Nanotechnology for Energy Conversion
Can we harvest the sun's vast energy using nanoparticles to fabricate inexpensive, next generation solar cell devices?

Students use nanotechnology and plant pigments to fabricate an artificial photosynthetic device for capturing the sun's energy and convert it to electricity. They are then challenged to design the most efficient dye sensitized solar cell using vegetable or fruit dyes.

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 use. 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 (ideally, approximately 10 hours) to complete.

Module At-a-Glance:
Activities
- Investigating the Photosynthesis of Spinach Leaf Discs
- Separating Leaf Pigments Using Paper Chromatography
- Measuring Silicon Solar Cell's Performance
- Making a Spinach Dye Sensitized Solar Cell

Design Project
- Designing a Dye Sensitized Solar Cell with Maximum Power Output

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

Materials World Modules
An Inquiry & Design Based STEM Education Program
Northwestern University • www.materialsworldmodules.org
847-467-2489 • mwm@northwestern.edu
Catalysts are part of the solution to protecting the environment – developing new catalytic technologies with nanoscale materials provides for a promising tomorrow.

Students learn what a catalyst is, gain an idea of the scope of catalysis research today, and become aware of the effect of catalysis on environmental protection. Advances in nanotechnology are also discussed as a solution to eliminate environmental pollutants. Students are challenged to design an original solution to an environmental problem of their choice.

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Module At-a-Glance:

Activities
- Catalyzing with Platinum Black
- Searching for Catalysts
- Using a Heterogeneous Acid Catalysis
- Using a Metal Catalyst to Degrade an Air Pollutant
- Using Photocatalysis to Degrade a Water Pollutant

Design Project
- Designing a Catalytic System to Degrade a Pollutant
- Conceptual Design for Environmental Catalysis

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Nanotechnology is applied to create targeted delivery of nanomedicine for localized treatment.

Students learn how nanotechnology is revolutionizing the approach to drug delivery and diagnostics. They are engaged in a simulated, as well as hands-on experience, in designing nanomedicine for targeted delivery. Students are challenged to design a nanodrug with an optimum time-release profile.

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Module At-a-Glance:

Activities
- Game: Designing a Search and Destroy Nanomedicine
- Hunting for Drug Delivery Systems that Use Nanoparticles
- Making Biodegradable Alginate “Drug” Capsules
- Determining the Rate of “Drug” Release

Design Project
- Designing a Fast Acting, Time-Release Nanomedicine

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Chemistry
Structure and Properties of Matter
- Atomic Theory & Bonding
- Solutions, Collids, and Suspensions
- Organic Chemistry • Reaction Kinetics • Biochemical Kinetics

Biology & Life Sciences
- Cell Biology • Biochemistry
- Diseases • Immune System • Drugs
- Molecular Biology • Biotechnology

Mathematics
- Measuring • Graphing (Making, Reading and Interpreting) • Computing
- Averages • Rates • Orders of Magnitude • Size and Scale • Surface-to-Volume Ratios • Mathematical Modeling

Physics & Physical Sciences
- Properties of Matter • Physical and Chemical Changes • Colors and Light • Spectrophotometry

Society
- Ethics and Impact of Uses of Nanotechnology

Technology/Engineering Education
- Iterative Design • Building Prototypes • Optimization • Communications

Language Arts
- Writing a Report • Public Speaking
What makes opals so colorful? What can optical engineers learn from a peacock feather?

Students learn about how light interacts with matter at the nanoscale. They will fabricate, test, and evaluate their own photonic crystals.

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 use. 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**
- Lights and Their Spectra
- Observing Diffraction
- Observing Interference
- Observing Iridescence

**Design Project**
- Fabricating Photonic Crystals

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