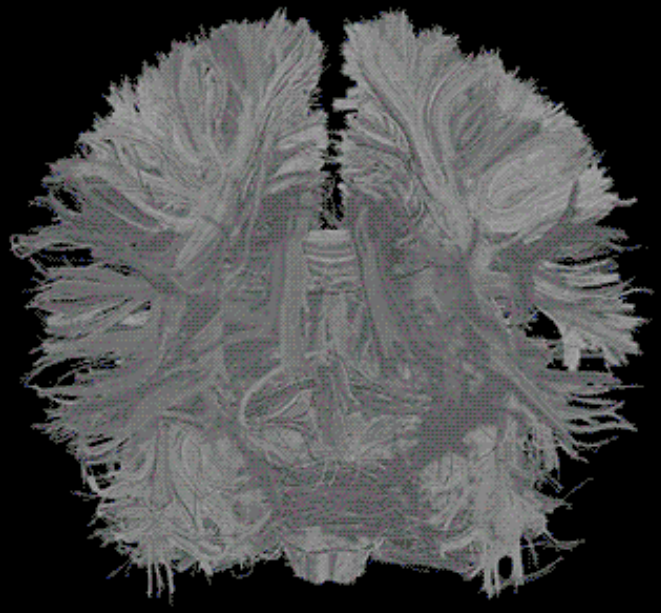
If It's Your Job to Develop the Mind, Shouldn't You Know How the Brain Works?"



Kenneth Wesson
Educational Consultant: Neuroscience
Morgan Hill, CA
kenwesson@sciencemaster.com

I hope I *die* during a conference keynote address.

Because the transition would be **so subtle!**

If It's Your Job to Develop the Mind…?

- **How does the human brain (1) work, (2) learn, and (3) what are the conditions under which the brain learns best? (ours is a biological and an emotional brain)**
- **What should teachers in my school district know about brain-considerate learning strategies that will (1) increase teaching effectiveness in our classrooms, and (2) increase student engagement/achievement?**
- **What is asset-based learning? Why teach SEL?**

…a visual and conceptual tour…

maximize learning = taking notes

A Highly *Visual* Brain – *6X*

Being a school board member is not easy. (CSBA)

Some days, it feels like you suddenly discovered a large hole in your parachute?

…and you are rapidly descending into *a lake.*

…that is surrounded by hungry AL alligators.

School Board Members

It’s your job to make certain that when your students graduate, they are ready to take on the world!

Teachers as Super Heroes

Teaching is the *most complex* of all professions… the most exhausting.

Teacher at the beginning
of the school year

Teaching: The *Most Complex* Professions

"Well, I'm a cardiac surgeon."

- **One researcher estimated that teachers and administrators rank 2nd only to air-traffic controllers in the total *number* of decisions they must make during their typical workday.**
- **Teaching and school administration are physically, emotionally, and intellectually demanding work.**

Learners in the 21st Century

It has been said that the next great journey for human-kind will *not* take place in the outer space. Instead, it will take place in the inner space of the human brain. Educators will need a working knowledge of the internal workings of the "inner space" inside the biological and emotional *brains* in our classrooms.

Connecting Education and Neuroscience

There is virtually *nothing* that you do that is not **connected to neuroscience** in one way or another.

If It's Your Job to Develop the Mind…?

1. The **brain** should be the **centerpiece** of all school district conversations on learning.
2. **Making connections** (neurons)
3. ***Active* learning** is brain-enriching and is dependent on consistent ***engagement***
4. **Brain plasticity** – constantly modifying circuits
5. **Poverty and stress** can impact brain development (including language → education → life)
6. **Relationships/interactions** (people and objects) are key factors in healthy brain development and academic development.

How does the human brain develop?

How can we enhance brain development?

Do you always look this good…

or is it just *today?*

The architecture of the brain depends on the mutual influences of

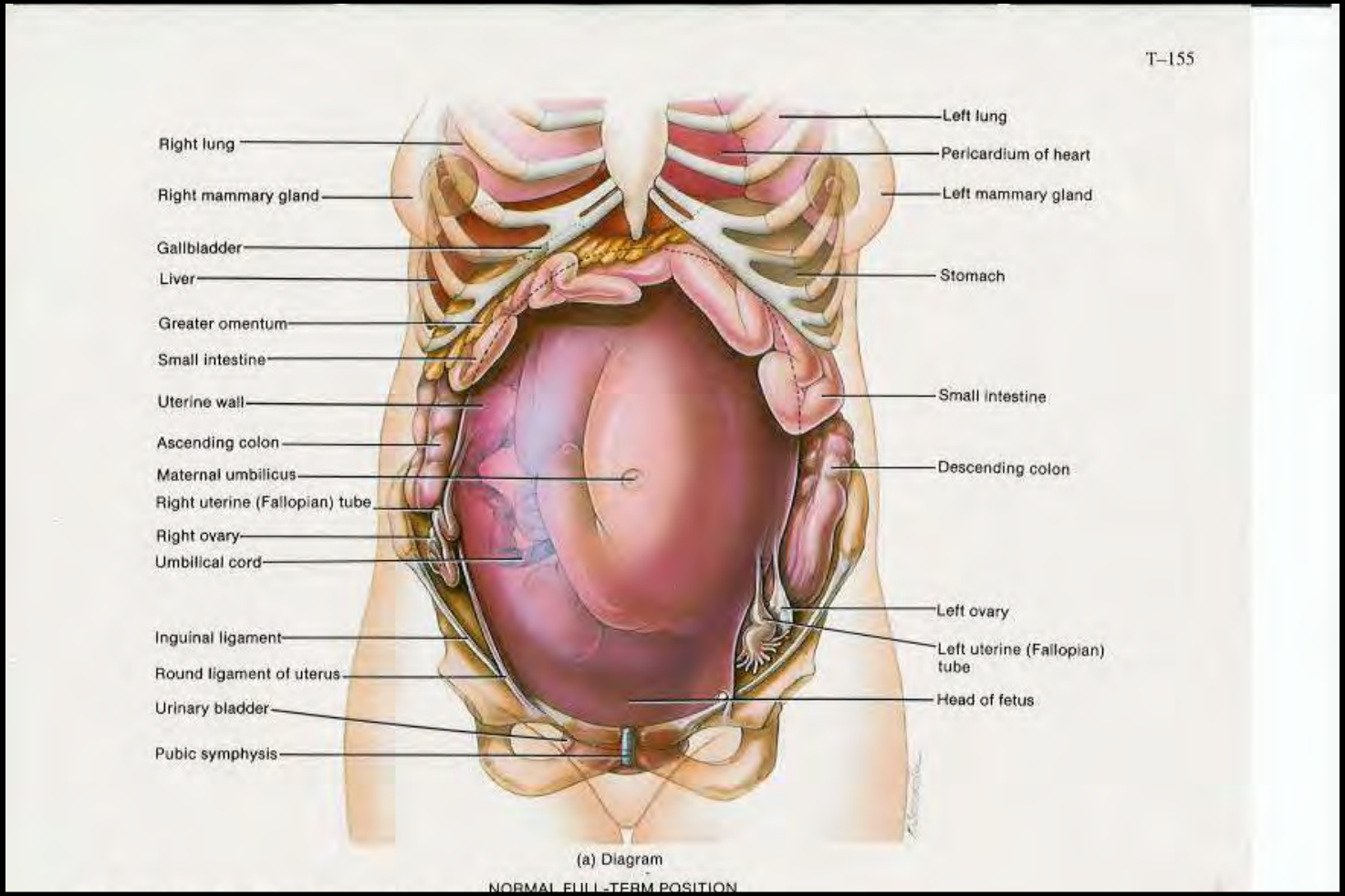
1. Genetics

2. Environment

3. Experience

Why Are Pregnant Ladies Grumpy?

Why Are They Constantly Nauseous?



The Biological Brain by the Numbers

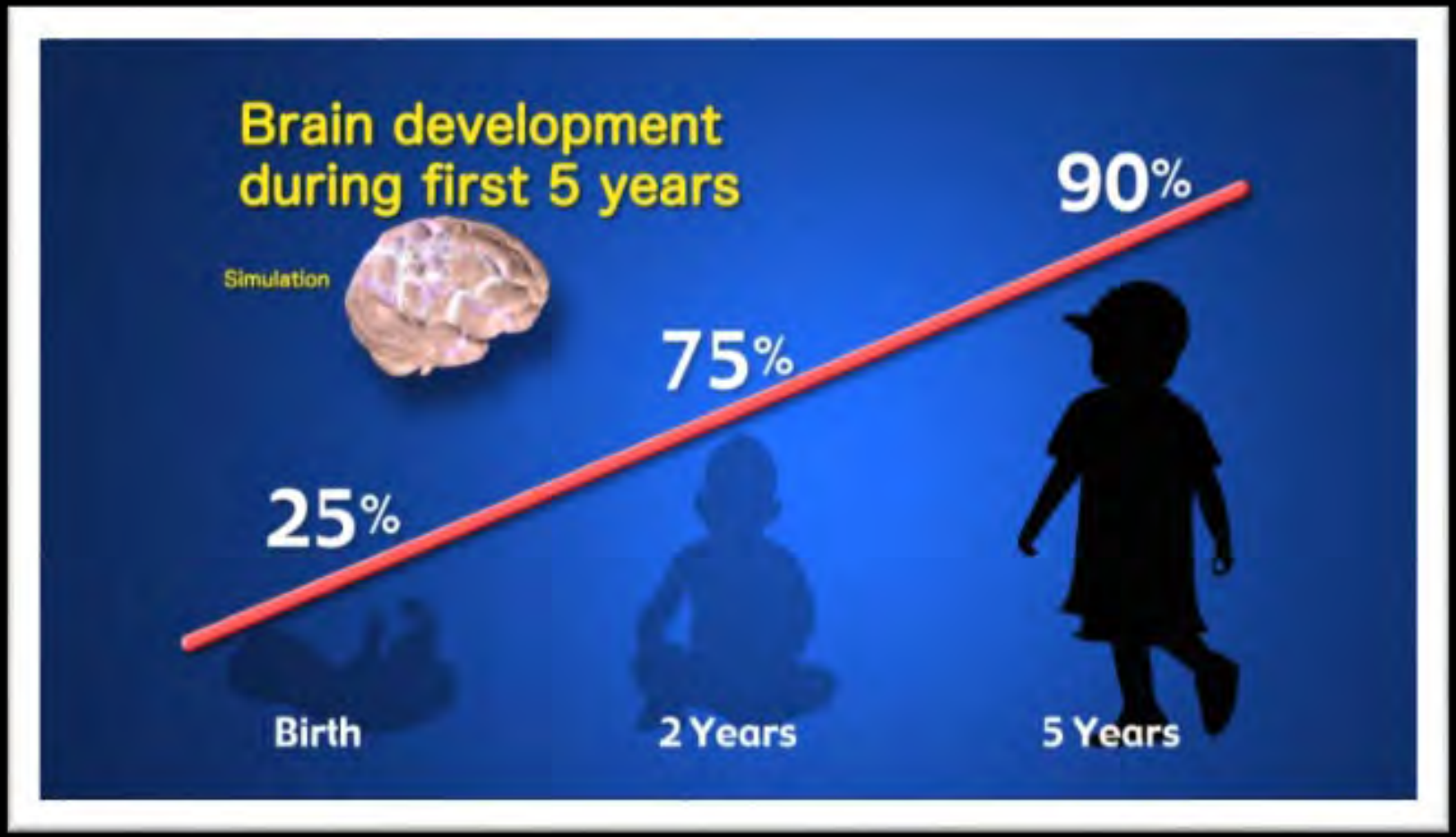
250,000 = Number of brain cells produced each minute during neurogenesis

Gerald M. Edelman, M.D., Ph.D. –
Neural Darwinism in cerebral *jungles*

…and teachers are the gardeners!

