Welcome to the Summer Institute:

Welcome to the 2010 Summer Institute "Neuroscience & the Classroom: Strategies for Maximizing Students' Engagement, Memory & Potential," co-sponsored by Learning & the Brain Conference and the Neuroscience Research Institute, University of California, Santa Barbara.

This Institute is based on cutting-edge findings from affective and social neuroscience, emphasizing the roles of engagement and memory in learning, motivation, creativity and the culture of schools. The Institute is designed to help you ignite student learning and turn on the brain's learning centers. You will explore ways to maximize and maintain attention and focus and increase memory retrieval in your students; inquire deeply into brain, cognitive and development as dynamically; and develop brain-friendly instructional strategies to improve outcomes.

Learning & the Brain Conference (presented by Public Information Resources, Inc.) has been a leader since 1999 in bringing neuroscientists and educators together to improve education. The Neuroscience Research Institute at UC Santa Barbara is a group of investigators whose mission is to foster knowledge and understanding of the brain and nervous system within an intellectual atmosphere that is not restricted by disciplinary boundaries.

We hope this in-depth program helps you develop the knowledge, skills and strategies necessary to responsibly apply neuroscience and cognitive science findings to improve teaching and learning. We are sure that your work here will redound to the benefit of many students.

Sincerely,
Daniel LaGattuta
President
Learning & the Brain Conference
Public Information Resources, Inc.

Sincerely,
Kenneth S. Kosik
Director
Neuroscience Research Institute
University of California, Santa Barbara
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Summer Institute Homework Overview

Approximately an hour and twenty minutes of preparation is required each evening for the next day. The assignments will relate to the day’s material in regard to using strategies to promote attention, memory and motivation. There will also be a group project that will be part of the homework the first and second evening to be presented to the group on day three.

Homework

All homework can be done individually or as a small group or partnership. The final project should be done with at least one partner. For all assignments, if possible, create documents, animoto.com, and/or PowerPoint of your work on a computer so you can share these in class and/or exchange your work with others using a thumb drive or email.

Night 1: Animoto and RAD instruction description

1. Create an animoto.com page advertising something for which you would like to promote interest and attention. (See page 9 about animoto.com sign up in advance).

2. Based on what you have learned so far about RAD, complete the parts of the RAD Module Template for “R” and “A” regarding a previous successful lesson, supervisory activity, faculty meeting, parent/faculty interaction/instruction, or student remediation or support (if you are a specialist). Write what you did that you now realize relates to how the brain successfully processes information. For example, if you did something to arouse curiosity and prediction, and the learners were particularly attentive, you now know why. Write that under “R” (The RAD Module Template can be found on page 11).

Night 2: RAD instruction

1. Based on the new information covered today, complete the first night assignment template by finishing the neuroscience correlations that made your previous successful lesson, supervisory activity, faculty meeting, student remediation or support (if you are a specialist) R, A, and D.

2. Go back to your handout and complete the parts for R, A, and D for your challenge lesson, supervisory activity, faculty meeting, parent/faculty interaction/instruction, or student remediation of support (if you are a specialist). You probably started this in class.
Now complete the sections so you have a plan for that challenge in the future that includes your R, A, D strategies. You’ll find these questions on pages 24, 31, and 38. You can also use the template to write your challenge RAD plans on a separate page. (Please see page 12).

3. **Begin your group project** for presentation on the last morning. Collaborate with the group or partner you matched with during Day One based on your choice or common goals (subject, grade level, job challenges in your particular work). Your animoto.com advertisement can be created with this final project in mind. Collaborate on your goals and how you will achieve them using neuro-logical interventions/strategies/activities you’ve already learned. You’ll complete this tomorrow evening for presentation on the last morning.

4. **Prepare for the jigsaw (card party) tomorrow by reading or rereading an article:** Each table group selects a different article to read (It can be one you read in preparation for the institute). Tomorrow you will do the jigsaw or card party activity with your knowledge of the article. First you’ll discuss it with your table group and decide what points are most valuable to communicate to others and how you will do this most effectively for attention and memory. You will then each go to new groups and take 2-3 minutes to “teach” the information to this group and “learn” about the articles from the person who is the “expert” on their article. (For more details please see page 179).

5. Contribute to our WIKI about Changes are Needed in Education. (Please see details about the assignment on page 13 and WIKI in general on page 15).

**Night 3: RAD project and narrative**

1. **Complete your group RAD plan** for presentation tomorrow. (Please see details on page 19). If possible create an Animoto as well as a document or PowerPoint you can show and exchange with others using the WIKI, thumb drive, or email.

2. **Create a Narrative** about something you teach/advise/consult that has a complex term or concept. If nothing comes to mind, create a narrative about one of the new terms or concepts you learned in the sessions. Feel free to include your own sketches, photos, or internet pictures to the narrative.
ANIMOTO.Com Instructions

We will be making brief video “advertisements” for lessons or other instruction you give to colleagues, parents, school board members, etc. The website is free for both limited and extended access, but you need your password to get the free educator extended access.

Sign up at: http://animoto.com

You can see some examples through the links below of first time “productions” by educators at several previous workshops.

http://bit.ly/7nZ2wN
http://bit.ly/7vBvBq

My first 2 animotos can be linked to on YouTube
RADTeach.com Neuroplasticity lesson advertisement for curiosity
http://www.youtube.com/watch?v=zxWlnIs2m7Q

Dopamine Fixes Brain Mistakes, http://www.youtube.com/watch?v=EEi3VXNmajo
RAD Module Template

A RAD MODULE You RECALL (can be done individually or with colleagues during workshop or as subsequent professional development)

What was one of the best learning experiences (supervised meeting/interaction) you recall attending, as a young student or as an adult in professional development, etc. (Or the best module/interaction you recall teaching/conducting)? Visualize that experience. See what is going well. What does the classroom sound like? How are the learners behaving? Write a short summary or sketch of what you visualized/recalled

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You can also use this template to write your challenge RAD plans on a separate page:

**WRITE:** How can you use RAS strategies for your challenge module (or student/faculty interactions)? Then share with table group and add ideas you hear from others that could be of use to what you teach (advise, direct).

---

**WRITE:** How can you use Amygdala strategies for your challenge module (or student/faculty interactions) to decrease stress and increase academic risk-taking and participation? For example, what community builders and/or confidence building activities or personalization strategies can you use or have you used to reduce stress from one of these stressors that interferes with learning?

---

**WRITE:** How can you use Dopamine Raising Strategies for your challenge module (or student/faculty interactions)?
Wiki Assignment Details

Add Your Own Suggestions to my Top Ten Necessities for Education Reform Education List below and we’ll end up with a group version that I’ll post as one of my Psychology Today Online posts. The original one below is my most viewed post with over 5000 views to date. It will be great to create one together as we experience the use of WIKI

Judy’s List from Fall 2009

Top Ten Necessities for Education Reform Education

For the first time since the institution of public education in the U.S., students currently in high school are less likely to graduate than their parents. We are the only industrialized country where that is true. Here are my recommendations to change the appalling dropout rate and prepare students for the 21st century.

1. **Collaborate:** Students in the U.S. need new skills for the coming century, not to be superior to students worldwide, but to be ready to collaborate with others on a global level to find creative solutions to problems now and in the future.

2. **Evaluate Information Accuracy:** The current curriculum focus on memorizing isolated facts to pass standardized tests is inadequate preparation for now or the future. New information is being discovered and disseminated at a logarithmic rate and the facts as students learn them today may not be fully accurate or complete in the near future. Students need to know how to find accurate information and use critical analysis to assess the veracity/bias and current/potential uses of new information. These are the executive functions students need to develop and practice in school today, or they will be unprepared to find, analyze, and use the information of tomorrow.

3. **Learn Tolerance:** In a global world of collaboration communication and tolerance (openness) to unfamiliar cultures and ideas will be the educational currency for the jobs and problems of the future. School needs to provide opportunities for experiences and discussions to help students learn about and feel comfortable communicating with people with other cultural norms and practices.

4. **Assessing Student Knowledge:** Standardized tests for federal NCLB funds test rote memory of isolated facts. Assessments need to include ways for different types of learners to demonstrate their knowledge. Once teachers do not have to teach-to-the-tests of rote memory, classrooms can become places of inquiry, student-centered discussions, and active, engaging learning.

5. **Beyond Differentiation to Individualization.** Children are born with brains that want to learn and with different strengths and intelligences that can best empower their success. Students grow best through their strengths. Discovering their strengths and engaging in learning through interests stimulates the strongest neural circuits so the brain is preset for engagement and knowledge building. One size does not fit all in assessment and instruction. The current testing system and the curriculum that it has spawned is unidirectional and leaves behind the majority of students who do not do their best with the linear, sequential instruction. With
greater differentiation of instruction we can lower the barriers, not the bar as all children learn to their full potentials.

6. **Inspiration and engagement** open the brain’s information filters (reticular activating system and amygdala) to accept sensory input. In the absence of these qualities at the beginning of a unit of instruction the brain, at an unconscious level, does not admit the input that is not determined valuable to survival or pleasure. To gain admission through these unconscious brain filters lessons need personal relevance, low in stress, incorporate enjoyable modes of information presentation.

7. **Lower Stress. React or Reflect?** The amygdala is an emotion evaluating structure through which all sensory input must pass. The state of stress or well-being determines if the input is directed to the **reflective**, higher cognitive “conscious” decision-making brain, or to the **reactive** brain where the only “choices” at this unconscious level are fight, flight, or freeze. These are often misinterpreted by teachers as ADHD, acting-out, or signs of low intelligence. The students are not consciously misbehaving. Their brains are simply in the reactive state in which they have no conscious control.

8. **Using Learning Beyond the Classroom.** New “learning” does not become permanent memory unless there is repeated stimulation of the new memory neural pathways. This is the “practice makes permanent” aspect of neuroplasticity where neural networks most stimulated develop more dendrites, synapses, and thicker myelin for more efficient information transmission. These stronger networks are less susceptible to pruning and become long-term memory holders. Students need to use what they learn repeatedly and in different, personally meaningful ways for short-term memory to become permanent knowledge that can be retrieved and used in the future.

9. **Teach students (and educators) the Brain Owner’s Manual.** The most important manual students and educators can read is the owner’s manual to their own brain. When we understand how our brains take in and store information, we hold the keys to operating our brains most successfully. Understanding that they can change their own brains and intelligence (neuroplasticity) builds students’ resilience and willingness to persevere through challenge.

