Welcome to a Brief Introduction to Your Brain! This will move F-A-S-T, so please, take notes. Use them as reminders and “talking points” for discussion.

Your Amazing Brain
It’s involved in everything we do, learn and achieve at school. In fact it’s about the only thing that is a constant among all your students. Isn’t that worth learning about?

Today’s Takeaway…

A – B – C

1. **Agree** on a clear, smart takeaway
2. “**Buy-in**” – are you “sold” on it?
3. **Commit** to implementation of one (1) powerful idea right away

You have much more to do with how your students turn out than you previously thought.
7 Discoveries
• Allostasis
• Emotion/Cognition Links
• Neuroplasticity
• Malleability of Memory
• Neurogenesis
• Social Neuroscience
• Gene Expression

Discovery #1 – Allostasis
Allostasis is the discovery that our bodies do NOT always return to homeostasis. This word describes the re-setting of your brain’s stress thermostat.

Chronic Stress Effects (T or F)?
1. Creates emotional problems (T or F)
   (Burgess et al. 1995)
2. Lowers IQ, reading scores (T or F)
   (Delaney-Black, et al. 2002)
3. Significant memory loss (T or F)
   (Lupien, et al. 2001)
4. Shortens dendrites (T or F)
   (Cook and Wellman, 2004), (Brown, et al. 2005)
5. Causes neuron death (T or F)
   (De Bellis, et al. 2001)
6. Fosters inappropriate attachments (T or F)
   (Schore, A. 2002)

Stress is a physiological response to a perception of a lack of control over an aversive situation or person

✓ Stress (on/off) is healthy for us. It often builds resilience. “Eustress” is the healthy stress you feel from a workout or excitement.
✓ Distress (chronic or acute) is toxic to our brain and body. It typically drains resources.

In Low SES Kids, the Chronic Stress Indicators Are 17% Higher Than They Are for the Non-Poor.
Stress is NOT “out there.” There are no stressful jobs; only people who experience stress at their workplace!

What Is Allostatic Load?
“Adjusted stress points which create excess demands on your mind and body that chronically deplete your available resources.”

EXAMPLES:
PTSD, Learned Helplessness, Depression, General Anxiety Disorder

Allostasis occurs when we re-set our brain’s thermostat (our “set point”) for metabolic functions

Distress Affects Neurons
Dendrites taken from rat PFC show effects.

How much (time) exposure to distress would you predict it would take for neurons to wither as shown?

a) 2 hrs./day…2 months
b) 30 min./day…7 weeks
c) 1 hr./day…10 weeks
d) 10 min./day…5 days

(Brown et al., 2005)

Pioneer in Allostatic Load
Originator of the “Allostatic Load” Concept, Bruce McEwen

The End of Stress
As We Know It

Bruce McEwen

Stress Activates
• Provide short-term energy
• Designed for short-term survival response
• Selective attention/Tunnel focus
• Immune function/Clotting
• Heart Rate/Blood flow

Allostatic Load Suppresses
• Growth and repair hormones
• Androgens, overall health
• Classroom creativity, patience, social skills and cognition
• Memory retrieval, neurogenesis
Allostatic Loads: Plasticity of the Nervous System

Stress “Load” Carried Daily

Each subject “feels fine” but one is paying a MUCH higher biological price.

Impact of Chronic or Acute Stress on Student Learning

Allostatic load reduces learning capacity in many ways:
1) reduced neurogenesis
2) impaired relationships
3) diminished cognition and memory
4) impaired creativity/patience

Distress is the “800 lb. gorilla” in the classroom every day.

Effects of Acute Environmental Stress on Neurogenesis

Telomeres (in yellow) Show Our DNA Age

A baby has about 1700 of these yellow bands (telomeres). They break off when cells duplicate. By age 70 we only have about 300 left.

Dr. Elisa Epel (in the back) is an asst. prof. in the UCSF Dept. of Psychiatry. She studied the effects of chronic stress on accelerated aging in humans through DNA markers on chromosomes.
Chronic stress aged women years faster than their healthy chronological DNA age!

**Effects of Chronic Stress on...?**
- Two groups of moms ages 20-50
- One group each had a healthy child (control group)
- The other group each had a chronically ill child

One way to measure aging is to examine DNA. Each time it makes copies, it loses telomeres.

