

# **BUILDING BETTER BRAINS: APPLYING BRAIN SCIENCE TO SCHOOL MENTAL HEALTH**

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# Various Influences

	<u>Metas</u>	<u>Studies</u>	<u>People</u>	<u>Effects</u>	<u>ES</u>	<u>se</u>
<b>Teacher</b>	<b>29</b>	<b>2,052</b>	<b>.5m</b>	<b>5,379</b>	<b>.50</b>	<b>.05</b>
<b>Curricula</b>	<b>135</b>	<b>6,892</b>	<b>7m</b>	<b>29,476</b>	<b>.45</b>	<b>.07</b>
<b>Teaching</b>	<b>344</b>	<b>24,906</b>	<b>52m</b>	<b>50,953</b>	<b>.43</b>	<b>.07</b>
<b>Student</b>	<b>133</b>	<b>10,735</b>	<b>7m</b>	<b>37,308</b>	<b>.39</b>	<b>.04</b>
<b>Home</b>	<b>31</b>	<b>1,998</b>	<b>10m</b>	<b>3,968</b>	<b>.35</b>	<b>.06</b>
<b>School</b>	<b>96</b>	<b>4,019</b>	<b>4m</b>	<b>13,609</b>	<b>.23</b>	<b>.07</b>
<b>Average</b>	<b>768</b>	<b>50,602</b>	<b>82/241m*</b>	<b>140,693</b>	<b>.40</b>	<b>.06</b>

# What Matters for School Achievement

- **Students become aware of how what they are learning is important to them**
- **Students evaluate/appraise (become responsible) for their own “getting of content”**

# What Matters for School Achievement

- **Students are not distracted**
  - **By other students**
  - **By their emotional reactions**
  - **By that which doesn't matter (focus on that which is irrelevant [distractions, rules])**

# Neuroscience Finding #1

What's good for the body is good for all its organs.

The brain is a body organ. So things that benefit the other organs are also good for the brain.

Back to school boards; sleeping at school is cost-ineffective and intrudes on classroom instruction

**School Start Time in Edina and Minneapolis was changed from 7:15am to 8:40am**

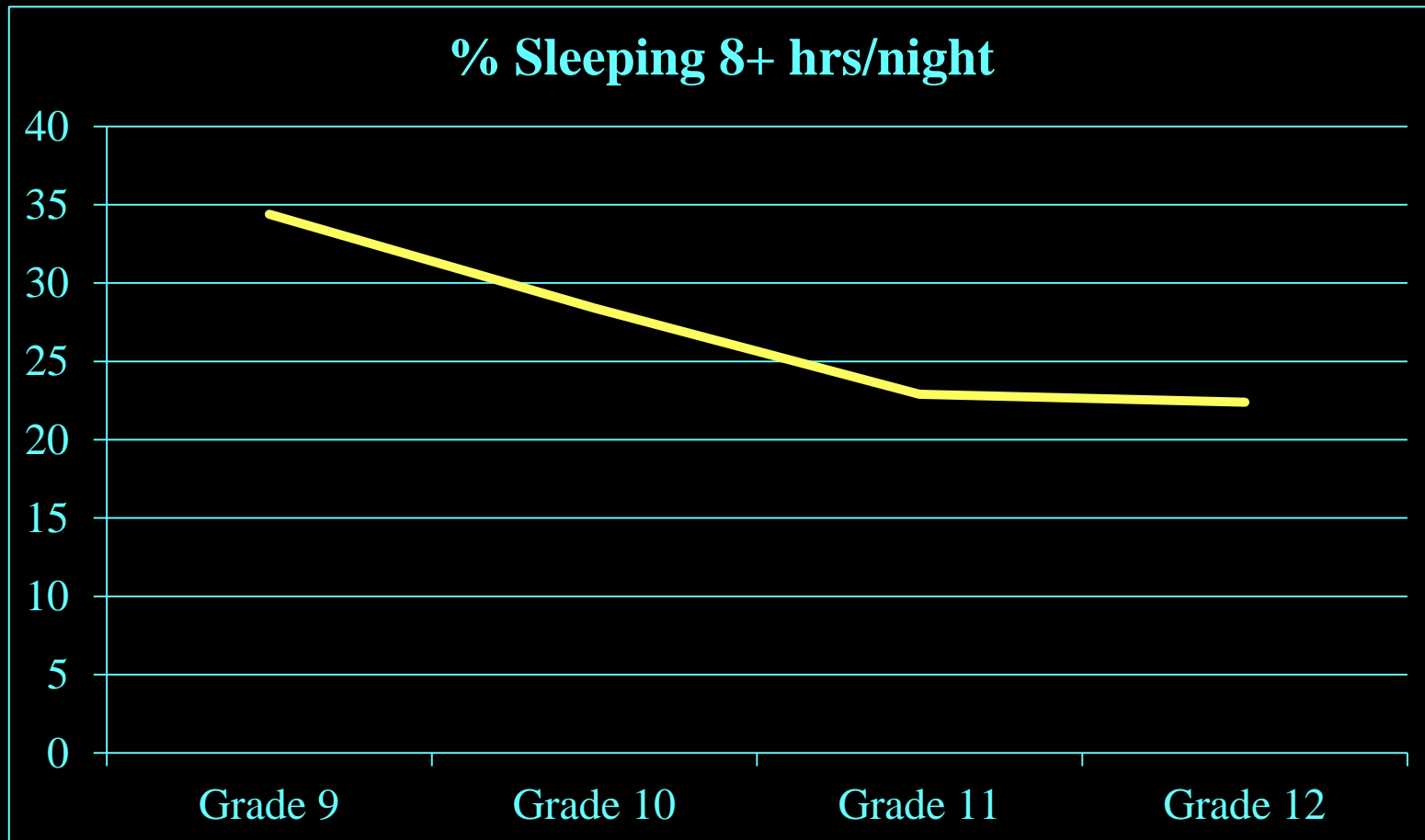
**Sleep increased by 1 hour in students throughout**