10. **Teaching is not brain surgery. It’s Harder.** When teachers receive the recognition, status, and more of the autonomy I receive as a neurologist, we will attract the best and brightest to teaching and keep professional educators longer than the current five year average.
Using WIKIs for Classroom or Faculty Tools

By Michele Morgan Bolton

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In an online world where language is regularly reduced to instant messaging abbreviations, a group of Westwood sixth-graders is using technology to explore traditional communication, kindling a new love of the written word. It’s goodbye to “OMG” and “IDK,” and hello to Shakespeare and poetry.

This new tool in Neil Kulick’s sixth-grade language arts classes at Thurston Middle School is a wiki, a collaborative website that allows students to post work, make comments or critique the work of others, and make revisions in a group setting.

In the traditional approach to writing instruction, the student writes for the teacher only, Kulick said, “like a soloist with an audience of one.” But when a student publishes on a wiki? “The audience includes not just the teacher but all of the other students, too,” he explained. “And each student can ‘hear’ every other student - now there is a symphony.”

And what’s miraculous, he said, is that even the shiest of students, who wouldn’t dream of raising a hand to share writing, now feel empowered to post work online and participate in the exchanges.

“The wiki is an equalizer in classroom participation,” he said. “Everyone has a role. It’s a way to showcase their comments and their give-and-take in a medium they take to like a duck to water.”

Thurston principal Allison Borchers said that while middle school students care about what their peers think, the biggest part of their journey is just figuring themselves out. That’s precisely why Kulick, who has taught in Westwood for 17 years, said he is drawn to this grade level. “My heart is in middle school,” he said. “When you are in sixth grade, you are still in the garden.”

The school district began implementing wikis last year, and Kulick set up his first one last spring, knowing that youngsters who love texting and instant messaging would be drawn to the new technology.
For the 100 students in Kulick’s classes, there is no fixed schedule for using wikis. It might be used more intensively for a subject like poetry, he said, and less so for novels. But students can use the wiki wherever there’s an Internet connection and whenever the spirit moves them.

On a recent morning in Room 212, where a giant silver thermos of coffee on Kulick’s desk explained at least some of his boundless energy, this semester’s students got their first taste of the wiki. About two dozen children were working on poems to illustrate the essence of fall, after being inspired by “Winter” from Shakespeare’s “Love’s Labour’s Lost.”

“How long should it be?” asked the owner of a waving hand.

“Long enough to touch the ground,” Kulick quipped, reminding students of Samuel Taylor Coleridge’s distinction between poetry and prose: Prose - the right words in the right order; poetry - the best words in the best order.

Fall is a time of year when leaves fall from trees like the swirling birds tumbling southward. . . . The cool winds lightly howl as they blow the leaves, The leaves of all earth tones - every one but green.

During the class, students wrote their poems on the wiki, then immediately began making comments on one another’s work. Among them was James Cassidy, who is an old hand at writing poems and plays but found the wiki opening up a new world.

“You get the results faster,” he said. “And it’s nice because you get to write what you want and change it when you want. You can show other people what you can do. And look at their work, too.”

Cassidy’s view of autumn is timeless:

fluttering leaves, like twirling acrobats fill the air . . . carved pumpkins litter the doorsteps of countless houses, their leering grins stare unblinking . . . the cold of winter looms nearer, and nearer with blistering days of fall.

For Emily Keith, in fall, “crows swarm in the sky, their haunting calls echo in the wind.”

Before wikis, all students could do is type and print, said Brigitte Farah: “Here you can do all sorts of different things.”

She wrote:
One Autumn morning I look outside my window and see colorful sparks drifting and dancing through the cool breeze until finally reaching the crisp ground. . . . I think how much fun I had in Autumn, now that winter is coming through. . . . After coming inside, I remembered feeling the sticky sap that made my cold fingers stick to each other like peanut butter to jelly.

Kathy Kinsman, an instructional technology specialist in the Westwood district, stressed that the wiki is a collaborative tool - not a social network - that gives children ownership of their work. A classroom homework wiki is accessible to parents, too, and another departmental wiki allows teachers across the district to work together.

Kulick’s wiki has been so successful that students in the last class he taught are now independently posting their work for him and others to critique, she said.

Clearly, the experiment has worked, Kinsman said, adding: “They are teaching each other.”

*Michele Morgan Bolton can be reached at mnbolton1@verizon.net.*

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Group RAD and Memory Project

How can you apply RAD and memory strategies to a future lesson/interaction

a. Brief description of challenge lesson/interaction:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What can I do to make it RAD?

R=RAS
How can you use RAS strategies for your challenge lesson (or student/faculty interactions)?

A=Amygdala
How can you use Amygdala strategies for your challenge lesson (or student/faculty interactions) to decrease stress and increase academic risk-taking and participation? For example, what classroom community builders and/or confidence building activities can you use or have you used to reduce stress from one of these classroom stressors that interferes with learning? Or how can you add positive emotion to the lesson/interaction to promote flow through the amygdala to the PFC?

D= Dopamine
Develop Motivation, Long-Term, and Conceptual Learning (strategies involving: Dopamine, Neuroplasticity with Mental Manipulation and Mistake supported by feedback, Inquiry for Prefrontal Cortex)

Memory

1. Create a narrative about challenging information you want your learners to remember
2. What strategies, such as prior knowledge activation, can you apply to be sure the information that successfully passes through the RAS and amygdala filters is consolidated into relational (short-term) memory in the hippocampus?
3. How will you promote mental manipulation for neuroplasticity to sustain short-term memory into long-term memory so new learning is successfully stored, retrieved, maintained, and applied?
4. What review strategies will you use in class and assign/recommend for independent preparation for formal assessments and/or subsequent successful use/performance of the learned information?
5. What opportunities can you provide so new knowledge and constructed concepts are applied through transfer?

Executive Function
What strategies/activities will you use to promote executive functions such as critical analysis, prioritizing, judging validity of information, multiple perspective taking, goal-setting/achieving, and creative problem solving?
How Will You Use Formal and Informal Assessments?

1. Frequent informal assessment during instruction so active participation is sustained and corrective feedback supplied soon enough to influence the permanence of accurate memory networks and correct inaccurate networks?
2. Assessments that provide opportunities for goal/interest directed use of learning
3. Opportunities for learner metacognition following assessments
4. How will you evaluate and interpret information from learner assessment results to alter you future instruction?
5. Self-assessment (or peer observation/feedback) to evaluate the effectiveness of your strategies and interventions

Professional Learning Communities

1. How would PLC be of value for you and your colleagues?
2. How can you develop or improve your PLC and insure the time spent is valuable for participants?
3. How can you promote active, engaged, motivated voluntary participation in the PLC?
Using the Developments of Neuroscience for Neuro-logical Teaching Strategies

Judy Willis, MD, M.Ed
www.RADteach.com
Learning and the Brain
Summer Institute August 3-6, 2010

Goals for This Presentation

How Does the Brain Learn in the Classroom and Beyond?

Learn Neuroscience Research Compatible Strategies to sustain attention, control focus, and direct input to the thinking brain (prefrontal cortex)

Practice using classroom ready tools, including curiosity, prediction, collaborative group work, to help motivate and empower students to achieve their maximal potentials with increased participation, engagement, and memory.

WRITE: What is one of your more challenging module/ (or student/faculty/advisee interactions)? As we go through RAD you'll have time to select at least one strategy for each letter in RAD to apply to make your challenge more successful and enjoyable next time it comes around.

When you have written this note to yourself, put the first letter of what you wrote on your white board and hold it up so I know you are ready. (White board represents individual whiteboards I use for multiple purposes, especially to increase responsive participation for engagement and ongoing formative assessment).

RAD LEARNING = Reach – Attitude – Develop
Reticular Activating System + Amygdala + Dopamine

R = REACH STUDENTS ATTENTION (RETICULAR ACTIVATING SYSTEM)
A = ATTITUDE (AMYGDALA)
D = DEVELOP MEMORY WITH DOPAMINE
Students complain about the material and ask, “Why do we have to learn this?”
Why do you as educators “Have to learn this?”

Reach Your Students (pass through the Reticular activating system): Use changes in
the environment, surprise, teachable moments, and multisensory instruction to reach the
conscious brain via this filter that alerts the brain to changes and gets it primed to interact with
new information and experiences.

Passage through Reticular Activating System
Students are criticized for not paying attention; they may just not pay attention to what their
teachers think is important.

Reticular Activating System (RAS): This lower part of the posterior brain filters all incoming
stimuli and makes the “decision” as to what people attend or ignore. The Reticular Activating System
alerts the brain to input from sense receptors. The sensory input that focus the attention of the RAS
and are selected for admission to the brain relate to novelty, potential threat, and curiosity

CURIOSITY & PREDICTION = ATTENTION AND MEMORY

Novelty (change) alerts the brain to pay attention and that sensory input is given priority to pass
through the RAS filter. If the change is perceived as potential threat, that sensory input is
selected over anything else. Only when threat is no longer perceived does the RAS admit sensory
input that provokes curiosity.

Students are criticized for not paying attention; they may just not pay attention to what
their teachers think in important.

Strategies to Maintain Attention and Focus with Curiosity and Novelty

- Music, costumes, speak in a different voice, optical illusions, bizarre factoids. When you
do or say things that are unexpected, that novelty is attended to. Walk backwards before
instruction to arouse curiosity before a lecture about foreshadowing of negative events as
a literary technique. Other topics that could follow walking backwards include
“backward” analysis or hindsight about events leading up to discoveries, historical
events, mathematical theories. Examples of these: the causes of a war, the spread of an
epidemic, discovery of laws of physics.
- Keep students’ attention and ability to keep content organized by varying the color of the
paper, font, spacing, and text
- Change
  - Suspenseful Pause: a significant pause before saying something important builds
    anticipation as the students wonder what you will say or do next.
  - Speak in a different cadence or volume to grab RAS attention,
  - Alterations in classroom, bulletin boards, person in room (guest speaker)
  - Discrepant Events
  - RAS in online courses: Will be described in the “computer game” model
Participant Group Work/Pair-Share: Let's be sure your brain cements the sensory input you took in about the RAS. Working as a group “mentally manipulate” your new learning for understanding, memory, and to sustain interest in the topic. After completing both activities below decide who will describe either one of them to all the participants and how the person(s) will do so.

1. Draw a diagram, graphic organizer, flow chart or other sketch representing your image of the RAS
2. Create a narrative or an analogy about the RAS:
   *The RAS is to a the Brain
   as a Password is to a Website*

Advertise in Advance and During Modules to Promote and Sustain RAS Curiosity

Animoto and MakebeliefsComix

Advertise and Students Predict: website [http://animoto.com/education](http://animoto.com/education)

**Animoto.com** for Attention Priming by Teachers and Summarizing (for homework, conceptualizing, or differentiation enrichment). Can be used during workshop by participants as it would be in class when they feel a section of the workshop is something that they already understand/use/in which they have insufficient interest to remain attentive.

