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# How to Fall in Love With Math

**By MANIL SURI**

BALTIMORE — EACH time I hear someone say, “Do the math,” I grit my teeth. Invariably a reference to something mundane like addition or multiplication, the phrase reinforces how little awareness there is about the breadth and scope of the subject, how so many people identify mathematics with just one element: arithmetic. Imagine, if you will, using, “Do the lit” as an exhortation to spell correctly.

As a mathematician, I can attest that my field is really about ideas above anything else. Ideas that inform our existence, that permeate our universe and beyond, that can surprise and enthrall. Perhaps the most intriguing of these is the way infinity is harnessed to deal with the finite, in everything from fractals to calculus. Just reflect on the infinite range of decimal numbers — a wonder product offered by mathematics to satisfy any measurement need, down to an arbitrary number of digits.

Despite what most people suppose, many profound mathematical ideas don’t require advanced skills to appreciate. One can develop a fairly good understanding of the power and elegance of calculus, say, without actually being able to use it to solve scientific or engineering problems.

Think of it this way: you can appreciate art without acquiring the ability to paint, or enjoy a symphony without being able to read music. Math also deserves to be enjoyed for its own sake, without being constantly subjected to the question, “When will I use this?”

Sadly, few avenues exist in our society to expose us to mathematical beauty. In schools, as I’ve heard several teachers lament, the opportunity to immerse students in interesting mathematical ideas is usually jettisoned to make more time for testing and arithmetic drills. The subject rarely appears in the news media or the cultural arena. Often, when math shows up in a novel or a movie, I am reminded of Chekhov’s proverbial gun: make sure the mathematician goes crazy if you put one in. Hanging thickly over everything is the gloom of math anxiety.

And yet, I keep encountering people who want to learn more about mathematics. Not only those who enjoyed it in school and have had no opportunity to pursue it once they began their careers, but also many who performed poorly in school and view it as a lingering challenge. As the Stanford mathematician Keith Devlin argues in his book “The Math Gene,” human beings are wired for mathematics. At some level, perhaps we all crave it.

So what math ideas can be appreciated without calculation or formulas? One candidate that I’ve

found intrigues people is the origin of numbers. Think of it as a magic trick: harnessing emptiness to create the number zero, then demonstrating how from any whole number, one can create its successor. One from zero, two from one, three from two — a chain reaction of numbers erupting into existence. I still remember when I first experienced this Big Bang of numbers. The walls of my Bombay classroom seemed to blow away, as nascent cardinals streaked through space. Creatio ex nihilo, as compelling as any offered by physics or religion.

For a more contemplative example, gaze at a sequence of regular polygons: a hexagon, an octagon, a decagon and so on. I can almost imagine a yoga instructor asking a class to meditate on what would happen if the number of sides kept increasing indefinitely. Eventually, the sides shrink so much that the kinks start flattening out and the perimeter begins to appear curved. And then you see it: what will emerge is a circle, while at the same time the polygon can never actually become one. The realization is exhilarating — it lights up pleasure centers in your brain. This underlying concept of a limit is one upon which all of calculus is built.

The more deeply you engage with such ideas, the more rewarding the experience is. For instance, enjoying the eye candy of fractal images — those black, amoebalike splotches surrounded by bands of psychedelic colors — hardly qualifies as making a math connection. But suppose you knew that such an image (for example, the Julia Set) depicts a mathematical rule that plucks every point from its spot in the plane and moves it to another location. Imagine this rule applied over and over again, so that every point hops from location to location. Then the “amoeba” comprises those well-behaved points that remain hopping around within this black region, while the colored points are more adventurous and all lope off toward infinity. Not only does the picture acquire more richness and meaning with this knowledge, it suddenly churns with drama, with activity.

Would you be intrigued enough to find out more — for instance, what the different shades of color signified? Would the Big Bang example make you wonder where negative numbers came from, or fractions or irrationals? Could the thrill of recognizing the circle as a limit of polygons lure you into visualizing the sphere as a stack of its circular cross sections, as Archimedes did over 2,000 years ago to calculate its volume?

If the answer is yes, then math appreciation may provide more than just casual enjoyment: it could also help change negative attitudes toward the subject that are passed on from generation to generation. Students have a better chance of succeeding in a subject perceived as playful and stimulating, rather than one with a disastrous P.R. image.

Fortunately, today’s online world, with its advances in video and animation, offers several underused opportunities for the informal dissemination of mathematical ideas. Perhaps the most essential message to get across is that with math you can reach not just for the sky or the stars or the edges of the universe, but for timeless constellations of ideas that lie beyond.

*Manil Suri is a mathematics professor at the University of Maryland, Baltimore County, and the author, most recently, of the novel "The City of Devi."*