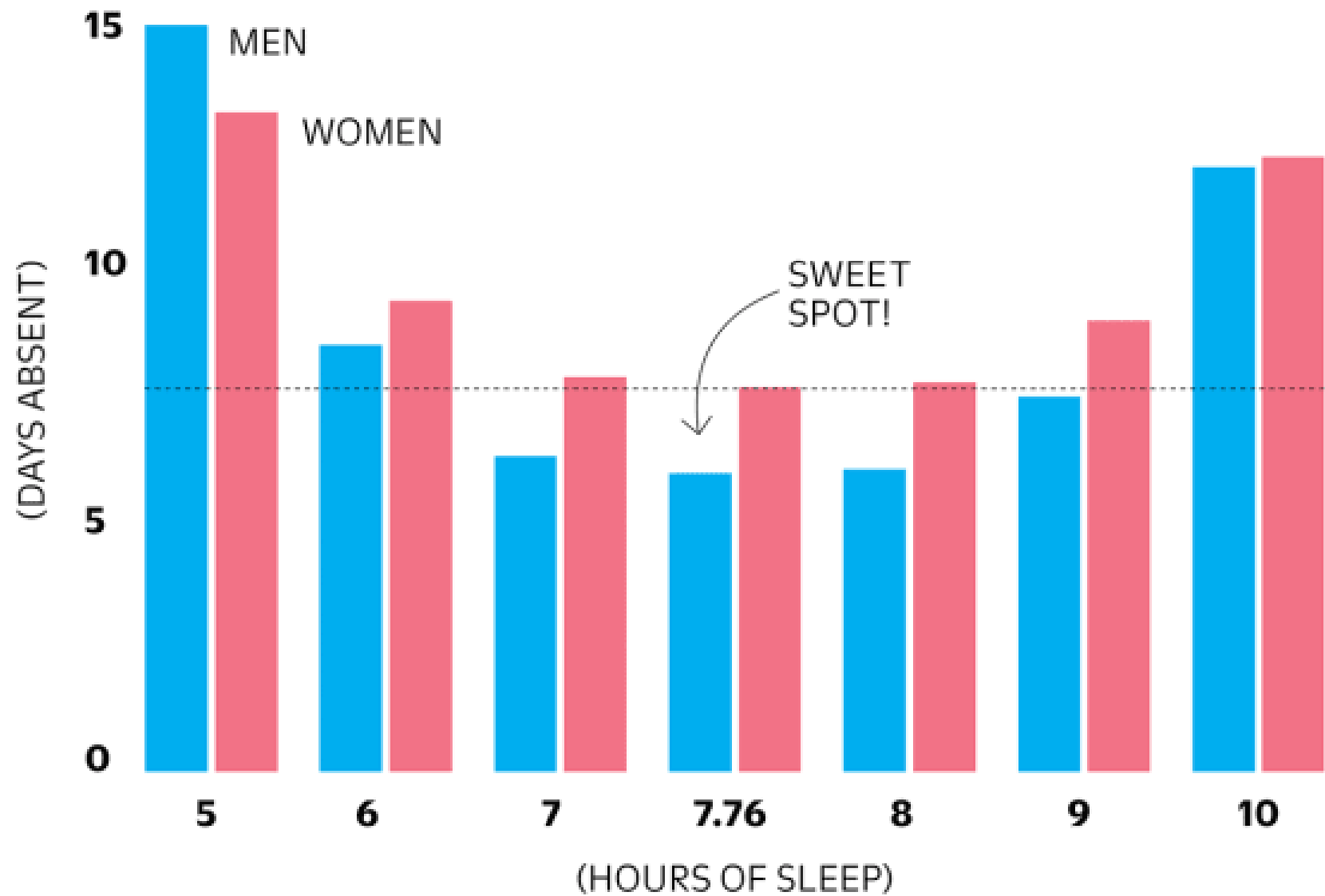
**Students less likely to fall asleep during am classes, or to be late**

