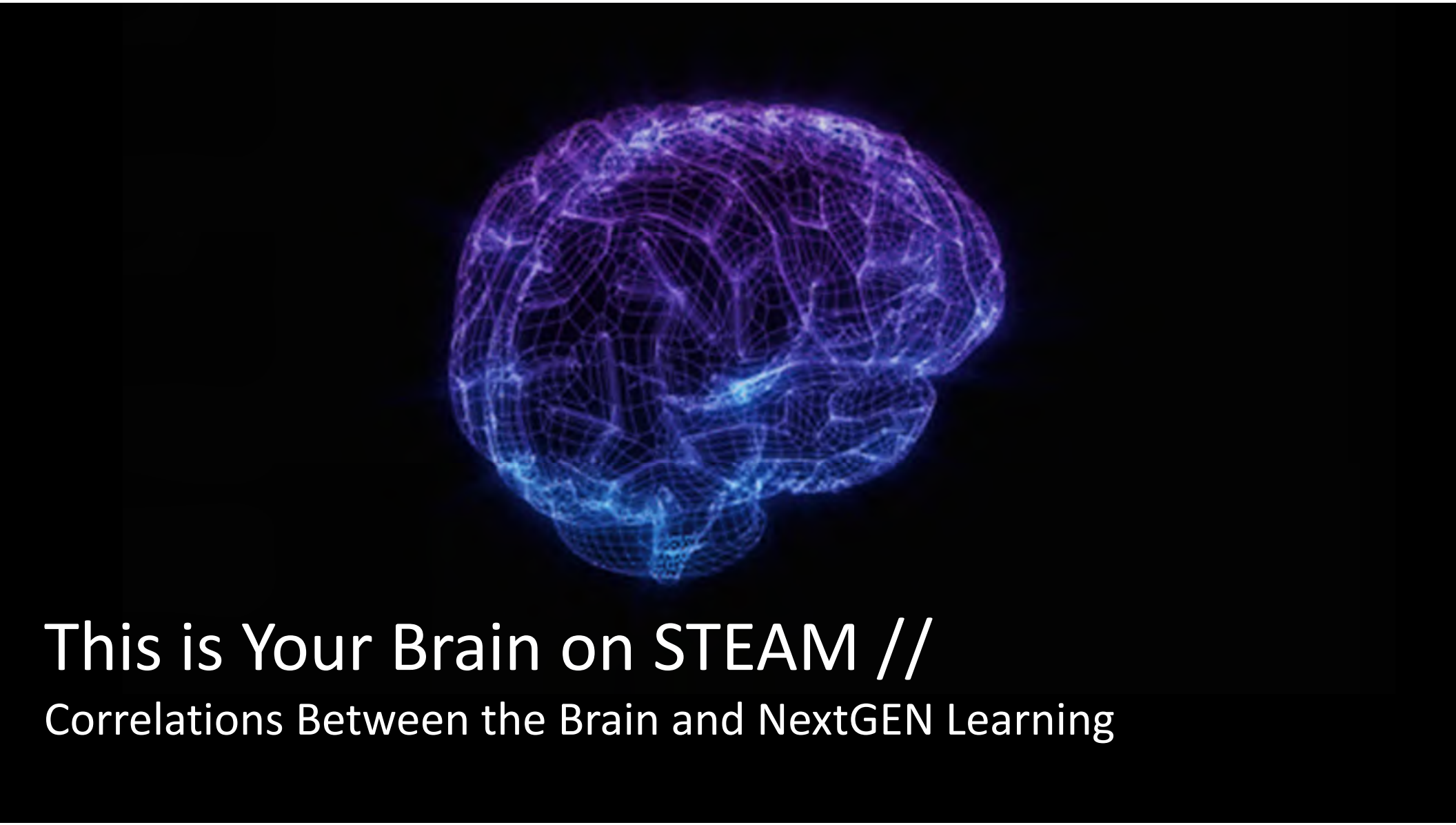
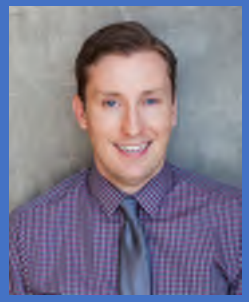


This is Your Brain on STEAM //

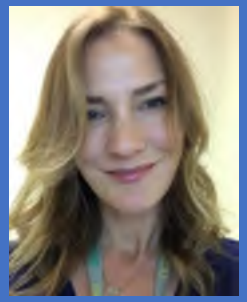
Correlations Between the Brain and NextGEN Learning

The Team



Aaron Buehring

Director of Educational Environments
Lionakis



Anna Iversen

MS, LMFT
UC Santa Cruz

John Pellman

Director of Curriculum and Instruction
Capital College & Career Academy

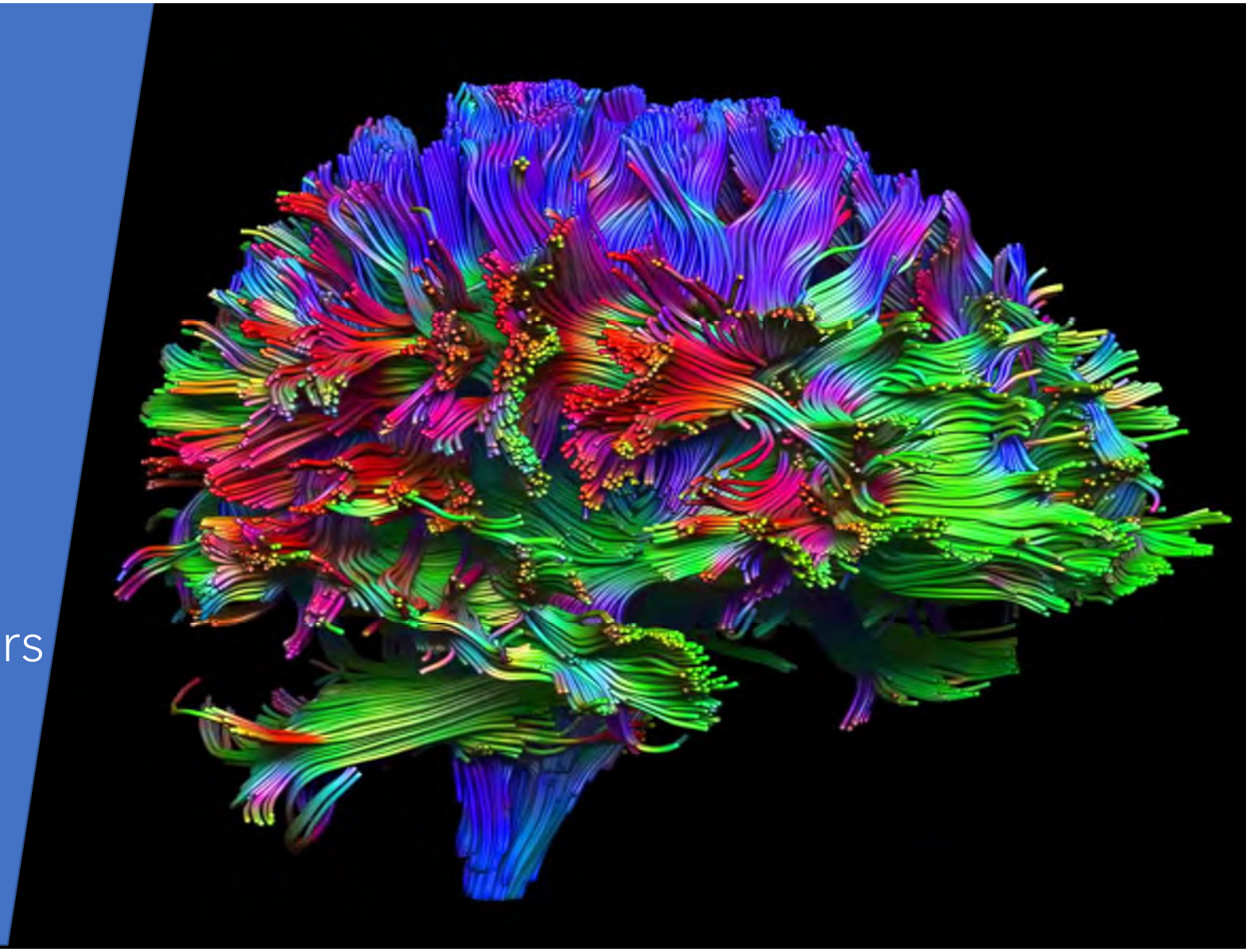
The Plan:

01:
Engagement

02:
“Average Brains”

