

We know there are a number of parents of GT students that seek a STEM curriculum for their child. Bell Middle School and Deer Creek Middle are two schools that currently offer such curriculum for 7th and 8th grade. We hope there may be more options in the future, so in order to facilitate thinking through STEM and Gifted Education for parents we are providing the following:

STEM and Gifted Education: Questions and Answers for Parents

January 2014

What does “STEM” mean?

The simple answer is that STEM is an acronym for “Science, Technology, Engineering, and Mathematics”. Things get more complex when we ask what each of those terms means. This is important, because without a common understanding of the body of knowledge that STEM includes, it is impossible to agree upon the design and quality of STEM education programs.

Math and Science are relatively easy to define, as they are well-established academic disciplines. Engineering is a bit more difficult to define; however, most engineers would probably agree with the definition of their profession as “the professional art of applying mathematical and scientific principles to the optimum conversion of the resources of nature to the uses of humankind.” Or, more succinctly: “the application of scientific and mathematical principles to practical ends.”

Defining the meaning of “Technology” is the most difficult challenge. In his book, “The Nature of Technology”, W. Brian Arthur begins by noting that “technology has at least half a dozen major meanings, and several of these conflict.” This is a critical issue, because, as Arthur notes, “the economy arises from its technologies.” His solution is to offer three definitions of technology that capture the most important ways in which we use this term: “The first and most basic definition is that technology is a means – the capture or programming of a core effect or effects -- to fulfill a human purpose...As a means, a technology may be a method or a process or a device...The second definition is a plural one: technology as an assemblage of practices and components... The third definition is technology as the entire collection of devices and engineering practices available to a culture...or as Webster's puts it, 'the totality of the means employed by a people to provide itself with objects of material culture.'”

Why is STEM education important?

Given its centrality to future economic growth, many different people have raised concerns about the quality of the United States’ “STEM workforce” (for three excellent overviews, see, “The U.S. Science and Engineering Workforce: Recent, Current, and Projected Employment, Wages, and Unemployment”, published by the Congressional Research Service; “STEM” by the Georgetown University Center on Education and the Workforce; and “Assuring the US Department of Defense a Strong Science, Technology, Engineering and Mathematics Workforce” by the National Academy of Engineering and the National Research Council). The general conclusion of these studies is that the United States must improve the quality of its STEM education programs.

That said, a key concern that runs through all these reports is the conflicting definitions of STEM and STEM jobs and workers that are used. As the above referenced National Academy of Engineering report noted, “No single, official definition of STEM is used by DOD or the federal government. Recent studies of the U.S. STEM workforce by various government agencies differ along three key dimensions: (1) the occupations included in STEM (e.g., inclusion or exclusion of social scientists, among others), (2) the minimum stated education requirement (e.g., bachelor’s degree and above versus no degree requirement), and (3) the data source used to generate the estimates (e.g., Census Bureau’s American Community Survey versus Bureau of Labor Statistics’ Occupational Employment Statistics)...Different estimates indicate that STEM employment in the United States ranges from as low as 4.75 million to as high as 8 million, a difference of almost a factor of two.”

What are the indicators of high quality STEM education programs?

As with STEM definitions and employment estimates, this is a question on which reasonable people can and do differ. The good news is that there is no shortage of research for a parent to consult. Here are some high quality publications we have found useful:

1. “STEM Education Primer” by the Congressional Research Service
2. “Successful K12 STEM Education” by the National Research Council
3. “Monitoring K12 STEM Progress” by the National Research Council
4. “Integration in K12 STEM Education” to be published in 2014 by the National Research Council
5. “Engineering in K-12 Education: Understanding the Status and Improving the Prospects” by the National Research Council
6. “STEM Reform: Which Way to Go?” by William Schmdit of Michigan State University
7. “Characteristics of Schools Successful in STEM” by Michael Hansen
8. “Developing the STEM Education Pipeline” by the ACT organization

Common findings include the need for rigorous and integrated math and science curricula, with high quality teachers, and greater use of collaborative projects that involve the application of math and science principles to solve real world problems.

At the state level, the Commonwealth of Massachusetts has produced some excellent materials, including:

1. “The Massachusetts Science and Technology/Engineering Curriculum Framework”
2. “Increasing Student Interest in Science, Technology, Engineering, and Math”
3. “A Program Director’s Guide to Evaluating STEM Education Programs”

How is STEM related to the Common Core Standards and to AP classes?