For participants to use (after demonstration during first section of presentation about attention) just as I have students who don’t need a section of a lesson or unit make a summary of the information using animoto or the other website, while the class continues at the lesson until they are at the equivalent level of mastery. That is when the students who have done the animoto return, share, and rejoin.

Make a video to advertise your topic or lesson:
- [http://animoto.com/play/NRZEC5V0WHdndnfl6ZHyhQ?autostart=true](http://animoto.com/play/NRZEC5V0WHdndnfl6ZHyhQ?autostart=true)
- [http://animoto.com/play/hIiMYgkAHKFf7CLVhf3Kw](http://animoto.com/play/hIiMYgkAHKFf7CLVhf3Kw)
- [http://animoto.com/play/IRZzA6MAHaGdcvsAv9FLcLA](http://animoto.com/play/IRZzA6MAHaGdcvsAv9FLcLA)


Use the website ANIMOTO and make RAS grabbing video ads. There is a free "all-access" membership available to educators (you apply at [http://animoto.com/education](http://animoto.com/education) with the name of your school and in about a day they send you an e-mail with an access code)

**www.makebeliefsComix.com** to assemble cartoons that summarize the new learning in a cartoon format
Emphasize Key Points so a Fox Would Know What is Important

Color (and hats) for Key Points: Marking key points in color results in increased recall. Write the most important facts of the day’s instruction in another color.

Planning Modules that Reach Students (Focused Attention & Engagement)
- Will your information get through RAS filter (low stress - high curiosity/interest)?
- In planning your instruction consider: Does the RAS input signal danger?
- What is the “So What?” Why should the RAS let the input into the brain?
- Would the RAS consider the sensory input valuable (survival, curiosity, or pleasure)?

WRITE: How can you use RAS strategies for your challenge module (or student/faculty interactions)? Then share with table group and add ideas you hear from others that could be of use to what you teach (advise, direct).


My students “act out” or “zone” out
Consequences and Interventions for “Immature” PFC & Executive Functions In Adolescents

Until the PFC is more mature, adolescents are more reactive than they are reflective, especially when they perceive stress. Stress comes in many forms to students and includes boredom (already having mastery of the information being taught) or frustration (having no opportunity to relate to the material through interest or prior knowledge activation OR being lost/confused thus unable to follow the information as it is offered). This section answers the above question with information about: Attitude, Amygdala, and Achievable Challenge.

Attitude that aims information toward thinking brain through the Amygdala:

Amygdala: Part of limbic system in the temporal lobe. It was first believed to function as a brain center for responding only to anxiety and fear. When the amygdala is in this state of stress, fear, or anxiety-induced overactivation, new information coming through the sensory intake areas of the brain cannot pass through the amygdala’s filter to gain access to the REFLECTIVE prefrontal cortex and the information is conducted to the lower, REACTIVE brain.
During high stress, the increased metabolic activity in the emotionally responsive amygdala gives control of our thoughts and actions to the lower, involuntary, reactive brain. In states of stress, fear, frustration, helplessness, or boredom, information can’t be conducted through the amygdala’s emotion sensitive affective filter up to the reflective prefrontal cortex. The lower, reactive brain has limited sets of instructions it can use to direct behavior, such as fight, flight, or freeze. Observing students during these states of stress-directed behavior it is not surprising they are misidentified as suffering from ADHD, petit mal epilepsy (staring spells), and oppositional-defiant syndrome.

Causes of Stress in School
Fear of being wrong
Embarrassed to speak in class, answer questions, present their work in class
Test-taking anxiety
Physical and language differences
Boredom from lack of stimulation due to from prior mastery of the material, lack of personal relevance connections
Frustration with material that exceeds foundational knowledge and/or about their inability to organize their time for the increased demands of each subsequent year of school.

Attitude, Stress, Behavior, and Cognition

- Negativity & Stress = Behavior Problems and Learning Blocks
- Participating in new learning requires students to take risks beyond their comfort zones
- Before students can attend to higher-order thinking they must meet lower-level needs like survival and safety
- Path determined by amygdala to Reflective prefrontal cortex (PFC) or to the lower, Reactive brain is directed by one’s emotional state
- Survival First: High stress, fear, frustration, or boredom ⇒ input and neural processing directed to lower brain ⇒ result is “reactive” behaviors such as fight/flight/freeze.
- Reduce Stress: Relaxed alert state ⇒ Input can go through the amygdala to the reflective brain – the Prefrontal Cortex (PFC).

Participant Group Work/Pair-Share: Let’s be sure your brain cements the sensory input you took in about the AMYGDALA. Working as a group “mentally manipulate” your new learning for understanding, memory, and to sustain interest in the topic by creating a skit to demonstrate how the amygdala works (responds to emotion), what it does, and if possible you can try to incorporate the survival value of a filter that sends input to the lower brain when there is high stress or threat perceived.

Open the gate to the Prefrontal Cortex by DESTRESSING THE AMYGDALA
The goal is to avoid the high stress state that blocks information entry through the amygdala into prefrontal cortex. Use curiosity promoting questions/demonstrations, stress reduction strategies, metacognition, teaching students how to recognize their incremental progress, and helping them link new input with prior knowledge, especially prior memories that have positive emotional associations are positive interventions. These interventions expedite passage of new learning through the amygdala’s filter to the PFC.

**Causes of Frustration and Negativity**

Students already alienated need additional motivation to regain confidence, perseverance, and motivation to nurture their attention while they connect to more challenging classes.

Experiences where they feel successful

*Explicit* personal relevance so they relate to topics of study, such as opportunities to hear about characters in books or people in history who have had experiences similar to their own.

Empower students who come with high negativity with brain knowledge, especially about their ability to modify their brains through neuroplasticity (see the two articles from Educational Leadership that I call my “Brain Owner’s Manual”). This can be especially motivating when students have been marginalized by learning differences. The “Brain Owner’s Manual” (see links at end of handout) has suggestions such as previewing and best bang for the buck reviewing, how students can distress so their amygdala does not prevent active learning and PFC transmission of information.

**Destressing with Scaffolding:**

1. Destressing: For the brain to successfully admit sensory information there must not be the interference of the stress of confusion, anxiety, or frustration blocking data transit through the amygdala’s affective filter. That means students must either have the background knowledge to make connections and pattern new information with relational memories, or they must know how to get the support they need to structure new patterns. This might mean some students may need to use calculators because their faulty memory tracking slows their mastery of the multiplication tables. (Later that delay is worked on with extra practice, tutoring, or computer feedback-mastery building programs). Some students may initially need partially filled in outlines upon which to write notes about what they learned about the new topic. Through practice and more familiarity with the new topic, they will need less scaffolding, but they will not be shut out from the lesson because of the brain-blocking impact of stress.

Students need to have the background knowledge to make connections and encode new information with prior knowledge to form initial working memory and progress with the class.

Others can stay in regular courses if provided with scaffolding that is gradually withdrawn such as:

Preunderlined books or partially filled in outlines from last year’s students or note-takers upon which to write notes about what they learned about the new topic. Through practice and more familiarity with the new topic, they will need less scaffolding.

Computerized learning of missing foundational information (ALEKS.COM for
The ACHIEVABLE CHALLENGE of Captivating Computer Games Offers Interventions for the Amygdala-Blocking Stress of Boredom or Frustration

The objective of most of the successful strategies for constructing and sustaining memories is to provide experiences and develop student goals based on individualized realistic challenge. These are challenges that are motivating because of student interest and supported by clearly structured goals, frequent feedback, and positive intrinsic reinforcement geared to students’ developmental levels, intelligences and learning strengths.

Individualized realistic challenge connects students to knowledge by communicating to them high expectations while insuring that they have the capacity to reach these goals. The confidence base is established when students know that they will have access to the tools and support they need to reach the high expectations differentiated for them. These are the classrooms where the bar does not need to be lowered or challenge eliminated in the name of access.

A longitudinal study noted that teachers who emphasize competitive comparisons of student ability discourage students from asking for help.

The Successful Computer Game Model Uses and/or Promotes

Computer Games are the most brain consistent learning system, so don’t try to beat them, join them. The progressive level games influence dopamine and motivation by engaging players (students) at their appropriate player ability level, with achievable challenge adjustments as learning and mastery progress. The most popular computer games take players through increasingly challenging levels as they became more and more skillful.

BECAUSE OF THEIR PRACTICE (just as reviewing increases procedural and factual memory through neuroplasticity). As skill improves, the next challenge stimulates efforts to obtain the new mastery because the player can reach that level with practice and persistence. This correlates to using achievable, incremental, challenge, with goal tracking and feedback in the classroom. Students need challenge at the appropriate level for their background knowledge and abilities to remain motivated to persevere and strategically build mastery.

Personalization of learning with contextual bridging (closing the gap between what is learned in theory and its use)

Motivation and goal orientation, high time-on-task with perseverance and patience even after failure

Scaffolding when needed: Providing players (learners) with cues, hints, and partial solutions to keep them progressing and motivated

Variable player-ability-based challenge. The most popular computer games take players through increasingly challenging levels as they became more and more skillful. As skill improves, the next challenge stimulates new mastery to just the right extent that the player could reach with practice and persistence. This correlates to using achievable, incremental, challenge, with goal tracking and feedback in the classroom, at the appropriate level for students’ abilities to motivating and strategically build mastery.

Achievable challenge differentiation that set students on appropriately challenging paths increases maximum brain engagement. The extra planning time will be rewarded by students’
successes, improved confidence and attitudes, as well as their achievement on standardized tests and the reduction in time that is required for basic behavior management in the class.

Strategies for Achievable Challenge

On-going Informal Assessment and Feedback During Instruction
- **Assessment During Class:** keeps all students actively connected to the instruction
- **Individual white boards or Clickers**
- **Group discussions or pair share so you can walk around and “listen in”**
- **Different color for different activities** and new day’s work helps you differentiate, because you are able to identify by color when students who work more quickly are working on homework, how much progress individual students are making (and at what level of difficulty) on a portion of the lesson, and who in the room needs your help.
- **Noncredit Pre-assessment Quizzes**

Collaborative Group Work for Participation and Preparation --
**Accountability:** Different color for different activities and new day’s work helps you differentiate, because you are able to identify by color how much progress individual students are making
- Builds the communication, open-minded, collaborative, active-listening skills critical for success in school, life, and 21st century opportunities.

