Rationale and Introduction

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Workshop Rationale:

The relation between mathematics and physics is one with a long tradition. For Galileo the book of nature is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures. A giant step forwards in using the language of nature to describe physical phenomena was made by Isaac Newton, who developed and applied calculus to the study of dynamics and whose universal law of gravitation explained everything from the fall of an apple to the orbits of the planets. The nineteenth century witnessed the greater sophistication of Maxwell's equations to include the behavior of electromagnetism, and the twentieth century saw this process take a major step forwards with Einstein's theory of special relativity and then of general relativity. At this stage both gravitation and electromagnetism were formulated as field theories in four-dimensional space–time, and this fusion of geometry and classical physics provided a strong stimulus to mathematicians in the field of differential geometry (http://geometryandphysics.gie.im/).

Even with the historical perspective and some current research on the importance of the relationship between physics and math, there is very little scientific findings linking academic success to teaching co-curriculum in high school science and math classes. However, we feel that students can develop a better fundamental understanding and connection between math and science if the importance of the relationship is stressed and made relevant to the student's everyday life.

Workshop Goals:

1. Develop working knowledge of model-based activities and lessons
2. Develop an awareness of using "cross-talk" to connect common concepts, variables, constants, etc… used in multiple science disciplines to build connections for students
3. Develop a working library of physics investigation and math modeling activities written and tested by your peers
4. Encourage educators to connect lessons and content to other disciplines

Examples of other workshops and classes:

1. Math and physics teachers navigate night sky for new strategies
Tuesday, August 09, 2011

The phrase "reach for the stars" took on new meaning for 15 mathematics and physics teachers from across the state after attending a science workshop at South Dakota State University.
AstroMath 2009, held for four days in mid-July, encouraged the use of astronomy-based activities in the classroom as a way to help students find success in math and science.

Through various projects and activities, teachers learned fun and motivating methods to teach geometry, algebra, trigonometry and physical science. All activities used astronomy as a common language to broaden students' understanding and interest in challenging subject areas.

"Astronomy is a great motivator since so many students are interested in it," said Judy Vondruska, an SDSU physics professor who assisted with the workshops. For more information visit South Dakota State University's website at http://www.sdstate.edu/news/articles/astromath.cfm.

2. Calculus Physics Workshop, Orono, June 2002. University of New Hampshire, Supported by the NSF, Grant 9752485.

See PDF on the wiki of PowerPoint presentation that outlines the workshop and list the goals and pedagogical strategies (meredithworkshop.pdf).

Resources:

Web-based:

- PhET – Colorado (http://phet.colorado.edu/) - interactive Java apps that simulate physics, biology, chemistry, earth science, math, & cutting edge research.
- There is strong evidence that students who complete a modeling-based instructional approach physical science class in 8^{th} and 9^{th} grade perform better on scientific reasoning and mathematical skills

based tests. See the list of current studies and literature at http://www.aapt.org/Resources/physicsfirst.cfm.

Articles: (Articles can be found on the wiki.)

- Sokolowski, A. & Rackley, R. (2011). Teaching harmonic motion in trigonometry: *Inductive inquiry supported by physics simulations. Australian Senior Mathematics Journal, 25*(1), 45-53.
- Clay, T. W., Fox, J. B., Grunbaum, D., & Jumars, P. A. (2008). How plankton swim: An interdisciplinary approach for using mathematics & physics to understand the biology of the natural world. *The American Biology Teacher, 70*(6), 363-370.
- Goetz, T., Frenzel, A. C., Ludtke, O. & Hall, N. C. (2011). Between-domain relations of academic emotions: Does having the same instructor make a difference? *The Journal of Experimental Education, 79*, 84-101.
- Wilt, J. R. (2005). Ninth grade physics: A necessity for high school science programs. *Journal of Curriculum and Supervision, 20*(4), 342-362.