

STEM Learning Modules (SLM) Pilot Program

6 May 2008

FLC Annual Meeting

WHAT IS ORIGIN?

- Sponsored by DDR&E
 - Deputy Under Secretary of Defense for Laboratories and Basic Sciences (DUSD(LABS))
Dr. William S. Rees, Jr.
- A Component of the National Defense Education Program
 - Pre-Engineering Partnerships (PEP)
 - **STEM Learning Modules (SLM)**
 - SMART
 - NSSEFF Program

WHAT IS SLM?

- A classroom centered initiative
 - Schoolteachers
 - Civilian scientists and engineers from the defense community
- Objective
 - Promote STEM subjects in a compelling manner
 - Enhance the learning experience for students

The SLM Methodology

- Inquiry-based interactions and materials
- Direct alignment with state and local standards
- The curriculum:
 - Initially based on Materials World Modules
 - Created at Northwestern University in the 1990's
 - Under NDEP new modules will be developed
 - i.e., robotics

Inquiry and the Materials World



MWM Pedagogy

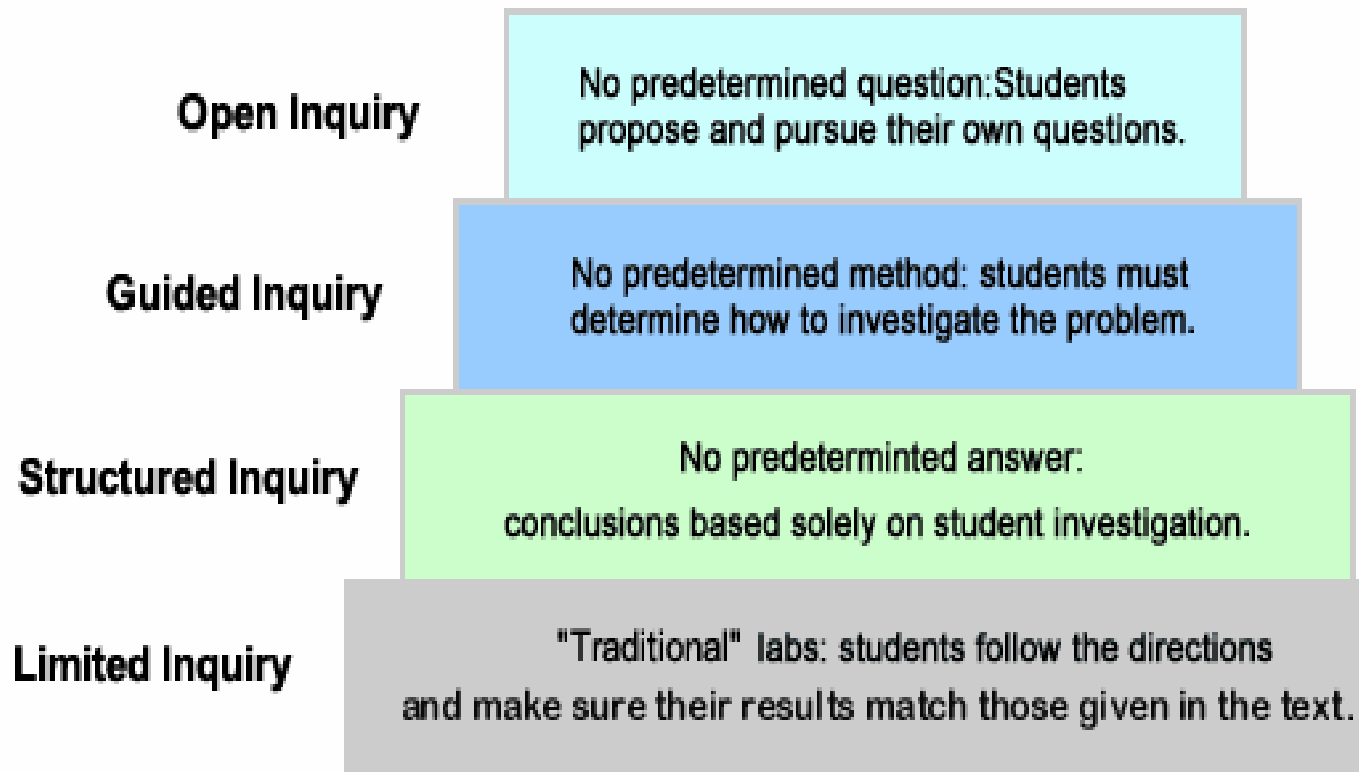
- **Inquiry and design** work together to help students better understand science.
- Use design as a means to engage students in scientific inquiry.
- By engaging in inquiry, students identify important scientific principles that they can apply to their design. Conversely, by engaging in design, students discover what it is that they need to know to improve their designs.
- Activities in the Materials World Modules give students an opportunity to engage in scientific inquiry in addition to learning how materials science concepts relate to real world design problems.

What is inquiry?

National Science Education Standards:

- Design and conduct scientific investigations using appropriate tool and mathematical analysis
- State scientific explanations and devise models following rules of logic and evidence
- Recognize and analyze alternative explanations and models
- Communicate and defend the conclusions of scientific investigations

Inquirey Continuum



What Makes Design a Good Context for Inquiry?