Pre-assessment & Ongoing Assessment for Sustained Achievable Challenge

**BENEFITS**
- Preassess so entry level is appropriate challenge level
- Help students coordinate their goals/interests with the instructional goal
- Frequent Assessment with Timely Formative Feedback Strengthens or Corrects Memory (see Nucleus Accumbens/Dopamine Reward)
- Model for students how they can recognize their own Incremental Progress (Not Just Final Product/Exam) so they sustain intrinsic motivation and perseverance

Pre-assessment Strategies Lower Stress and Increase Positive Motivation

**Brain Benefits of Noncredit Pre-assessment Quizzes**
- Pre-tests of content knowledge - self-corrected, not graded quizzes that include questions to reveal potential misconceptions
- Preview of key concepts (big picture)
- Attentiveness/Accountability (Tell students you will sometimes use the same pretest later as a graded quiz)
- Prediction (answers) motivates interest in and attentiveness to the correct answers
- Stimulate circuits with related prior knowledge to connect with upcoming new learning
- **Students correct their own quiz in class**
  - Timely feedback to correct misconceptions
  - Insight about their own foundational knowledge - what they need to review in preparation for the unit
You Have Information for Planning for Achievable Challenge
Mastery or deficiency in prerequisite concepts, facts, procedures and/or skills
Awareness of students’ misconceptions
Armed with this diagnostic information, you know who needs essential
preknowledge and who needs enrichment.

RUBRICS: You can provide pre-feedback or feed-forward and help students develop
goals before students begin a project or paper with rubrics or examples of the work of students
from previous years. The latter is especially helpful if you include examples of A, B, and C level
papers that match the high, medium, and low criteria included on the rubric.

- Ongoing feedback that includes evidence of some area where students have made even
  some incremental progress helps them perceive their progress from an outside
  perspective or as compared to preset standards.
- Good feedback can help students see how they are progressing to their short and long-
  term goals.
- Intrinsic reward (self acknowledgment of progress as a result of one’s practice and
effort).

YOUR Preassessment (SELF GRADED) RAD WITHOUT Your Handout
(As many ideas as you like for each question)

1. What types of input do you think get priority brain attention and are selected as the sensory
   input at any moment to enter the brain? _____________________________________________

2. During high stress, the information is conducted through the emotion sensitive affective filter
to the lower, reactive brain that has a limited sets of instructions it can use to direct behavior:
These behavior reactions include: ___ ___ ___? (Hint: think “f”)

3. Syn-naps (brain breaks) could help to ____________________________________________
   _____________________________________________

4. The prefrontal cortex is place we want our input to reach because this 17% of the brain
controls or coordinates ___________________________________________________________?

5. What strategies/activities do you think increase positive feelings of satisfaction and pleasure
that promote learning and memory _____________________________________________________?
(Hint/Curiosity Promo: These are likely to be related to dopamine levels in the brain and the
dopamine-associated pleasure response.)

Personalization is Amygdala Positive
To best promote passage through the amygdala and increase long-term memory storage,
information should be taught in context of personal relevance with opportunities for students to
make meaningful connections between themselves and the key concepts of the module. This
increase entry to PFC and later there are the links in place to maximize transfer from short to long-term memory and to connect separate memory networks together as concepts.

**Strategies to Build Personal relevance through student interests and real world connections**

- Show how what they are about to study relates to their lives or the world around them. When students understand the reasons for what they are expected to learn, they are more likely to be intrinsically motivated to participate actively in the class. Otherwise the information may be perceived as unrelated chunks of data, like memorizing a list of people’s names without knowing why they are important.
  
  Watch a video (such as [http://www.thefutureschannel.com/](http://www.thefutureschannel.com/) “Real World” videos about Math and Science

- Connect module with current events

- Read aloud something curious or of high interest to students that relates to the topic at hand

- Before a unit about a class topic or book find out something about the life of the author, scientist, historical figure, or mathematician when he/she was about the age of your students. Update the information so it sounds current day and is perceived as personally relevant by students as you tell a narrative about person before revealing their identity or discovery

- **Real World Connections and Teachable Moments**: Memories that are associated with emotional or personal meaning are most likely to become relational memories and be stored.

- **Active Personalized Reading** ("*Talk back to your book*")
  
  **Before Reading** Predict: Preview and Predict: What do I already know about this topic? Prompts can be end of chapter questions or bold headings

  **As You Read** Interact
  
  - How is this different from what I already know?
  - What new ideas are here for me to consider?
  - Make notes in the margin or on a post-it when
  - You disagree
  - Something is not what you expected
  - You get an idea or insights

  **The “So What” a Desirable Goal for Learning the Information**: They WANT to learn what you HAVE to teach (group projects, inquiry, curiosity from discrepant event, “grapes of math”)

- **Active Personalized Note-taking/Note-making**

**Evidence of Active Learning and Participating (not what I saw in classrooms I visited)**

- Observing and noticing with focused attention
- Discovering, thinking, questioning
- Solving traditional and extended problems
- Engaged, motivated, interested=self propelled learners
Students who understand the brain and experience the benefits of active participation and the use of executive function become experts in their own best strategies (metacognition).

As you help them recognize their incremental progress (as related to their intentional use of their best suited study and planning skills) students ultimately realize they are the best experts about how they learn best. They then feel capable to be in charge of their own learning and build executive function (self-control, planning, goals). Students move from learned helplessness to a positive mindset and responsibility for their own success.

**Emotional Charging of Memory Connections** - Personally meaningful and positive emotional experiences increase memory storage. Help students remember important information by connecting the critical information to positive experiences.

**The “So What” a Desirable Goal for Learning the Information:** They WANT to learn what you HAVE to teach (projects, inquiry, curiosity from discrepant event, robots)

**Gray Matter: Reading Memory Study:** Students are most focused and have greater recall when they know they will do something positive with the information. (PET scan and reading study—the greatest brain activation when the students were told they would have to retell the story to younger children).

**Sample “so what” positive motivators:** Knowing a think-pair-share will follow a section of class discussion, video, or reading increases active focus. Pairs write down what they recall or liked and share one or two of their items with the whole class, students do quickwrite and read a favorite sentence, hot potato, team game (create questions with answers that will be used in a team game or might be selected by you for the quiz)

**Your Group Activity: Active Listening—An important skill students need to develop until their PFC has more control**

One person starts by telling the others one thing he/she found interesting or useful about the any of the topics in this last “A” section such as: amygdala, stress, achievable challenge, the computer model, strategies to promote amygdala passage of information into the PFC versus the lower, reactive brain, etc.

The next person in the group repeats back what they understand the previous person to have said then adds their own additional input. Continue in a circle with this until time is called. You need only summarize what the person before you said.

Take notes under the “A” section of your RAD solutions for your “challenge” as you hear ideas from your group.

**During or after this group activity, fill in the “A” section of your “RAD” module plan:** How can you use Amygdala strategies for your challenge module (or student/faculty interactions) to decrease stress and increase academic risk-taking and participation? For example, what community builders and/or confidence building activities or personalization strategies can you use or have you used to reduce stress from one of these stressors that interferes with learning?
**Bingo**

*Copy these 25 words onto individual boxes on your grid in any order for BINGO*

<table>
<thead>
<tr>
<th>Neuroplasticity ✓</th>
<th>Myelin ✓</th>
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</thead>
<tbody>
<tr>
<td>Neural network ✓</td>
<td>Assessment ✓</td>
</tr>
<tr>
<td>Concept ✓</td>
<td>Choice ✓</td>
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<tr>
<td>Prediction ✓</td>
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<td>Prior knowledge ✓</td>
<td>Pleasure ✓</td>
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<td>Axon ✓</td>
<td>Syn-Naps ✓</td>
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<td>Dendrite ✓</td>
<td>Feedback ✓</td>
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<td>Dopamine ✓</td>
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<td>Mistake ✓</td>
<td>Gratitude ✓</td>
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<td>Optimise</td>
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<tr>
<td>Nature</td>
<td>Nerve Transmitter</td>
</tr>
</tbody>
</table>
Delight from Dopamine

Develop Motivation and Increase Participation with Dopamine

Topics: Dopamine, Neuroplasticity, Brain Changing Benefits of Mistakes, Mental manipulation, and Concept Construction, Patterning, and Concept Construction

Develop Memory & Motivation with Dopamine: Dopamine is associated with pleasurable experiences and in expectation of pleasurable experiences. Its release also increases focus, memory, decision-making, and executive function.

When dopamine levels go up, the following behaviors are more prominent:
- Pleasure
- Creative imagination
- Inspiration
- Motivation
- Curiosity
- Persistence and perseverance

Activities/Strategies that increase Dopamine levels and the Dopamine Response
- Collaborating
- Enjoying music
- Being read to
- Feeling self-appreciation-recognizing their progress to a personally meaningful goal
- Acting kindly
- Interacting and collaborating well with classmates (such as group work)
- Expressing gratitude
- Experiencing humor
- Optimism
- Choice
- Movement

EXAMPLES OF Strategies to Increase Dopamine

Choice with Prediction and Discovery: Do you want to spend less time on homework this year?
Students hypothesize about what strategies or conditions (such as taking too-frequent snack breaks, interrupting their focus with texting, creating a homework schedule, or turning off the television) will help—or hinder—their learning. Choice of summarizing activities (texting, twitter, or telephone simulations)

Pleasurable Lists: Students list words by their own choice of most to least “pleasurable”
Movement for Dopamine

- Pantomime vocabulary words (English, Foreign Language, Content Specific)
- Word Gallery: Vocabulary review can incorporate movement, positive peer interactions, even music. If students have a list of vocabulary words they can walk around the room and write the number of the poster that has a verbal or pictorial representation of word. This can vary from actual definitions to the word used in sentences. Subsequently students can add their own sentences or drawings to the wall charts. Scaffold by allowing some students have a one-word definition or work with a partner as they boogie the vocabulary walls to music.
- Ball-toss to review high points of a lesson
- Snowball fight
- Write words with elbow or ear

Choice with Prediction and Discovery: Choice of summarizing activities (texting, twitter, or animoto.com)

Peer Interaction for Dopamine

Collaborative Activities and GROUP Work Benefits

Students, even in middle school, can listen to directed lecture with focused attention for fifteen to twenty minutes.

Group work can be the change of brain region activity and add the benefit of dopamine (from positive peer interaction and greater evidence of incremental progress toward a shared goal) to increase interest and level of concentration.

Groups work best to increase learning if the groups have a common, relevant, high interest goal that they can only achieve if all group members are accountable for the outcome. In some cases, students have to teach each other, because their own success depends on it. More likely to ask questions in small group than whole class.

