



# SMART SENSORS

Microphones, interactive touch screens, light switches, and coin counters. Can you name other smart sensors?

Students investigate the behavior of pressure and heat sensitive piezoelectric films. They use these materials to make coin-counting and other smart sensing devices.

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.

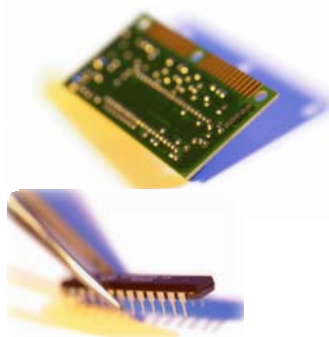
## Module At-a-Glance:

### Activities

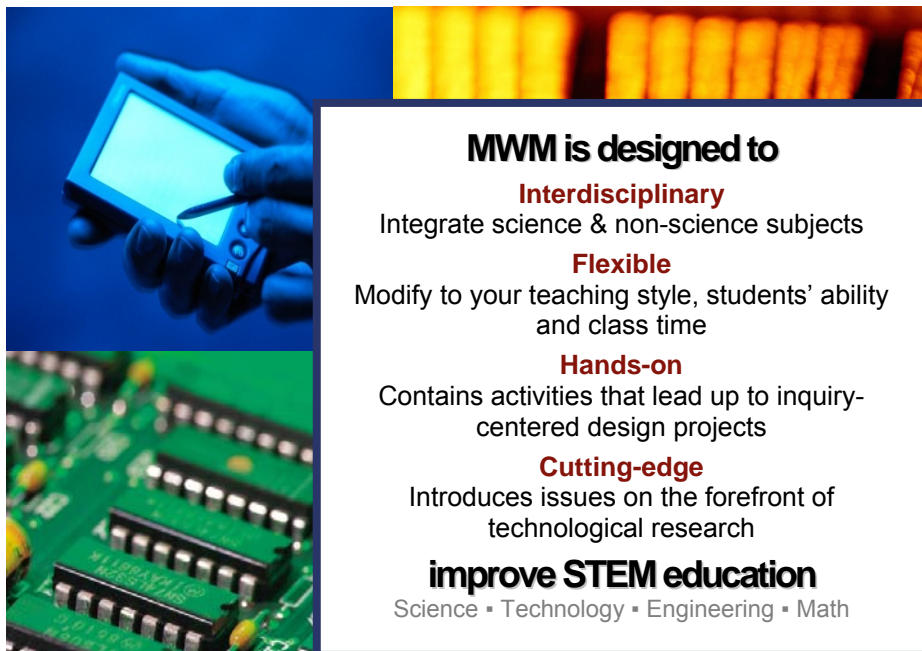
- Evading Motion Detection
- Taking a Tour of Some Sensors
- Making a Microphone
- Exploring the Piezo Effect
- Measuring Piezoelectric Response

### Design Project

- Designing a Coin Counter
- Designing a New Sensor



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**  
Integrate 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

**Connects  
to Your  
Curriculum**

## Chemistry

- Physical and Chemical Changes ■
- Chemical Reactions ■ Energy Absorbed or Released ■ Changing Properties ■
- Electronegativity ■ Structure of Atoms and Molecules ■ Ball and Stick Models ■ Electrons ■ Polarity and Dipoles ■
- Molecular Weight ■ Intermolecular Forces ■ Covalent Bonds ■ Conductivity ■
- Carbon Compounds ■ Polymerization ■ Organic Polymers

## Biology & Life Sciences

- The Nervous System ■ Stimulus Response ■ Sense Organs ■ Piezoelectric Properties of Bones and Other Tissues

## Mathematics

- Algebraic equations ■ Graphing ■ Inverse Square Law

## Physics & Physical Sciences

- Electromagnetic Forces ■ Mechanical Forces ■ Relationship Between Electricity and Magnetism ■ Interactions of Energy and Matter ■ Sound Waves ■ Light Waves ■ Wave Frequency ■ Crystallinity ■ Charge Separation ■ Electric Potential (Voltage) ■ Electric Circuits ■ Induction ■ Displacement ■ Speed

## Earth & Space Science

- Piezoelectric Crystal Such as Quartz ■ Seismology ■ Heat Absorption ■ Infrared Radiation

## Technical Education

- Plastics ■ Generators ■ Motors

## Language Arts

- Writing a report ■ Public speaking

## Materials World Modules

### An Inquiry & Design Based STEM Education Program

Northwestern University ■ [www.materialsworldmodules.org](http://www.materialsworldmodules.org)

847-467-2489 ■ [mwm@northwestern.edu](mailto:mwm@northwestern.edu)

