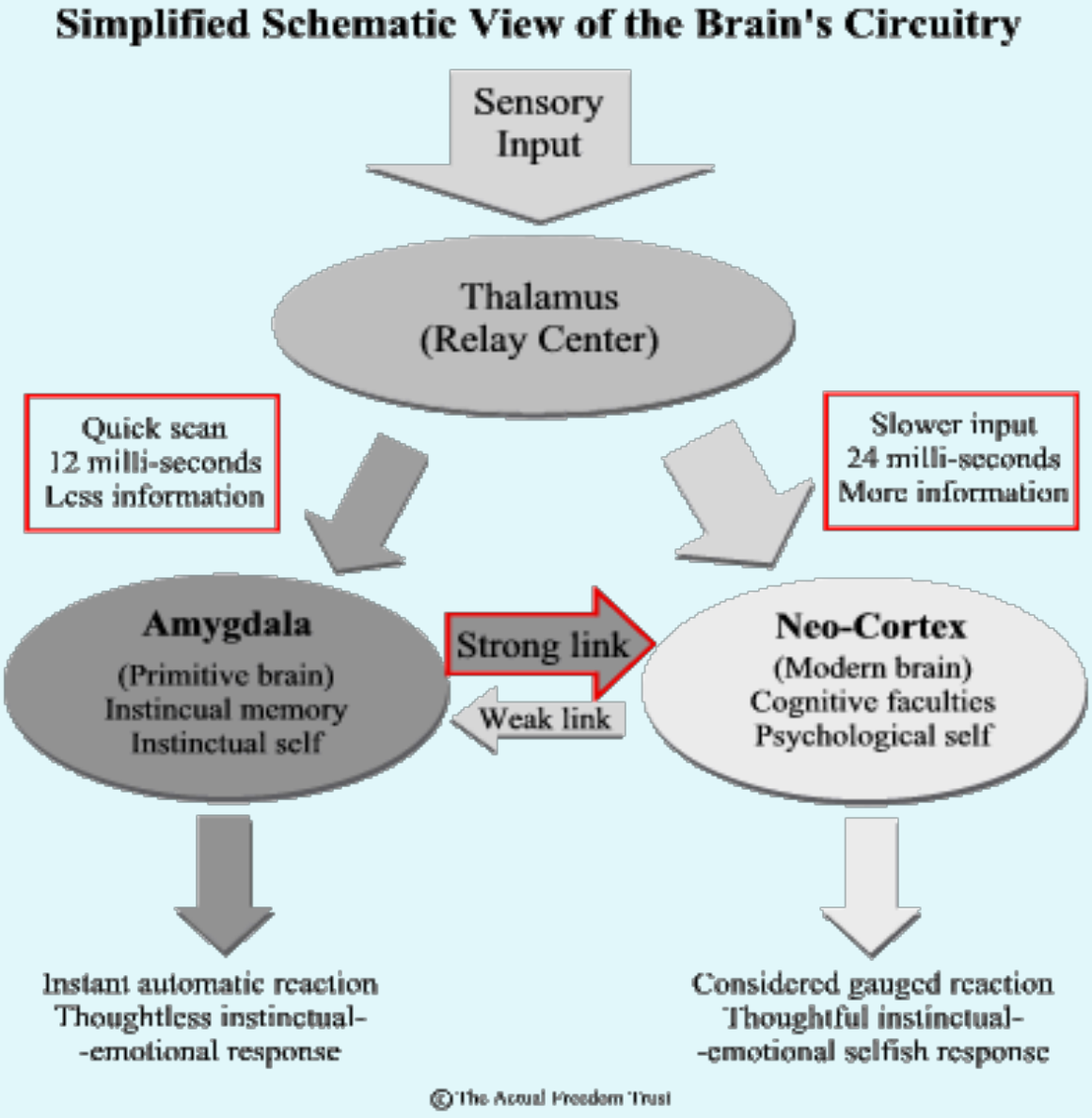
- Most powerful determinant of memory
  - Emotions control connection-formation (acquisition)
  - AND the ability to recall what was learned
- Negative emotions (especially fear and stress) block the ability to learn and to recall
- Positive emotions enhance engagement, motivation, making it easier to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

Manage emotions in your classroom to create an environment conducive to learning

Emotion and chemistry: Your amygdalas



Emotion: Fear response



The Power of Emotions

vs.