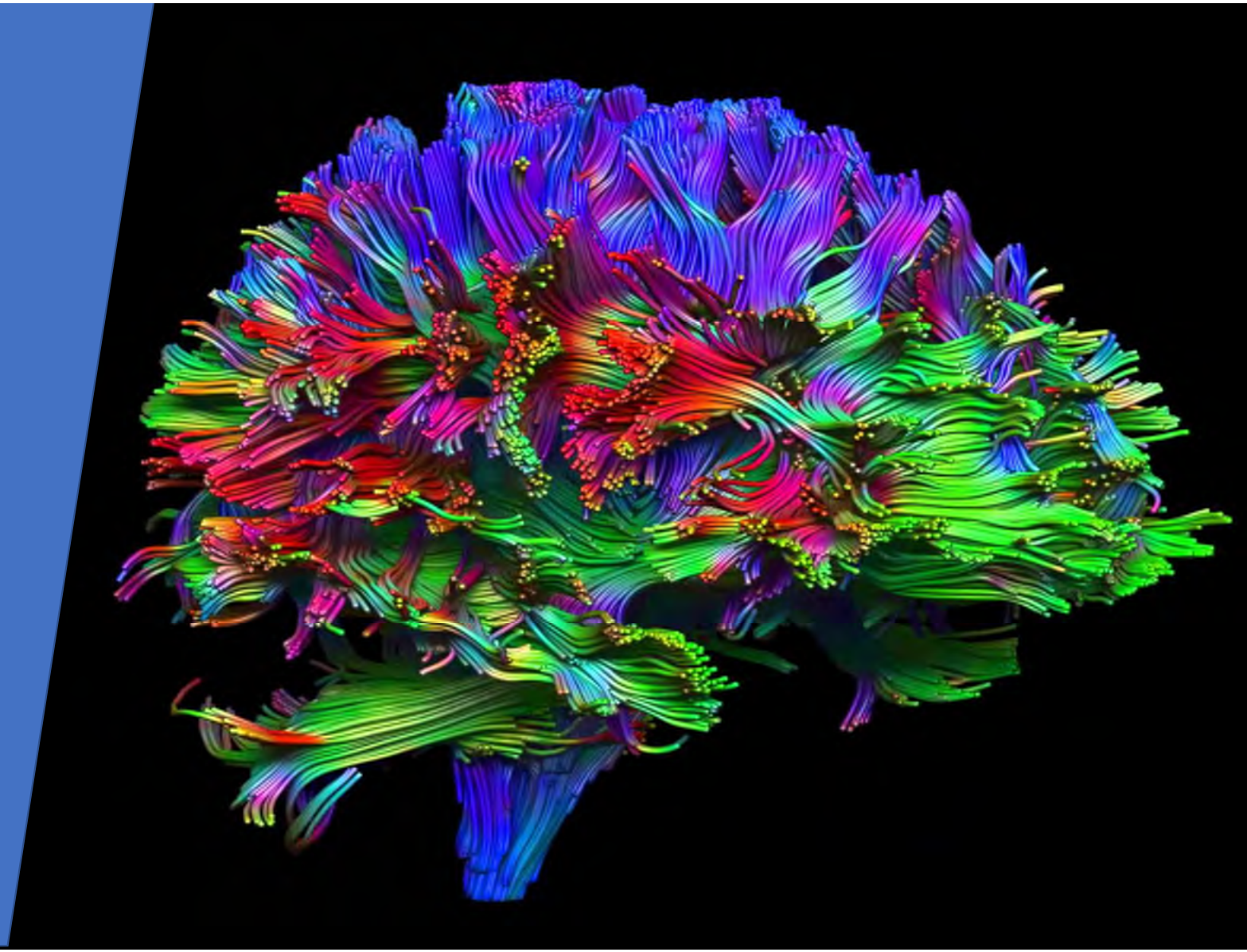
03:
Movement Matters

04:
Nature’s Cure



Engagement

01



49% of U.S workforce is disengaged

2018 Gallup Poll

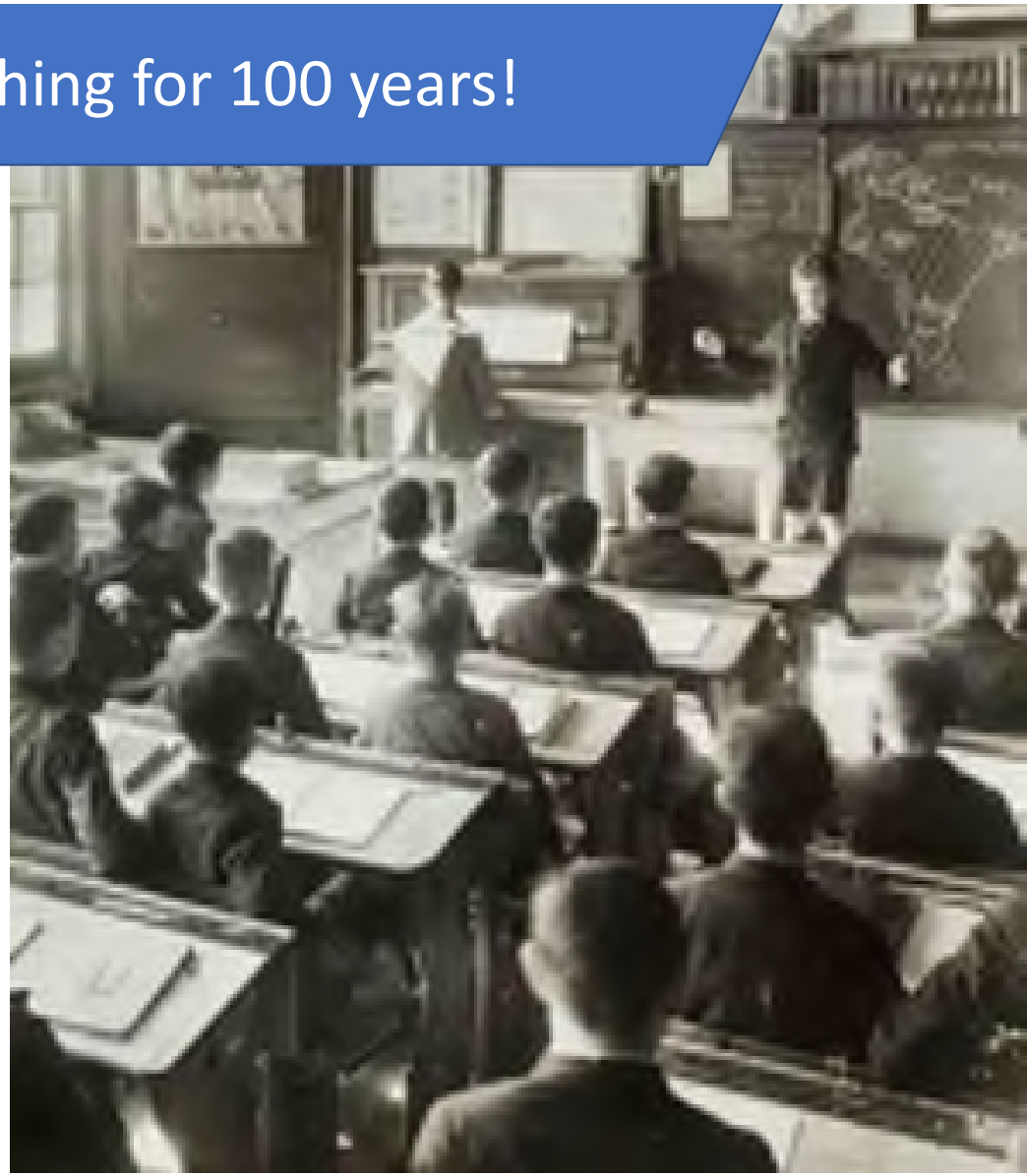
A study of High School students said similar:

- 73% said, "I didn't like the school."
- 61% said, "I didn't like the teachers."
- 60% said, **"I didn't see the value in the work I was being asked to do."**
- 25% said, "No adults in the school cared about me."

2013 Indiana University High School Survey of Student Engagement (HSSSE), reached more than 81,000 students in 110 high schools across 26 states, predominantly in the Midwest

No wonder!

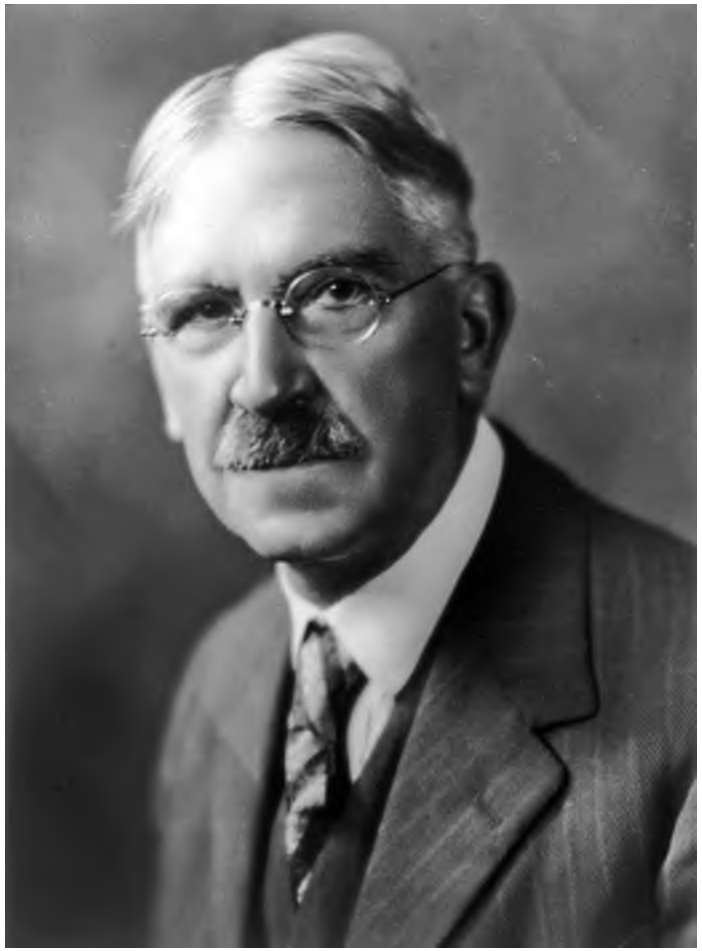
And we have been doing the same thing for 100 years!



Learning Theory and History of Education

John Dewey (1859-1952), recognized as usher of the modern era of schools believe schools were not only a place for students to content knowledge but also a place for them learn how to live.

Secondary School Growth – 1890 7% of youth 14-17 enrolled in high school, rising to 32% in 1920, primary purpose was to prepare students for higher education. Vocational education added in 1910 as mechanism to train technicians and skilled workers

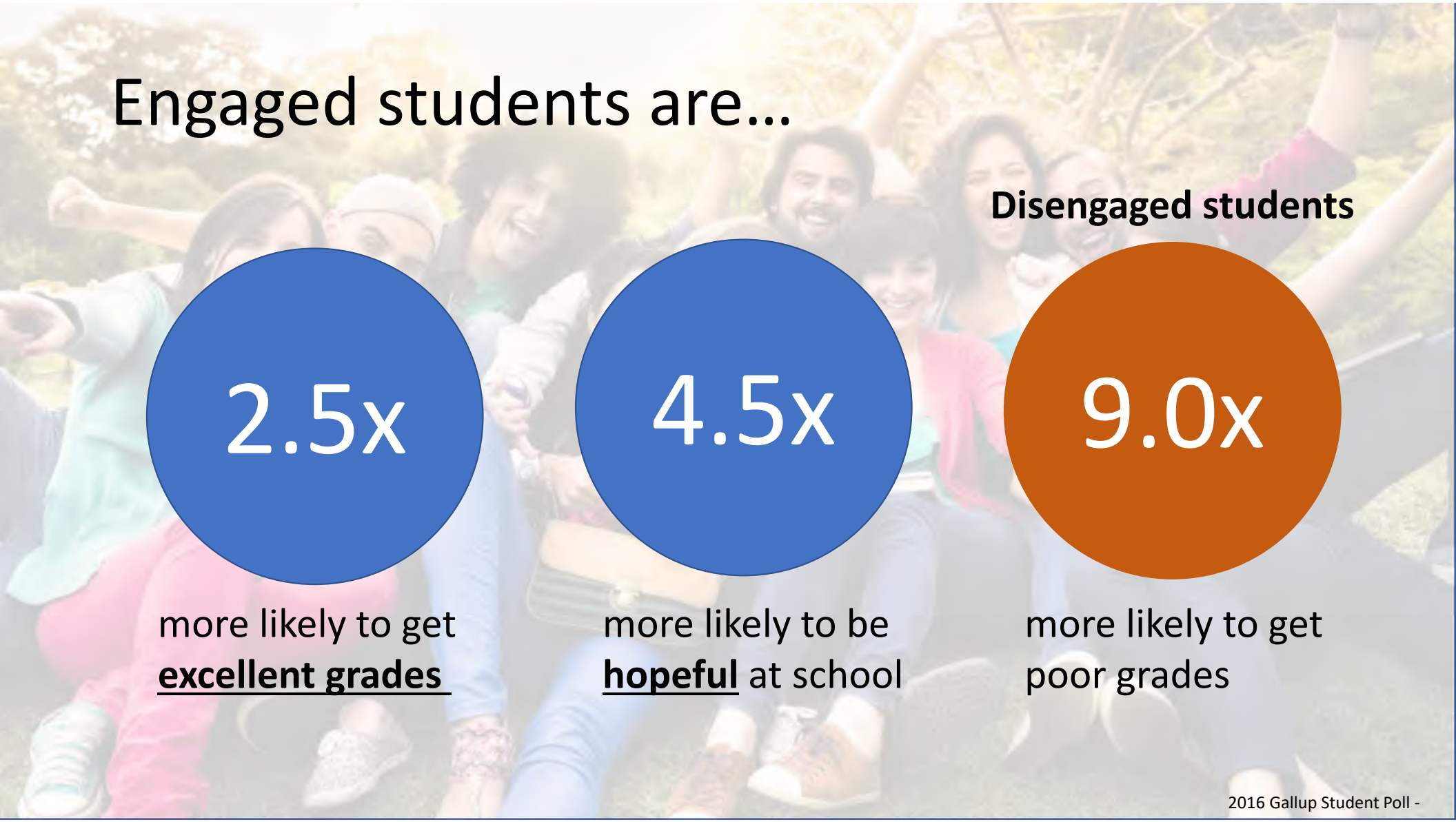


Learning Theory and History Education

Constructivism – roots in philosophy, a theory of knowledge. Traced to Jean Piaget (1896-1980) theory of cognitive development. Piaget focused on how humans make meaning in relations to the interaction between their experiences and their ideas.

Lev Vygotsky (1896-1934) – theory of social constructivism emphasized the importance of sociocultural learning; how interactions with adults, more capable peers and cognitive tools are internalized by learners to form mental constructs through the zone of proximal development (what a learner is capable of doing unsupported, and what they can do supported)