Synaptic proliferation and neural pruning gets us to a finished product

No “Mulligans” in Brain Development



Nearly all *early* brain development is “activity-dependent”

The Environment and Brain Development

Factors contributing to cognitive deficits, as well as mild to profound brain damage include the following:

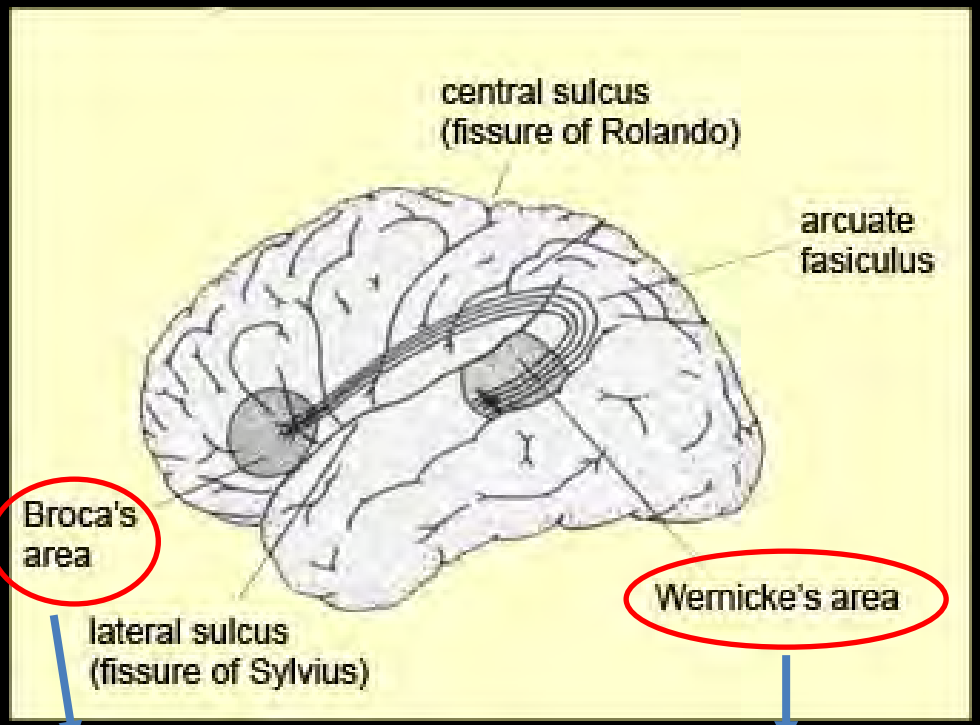
- **inadequate prenatal care**
- **poor perinatal nutrition**
- **smoking during pregnancy**
- **second-hand smoke**

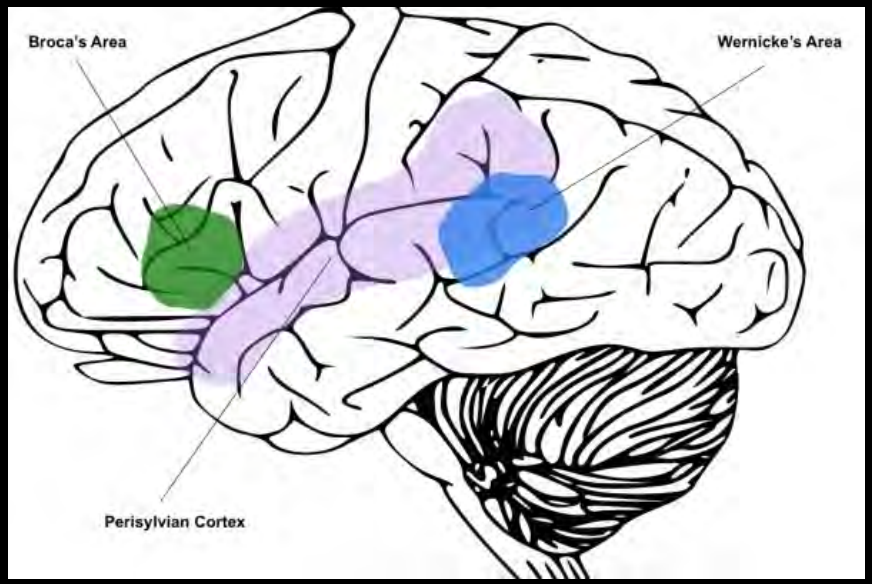
- **lead poisoning from lead pipes and lead-based paints**
- **premature births**
- **babies with low birth weights**
- **prenatal substance exposure (recreational drugs)**

"Health disparities" with ↑ predictable consequences

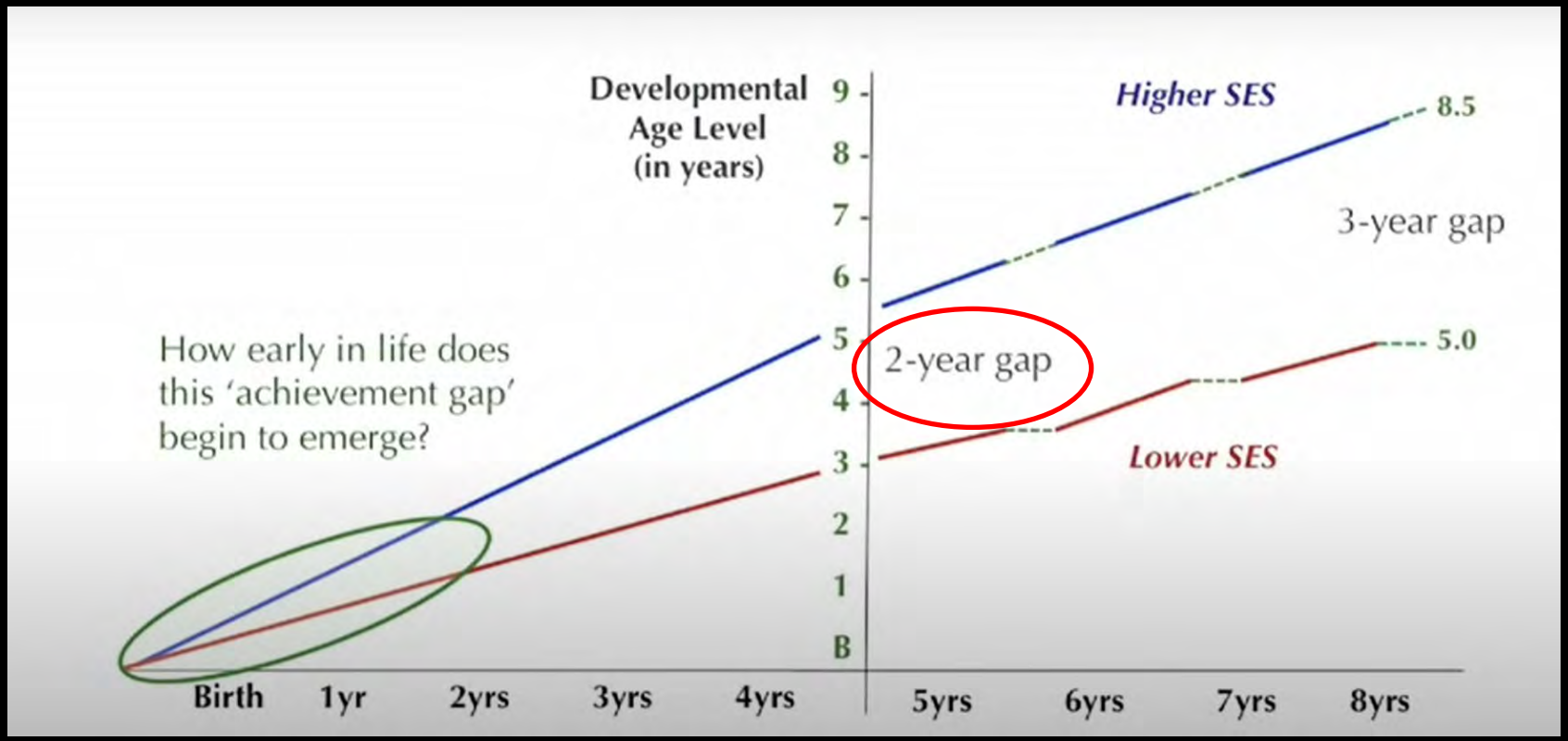
Human Language: Unique

- Over the past 80 years, we have learned about two critical language areas in the *left perisylvian cortex,* primarily from individuals' diseases, misfortunes, and brain damage. (SES can account for 30%+ variation).