**Chronic Stress is Killing You!**

- Actual Chronological age
- Altered DNA Stress age

**How Much Does Chronic Stress Age Your Body?**
- HOW much faster did the stressed women age than their official chronological age on their license?
  - a) 6-12 months
  - b) 1-3 years
  - c) 3-10 years
  - d) 9-17 years

**Do I have your attention yet?**

**The Stress We Experience Is Our Reaction To a Perceived Loss of Control Over an Adverse Situation**

- Increase the control and our stress goes down
- Decrease the control and our stress goes up

**The Chronic Stress Tie-in**

- Effort
- Behavior
- Capacity
- Attitude

*Everyone of these is Teachable!*
Solutions

- Empower students/staff in self-regulation strategies
- Create outlets for stressed kids
- Reduce chronic stressors in school environment
- Increase control

How to Reduce Chronic Stress

- Take Action (get control)
- Write it Down for Later
- 1 Week Rule
- Redirect Attention
- Let it Go
- Reframe the Experience
- Burn off Energy (play/exercise)
- Relax/Meditate/Sleep

Action Summary

Stop distressing and start thriving: 1) there is no stress “out there” or at our school, 2) choose a novel strategy you can use to reduce your “killer” distress and stick to it.

Discovery #2: Emotion/Cognition Links

The discovery that emotions influence our mind and bodies far more than we ever believed.

Pioneers in Links Between Emotions & Cognition

Richard Lazarus

Antonio Damasio

The separation model is NOT supported by recent brain research.
Why are Good States So Critical to Learning?

Our Brain Can Learn Simple Things Under Extreme Conditions But Complex Learning Requires Student Vesting, Working Memory, Retrieval, Critical Thinking and Risk Taking (All of Which are State Dependent)

States

1. States usually last for s______ or minutes, moods last for hours or days.
2. We experience 1____ of states every day.
3. More states i_____ learning than help it.
Expert Teachers Will Consistently Orchestrate Optimal Learning States

Teachers who criticize, hold negative attitudes and use sarcasm as classroom discipline will activate the fear and stress areas of the student’s brain.

How Much Input Does the Amygdala Have to the Rest of the Brain?

A lot! It also takes time to recover from fear activation!

Fight, Flight or Freeze?

Once the amygdala is activated in class, it takes at least 30 – 90 minutes to calm down for quality learning.

Emotional States: How To Influence Them

✓ Compelling Questions
✓ Social Structures
✓ Purposeful Music
✓ Celebrations
✓ Environmental Changes
✓ Storytelling

Savvy teachers are proactive and they orchestrate events, interactions and strategies in ways that enhance states.

The Emotions Tie-in

Everyone of these is Teachable!
Action Summary

Get savvy: 1) there are no unmotivated students in your class, only students in unmotivated states, 2) you’re in charge; change their states and you’ll change the class climate.

Discovery #3
Neuroplasticity

The discovery that the brain is highly susceptible to specific targeted environmental input and it follows reliable rules for change.

Pioneers in Neuroplasticity

Michael Merzenich
Paul Bach-Y-Rita
Paula Tallal

Your students DO NOT arrive at school “preassembled” by their DNA. Instead, they are “glued together” by life experiences.

What is Neural Plasticity?

LABEL: the brain’s capacity to physically change the size and capacity of cells based on experience.

PROPERTIES:
1) it is present in all animals, 2) it allows for strategic differentiation, and 3) it is regulated by age, experience and chemical signals.

Life Experiences Physically Change the Brain

- Human brains exhibit lifetime plasticity (capacity to physically change)
- Wide range of measurable changes
- The brain is designed to change from:
  a) genes
  b) gene-environment interaction
  c) environments
Follow the Rules for How the Brain Changes and You Will Get Dramatic Results

How do we know (for certain) that teaching changes brains?

A wide body of evidence suggests that the human brain is highly susceptible to environmental input. Teaching is a highly targeted form of environmental input. Therefore, teaching changes brains.

Follow the Rules for How the Brain Changes and You Will Get Dramatic Results
DNA is NOT Your Destiny!

Sometimes the apple DOES fall far from the tree!

