The Amazing Developing Brain

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How the Brain Works

What are some of the common neuromyths concerning the brain?

The brain is covered with a thin layer of cells called the neocortex.
(Latin for "new bark")
Vascular System of the Brain

You can go 30 days without food, a week without water but only 4 or 5 minutes without oxygen!

Brain imaging techniques allow us to see which areas of the brain control various functions.

The Lobes of the Brain

Each lobe is covered with cortex: visual cortex, auditory sensory cortex and association cortex.
Two Types of Long-term Memory

1. Procedural Memory
   (Best rehearsed by repetition)

   Processes that have been practiced or repeated to the extent that they have become automatic.

   Driving a car, writing, reading, typing, throwing a pass in football, walking, playing the piano, etc.

Two Types of Long-term Memory

2. Declarative Memory
   (Best rehearsed with elaboration.)

   Semantic
   Our general knowledge:
   Language, people, places, faces, concepts, facts.
   (Independent of context, acquired by learning.)

   Episodic
   Our life experiences:
   Specific events and emotions connected with these events.
   (Reconstructed over time, recall not necessarily accurate.)

Planning for Procedural Memory

• Carefully plan and practice the routines and procedures you will use in your classroom.

• Repetition is necessary to get these skills and habits to the automatic level.

• When routines and procedures become automatic, discipline problems are greatly reduced.
Brain Cells

• The brain is composed of two types of cells...

• Neurons – the basic functional unit of the nervous system

• Glial cells (neuroglia) – provide support and bring nutrients to the neurons

The 100 billion neurons communicate with one another at junctures called synapses.

What is Learning & Memory?

• Learning is the act of making (and strengthening) connections between thousand of neurons forming neural networks or maps.

• Memory is the ability to reconstruct or reactivite the previously-made connections.

• Neurons that fire together, wire together!
Neurogenesis (Growth of Neurons)

• During the 9 months of fetal development, neurons grow at the rate of 250,000 per minute.

• At birth the brain has approximately 100 billion neurons and weighs about 1 pound. By one year it has doubled and by age 5 or 6 it is 90% of its adult size and weight.

• What causes this tremendous growth in such a short time? (Hint: It's not more neurons.)

Answer: Growth of Connections (Synaptogenesis)

Cerebral cortex neurons in a newborn and a two-year-old.

• Between the second month in utero and the age of two, each neuron in the cortex forms an average of 1.8 synapses per second. At this point the brain begins to prune away large numbers of connections.

• Which connections remain, and which are pruned, depends on whether or not they are used.

• Experience literally changes the brain!
Neuroplasticity

• When children are born, they can hear the sounds of 6000 languages. However, very early the neural connections representing the sounds that have been reinforced remain and the others wither away.

• What do you think would happen in the brain of a person born blind?

• Plasticity is a feature of the brain throughout an individual’s lifetime, however, young brains are much more plastic than adult brains.

Mirror Neurons

• Our brains actually practice what we watch others doing! (looking up…yawning…crossing arms)

• Within hours after birth, newborns begin to imitate faces of adults around them.

• Mirror neurons are found in Broca’s area…a language area of the brain.

• Listening to speech activates tongue muscles and aids in learning to speak.

Mirror Neurons

• Children “catch” their sense of security and self worth from parents and caregivers.

• Teachers can positively or negatively influence children’s learning and well being.

• Positive – optimism, encouragement, smiles, patience

• Negative – disapproval, prejudice, biases,
There are two factors that determine how the brain develops...

1. **Genes** are the building blocks.
   
   Some genes are determinants.
   Some genes are predispositions.

2. **Environment** - the on-the-job foreman.
   The environment provides the instruction for the final construction of the brain.
   
   The brain gobbles up the external environment through its sensory system and then reassembles the digested world in the form of trillions of connections which are...
   
   Constantly growing or dying, becoming stronger or weaker...
   
   Depending on the richness of the banquet.

(Adapted from Kotulak’s Inside the Brain, 1997.)

Genes and the environment work closely together during the first three to four years to form a healthy brain.

It is during these years that the foundations are laid down for:

- vision
- language
- vocabulary
- intellectual development
- emotional development
Myelin... is a fatty substance (a type of glial cell) that coats axons and speeds the electrical impulse.

Why Myelin? (The Case for Differentiation)

Myelination appears to determine the critical periods or "windows of opportunity" for proper development of neural pathways.

If the necessary stimuli aren't available or if certain skills remain unused during these periods, the pathways may not develop properly and the potential for those skills may never be developed.