Engaged students are…



2.5x

more likely to get **excellent grades**

4.5x

more likely to be **hopeful** at school

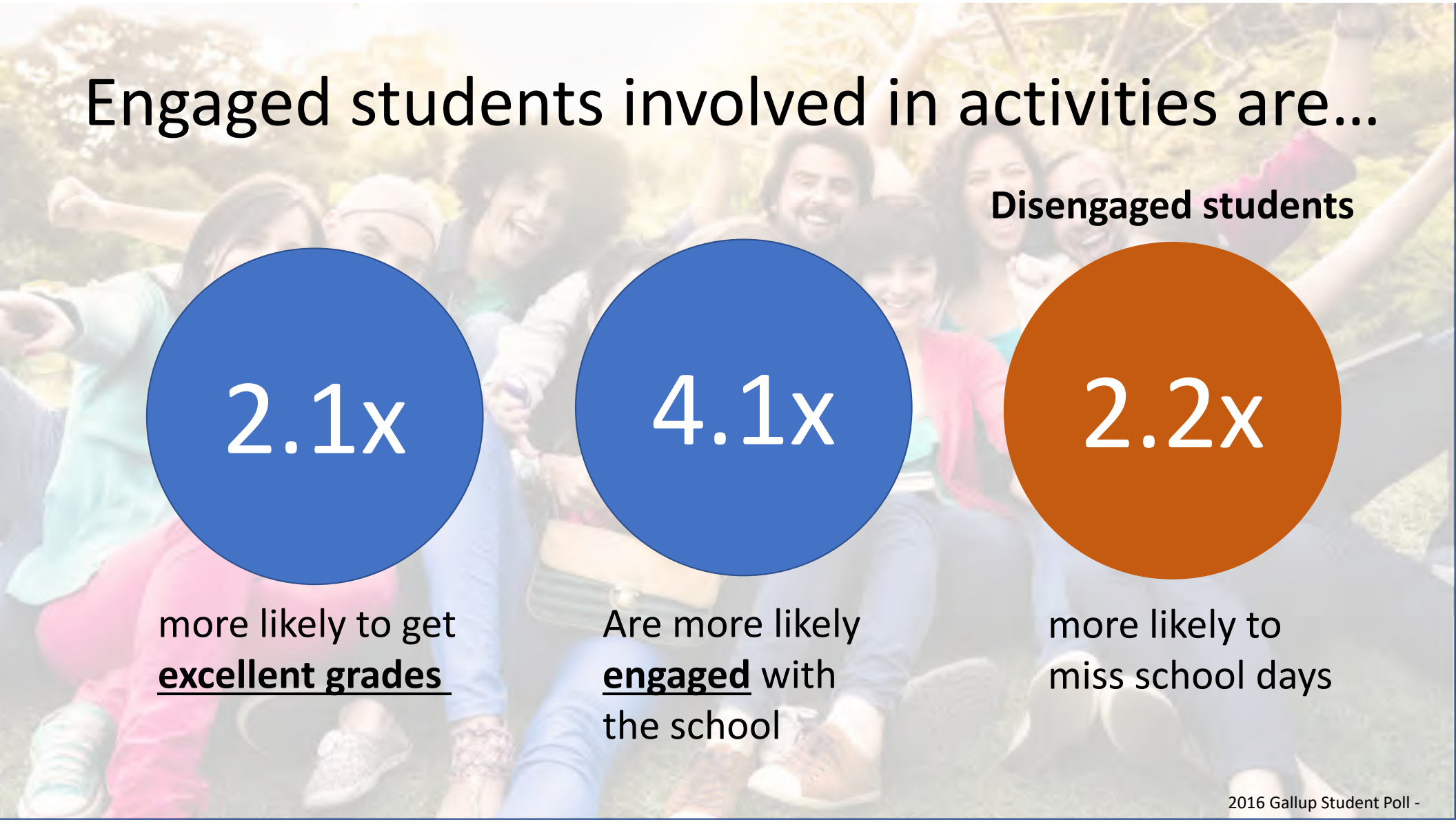
Disengaged students

9.0x

more likely to get poor grades

2016 Gallup Student Poll -

Engaged students involved in activities are…



2.1x

more likely to get **excellent grades**

4.1x

Are more likely **engaged** with the school

Disengaged students

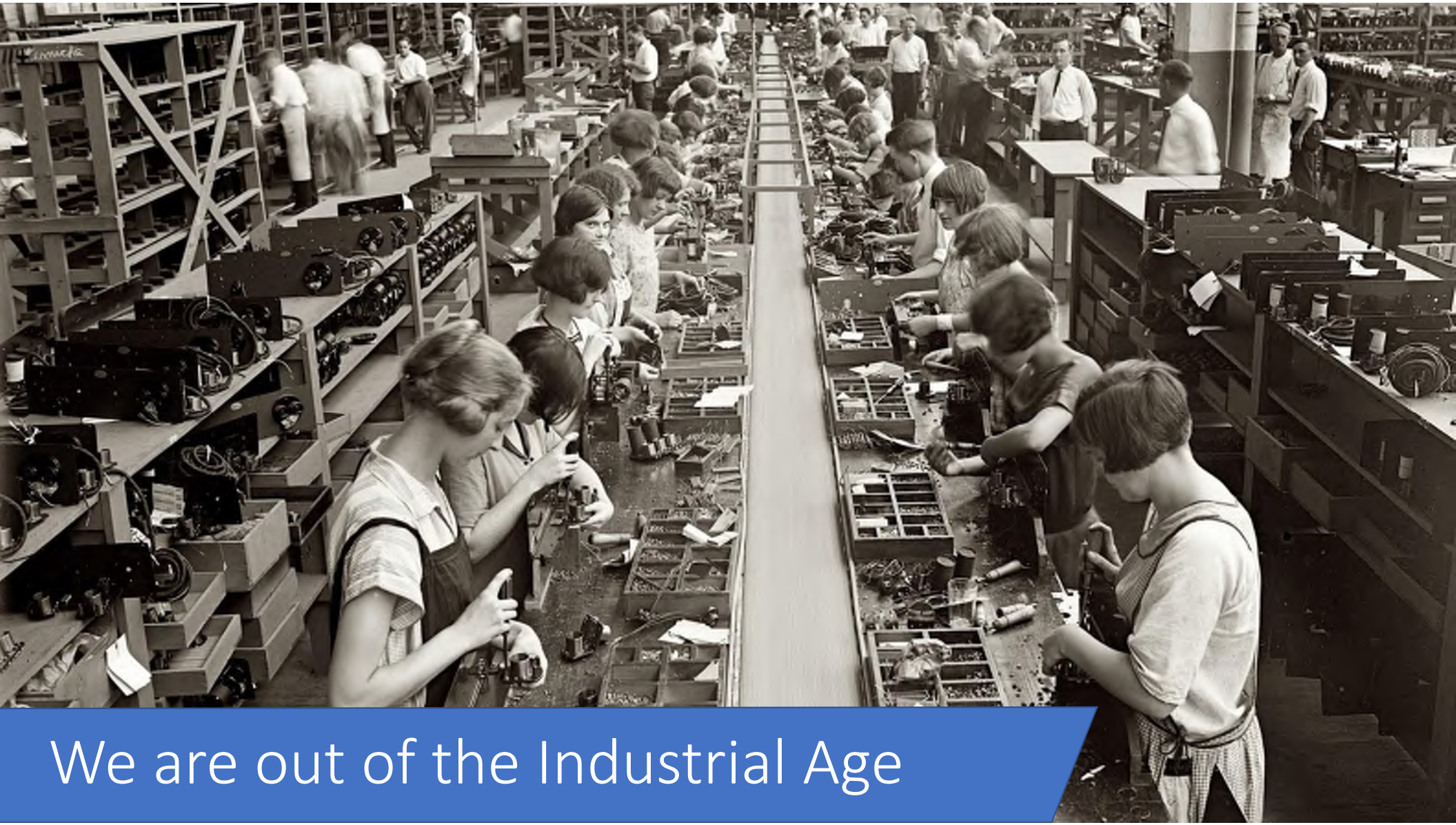
2.2x

more likely to miss school days

2016 Gallup Student Poll -

We are at a paradigm shift in education

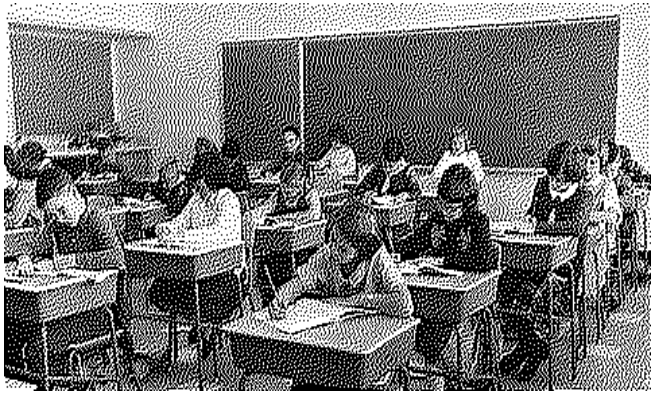

WHY?



We are out of the Industrial Age

And into the Information Age









What does this mean for students?

School is no longer about data retention

20 years ago

28,000 words per day

VS

Now

100,000 words per day

There are over 3.5 billon google searches A DAY

Connecting diverse data sets

Individualized connections to information

Learning through Youtube is a thing!

Its about connecting data

NextGEN is about engaging and exploring

A study of HS students in Maker programs:

Subscale (n=84)	% Very True/ Usually True	% Usually Not True/ Not at All True	% Sometimes True
Interest/Enjoyment	89%	2%	9%
Effort/Importance	88%	3%	9%
Perceived Choice	83%	11%	6%
Value/Usefulness	81%	5%	14%

Small et al 2

Follow the money

2013 - **California Careers Pathway Trust** - $15M state wide, this was an internal capacity-building grant to get districts hiring staff in CTE departments

2016-18 - **CTE Incentive Grant** $900M this was initially a three-year grant it is now ongoing, it funds the majority of CTE activities in public HSs in CA

2019 $150M statewide

2020 $300M statewide

2021 $300M statewide

2022 $300M statewide

Total to present $1,650B

K12 Strong Workforce - this is to form pathways between HS CTE programs and the Community colleges, the funding is on going

