Diabologic: Mathemagician
by Frank Dolinar

2 + 2 = 5 (for large values of 2 or small values of 5)

My friend Steve and I were teaching an informal Saturday morning class on science discovery at the local children's science museum. The week's topic was Mathematics. I picked up the chalk and wrote the "equation" shown above on the blackboard. As soon as I finished writing, I received a loud chorus of "No!" from the group of pre-teens who comprised my class. I had their attention. We were off and running.

The rest of the class went something like this: Two (2) and five (5) are numbers, but the marks we make for these "numbers", the names we give them, the meaning we assign to them, and the order of their appearance (for the natural numbers, at least) are all historic accidents. It could have been any mark, name, meaning, and order.

It was an easy progression to asking for the value of 'x' in the equation "2 + x = 5". The class quickly responded correctly with "3". This was their first lesson in algebra. The discussion moved from the concepts of algebra to number theory and to a very rudimentary introduction to topology. They understood and enjoyed it. The next week they returned with stories about explaining our class to their teachers at school (to mixed reviews from the teachers that ran the gamut from "Hooray!" to "Heresy").

Medieval universities taught 'Arithmetic' (mathematics) as part of the Quadrivium (arithmetic, geometry, music, and astronomy) [Latin: "the four ways"]. This coursework was considered the completion of the Liberal Arts – which began with the Trivium (grammar, logic, and rhetoric) – and preparation for the serious study of Philosophy and Theology. This is often thought of as "classical" education, as if it came to these universities in a direct line from ancient Greece. This educational program was a development of European academies in the 12th and 13th centuries with a number of elements from Greek antiquity recovered from Islamic classical scholarship.

At the beginning of the 21st century, mathematics is everywhere as a foundation for or tool used by our science and technology. Computers, and all the rest of our communications technologies, are an ubiquitous example of applied mathematics.

The popular television drama *NUMB3RS* is written to demonstrate how mathematics can be used to help find solutions to crimes. The math in each show is real and is applicable to the situations presented. Texas Instruments, CBS, and the National Council of Teachers of Mathematics (NCTM) have created a website of educational resources based on the series. http://www.weallusematheveryday.com/tools/waumed/home.htm

A year ago, *Business Week* magazine reported on the growing need for mathematicians in a world obsessed with statistics, advertising, search engines, and algorithms and the related issues of privacy. The statistics on our credit card purchases and the search engines we use to make Internet queries provide massive databases on every transaction tracked by a computer. This data, processed by sophisticated algorithms that extract every bit of useful (or even potentially useful) information from the data, is fed to equally sophisticated advertising used to anticipate our every need even before we know them ourselves.

The goal is to target an audience of one: You!

Math is fascinating in its own right, as theoretical mathematicians have known for a very long time. Most people recognize that it's applied math that produces tangible results. Often it's a combination of the two: theory provides insight and direction; application provides a working solution.

Math helps solve problems in such diverse fields as computer science, physics, engineering, economics, statistics, actuarial sciences, psychology, government, medicine, management, social science, mathematical modeling, cryptography, and (of course) teaching – to name only a few.

You can't be a rocket scientist without knowing a lot of math.

[Posted 2007 Jan 14]

There are awards for the best of the best, people who work with mathematics at a level that most of us probably cannot even imagine (as in the film *Good Will Hunting*). These are the Fields medals, awarded every four years by the International Congress of Mathematicians (http://www.icm2006.org/). They are generally described as the Nobel Prize for Mathematics. A posting on Slashdot.org on August 22, 2006 listed last year's winners:

"Grigory Perelman (famous for the ideas underlying the proof of the Poincare and Thurston geometrization conjectures) — who declined the prize, Terence Tao (a child prodigy famous for proving there are arbitrarily long arithmetic progressions of primes, but who works mainly in nonlinear partial differential equations and harmonic analysis), Wendelin Werner (a probabilist working on links with 2D conformal field theories), and Andrei Okounkov (who works on the interface between algebraic geometry and physics)."

Michael Guillen, Ph.D., wrote an informative and entertaining book: *Five Equations that Changed the World*. It's a history of development of these equations and the story of the individual scientists responsible for each. I recommend it. The equations are:

1. $E = mc^2$
   Albert Einstein's famous equation from the Theory of Special Relativity, which is possibly the most famous equation in the history of the world. It is the equation that describes the amount of energy locked in any bit of matter. It's a very large number. Today we think of it as the equation for the atomic bomb, but a slower more controlled reaction devised from this equation provides for safe nuclear power plants.
2. $F = G \times M \times m \div d^2$
   Sir Isaac Newton – The Universal Law of Gravity. This equation says that the force of attraction of two masses is determined by the gravitational constant (G) times the two masses divided by the square of the distance between the two masses. It's the basis for a lot of physics and astronomy.
3. $\nabla \times E = -\delta B/\delta t$
   Michael Faraday – The Law of Electromagnetic Induction. Electrical generators, telegraph, telephone, computer chips, and networks (among other developments) derive directly from this equation.
4. $P + \rho \times \frac{1}{2}v^2 = \text{CONSTANT}$
   Daniel Bernoulli – The Law of Hydrodynamic Pressure. Without this we wouldn't have an understanding of how an airfoil works and our planes would never get off the ground.
5. $\Delta S_{universe} > 0$
   Rudolf Clausius – The Second Law of Thermodynamics. This says that the disorder (chaos) of a system increases as the result of natural processes. One of my chemistry instructors described the three laws of thermodynamics as 1. You can't win; 2. You can't break even; and 3. You can't get out of the game.
   Since the "system" in this case is the entire universe, it's a pretty big game. The second law of thermodynamics can be interpreted to indicate that every organized object in the universe (such as stars, planets, and galaxies) will eventually cool and dissipate, i.e. the end of "Life, the Universe, and Everything".

Finally, here's a small story and a problem to solve. This is quoted from the book *Innumeracy: Mathematical Illiteracy and Its Consequences* by John Allen Paulos:

> ***The mathematician G. H. Hardy was visiting his protégé, the Indian mathematician Ramanujan, in the hospital. To make small talk, he remarked that 1729, the number of the taxi which had brought him, was a rather dull number, to which Ramanujan replied immediately, "No, Hardy! No, Hardy! It is a very interesting number. It is the smallest number expressible as the sum of two cubes in two different ways."***

What are the two pairs of cubes?