**Principals, Counselors reported students “calmer” and fewer discipline referrals**

**Parents reported students “easier to live with”**

# Sleep Among Youth YBRS, 2015







# BETTER SLEEPING

- Body Routine:
  - Caffeine restriction  
(beginning in the afternoon)
  - Meals/drinks *small* before
  - Complete exercise (3 hours before)

# BETTER SLEEPING

- **Temperature:**

- Optimal bedroom temp is **60-67F**)
- Baths/showers (warm); body temperature changes when out and into room so more dramatic cooling (and easier to fall asleep)
- Face into cold water (Mammalian Dive Reflex: lowers BP/HR)
- Melatonin; cools and responds to darkness

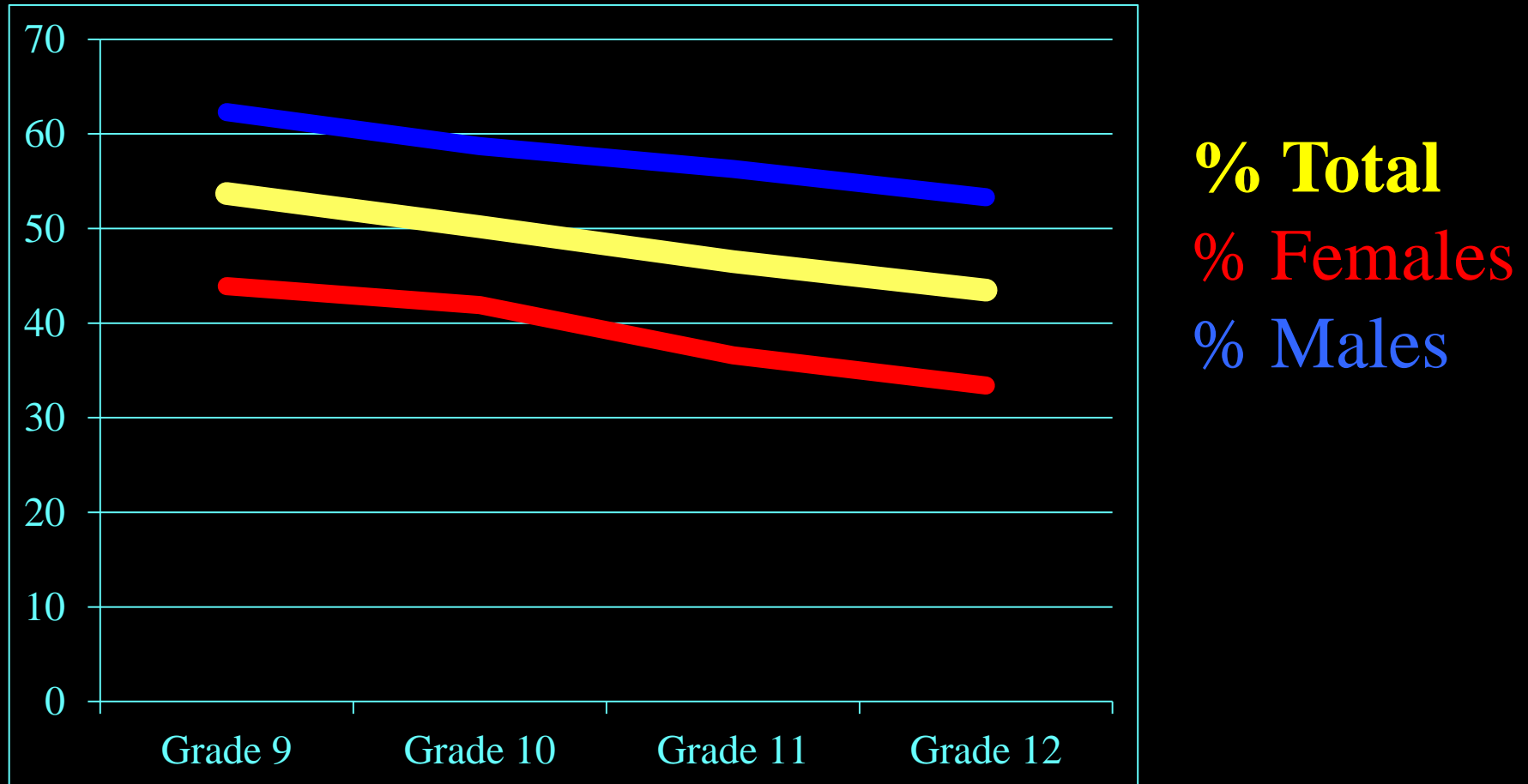
- **Light:**

- Daylight during the day and not at night (fluorescent lights, LED);
  - Set Phone for night (more red or yellow light instead of blue)
  - Apps/Software (currently free):
    - **FLUX** (for Mac: [www.getflux.com](http://www.getflux.com))
    - **TWILIGHT** (for Android)
  - Can wear tinted glasses at night
- **Screens off 1-2 hours** before or adjust for blue-light
- **Candlelight for dinners, baths)**

# BETTER SLEEPING

- **Sound**
  - Classical or *slow music at 60-80bpm for 45min before sleep* (2008 study in students 19-28 showed improved sleep quality and decreased depression)
  - White noise, fans
- **Smell**
  - Sniff **lavender oil** in bedroom for several minutes about 30min before go to sleep
- **Breathing:**
  - Blow bubbles; relies on deeper breaths, decreases stress
  - 4-7-8 breathing (DrWeil.com): inhale through nose as count to 4, then hold for 7 seconds, then exhale with tip tongue raised behind upper teeth for 8 count, then repeat 3 more times (increases oxygen in blood, releases more CO<sub>2</sub> from lungs and lowers HR)

# % Getting 60min Exercise 5 days/wk YBRS, 2015



- Decreased BDNF in hippocampal regions associated with suicide, regardless of Dx (Karege F et al., Brain Res Mol Brain Res. 2005 May 20;136(1-2):29-37)