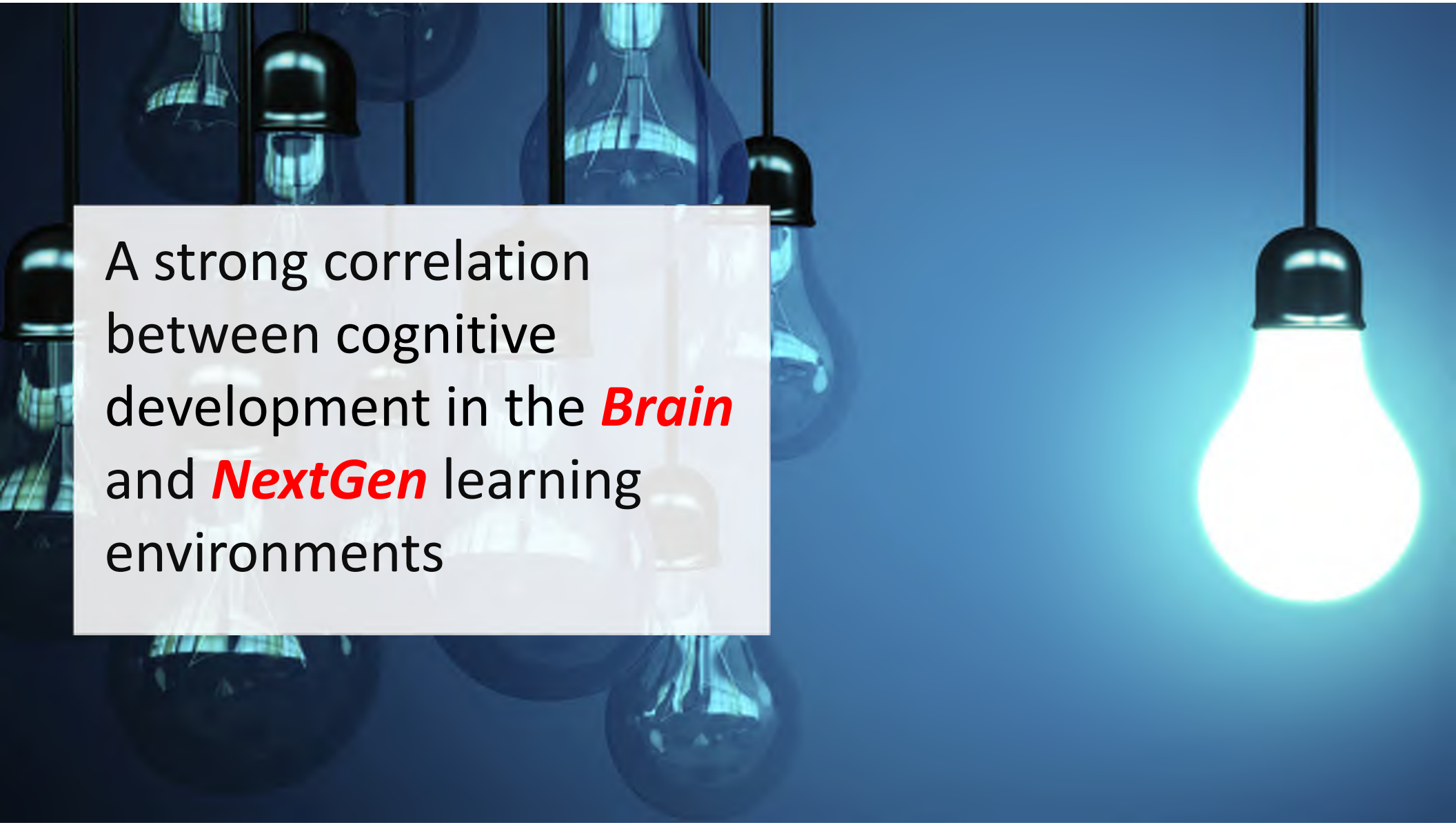
2016 to present $150M or $1,050B

Proposition 51 - this was a CTE Facilities Grant

2017 to 2019 $500M

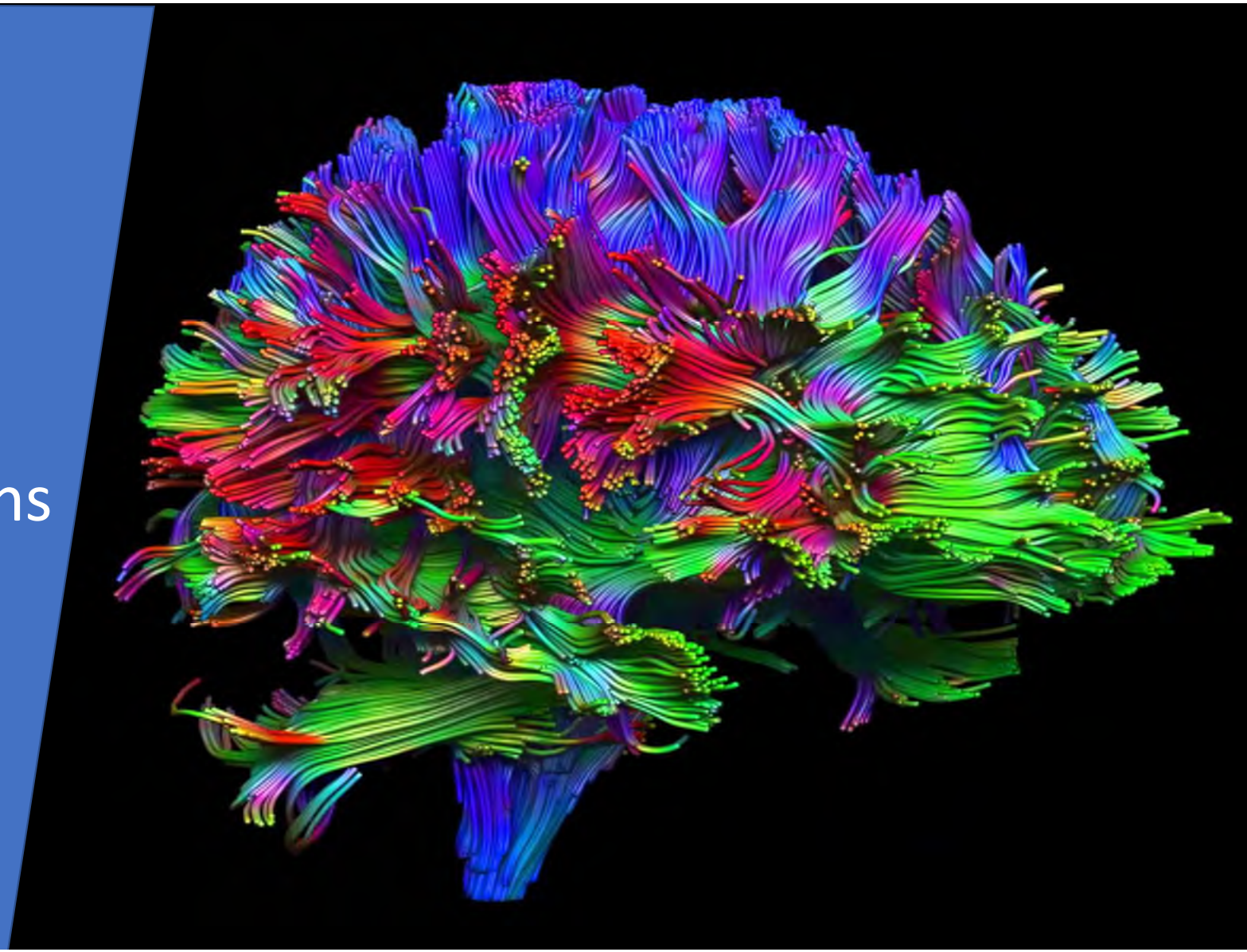
Of new funding for CTE since 2013 California has invested $3,215 Billion Dollars in CTE.


What is causing this response in Students?


A strong correlation between cognitive development in the *Brain* and *NextGen* learning environments

“Average” brains

02

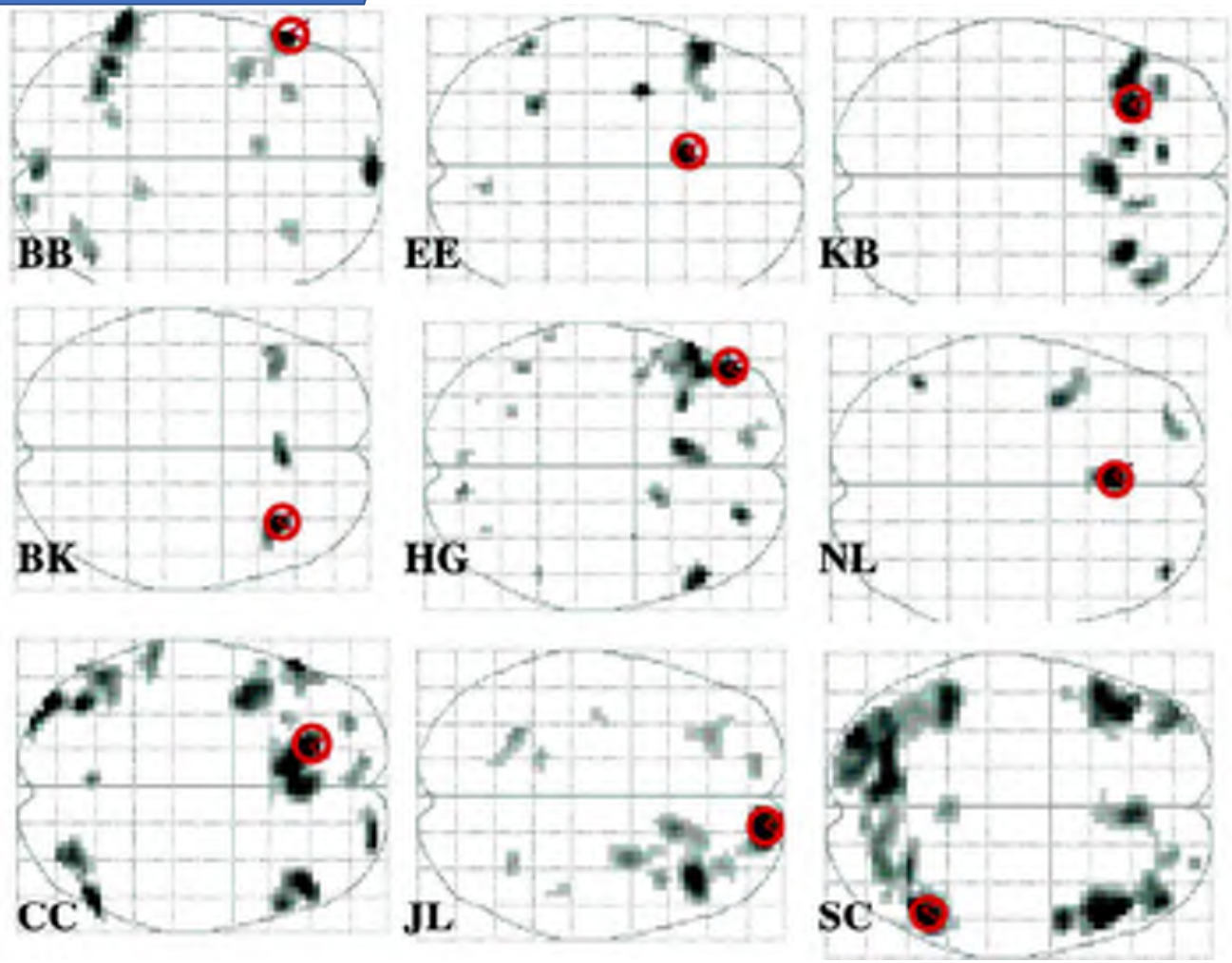


Interaction Time

The voting code **3174 8769**

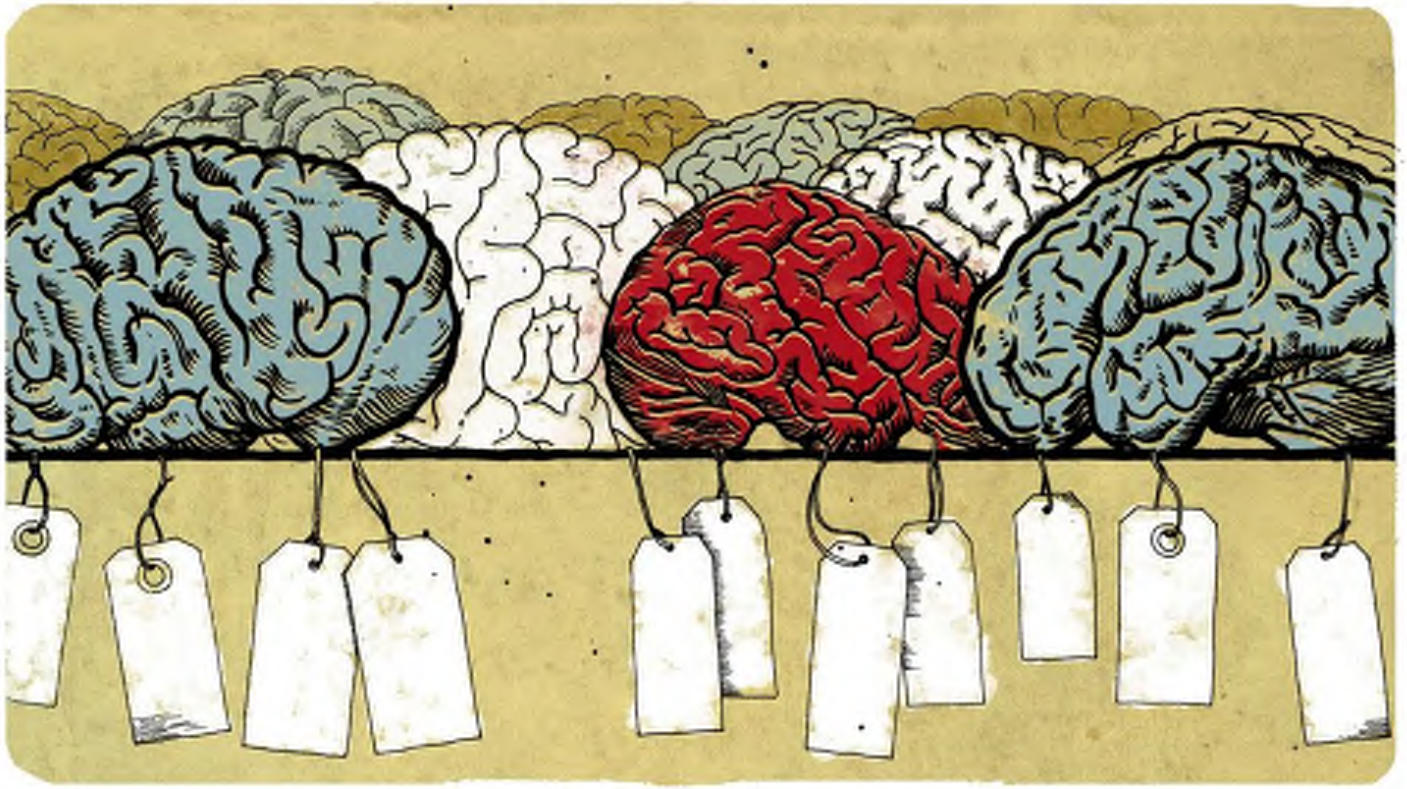
Every brain is different

9 different patterns of brain activation in Study Participants engaged in the same task



Miller et al 2002

Every brain is different



In 2018 the University of Zurich found that much like with fingerprints, no two people have the same brain anatomy, attributing this to the influence of genetic factors and individual life experiences.

Designing to the average

Audio learner
Problem-Solver
Hands on

Conceptual thinker
Strong writer
Social-Emotional

Sensitive to noise
Methodological
Short term memory

Introvert
ADHD
Creative

Instituting student choice

Direct connection to technology

Maker tables

Quick seating relocation

Integrated whiteboard on the back of storage unit for ideation

Students who want to sit by the window can

Decentralized teaching station

How the brain works

Cortical Brain:

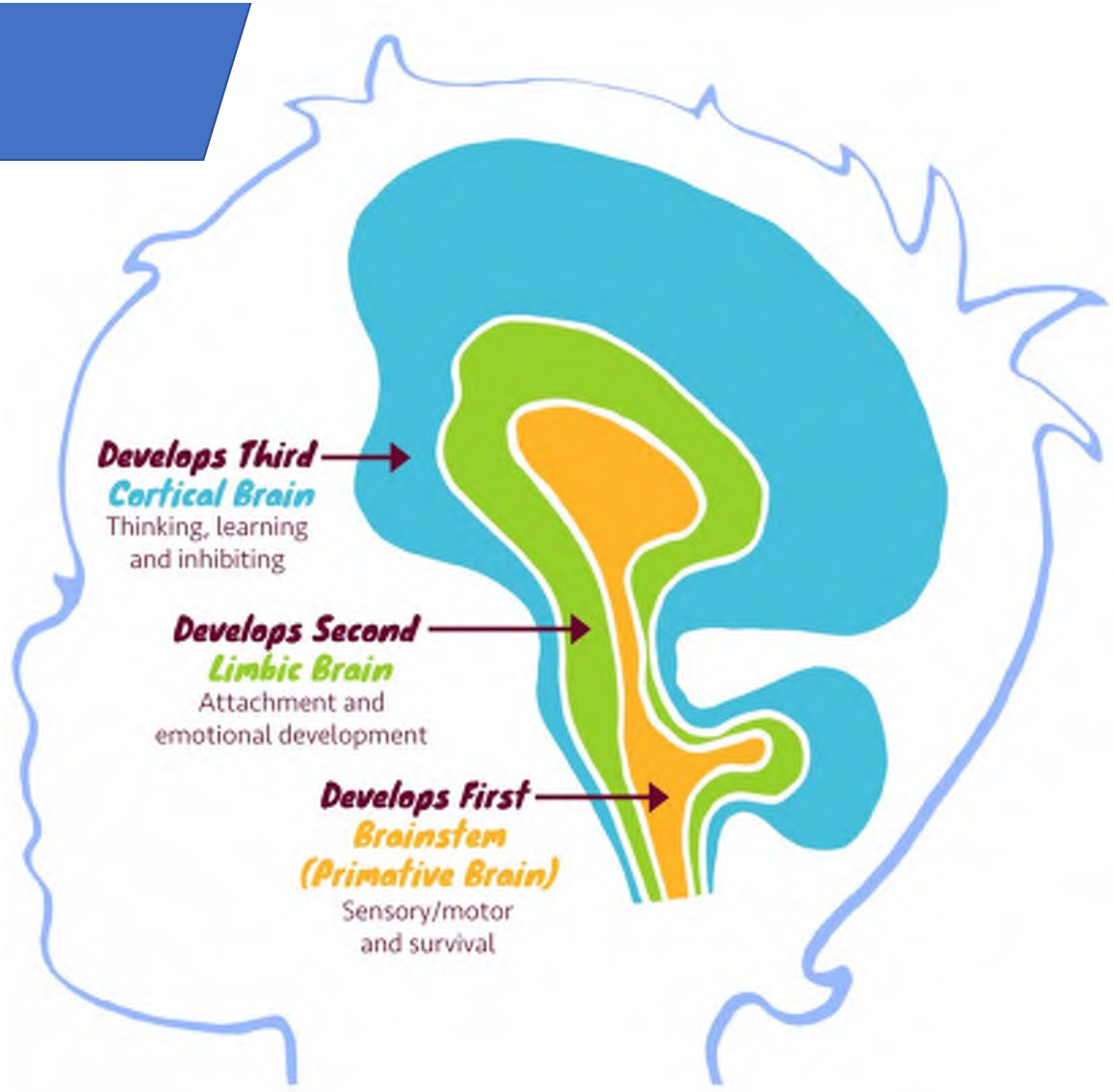
- Information processing
- Executive Thinking
- Problem solving

