

## Using Roller Coasters to Bridge Mathematics, Science and the Arts

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### Abstract

The goal of this workshop presentation is to help teachers find meaningful ways to integrate the arts, mathematics, and science to promote creativity, and interdisciplinary and real-life connections in their classrooms. Through designing and building roller coasters the participants will develop their own creativity and understanding of the problem solving and inquiry approaches to teaching mathematics and science.

Based on the constructivist philosophy of learning, recent reform movements in mathematics education shifted attention from procedural knowledge to conceptual understanding see Ellis & Berry [4]. In science, attention has been concentrated on the method for which investigations are introduced. This refocus has been from a progressive introduction of discrete processes to a whole investigations approach, where advancement is dependent on each individual's procedural and conceptual understanding see Bennett [2]. These shifts have resulted in a new definition of mathematical and scientific knowledge, emphasizing problem solving, the exploration of big ideas, the connections between those ideas, and communication about them.

The above process has impacted the role of teachers through shifting the focus from the teacher to the student. Student-centered teaching through inquiry and problem solving promotes the students' construction of knowledge through creating, exploring and testing their mathematical and scientific ideas see Alsardary & Blumberg [1]. Therefore, educators are not only expected to develop a knowledge and understanding of the mathematics and science they teach, but also of the ways children understand and think about different concepts. Not being taught through problem solving and inquiry methods during their educational experiences, teachers often struggle with understanding the pedagogy behind this form of instruction see William, Abell, Hubbard, McDonald, Otaala, & Martini [9]. In order to accomplish this task, incorporation of the arts, through enhancing students' enjoyment and engagement of content, can help individuals gain access to this knowledge through new intelligences see Johnson & Edelson [6].

To be able to help students create more powerful constructions see Confrey [3], teachers need to identify and make sense of children's ideas and their ways of thinking. Educators should focus on processes that build conceptual bridges, which are adjusted to the children's abilities to construct knowledge and move "from their current level of understanding toward more refined and integrated understandings" see Griffin and Case [5].

Making connections among particular concepts is not only important within a given subject area, but the significance of interdisciplinary connections is also highly promoted by organizations such as the National Council of Teachers of Mathematics (NCTM) and the National Science Teachers Association (NSTA). Both of these organizations outline standards see NCTM [7]; National Research Council [8] that encourage curriculum connections to enhance students' use and understanding of academic content.

Building on students' prior knowledge in terms of content knowledge and real-life experiences not only promotes strong and meaningful connections, but it also allows for much creativity and critical thinking in the mathematics classroom. Activities that encourage students to express themselves artistically, mathematically, and scientifically, have the potential to nurture creativity to its fullest extent. The goal is for learners to "play" with mathematical and scientific ideas.

In this workshop the participants will first focus on using self-created stories to exemplify and explain graphical representations. Discussions of these stories and how they characterize the provided visual will lead the first part of the session. The participants will then, relying on their own artistic, mathematical, and scientific creativity, design and build roller coasters using pieces of Armaflex<sup>®</sup> pipe insulation, masking tape, structures in the environment, and marbles. Through the use of roller coaster uphill, loops, and corkscrews, individuals will evaluate the effectiveness of their design in terms of its success at carrying a marble from the apparatus' beginning to its end. Finally, participants will choose a means by which they can illustrate their design to other members partaking in the workshop through the use of graphing, allowing the session components to come to full circle. In this problem-based inquiry the participants will construct their own understanding of data collection, data representation, data analysis, length measurement, the scientific method, and the art of motion and 3-D design

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