- VFX TX: increased BDNF (18-34ng/ml) levels correlated with decreased HAM-D Scores (23-8) Aydemir O et al., Prog Neuropsychopharmacol Biol Psychiatry. 2005 Feb;29(2):261-5.
- S-Cit TX: decreased BDNF in depressed Pts, and S-Cit 10mg/d increased BDNF levels by 6 wks S-Cit Tx back to levels of healthy controls Aydemir O et al., Prog Neuropsychopharmacol Biol Psychiatry. 2006 Apr 27: ePub.

43 Canadian athletes from high and low impact sports were MRI'd; ½ had concussions

Decreased Frontal lobe volume & blood flow

Repeated concussions decreased insular regions (emotional regulation area) “don’t slow down/regulate—just run”

Hippocampus increased (emotion and memory connection center) “don’t do that again—that really hurt”

(Churchill N, Hutchison M, Richards D, et al. Brain Structure and Function Associated with a History of Sport Concussion: A Multi-Modal Magnetic Resonance Imaging Study. *Journal of Neurotrauma*. 2016 )

Paul J Kenney: Nature Neuroscience, 2010: rats fed high fat and high sugar foods triggered reward centers like cocaine, and sought more and more often to achieve same pleasurable sensation from eating, even if “shocked” while eating (3 groups (eat all wanted, eat limited amount, or no sugar), the group that could eat as often as wanted became more obese and “tolerance” developed so that needed more chocolate to get same pleasure, while other 2 groups would stop eating if shocked); appears to be burning out of the dopamine receptors that leads to overeating.

Furthered by J. Schroeder, Connecticut, 2013: rats ate Oreos, rat food, or cocaine or morphine, and examined the nucleus accumbens, the brain’s pleasure center, measured the expression of a protein there [c-Fos]. So it basically tells whether that brain center is being turned on or not in response to a behavior. found that there was a greater number of neurons that were activated in the brain’s pleasure center in animals that were conditioned to Oreos compared to animals that were conditioned to cocaine [or morphine]."

