# INQUIRY INTO MATHEMATICS AND SCIENCE THROUGH THE USE OF TECHNOLOGY ☺

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# Today's Presentation Agenda

- 10 minutes
  - Introductions and explanation of the two laboratory experiences
- 10 minutes
  - Participants investigate lab equipment
- 10 minutes

# Today's class

- 5:00 - Introductions
- 5:15 - Probeware Integration – Why?
- 5:30 - Introduction to Probeware
- Short Break
- 6:00 - Station #1 – Graphing Your Motion, Experiment #33 (45 Minutes)
- 6:45 - Station #2 – The Greenhouse Effect, Experiment #3 (60 Minutes)
- 7:45 - Conclusion

# Interdisciplinary Lessons… Science and Mathematics

"Making connections and transferring ideas to a new context are difficult processes that many students cannot accomplish on their own…

The opportunities to make such connections does not always arise in the context of single-subject classes unless teachers take time out… "

(Marrongelle, Black, Meredith, 2003)

# Mathematics

- The Principles and Standards for School Mathematics (NCTM, 2000) suggests students should make connections to other disciplines, particularly science.

# Science

- National Science Education Standards (NRC, 1996) notes “coordination of science and mathematics programs provides an opportunity to advance instruction in science beyond the purely descriptive. Students gathering data in a science investigation should use tools of data analysis to organize these data and to formulate hypotheses for further testing” (p. 218 – 219).

# Scientific Inquiry

- **LEARNING SCIENCE IS AN ACTIVE PROCESS.**
- Learning science and math is something students do, not something that is done to them.
- In learning science, students describe objects and events, ask questions, acquire knowledge, construct explanations of natural phenomena, test those explanations in many different ways, and communicate their ideas to others.
- In the *National Science Education Standards*, the term "active process" implies physical and mental activity. Hands-on activities are not enough—students also must have "minds-on" experiences.

# “Real-World” Mathematics & Science

- Mathematics and Science are intimately interconnected. Scientific principles and laws are tested, analyzed, and confirmed experimentally through mathematics.
- CBLs/LabPro Systems provide opportunities to conduct a wide range of data-collecting activities relatively inexpensively.
- Teachers should incorporate technology as a tool to examine mathematics and science ideas

(Randall, 1998)

# LabPro/CBL Probes

- Distance (motion detector)
- Force
- Pressure
- Temperature
- pH
- Microscope

# Mathematical Ideas

- Functions
  - linear
  - quadratic
  - logistic
  - piecewise
  - sinusoidal…

(data analysis, predictions, graphing, modeling…)

# Science Ideas

- Velocity
- Water Quality
- Air Pressure
- Harmonic Motion
- pH Change
- Digital Microscopy

# Station #1 – Graphing Your Motion

- Graphs made using a Motion Detector can be used to study motion.
- In this experiment, you will use a Motion Detector to make graphs of your own motion.
- Objectives
  - Use a Motion Detector to measure position, velocity, and acceleration.
  - Use a computer to produce graphs of your motion.
  - Analyze the graphs you produce.
  - Match position *vs.* time and velocity *vs.* time graphs.

# Summary Thoughts?

- What did you enjoy about this type of "recipe-based" laboratory experience?
- How do you think your students would respond to this type of technology integration?
- Are there implementation barriers that teachers would need to be aware of?
- What was the math and science content? Was the content understood?
- Would you be willing to work in an interdisciplinary team in the future?

# Station #2 – The Greenhouse Effect

- Greenhouses allow gardeners to grow plants in cold weather.
- This is because a greenhouse stays warmer than the outside air. You can feel this effect in a car parked in the sun.
- On a larger scale, the greenhouse effect helps keep our planet warm. It makes Venus one of the hottest planets in our solar system.
- In this experiment, you will use Temperature Probes to measure temperatures in a model greenhouse and in a control as they are heated.
- You will then calculate the resulting temperature changes.

# Summary Thoughts?

- What did you enjoy about this type of "inquiry" themed laboratory experience?
- How do you think your students would respond to this type of technology integration?
- Are there implementation barriers that teachers would need to be aware of?
- What was the math and science content? Was the content understood?
- Would you be willing to work in an interdisciplinary team in the future?

# Conclusion

- All Students are required to submit the following:
  - Complete Station #1 (Experiment 33) – Laboratory Handout
  - Complete a one-two page reflection
  - Complete Station #2 (Experiment 3) – The Greenhouse Effect
  - Complete a one-two page reflection

# Math Student Quote

I liked the “inquiry-based” laboratory experiment about green house gases much better. It was more open-ended and was almost like we were able to come up with our own interdisciplinary lesson.

# Math Student Quote

I truly enjoyed this experiment on graphing motion with a motion detector. I had never used any lab pro equipment, but I wish that I could have had experiences like this in my high school math and/or science classes…

I was impressed with the amount of mathematics and science contained in this experiement.

# Math Student Quote

There were no explicit instructions and students were free to decide how they would complete the experiment on their own, with only the basic idea of testing the greenhouse effect given to them. As a student, I really enjoyed this experiment…

At first, I was a little confused because I think I expected those clear directions, but I soon realized that this gave us much more freedom to work on the experiment how we pleased.

# Math Student Quote

This laboratory experience was fun and intellectual… I enjoyed being able to get out of my seat and actually participate in a hands-on activity that could help me understand concepts better.

If students could participate in experiments such as these, they may be able to see how these concepts relate to real world situations.

# Math Student Quote

… honestly, I would have never come up with the second hypothesis of would the green house model retain the heat after the heat source was removed. I would have only worried about our first hypothesis which was the greenhouse model would heat up faster.


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