Children in Poverty:
Start off Behind in Kindergarten



Professional Learning Opportunities

If we teach *today's* students

as we did *yesterday*

then we rob our students

of *tomorrow.*

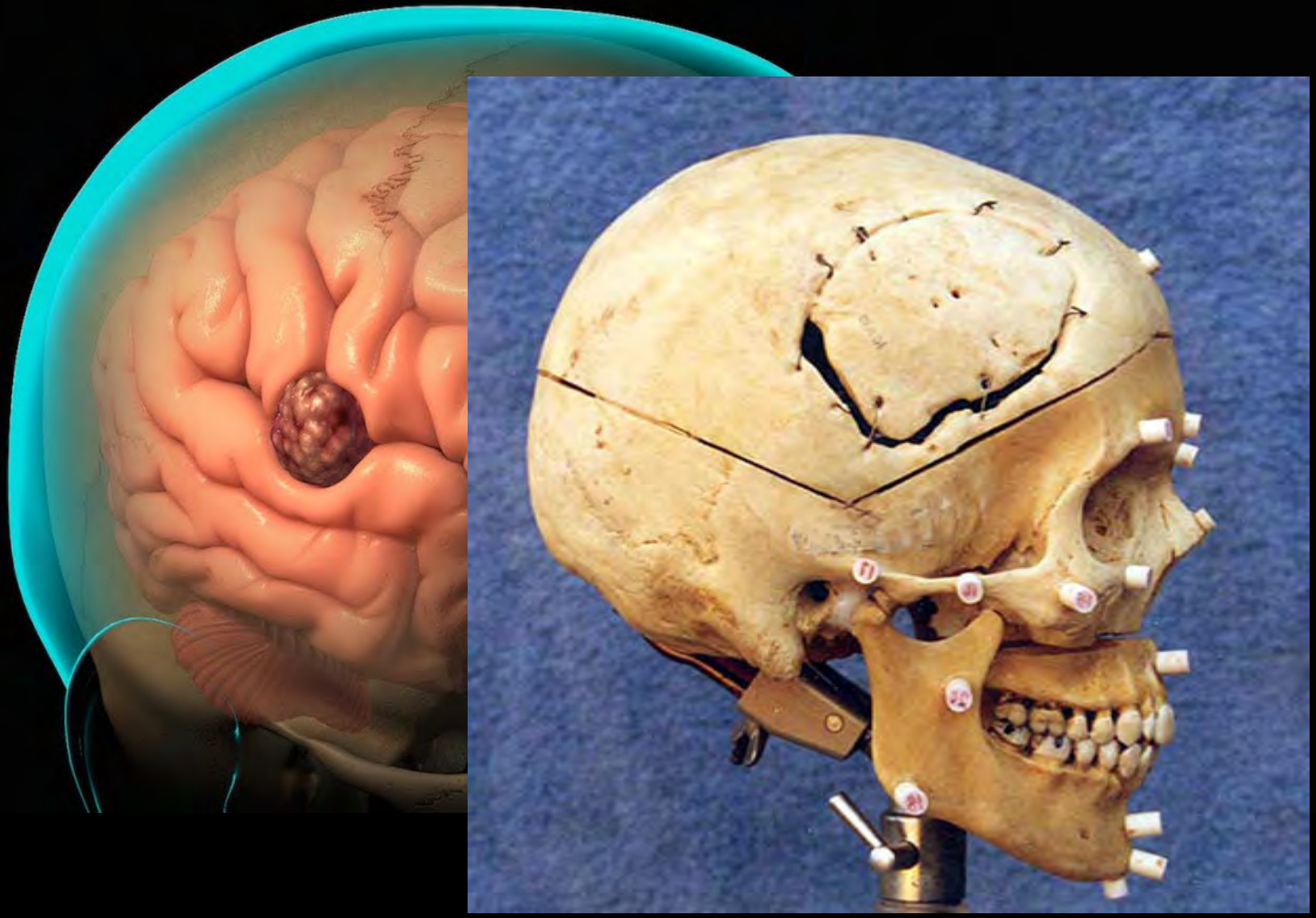
-- John Dewey

The Knowledge Explosion

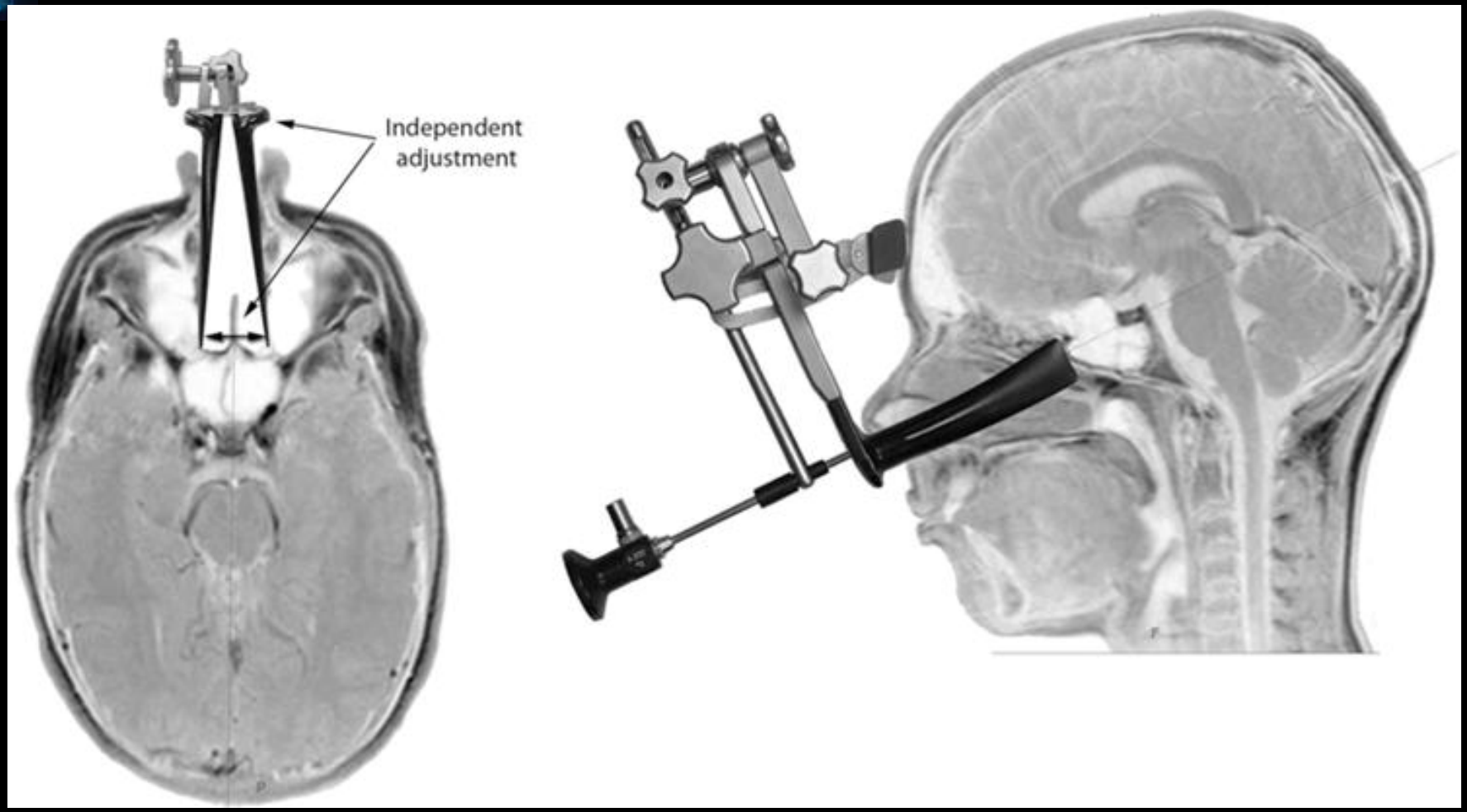
For students who started a 4-year computer science (or any technical degree) in 2018…

50% of what they learned in their 1st year of study was outdated by their 3rd year of college (2021), and 75% will be of little/no value upon their graduation in next Spring 2022.

The Knowledge Explosion

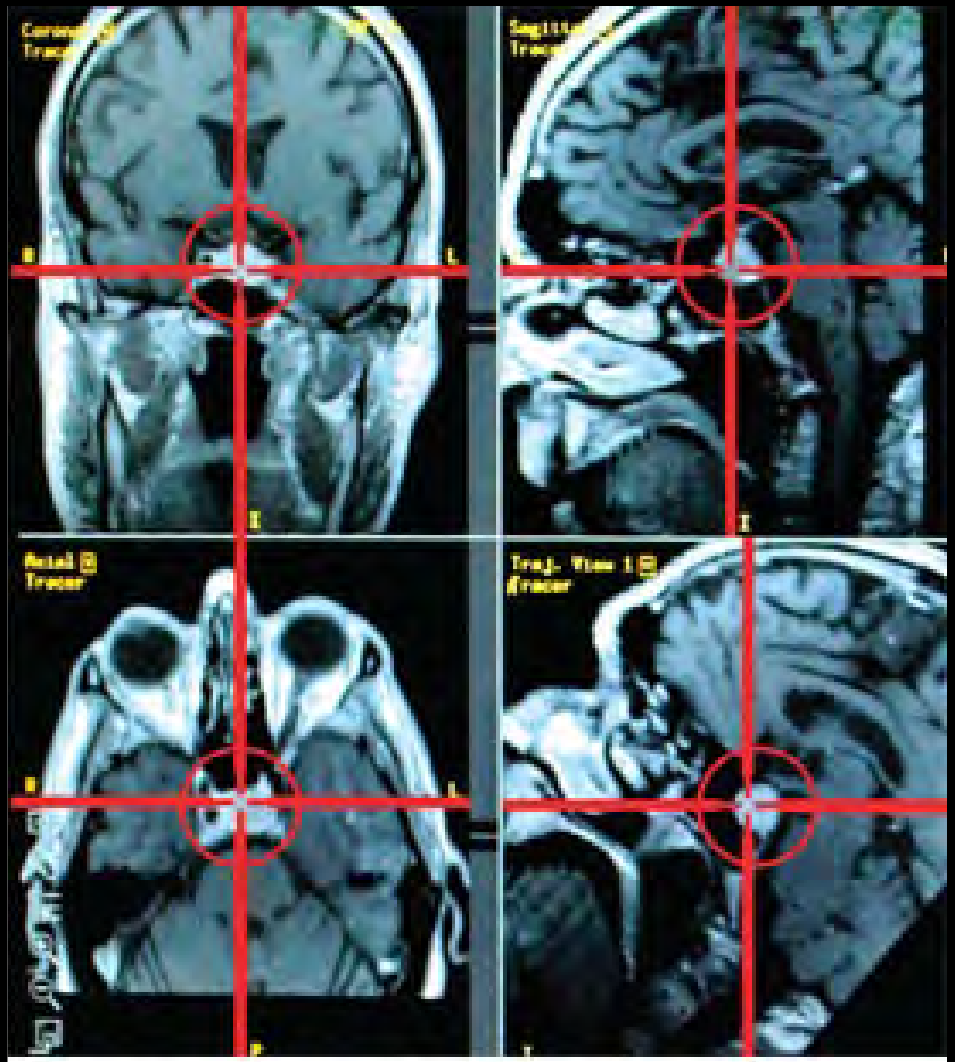


Brain tumor → craniotomy



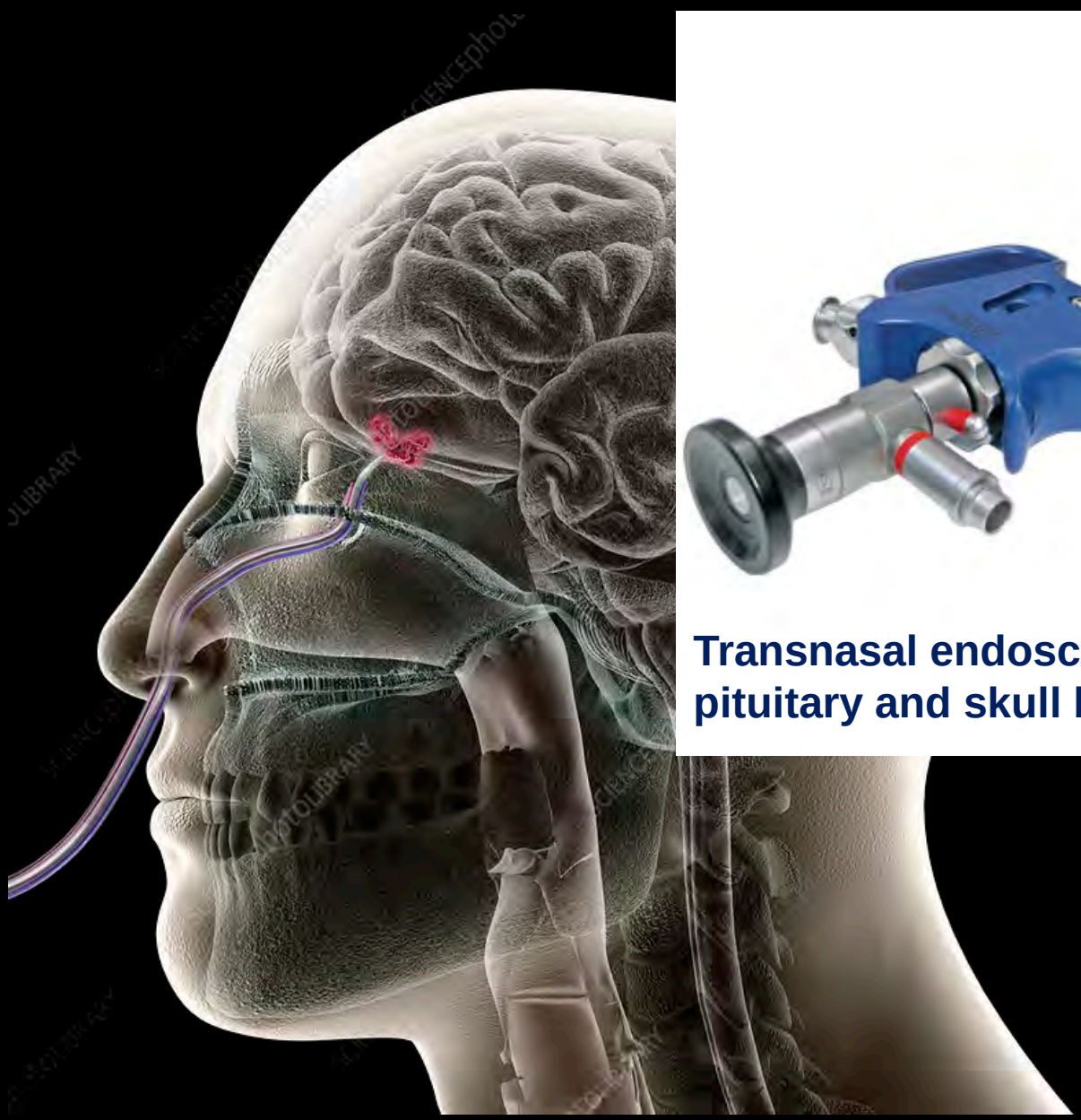
Transnasal transphenoidal speculum

-dal -noi-dal -phe-noi-dal trans-phe-noi-dal



Computer image guidance system

Transnasal neurosurgery



Transnasal endoscopic system for pituitary and skull base surgery

Transnasal neurosurgery

Patients can undergo the same successful surgery without the permanent reminder that the operation was ever performed.

