STEM in the Mathematics Classroom

What is STEM?

STEM is a philosophy. It is a way of acquiring, reflecting, and applying knowledge in daily life. It takes the individual skills and concepts that students learn in Science, Technology, Engineering, and Mathematics and integrates them within these disciplines as well as other disciplines such as Social Studies, Literature, and Art. A STEM environment requires active engagement, reflective thinking, problem solving, strategic reasoning, and academic communication. Cultivating a STEM culture requires a community of stakeholders who are committed to behaving as critical thinkers by demonstrating a willingness to be introspective as well as perceptive. These critical thinkers must be willing to question ideas, challenge assumptions, explore concepts, examine points of view, and analyze implications. These behaviors lead to deeper understanding and better application of knowledge. Cultivating a STEM culture provides an expectation that our students will be fully equipped to explore, understand, and apply the knowledge and skills learned in the classroom. In turn, students will be well prepared to live, work, and play in our global society.

Accentuating the M in STEM

Mathematics is a science focused on the logic of shapes, quantities, and sequences. It is a valuable mode of thought. Mathematics is usually associated with numbers and shapes, but it is much more. Mathematics is about patterns, structures, calculations, and logic. When patterns are found in our universe, as they often are, mathematics can help explain and control these natural happenings. Mathematics permeates our daily lives and contributes to the wealth of the world. Mathematics is a process of thinking, deriving, applying, and rethinking. It is the foundation of logical and critical thought.

The purpose of mathematics education is to build a body of knowledge that will support students with developing reasoning, thinking, and analyzing skills that will lead to them deriving justifiable conclusions. “The study of mathematics instills an ever-increasing sense of wonder and awe at the profound ways in which the world displays order, patterns, and relationships” (St. Jerome Classical School, 2014). It is incumbent on mathematics educators to prepare our students to apply, explain, harness, or at least appreciate mathematics’ contributions.

Enriching Mathematics through STEM

Productive disposition toward mathematics is the habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence in one's own efficacy. Productive disposition effects mindset and mindset effects how one reacts to challenges (Dweck, 2006). Therefore, our students must develop a willingness and confidence to explore and persevere through mathematics. Integrating science, technology, engineering, and other disciplines with mathematics requires students to apply it in their daily lives, allowing students to associate mathematics as relevant and useful. STEM also requires students to explore the concepts of mathematics, developing a deeper understanding of its connections, components, and applications. Mathematics in isolation is senseless and disjointed. STEM offers mathematics educators a natural environment for expanding mathematics knowledge to improve achievement.

STEM and the Georgia Standards of Excellence in Mathematics

The use of STEM practices and dispositions is an expectation in the mathematics classroom. The Georgia Standards of Excellence in Mathematics (MGSE) communicate this expectation in the wording of the standards and through the inclusion of the Standards for Mathematical Practice. Consistent and strategic implementation of these practices into structured systematic instruction leads to mathematically proficient students.

The Four C's in Mathematics

Communication

Starting a retirement plan at an early age or using the right size beams to build a deck would be impossible to articulate without mathematics. Not only does mathematics have a language of its own, but it provides a method for communicating efficiently and effectively. Through the study of mathematics students don't just learn the language of mathematics, they also learn how to apply the elements of thought in order to improve their abilities to communicate in any situation.

Collaboration

Collaboration provides opportunities for reflection, investigation, and improvement. Through collaboration, students have the opportunity to examine and refine their own thinking, explore a variety of viewpoint, and discover new ideas. Math lessons that engage students in authentic problem solving provide an environment where students can practice collaborating as they develop new ideas.

Creativity

Problems are solved by those who can think outside the box. It is not the people who follow the standard algorithms who discover the next great invention. Valued solutions arise through divergent thinking. Practicing mathematics provides students with the opportunity to be creative in their thinking, leading to new and exciting products.

Critical Thinking

The practice of learning mathematics directly aligns with the process of refining thinking. Mathematically proficient students consistently practice problem solving, perseverance, precision, reasoning abstractly and quantitatively, inquiry, and perspective. These processes are directly related to the intellectual standards that must be applied to the elements of thought that a student applies to developing the intellectual traits necessary for becoming a well-cultivated critical thinker.

Examples of STEM in the Georgia Standards of Excellence

Kindergarten: MGSEK.G.1 Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.

Grade 5: MGSE5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation

Grade 7: MGSE7.EE.2 Understand that rewriting an expression in different forms in a problem context can clarify the problem and how the quantities in it are related. For example a + 0.05a = 1.05a means that adding a 5% tax to a total is the same as multiplying the total by 1.05.

Algebra: MGSE9-12.A.CED.4 Rearrange formulas to highlight a quantity of interest using the same reasoning as in solving equations. Examples: Rearrange Ohm's law V = IR to highlight resistance R; Rearrange area of a circle formula A = π r2 to highlight the radius r.

Geometry: MGSE9-12.G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor.

Calculus: MMC.D.1 Students will explore the continuity of functions of two independent variables in terms of the limits of such functions as (x, y) approaches a given point in the plane.

Standards for Mathematical Practice