In general, advocated for STEM education support initiatives to increase the rigor of K-12 education in the United States, which includes the new Common Core Standards and the Next Generation Science Standards, which explicitly connect science and engineering. That said, some STEM advocates have been critical of the Common Core Math Standards (for example, see “Lowering the Bar” by the Pioneer Institute).

With respect to AP, *US News and World Report's* "Best High Schools for STEM" ranking was based on a STEM curriculum that included the following AP classes: Calculus AB; Calculus BC; Computer Science A; Computer Science AB; Statistics; Biology; Chemistry; Environmental Science; Physics B; Physics C: Electricity and Magnetism; and Physics C: Mechanics (note also that the AP Physics courses are being redesigned).

What is the relationship between STEM and International Baccalaureate programs?

IB provides students with a rigorous, highly structured program that includes math and science classes. However, unlike AP, IB students do not, to our knowledge, have a specialized STEM option.

How is Jeffco implementing K12 STEM education?

Jeffco currently has pilot STEM education programs in operation [Bell Middle School](#) and [Deer Creek Middle School](#). In addition, on their individual web pages, different high schools have referred to their STEM offerings as including a wide range of classes, including film editing/broadcasting and architectural drafting. To JAGC's knowledge, there is, as yet, no district-wide integrated K-12 STEM curriculum in Jeffco; instead, individual schools are developing their own STEM programs.

How are Jeffco's STEM programs related to its GT programs?

As you can see from the attached, as a practical matter, over 50% of the Jeffco students who score at the Advanced level on TCAP math and science tests are GT students. However, STEM and GT programming are separate. Students at GT Center Schools for elementary and middle school students are taught using an accelerated/one-grade ahead curriculum for all subjects (including math and science) by teachers who are GT certified. The extent to which those teachers include in their classes the application of math and science principles to solve practical problems varies by school and teacher. It is not clear to us whether Jeffco's STEM programs employ acceleration; thus far, we have seen no indication that they will. At the high school level, GT students can take the classes that are included in the AP STEM program.

Who at the Jeffco District Office can I contact to discuss STEM and GT issues?

Matt Flores (mdflores@jeffco.k12.co.us) (303-982-0990) is the Director of Curriculum and Instruction for STEM.

Dr. Blanche Kapushion (bkapushi@jeffco.k12.co.us) (303-982-6650) is the Director of Gifted Education.

The Relationship Between STEM/Gifted and Talented (GT) in Jeffco

Overlap Between STEM and GT is Extensive

- GT students are approximately 10% of population
- GT students account for over half of TCAP/Advanced Math and Science:

2013 Grade 10 TCAP Scores for Jeffco		
	Science	Math
Total Students Scoring Advanced	677	564
Number of NonGT Student Scoring Advanced	306	231
Percent of NonGT Students Scoring Advanced	0.5%	4.2%
Number of GT Students Scoring Advanced	371	333
Percent of GT Students Scoring Advanced	39%	35%
GT Students as Percent of All Advanced	55%	59%
More Granular Detail for 2013 Grade 10 TCAP Math		
	Percent Scoring Advanced	
	Not GT	GT
Female/Free and Reduced Eligible	0.9%	3.8%
Female/Not Free and Reduced Eligible	4.1%	32.0%
Gap Multiple	4.6x	8.3x
Male/Free and Reduced Eligible	1.8%	17.1%
Male/Not Free and Reduced Eligible	7.1%	43.1%
Gap Multiple	4.0x	2.5x

Background GT in Jeffco

- GT and SPED students are covered under CO Exceptional Children Education Act
- Colorado law requires mandatory GT testing of ALL students in grades two and five
- Our key challenge is to ensure that GT students are adequately challenged, so that they can make the full use of their cognitive capabilities, and in the process develop the grit and resilience that are critical to long term success in life

Improved Programming for GT Students Will Also Benefit STEM:

- Increased use of Accelerated Learning options
- Greater provision of challenging courses (AP, IB, etc.)
- More access to on-line learning opportunities (district provided, university MOOCS)
- Level Playing Field for all Dual/Concurrent Enrollment Options (e.g., CU Succeeds)
- More programming to assess and address affective needs/provide timely supports
- Better integration with business community (mentorships, speakers, etc.)
- Use GT/STEM to pilot accelerated transition from “seat-time” to competency-based K12 education system