What this Discovery Suggests

• We can be more effective teachers when we use the factors known to change the brain. Our success is determined by...
  1) quality of the plan
  2) being consistent
  3) staying persistent.

Schools and Brain Changing

• It is the consistency of positive environmental factors that counts.
• Your staff must buy-in to the process and goals of “upgrading the student’s brain” instead of complaining about it.
• Staff needs to be relentlessly focused on the few variables that matter most, day after day, to get miracles.
Here Are the Rules of How Brains Change!

1. Students absolutely must buy into it.
2. Process must be coherent to the student.
3. Their brains need error-correction.
4. The process needs increasing difficulty.
5. Students need to do it for 10-90 min. 3-5 days per week and the longer is better.
6. Once they get it right, they still need practice. (How many staff could name these?)

Neuroplasticity Tie-in

Everyone of these is Teachable!

Which Factor, (When Tested at Age 5) is a Far Greater Predictor of Student Success at Age 11 than IQ?

- reading scores
- motivation level
- math scores
- attitude
- working memory

Working Memory is Free, Easy to Build and It's a Teachable Skill

If You Don’t Teach It, Don’t Punish Kids for Not Being Good At It.

71 Working Memory and Attentional Skills Improved

A research-based software program from was used for 5 weeks. Students showed significant levels of improvement in many areas of executive function including working memory and attention.
Strategies for Working Memory

1. Games (e.g. Simon Says)
2. Clapping repeats
3. Repeat the directions
4. Repeat prior effort then add (sound, number or word, sentence)
5. Long-term? Music lessons!

Action Suggestion:
Brains are not stuck. You can make significant and lasting changes in your student’s brains. First, make the decision, then make a plan, then follow through.

Discovery #4
Malleability of Memory

The discovery that memories are not fixed; that they can and do change often.

Pioneers in Malleable Memories

Daniel Schacter
Elizabeth Loftus
Write Your List Here

**Our Brain as a “Gist” Gatherer**

We rarely get new and complex explicit learning right the first time. Instead, we gather the “gist” and make “rough drafts.” This is not what most teachers hope to happen. Nor is it what we test for.

**Malleable Memories: What Do We Do About It?**

- Attention/Buy-in
- Emotional Intensity
- Repetition/Revisit
- Coherent/meaningful
- Embody/Physical
- Rhymes/Mnemonics
- Multiple pathways

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"Great theory! But what do we do?"

Students will forget or have false memories about most of what they learn.

Staff must learn to teach working memory, do spaced (vs. massed) learning, error correct and review work.

**Action Summary**

Never complain that students forget things. Start teaching:
1) better memory tools for both long and short term, 2) use classroom strategies that make learning more meaningful and lengthen the time of the learning.

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For Over 100 Years, Scientists Accepted as “Fact” that Our Brain Never Grew New Cells
After all, if it were true, it would mean that we could grow and “rewire” ourselves during our own lifetime!

Neurogenesis
Importance
- That it occurs
- That neurons survive
- They become functional
- They influence mood, learning, memory and weight control
- The process is regulated by our everyday behaviors

Neurogenesis (the production of brand new brain cells) is...
Enhanced by:
- Exercise
- Complex Environments
- New Learning
- Prosocial Contact
- Nutrition
- Low Stress

Reduced by:
- Distress
- Inactivity
- Boredom
- Depression
- Poor Nutrition
- Isolation & Low Social Status

P.S. Teachers can influence many of these factors!
“Great theory! But what do we do?”
Your students will generate new neurons each day. Some neurons will die.
But whether your students have a “net gain” or “net loss” is partly up to how their school day goes. You can foster neurogenesis.

Put P.E. Right Before a Math Class?
Here’s the % Boost in Algebra Scores

<table>
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<tr>
<th>Test</th>
<th>Exercise</th>
<th>Without Exercise</th>
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<tr>
<td>Ratey (2007) Score</td>
<td>15</td>
<td>11</td>
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+ 4%  + 20%

Smart educators are making sure their students get plenty of voluntary gross motor physical activity every day!

Evidence of Exercise-Induced Changes in Brain (Neurogenesis)

On L, before exercise, on R, after exercise. The new neurons in the hippocampus are the labeled red and yellow dots.