Old Models of S-R Learning

and

New Models Based on Neuroscience

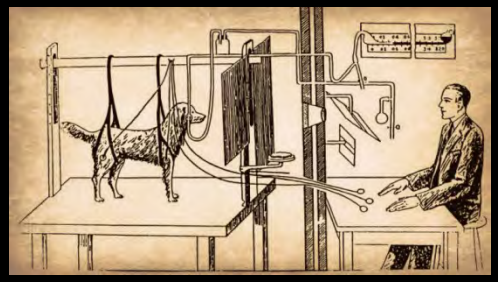
Expanding the Traditional Model of Thinking and Learning

Does the name "Pavlov" ring a bell?

Stimulus → Response

S → R

Teaching → Learning



Factors Encumbering the Stimulus → Response Model

In addition to desires, tendencies, appetites, instincts, inclinations…

Genetics	**+Epigenetics and early nutrition**
+Pre-natal care	**+Age**
+Early development (0-3)	**+Emotions/emotional state**
+Parenting	**+Gender**
+Physical history	**+Perception/expectations**
+Neuro-physiology	**+Memory**
+Prior learning (situated L')	**+Diet**
+Prior experiences	**+Self-esteem**
+Need state	**+Disability**
+Strengths	**+Neural circuitry/plasticity***
+Formal Education	**+Stress factors**

Learning/Memory/Behavior

*** Neural plasticity:** **The flexible nature of the brain to modify structures, alter its functioning and re-route neural circuitry as a response to new stimuli and ongoing learning experiences.**

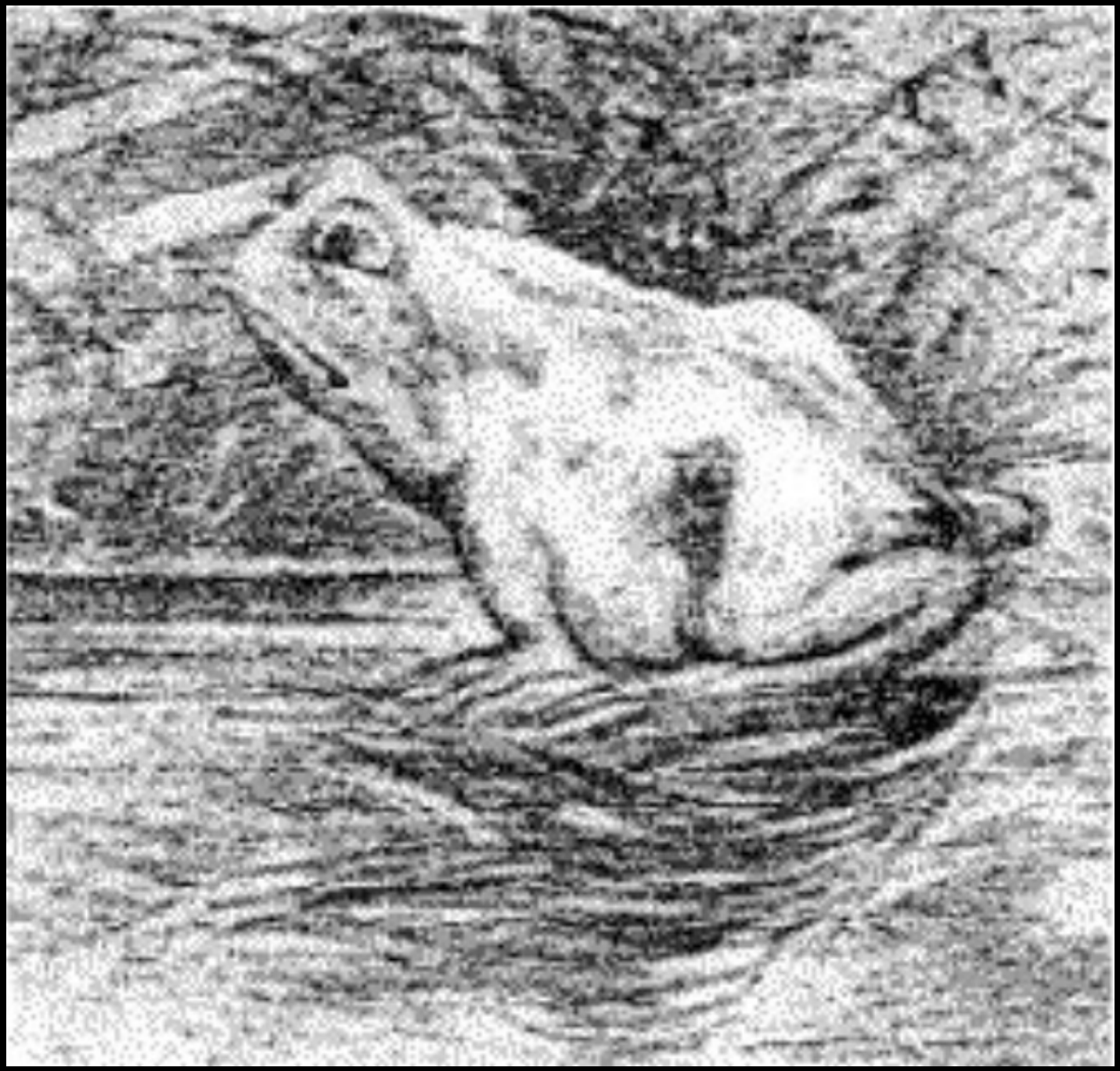
Emotions and Memory

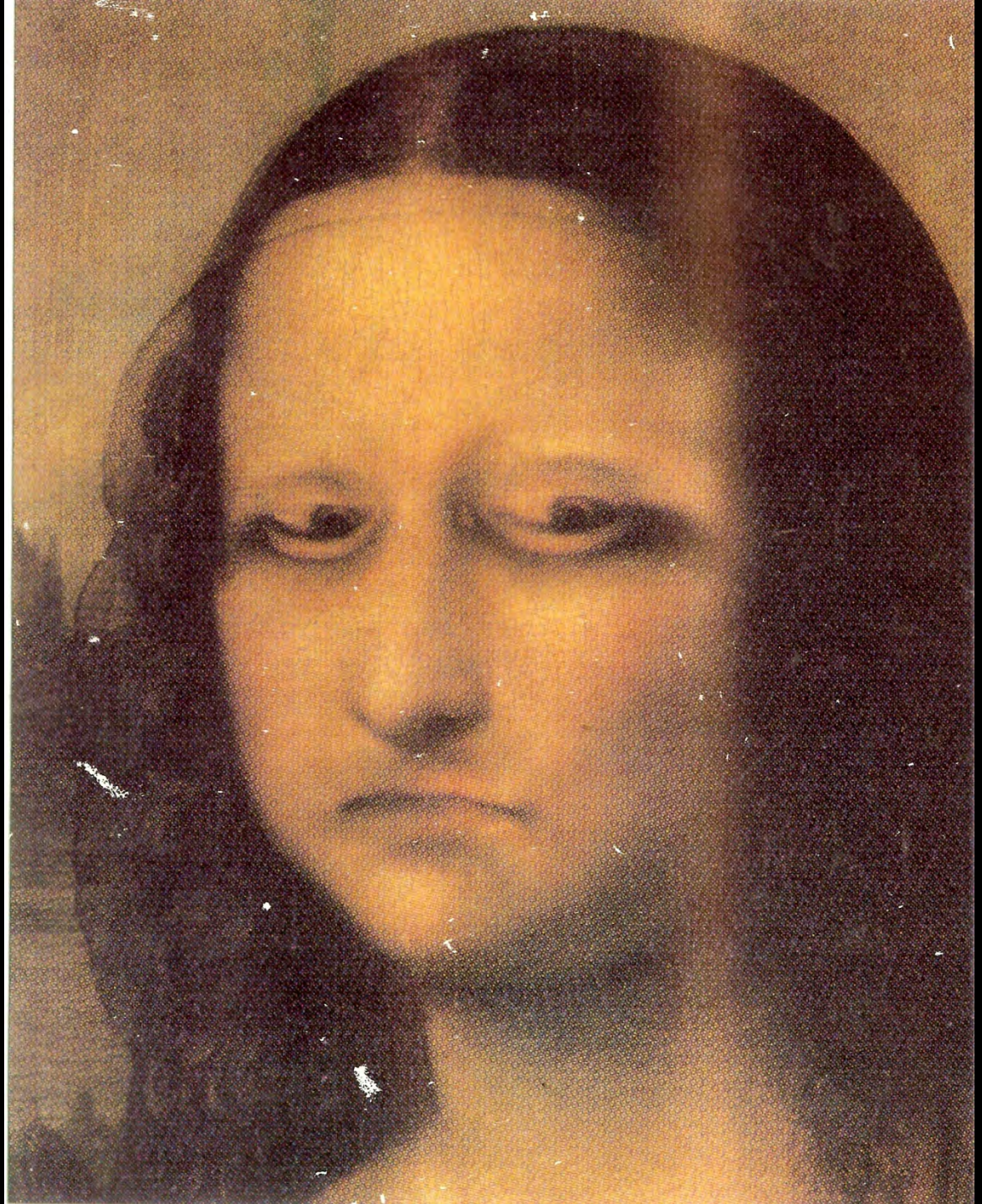
Only one of these images of a penny is correct.
Which one is it?

Past experiences determine future **expectations**

Thinking Differently

- **Orientation** impacts how we see things, which effects how we ***process*** them differently.





Species-specific Responses

Species-specific Responses

Lock your wife and your dog in the garage for an hour. Then open it and see which one is happy to see you.

Common Eye Movements

- We will work in pairs, so find a partner. Identify yourselves as either an A or a B.
- The A's will face the back wall, with the B's facing the A's (looking towards the front of the room) 3-4 feet apart.

- I will pose 3 questions that only the "A's" will answer.
- Here is what the B's will do. (Do not let the A's know.)

Common Eye Movements

On your sheet of paper, indicate ***the direction*** that your partner **looked towards** has he/she answered each question.

Questions

1. How do you spell the word **corpus callosum?**
2. How many **rooms** are there in your home or apartment?
3. How do you spell the word **“child”?**

COMMON EYE MOVEMENTS

Eyes Upper Right
Creating Images

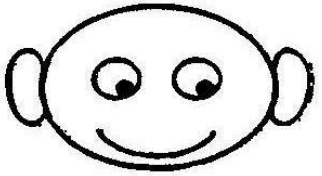
("corpus callosum": our fabrications)

Eyes Upper Left
Recalling Images

(Rooms in your home: our "pictures in the mind's eye")

Eyes Right
Creating Sound

Eyes Left
Recalling Sound



Eyes Lower Right
Experiencing Feelings

Eyes Lower Left
Conversing with Self

("Where did I put my keys?")

Eyes Centered Recalling
Memorized Information

("child," your own name, etc.)

Expanding the Traditional Model of Thinking and Learning

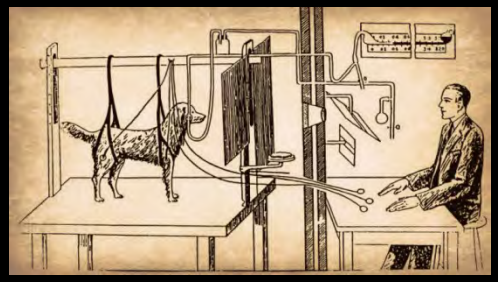
Does the name "Pavlov" ring a bell?