## Socrates drank Hemlock; We drink Diet Soda

### Why is Diet Soda Addictive?

Aspartame, the chemical sweetener used to replace high fructose corn syrup in diet soda, activates the reward centers in your brain. <sup>[1]</sup> The trouble is, because aspartame doesn't provide any calories (energy), the body misses out and makes it crave more. It's your body's way of basically "reaching out" for fuel when it's missed the calories from the first hit of diet soda consumption. Diet soda is trying to trick the body, but the body rebels and makes you want more and more to satisfy those reward centers in the brain and provide energy for cells.

Brain chemistry is also tampered with when aspartame is ingested. Aspartame is comprised of two amino acids and a methyl ester, and these compounds can affect the dopamine system in the brain linked to positive reinforcement. <sup>[2]</sup> Alcohol and drugs can cause similar effects, but at different levels of severity. The caffeine in diet soda—not to mention in regular soda, coffee, and energy drinks—is considered a drug, and an addictive one at that. Caffeine is a psychostimulant, and, when combined with aspartame's dopamine effects, increases addictive behavior. <sup>[3]</sup>



Here are 10 of the healthier protein bars to try; best if replacing a small meal or large snack (not just an addition to other meals)

Big rules: 1) if snack < 200 calories, if meal replacement >200 cal; 2) look for fewer ingredients as lower “processing”; 3) sugars are deceptive as “alcohol sugars” such as marnitol, xylitol in ThinkThin can be hard for stomach (pain, bloating), so look for <12g sugar/bar

from <http://www.eatthis.com/best-protein-bars/>

# Why do we choose unhealthy foods?

- 1) Lighting: darker rooms make us more likely to eat bad foods (less focused)
- 2) Planning: Planning before go to lunch decreases caloric intake by 10%
- 3) Menu'ing: “ironic self-control” : if shown menu with healthy option (veggie burger), more likely the choose the bacon cheeseburger as “did my healthy part looking at it, so now enjoy what tastes better”
- 4) Sleep: When sleep is restricted, the primal reward center of the brain becomes more active while executive functions of the frontal lobes become more suppressed. This effectively diminishes willpower, making people more likely to seek out foods high in fat and sugar, which are logically poor choices that trigger the reward center.

# APPETITES

- Fruit = lower rates of anxiety, depression, emotional distress (compared to chocolate) (Smith et al, 2014)
- High-sugar snacks increase dysphoria (Smith et al, 2014)
- Rodents fed high fat & sugar diet decreased BDNF (so higher levels of depression & anxiety) (Knuppel, 2016)
- High sugar diets associated with increased risk of depression, possibly related to decreased BDNF, increased inflammatory markers and hypoglycemia secondary to exaggerated insulin response; those with the highest sugar intake found to be increased risk for common mental health disorders like anxiety and depression (Knuppel, 2016)

# Family Dinner

## 1) Science

- a) Compare 3 different flavored waters (flexibility)
- b) Notice differences between these leaves

## 2) Language Arts

- a) Compare/contrast leaves/waters
- b) Study the leaf—write the Leaf's Story

## 3) Math

- a) How should we build a treehouse?
- b) How could you/we save for a \_\_\_\_\_?

## 4) Arts

- a) Discuss preferred characters in a movie, or why character did what did
- b) Listen to (soft) music during dinner; what like and why

- Meta-analysis of 19 studies of music training for 3-12yo's showed improved visual-spatial ability (Hetland, 2000)
- 36 wks improved cognitive abilities of Canadian 6yo's (Shellenberg, 2004)
- 24 wks improved reading ability (but not IQ) in Portugese 3<sup>rd</sup> graders (Moreno et al., 2009)
- Improvements in self-esteem (Rickard et al., 2013), and school engagement (Eerola & Eerola, 2014)

# How to Practice Playing Music

The Study: Robert Duke (UT), Amy Simmons (UTSA), Carla Cash TTU) : 17 pianists, new Shostakovich piece, learn 3 bars to be judged next day; spent 8-57 min, couldn't rehearse thereafter, and played the next day and evaluated (by playing it correctly, right notes in time, but also musically)

# BAD MUSIC HABITS

- 1) Play same speed all the way through and “do the best you can” with the hard parts
- 2) Stare at the music on the page—as long as you’ve played all the notes, it’s music
- 3) If you get through the whole piece without stopping, you did good
- 4) If you play your part well, the band sounds good

# GOOD MUSIC HABITS

- 1) Both hands together early in practice.
- 2) Practice with musicality (inflection) early on
- 3) Practice it thinking musically, by singing/humming, pauses, figuring out what's new.
- 4) Errors were preempted by stopping (stop before butcher section and create "error" neural pathway; practice makes \_\_\_\_\_).
- 5) Errors were addressed immediately when they appeared (go over the mistake til correct, then play the whole section).