The problem or question for the group should involve opportunities for critical thinking, reasoning things out together and requires that all participants understand or develop understanding of background information because the problem/question/inquiry requires that they use this transfer this knowledge to a new situation.
• **PARTICIPANT ACTIVITY: Consensus:** Let's try it with this Graphic Organizer/THINKING MAP—BRIDGE. On your own, FILL IN THE NAMES OF THE TWO FILTERS THROUGH WHICH SENSORY INPUT MUST PASS TO BECOME LEARNED INFORMATION. FILL IN THE NAME OF THE PART OF THE BRAIN WHERE CONSCIOUS MEMORY AND LEARNING TAKES PLACE. Then as a group, use your knowledge, notes, collaboration, negotiation, and communication skills to reach full group consensus on the final “answers” you group will submit for this graphic organizer about dopamine.

• **Team review activities:** Using game show formats and team reviews can pair students who have strengths in the academic subject matter with classmates who need added support to participate in whole-class reviews. When students do not have to give individual answers because they collaborate on team answers, they can approach convivial review competitions with lowered affective filters. There can be added components to the review that provide Differentiated opportunities for multiple intelligences and game show formats are fun, so dopamine-reward reinforcement takes place.
• **Team Review Presentations:** Teams can collaborate on graphic organizers or they prepare to relate newly studied information to the game show topic. If the game show topic is the Summer Olympics and the test is about parts of the body, a team might make a graphic organizer where a figure of a person has different body parts doing different sports all at once. While the right foot is skiing, the left foot is snowboarding, and the arms are lifting an ice-skating partner overhead. Because art and sports knowledge are part of the game show knowledge needed, more students in the Differentiated class have an opportunity to participate through these areas of interest of knowledge, while actively reviewing for the test and having fun. Teams present their organizers on overhead projections with the added fun of using the teacher's special tools and the watching students see and hear the test material reviewed and reinforced.

**MOVEMENT FOR DOPAMINE (AND RAS)**

• Word Gallery: Content Specific new vocabulary review can incorporate movement, positive peer interactions, even music. If students have a list of content specific vocabulary words they can walk around the room and write the number of the poster that has a verbal or pictorial representation of word. This can vary from actual definitions to the word used in sentences. Subsequently students can add their own sentences or drawings to the wall charts.
• Ball-toss to review high points of a new information
• 4 corners of the room-move to the one with the answer you predict

**Participant Activity: LETS WRITE “Dopamine” with your choice of your elbow or ear**

**Participant Activity: Let’s Play Hot Potato writing things you recall about Dopamine**

**PARTICIPANT ACTIVITY FOR “D” Dopamine: HOT POTATO**

This game will reinforce new learning, give your brain a syn-naps, and prepare you to fill in the information about how you’ll use what you’ve learned about dopamine relating to YOUR challenge module on the first page of the handout.

The topic is “Anything you remember about the dopamine” and you’ll have a few minutes to look back over these notes or discuss as a group before we start the game.

• **Hot potato:** Teams of 4-6 students sit in a circle and pass a piece of paper on a clipboard with a pen attached. After a module or as the test review the topic is announced and each student writes something they recall about the subject on the clipboard when it is passed to them. If a students can't think of something to add they can ask the group for help, but they must write (in any spelling or handwriting) the words themselves. This gives them the review and written reminder, and they still feel like participants because they wrote the words, and the students who helped them are appreciated.
• The team with the most correct data points not written by any other team wins. By not
counting items that are contained on multiple lists, even the reading of answers can add to
the review, because students are motivated to listen to opponents’ answers.
• Representatives from each team take turns reading out their data, skipping the ones that
other teams have already said, until all items are reported. Any class member may
challenge the accuracy of a fact and the teacher is the final judge.

Participant Activity: With the scaffolding of the last 3 activities, share ideas
with table group about DOPAMINE RAISING STRATEGIES you have applied or
could apply to your challenge module. It can be something you’ve already used with students,
but now you realize you can modify it for the challenge module.

As you actively listen and participate in the collaboration, jot notes on your handout
about useful ideas you can apply to your challenge modules in the future.

When your group has finished, select one strategy to share with all the participants.
The “presenter” does not have to be the “creator” and the group can include visual
aides such as flow charts, humorous cartoons, dramatizations that will raise your
dopamine and those of the rest of our “class”.

When your group is finished, ALL Group Members hold up your white boards
simultaneously with first letter of your idea. (Or be extra creative and use a curiosity-provoking
symbol.) While waiting for all groups to finish, preview the rest of the handout notes, predict and
use “active reading” strategies, or “peruse” the Brain Owner’s Manual articles.

Alternatively, as I have students do during syn-naps, review your notes and ask your
group about things you don’t think you understand fully. If the group members are also stumped,
this is a confidence builder for students otherwise too self-conscious to ask the professor
questions in class. They realize their group is also confused. After the group work time and
before the sharing, anyone can ask the “group’s” question. Ideally, other class members would
have first opportunity to respond so it becomes a student-centered discussion.

This extra group time is also valuable for extending the learning (transfer) using
a list of prompts you can post on the wall as Dend-Writes.

WRITE: How can you use Dopamine Raising Strategies for your challenge module (or
student/faculty interactions)?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
MEMORY CONSTRUCTION

“I learned this? I don’t remember learning it!
What does this have to do with anyway?”

GOALS
Connect new information input to prior knowledge
Strengthen & Lengthen long-term memory
Develop higher-level executive function thinking

Working memory (short-term memory): memory of what you think you need now - the mind looks for patterns. Fades in less than minute. Limited capacity, approx 5-9 items so as new comes in, others go out

Hippocampus: A ridge in the floor of each lateral ventricle of the brain that consists mainly of gray matter that has a major role in memory processes. The hippocampus takes sensory inputs and integrates them with relational or associational patterns thereby binding the separate aspects of the experience into storable patterns of relational memories.

Working Memory to Relational Memory

Relational Memory: When new input connects with a previously stored memory the dendrites connect in new pattern sequences and the new relational memory is integrated into neuronal memory networks with previously stored memories. When either fact is later recalled or prompted, the patterned integration or association that was created will efficiently activate the related memory.

Patterning: To survive successfully animals need to understand their environments and make meaning of what they see, hear, smell, and touch all around them. The brain is designed to perceive and generate patterns and uses these patterns to predict the correct response/decision/behavior/answer to new information.

Presenting information in context (real world connections, cross-curricular themes of study, experiential learning, from concrete to abstract) helps students identify patterns and connect new information with previous experiences and memories (relational memories).

Patterning: After factual information about characteristics of topics such as mammals has been provided in lecture, discussion, reading, and students have access to that information, such as characteristics of animals in each genus (animals native to a continent, farm/zoo animals) depending on differentiated levels:

Patterning Activity Patterning with students (they guess the pattern as you call up students with a similar characteristic such as blue shirts; Moving students to fill in spots in a living sentence for parts of speech or punctuation)

Patterning Activity: You give examples and non-examples of a concept (such as past tense and present tense) and students make silent independent predictions as to what category or concept the items share.
Core Ideas and Clear, Valued Goals

When students know the core concepts their brains are alert for input to place into existing related categories. This increases attentive focus and memory in their class participation, reading, homework, and increases neural networks that become concepts.

Students can select the most important information instead of passively copying and giving equal, but limited, weight to all they hear and read.

The concepts they develop can be applied to other areas and extended because they are clearly stored in a related neural memory circuit.

Key or Core Questions:
Ask questions that relate to the core concepts and add information (like clues) to promote curiosity (and prediction)

Students are prompted by these central questions to relate new input back to core concepts throughout the module, in group work, and as they listen and read.

Evaluate and plan your key questions
Do they guide and propel critical thinking and more than one single answer?
Are they planned to build sequentially toward further development of the core concepts?
Do the key questions promote students to read and listen for reasons and evidence and critically examine information they find (such as on the internet) for validity and appropriate, evidence-based conclusions?

Why Learning for Concepts and Transfer
As information increases in quantity, changes due to better analysis and more data, and is constantly replaced by the new or more accurate information, future employees will be valued for their ability to transfer concepts to successfully and creatively use the new information.

New learning is built on prior knowledge. Learners use their experiences and background knowledge to actively construct meaning about themselves and the world around them. Therefore, students must be helped to actively connect new information and ideas to what they already know.

Connect With Prior Knowledge: Help students relate the new information with data they have already acquired through personal experience or real world associations. The hippocampus takes sensory inputs and integrates them with relational or associational patterns. This binds the new information with already stored and patterned information and builds long-term relational memories.

Examples of activating prior knowledge: KWL, pre-unit assessment, video, class discussion starting with Here-ME-Now by using current events of high interest to the students to connect them to the unit or topic, relating the unit to prior knowledge with ball toss or discussing what they learned about the topic from the perspective of another class (if there is cross curricular planning).

Syn-naps Activities during relational memory building:
Ask students to do a walk-about to connect the concept or new knowledge to something of personal interest and exchange these with three different partners. After the allotted time, write a list on the board. Students will learn of each other’s interests (as will you) and find more ways the topic relates to their own interests.

- **Pair-Share-Write:** How have I or could I provide opportunities for students to process learning using patterning to help facilitate the way the brain stores information in patterns (categories).

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### Neuroplasticity & Mental Manipulation

**Neuroplasticity** *Neurons that fire together, wire together*

*Dendrites, Synapses, Myelin and “Oli”*

**Neuroplasticity:** Dendrite formation and dendrite and neuron destruction (pruning) allows the brain to reshape and reorganize the networks of dendrite-neuron connections in response to increased or decreased use of these pathways. Plasticity refers to the ability of synapses, neurons, or regions of the brain to change their properties in response to usage (stimulation).

**Neuron:** Specialized cells in the brain and throughout the nervous system that conduct electrical impulses to, from, and within the brain. Neurons are composed of a main cell body, a single axon for outgoing electrical signals, and a varying number of dendrites for incoming signals in electrical form. There are more than 100 billion neurons in an average adult brain.

**Axon:** The single fiber that extends from a neuron and transmits messages to the dendrites of other neurons (or to body tissues).

**Dendrite:** Branched protoplasmic extensions that sprout from the arms (axons) or the cell bodies of neurons. Dendrites conduct electrical impulses toward the neighboring neurons. A single nerve may possess many dendrites. Dendrites increase in size and number in response to learned skills, experience, and information storage. New dendrites grow as branches from frequently activated neurons.

