

Montessori Maths and brain building

In an extract from his latest book for parents, **Michael Duffy** explains the science behind the Montessori maths materials.

The concrete, multi-sensory, and manipulative nature of the math materials ensures that they simultaneously engage multiple areas of your child's brain, including all four lobes of her cerebrum.

Her occipital lobe sees the colors and shapes of the materials. Her temporal lobe takes in the auditory cues that accompany their use and triggers memory associations. Her parietal lobe is engaged in the purposeful movement of the materials. And her frontal lobe provides the problem-solving processing to put all the sensory input together and find a solution to the problem.

The simultaneous activation of all four lobes creates a multiplicity of neural connections and builds a network in your child's brain.

Contrast this to the typical "listen to the problem and grab an answer from your memory databank" approach to mathematics that depends on memorization rather than concrete experience and understanding. This depends almost exclusively on the memory center of the brain and is simply not as rich a brain-building experience as the Montessori materials-based approach.

Multi-sensory, experiential learning "contain data from all the senses at once, rather than just vision, or just sound. They are 'sense-luscious.'" says Zull. Jensen goes so far as to say that "challenging sensory stimulation has been rightfully compared to a brain 'nutrient'."

The production of new neural networks through use of Montessori math materials has an impact on the permanent wiring of the brain that will be available as your child gets older and uses her brain for analytical thinking and problem-solving.

Right and Left Hemispheres

Montessori materials also activate the neural connections between the right and left hemispheres of your child's brain.

The use of geometric shapes to



The materials promote active rather than passive learning.

represent arithmetical, or even algebraic, processes ensures that your child engages both sides of her brain as she works to solve a math problem. Her right brain is activated by the geometric, spatial component of this pairing, and her left hemisphere is primarily involved in the algebraic, abstract concepts and processes involved.

This is a great way to make sure that your child learns in the most efficient way for her learning style and preferred intelligence.

If your child is more spatial than analytical, or if she is more logical than creative, she does not have to be left out or penalized for her unique way of exercising her intelligence. Both sides of her brain are activated together, so her strong suit can support the weaker one.

Those familiar with Howard Gardner's theory of multiple intelligences know how important it is to approach learning with different intelligences in mind rather than depending solely on linguistic and logical-mathematical functions of the brain.

Once again, these frequently activated connections between hemispheres of your child's brain create permanent pathways for adult problem solving, building the mathematical mind of which Maria Montessori spoke.

Prefrontal Cortex

Because Montessori math materials promote active, discovery learning and allow for self-monitoring and self-correction they activate the prefrontal cortex, the most "advanced" part of your child's brain in terms of evolutionary development and higher powers of thinking.

If you want your child to use her brain to its fullest potential, you want her to exercise this higher part of her brain. Montessori math materials do this.

Getting the right answer to a problem can be quick and easy - and shallow; or it can be a little slower and more arduous - and produce a much deeper kind of learning. For example, I can tell



The checkerboard is a geometric pattern and visual representation of the rules for compound multiplication.

your child that when she divides one fraction by another fraction, she can merely invert the second fraction and multiply. Or...I can show her how to use the fraction circles and allow her, through repeated experience and the recognition of patterns in those examples, to discover for herself how to generalize the rule for division of a fraction by a fraction.

The first approach draws heavily on the temporal lobe in your child's brain. The Montessori method of teaching fractions makes use of many more parts of her brain, most particularly that all-important prefrontal cortex.

The Montessori approach, rather than producing quick answers with little understanding behind them, creates a series of "Ah-ha!" moments of discovery. Your child's face lights up with delight at such moments, and these light bulb moments are centered in the frontal cortex.

Jensen recognizes what Maria Montessori called the primacy of process over product. "Surprisingly, it doesn't matter to the brain whether it ever comes up with an answer. The neural growth happens because of the process, not the solution. A student could go to school for 12 years, rarely get right answers, and still have a well-developed brain." Montessori math grows your child's brain and produces an architecture of neural networks for higher thinking and problem solving that she will take with her into the rest of her life.

Michael Duffy is the author of 'Math Works' reviewed on page 28. He has been a Montessori teacher and trainer for almost 20 years. He holds AMS credentials at the 6-12 age range and has taught lower and upper elementary classes at a school founded by his wife. This extract has been printed with kind permission from Parent Child Press, Inc.