# GOOD MUSIC HABITS

- 6) The precise location and source of each error was identified accurately, rehearsed, and corrected.
- 7) Tempo varied systematically; slow things down to get tricky sections correct, then play faster.
- 8) Target passages were repeated until the error was corrected and the passage was stabilized, as evidenced by the error's absence in subsequent trials.

# School Applications

- Exercise: 5 times/wk
- Music: 30min/day
- Sleep: 8-10 hrs/night
- Nutrition: dance with fruits and vegetables

# The Brain Becomes the Brain

By overproducing...

then fighting it out

# Eliminate Distractions

- **Top 5 distractions: cell phone/text, Internet, gossip, social media, email**
  - | **Limit E-mail/social media 3 times per day and scheduled; unfriend/unfollow everyone who's not truly important to you (measuring your life by # of "likes" yields little)**
- **If hard to get going, set timer for 2 min and then *start (jump in to task)***

# Early Experiences Matter

# Overheard Cell-Phone Conversations in Psychological Science 2010

*When Less Speech Is More Distracting*

[Lauren L. Emberson, Gary Lupyan, Michael H. Goldstein, Michael J. Spivey](#)

Why are people more irritated by nearby cell-phone conversations than by conversations between two people who are physically present? Overhearing someone on a cell phone means hearing only half of a conversation—a “halfalogue.” We show that merely overhearing a halfalogue results in decreased performance on cognitive tasks designed to reflect the attentional demands of daily activities. By contrast, overhearing both sides of a cell-phone conversation or a monologue does not result in decreased performance. This may be because the content of a halfalogue is less predictable than both sides of a conversation. In a second experiment, we controlled for differences in acoustic factors between these types of overheard speech, establishing that it is the unpredictable informational content of halfalogues that results in distraction. Thus, we provide a cognitive explanation for why overheard cell-phone conversations are especially irritating: Less-predictable speech results in more distraction for a listener engaged in other tasks.

/abstract content

# Neuroscience Finding #2

The brain responds to  
“environmental clarity.”

Whatever proves most important and is done repetitively, remains, while the other connections are pruned away to allow those pathways to become super highways.

# School Applications

- Decide priorities and create and favor experiences in that direction
- If want students who can solve novel problems, practice novel problem-solving



# Neuroscience Finding #3

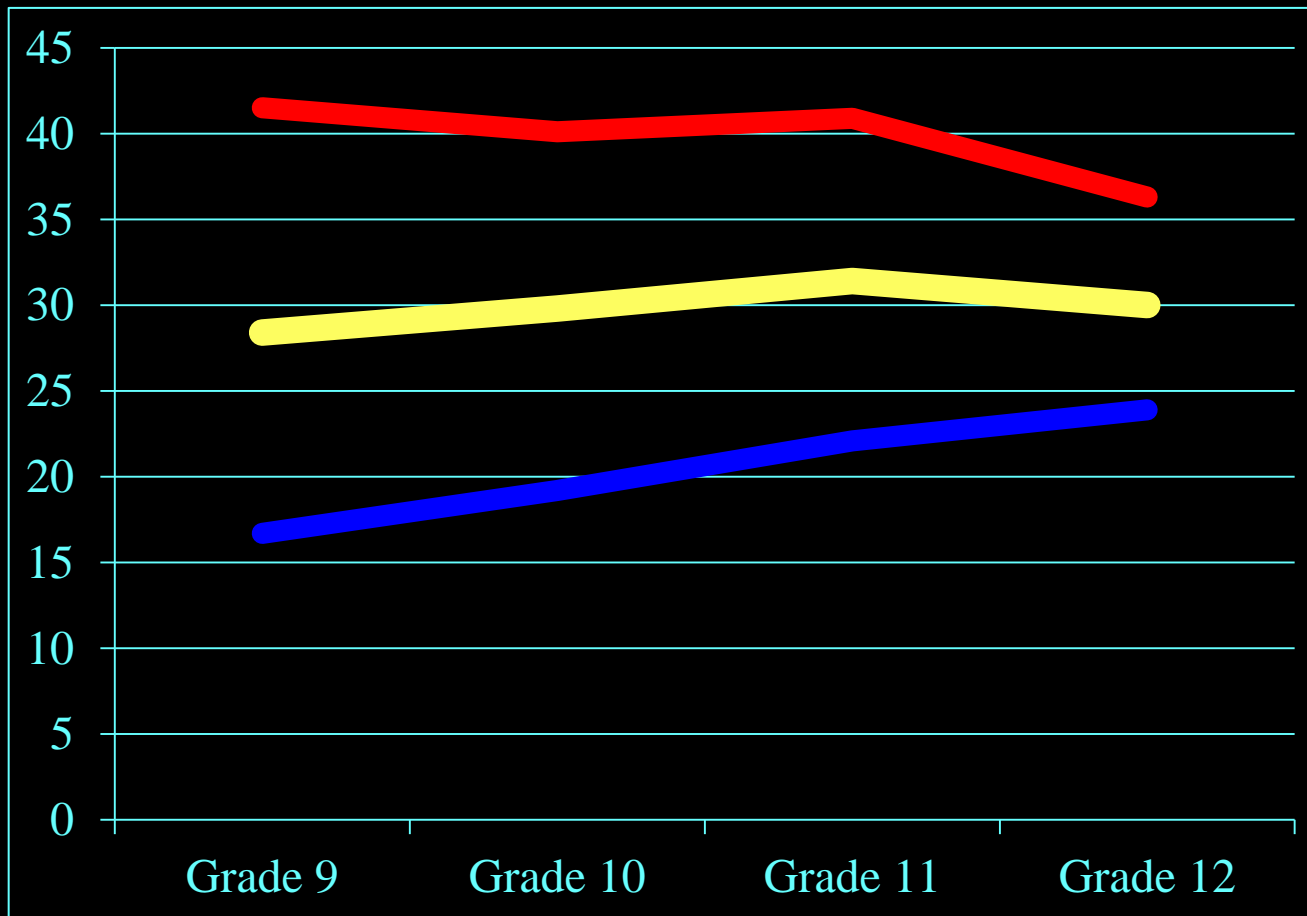
The brain seeks to find, or  
create, meaningful  
connections