**Synapse:** These gaps between nerve endings are where neurotransmitters like dopamine carry information across the space separating the axon extensions of one neuron from the dendrite that leads to the next neuron in the pathway. Before and after crossing the synapse as a chemical message, information is carried in an electrical state when it travels down the nerve. It is through synaptic transmission that cells in the central nervous system communicate when an axon sends a neurotransmitter across the synaptic cleft to activate the receptor on the adjacent dendrite.
Neuronal Circuits: Neurons communicate with each other by sending coded messages along electro-chemical connections. When there is repeated stimulation of specific patterns of a group of neurons, their connecting circuit becomes more developed and more accessible to efficient stimulation and response. This is where practice (repeated stimulation of grouped neuronal connections in neuronal circuits) results in more successful recall.

Multisensory Input

Efficiency of Functional Brain Networks and Intellectual Performance Research:
“Learning and reviewing with seeing, hearing, touching, moving, etc. all help activate related information throughout the brain.” There is a greater chance of recall when there are multiple brain storage areas. When one area is stimulated (pull on the string from that sensory part of the room’s brain) the related information from the other sensory storage region are “pulled in”. (van den Heuvel, M., Stam, C., Kahn, R., Hilleke, E., Hulshoff, P.(2009). Efficiency of Functional Brain Networks and Intellectual Performance. The Journal of Neuroscience, June 10, 2009 • 29(23):7619 –7624 • 7619

Reasons for increasing cross connections among areas of information storage, such as by activating prior knowledge, using different sensory input to teach-review information in more than one way, giving students opportunities to make creative connections.

Greater brain region stimulation promotes the growth more connections between synapses and dendrites and more myelination there is value in multisensory learning and repeated stimulation of neural networks containing useful learned information through neuroplasticity. When children use what they learn the electrical activity of these networks can promote the laying down of more myelin resulting in more efficient accessibility and transportation of information into and out of memory storage.

In multisensory learning more areas of the brain are stimulated as information is presented through multiple senses. These pathways interconnect and the stimulation of one appears to activate related ones as a part of the brain’s patterning system. Multisensory presentations of the information stimulate the growth of more brain connections.

MISTAKES

Students’ greatest fear is making a mistake in front of the whole class, but the goal is to keep all students participating and engaged because only the person who THINKS, Learns.

Most students’ greatest fear is making a mistake in front of their peers, even though learning increases with mistakes. In order to construct and strengthen memory patterns (networks) of accurate responses and revise neural networks that hold incomplete or inaccurate information, students need to participate by predicting correct or incorrect responses. The goal is to keep all students engaged and participating because only the person who thinks, learns. Students who risk making mistakes benefit from the dopamine pleasure fluctuations. The dopamine response to correct or incorrect predictions increases the brain’s receptivity to learning the correct response. However, immediate corrective feedback must follow the students’
incorrect predictions. The brain’s motivation is to retain and reinforce the response that results in pleasure and to alter the incorrect information in the neural network that resulted in the wrong prediction so as to avoid the mistake in the future.

**Reducing Mistake Fear to Increase Participation and Learning**

Students’ greatest fear is making a mistake in front of the whole class, but learning increases with mistakes!

To construct and strengthen memory patterns (networks) of accurate responses and revise neural networks that hold incomplete or inaccurate information, students need to participate – predict correct or incorrect responses.

Mistake negativity and correct prediction influence dopamine levels and the associated pleasure. Neuroplasticity and pruning strengthen the correct networks and alter the patterning that resulted in the error when there is immediate corrective feedback and low stress.

**WHAT is happening in the brain when we learn from mistakes:** Unconsciously the nucleus accumbens or Dopamine Reward/Mistake Negativity releases more dopamine when our prediction (answer) is correct and less dopamine when the brain becomes aware of a mistake, even before the person is. As a result of the lowering of dopamine pleasure after making an incorrect prediction, the brain patterning that lead to that choice is deactivated. When a choice/answer is correct, the dopamine networks release more dopamine, positive feelings increase, and the neural memory circuit becomes stronger and is used to make future choices more successful.

Since students’ greatest fear is making a mistake in front of the whole class, recall a time you made a mistake in front of peers, perhaps when you were a student (or as a teaching in front of faculty, parents, etc.)

What did your teacher or another adult do to help decrease your stress? OR if no one did help you during that stress, what do you think would have been an intervention, words, actions, etc. that would have lowered the stress and possible long-term impact of your mistake moment.

Next, think how you can apply these memories or ideas to things you can do with students when they are embarrassed or stressed after making a mistake in front of peers. Remember the goal is to keep all students participating because only the person who THINKS, LEARNS.

**How can you Increase Participation when Students Fear Mistakes?**

- Activate Prior Knowledge
- Frequent Assessment During Instruction: keeps all students actively connected to the learning.
- Use Safe Prediction Opportunities
- Examples and Non-Examples Columns
- Repeat the part of their answer that is correct
Group Activity: Active Listening—an important skill students need to develop until their PFC has more control

One person starts by telling the others one thing he/she found interesting or useful about the nucleus accumbens, need for participation, or how to decrease mistake risk fear. The next person in the group repeats back what they understand the previous person to have said then adds his/her own additional input. Continue in a circle with this until time is called. You need only summarize what the person before you said.

The Brain Owner’s Manuals

TEACHING ABOUT NEUROPLASTICITY Motivates PARTICIPATION and even HOMEWORK AND REVIEW—“You can change your intelligence” Teach students the “Brain Owner’s Manual” which includes information about how they can change their intelligence

What You Should Know About Your Brain link:
http://www.radteach.com/page1/page8/page45/page45.html

How to Teach Students About the Brain link:
http://www.radteach.com/page1/page8/page44/page44.html

What does this have to do with me?

Or

“I’m just not smart” Change Negativity to Motivation

Recall that the RAS is interested in “Here-Me-Now” Before students will put in the effort needed to strengthen their neural networks; they need to believe there is personal value to them. One of the strongest tools for transforming negativity to motivation is the empowerment you provide your students when they understand they can change their own brains and that using best learning practices gives them the power to change their intelligence. Topics include negativity influences, stereotype threat, and incorrect assumptions about the absolute power of genetics.

Examples from Brain Owner’s Manual

• If you make it your own, you have the knowledge to use for things you want to do. Things you “mentally manipulate” become knowledge you own then it is yours to apply to anything you care about. Topics include: Mental manipulation: Practice makes permanent and neurons that fire together wire together versus Use it or Lose it
• Genes can direct different outcomes depending on which alleles (sections of the gene) are activated or deactivated by environmental factors (nutrition, hormones, parenting
behaviors, and other psychosocial influences)

- **Neuroplasticity**: Practice improves our performance and changes the neural networks in the brain through neuroplasticity. REPEATED brain region stimulation promotes the growth of new neurons and dendrites and more myelination.

- Effort with corrective feedback: Exceptional abilities and talents are significantly correlated with effort and practice with corrective feedback (Video, *The Genius Factory*). Anders Ericsson, much like Henry Higgins and Eliza Doolittle, trained a young man of average intelligence to hold more than 80 digits in short term recall.

- Most athletes, dancers, musicians, and top students acknowledge the relationship of practice to their growing skills.

- Mistakes are learning tools through corrective feedback followed by directed practice to restimulate the neural network so it adds and strengthens the modification or correction to the circuit.

- Show students brain scans and have them teach their parents for homework. (Email or send home photos of growing dendrites taken through an electron microscope and **assign students to explain to family members** the neuroanatomy behind these photos. See the Neuroscienceforkids.com site and Google Images for sample photographs/diagrams)

- The strongest tool in the BOM for transforming negativity to motivation is the empowerment you provide your students when they understand they can change their own brains - that best learning practices give them the power to change their intelligence.

  - Older students personalize/translate the information by interpreting some of the Catch Phrases about Neuroplasticity. Use the phrases below for discussions, student skits, drawings, narratives, prompts for quickwrites, or have students create their own neuroplasticity catch phrases to post in the hallways.

  - **Practice makes permanent**: "Would you like this to be the last time you have to learn how to find a 'least common denominator'? Your brain has unlimited potential to grow in power and unlimited memory storage space. You can do things to remember things you learn permanently! When you review the day's notes, use new learning outside of school, give homework you best effort, and participate in class, you strengthen the wiring in your brain so you learn things more successfully and remember what you learn."

  - **Neurons that fire together, wire together**

  - **The person who does the work (thinks), LEARNS**

  - **A brain stretched to new limits never regains its original shape**

**MENTAL MANIPULATION IN THE PFC**

**PFC=Prefrontal Cortex**

**Patternning and PFC** Children (and adults) who sustain damage to their prefrontal cortex can become oblivious to the consequences of their actions, insensitive to others’ emotions, and unable to learn from their mistakes. Even when these patients had no loss of knowledge or lowering of IQ they had disturbances in emotional-neuroprocessing as a consequence of damage to their prefrontal lobes that resulted in poor decision-making. This may be attributable to both the loss of PFC cortex and part to decreased ability to encode new sensory input into patterns of
neural networks. If they cannot categorize and interpret new input their information analysis, feedback, and abilities to self-correct are impaired.

Increasing prefrontal cortex executive practice can, through neuroplasticity strengthen prefrontal executive function. Practice helps children build their information processing skills they may also be increasing the networks for emotional processing and decision-making skills. Inquiry and discussions that involve opinion development, analysis, judgment, and decision-making may strengthen information and emotional processing. Children learn how to rapidly process information and distinguish between what’s reliable and what’s not.

Activities to stimulate the executive functions include exploring and discussing current or historical events through films, books, Internet, primary sources, or the daily newspapers from multiple perspectives. How would the French Revolution have changed your life if you were in the royal family? How would the end of slavery and the loss of population due to Civil War deaths changed your life if you had no one to work your farm for a full growing season? Students can select the position they want to defend in a class debate or report and then be asked to switch or write a dissenting opinion on a Supreme Court decision they disagree with. Pair up with someone in different corner of the room after students go to the corner depending on their opinion about a topic. Try to convince each other. Do something with the analysis such as write a letter to a government official or to the editor of the local paper.

Examples of Mental Manipulation (especially in the first 24 hours)
1. Narrative – tell a story about what they learned
2. Teach it to someone else
3. Pair-Share or collaborate: Students experience a greater level of understanding of concepts and ideas when they talk, explain, predict, and debate about them within a small group, instead of just passively listening to a lecture or reading a text.

Graphic Organizers (Visual Maps, Timelines, Flow charts) Are Like an External Prefrontal Cortex. Graphic organizers match the brain’s pattern recognition, extension, and correction processing that it uses to make more and more meaningful connections and accurate predictions for future choices (answers on tests, social/emotional decisions, creative solutions for new problems). These g.o. provide tools for managing information in a special organization that links and patterns relationships among facts, ideas, concepts, topics, and other categories of knowledge.

