

**MATH IS BEAUTIFUL: TEACHING (YOURSELF) AND INSPIRING (YOUR CHILD)
TO LOVE THE COSMIC LANGUAGE (A MENTOR MOM© CLASS)**
JENNIFER GEORGIA

Prepared for the 2009 LDSEHE Home Education Conference in Buena Vista, Virginia

"The vast book which stands forever open to our eyes, the universe, cannot be read until we have learned the language and become familiar with the characters in which it is written. It is written in mathematical language, without which means it is humanly impossible to comprehend a single word." *Galileo*

Principles of Math Education

One to one correspondence

- Numbers are symbol=name=quantity; letters are symbol=name=sound.
- Use numbers as adjectives, not nouns. "Three" doesn't mean color or shape or size, etc. but is for quantity.
- Build up thinking skills that use groups of fives and tens (fingers, tally marks). Play the "ten-pair" game. Teach eleven as ten-one, twelve as ten-two, etc. - they'll learn the proper names later.

Make it concrete.

- Help children develop "number sense" with real objects. Build models FIRST before writing with symbols. Play with rods, various types of counters, plastic chains, base-ten number sets. Play the hidden bean game.
- If you are stumped on a problem, substitute simple numbers of concrete objects for the complex numbers, then figure out how to manipulate them. I just tell my kids "Apples!" and they know what to do.
- Use less explanations, more hands-on time.

Avoid the wall.

- When they struggle with the abstract, go back to the concrete. They may use fingers, beads, rods, number lines, charts, an abacus; whatever they need to avoid the state of "math anxiety" which builds road-blocks for future learning.
- Use calculators when you are exploring a new concept that uses math beyond what the child is comfortable with, so that they can focus on the concept, not on the arithmetic.

Look for patterns...

- In number charts, the multiplication table, square numbers, cube numbers, odds and evens, prime numbers, the Fibonacci series, Pythagorean triples, Goldbach's numbers....
{1+2+3+4=10}
{point, line, triangle, tetrad}
{0th, 1st, 2nd, 3rd dimensions}

"Our minds are much more powerful when discovering than when memorizing, not least of all because discovering is much more fun." *John Holt*

Keep it open-ended.

- Early on, work with problems that have more than one answer. Show various ways of writing problems.
- Encourage your child to come up with his own way of finding an answer, then when he gives you an answer, have him tell you his mental process of how he got there. If he gives an incorrect answer, lead him through it again and have HIM find where he went wrong. Correct answers are 1% of the goal; learning the process is 99% of what you're after.

Get into it.

- Some things you will only see the significance of after you play around with them for a while. You WILL have the "Ah Ha!" moment if you keep at it.

"In our concern about the memorization of math facts or solving problems, we must not forget that the root of mathematical study is the creation of mental pictures in the imagination and manipulating those images and relationships using the power of reason and logic." *Mindy Holte*

Recommended Math Toys, Games, Puzzles, and Manipulatives:

Cuisenaire Rods (be sure to get a rod track too), Base Ten number set, Learning Wrap-ups, Weigh to Learn Math kit, abacus, measuring tapes, rulers, measuring cups and spoons, calculators, clocks, pattern blocks, attribute blocks, fraction "rods," Tangrams, Tip Over, Rush Hour, Top This!, Blockus, Chess, Set, Sudoku, Mighty Mind, Mind Benders.

Books to Read (by age-appropriateness):

Early-reader counting books like *Ten Apples Up On Top*; the *Sir Cumference* series by Cindy Neuschwander; *The Great Graph Contest*, by Loreen Leedy; *What's Your Angle, Pythagorus*, by Julie Ellis; *The Librarian Who Measured the Earth*, by Katherine Lasky; *How Much Is A Million?*, *G is for Googol* and others by David Schwartz; *Socrates and the Three Little Pigs*, by Anno and Mori; *A Cloak for the Dreamer*, and others by Marilyn Burns; *The Adventures of Penrose the Mathematical Cat*, and others by Theoni Pappas; *Mathematicians are People Too*, by Reimer and Reimer; *Archimedes and the Door of Science*, by Jeanne Bendick; *The Phantom Tollbooth*, by Norton Juster; *Flatland*, by Edwin Abbott; *The Chosen* by Chaim Potok; *Euclid's Window*, by Leonard Mlodinow; *You Can Teach Your Child Successfully*, by Ruth Beechick

