

What Should You Know About the Developing Brain?

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The Kindergarten Teacher's Creed

by Betty Peck

I bring the gift of myself to this **celebration** of life we call the Kindergarten.

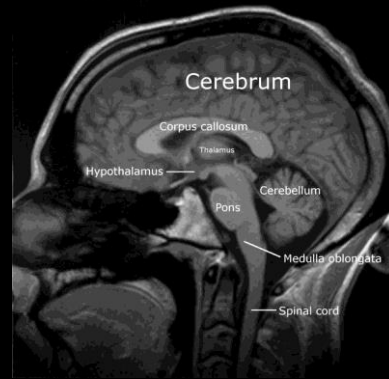
I come each day to be refined, smoothed, and tempered, for I hold in my hands with wonder and gratitude the future!

The seeds of the future are in the oneness of all nature, all people in tune with the divine to be found in our hearts that I give through the joy and beauty of love.





When it Comes to Learning Only the Gray Matter Matters



- Our students come in a variety of **colors**, but all brains are basically gray. It is only the gray matter that *truly matters* in learning and neuroscience.



- Boosting achievement and maximizing student potential hinges on educators developing a respectable knowledge reservoir for **teaching with only the brain in mind.**



The Developing Brain

- The astonishing young brain and how we can nurture its **full development**
- What works for all young learners? Why do some **types of learning** endure, while others fade more quickly?
- What are the preferred teaching **strategies** by which we can incorporate brain research into the early learning **experience?** (making connections)

Quick writes and table-talks





The illiterates of the future are not those who cannot read or write, but those who cannot learn, *un*-learn, and *re*-learn.

--Alvin Toffler

Change



By Adding Just One Degree

212°

instead of

211°





The brain is without doubt our most fascinating organ. Parents, educators, and society as a whole have a tremendous power to shape the wrinkly universe inside each child's head, and, with it, the kind of person he or she will turn out to be. We owe it to our children to help them **grow the best brains possible.**

*-- What is Going in There?
Lise Eliot*



**What Teachers
Must Know,
Must Do,
and
Must Know How To Do
Today**



From the College of Education, We Became Familiar with...

Learning theorists:

Piaget: Stages of development

Bruner: Discovery learning

Von Glasersfeld: Constructivism

Bloom: Taxonomy of L'

Vygotsky: Zones of proximal development

Fleming: Learning styles

Lave & Wenger: Communities of practice

Ausubel: Meaningful learning

Dewey: Experiential learning

Freire: Critical pedagogy

Kolb: Experiential learning

Gardner: Multiple Intelligences

Levine: Schools attuned

Holt: Un-schooling

Goleman: Emotional intelligence

Skinner: Behaviorism

Montessori: Montessori education

Hargreaves: Interpersonal relations

Pask: Conservation theory

Pavlov: Classical conditioning

Thorndike: Memory theory



Teachers Memorized 40+ Different Types of Memory and Memory systems

- associative memory
- auditory memory
- autobiographical memory
- conceptual memory
- conditional memory
- declarative memory
- echoic memory
- emotional memory
- episodic memory
- explicit memory
- flashbulb memories
- iconic memory
- implicit memory
- informational memory (which isn't a survival mechanism)
- long-term memory
- motor memory
- permanent memory
- primary memory
- procedural memory
- reflective memory
- secondary memory
- semantic memory
- sensory memory
- short-term memory
- source memory
- state-dependent memory
- working memory

What Teachers Are Required to Know Today - 3

Hueristics

Dialectics

Mnemonics

Didactics

Problem solving

Cognitive structures

Metacognition

Epistemic cognition

Thinking Skills

Study Skills

Learning to Learn

Depths of Knowledge

Student Learning Objectives

Learning paradigms

Intentional Talk

Accountable Talk

Strategic Reasoning

Artificial Intelligence

Logic

Induction

Deduction

IQ

Multi-sensory learning

Active Learning

Hands-on learning

Standards-based learning

Brain-considerate learning



What Teachers Are Required to Know Today - 5

Hemisphericity

Periodicity

Autoplasticity

Procedural Knowledge

Noetics

Time-on-task

Socratics

Inquiry Learning

Mind-mapping

Semantic-mapping

Brain-storming

Schema theory

Differentiated instruction

Data-driven decision-making

Structures of Intelligence

Instrumental Enrichment

The Innovative sciences

Teaching across the Curriculum

Interdisciplinary teaching

Executive function skills

Authentic Assessment

Alternative Assessment

Performance Assessment

Portfolio Assessment

What Teachers Are Required to Know Today - 6

Interpersonal relations
Educational objectives
Multiple intelligences
Conversation theory

Direct instruction
Scaffolding

Critical Thinking
Lateral Thinking
Remedial Thinking
Flexibility in Thinking

Platooning
Transitional Pre-K

Behavior modification
Situated learning
Learning communities

Educational objectives
Learning communities
Procedural knowledge
Learning styles
Instructivism
Behavior modification

Process vs. Content
Process vs. *Product*
Whole class vs. Facilitator

What Teachers Are Required to Know Today - 7

H.O.T.S.

B.Y.O.D.

M.O.O.C.s

1-to-1 Classrooms

Flipped Classrooms

Digital literacy

e-Books

Coding

Interactive Whiteboards

Smart Boards

Computer-Assisted L'ng

Gamification

On-line Educational
Resources (OERs)

21st Century Skills

College and Career Readiness

STEM or S.T².R.E.A.M.