Benefits Graphic Organizers

Graphic Organizers mentally manipulate: Graphic organizers with visual, diagrammatic, pictorial, or graphical ways to organize information and ideas for understanding, remembering, or before writing a paper. For the most part, the information on a graphic organizer could be written as a list or outline, but graphic organizers give students another way to see and mentally, as well as visually and kinesthetically, manipulate the information.

Graphic organizers allow students to create visual pictures of information in which their brains discover patterns and relationships. When the brain can find and interpret information as a pattern, such as in a graphic organizer it receives the information as meaningful input for memory storage.
The format of organizing, prioritizing, categorizing, recognizing relationships as well as using concepts to analyze future related knowledge are all PFC executive functions, not yet mature in students.

A form of summarizing which is active thinking that makes large amounts of information, from different sources manageable because it is consistent with the brain’s patterning systems.

Activates related prior knowledge and become a category network where the brain can organize future related information and supporting details

Uses core concepts as central parts of the template

Provides a brain-pattern consistent opportunity for students to actively learn as the reconstruct information they hear, read, and discover, into a personally meaningful framework

Can be a syn-naps and/or group activity
Choice of template (dopamine)
Can be Group, individual, or a combination

Samples of graphic organizers can be found at these websites:
Inspiration.com
http://www.ncrel.org/sdrs/areas/issues/students/learning/lr1grorg.htm
http://www.teach-nology.com/web_tools/graphic_org/
http://www.inspiration.com/freetrial/index.cfm
http://www.ncrel.org/sdrs/areas/issues/students/learning/lr1grorg.htm

More Mental Manipulation for Long-Term Memory & Concept Construction
Transform into different form than the way the material was taught:

- **Similarities and Differences**: just as survival depends on recognizing the changes in an animal’s expected environment (RAS of fox), people are also responsive to remembering information by identifying similarities and differences. Marzano compared studies research result for identifying similarities and differences and found a 12-46-percentile gain, greater than for any other relational memory strategy.

- **Analogies** for relational memory: White is to Snow as Blue is to Sky
Scaffold analogies, use ones students made last year) and leave out one, or two, of the four components of A is to B as C is to D. Then they can add the characteristic or relationship that ties the two sets together.
- **Similes**: Exercising my muscles makes me stronger like reading makes me smarter.
- **Puzzlemaker.com**
- **Mnemonics**: like PEMDAS for order of operations or ROYGBIV for the colors of the rainbow (red, orange, yellow, green, blue, indigo, violet).
- **Summarize**: Use texting activity for summarizing
“DEND-writes” to Summarize and Much More

During a Syn-naps or at the completion of a segment of instruction depending on student age and topic complexity, students respond to dend-write prompts. Their responses help them solidify learning and help you plan appropriately for their needs. Some dend-write prompts further clarify their areas of confusion, others provide personalization and mental manipulation for memory, and others promote higher conceptual thinking.

You can leave a permanent list of dend-write prompts up on the classroom wall that suit your subject matter and students’ ages.

Which Dend-Write and How to Respond
When checking for understanding, especially when on-going feedback tells you there are problems, you can use dend-write prompts such as #4, #7, or #8. Students should always start the response to include the positive statement that relates to the first part of the question. For #8 one would write, “The part of the lesson I enjoyed the most was ........ and something that still confuses me is........” In that way the will have a burst of brain satisfaction (dopamine) because they are recognizing an accomplishment. They then feel less anxious expressing what they still find confusing or difficult in the second part of their dend-write.

Dend-write Prompts

1. Create an analogy; write what it reminded you of, or how it fits with what you already know
2. Draw a picture, diagram, or graphic organizer of what you learned
3. A reaction/reflection of how something you learned relates to your life
4. Something that made you wonder or surprised you - a new insight or discovery
5. What do you predict will come next?
6. How could you (or someone in a profession) use this knowledge?
7. What you understood today that you haven’t understood before and something you are confused about or find difficult
8. The part of lesson that you enjoyed the most and the part most difficult for you
9. What strategy did you use to solve a problem today?
10. The “So What?” – What do you think were the most important things in the lesson and why are they important?

More Uses of Dend-writes

- Feedback to you- how accurately the lesson was understood
- Next class or after the syn-naps, correct any misperceptions you discover
- Check one or two responses on the best cards
- Students with checks share those insights with the class as review or to promote discussion (Lower participation anxiety – increased participation because confident that their response is correct)
- Students can add to their own notes based on their classmates’ dend-write reading
- Cards become study aides
Prefrontal Cortex for Highest Cognition and Executive Function

The prefrontal cortex is the last part of the brain to mature-myelination, pruning. The brain maturation of this executive function control center is the last to come “online” (and the maturation process continues into the mid twenties). The prefrontal cortex (PFC) responds to event and memory processing and makes conscious decisions. It is the region of the frontal lobe where the brain directs the planning of the movements to do a task.

The PFC, once mature is associated with the highest cognitive processes, also referred to as executive functions, including planning, decision-making, reasoning, and analysis. These executive functions, when formed into complete networks, allow for patterned information to be used for organizing, analyzing, sorting, connecting, prioritizing, self-monitoring, self-correcting, assessment of one’s strengths and best strategies, abstractions, creative conceptual problem solving, attention focusing, and linking information to appropriate actions.

Executive Functions: Cognitive processing of information that takes place in areas in the prefrontal cortex and allow one to exercise conscious control over one’s emotions and thoughts. This control allows for patterned information to be used for organizing, analyzing, sorting, connecting, planning, prioritizing, sequencing, self-monitoring, self-correcting, assessment, abstractions, problem solving, attention focusing, and linking information to appropriate actions.

- Mature humans are the only creatures with the ability to analyze their thoughts and behaviors and then act in accordance with expectations for goal attainment.

Executive Function Building and Concept Development Activities

- **Judgment**: This executive function includes self-checking strategies such as estimating or checking grammar accuracy, time planning, looking for clues for questions in subsequent questions, and checking in with oneself to monitor their focus.

- **Remembering and applying past** emotional behaviors and responses, test prep strategies that were successful, report planning experiences, and applying potential “learning experiences” from those past experiences to new situations and future decision-making, analysis, and judgments.

- **Prioritize**: Practice separating low relevance details from the main ideas as in word story problems. This represents the executive function of prioritizing skills to help students practice the cognitive strategy that will help them make the most efficient use of study time.

- **Setting goals, providing feedback, monitoring progress:**
  - Goal setting is an important life skill that students should develop before graduation along with academics skills
  - Students need more practice in setting manageable goals
  - Provide feedback on learning goals throughout the unit,
  - Metacognition opportunities: remembering and applying past emotions and experiences to new situations, decision-making, analysis, and judgment.
**Progress Tracking:** In 14 different studies, teachers had students in one class track their progress on assessments; in a second class, these teachers taught the same content for the same length of time without having students track their progress. On average, the practice of having students track their own progress was associated with a 32-percentile point gain in their achievement.

- **Concept Construction (also framegames)**
  
  **Concept Development Strategy:** Teacher gives examples and non-examples of a concept (mammal) that includes characteristics of mammal. They can use their notes. For scaffolding, students who need the help can be given defined categories into which some of the items have been sorted (and they have a list from which to sort others). Ask students who have a prediction first to see if they can make the correct prediction of the next few examples and non-examples before she says if it is a yes or no. Then, if correct about the connecting concept, they can offer another example (like button patterning). They then can add others independently and write what the commonality or concept is and share in small groups. Each group states the shared concept of the category into which the items fit by characteristics, with the whole class.

- **Open-ended, student centered discussions**
  
  Ask questions related to the topic of study that connect the new information to things about which students are already interested. These discussions start with core topic questions you frame that have more than one answer and ask for opinions so there is little risk of being wrong. Give wait time before any response is permitted to build judgment and communication skills. Encourage more than one opinion (problem-solving skills, patience, creative problem solving) and ask for reasons to support the opinion.

  **Discussion topics:**
  
  Any subject: Why might this information be useful to you someday? What people, doing what jobs might use this information? How could you use this information to build a better skateboard, advertise a product you invent, plan a party with a budget, write a book for a younger child about this topic. How might you explain this new information to a child from another country who has never seen a (fill in the module topic word here).

  **History:** How does learning about history help people in the present?

  **Science:** What is your favorite modern invention and how do you think it came to be invented – what did the inventor needed to know or have on hand to create the final product?

  **Literature:** How are you like the character in the book? What would you do if you had his problem? Why do you think he did ______?

**Historical inaccuracies in Videos for Executive Function and Engagement:** Historical inaccuracies are in many popular films like *Amistad, Amedeus, Glory, The Last Samurai* (the hero was French, not American). These can provide opportunities for Active Viewing, (like active reading when you provide them with goals, opportunities to make predictions, and preactivate interest by pointing out or having discussions about the ways to find personal
relevance in the chapter/book/film or certain characters). In viewing films with historical inaccuracies promote their curiosity and inclination to read the material in advance of the day you show the video, by challenging them to find the historical inaccuracies. This activity also builds students’ PFC executive function of critical analysis (fact vs. opinion/intentional distortion) of internet and other information sources.

Be sure to include a class discussion of these inaccuracies, or mention them yourself after the film so they sustain the correct memory in their neural circuits as studies relating film learning to class/textbook learning show the inaccuracies from the film are remembered preferentially unless clarified.

**Resources:**


We’re only human blog and podcast@ [www.psychologicalscience.org/onlyhuman](http://www.psychologicalscience.org/onlyhuman)

**Useful Definitions**

**Amygdala:** Part of limbic system in the temporal lobe. It was first believed to function as a brain center for responding only to anxiety and fear. When the amygdala is in this state of stress, fear, or anxiety-induced overactivation, new information coming through the sensory intake areas of the brain cannot pass through the amygdala’s filter to gain access to the prefrontal cortex and the information is conducted to the lower, reactive brain.

**Axon:** The single fiber that extends from a neuron and transmits messages to the dendrites of other neurons (or to body tissues).

**Cerebral Cortex:** This outer layer of the brain where most neurons are located is also called gray matter due to the coloration of the neurons. The cerebral cortex is associated with the highest cognitive processes, also referred to as executive functions, including planning, decision-making, reasoning, and analysis.

**Dendrite:** Branched protoplasmic extensions that sprout from the arms (axons) or the cell bodies of neurons. Dendrites conduct electrical impulses toward the neighboring neurons. A single nerve may possess many dendrites. Dendrites increase in size and number in response to learned skills, experience, and information storage. New dendrites grow as branches from frequently activated neurons.

