If It’s Your Job to Develop Young Minds, Shouldn’t You Know How Their Brains Work?

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Teaching is the most complex of all professions.

-- Dr. Art Costa

... the most exhausting.
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.
"Far and away the best prize that life has to offer is the chance to work hard at work worth doing."

-- Theodore Roosevelt
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 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
Kindergartners this fall...

• Will *retire* in the year 2077

• What foundations for learning *must* we establish for them?

• In what ways are you preparing them for success in *the years between* 2016 and 2077?
**How Do Their Little Brains Work?**

- How do we nurture the development of the astonishing young brains in our classrooms?
- What are preferred teaching **strategies** by which the brain learns and how we can incorporate **brain research** into the ECE? (making connections and engaging in experiences)
- What are the neurobiological, emotional and psychological aspects of learning? What works for **all** young learners? (...tomorrow)

**Quick writes and table-talks**

...a visual and conceptual tour... *(a highly visual brain)*
The Human Brain: Astonishing!

“Let me keep my mind on what matters, which is my work, which is mostly standing still and learning to be astonished.”

-- “The Messenger” by Mary Oliver
Child development – the Greatest Show On Earth!

Neuro-plasticians
Five Periods of Child Development

1. The prenatal period: from conception to birth
2. Infancy and toddlerhood: from birth to 2 years
3. Early childhood: from 2 to 6 years
4. Middle childhood: from 6 to 11 years
5. Adolescence: 11 to 18 years - transitioning into adulthood
Five Periods of Child Development

The prenatal period: *from conception to birth* (transforming a one-celled organism into a human being with remarkable capabilities — but development is not guaranteed. The environment will play an essential role in its development).

- At birth, infants are assessed in making the adjustment to the extra-uterine environment. To assess and infant’s physical condition, doctors/nurses use the “Apgar Scale,” which stands for appearance, pulse, grimace, activity, and respiration. Infants are assessed at 1 minute and at 5 minutes after birth. Any one of the APGAR conditions might suggest early brain difficulties that can lead to later cognitive deficits.
All young brains are predisposed to actively seek out first-hand experiences that will help shape their developing brains in ways that assure that they will thrive (not merely survive) in the local environment.
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).
Infancy and toddlerhood: from *birth to two years* there are dramatic motor, perceptual, emotional, intellectual, linguistic changes in the developing body-brain.

- Adult **touch and comfort** - responsiveness to an infant’s cries determines LT emotional stability-- protection, survival. **Nonorganic failure to thrive** – a growth disorder that results from a lack of parental love, where infants show all the signs of **marasmus** -- their bodies look wasted and they are emotionally withdrawn and apathetic, although no organic/biological cause can be found for the infant/toddler’s **failure to grow** physically.)
Neural Pruning and Environmental Factors

- A mother rat licking and grooming infants initiates a cascade of events that turn on genes for growth.

- Researchers found that merely stroking infants with a small brush could prevent the effects.

- Rats who received physical attention in youth had considerably less hippocampal cell loss during old age and they performed better on certain memory tasks in old age.
Five Periods of Child Development

**Early childhood: from 2 to 6 years** - Motor skills are refined; increased motor and muscle control; more emotional control; emerging understanding of the distinction between play and real world; thought and language expand at an astounding pace.

**Middle childhood: from 6 to 11 years** - Enhancements in self-understanding, stability in friendships, and basic literacy skills; their emerging competencies include a sense of morality, abstract and complex thinking, and logical thinking.
Are some people “left-brained,” while others should be considered “right-brained”?

Hemisphericity

“Left- and right-brained” should be retired from serious scientific literature and discourse
Corpus Callosum: Provides a pathway for communication between the two hemispheres
Five Periods of Child Development

Adolescence: 11 to 18 years - transitioning into adulthood; approaching adult-sized body and sexual maturity; thinking becomes idealistic; risk-taking ↑; ↑ abstract thinking; emerging sense of autonomy; ↑ divergence from stated family values; ↑ focus on personal appearance, personal desires and short-term ambitions.
Five Periods of Child Development

All children are impacted by experience-expectant brain growth, referring to how the young brain rapidly develops based on ordinary experiences we would expect any child to have -- opportunities to see and touch objects, to hear language and sounds, to move about and explore the environment, etc.

Children are also impacted by experience-dependent brain growth, which extends throughout our lives. These experiences consist of additional growth and refinement experiences that can alter brain functions/structures as a result of specific learning experiences that can vary widely from individuals and from culture to culture, such as reading, playing video games, weaving an elaborately colorful rug, learning to play a piano — all of which are experiences constructed by a particular society/culture/educational system.
Author Joseph Epstein said, "We are what we read." Neuroscientists would modify that statement to say that “We are what we experience.”