(addressing *content* for the 1st time)

Common Core State Standards
for **Reading/Language Arts**

Common Core State Standards
for **Mathematics**

English Language Development
Standards

The Next Generation **Science**
Standards

National Core **Arts** Standards

Cognitive Overload!



“This (educational) revolution arises from ongoing and compelling research on **how children and adults learn (i.e., a science of learning). The **old model of teaching as simply telling**, and of learning as passive sit-and-get listening *will not* meet the needs of tomorrow’s citizens.”**

Science for the Next Generation: Preparing for the New Standards
Thomas O’Brien, Professor of Science Education.
Binghamton University



The New Generation Gap

We are living in a uniquely historical time relative to our ability to shape the human brain.

We are neurologically shaping young brains for a **future** that is vastly *unlike* our own recent past – constantly inventing new ways to solve problems (which are also *re-shaping the brain*)

Teaching is “**Applied Neuroscience**”

~~Teachers~~ = **Neuro-plasticians**



Our best efforts in teaching requires a shift
from...

“What am *I* supposed to *teach*?”
to

“How do *my students learn*?”
and

“How do I prepare them for a *new and unknown* world?”



Teaching Thinking vs. Lecturing

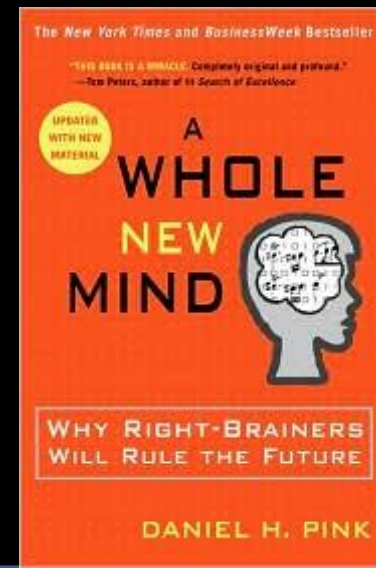
Who is more inclined to say the others “talk too much!” – Teachers or students?



Lecturing, the 2nd oldest form of teaching, comes from the Latin *lecture*, meaning “to read aloud.” Books - the earliest form of ed-tech (few and \$\$), so they were combined with the lecture (“*Audi* – torium” not a “*Thinka*-torium”)

Creative Thinkers Learners

- **Agricultural Age**
 - **Industrial Age**
 - **Information Age**
- **Moving from the Information Age**
 - **The Innovation Age**





The US Is Prospering

- The nation produces **28%** of the world's economic product with less than **5%** of the world's population.
- America's economy has been creating nearly **2 million net** new jobs a year.
- *Business Week* ranks **8 US firms in the top 10** “most innovative” companies in the world.
- America has a gross domestic product close to **\$13 trillion** and has contributed **one-third** of the **growth** in **global output** over the most recent **15-year period**.
- Its household net worth is now over **\$55 trillion**.
- U.S. universities employ **70%** of the world's **Nobel Laureates**.



Technology

Because we are “**online most of our lives,**” the constant use of technology is chipping away at our **capacity for concentration, contemplation, and reflection.** Instead, our lives are bombarded by eBay, Amazon, MP3s, broadband, dish TV, Napster, Google, iPods, Wi-Fi, YouTube, blogging, smart phones, netbooks, blogging, tweets, and **streaming video has become an American tidal wave.**

Technology: the more we use it, the more it alters the way we **work and think** (modifying existing brain circuitry).



Technology in the 21st Century

Caveat #1

Technology will not replace the need to be literate.

--Rebecca Alber, UCLA

Caveat #2

“I’ve seen students with i-Pads and the novelty is there and the engagement is there, but it’s not clear that novelty and engagement will lead to increased academic achievement.”

--Larry Cuban, Stanford University



*Over The Last 20 Years, Research From **Cognitive Science** Indicates That...*

- **People learn best** through **real-world first-hand experiences**, not through **memorization**.
- Children are born **investigators**
- Understanding builds **over time**, not in one sitting
- The human brain learns everywhere it goes and during **every moment of the day** (awake or asleep)



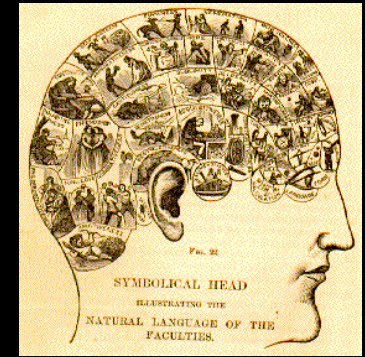
**Old learning paradigm of
the S-R Learning**

and

**New Model Based on
Neuroscience**



Aristotle (384-322 B.C.)



- **Cardiocentric** view of cognition

The heart = central to cognitive responsibilities including **morality** and higher **intelligence**

- Contemporary phraseology - successfully memorized information as content **we know** “**by heart**”



Expanding the Traditional Model of Thinking and Learning

Does the name “Pavlov” ring a bell?