Limbic Brain:

- Memory
- Emotions
- Detects fear

Brainstem:

- Sensory Processing
- Keeps systems functional
- Body message system



(Image from Beacon House 2015)

Promotion vs Prevention

In a University of Maryland study Students were given a simple maze to complete.

Half were asked to help the mouse seek the cheese (promotion).

The second half were asked to help the mouse escape an owl (prevention).

Following mazes both groups were asked to perform a creativity task.

Outcomes:

The promotion (cheese) group was twice as creative as the prevention (owl) group

Even an imaginary threat can cause a stress response.

Friedman and Forster 2002

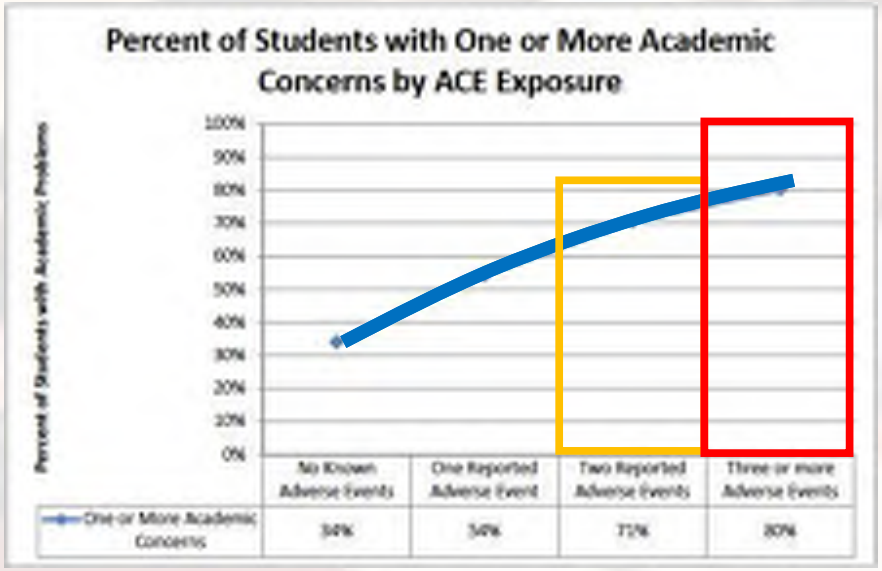
Adverse Childhood Experiences (ACEs) Study

A collaboration between the Center for Disease Control and Kaiser Permanente (HMO Members)

Over a ten year study involving 17,000 people

Looked at effects of adverse childhood experiences (trauma) over the lifespan

Developed a scoring system by categories



1 in 16 exposed to 4 categories

1 in 4 exposed to 2 categories

Elementary aged school children in Washington State, Blodgett, 2010

In 2,100 children (K-6th in 10 elementary schools):

On average 2 students in each classroom had a score of 4 or more

This kids with an ACE score of 3 or higher experienced:

3x the rate of academic failure

4x the rate of poor health

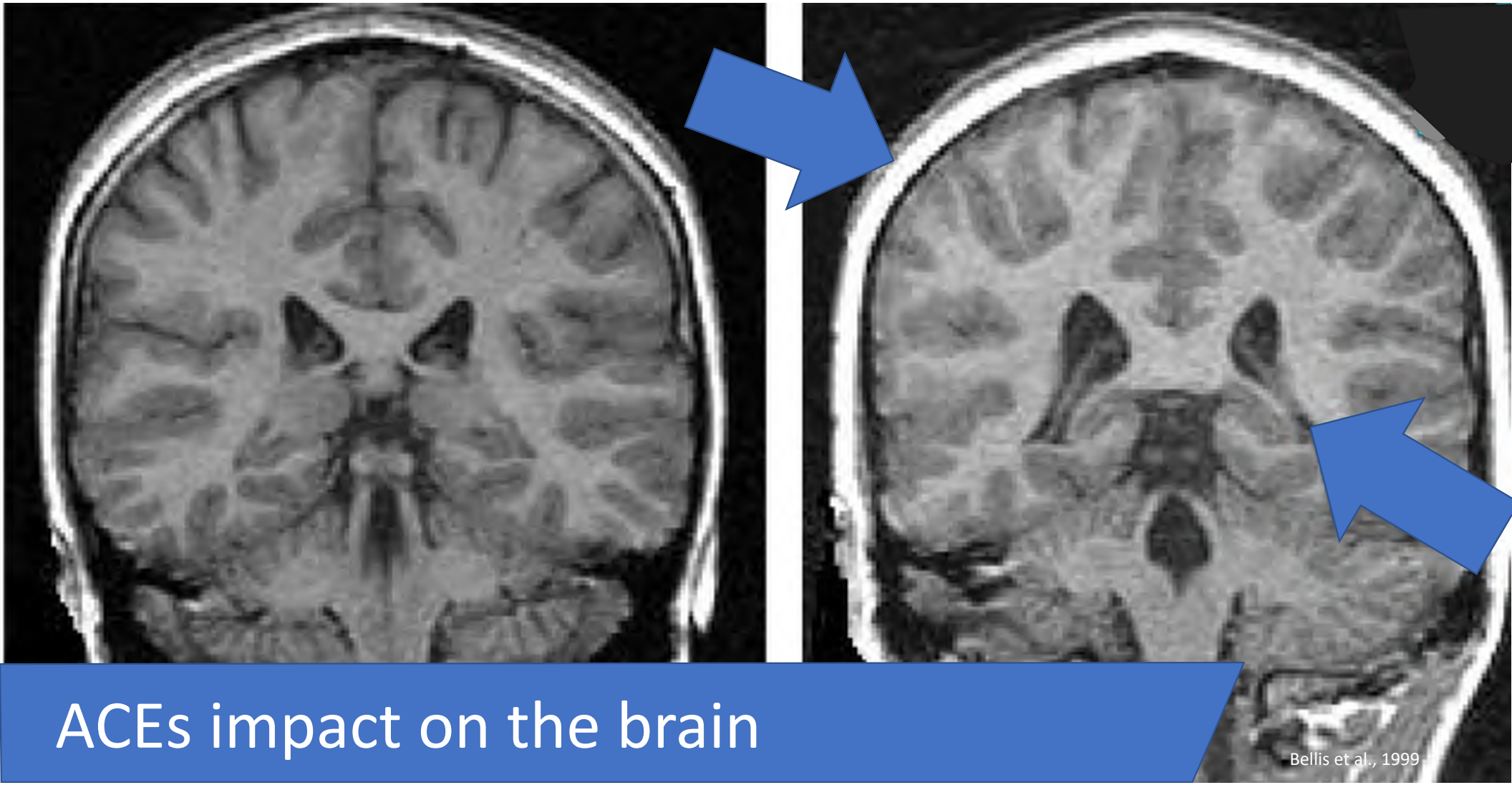
5x the rate of severe attendance problems

6x the rate of behavior problems at school

ACEs impact on learning

Felitti et al 1998

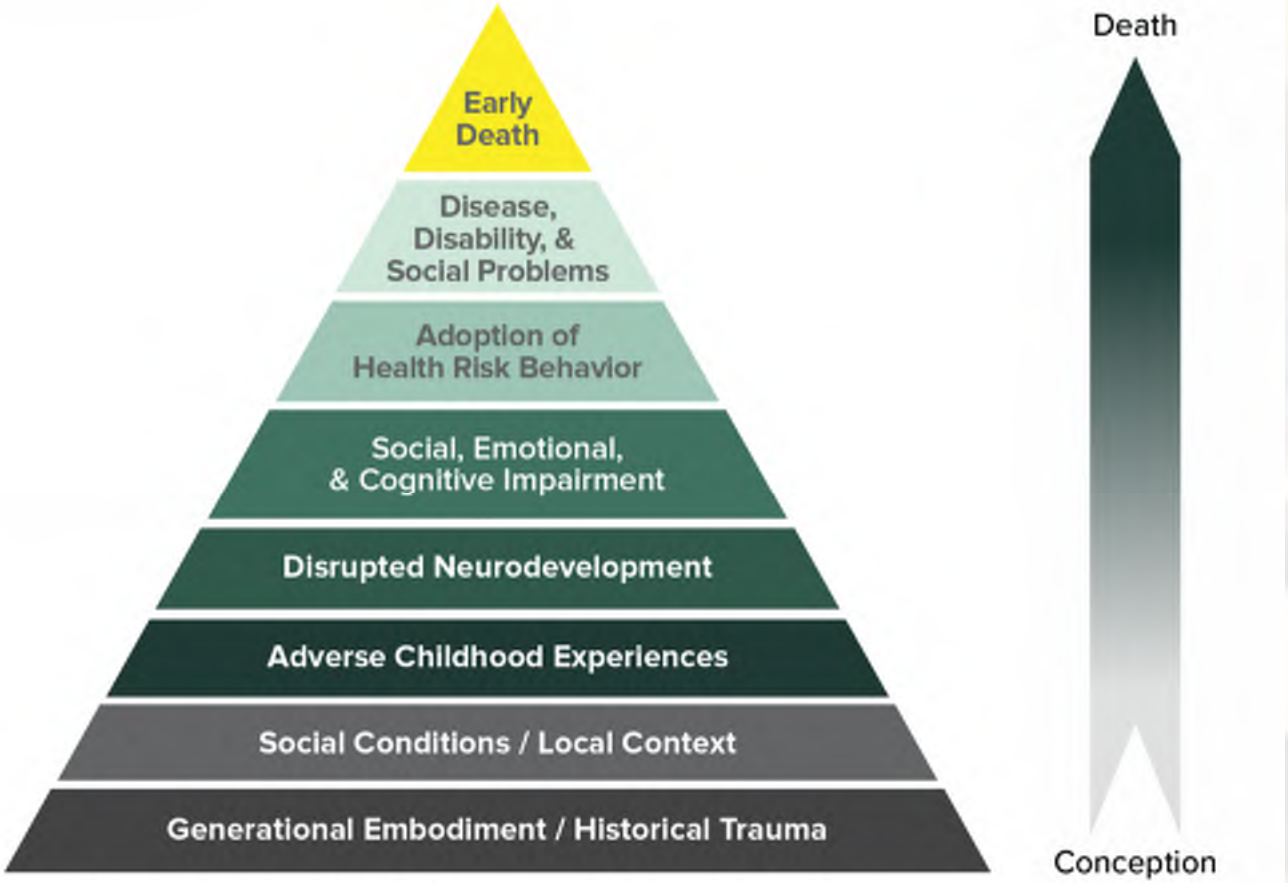
Lateral Ventricles Measures in an 11 Year Old Maltreated Male with Chronic PTSD, Compared with a Healthy, Non-Maltreated Matched Control



ACEs impact on the brain

Bellis et al., 1999

ACEs impact on learning



Mechanism by which Adverse Childhood Experiences Influence Health and Well-being Throughout the Lifespan

Felitti et al 1998

ACEs impact on learning

National Health Interview Survey (NHIS) reports from the study period (2009–2017)

About 1 in 6 (17%) children aged 3–17 years were diagnosed with a developmental disability, as reported by parents.

Specifically, attention-deficit/hyperactivity disorder (ADHD) (9.5%), autism spectrum disorder (ASD) (2.5%), and intellectual disabilities (ID) (1.2%).