(so we have to help new  
information appear  
meaningful)

# School Applications

- Experiences that are Fun and Meaningful Stick Better
- Find, identify, have them look for connections between learnings (and how connects/applies is meaningful to their life
- Know about your Students' Interests and Vulnerabilities

# % Feeling Sad or Hopeless YBRS, 2015



**% Total**  
**% Females**  
**% Males**

# % Seriously Considering Suicide YBRS, 2015



**% Total**  
**% Females**  
**% Males**

# Emotions

MDD adolescents (n=16) compared to healthy controls; more amygdalar connectivity, and intensity related to duration of illness  
C Jin. Neuroscience Letters, Oct 3, 2011, Vol.503(2), p.105(5)

# Neuroscience Finding #4

The adolescent brain selectively processes information through emotional centers

# School Applications

- Anticipate Emotional Reactions and Preview Cognitive Options
- Help Students Save Face
- Take out of Emotional Cycle
  - Is it warm in here?
  - Are you thirsty?

(D Yurgulun-Todd; J Giedd)

# Neuroscience Finding #5

The brain selectively looks  
for trouble  
(to remain alive)...

But that's limited fun.



# The Science

- **The present moment is but one point in your life—a minute to an hour**
  - **Humans overestimate the time and intensity they'll be impacted (good or bad) by an event**
  - **We don't know what we don't know—we have little accuracy about the future (what imagine life will be like is altered by what it is [love will be bliss...but also arguments])**

**(T Wilson & D. Gilbert, 2005)**

# School Applications

- Students will anticipate the worst
- Students will overvalue negative experiences
  - Sooooo.... “evaluate” all the evidence
  - Alter destructive thought cycles
  - Reflect...when calmer

# Neuroscience Finding #6

Traumatic events  
overwhelm the brain and  
induce shutdown.