Stimulus → Response

S → R

Teaching → Learning



Factors Influencing Stimulus → Response

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

Genetics

+Pre-natal care

+Early development (0-3)

+Parenting

+Physical history

+Neuro-physiology

+Prior learning (situated L')

+Prior experiences

+Need state

+Strengths

+Formal Education

+Epigenetics and early nutrition

+Age

+Emotions/emotional state

+Gender

+Perception/expectations

+Memory

+Diet

+Self-esteem

+Disability

+Neural circuitry/plasticity*

+Stress factors

Learning/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.



Brain-considerate Learning: PERC³S

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 (derivatives of experience)

(2) Emotions

(3) Relevance

(4) Context, Content, and Cognitively-appropriate

(5) Sense-making → **Problem-solving**



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.



Hemisphericity

Are some people “left-brained,” while others should be considered “right-brained”?

a. Yes

b. No

Corpus Callosum

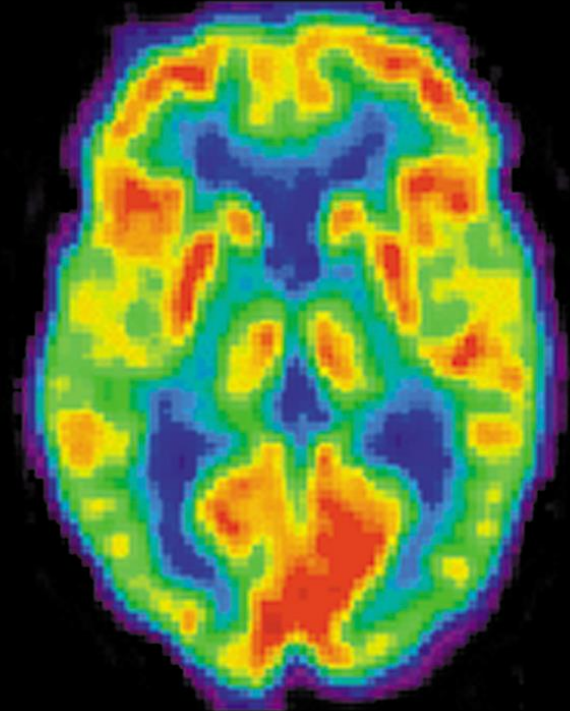




Do you know your brain?

What percent of our brain do we use?

- a. 10%
- b. 20%
- c. 50%
- d. 100%



Why is Hands-on Learning Effective? Developmental Neurobiology



Sensory Cortex



(a) Four weeks



(b) Eight weeks



(c) Twelve weeks



(d) Sixteen weeks



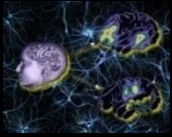
Motor cortex

In the “digital age,” it is critical that educators remember that the 10 **digits** on your **hands** were the **first human digital devices** (and remain the most powerful).



Cognitive Rehearsals

The hand is where **thought, movement, touch, feeling** and **abstract thinking** all *intersect* during active experiences.



We Learn Best by 1st Hand Experiences

What is the difference between **knowing** and **understanding**?

1. Experiencing/doing
2. Distinguishing “what” from “why?”
3. “Learning about” vs. **application(s)**





First-hand

“If you hold a **cat** by **the tail**,
you learn things you can't
learn **any** other way.”

-- Mark Twain



Fun-da-Mental Learning

The 4 E's of Cognition and (LT) Learning

1. **E**motions – ↑**dopamine** (essential to activating the brain's reward circuitry – mesolimbic dopamine system)
2. **E**nthusiasm – **feedback** → confidence to move forward
3. **E**xperience – builds the **brain circuitry** that represent who we are, what we know and what we are capable of doing
4. **E**ngagement – **hands-on**, minds-on, hearts-in learning experiences



Better Than Eating: Reaching the Emotional Apex in Student Engagement

- Whether we *label* the active learning experience as play, exploration, thinking, building, constructing, etc., **↑ levels** of student engagement →
“Maximum Harmonious State” in the brain (“flow”)
- That is when students reach **learning at its highest attentional level**, they will frequently rather stay, play and learn than to eat. The **drive to learn** can become **greater** than the **drive to eat** or the need for food.
- How often do your students get to the **Maximum Harmonious State** of learning?



Astonishing Potential for Learning and Processing

Neurons and synapses.

The number of **neurons** (the information processing cells) inside your brain is approximately equivalent to **all of the trees** found in the **Amazon rain forest** (100,000,000,000). The # of plausible permutations and combinations of brain activity > the # of elementary particles in the universe.

They operate by making connections with one another. The number of **connections (synapses)** inside your brain is comparable to **all of the leaves on all of the trees** in the Amazon rain forest (approx. 62 trillion connections among the 100 billion brain cells.)



Chemicals and Behavior

Type of Medication	Brand Name	Generic Name	Approved Age
Stimulant Medications	Adderall	amphetamines	3 and older
	Concerta	methylphenidate	6 and older
	Cylert*	pemoline	6 and older
	Dexedrine	dextroamphetamine	3 and older
	Dextrostat	dextroamphetamine	3 and older
	Ritalin	methylphenidate	6 and older



Emotions, Attention and the Brain

- Emotions → attention → learning
- Our attention is (personally) “selective” because *our* emotions determine what we attend to.
- It is **neurologically impossible** to learn and remember information to which the brain has ***not*** paid **attention**.



“Sawu bona”

I see you, I am taking you in, and I like it.

“Sikhona”

I am here now (because of you).

A person is a *person*, because of our relationships with other *people*.



"Tak for sidst" (*Tock fah seest*)

Thank you for the last time we were together.