Books to Do – For the more interesting aspects of mathematics, and open-ended problem-solving skills, we like these:

Miquon Math Lab, by Lore Rasmussen (ages 4 to 8) Using Cuisenaire rods, children build concrete examples of abstract math concepts. The emphasis is on understanding the concepts and uses a variety of teaching methods targeting many learning styles. Creativity is encouraged as children are asked to make up their own problems. Within the first year children have worked with multiplication, division, and fractions,

and have been subtly prepared for algebraic thinking. A bargain at \$5 per book, it is also recommended that you get the teacher's manual *Lab Sheet Annotations*.

Mathematics: a Human Endeavor – a book for those who think they don't like the subject, by Harold Jacobs (age 8 to adult) Often used for high school students, this is the ultimate "Love of Learning" book for math. If you went through math just doing what the teacher said, but never really understanding why or what relevance it had (as I did), try this book. I have used it to supplement both of my boys' math curriculum (at around the age of ten), and they both now see math as a fascinating puzzle to be solved.

From a review on Amazon: "(Jacobs) showers the student with so much real-life relevance and humor, that even a slight amount of curiosity about the subject bears delicious fruit. Working through this book will convince any human being, of almost any age, that he or she is a born mathematician."

Family Math, and *Family Math for Young Children*, by Stenmark et al. Full of games, puzzles and projects to do together.

Calculus By and For Young People, by Don Cohen This is a presentation of problems and their solutions created by young children. It is thus calculus without the technical language and symbolic notation. From two reviews on Amazon: "With Don as a guide and mentor, I love to play with mathematics. I have seen my students jump up in the air with glee when they solve one of Don's challenges--or giggle as they work at an assignment." Also: "Somewhere between kindergarten and high school graduation the concept of math as a joyful, experimental science disappeared for most of us. The drudgery of repetitious arithmetic with right and wrong answers is NOT the approach taken in Cohen's book. My kids are primarily visual learners who do math in a non linear fashion and suffer with current school curriculum. The workbook's emphasis on ideas rather than methods has supported their learning style and increased their confidence."

Algebra Lab (and *Algebra Lab manipulatives*) by Henri Piccioto. I was amazed to find that variables, which I had thought of as un-model-able, are in fact something that you can get your hands on. Algebra Lab Gear uses rods and blocks to represent x , y , xy , x squared, x cubed, etc. with which you can explore many algebra concepts.

"It is widely believed that working with numbers automatically generates an understanding of such concepts as the

distributive law. Many teachers and textbooks describe algebra as the "natural" extension and generalization of arithmetic. And of course, there is some validity to that point of view. However the fact of the matter is that many students have tremendous difficulty making the transition to these ideas with variables, perhaps because they have a shaky sense of number. In any case, work with well-designed manipulatives can help build the necessary foundation to facilitate the leaps to abstraction that are embedded and embodied in the notation of algebra. For some students manipulatives provide an important tool, for others, they provide a geometric context where they can broaden and deepen their understanding, which is often only

mechanical mastery of algorithms." Henri Piccioto, from <http://www.picciotto.org/math-ed/manipulatives/lab-gear.html>

Good math web sites:

<http://www.picciotto.org/math-ed/index.html>

<http://gwydir.demon.co.uk/jo/index.htm>

<http://www.alabacus.com>

<http://wholemovement.com/>

http://www.sciencenews.org/sn_arc98/10_3_98/mathland.htm

<http://www.mathman.biz/>

<http://www.schoolofabraham.com/criticalthinking.htm>

Jennifer Georgia and her husband Paul have been homeschooling their four children since birth, and their oldest is now a sophomore in college. www.georgiatimes.blogspot.com