# School Applications

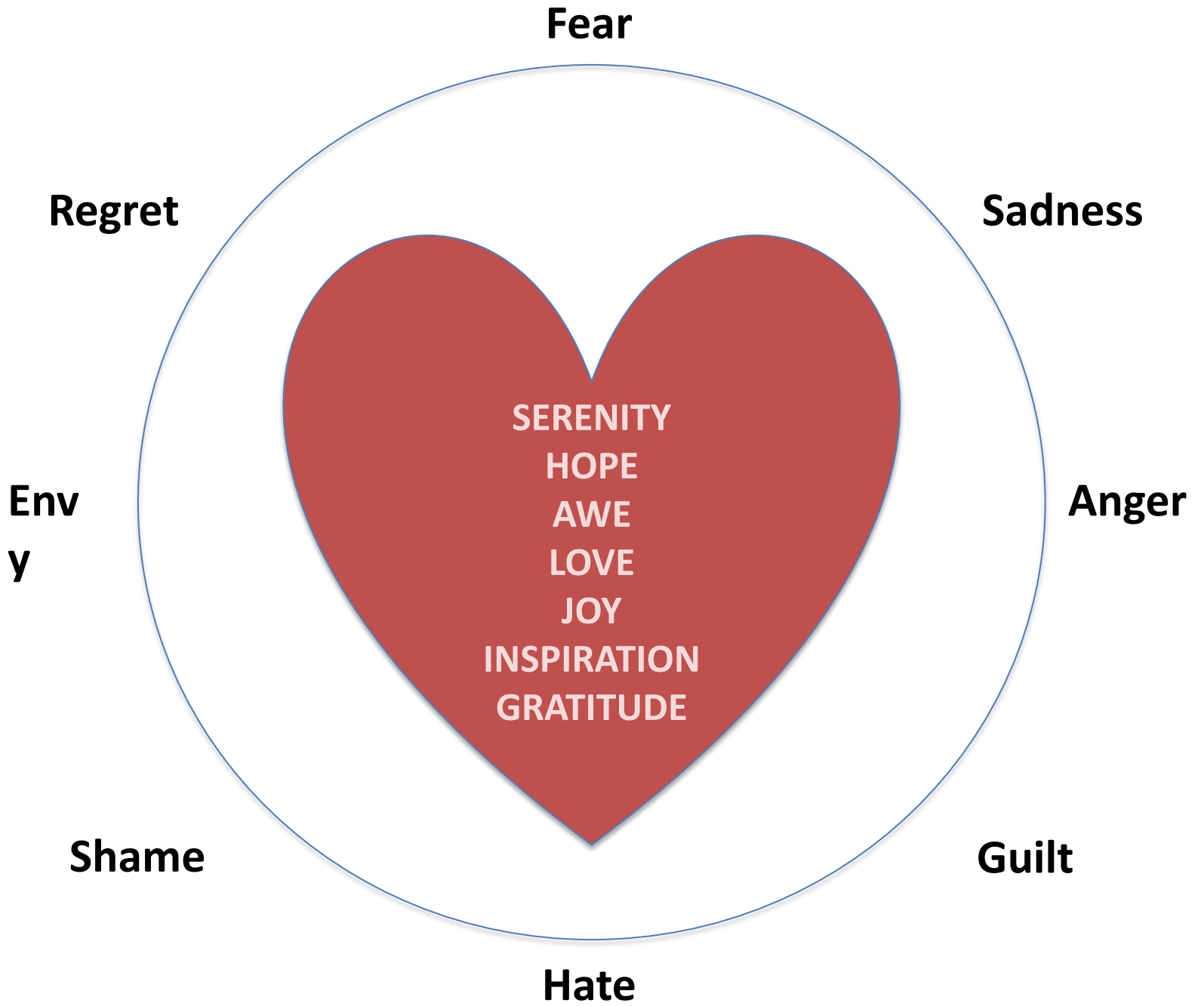
- Students may be triggered by peculiar stimuli
- Monitor Shutdowns and Dissociative Moments
- Preview what's coming up
- Anticipate Trigger situations and rehearse (cognitively)

# Neuroscience Finding #7

The brain focuses first and foremost on dangers, and when found, reverts to and relies on primitive brain reactions to survive.

# School Applications

- Focus always on what do you want
- Don't say "don't do that" 😊
- Instead say what options are, elaborate consequences to different options



# Negative ~ Survival Emotions

- **Trying to ignore, suppress, fight against urge (e.g., substance abuse) lead to more intrusive negative thoughts (EL Garland, 2012; DJ Kavenaugh, 2009)**
- **Trying to suppress insomnia thoughts increased dreaming about (RA Bryant, 2011)**
- **Holding simultaneous positive and negative thoughts about topic (“feel sad about failure but positive about changing job”) heralded change (JA Adler & HE Hershfield, 2012)**



# Negative ~ Survival Emotions

- 1. Breathe as stay with/experience negative emotion and let it pass (AP Jha, 2013)**
- 2. Accept negative thoughts as part of life so can recognize “direction” (going in better or worse ways)**
- 3. Goal is to use it (the negative emotion) and then lose it (to a positive emotion: “I survived that sadness...I’m proud/happy/inspired”)**
- 4. Use preferred emotions as signal of strength, rather than trigger to prepare for impending disaster (Brene Brown, 2013)**

# School Applications

- Resonating+ with Child's Survival Emotions (sympathetic error)
- Instead of resonating then escalating (RTE), this too shall pass (better in seconds than hours)
- Competing response/activity to go from amygdala to frontal lobe