*The **current status** of any relationship is determined by the summation (the "+ and –" summative qualities of the **last 5 encounters** of those members composing the relationship.)*



The 4th “R”

- High-quality interactions *with* students
→ high-quality relationships *with* students

 (“My students don’t listen.” We can’t attentively listen to people who we consciously do not like.)



The Brain and “Input”

- Brain cells process approximately **40,000 stimuli/sec.**
- Fortunately (unfortunately?) the brain cannot consciously attend to more than **one dominant entry at a time.** It can attend to (pay attention to) countless different types of information at one time -- the “Cocktail Party” effect.
- A vital responsibility of the developing brain is learning how to effectively **attend to relevant** environmental information and to simultaneously **screen out** unimportant stimuli.
- How do we distinguish the **relevant** from the trivial or **superfluous?**



Attention Span:

Ages **2-3** - Have attention span 3 - 4 minutes

Ages **4-5** - between 5 - 10 minutes

Ages **6-8** - 15 - 20 minutes

Ages **9-12** – 22 - 35 minutes



Headline:

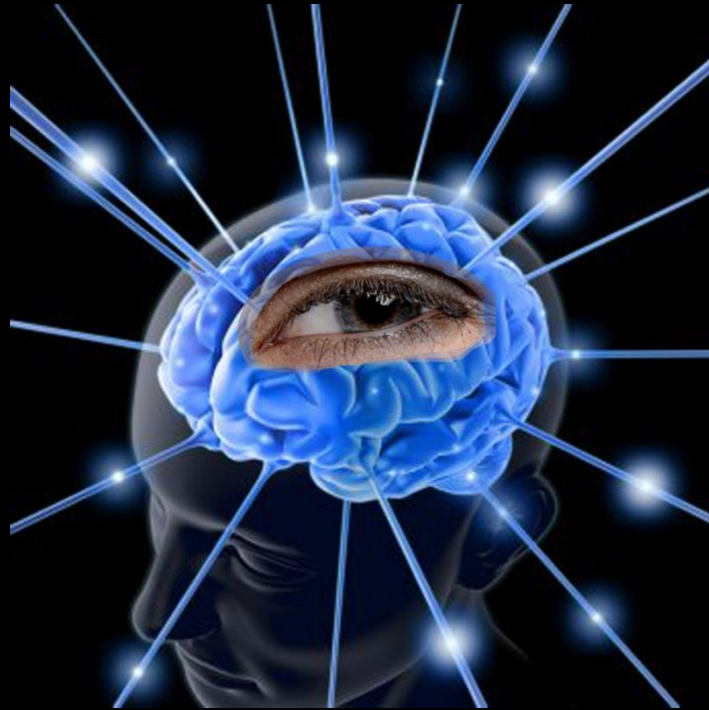
“Pres. Obama Snubbed”

My arm is...

Performance avoidance



Brain-sight: Seeing With the Mind's Eye





Why aren't we spending
more instructional time on
drawing,
abstract thinking
and ***visualization?***



~~N.C.L.B.~~

**Non-educators Consumed by
Legislation and Bureaucracy**

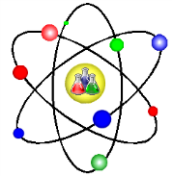
**No Considerations for human
Learning and Behavior**

**Neuroscience, Cognition,
Learning and the human Brain**



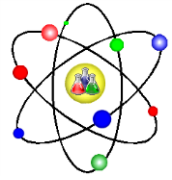
Innovation and Creativity

Human beings are the *only animal* on the planet that looks for problems and for **problems to solve**. In the late 1800s to the mid-20th century, highly **creative minds** were needed to solve contemporary challenges. If a problem that was **frequently** encountered, someone **visualized, designed and produced** a tool to solve that problem.



