

## ***Diabologic: S.T.E.M. – S is for Science***

by Frank Dolinar

As I noted in last month's column, in the early 21<sup>st</sup> century in America fewer students are interested in science than in years past. Many think that science is boring, that they aren't smart enough to study science, or both. Teachers may also be uncomfortable around or uninformed about science. Because of this, there has been a gradual move away from coursework in science, technology, engineering, and mathematics (STEM) education. An unfortunate trend.

I've been enamored of things science since my first introduction to it in the late 1950s, sitting in front of the television on Saturday mornings watching Mr. Wizard (Don Herbert). Some of you may know Don Herbert from the Nickelodeon series Mr. Wizard's World, which ran from 1983 to 1990.

I got interested in, and seriously addicted to, science well before I knew whether I was smart enough and never found it boring – occasionally difficult, but never boring. Somewhere in this process I found that I “got” what science was about. It's not what most people think it is.

Natalie Angier is a Pulitzer Prize-winning journalist who writes for the New York Times. In her book ***The Canon: A Whirligig Tour of the Beautiful Basics of Science***, she says, “Science is not a body of facts. Science is a state of mind. It is a way of viewing the world, of facing reality square on but taking nothing on its face. It is about attacking a problem with the most manicured of claws and tearing it down into sensible, edible pieces.”

This state of mind wants to know, needs to know, has a passion to know. For any given situation, it asks the “What If...” question that drives so much of science fiction, does everything in its power to remove the fiction from the conversation, then moves on to ask “How...”.

For example, it's one thing to know that a light year (which is a measure of distance, not time) is approximately 5.87 trillion miles (that's a fact). It takes an understanding of the reasons for the propagation speed of electromagnetic radiation (the famous ‘c’ from Einstein's equation “ $E=mc^2$ ”) to get why 5.87 trillion miles is the right number (and that understanding is a state of mind).

Many science courses are presented by teachers as a litany of facts to be memorized, which distorts the view of science and turns the study – of anything – into a joyless drudge.

The first century Greek philosopher Plutarch has a message for such teachers. He said, “The mind is not a vessel to be filled, but a fire to be kindled.” Teachers who present science as nothing more than a litany of facts have forgotten (or possibly never learned) that their job is to be a fire-starter.

How does a teacher teach a student to play with matches without getting burnt?

Start with the concept of critical thinking, the process of assessing which ideas are reasonable, which are not, and why the difference exists. Getting it right requires the student to learn and to practice, practice, practice, as if the goal is performing at Carnegie Hall. This takes time and effort.

Popular culture in America has, apparently, come to a place where the need for instant gratification has pushed out of our daily lives the willingness to spend time to achieve a result. Why? Have we become so seduced by sitcoms, “reality” shows, and drugs to instantly banish our ills, that we no longer feel the effort is necessary.

Learning is not something we can achieve with a pill.

Learning science requires the time to think like a scientist, to make the effort to see the wherefore and why, to cultivate a passion to know, to light the fire.

The illumination that occurs when you understand some concept you've been grappling with can send a shiver through your nervous system. It's happened to me a number of times. For example:

- seeing why the fundamental theorem of integral calculus works;
- recognizing that the names of compounds in organic chemistry conveys as much or more precise information as control statements in a computer programming language;
- understanding why a photon travels at, and only at, the speed of light.

Neil Shubin, a paleontologist at the University of Chicago, is quoted in Ms. Angier's book. He says, “Science is not a rigid body of facts. It is a dynamic process of discovery. It is as alive as life itself.”

There is an excitement in the realm of science that is not achievable anywhere else.

As Don Herbert taught me, there is a magic and mystery to science.