Stimulus → Response

S → R

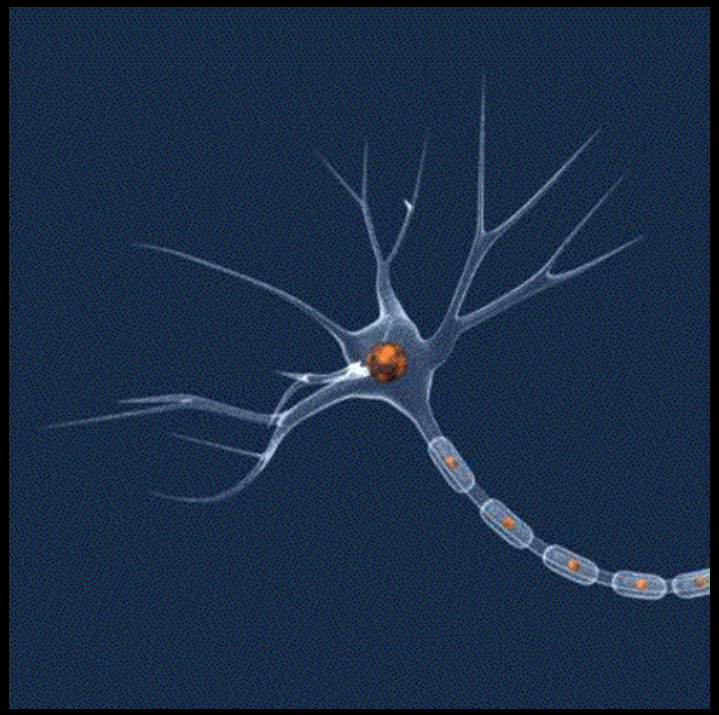
Teaching → Learning

Learning is a *neurobiological* processes occurring inside the brain, just as digestion takes place in the pancreas and the stomach.



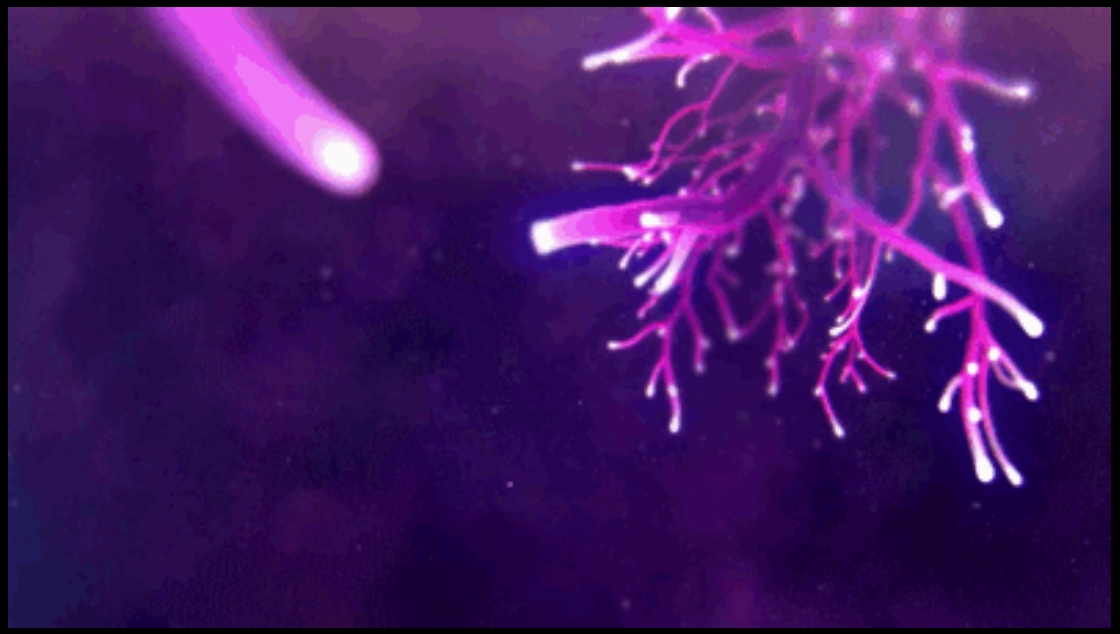
The neural basis of cognition rests in the work of the neurons.

Infants…



100 billion = Number of neurons that we are born with (full-term)

Ensemble of neurons



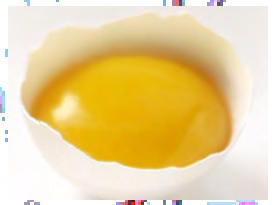
Learning = building a neural pathways to store what we have experienced → a change in brain circuitry -- 24/7

The Science of Learning: Making Connections

Experience → builds the representative network

Making Connections

Egg yolk



ball

Baseball

round

basketball

yellow

Tennis

coconut

Brown

School bus

banana

Taxi

fruits

persimmon

orange

pear

pineapple

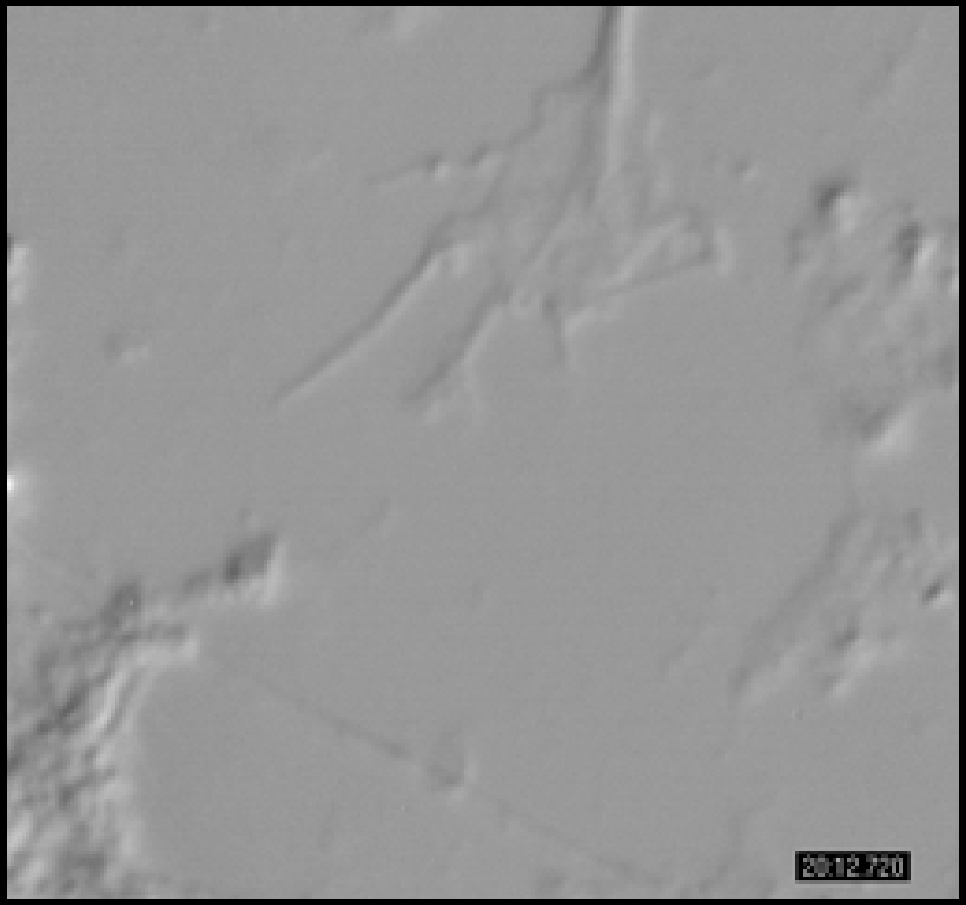
“Re-purpose” the same cells for participation on countless *related* brain circuits

Flying a Kite

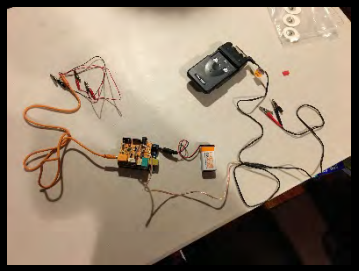
(the missing piece to the comprehension puzzle)

A newspaper is better than a magazine. A seashore is better place than the street. At first it is better to run than to walk. You may have to try several times. It takes some skill, but it is easy to learn. Even young children can enjoy it. Once successful, complications are minimal. Birds seldom get too close. Rain, however soaks in very fast. Too many people doing the same thing can also cause problems. One needs lots of room. If there are no complications, it can be very peaceful. A rock will serve as an anchor. If things break loose from it, however, you will not get a second chance.

On Being Certain: Believing You Are Right Even When You're Not
Robert A. Burton, M.D.



“Ah-hah!” moments in the classroom



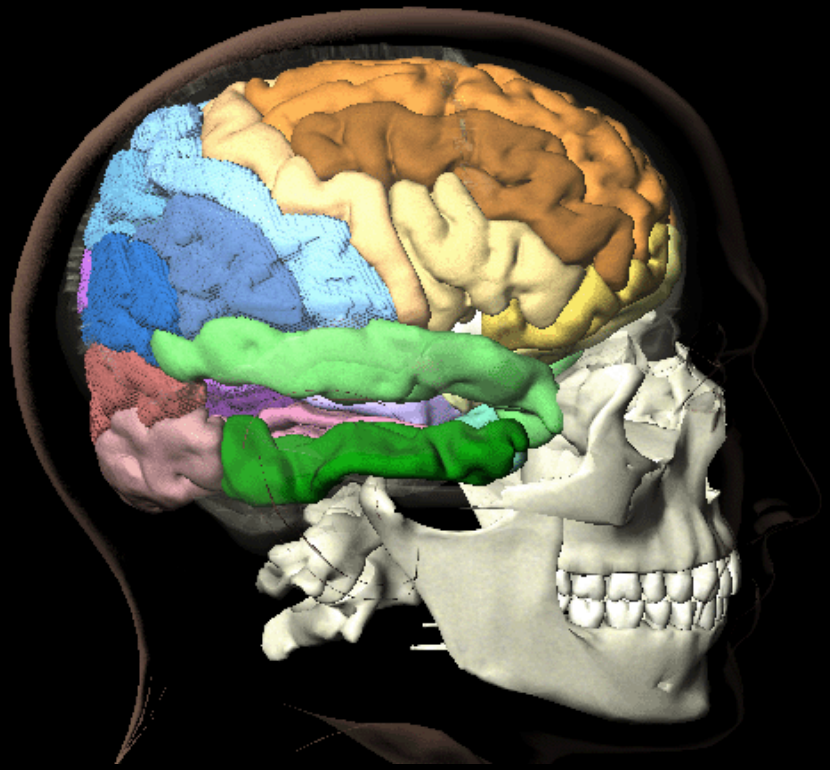
Human-to-Human Interface:

Transferring the electrical signals from one person's brain to the hands of both people

Button electrodes

270 = m.p.h. – the speed at which neuronal signals travel

How does the magnificent human brain learn, and *"learn best?*



Brain development occurs via an on-going and cumulative "dance" between nature (genetics) and nurture (experience)

- *A male kid (baby) goat was placed into a pen with an adult female sheep. The sheep nursed and reared the male goat all the way into his adulthood.*

- ***Question:*** *When the male goat became an adult, was he attracted to*
  - *a. female **sheep** (experience)*
  - *b. female **goats** (genetics)*
  - *c. both?*

If they don't learn the way you teach,

Then, why not teach the way they learn?

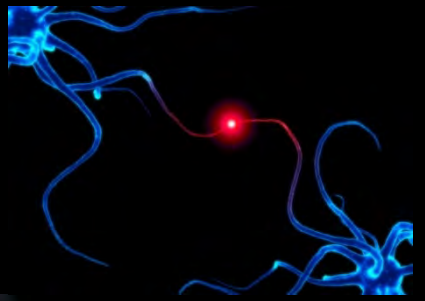
The human brain has *evolved* to learn most efficiently through "*doing*"

(not by listening, watching, not filling in teachers-pay-teachers worksheets, or keyboarding)

C.H.A.M.P.S.

