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Opinion

Making STEM Work for Students

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Opinion

Courses in schools in the Science, Technology, Engineering and Mathematics (STEM) areas are becoming more popular as students look to find career paths. However, the way these topics are taught often makes students want NOT to develop a future in these areas. Why does this happen and what can be done about it? One problem is that the excitement and fun of technology and science is not transmitted to the students. As professionals, we know the pleasure of being able to find and apply new knowledge to the systems that we use every day and that we can enhance for the future. But standard curricula in technology and science leaves a lot to be desired. Curricula often start with basic principles and theories such that students cannot see the excitement through the details. Part of this is built into the schools. School systems were never designed to meet today's needs-and curricula are largely unchanged from when we were in school [1]. Today's students need to see a reason for learning, and ask "Why do I have to learn this?" So why don't we show them!

As a Materials Scientist with background in Physics and Metallurgy, there are so many examples of "why we do this," based on the systems we have designed and built in areas from aerospace, to automotive, to basic infrastructure, and to the details of developing the computer chips that run our lives. Physics is sometimes considered too hard; Chemistry, too boring; Biology, too messy. Why not show students the relationship to real systems while they learn the basics of their STEM field? An example in Physics could be the bicycle. There are so many obvious physics applications in this machine that many students use daily but do not appreciate! Why not use something like the bicycle to pique the interest of the student in technology as she/he proceeds in studies in physics? And of course, there is lots of engineering and material science in the bicycle as well due to all the different materials that are used, especially in high-end bicycles due to the high stresses on the bicycle frame. Further, why not use real, everyday chemistry to enhance interest in that subject. The most common chemical reaction that students might encounter is just plain rust, the reaction of iron with oxygen. Why not use rust as a basis for and a lead-in to chemical reactions? I once had a student tell me that she did not really appreciate algebra until she started balancing chemical reactions! So, let's do it-the Chemical Education Foundation [2], for example, has projects and curricula that can stimulate interest in a wide variety of areas. Other professional societies also have programs that can stimulate interest among students, such as the programs for teachers and students developed and sponsored by the ASM Materials Education Foundation [3].

In many cases the least appreciated area in STEM is technology. Many relate technology to computers, and that is indeed a large area that can be very mathematical-and engineering-oriented, with applications all over the map. But technology is much more than computers and mobile phones. Sure, we learn how to use them but generally do not understand them. Students must not be put off to technological studies because they think technology (computers) are too complex. The world could not function without plumbers, mechanics, electricians and the like, and programs focusing on these areas should be encouraged. These fields often seem very basic but in fact can be quite advanced in the application of all STEM areas. And challenging curricula exist in many scenarios in technology education, often enhanced by projects such as the Advanced Technological Education program by the U.S. National Science Foundation [4]. Focusing on the breadth of applications for modern engineering materials is a quality digital library developed as part of the NSF-sponsored Materials Education project [5]. A related problem on making STEM work for students is the perception of the population (and parents) that more study and more degrees are somehow better-and that students should focus on science and engineering over technology studies. Many students feel left out because they do not have the needed background for advanced studies, or perhaps do not have the financial or social support needed for such work. But technology at all levels needs science and engineering. In fact, STEM subjects are all so interrelated that they often today rely on highly interdisciplinary teams to solve problems. Students can start on a bottom rung of a technology area and contribute their practical knowledge to the solution of problems all the way up the line.

So how do we approach the question of making STEM work for students in the schools. Changing the curriculum is difficult in many school systems-mainly because it is easier to teach the way subjects have always been taught. The recent development of new science and technology standards has helped, although the accompanying guidelines often restrict what can be taught-and the most creative teachers often feel restricted in terms of how they can follow these standards while focusing on everyday technology and science. Some new curriculum development projects have made it a focus to demonstrate how their curricula fit specifically with the new standards, which is a start. Next, school administrators need to allow teachers the leeway to use the new curricula in lieu of traditional textbooks. That is more difficult, and has stopped new ideas from being injected into the schools for some time. The key is to ensure that teachers are guided to the newer curricula and that they understand that these new concepts do indeed fit into a new approach to technology and science curricula.

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