Martinson Center for Mathematics and Science
Regent University

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ACUMEN

INSTRUCTING, EQUIPPING & INSPIRING TEACHERS OF MATH & SCIENCE

WATCH OUT...THEY MIGHT LIKE IT!

Ever have an unmotivated student? Ever have someone ask, "What's the point of this?" If so, then you probably have a student who has yet to learn the value of investigative questioning. In order to move students from being dependent learners to independent learners in the science classroom, it's essential that they learn how to design investigative questions. In many science classrooms, students are not actively involved in designing the experiment or even designing questions that would lead to forming testable hypotheses. Rather, they are simply given the procedure for an experiment and they follow it like a recipe in a cookbook. However, in order to develop student scientists and spark interest and involvement, students must have ownership in the process rather than just follow a prescribed list of directions. How then can this be accomplished? It starts with very structured inquiry experiences that guide them through the design process of an experiment. Authors Cothron, Giese, and Rezba in their book, *Students and Research—Practical Strategies for Science Classrooms and Competitions* (1989), explain the use of the four-question strategy, which is a brainstorming tool that helps students develop their own testable questions. The use of this strategy has proved highly beneficial to students' taking charge of the design process as well as learning valuable content. In turn, this strategy also increases student interest in experimentation and develops effective problem solving skills, which is a skill that transcends the science classroom into the whole of life itself.

OUR MISSION

The mission of MCMS is to improve the quality of mathematics and science teaching in public and private K-12 schools in the Tidewater region by promoting knowledge, attitudes, skills, and habits of mind necessary for student literacy and success in mathematics and science.

INSIDE THIS ISSUE

"If you plan for a year, plant a seed. If you plan for ten years, plant a tree. If for a hundred years, teach the people. When you sow a seed once, you will reap a single harvest. When you teach, you reap a hundred harvests."

—Kuan Chung

Candy in the Classroom

USING GOBSTOPPERS TO DEMONSTRATE THE FOUR-QUESTION STRATEGY

The following has been taken and adapted from the article, Caution! Scientists in the Making by Dr. Jenny Sue Flannagan and Rachel McMillan. (Science Scope, 2008. p61)

In an effort to use the four question strategy introduced in the book by Cothron, Giese, and Rezba, with experiments in the science classroom We decided to try it with a matter unit to see if we could use it with labs already embedded in the curriculum. Normally, we have sixth grade students conduct an experiment in which they dissolve candy in hot and cold water to observe how changes in temperature affect states of matter. We chose to use the same lab, but this time instead of giving students the question to investigate, we would use the four-question strategy with students to generate the testable question: How does changing the temperature of a liquid affect a submerged solid?

We began the lesson by sharing with students that they would be designing an experiment using gobstoppers in order to examine the idea of how temperature can affect states of matter. We then introduced the first question of the four-question strategy (see Figure 1). Many of the students were confused at first, so we helped them out by giving each group of four students a gobstopper and had them brainstorm everything they knew about a gobstopper and what it could do. Students immediately were able to give us some answers which made us realize that students needed to focus on the action of the object first instead of jumping in with brainstorming materials. As a result of this, we moved question 2 to become question 1. By giving students time to observe the gobstopper, they would be able to generate stronger ideas. We tested our idea on revising the strategy with the second class period and began the next class by giving the gobstopper and a cup of water to the groups of students. We told them to put it in the water and then observe what happened. This led them to the first question of the revised

strategy which asks them to describe how they saw the gobstopper act while it was in the water. Once students listed words such as melted, dissolved, and changed colors, we were able to select an action from question 1. This action would then be used as the springboard for the other questions. We then told the students we'd be doing an experiment around dissolving gobstoppers. This made coming up with a list of materials much easier since they'd already observed what it would take to do so. After the materials were established, we led students into the third question of the strategy—"How could you change the following materials to affect how the gobstopper dissolves?" Students discussed how they could change the liquid in order to see if it would affect the dissolving process. By focusing on changing one material at a time, we were able to guide students to discover a list of potential independent variables by answering question 3. The teachers then selected one material students would change (temperature of water, hot or cold). All other variables became constants. Then with question 4, students were given the prompt, "If we are going to change the temperature of the water, what could we observe or measure that would tell us if temperature affects how gobstoppers dissolve?" After students brainstormed, they generated a list of ideas that became dependent variables in the experiment. All that was left to do was to create their research question. This was easy since they already had identified their independent and dependent variables in questions 3 and 4. They simply put it together: "What is the effect of changing the temperature of water on the time it takes a gobstopper to dissolve?"

What we learned through this was that not only did students learn a valuable strategy to help them take charge of the design process, but they also learned content, and how to identify independent and dependent variables quickly. As they came to understand the strategy better, they saw it helpful for designing questions for a science fair or other inquiry labs. As the school year progressed, we gradually released control to students and allowed them more freedom to design the procedures and data tables for experiments. Eventually, we became facilitators, observing and assisting only as needed. Using the revised four-question strategy, students developed into effective problem solvers as they directed, monitored, and evaluated their own learning and progress. ▪

Figure 1 : **FOUR-QUESTION STRATEGY**

Question 1

What materials are readily available for conducting experiments on _____?