"On average 2 students in each classroom had a score of 4 or more"

2 + 6 = 8 students per classroom or 22%

Zablotsky et al 2019

ACEs impact on learning

"On average 2 students in each classroom had a score of 4 or more"

2 + 6 = 8 students per classroom or 22%

According to 2019 estimates by the California Legislative Analyst Office, the average annual cost of educating a student with disabilities is **$27,000**

Almost triple the cost to educate a student without disabilities, about $10,000.

Total cost per classroom: 8 x $27,000 = **$216,000**

Zablotsky et al 2019

Steps in the right direction

***Autonomy*:** Create “YES” environments

Control: Design for predictability clear expectations. Share power / decision making and use space to build community with collaboration

Empowerment, Voice and Choice: Provide opportunities to make decisions

***Physical Safety*:** Self directed space to foster choice and empowerment.

Emotional Safety: Environment is predictably consistent (Trustworthiness and Transparency).

Physical exercise and gross motor development

Implications for the Constructivist Learning

Responsibility of Learning – Argues the responsibility of learning should reside increasingly with the student. Social constructivism emphasizes the importance of the student being actively involved in the learning process.

Instructors as Facilitators - Instructors have to adapt to the role of facilitators and NOT teachers. Whereas a teacher gives a didactic lecture that covers subject matter meaning the learner is passive. The dramatic change from teacher to facilitator is that the teacher tells, the facilitator asks, the teacher lectures from the front, the facilitator supports from the back, the teacher gives answers, and the facilitator provides the initiative to steer the learning experience to where the learner wants to create value.

Implications for the Constructivist Learning

Constructivist Approach - not only acknowledges the uniqueness and the complexity of the learner, but actually encourages, utilizes and rewards it as an integral part of the learning process

Motivation for Learning – Sustaining motivation to learn is strongly dependent on the student's confidence of his/her potential for learning. The belief in their potential to solve problems are derived from their first-hand experience of mastery. This relates to the zone of proximal development, in that each new attempt to solve a problem should be based on solving something slightly more challenging than what they solved previously. This is more motivating than external acknowledgment.

The dreaded “group project”

Students and not the teacher are responsible for accomplishing their tasks in the way they think best

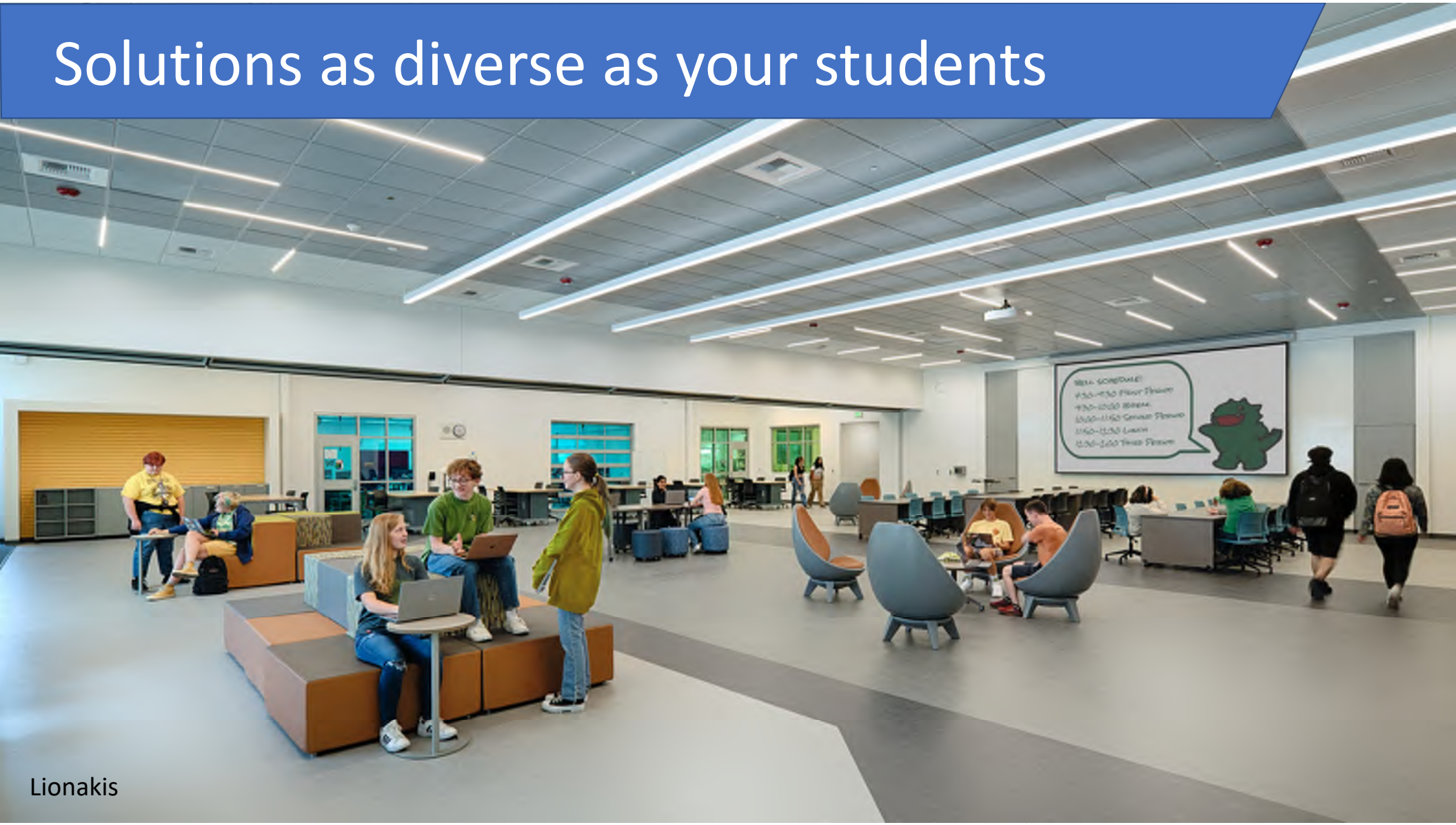
The process of collaborative work increases neural activity in relational and emotional memory connections and long-term memory storage

The more a student is engaged in a learning activity with multiple sensory modalities, the more parts of the brain are actively stimulated.

Willis 2019

Solutions as diverse as your students

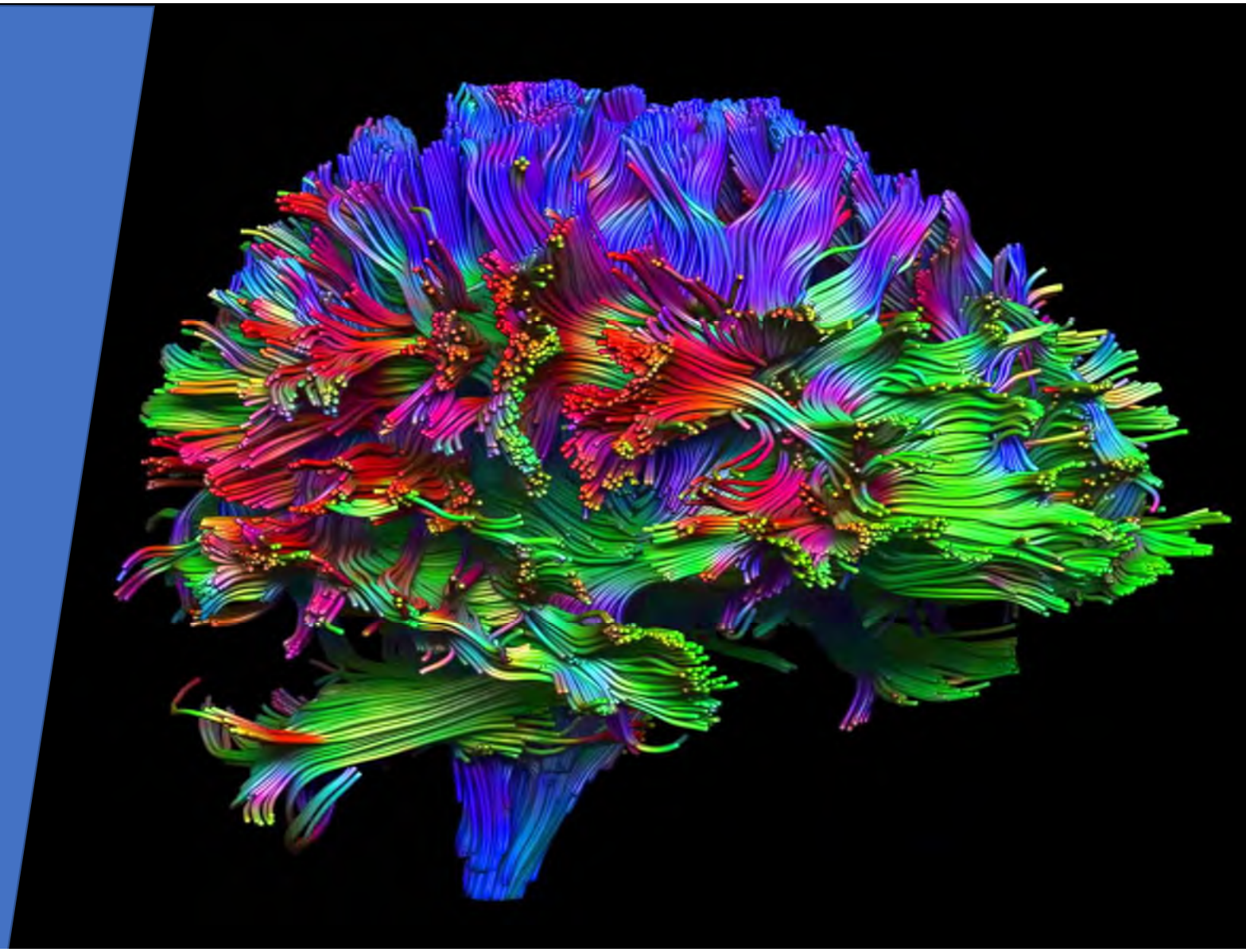
Solutions as diverse as your students



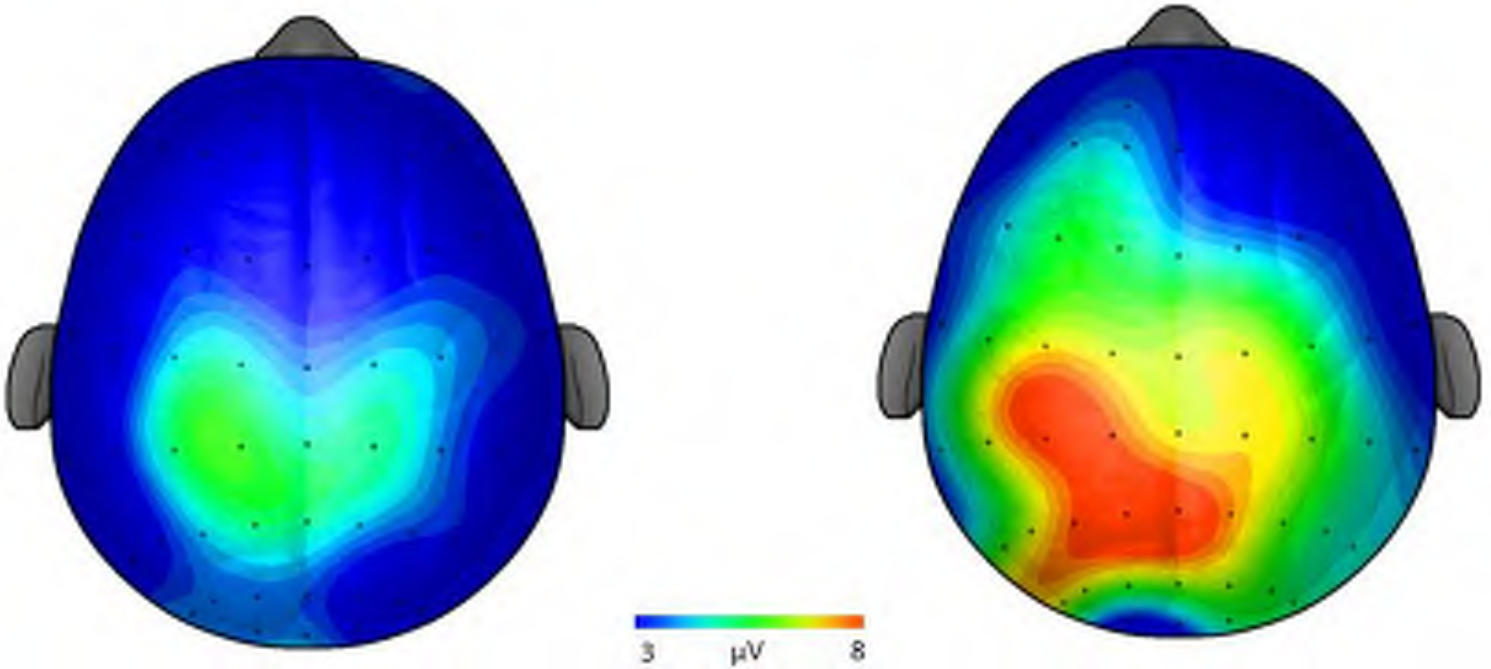
Helpful solutions

Movement Matters

03



Brain activity after movement



After 20 minutes of **sitting quietly**

After 20 minutes of **walking**

Hillman et al. 2009

Cognitive development and movement

"The ratio of brain volume to cranial volume has been reported to be low (60% encephalization) compared to other marsupials."

