Designs For Strong Minds
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Designs for Strong Minds & Math

By Donalee Markus, Ph.D.

Why Math Is Important

Anybody who has school age children has heard them lament, "Why do I have to learn this stuff?" While we are tempted to reply, "Because I had to," we know that answer is neither sufficient nor helpful. When the "stuff" that has to be learned is mathematics, we might reply, "So you can fill out your income tax form." This answer covers arithmetic but sheds no light on algebra, geometry, calculus, or trigonometry. What then is the reason for learning any kind of math we cannot easily solve with a calculator?

In October 1984, in the *Bulletin of the American Academy of Arts and Sciences*, Andrew Gleason of Harvard University wrote "It is the goal of mathematics to identify and describe sources of order, kinds of order, and the relations between the various kinds of order that occur." In short, the study of math helps us think in a logical, orderly way about the relationship between things in the past, the present, and the future. Even more directly, math is a precise way of describing patterns.

Patterns are regularities that we can recognize. Where no recognizable pattern exists, there is chaos. Heartbeats are patterns. So is walking. Weather patterns are used to predict the five-day forecasts. When we mentor someone, we pattern a behavior that will help him or her succeed. Pattern recognition even helps us identify a familiar face in a crowd of strangers.

By describing patterns, math enables us to see beyond the immediate and to extend our experience beyond our senses. The Greek mathematician Eratosthenes used math to prove the Earth was round 1,700 years before Christopher Columbus set sail and discovered the New World. Aristotle used math to describe the patterns of sound that make music. The Big Bang Theory about how the universe began, what happened afterwards to form the galaxies and, billions of years later, produce us can only be re-enacted mathematically. Political analysts use math to predict election results often with considerable accuracy. Insurance companies use statistics and probability theory to set their premiums. It takes more than luck to make a profit on Wall Street. It takes analysts who know how to use mathematical theories to map a changing world market.

The reason math is important is because it helps us understand the world we currently live in, its past and its future.

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What Math Really Means

Say the word "math" and most people immediately think "arithmetic." But the meaning of math has changed over the course of human history. Until about 500 BC, all mathematics was arithmetic—adding and subtracting numbers to find out how many sheep, goats, or wives someone had. Then the Greeks discovered math was also geometry. Thales added the concept of arguing mathematical proofs through logic. For the next 800 years, mathematicians studied numbers, shapes, and formal arguments. In the mid-seventeenth century, calculus was added to the team. Calculus describes motion through space and change through time. So mathematicians could now logically examine numbers, shape, motion, space, and change.

Calculus is an extremely useful tool. With it, gravity and the orbits of planets can be described, as can the flow of liquids and the expansion of gases. It enabled people to invent complex machinery, examine magnetism and electricity, understand flight and the growth of plants and animals, and predict how epidemics spread.

Calculus had such an important impact on the way people thought about the world that soon after its introduction, it inspired the development of mathematical theory. By the beginning of the Twentieth Century, mathematicians studied numbers, shape, change, space, motion, and the tools used to study math. In fact, more variations of math have been developed over the last hundred years than in the previous 3,000. In 1900 math could be divided into twelve branches like arithmetic, algebra, geometry, etc. Today there are sixty plus primary categories and many more sub-categories.

Nevertheless, all forms of math can still be boiled down to pattern recognition. Arithmetic is based on the pattern of numbers and counting. Geometry looks at the pattern of shapes. Calculus describes the pattern of motion. Logic traces the pattern of reasoning. Probability theory explores the pattern of chance.

Patterns are abstract. They are they products of our imaginations, but that does not mean they are false. What it does mean is that we need a way to describe the patterns our brains formulate to other people. That is the purpose of mathematical notation. Mathematical notation lets other people experience our ideas in the same way musical notation lets musicians play songs someone else has composed.

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Why Math Is Difficult for Some People to Learn

There are two kinds of people in the world—those who love math and those who hate it. People who love math understand it differently than those who hate it. Brain scans show that math-philiacs actually use different parts and more of their brains than math-phobics when solving a problem.

People who do not "get" math think verbally. That is, they associate math with the multiplication tables they had to memorize in school. The math-minded think visually. The answers to complex problems come to them in a flash of insight. Sometimes it takes months or even years for that flash to ignite, but they know immediately when—EUREKA!—they have got it. The actual writing out of the formula in mathematical notation is the final step in the thought process.

Mathematicians use rules to structure their thoughts, but they also explore their thoughts from every possible perspective. This explanation sounds strange to people who are not math-oriented precisely because they have not developed the cognitive skills to manipulate an image in their minds. But through visual processing, the math-minded "separate the wheat from the chaff." They determine which details are relevant and which are not. We all use this same ability to recognize friends and relatives. We instinctively focus on key facial features and ignore the minor details like a new hair-do or moustache. The difference is that mathematicians use their visual systems consciously and intentionally.

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How *Designs for Strong Minds* Improves Mathematical Skills

Other programs teach math through rules and practice problems, thus reinforcing the concept that mathematical thinking is a verbal process. At best recipients of this traditional training may do well enough in standardized tests but not be able to remember or apply math in real life situations.

Designs for Strong Minds (*DSM*) teaches math the way professional mathematicians actually think about math—visually. With puzzle designs based on neuroscientific research in the relationship between human visual systems and cognitive behavior, *DSM* sneaks the learning into the fun. As students solve puzzles, they practice manipulating images in their minds and sharpening their visual memories—the two key components in real mathematical thinking.

Admittedly, *DSM* takes a radical new approach to teaching math. By emphasizing the neuro-cognitive connection, *DSM* programs prepare the student's brain for a new way of thinking about the world—the mathematical way.