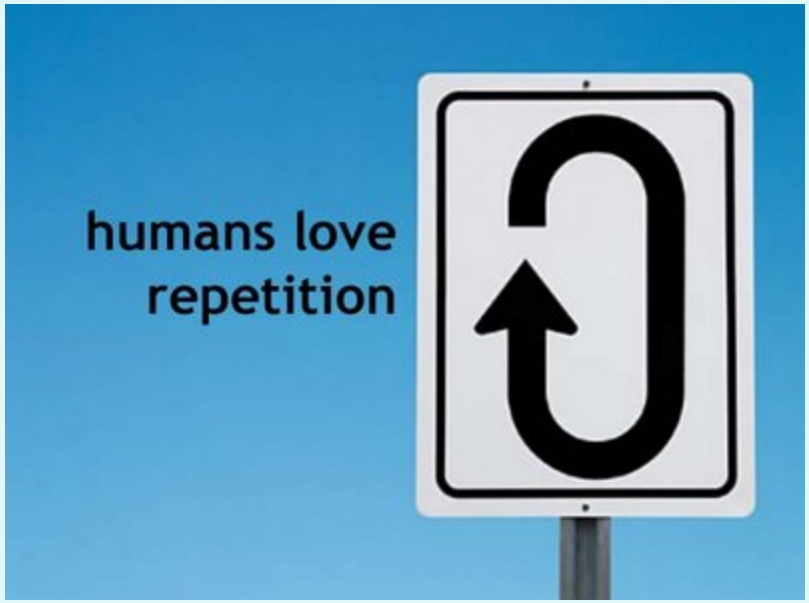
Test, Analyze, INtegrate

- Passive review has low correlation with ability to recall what was learned. Don't highlight or reread.
- Ability to recall depends on practice of recall: Frequent (self-)testing is possibly best way to learn.
  - 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)

Teach students in class *how* to do the learning you expect them to do outside of class

Key Factors Shaping Retention

- Strong emotion
- Repetition and reinforcement
- Richness of the learning and studying environments



Civic Engagement and Retention

Learning by doing facilitates retention and habit-formation because it:

- creates a constant need for repetition and review
- constitutes repeated low-stakes testing and requires distributed practice
- engages students' emotions in positive ways
- provides a richer learning environment

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

Teach transfer explicitly and give students frequent opportunity to practice—in class and out

Civic Engagement and Transfer

Civic engagement aids transfer because it:

- requires pattern recognition at ever-increasing levels of complexity
- encourages rapidly changing mental set and integration of knowledge acquired in different disciplines to solve problems
- forces students to constantly move back and forth from theory to practice in always-changing contexts

Principles derived from neurobiology:

1) Learning IS making connections/patterns.
2) Learning ONLY works when it is active and conscious.
3) Learning connects new ideas to old information.
4) Involving multiple senses enhances learning.
5) Learning requires real effort (difficult is good).
6) Learning depends on managing emotions well.
7) Practice is critical:
    a) Multiple modes of practice create richer and more persistent connections
    b) Reinforce learning within 24 hours to move what was learned from short-term to long-term memory.