Taylor et al. 2006

Science Talk

1) Optimizes your mind-set to improve alertness, attention, and motivation

2) Prepares and encourages nerve cells to bind to one another, which is the cellular basis for logging in new information

3) Spurs the development of new nerve cells from stem cells in the hippocampus

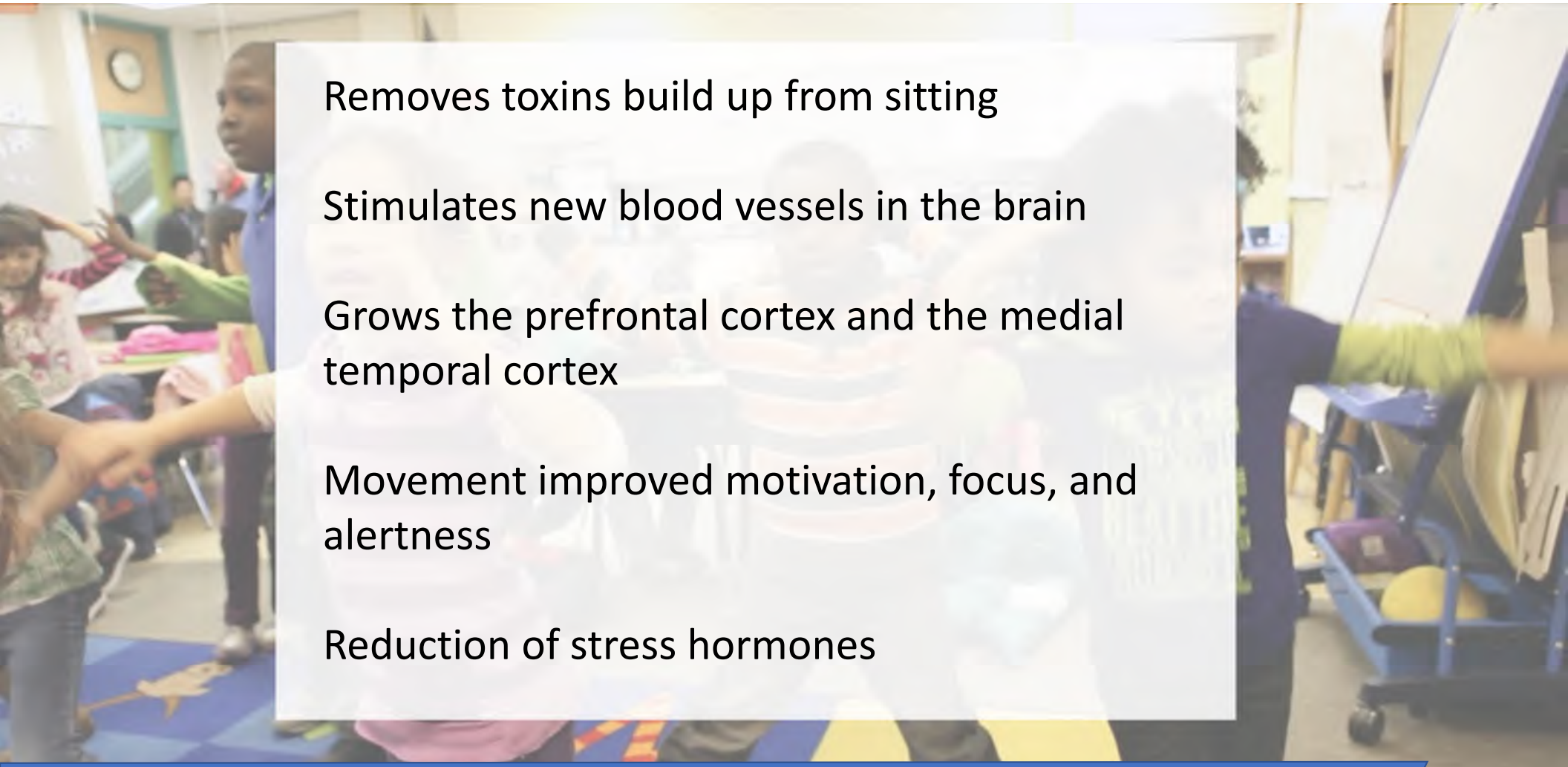
Real Talk

1) You are ready and willing to receive new information

2) What you are learning stays in your brain

3) Creating more storage space in your hard drive

Hillman et al. 2009



Removes toxins build up from sitting

Stimulates new blood vessels in the brain

Grows the prefrontal cortex and the medial temporal cortex

Movement improved motivation, focus, and alertness

Reduction of stress hormones

Blood cycles in the Brain

Harvard Health Publishing 2018

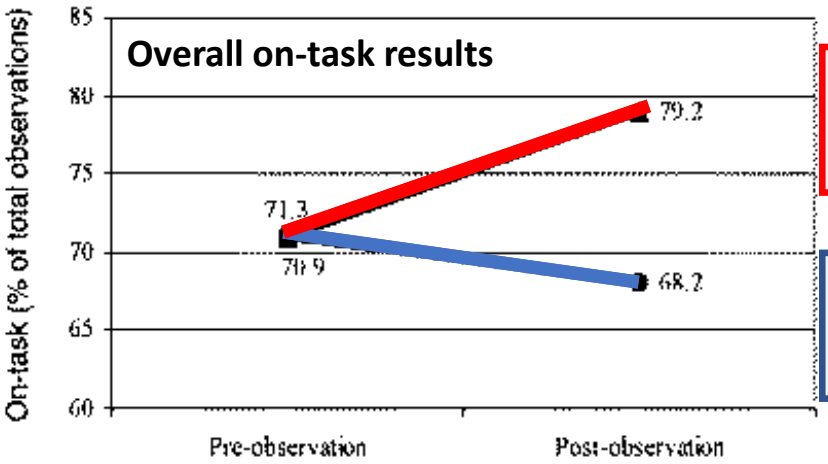
On task behavior

2006 Study of a public-school 3rd/4th graders in Eastern North Carolina for 12 weeks

Tracked the difference in "on-task time" in classrooms with "short classroom-based physical activities" vs. "traditional classroom activities"

Physical activities are defined as: "allowing students to stand and move during academic instruction, these activities provide students with an opportunity to increase daily physical activity levels during the school day. The activities last approximately 10 min, integrate grade-appropriate learning materials, involve no equipment, and require little teacher preparation.

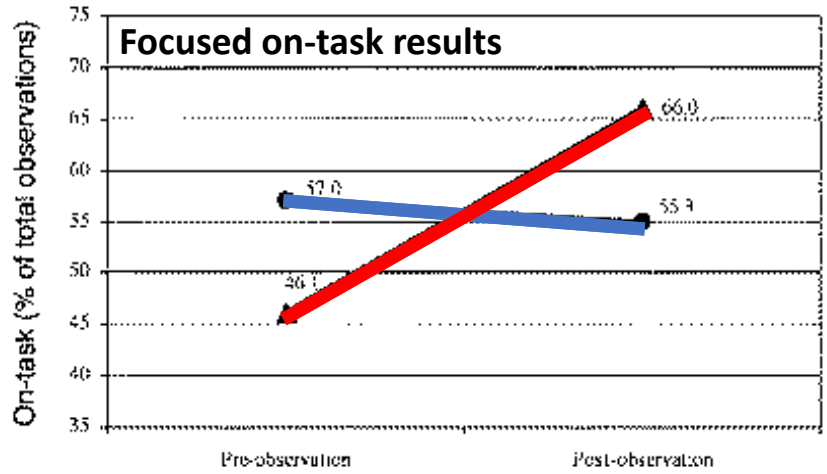
Mahar et al 2006



Classrooms with Physical Activity Program

Classrooms **without** Physical Activity Program

+9%



Students with on-task challenges with Physical Activity Program

Students **without** on-task challenges with Physical Activity Program

+20%

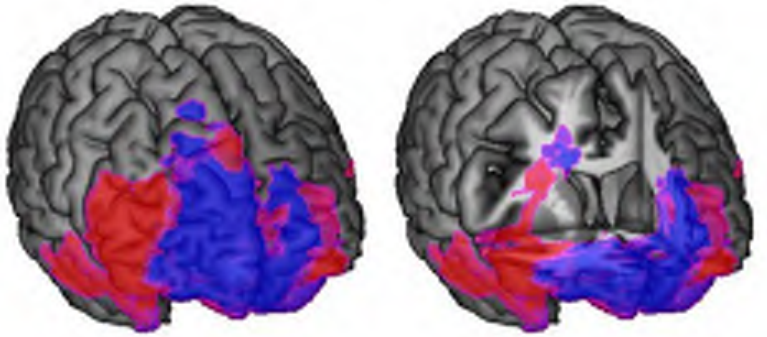
On task behavior

Mahar et al 2006

Lionakis

Hands on, Brains on!

Hand dexterity is also positively associated with working memory performance by moderating the relationship of task-evoked frontoparietal network and default mode network activation



Ishihara et al 2020

Implications for the Learning Laboratory

Collaboration Among Learners – Learners with different skills and backgrounds should collaborate to arrive at a shared understanding. Note this is direct contradiction to competitive approaches.

Importance of Context – Learning should not be separated from context. When learning is taken out of context it is difficult for learners to apply understanding to authentic tasks because the work is not happening in the complex environment.

Implications for the Learning Laboratory

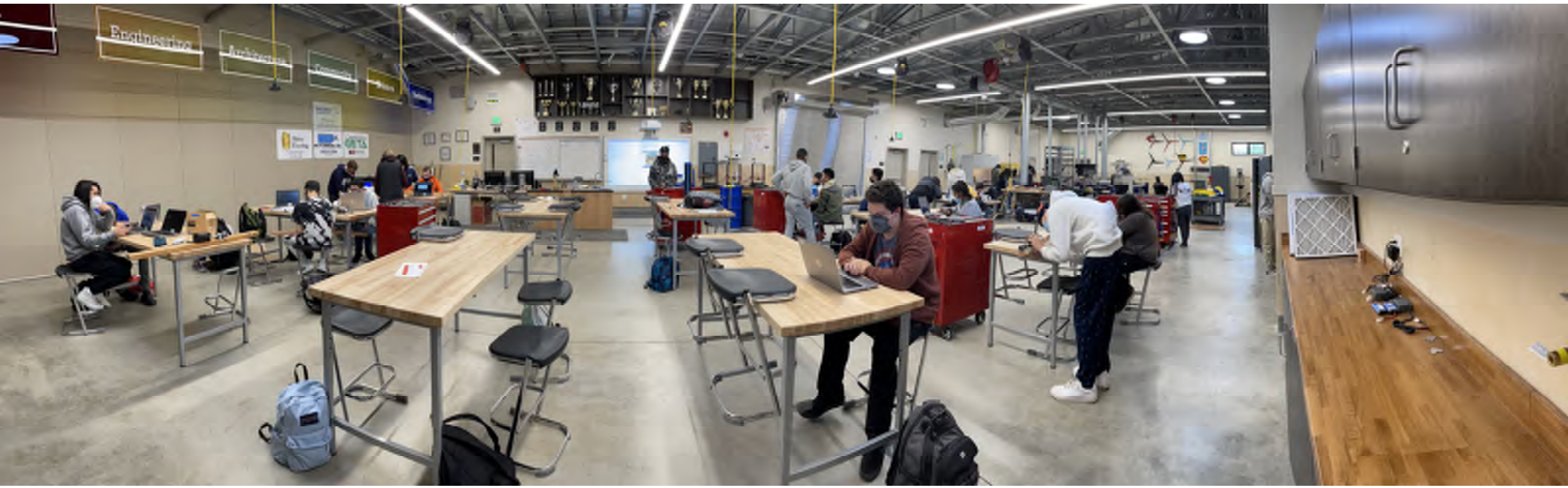
Engagement and Challenges – Leaners should be constantly challenged with tasks that refer to skills and knowledge just beyond their current level of mastery.

The Carpenter and the Gardner – Alison Gopnik, the difference between how we teach science and how young people learn to play sports. The implication is you must first learn about being a scientist before becoming a scientist, with the sport you are an athlete from the moment you step on the field.