Common and/or shared learning experience(s)

Hands-on/**experiential** learning



Applications of learned knowledge

Making connections

Productive struggle

Sense making

C.H.A.M.P.S.

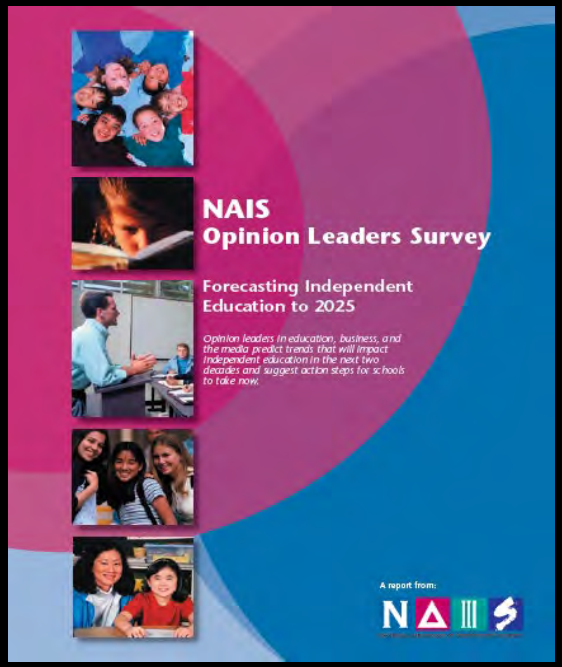
Common and/or shared experience(s) are the vital "on-ramp" to (1) student engagement → (2) student learning

C.H.A.M.P.S.

Hands-on experiential learning that takes place in the 1st-person, not through books, illustrations, or simulations. ("in silico" not of the real world, not of the world as *I* see it or know it. Internet <40% scientifically inaccurate)

Hands-on, Minds-on, Hearts-in

NATIONAL ASSOCIATION OF INDEPENDENT SCHOOLS



Each year, new findings in cognitive psychology and neuroscience will be infused into teacher preparation, curriculum, instruction, student assessment, and the classroom environment. The works of **Howard Gardner** *("Multiple Intelligences")*, **Daniel Goleman** *("Emotional Intelligence")*, **Kenneth Wesson** *("Brain-considerate Learning")*, and others have already been influential in reshaping the independent school classroom, while programs like **Mel Levine's** *Schools Attuned* are assisting educators in using neurodevelopmental content in their classrooms to create success at learning and to provide hope and satisfaction for all students.

Forecasting Independent Education to 2025

-- NAIS

Four Boys and Hands-on Science

Jose Martin

Brian Swann

Willie Stevens

The questions, the connections, and the learning (inquiry) never stopped for us, just because a bell started ringing.

C.H.A.M.P.S.

Applications: **meaningful and effortful** practice opportunities that **deepen** the students' **understanding** of the target science concept, skill, and/or procedure (the "what," "why" "how" and "under what conditions" within the context of science and *reasoning*) – Parker, "…knowing something vs. knowing what it is good for.")

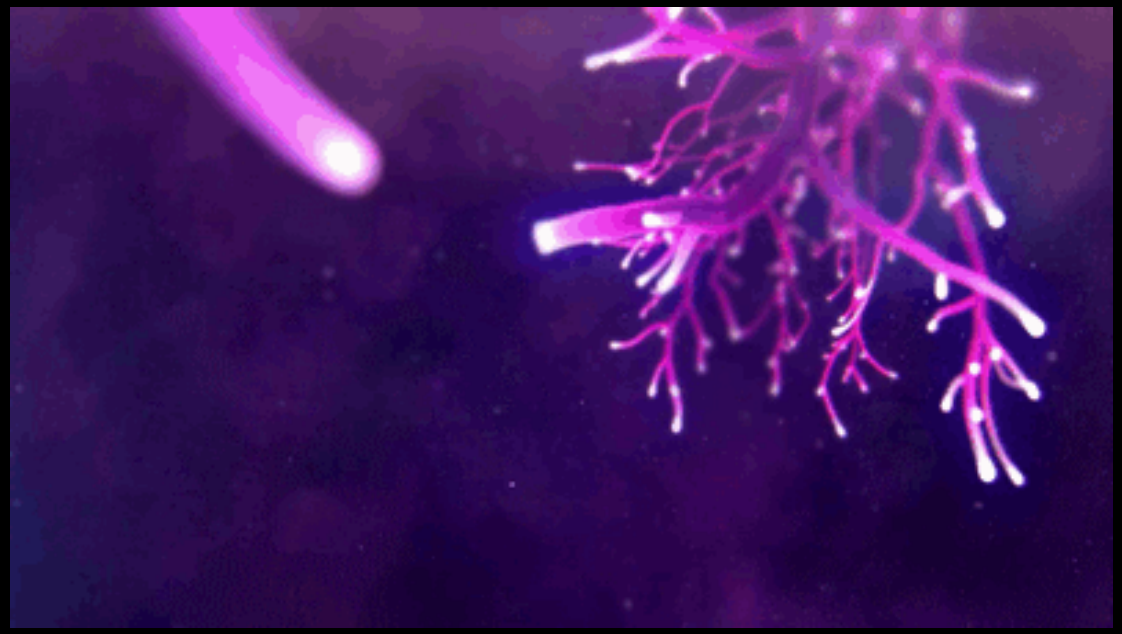
Brain Development

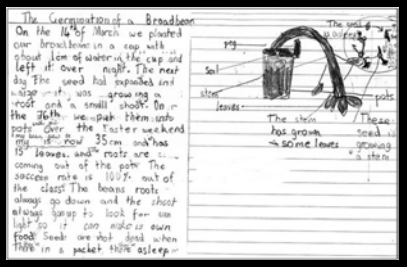
1. Experiences *wire* the brain.

2. Application and repetition *strengthen* all existing brain *wiring.*

C.H.A.M.P.S.

Making connections: Connecting concepts with real-world relevant phenomena (personal experiences or memories) and connecting the concept with other subject areas (the "Ah-hah" and "Oh, yeah!" reactions).





Applying Cognitive Skills in Science

Learning is *not* a spectator sport. Google makes facts and information readily available, but **understanding** comes from **personal hands-on experiences** and **reflections** where students learn how **to create…**

- **Visual** representations (pictures, illustrations, sketches, etc.)
- **Physical** representations (models)
- **Symbolic** representations including:
  - Written words (words, sentences, paragraphs, reports/thesis)
  - Numbers (quantifying, using charts, graphs, statistics, etc.)
- **Contextual** representations (source memory): their personal experiences provide the contexts for memories and practicing new ideas/concepts/procedures/skills, etc.)
- **Verbal** representations (precise descriptive accounts - oral reports)

All of the above can **make the *abstract* real** and **make the *unfamiliar* familiar** to the learner and easier for students to **recall.**

C.H.A.M.P.S.

Productive struggle: a productive purposeful challenge associated with learning a new concept.

- **feedback comes from the learning event/activity itself, rather than from the teacher**
- **the knowledge gained serves as a building block for new learning and "complexity" (deep and long-lasting conceptual understanding - transferrable)**
- **includes learning progressions - *multiple* parts to conceptual exploration, which occurs over time (with "downtime" for encoding, processing, and consolidating memory - thinking) and uses *multiple* learning modalities as students "*un*cover" the targeted science content.**

“Complexity” vs. “Complicated”

No struggle

“Of course we know that”

Productive struggle

“I’m learning”

Destructive struggle

“I give up”

Many of life's failures are people who did not realize how close they were to success when they gave up.

— Thomas A. Edison

Productive Struggle

After a period of productive struggle, students suddenly make the connection

(Khan Academy – Metrics: Student data captured on the unseen backside)

C.H.A.M.P.S.

Sense making: give students opportunities to do the following in order to articulate how they make sense of the target concept or phenomenon.

Exploring
Investigating
Thinking *and* ***questioning***
Reasoning
Communicating **- Engaging in continuous dialogues** with **peers (and teacher)**
+ ***Writing/drawing***
= Conceptual understanding

C.H.A.M.P.S. → Student Engagement

“I Have a Discipline Problem.”
No! You Have an *Engagement* Problem

Engagement

- Active learning
- Inquiry (self-generated questions)
- Student-centered
- Social connections (SEL)

Emotions → attention → learning → memory (integrated in the brain)

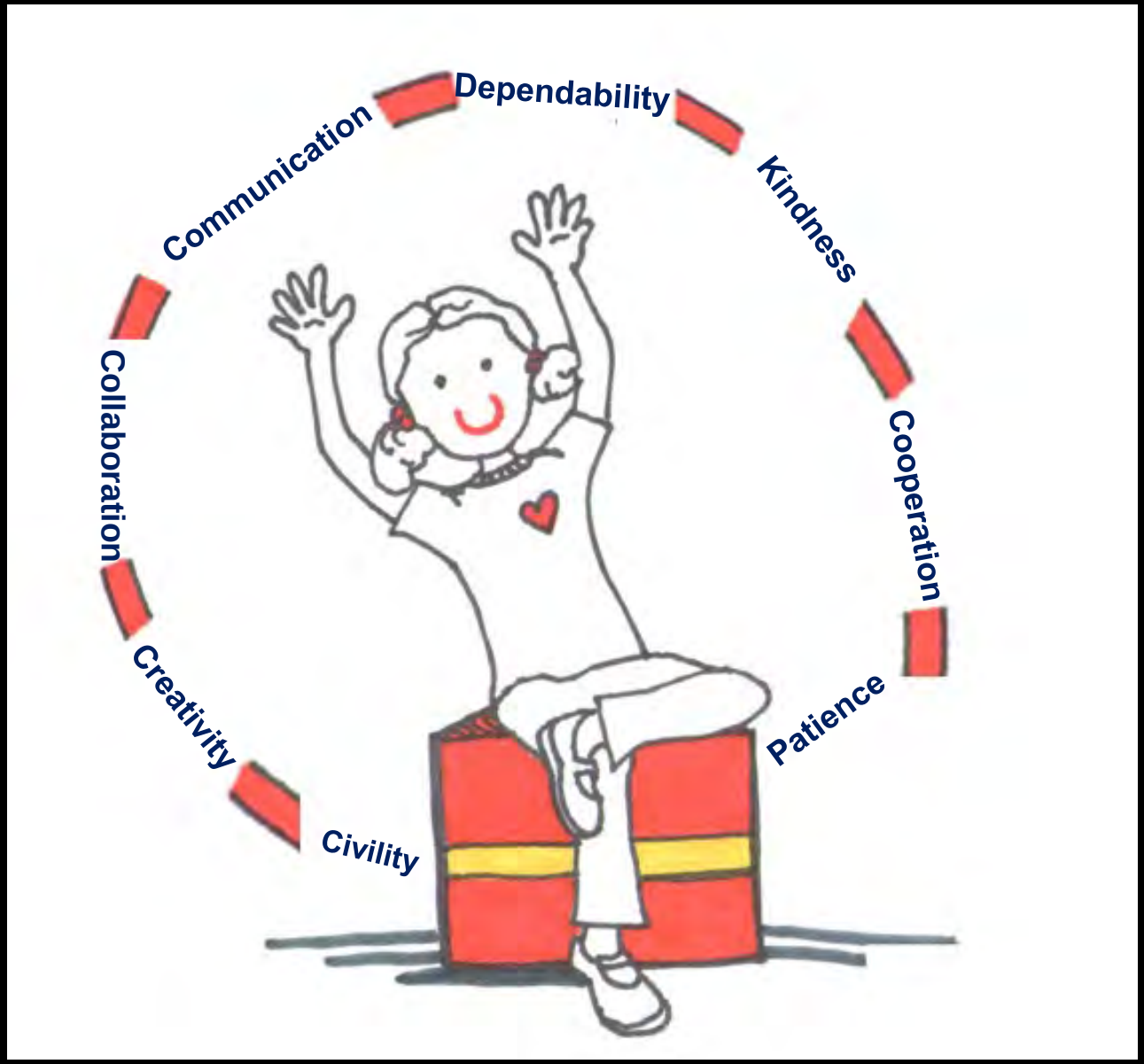
Episodic Memory

STEM/STEAM, PBL, and deep content-area investigations (+SEL)

Guess what I did today?

