Diabologic: S.T.E.M.

by Frank Dolinar

The universe is made of rubber bands.

It wasn't always that way. Writings from the early Greeks state that the world (the modern concept of the universe didn't exist) was made of only four elements: earth, air, fire, and water. Everything on Earth was made of one or more of these elements. Everything off Earth, such as the sun, moon, stars, and planets, was attached to crystal spheres that rotated around the unique, fixed, unmoving, flat Earth located at the center of the universe.

Today, we know that the Earth is one of a family of planets, all roughly spherical, which traverse elliptical orbits about the star that we call the Sun at the center of our solar system. It took centuries of work by dozens of astronomers and physicists to accumulate the evidence needed to allow us to have the knowledge and to make that statement. We now know that the sun and our solar system are just one tiny speck in the galaxy we know as the Milky Way, which is but one of billions of known galaxies. Earth is no longer the center of the universe. Indeed, it never was.

The elements have undergone a similar evolution. Instead of four, there are about 92 naturally occurring elements – there is still debate over the exact number. Our understanding of these chemical elements and their properties took a giant leap forward when, in 1869, Dimitri Mendeleev, devised the periodic table of the elements, a method for classifying the elements and their characteristics. Without this tool, the state of numerous technical disciplines would be primitive if they existed at all.

The physics of the small has perhaps undergone the strangest evolution.

As we developed tools to manipulate and measure progressively smaller chunks of matter we gained evidence that the ancient Greek concept of atoms was an actual physical reality. Atoms, once perceived as small billiard balls, had an internal structure of so-called elementary particles, protons and neutrons in the tiny central speck known as the nucleus and electrons in a surrounding cloud. These "elementary" particles themselves have an internal structure of whimsically named quarks (from James Joyce's book Finnegan's Wake). Quantum mechanics came into play in an attempt to understand and describe the behaviors of these quarks. The esoteric mathematics of these descriptions generated more questions than answers. Theorists found themselves dealing with ten dimensions of space and infinitesimally small "strings" – ultimately small rubber bands whose vibrations define the type of particle they are.

Thousands of scientists over the centuries provided this basic scientific knowledge. Applications of these sciences become the technological foundations of our modern society.

It's easy to think our technology makes us smarter and more capable than our ancestors. I don't agree. While current technologies might, initially, be perceived as magical to someone from the past, they'd quickly grasp the idea of technology. Besides, in many ways they're just as magical to us today.

Fewer students are interested in science than in years past. Many of these students think science is boring, that they aren't smart enough to study science, or both. Teachers may also be uncomfortable around or uninformed about science. It's been a gradual move away from coursework in science, technology, engineering, and mathematics (STEM) education. I believe STEM should be a core curriculum at every level of education, rather than being marginalized.

Effective science education cannot exist without knowledgeable teachers, engaged students, and the support of the community – and the ability to engage in critical thinking. Recently, there has been less involvement of these populations in the conversation. The risk is that the level of involvement may drop below that needed to sustain it.

Much of this problem comes from a failure to understand science and the scientific method. A large portion of the population thinks the goal of science is to provide answers. It's more a process of trying to find the right question, hypothesis, and experiment to determine whether a particular idea describes how the world really works and, if possible, to understand that process.

The journey takes work. Research sometimes leads to dead ends. These are not failures, just a way of reshaping the universe of discourse. This process may ultimately lead to answers.

The 21st century will be dominated by science and technology. We need people in business, politics, education, and everywhere else who understand the capabilities and limits of science. Decisions made without that understanding could be politically, economically, and/or socially catastrophic.

This task won't be easy, but it must be undertaken because science works.

It starts with education – S.T.E.M. education.

Any questions?