CS Computer Science


TORMACH


EXIT


Engineering
Architecture

LEARN

THINK

DO

Lionakis

Lionakis

Lionakis

Activating furniture solutions

Santa Monica Malibu NextGen Furniture Standards Project

Student/Teacher Survey

84% students polled liked soft seating options

60% of teachers found value in soft seating in the classroom

89% students polled liked the furniture on wheels

30% of teachers say mobile furniture is a lot distraction

40% of teachers say everything should be mobile

Which is your preferred classroom? 7% 93%

Lionakis

Elementary	Middle School
33% single desks	19% single desks
15% group of 4-6	12% group of 4
40% maker table	**39% maker table**
16% Soft seating	30% Soft seating

Activating furniture solutions

Lionakis

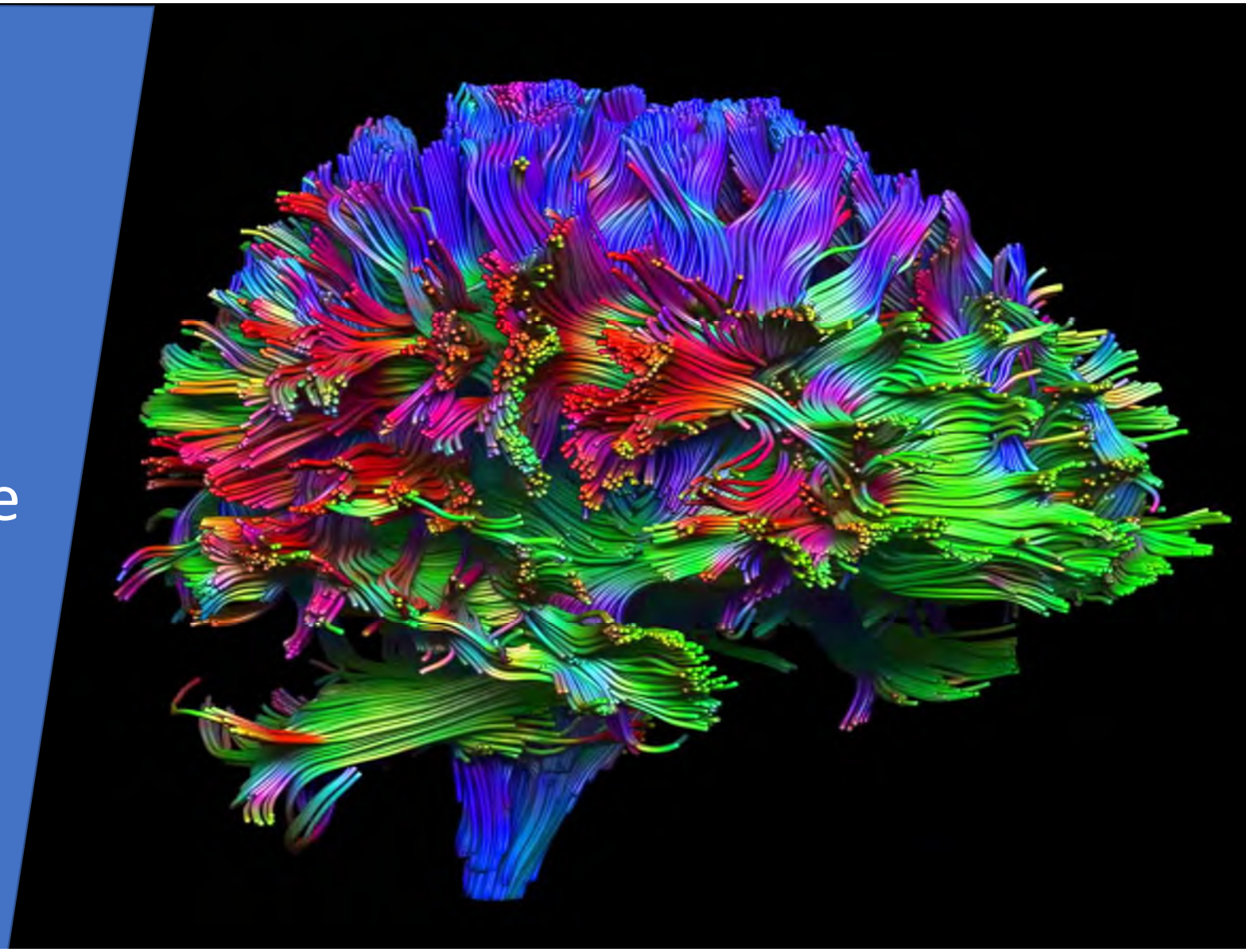
Outdoor movement

Lionakis

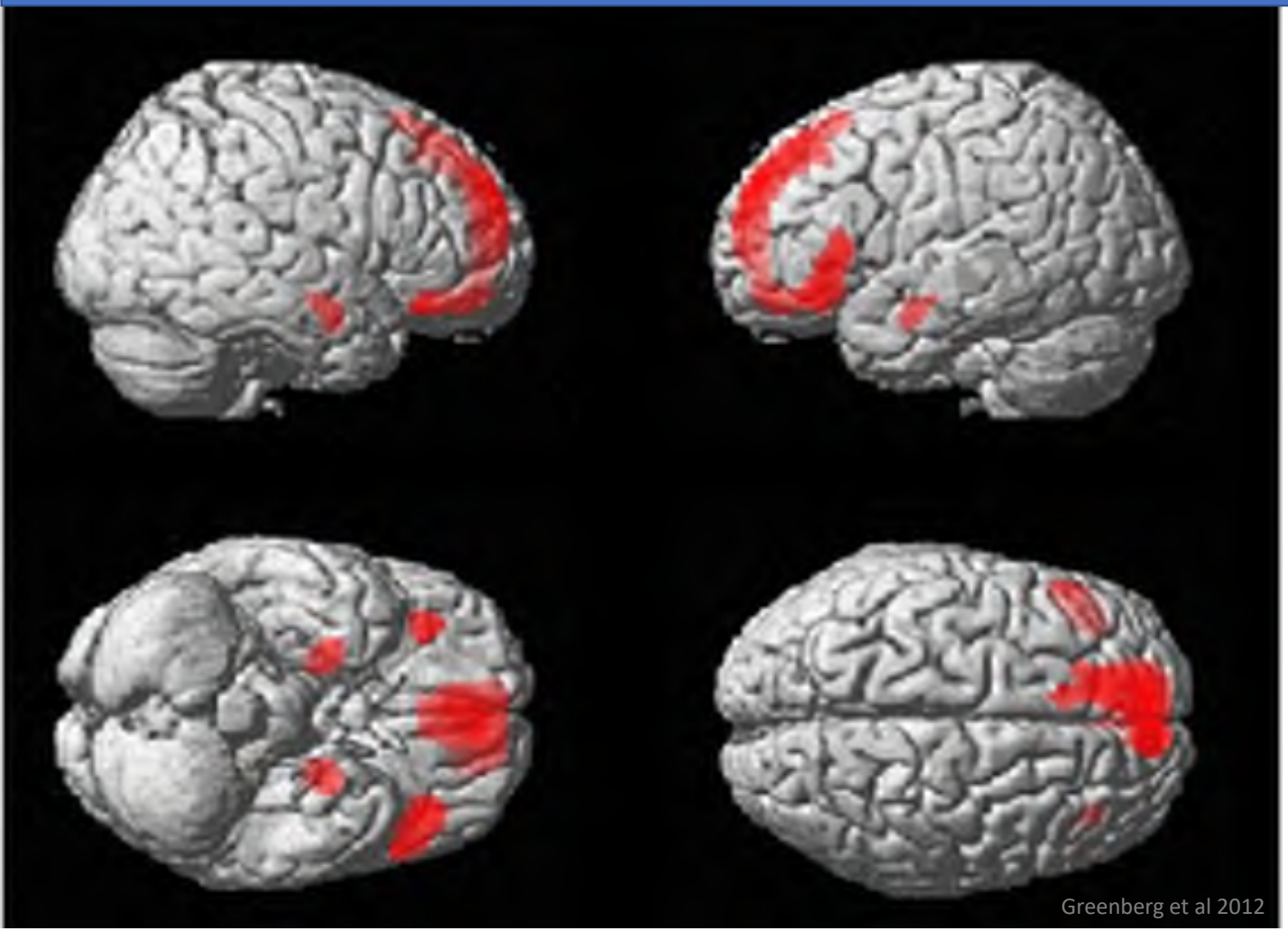
Outdoor movement

Nature’s Cure

04



Your brain on nature



Viewing nature suggests restorative effects on the prefrontal cortex-mediated executive attentional system, which can become depleted with overuse

In a 2012, Study showed

50% increase in creative problem solving performance after four days of exposure to nature

Atchley et al 2012

Hundreds and hundreds of studies show the positive impact of nature on humans in:

- Healthcare
- Corporate
- Retirement homes
- Airports
- Mental health
- Schools

- Quicker recovery
- Positive outlook
- Longer live spans
- Calming
- Hope
- Creativity

Global response to nature

Classrooms with the most amount of daylighting are seen to be associated with a

20% to 26% faster learning rate, as evidenced by increased test scored over one school year

Classrooms with operable windows are seen to be associated with

7% to 8%

faster learning rate

Response to nature in classrooms

Heschong et al 2002

Students' capacity to pay attention increased 13 % if they had a green view outside their classroom window

Response to nature in classrooms

University of Illinois at Urbana-Champaign/Science Daily 2016

Go outside!

Lionakis

Go outside!

Lionakis

Go outside!

Lionakis


When you can’t go outside!
Lionakis

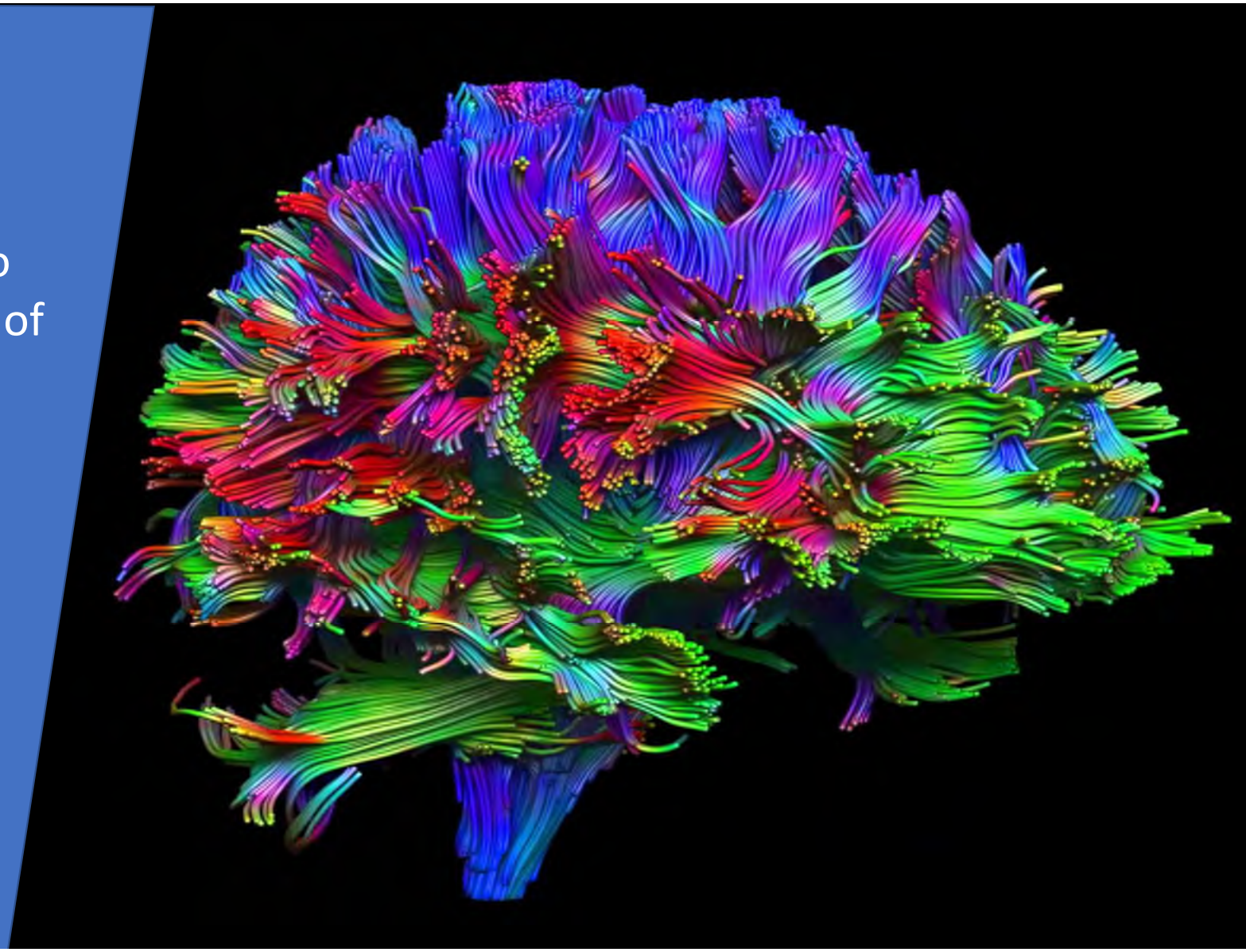
When you can’t go outside!

Lionakis

Summery:

Student's brains positively respond to numerous elements of STEAM learning

Movement
Choice
Hands-on, Brains-on
Safety
Nature



These studies are only the beginning…

70% of teachers are not engaged at work…

2017 Gallup Poll

Questions?

Thank you

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