Doyle: “The one who does the work, does the learning.”

How Do We Close the Performance Gap? By Applying SEL (and 21st Century) Skills



Asset-Based Pedagogy

Why should Asset-based ed. be important to you/your school?

- **Goal: To provide a learning environment that capitalizes on our students' strengths.**
- **Beliefs needed: Students flourish when we build on their strengths, and learning is easier for them when we are enhancing students' assets rather than *"correcting"* their "deficits." They are not "broken" and do not need to be "fixed" (hospital model).**
- **We should be asking: "What works best with students? How can we do more of it and do it more frequently?**

Healthy Positive Emotions →

Growing Dendrites = Learning

Asset-Based Education

Why is it that some students within the same family or community thrive and succeed while others wither and fail?

- **Researchers looked deeper into the non-cognitive factors because some children did well while similarly talented students struggled. Why?**

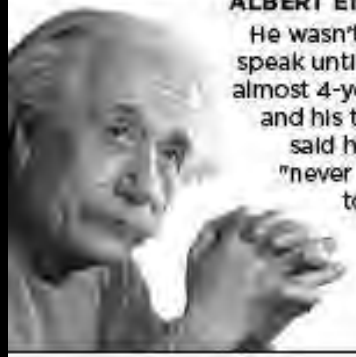
Growth and development are not always limited to ideal environments.

How Do Children Thrive Social-Emotionally?

- Nearly always, *someone* saw something special in them -- a strength -- and nurtured that strength into a personal, and academic asset.
- At that point, a transformational journey began in the life of that student.
- In an environment where others see defeat, helplessness, and hopelessness, comes a teacher who identifies the "wins," inspires a child, and that child flourishes.

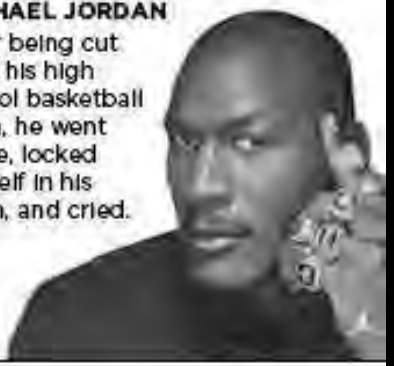
The key factor:
Asset-based

FAMOUS FAILURES



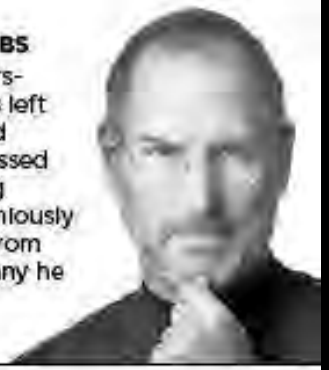
ALBERT EINSTEIN
He wasn't able to speak until he was almost 4-years-old and his teachers said he would "never amount to much"

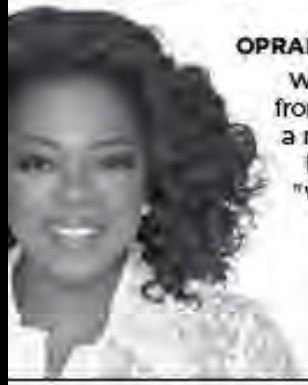
MICHAEL JORDAN
After being cut from his high school basketball team, he went home, locked himself in his room, and cried.



WALT DISNEY
Fired from a newspaper for "lacking imagination" and "having no original ideas."

STEVE JOBS
At 30-years-old he was left devastated and depressed after being unceremoniously removed from the company he started.





OPRAH WINFREY
Was demoted from her job as a news anchor because she "wasn't fit for television."

THE BEATLES
Rejected by Decca Recording Studios, who said "We don't like their sound—they have no future in show business."

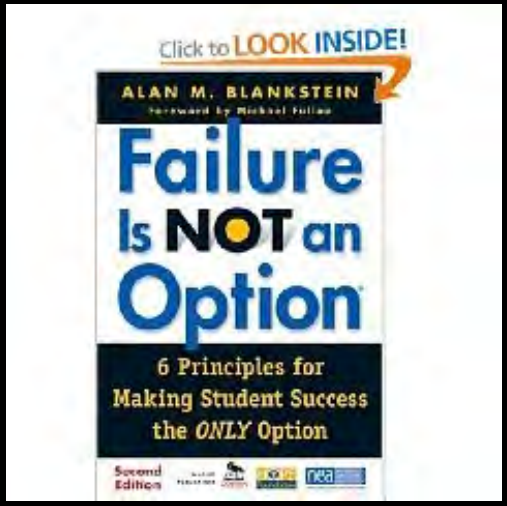
IF YOU'VE NEVER FAILED,
YOU'VE NEVER TRIED ANYTHING NEW

Emotions Can Become a Catalyst or an *Obstacle* to Learning

Afraid to "fail"

Performance avoidance

"**Failure** is not an Option"



Failure is nearly always a ***prerequisite*** for future learning, success in **learning.** Most ***initial learning and discoveries*** occur via trial-and-error strategies.

Science - Technology - Engineering - Art - Math

In 60 seconds, draw a quick sketch of the person sitting next to you.

Science - Technology - Engineering - Art - Math

Pass your picture to the subject of your art.

“I’m sorry.”

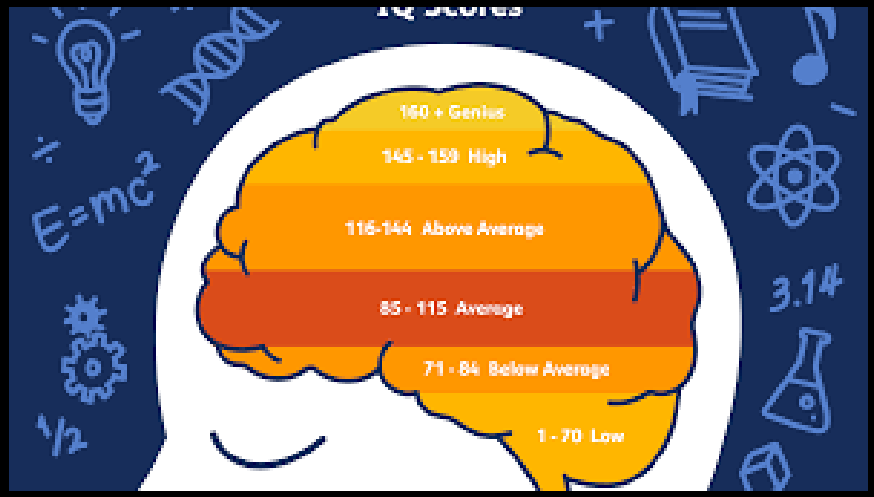
Would a child ever say that?

Mindset and Accomplishments

What else might you have been able to achieve in life, if you had not been afraid *to try* or if you were less fretful about what other people would think/say?

By Changing Expectations

- Researchers administered the Stanford-Binet Intelligence Scale-V to (30+) 1st grade students at the beginning of the school year. "The test results indicate that 5 students scored at or above the *genius* level (140)." → Confidentiality agreement.
- Monitored the behavior of teacher & students
- At the end of the academic year, the students were re-tested to determine if there was any variance from the first set of IQ scores.
- Q: Guess how many scored at the genius level on the second administration of the test? Who? Why?



By Changing Expectations

- Answer: The same 5 students.
- However, *their* scores on the 1st test were *not* even close to the best scores – only slightly ↑ average.
- The quality of her teaching, her treatment, and her expectations ↑ the test scores of the 5 targets
- Her efforts to "keep" them at the ↑ performance level, "elevated" them to ↑ level in the classroom.

* The *results* we get from students, often reflect what we *expected from* those students and how we nurtured them (causal effect) to achieve.

My teacher thought I was smarter than I was – so I was.

Six-year-old

Emotions and Education

His 2nd day of Kindergarten

He thought school was for one day only 😭

PERC^{3}S

There are five BC elements that the human brain seeks while processing incoming stimuli for personal "meaning," which makes the information "memorable" and worth remembering.

(1) Patterns (derivative of visual experience)

(2) Emotions

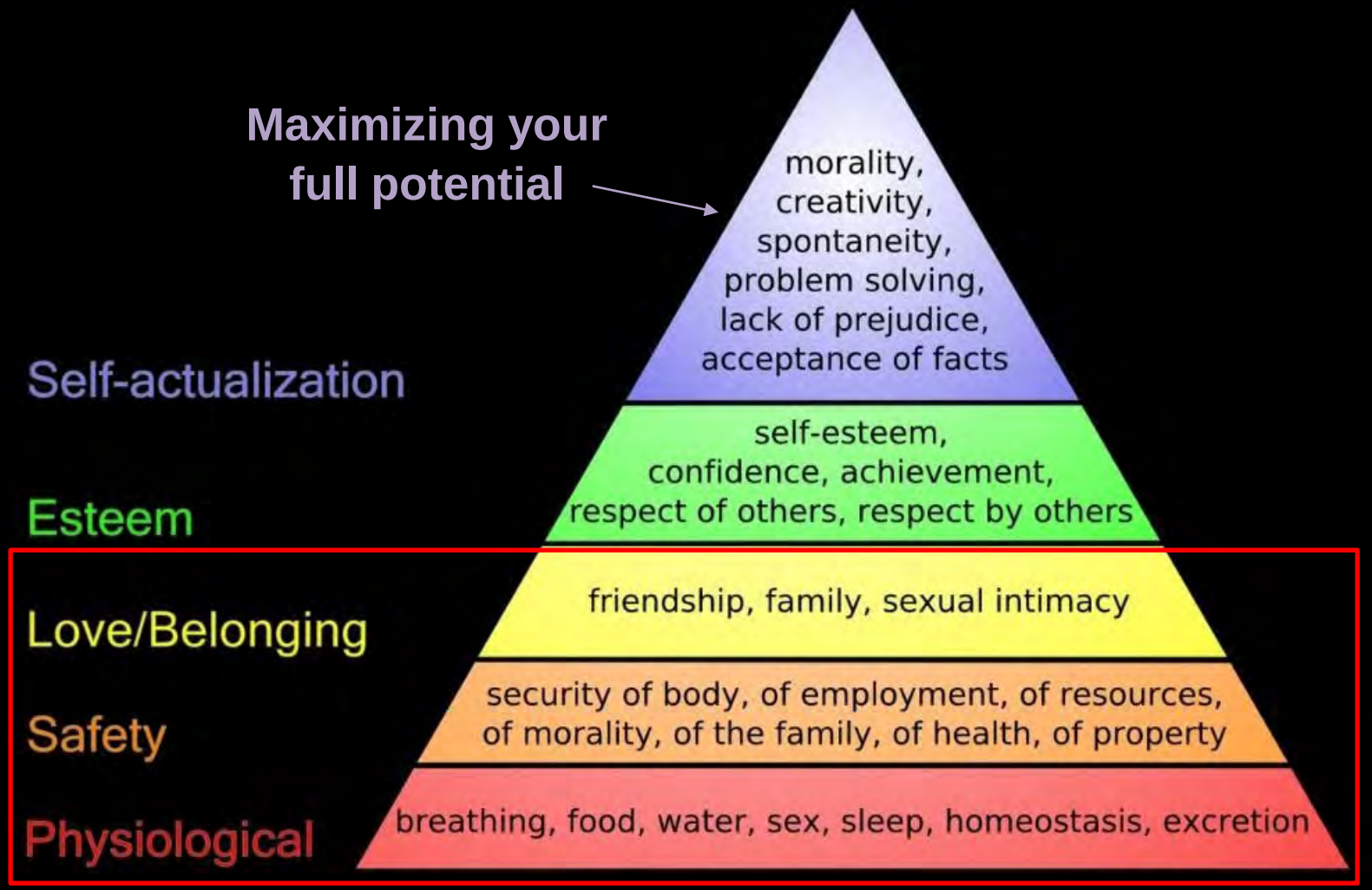
(3) Relevance

(4) Context, Content, and Cognitively-appropriate

(5) Sense-making → Stories (narrative)

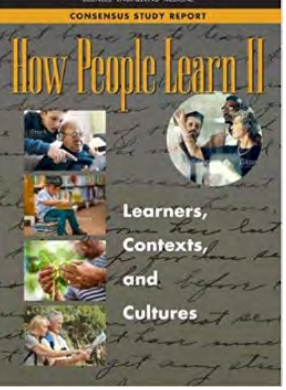
Patterns, emotions, relevance, context, content and sense-making are critical factors in driving (1) attention, (2) motivation, (3) learning, (4) memory formation, and (5) recall. Collectively, these 5 factors are the primary criteria for transfer into long-term memory storage.