- Design problems are often tied to real-world problems.
- Design problems are typically ill-defined or open-ended.
- Building and testing designs results in data - data that students can use to reason about which design is better.
- Design is iterative.
- Design problems offer a context for scientific communication.

The Design Process

- » State Design Goals
- » Brainstorm and Select Best Option
- » The Design Proposal
- » Build the Design
- » Test the Design
- » Evaluate the Design
- » Redesign

What is a Materials World Module?

- Each module is a supplemental unit that takes 1 to 3 weeks of class time (approximately 10 hours)
- Each module has 3 parts:
 - **The Hook**: a compelling introductory activity that inspires inquiry
 - Four to five hands-on **exploratory activities** that are based on materials science and nanoscience concepts
 - **The Design Project**, where students apply their learning to create a functional prototype product
- Designed for middle school and high school students
- Each kit contains supplies for 24-32 students
- Student and teacher editions of books are sold separately from kits
- Activities are designed for 8 groups of 3 or 4

MWM PUBLISHED MODULES

- Biodegradable Materials
- Biosensors
- Ceramics
- Composites
- Concrete: An Infrastructure Material
- **Environmental Catalysis - *Coming Soon!***
- Food Packaging
- **Nanotechnology - *Coming Soon!***
- Polymers
- Smart Sensors
- Sports Materials

Sports Materials Quick Look



SPORTSMATERIALS

Today's lesson: basketball, soccer, baseball, golf, and tennis – and this isn't gym class!

Students explore the design and function of a wide variety of balls used in athletics, as well as test and analyze their interactions with many surfaces they come in contact during play. Then students design a suitable material for use in a newly invented game.

By incorporating everyday materials into science lessons, the Materials World Modules (MWM) program at Northwestern University has found the solution to getting students excited about learning science while helping teachers meet national and state education standards.

The modules are easy to organize and inexpensive to run. They can be incorporated into any science class because of the breadth of subjects covered in the Activity and Design Project sections. Each module is a supplemental science unit that takes 1-3 weeks of class time (approximately 10 hours) to complete.

Module At-a-Glance:

Activities

- Exploring Ball Design and Materials
- Measuring the Rebound of Sports Balls
- Investigating Energy Absorption
- Comparing Rolling Friction
- Researching Sports Materials

Design Project

- Designing a Mini-Golf Game
- Designing New Sports Equipment



MWM will give students an opportunity to understand the world around them in a way they have never experienced before. The modules promote an awareness of the roles science and technology play in society and guide students to take increased control of their work.



MWM is designed to

- Interdisciplinary
Integrates science & non-science subjects
- Flexible
Modify to your teaching style, students' ability and class time
- Hands-on
Contains activities that lead up to inquiry-centered design projects
- Cutting-edge
Introduces issues on the forefront of technological research
- Improve STEM education
Science • Technology • Engineering • Math

Materials World Modules

An Inquiry & Design Based STEM Education Program
Northwestern University • www.materialsworldmodules.org
847-467-2459 • mwm@northwestern.edu



Connects
to Your
Curriculum

Chemistry

Properties of Matter •
Molecular Bonds • Polymers

Biology & Life Sciences

Biological Materials • Structure and
Function • Biomechanics
• Human Body • Joints •
Microbiome • Skin

Mathematics

• Measuring • Graphing (Making and
Interpreting) • Computing • Averages •
Ratios • Percentages

Physics & Physical Sciences

Forces • Friction • Energy • Conservation
of Energy • Energy Absorption •
Stored and Kinetic Energy •
Elastic and Plastic Deformation • Inertia

Geology & Earth Science

Air pressure and Altitude •
Environmental Issues

Technical Education

Designing • Materials • Controlling Energy
Absorption Controlling Friction

Language Arts

• Writing a report • Public speaking

Sports Materials: Module At-a-Glance

● **Activities**

- Exploring Ball Design and Materials
- Measuring the Rebound of Sports Balls
- Investigating Energy Absorption
- Comparing Rolling Friction
- Researching Sports Materials

● **Design Project**

- Designing a Mini-Golf Game
- Designing New Sports Equipment

NSWC PCD and SLM

OUTLINE OF FY 08 PROGRAM

NSWC PCD and SLM

- DDR&E funded for FY08
- Partnerships
 - Florida State University
 - Gulf Coast Community College
 - Bay County School District
 - School District of Gulf County
 - School District of Holmes County

Objectives

- Improved STEM Programs in region
- Teacher Training
 - Middle school science teachers
 - High school teachers
- New materials for classroom use
 - Kit materials and instruction books (teacher/student)
- Partnerships with Scientists and Engineers
 - A continued relationship

Summer FY08 Program - I

- TRAINING by CASE (June 9 -11)
 - Inquiry based science education
 - Material Worlds Modules
 - Composite Materials
 - Sports Materials
- Training by College of William and Mary (June 12-13)
 - Collaborative/cooperative education
 - Educational Ethics
 - Robotics and MWM

Summer Program - II

- **Summer Institute**
 - Preparation Day for educators and S&Es
 - (June 16)
 - **Summer SLM Science Session**
 - June 17 -20
 - 4 ~ half day sessions
 - ~ 26 teachers
 - ~ 12 S&Es
 - ~ 100 students (rising 9th graders)

POC

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