

Diabologic: S.T.E.M. – M is for Mathematics

by Frank Dolinar

I once taught a science discovery class for nine to twelve year olds that began with the simple assertion – “ $2 + 2 = 5$, for large values of 2 or small values of 5”. This was an assertion that every child in the class immediately and correctly identified as being wrong.

We spent the next couple of hours playing with the mathematics while the students came to understand why they were right, and why the statement wasn’t completely wrong.

If it seems odd to think of playing with math, it’s only because so many never understand that math can be fun. Dealing with math makes many people cringe. It’s not just distasteful, it borders on agony.

Why? I don’t know. I suspect that poorly designed courses and approaches to thinking about math could contribute to the problem. I further suspect that many math “teachers” don’t truly understand the subject and therefore cannot present it with any enthusiasm.

Mathematics is often accurately identified as the language of science. There are many concepts, particularly in the hard sciences of physics and chemistry, that may be qualitatively described in English or other natural languages but which cannot be quantitatively defined except in the realm of mathematics.

Math runs the gamut of concepts from counting to calculus to levels of infinity. Some concepts are easy, obvious, and intuitive, others are not. To gain facility with some concepts, to truly understand how they fit together and work, you must memorize them. Basic multiplication is a prime example.

Lots of people never get past high school algebra and geometry. I suspect they were intimidated when someone told them that calculus, differential equations, and other forms of higher mathematics were hard subjects. Advanced mathematics is difficult, but worth the effort.

Failure to understand mathematics at a level that lets you use it on a day-to-day basis without thinking about the basics is a problem. I have seen people in retail establishments who can’t make change for a small purchase without the help of the electronic cash register and others, some of them college students or beyond, who can only add numbers by counting on their fingers. No, I’m not joking.

Mathematics is all around us, every day. Our modern technologies would be impossible without it.

The recent TV series *Numb3rs*, dealt with a mathematician who helped the FBI solve crimes by applying math to the available data for each case. I thought the math being used was believable, even compelling, and I was right. The math consultant for the series was the math department at CalTech.

More recently, I encountered a website called “Do the Math” (<http://physics.ucsd.edu/do-the-math/>), written by Tom Murphy, a physicist at the University of California at San Diego, that uses physics and the mathematics of estimation to assess possibilities for energy, growth, and related options in our lives and our world. It’s well worth reading for several reasons. First, it helps to see that the mathematics involved can be easily understandable. Second, it’s worthwhile to see that politics and economics can be large influences that distort the available data and which, therefore, lead to incorrect conclusions. (An example of the idea that if the data isn’t accurate, it doesn’t matter how precise it is.) Third, it’s important to know that there are limitations to what the math can do.

A new book about mathematics (as opposed to a math textbook) titled “The Joy of x : A Guided Tour of Math, from One to Infinity” was recently published. The author, Steven Strogatz, a world-class mathematician, Cornell math professor, and regular contributor to the *New York Times* hosts a delightful tour of the greatest ideas of math. This tour reveals how math connects to literature, philosophy, law, medicine, art, business, and pop culture. It communicates the author’s fascination with his field in a welcoming entrée to mathematical thinking. Just the kind of approach we need in all our math classes.

Finally, there is a comment from Robert Heinlein’s “Notebooks of Lazarus Long”, which says,

If it can’t be expressed in figures, it is not science; it is opinion.

We need the basis of our S.T.E.M. education to be firmly grounded in the best science we can get. As part of that we need everyone to learn and understand as much mathematics as they can.