Abstract Thinking

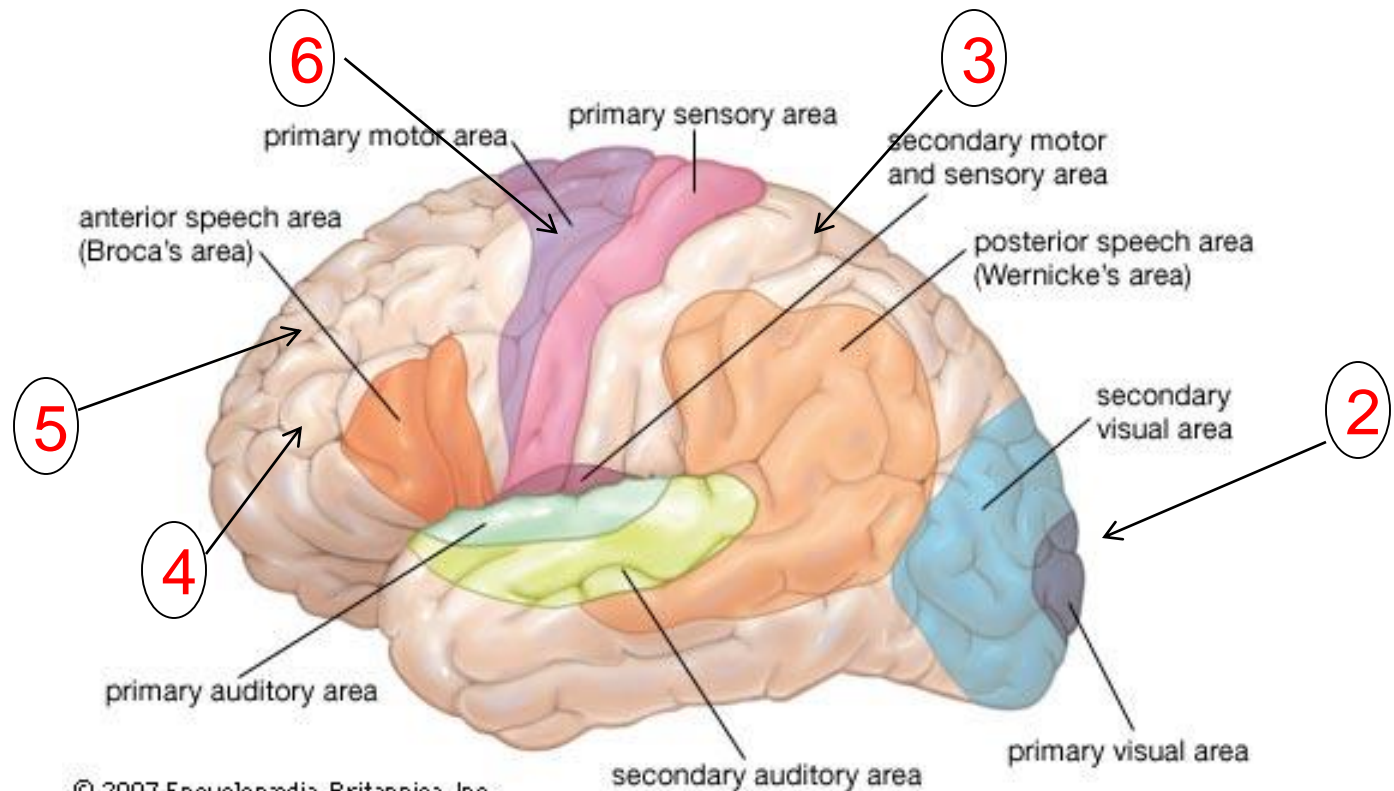


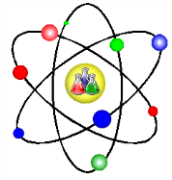


Using your Reflexes

(Each takes 0.05 – 0.1 sec.)

- (1) Eyes → **sight** (2) visual cortex – **vision** → (3) association cortex - **meaning** → (4) frontal lobes – **plan of action** → (5) PFC – **prepares response** → (6) motor cortex – **takes an action**

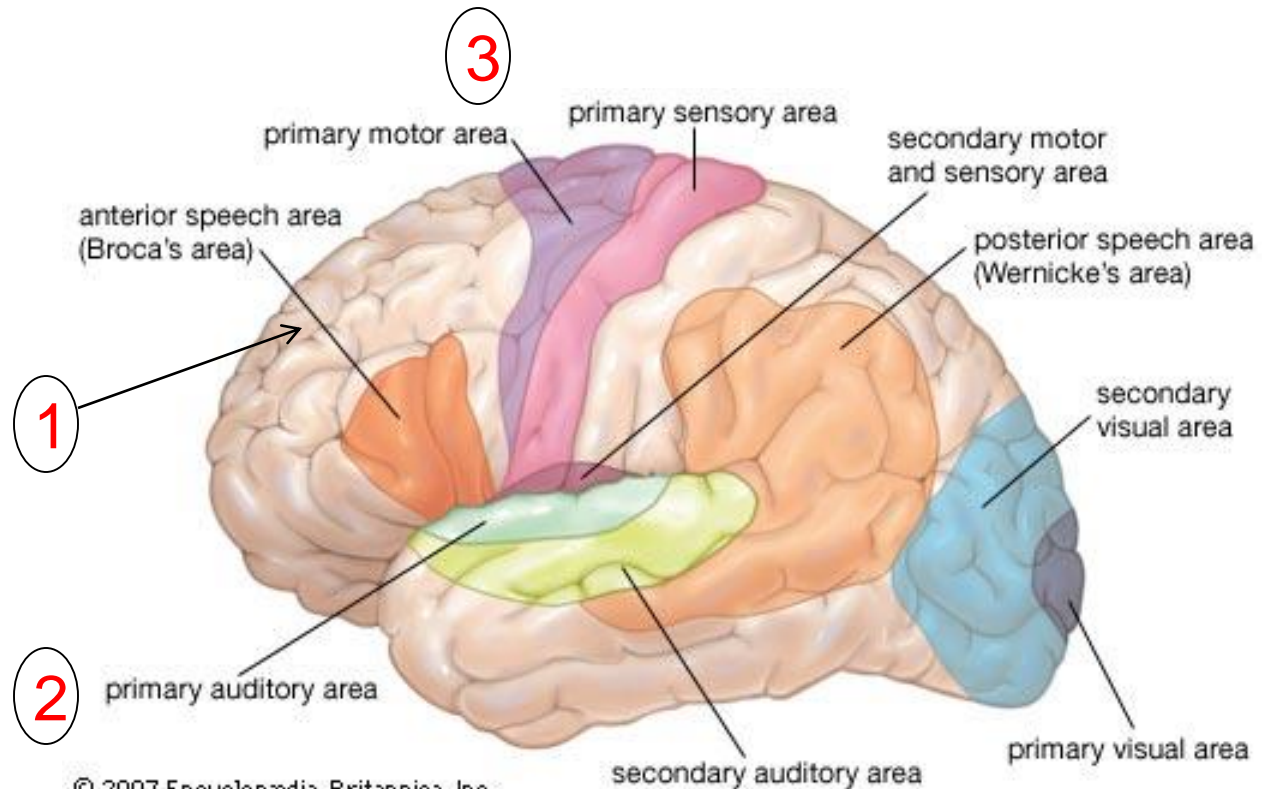


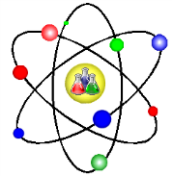


Reflexes: In the Mind

(Each takes 0.05 – 0.1 sec.)