Emotions in the Classroom



Safety: The Need for Safety

Emotional <u>and</u> physical safety



Emotions and Learning

The S.A.I.L. Concept

The environmental preconditions that should be experienced by students ***prior to*** initiating formal instruction include...

S — **Safety**
Physical and emotional

A — **Acceptance**
No "put-downs"

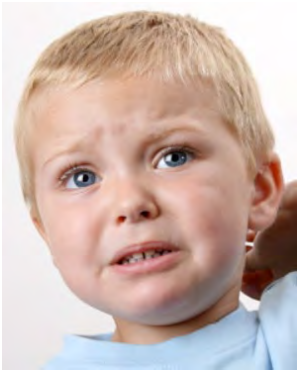
I — **Inclusion, interactions and involvement**
Interpersonal/social aspect of memory formation

After satisfying these prerequisite neurophysiological and hierarchical conditions, ***students are biologically ready for...***

L — **Learning**
Students feel their immediate environment is secure enough for them to take risks, explore and discover

Source: Kenneth Wesson (2011). *Education for the Real World; Six great ideas for parents and educators.* Brain World, issue 2, Volume II Winter 2011

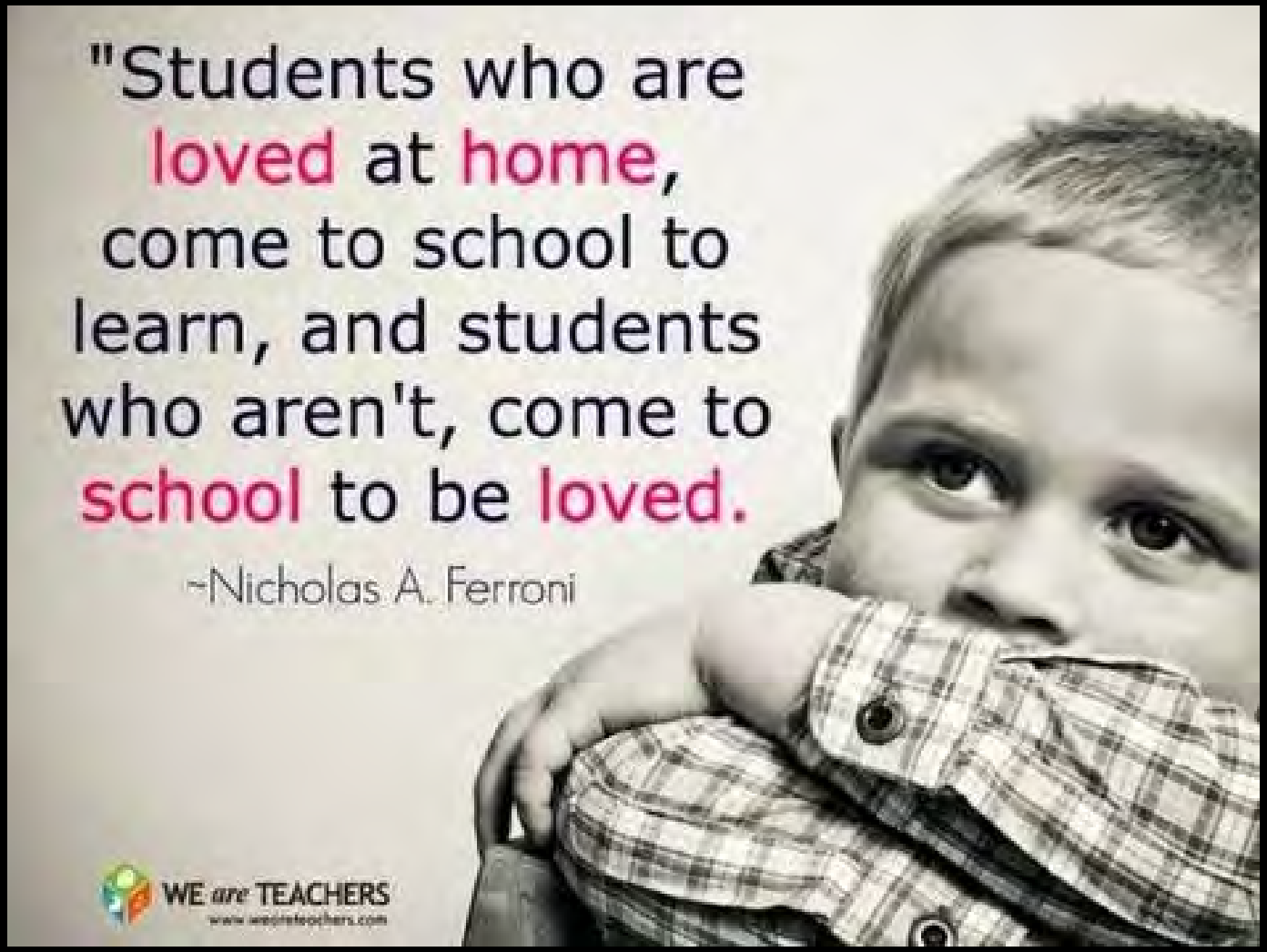
Students who have chronic safety concerns also tend to *underperform* academically *(Pratt, Tallis, & Eysenck, 1997).*

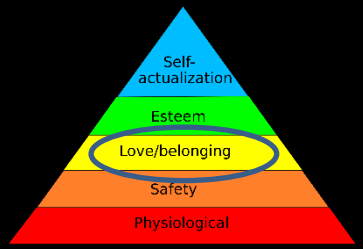


Still Face Experiment:
Dr. Edward Tronick

Long-term unswerving neglect can be more damaging than physical abuse.

The Need to Belong



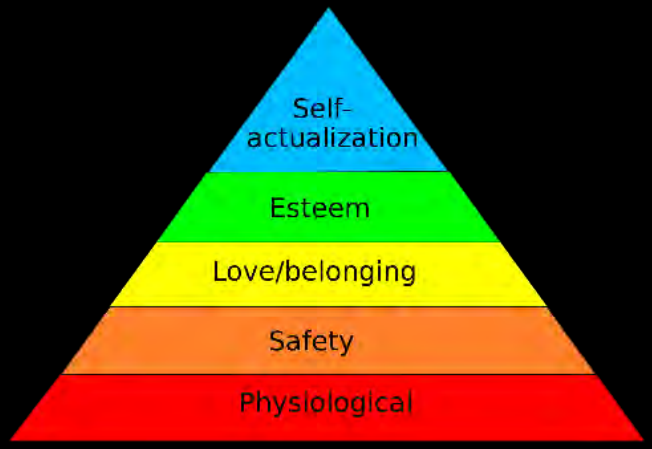


The Need to Belong

Jax

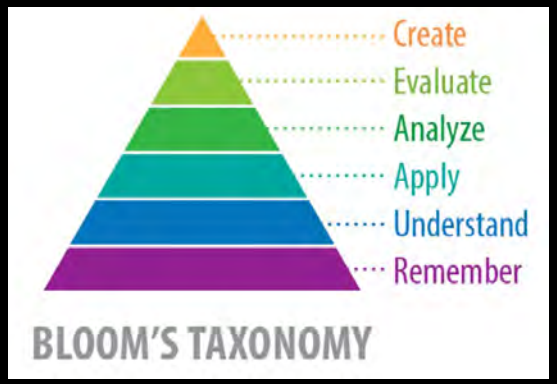
Reddy

Working together, learning together = break down barriers (our differences no longer make a difference)



Maslow before Bloom

and



Bloom before any Standards

SEL
in Education

Social Emotional Learning

What Every Child Needs to Know

Every child needs to know that every parent and teacher within that child's personal orbit wants

- **to be proud of him/her**
- **him/her to succeed in school**
- **to watch him/her grow and develop in healthy ways**
- **the best for them in life**
- **him/her to make intelligent choices**
- **him/her to be part of a social group that has a positive influence on him/her**
- **him/her to spend time around people who are supportive and positive**
- **their school to maximize their gifts, talents, and strengths**
- **to hear good news about him/her, and not be surprised in the least**
- **to be a good parent or a good teacher for him/her**
- **to find out what that child is good at doing and nurture it to its fullest**
- **him/her to know that he/she is not "broken" and does not need any fixing**
- **each child to know that we will cling to these wishes for a lifetime for him/her (whether we express it daily or not).**

Source: Wesson, Kenneth, *Lifting Our Voices. Learning and Healing Together.* CCEE & CAAASA (2021)
https://drive.google.com/file/d/16nyd-s6_to85TVfRnlV-jQ-HWwEJxrWJ/view

Be *somebody,*

who makes *everybody*

feel like *somebody.*

“I’m Just a Board member

What do you make?

“I make a difference!”


Even on your very *worst* day, you are still some child's very *best* hope.

The Gift

Yesterday is history,

Tomorrow is a mystery.

But, today is truly a *gift.*

That's why it's called

The ***Present.***

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San Jose, CA

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sciencemaster.com

Possible??

Treatment → How the Brain Develops: Signaling

- A mother rat licking and grooming her pups initiates a cascade of events that turn on genes for growth.
- Researchers found that merely stroking infants with a small wet paint brush could prevent the ↓ developmental effects of physical/neglect.
- Rats who received physical attention in their youth had considerably less hippocampal cell loss during older age, and they performed better on certain memory tasks as adults and in old age.

Possible??

Possible??

Possible??

Started these slides at: 315
Now at: 134
Goal for this cut: 90
Ended at:
Goal: 90
Time: 55 minutes
USED:

Possible??

Piano Stairs

Possible??

Possible??

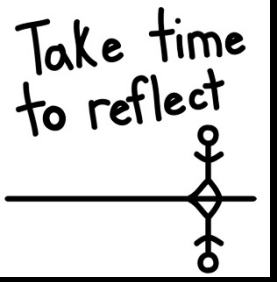

“Act as if what you do makes a difference. It does.”
—William James—

HEADLINE

President Obama's Handshake Rejected

Implicit bias/implicit social cognition

Possible??



"Reflect and Connect"

"We don't *learn* from experience, we learn by *reflecting* on it."

-- John Dewey

- What was the most valuable idea that *you learned* this morning? What makes it so important to you?

- Please write down two "I will-statements." Based on what we have discussed today, what will you do differently with your students?

The Gift

Yesterday is history,

Tomorrow is a mystery.

But, today is truly a *gift.*

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The ***Present.***