Question 2

What does _____ do? How does it act?

Question 3

How can I change the set of _____ materials to affect the action?

Question 4

How can I measure or describe the response of _____ to the change?

(Cothron, Giese, and Rezba, 1989, p.28)

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MARTINSON CENTER FOR MATHEMATICS AND SCIENCE

The Center offers:

- Workshops dealing with a variety of instructional strategies, tools and models to improve the development of students' critical thinking, problem-solving and best practices in math and science
- Partnerships with schools and school divisions designed to improve the teaching of math and science
- Curriculum development and review
- Lecture series dealing with issues surrounding math and science
- Graduate courses and institutes to strengthen math and science content knowledge in grades K-12

Martinson Center for Mathematics and Science

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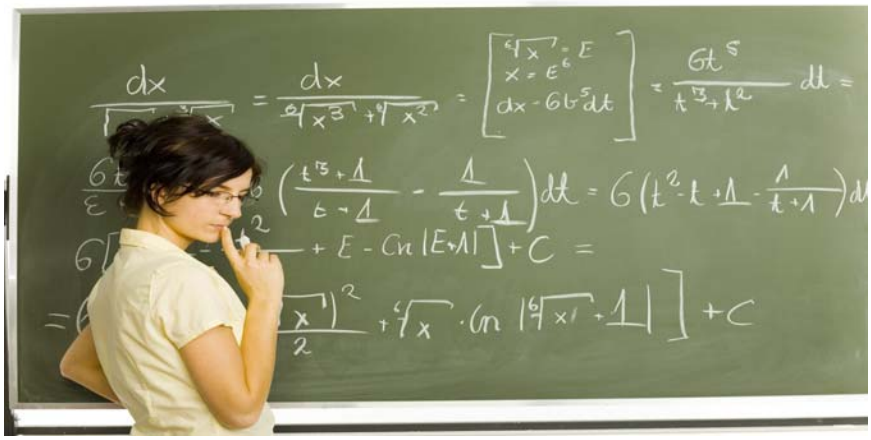

MARK YOUR CALENDARS! SUMMER '09 COURSE OFFERINGS

- **Hands on Equations® for Elementary School. Grades 3-5; June 6 and June 13; 9:00a.m.—4:00 p.m. Cost: $125 Early Bird ($175 after 3/6/09) Discount for Schools: Send 2 Get One Free!**

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- **Hands on Equations® for Middle School. Grades 6-8; June 29 -30: 9:00 a.m.– 4:00 p.m. Cost: $125 Early Bird ($175 after 3/6/09) Discount for Schools: Send 2 Get One Free!**

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- **Bringing Literacy to Life thru Children's Literature; July 6-8: 9:00 a.m.—2: 00 p.m. Cost: $40**

This professional development course will show you how to incorporate science experiments and math activities with writing, children's literature and shared reading.

- **Technology in the Elementary Classroom; July 9-11: 9:00 a.m.-2:00 p.m. Cost: $40**

Technology has changed in the last decade. This course will help you learn how to use these tools with your students to get them engaged and prepared for careers in the 21st century workplace! Teachers will receive free claymation kit, probes, and other technology tools!

- **Inquiry Institute; July 15-17: 9:00a.m.-2:00 p.m. Cost: $125 Early Bird ($175 after 3/6/09) Discount for Schools: Send 2 Get One Free!**

Participants will explore scientific investigation, reasoning and logic through a variety

of experiments and activities in order to consider how inquiry-based learning promotes understanding of the nature of science. Concrete strategies and assessment tools will be provided.

- **Math That Works! Grades K-5 ; July 21-22: 8:30 a.m.-3:30 p.m. Cost:$125 Discount for Schools: Send 2 Get One Free!**

Nanci Smith, an international consultant on Differentiation and Mathematics, shares insights into math instruction that makes a difference for students. Teachers will receive free classroom materials.

- **Math That Works! Grades 6-12; July 23-24: 8:30 a.m.-3:30 p.m. Cost:$125 Discount for Schools: Send 2 Get One Free!**

Nanci Smith, consultant on Differentiation and Mathematics, addresses the impact of students' differences on instruction and how those differences can be addressed through math instruction that emphasizes conceptual understanding along with procedural fluency. Teachers will receive free classroom materials.

- **Kindergarten Science Institute; August 6 & January 9, 2010: 9:00 a.m.-3:00 p.m. Cost: $40**

Learn hands-on experiments that can be easily replicated in your classroom that are designed to engage students' curiosity for science! Free lesson plans and materials!

- **Math in the Real World; August 3 & 4th, 9:00 a.m.-3:00 p.m. Cost: $40**

Come learn how using manipulatives can help your students learn mathematics! Topics include problem solving, differentiation, fairness, geometry, algebra, combinations, mapping, and literature connections. Free materials!

You can register online now at www.regent.edu/mcms to reserve your spot!