(1) **PfC – prepares response** (2) **Ears → hearing** → (3) **motor cortex – takes an action**

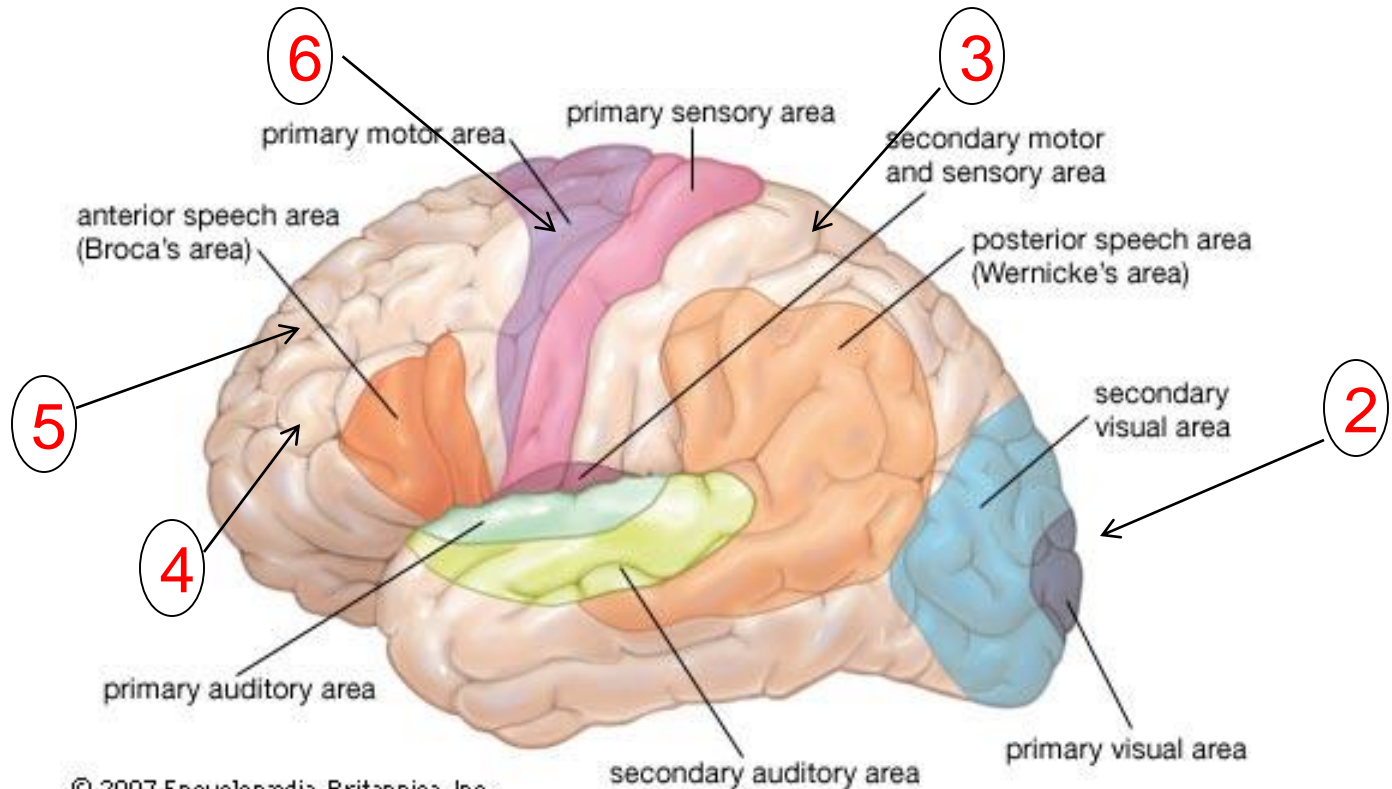




Reflexes: Visualization

(Each takes 0.05 – 0.1 sec.)

(1) Eyes → sight (2) visual cortex – vision → (3) association cortex – meaning → (4) frontal lobes – plan of action → (5) PFC – prepares response → (6) motor cortex – takes an action





Students who lack ability . . .

to **create visual images** when reading, often experience comprehension difficulties.

They cannot describe the **pictures in their minds** as they read.

Learners who were instructed to **create mental images** of events...learned **two to three times as much** as learners who read aloud the sentences repeatedly. (Anderson, 1971)

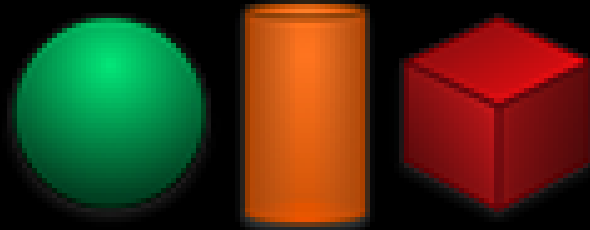


The Evolution of Human Reading

- We were never born to **read**.
- We were born to *learn*.



