STEM: Some Basic Definitions

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In order to better understand STEM, some current definitions used in the U.S. are relevant. STEM may be defined as the integration of Science, Technology, Engineering, and Mathematics into a new transdisciplinary subject in schools. Defining the four individual areas of STEM is important in the understanding of the acronym:

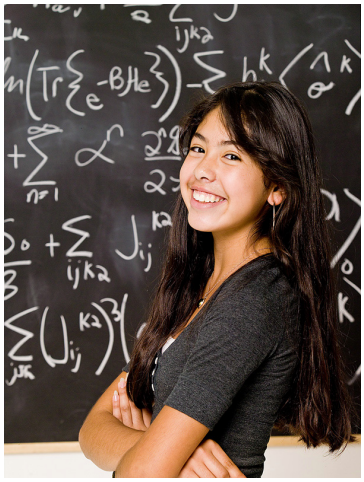
S — Science, which deals with and seeks the understanding of the natural world (NRC, 1996, p. 24), is the underpinning of technology. Rodger Bybee, Past-President of the Biological Sciences Curriculum Study (BSCS), explains more about the relationship between science and technology.

A lack of technological literacy is compounded by one prevalent misconception. When asked to define technology, most individuals reply with the archaic, and most erroneous, idea that technology is applied science. Although this definition of technology has a long standing in this country (Stokes, 1997), it is well past time to establish a new understanding about technology. So, my interest in technological literacy is fairly simple: it is in the interest of science, science education, and society to help students and all citizens develop a greater understanding and appreciation for some of the fundamental concepts and processes of technology and engineering. (ITEA/ITEEA, 2000/2002/2007, p. 23–28)

Science is very concerned with what is (that already exists) in the natural world. Many of the courses in schools, colleges, and universities reflect the study of the natural world. These courses deal with biology, chemistry, astronomy, geology, etc. Some of the processes that are used in science to seek out the meaning of the natural world are "inquiry," "discovering what is," "exploring," and using "the scientific method."

T — Technology, as defined in ITEEA's *Standards for Technological Literacy, Content for the Study of Technology* (*STL*), is the modification of the natural world to meet human wants and needs (ITEA/ITEEA, 2000/2002/2007, p. 7). Expanding on the seven elements in *STL*'s Designed World Standards, technology helps us to improve our health; to grow and processed food and fiber better; to harness and use energy more efficiently; to communicate more effectively; to process data faster and accurately; to move people and things easier; to make products to enhance our lives; and to build structures that provide shelter and comfort (Dugger, 2011). This definition is comparable with the definition provided in the *National Science Education Standards*, which state, "The goal of technology is to make modifications in the world to meet human needs" (NRC, 1996, p. 24). The American Association for the Advancement of Science's (AAAS) *Benchmarks for Science Literacy* presents the following similar insight of technology: "In the broadest sense, technology extends our abilities to change the world; to cut, shape, or put together materials; to move things from one place to the other; to reach further with our hands, voices, and senses" (AAAS, 1993, p. 41). In the National Academy of Engineering (NAE) and the National Research Council's (NRC) publication, *Technically Speaking: Why All Americans Need to Know More About Technology*, technology is described as "...the process by which humans modify nature to meet their needs and wants" (NAE & NRC, 2002, p. 2). All of these nationally-recognized definitions of technology in the U.S. are very much alike and they reinforce each other. Technology is very concerned with what can and should be designed, made, and sustained from natural world materials and substances to satisfy human needs and wants. These human wants and needs are essential in that they provide the stimulus for the human adaptive processes used in technology to alter and change the natural world.*

E — Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind" (Accreditation Board for Engineering and Technology [ABET], 2002, back cover). There are strong philosophical connections between the disciplines of technology and engineering. The engineering profession has begun to work with technology teachers to develop alliances for infusing engineering concepts into K–12 education. The alliances will provide a mechanism for greater appreciation and understanding of engineering and technology. The National Academy of Engineering is a valid supporter of technological and engineering literacy.



M — Mathematics is the science of patterns and relationships" (AAAS, 1993, p. 23). It provides an exact language for technology, science, and engineering. Developments in technology, such as the computer, stimulate mathematics, just as developments in mathematics often enhance innovations in technology. One example of this is mathematical modeling that can assist technological design by simulating how a proposed system may operate.

STEM should be taught in an integrated and a cross-curricular manner, not just in "silos" where the individual subject areas dominate and the other subjects are only afterthoughts.

*Technology as discussed above is much more than just computers. Many times it is confused with information and communications technologies (ICT), which "Includes a wide variety of technologies, including computers and software learning tools, networking systems and protocols, hand-held digital devices, digital cameras and camcorders, and other technologies, including those not yet developed, for accessing, creating, and communicating information" (WestEd, 2009).

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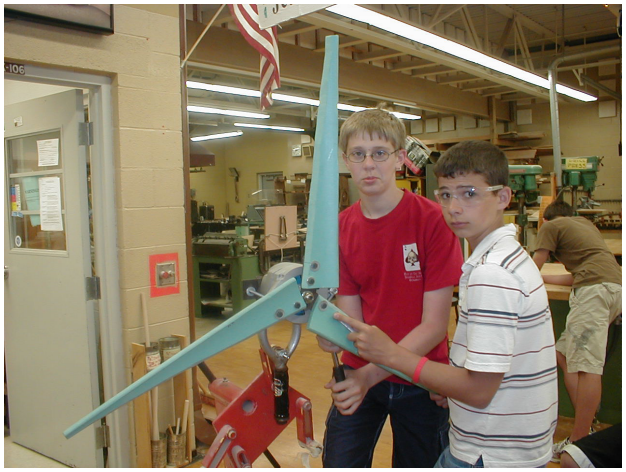

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