**Dopamine:** A neurotransmitter most associated with attention, decision-making, executive function, and reward-stimulated learning. Dopamine release on neuroimaging has been found to increase in response to rewards and positive experiences. Scans reveal greater dopamine release while subjects are playing, laughing, exercising, and receiving self-acknowledgement for achievement.

**Executive Function:** Cognitive processing of information for higher functions such as organizing, analyzing, sorting, connecting, planning, prioritizing, sequencing, self-monitoring.
self-correcting, assessment, abstractions, problem solving, attention focusing, and linking information to appropriate actions.

**Graphic organizers:** Diagrams that are designed to coincide with the brain’s style of patterning. For sensory information to be encoded (the initial processing of the information entering from the senses), consolidated, and stored the information must be patterned into a brain-compatible form. Graphic organizers can promote this more patterning if they guide students’ brains when they participate in this creating of relevant connections to their existing memory circuitry.

**Hippocampus:** A ridge in the floor of each lateral ventricle of the brain that consists mainly of gray matter that has a major role in memory processes. The hippocampus takes sensory inputs and integrates them with relational or associational patterns thereby binding the separate aspects of the experience into storable patterns of relational memories.

**Limbic System** A group of interconnected deep brain structures involved in olfaction (smell), emotion, motivation, behavior, and various autonomic functions. Included in the limbic system are the thalamus, amygdala, hippocampus, and portions of the frontal and temporal lobes. If the limbic system becomes overstimulated by stress-provoking emotion (seen as very high metabolic activity lighting up those brain areas) the information taught at that time will be poorly transmitted or stored in the long-term memory centers.

**Neuroimaging (PET scans, fMRI scans):** The use of techniques to directly or indirectly demonstrate the structure, function, or biochemical status of the brain. *Structural* imaging reveals the overall structure of the brain and *functional* neuroimaging provides visualization of the processing of sensory information coming to the brain and of commands going from the brain to the body. This processing is visualized directly as areas of the brain “lit up” by increased metabolism, blood flow, oxygen use, or glucose uptake. Functional brain imaging reveals neural activity in particular brain regions as the brain performs discrete cognitive tasks.

**Neuron:** Specialized cells in the brain and throughout the nervous system that conduct electrical impulses to, from, and within the brain. Neurons are composed of a main cell body, a single axon for outgoing electrical signals, and a varying number of dendrites for incoming signals in electrical form. There are more than 100 billion neurons in an average adult brain.

**Neuronal Circuits or Neuronal Networks:** Neurons communicate with each other by sending coded messages along electro-chemical connections. When there is repeated stimulation of specific patterns of a group of neurons, their connecting circuit becomes more developed and more accessible to efficient stimulation and response. This is where practice (repeated stimulation of grouped neuronal connections in neuronal circuits) results in more successful recall.

**Neuroplasticity:** Dendrite formation and dendrite and neuron destruction (pruning) allows the brain to reshape and reorganize the networks of dendrite-neuron connections in response to increased or decreased use of these pathways. Plasticity refers to the ability of synapses, neurons, or regions of the brain to change their properties in response to usage (stimulation).
Neurotransmitters: Brain proteins that are released by the electrical impulses on one side of the synapse, to then float across the synaptic gap carrying the information with them to stimulate the next nerve ending in the pathway. Once the neurotransmitter is taken up by next nerve ending, the electric impulse is reactivated to travel along to the next nerve. Neurotransmitters in the brain include serotonin, tryptophan, acetylcholine, dopamine, and others that transport information across synapses. When neurotransmitters are depleted, by too much information traveling through a nerve circuit without a break, the speed of transmission along the nerve slows down to a less efficient level.

Prefrontal Cortex (front part of the frontal lobe): The prefrontal cortex responds to event and memory processing and makes conscious decisions. It is the region of the frontal lobe where the brain directs the planning of the movements to do a task.

Reticular Activating System (RAS): This lower part of the posterior brain filters all incoming stimuli and making the “decision” as to what people attend or ignore. The Reticular Activating System alerts the brain to sensory input that sense receptors in the body send up the spinal cord. The main categories that focus the attention of the RAS and therefore the student include physical need, choice, and novelty.

Scaffolding: This is instruction based on the concept that learning always proceeds from the known to the new. Students construct their new learning on the foundations of what they already know with the help of teachers, parents, or a more knowledgeable other who support them with instruction to help them build upon the abilities and knowledge they have to reach a higher level.

Synapse: These gaps between nerve endings are where neurotransmitters like dopamine carry information across the space separating the axon extensions of one neuron from the dendrite that leads to the next neuron in the pathway. Before and after crossing the synapse as a chemical message, information is carried in an electrical state when it travels down the nerve. It is through synaptic transmission that cells in the central nervous system communicate when an axon sends a neurotransmitter across the synaptic cleft to activate the receptor on the adjacent dendrite.
For Future Professional Learning Community Activities

RAD Lessons Taught by Teachers at Your School(s)

If you share the RAD strategies with teachers at your school, they can formalize them for your school to share and/or to contribute to a series of books I'll be writing. Since I have been sharing my suggestions for neuro-logical strategies to engage all learners in books and presentations I have received many emails from educators writing about strategies they learned from my books or presentations and the success they had when they applied these in their schools or homes. I realized we all learn so much from our fellow educators that I should make these specific applications of strategies available to our fellow educators. Your contributions are especially useful because they include how you modified my suggestions to best suit different age groups, subject areas, and types of learners.

Because this will be an ongoing book series there is no time limit. After the lessons are collected for the first book, the next ones submitted will automatically be considered for the second book in this continuing series of books.

You can use the instructions below to guide teachers or for your own RAD contributions

**MY RAD LESSON**

What strategy or lesson have you used, about which I have spoken or written, that has been successful for you. For example, lessons where you use one or more parts of "RAD" teaching

**Reach** (Focused attention & engagement, get through RAS filter to reach thinking brain in prefrontal cortex)

**Attitude** (Negativity & Stress = Behavior Problems and Learning Blocks. Solutions such as: Directing input through Amygdala with positive attitude, using Individualization for Achievable Challenge)

**Develop** Motivation, Long-Term, and Conceptual Learning (strategies involving: Dopamine, Neuroplasticity with Mental Manipulation and Mistake supported by feedback, Inquiry for Prefrontal Cortex)

Suggestions are listed below as to what to include, but it is not necessary for you to explain what may have happened in your students' brains during the experience. Please do so if you wish! I will write my interpretation of why I believe your lesson/strategy was neuro-logical.
Suggested information to include (only the first two are required)
Grade/subject where you taught this lesson or used this strategy
Grade/subject to which this lesson could be applied

Optional information to include
What brain-research based strategy did you have in mind?
Students' verbal, behavioral, written, and/or assessment results.
Your impression of what worked well (and if possible why you think it did).
Would you do anything differently next time?
Your advice to teachers who will use your strategy/lesson.

If available, please send your created materials and typed versions of student work.
*I will write the brain-link/gray matter - my impression of the neuro-logical basis and strengths of your lesson/strategy. (I won’t include any criticism because I will only select submissions that I can support). If you would like to include your own metacognition about the connection to what you did and how the brain learns, please do so.

Include with your submission:
Your name and credential:
Grade/subject you teach:
Name of school:
City and State:
Your email:
Your mailing address (to receive a copy of the book if your submission is included)
Email your lesson to jwillisneuro@aol.com

Options for Crediting You as the Source
After I return my edited version of what you submit, with my added neuro-logical connections, to you, you’ll have a choice of how you would like to be credited – with or without your name, school, city, head of school, or other information you choose.
Nothing sent will be used as a “bad example”.
If your input is selected it will be because it reasonable, appropriate, & neuro-logical.

Here is an example, from my own classroom, you can use as a guide for your submission.

Lesson objective: Introduction to unit about rules of punctuation
Grade: Taught to grade 5. Could be applied to upper elementary through high school.

Objective: To promote student interest in wanting to learn about proper use of punctuation so the lesson would engage their attentive focus.

Lesson description: The Problem - Low interest in learning required material:
We all know how much students love to learn and practice rules of punctuation. I can clearly visualize their glazed looks when I previously listed, lectured, and had them drill on placement of commas. Even when they “learned” these rules to successfully answer test questions, this knowledge did not become permanent long-term memory or the students did not recognize the concept of comma rules as something of value or personal relevance to apply to their own writing.

To promote curiosity and engage students through an area of high personal interest I told them I had an advance copy of the first pages of a new Harry Potter book by J.K. Rawlings. I explained that although she did not plan to write any more, she was inspired to do a follow up to her last book and a friend had gotten me a sneak preview.

After the students asked questions (I kept answering “you’ll see”) and class curiosity rose, I distributed a page of print. I actually took random paragraphs from an earlier Harry Potter book and typed them into the computer as a single paragraph. I did not include any punctuation or capitalization.

Student responses: After I distributed the page and put one on the overhead and varying durations of trying to make sense out of the page, students protested that they could not read the page. They were truly frustrated. I listened to their complaints and nodded agreement with most of them. The class was so engaged they essentially lead the discussion.

I then asked them to what they wanted to happen to resolve their frustrating dilemma. The initial responses were what has been called, “welfare teaching” where the teacher does the work for them.

“I want you to put in commas or periods or quotes so I know who says what.”

“I can’t read this because it is not separated into sentences and paragraphs. I need you to put things together that go together.”

My response was that I would help them figure out how to make the page readable if they would write down specifically what they needed to read it successfully.

Now the students took control of finding solutions to a problem they wanted to solve. They wrote:

“I need to know where to put periods so I can separate the sentences.”

“I want to learn how to pick words that should have capital letters and make those changes in this page.”
“I think there are people talking. I see Harry's name and words that don't look like regular words but that people use when they speak. I think those things are clues to where quotation marks go. I want to know if I am right and how else to figure out where to put quotes so I know who says what.”

**RAD Connection:** This is where you could write your impression of your lesson such as, this lesson connected with the “R” in RAD. By stimulating students’ interest and curiosity about personally meaningful reading their RAS filters were open to selecting the sensory input I offered in the lesson. The novelty, surprise, and high motivation of these students to read a “new” Harry Potter book resulted in their personalization of the learning goal. They had a “Here-Me-Now” desire to have punctuation. THEY WANTED TO LEARN WHAT I HAD TO TEACH.

I would then add any additional RAD connections I found in your lesson to your interpretations and make suggestions for adapting the lesson for other subjects or grades.