Geons

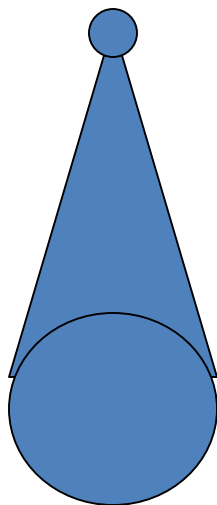


Circles, spheres, squares, blocks, cylinders, cones, etc., are among **the 24 basic “geons”** (geometric forms) -- the natural environment.

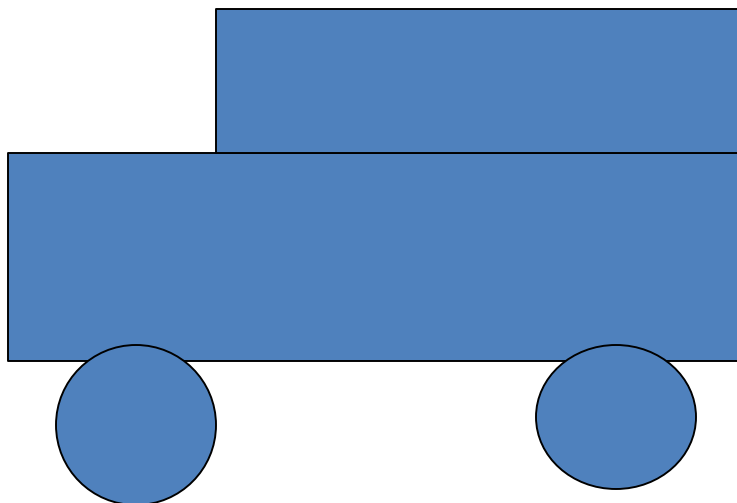
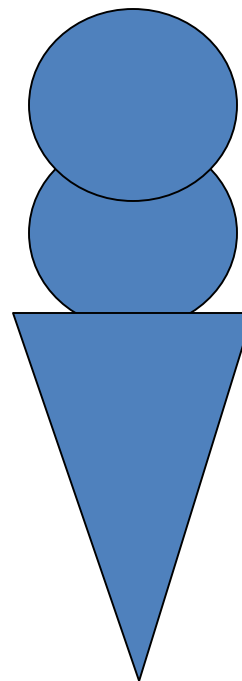
Simplistic **“stick” representations** (straight or curved-lines) of these **concrete objects** elicit a mental reminiscence of the **“real thing.”**



Clown in hat



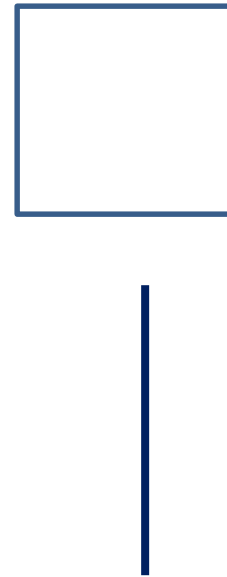
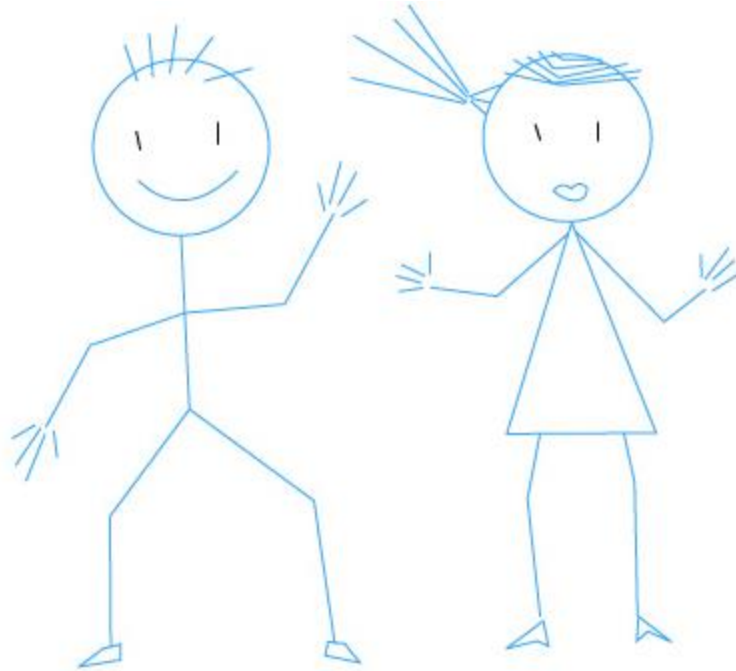
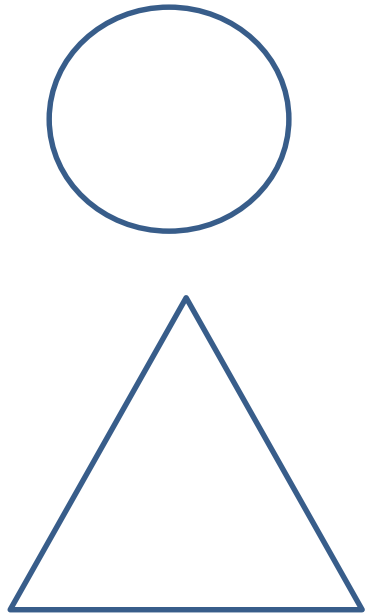
**Ice
cream
cone**