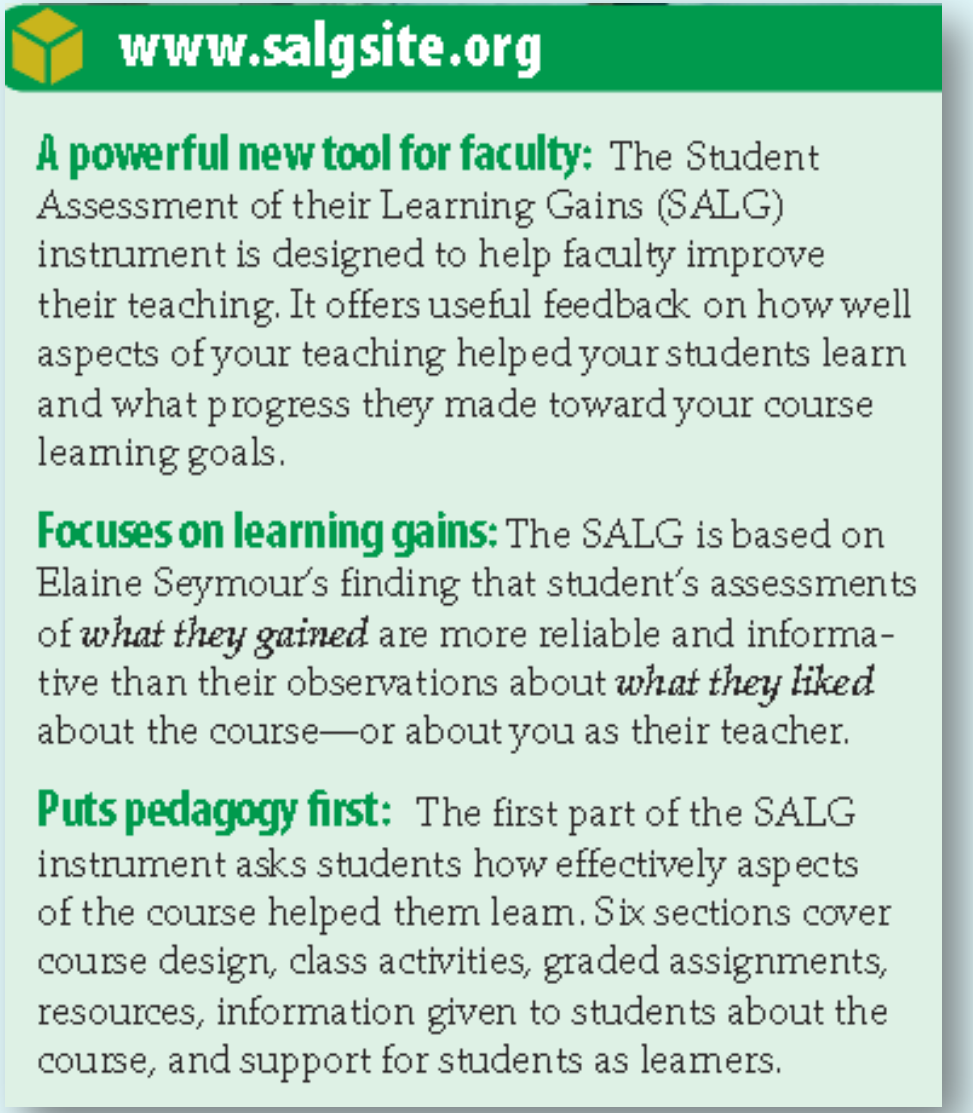
Conclusion

Pedagogies based on civic engagement and learning by doing are exceptionally effective because they align teaching practices with how people actually learn.

Learning Assessment for Courses

The Student Assessment of their Learning Gains (SALG)

Free Tools at www.salgsite.org



Why SALG?

- Research shows that students will punish innovative teaching on standard student course evaluations *even if the students learned more and even if the students recognize that they learned more*.

- Therefore, to protect yourself, you need to use an evaluation instrument that focuses on learning, not on teacher behaviors and/or student satisfaction.

Evidence that Civic Engagement Improves Learning

- Over the past 5 years, SENCER faculty have consistently scored higher in all learning categories (understanding, skills, affective, integrations) than their STEM colleagues.
- The marginal advantage is highest in affective and integrative gains, meaning that the learning gains students make in SENCER courses are likely to be more durable than those made in other STEM courses.

More Evidence

- SENCER faculty who made changes to their pedagogies based on their SALG results got consistently higher scores in all categories even than other SENCER faculty.

Thank You!

Stephen: scarroll@scu.edu
metalearninghabits.org

Inspiration

What Teachers Make