The human brain is the only organ that depends on experience to determine its development (how, where, when and if it develops and when it stops.)
Development is experience-dependent.

No land = No fully-developed frog

Sensitive period - tadpoles arrest process of metamorphosis = if there are no signs of land.

When it comes to the brain, as Wadsworth wrote, “The child is the father to the man.”
Human Brain Development
Neural Connections for Different Functions Develop Sequentially

Sensory Pathways (Vision, Hearing)
Language
Higher Cognitive Function

FIRST YEAR

Birth (Months) (Years)

<table>
<thead>
<tr>
<th></th>
<th>Optimal window</th>
<th>Secondary Window</th>
<th>Extent of Future Developmental Possibilities</th>
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</thead>
<tbody>
<tr>
<td><strong>Vision</strong></td>
<td>0 – 6 months</td>
<td>6 – 24 months</td>
<td>The lack of visual stimuli entering the eyes will eventually cause permanent blindness in a perfectly healthy eye. (Primary visual cortex must process incoming visual information.)</td>
</tr>
<tr>
<td><strong>Motor development</strong></td>
<td>0 – 24 months</td>
<td>2 – 4 years</td>
<td>Capabilities rapidly decrease with advancing age. (Functionality of the cerebellum/motor cortex for balance/coordination can be lost).</td>
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<tr>
<td><strong>Hearing</strong></td>
<td>0 – 6 months</td>
<td>6 – 18 months</td>
<td>Severe learning and language problems will result from CAPDs based on the lack of stimuli processed by the auditory cortex. Problems occur from the absence of any sounds to handle and/or distinguish.</td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>0 – 24 months</td>
<td>2 – 5 years</td>
<td>With the onset of puberty, “new language” mastery begins a sharp and typically uninterrupted decline.</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td>4 – 5 years old (girls) 6 – 8 years (boys)</td>
<td>7 – 12 years old (puberty)</td>
<td>Learning to process symbolic language can occur throughout one’s lifetime. It becomes more difficult (1) with time, and (2) if there are only modest opportunities for auditory processing of the rich usages and varieties of ideas. Early drawing provides a foundation for languaging.</td>
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<tr>
<td><strong>Emotional development</strong></td>
<td>0 – 24 months</td>
<td>2 – 4 years</td>
<td>Screening events through one’s emotional filter becomes difficult; personal relationships are characterized by weak attachments that are easily terminated. (Similar to limbectomized mammals)</td>
</tr>
<tr>
<td><strong>A second language</strong></td>
<td>0 – 5 years old</td>
<td>7 – 12 years old</td>
<td>Learning a second language after puberty is far more challenging than language learning at any other prepubescent period. The “second” language will almost invariably be accompanied by an accent.</td>
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<tr>
<td><strong>Musical abilities</strong></td>
<td>0 – 6 years old</td>
<td>7 – 12 years old</td>
<td>Research suggests that early musical exposure enhances the development of spatial and mathematical skills. Beyond puberty, learning a musical instrument (particularly learning to read musical notation) is frequently as complicated as learning a new oral language.</td>
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Neuroplasticity: the ability of the brain to change cellular, structural and functional properties as a result of experience. Researchers have shown that early brain connections are not hard-wired (fixed) and can be modified by experience – they are malleable or “plastic.”

One of the most transformative discoveries/take-home messages

All brains can change, all brains do change, brains are designed to change.

Years of keyboarding → handwriting?
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
“How does the human brain work?”
“An emerging theme is the question of how emotions interact with and influence other domains of cognition, in particular attention, learning, memory and reasoning.”

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

**S**afety (physical and emotional)

**A**cceptance (no “put-downs”)

**I**nclusion, interactions and involvement

( interpersonal/social aspect of memory formation)

After satisfying these prerequisite neurophysiological and hierarchical conditions, students are biologically ready for **L**earning (students feel their immediate environment is secure enough for them to take risks, explore and discover).

Fight or Flight

1. Freeze
2. Flight
3. Fight
4. Fright

Fight or Flight
Expanding the Traditional Model of Thinking and Learning

Does the name “Pavlov” ring a bell?