Neurogenesis Tie-in

Everyone of these is Teachable!
Action Summary
You can influence student’s brains: 1) boost neurogenesis, 2) use physical activity like recess or PE, then add greater social bonding and cognitive complexity.

Discovery #6
Social Neuroscience
The discovery that social conditions have a much greater impact than previously believed.

Pioneers in Social Neuroscience
John Cacioppo
Gary Berntson

Invest Time in Your Students Differently as Their Social Brain Matures
K-2 level
1. Relationship building

Grades 3-5
1. Relationships
2. Affiliation

Grades 6-12
1. Relationships
2. Affiliation
3. Status-building

Social Conditions Influence:
- Stress levels
- Cognition
- Mood and affect
- Status
- Immune systems
- Self-concept
- Motivation
- Performance
- Use of drugs

Students are Hard-Wired to Affiliate, Seek Acceptance, and Prefer Peer-Bonding
Yet much of their day they are disciplined for talking, texting, joking, passing notes, bonding and seeking friends. When your classrooms and schools are run the way the brain naturally works, the kids will start learning and quit annoying you!
Two Brain-Based, Hard-Wired Social On-going Student Quests

1. The quest for acceptance and affiliation (“How can I become part of a group?”)
2. The quest for social status (“How can I feel special?”)

HINT: DO NOT get in the way of these; simply anticipate and facilitate the inevitable process in productive ways!

Teachers Strongly Influence Student Social Status

How? Through decisions, privileges, affirmation, mentors, drama, team culture, social recognition, cooperative learning, positive feedback, skill-building and giving responsibility and leadership roles.

Suggestions

• Make pro-social climate a school-wide priority
• Insist on mentoring, clubs, teams and social skill-building
• Nobody goes unnoticed!

Action Summary

Make your learning time half social and half individual. 1) put kids in cooperative groups or teams, 2) use partners or social media.

Discovery #7: Gene Expression

The discovery that our genes are NOT our destiny and that gene expression is more critical than the original “blueprint.”
Old Paradigm: Brains Stay the Same; Kids Stay the Same

New Understanding: Brains can and do change everyday. But if the circumstances around a kid (home and school) remain the same, so will his or her brain!

What Determines Our Destiny?

Heritability of IQ Varies

Can Educators Trigger Gene Expression? Yes!

Genes Are Not Your Destiny: Both Genes (10%) and Environment (90%) Influence Cancer Risk

The Relevance?

There’s nearly a 2-1 advantage of the potency of environmental influences over genetic ones. This suggests hope for all students! (Devlin et al., 1997)
What this Discovery Suggests

It’s *the aggregate* of good things *over time* that make such a positive difference in the brain.

The Student’s “Big Four”

Everyone of these is Teachable!

- Every staff member should know and use FACTORS that drive positive brain changes.
- There is plenty of time for your staff to transform student attitudes and learning IF they learn to teach SMARTER not harder.

CRITICAL:

How Much do Teachers Matter?

Recent research suggests that in total, approximately 50-60% of the variation in the performance of students comes from their school experience with the remaining being due to genes, student background, homelife or random influences.


10-Yr. Effects of Low vs High Effective Teachers on State Test Scores in TX

DNA is NOT Your Destiny!

Sometimes the apple *DOES* fall far from the tree!
Brain Research May Effectively Be Used as a Filter for Understanding and Developing Policy as Well as Selecting Smart Classroom Practices

Policy makers and educators can either use what we know… or Struggle because you’re working against yourself. “What did you learn today?”

Let’s Simplify… A – B – C

1. **Agree** on a clear, smart path
2. “Buy-in” from yourself
3. **Commit** to implementation

7 Discoveries

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Transfer Time!

Take what you have learned and ask yourself how it might apply to your own job. Which area of your work, in particular, can you apply this to and how would you do it ASAP?

Nothing will change in your classroom until you: 1) make a decision to change, 2) act on that decision, and 3) sustain and strengthen the strategy over time. So, what will it be?
The next two slides were from the working memory quiz given earlier.

**My Follow-Up Plan**

1. WHAT WILL I DO DIFFERENTLY:

2. EVIDENCE of MEASURES:

3. START DATE

4. WORK PARTNER:

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