Car

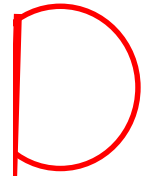
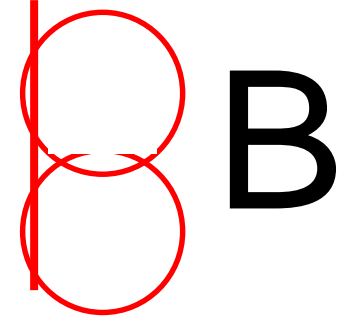
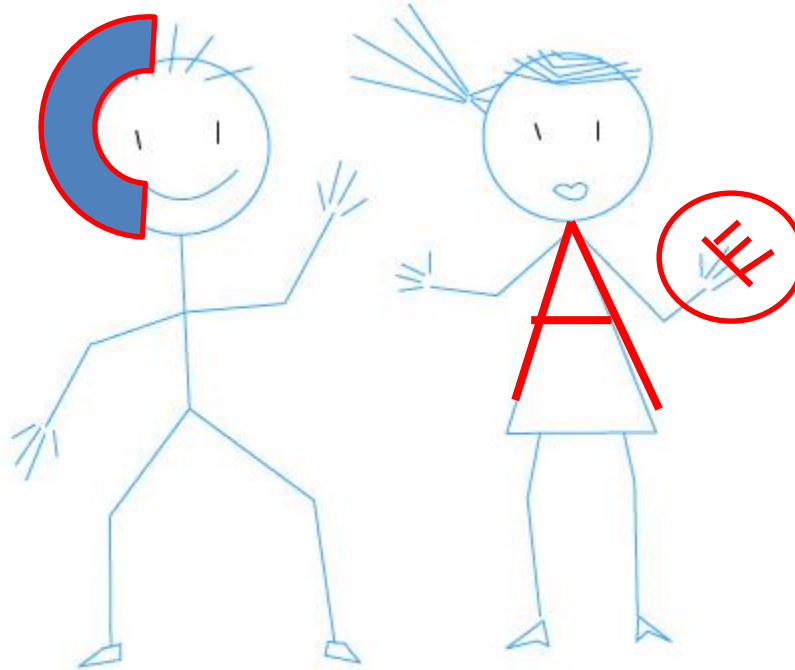
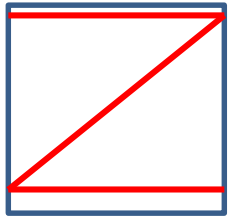
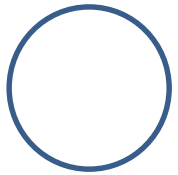
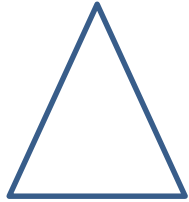


“But, he can’t write.” The “Drawing-Initial Writing” Connection





The “Drawing-Initial Writing” Connection (If s/he can draw, s/he can write.)





- Encourage early learners **to draw** as often as you encourage them **to write**, preferably **combining** the two.
- To **monitor growth and development**, **date** each art piece and all student writing. You will notice growth...
 - from **scribbling** → **clearly written words**
 - from **stick figures** “me” → **full-bodied forms**
 - Objects (e.g., cars) will transform from **rectangular blocks** to cars with more realistic, stylish and even creative forms.



Drawing does for the brain during the **day**,

what

Dreaming does for the brain at **night**.





Child development – the **Greatest Show On Earth!**

Reflections

“We don’t learn from experience, we learn by *reflecting* on it.”

John Dewey

24 hours: Compose two “I will” reflections on this morning’s experience together.



Now let's take today's ideas - Extra 1°

**It's time to...
turn up the heat.**

212°

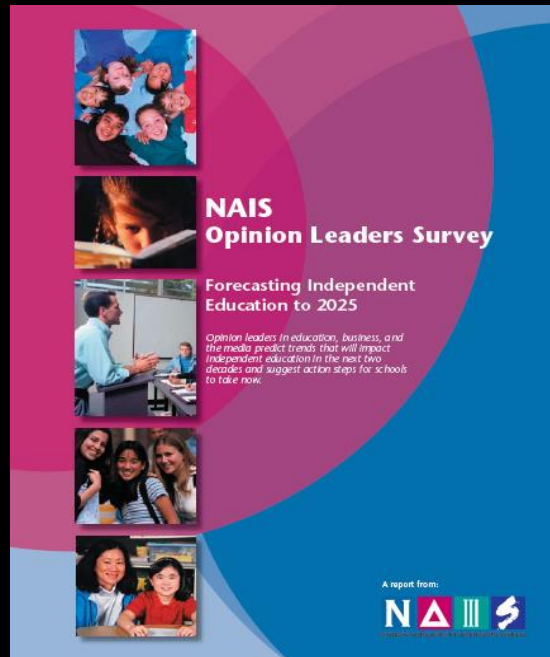


Be a **visionary** and a **Dream-maker**

Susan Boyle



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

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