Stimulus → Response

S → R

Teaching → Learning
There is Never Just One Stimulus, and there are Factors Influencing A Single Response

<table>
<thead>
<tr>
<th>In addition to desires, tendencies, appetites, instincts, inclinations...</th>
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<tbody>
<tr>
<td>Genetics</td>
</tr>
<tr>
<td>+Pre-natal care</td>
</tr>
<tr>
<td>+Early development (0-3)</td>
</tr>
<tr>
<td>+Parenting</td>
</tr>
<tr>
<td>+Physical history</td>
</tr>
<tr>
<td>+Neuro-physiology</td>
</tr>
<tr>
<td>+Prior learning (situated L’)</td>
</tr>
<tr>
<td>+Prior experiences</td>
</tr>
<tr>
<td>+Need state</td>
</tr>
<tr>
<td>+Strengths</td>
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<tr>
<td>+Formal Education</td>
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**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.
These four photographs represent a computer estimation of what a picture of a face looks like to a 1-month-old, a 2-month-old, a 3-month-old, and a 1-year-old (approximates the visual acuity of an adult.) At birth, infants perceive objects at a distance of 20 feet as clearly as adults see the same object at 600 feet (Slater, 2001) and are not yet good at discriminating colors.
In a research study by Najjar: Students have 3X better recall of visual information over oral information, but 6X better when the info was presented using both oral and visual methods simultaneously rather than just lecture.

Students who hear information, will remember 10% three days later. By adding picture, they will remembered 65% (Medina, 2008) – (visual examples)
Expanding the Traditional Model of Thinking and Learning

Does the name “Pavlov” ring a bell?

Stimulus → Response

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Learning is a neurobiological processes occurring inside the brain, just as digestion takes place in the pancreas and the stomach.
Good thinking is a matter of making connections, and knowing what kinds of connections to make.

---David Perkins
100 billion neurons, each of which has approximately the processing capacity of a PC. When those neurons interact with one another, your students’ brains have the information-processing power of 100 billion networked computers!
The neural basis of cognition rests in the work of the neurons.

100 billion = Number of neurons that we are born with (full-term)
A Neuron’s Job: Make Connections

Experience the World

24/7 we translate our interactions with the world into the chemical language of the brain, and create circuits that represent what we have experienced.
Experience → builds the representative network
Memory Test

- Knitting
- Thread
- Knife
- Syringe
- Silver
- Pin
- Sewing
- Sharp
- Point
- Thimble
- Haystack
- Shiny
- Injection
- Embroidery
Memory Test

Embroidery
Knitting
Needle
The human brain naturally organizes related information into a Gestalt, not in random lists or individual parts.
## Maintaining and Strengthening Memory

<table>
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<tr>
<th>Bridge</th>
<th>Build</th>
<th>Extend</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>80%</td>
<td>10%</td>
</tr>
</tbody>
</table>

- **Past content**
- **New information**
- **Preview**
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.
Learning requires effort, and one of the best predictor's of students’ effort and engagement in school is the relationships that they have with their teachers (Osterman, 2000.)

Students function more effectively when they feel respected and valued and function poorly when they feel disrespected or marginalized (National Research Council, 2004)
A Great Teacher

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
Students may forget what you **said**, but they will never forget how you made them **feel**.

-- Carl W. Buechner
Our STEM Mission is Bigger than “Content”

One of the most important things a teacher can do is to send a student home in the afternoon liking himself just a little bit better than when he came in the morning.

– – Ernest Melby

Most powerful question… “Guess what I did today?”
Be a visionary and a Dream-maker

Susan Boyle Highest-Paid Singer in the World

It's been a rough year for the singer, but at least she has her millions of dollars to ease the pain. 54-year-old Susan Boyle has taken the No. 1 spot on People With Money's top 10 highest-paid singers for 2015 with an estimated $96 million in combined earnings.

UPDATE 09/10/2015: This story seems to be false. (read more)

Susan Boyle tops annual list of highest-paid singers

In 2013 it looked like the singer's spectacular career was winding down. Suddenly, she was back on top. People With Money reports on Thursday (October 6) that Boyle is the highest-paid singer in the world.
“Reflect and Connect”

• What was the **most valuable** piece of information that you **learned** this morning? What **new question** is now on your mind?

• How did our conversation **change your thinking**?

• Write down two “**I will**” statements from this experience. (What will you look at differently/?do differently in your school/district, program or institution?)
Factor V Leiden thrombophilia - an inherited disorder of blood clotting, that results in thrombophilia, which is an ↑ tendency to form abnormal blood clots that can block blood vessels.

“Will I start to die right away?”

Teaching with the brain in mind
The Gift

Yesterday is history,

Tomorrow is a mystery.

But, today is a *gift*.

That’s why it’s called

The *Present*. 
…Shouldn’t You Know How Their Brains Work?

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