



DYE-SENSITIZED SOLAR CELLS

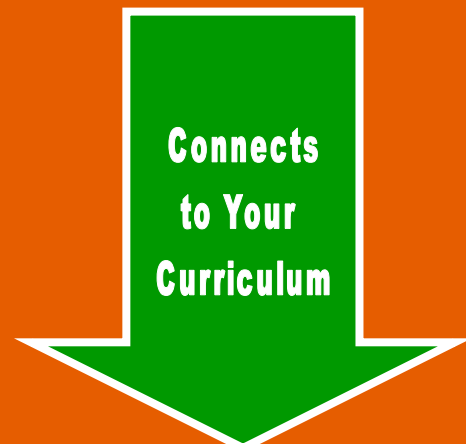
Nanotechnology for Energy Conversion

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.



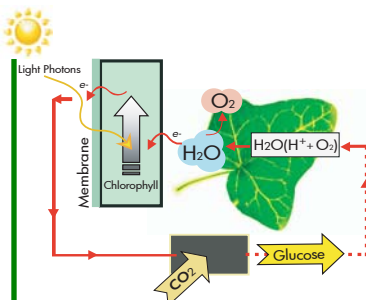
Module At-a-Glance:

Activities

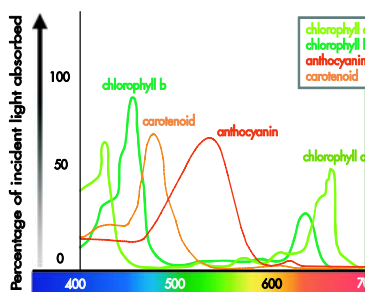
- Investigating the Photosynthesis of Spinach Leaf Discs
- Separating Leaf Pigments Using Paper Chromatography
- Measuring Silicon Solar Cell's Performance
- Making a Spinach Dye Sensitized Solar Cell

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

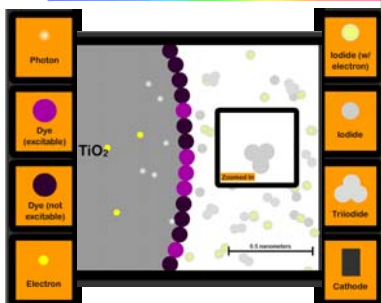
Can adapt to your teaching style, students' ability and class time

Hands-on

Contains activities that lead up to inquiry-centered design projects

Cutting-edge

Examines issues on the forefront of technological research



Chemistry
 Atomic Structure ■ Bonding ■ Polarity ■
 Redox Reactions ■ Rates of Reactions ■
 Chromatography ■ Solutions, Colloids, and
 Suspensions ■ Hydrocarbons ■ Catalyst ■
 Electrochemistry

Biology & Life Sciences
 Cell Processes ■ Photosynthesis ■
 Energy Pathways ■ Ecosystems ■ Carbon
 Cycle ■ Food Web ■ Decomposition

Mathematics
 Orders of Magnitude ■ Size and Scale ■
 Surface-to-Volume Ratios ■ Graphing
 (Making, Reading and Interpreting) ■
 Averages ■ Rates

Physics & Physical Sciences
 Electromagnetic Waves ■ Colors and Light
 ■ Capillary Forces ■ Circuits ■ Electron
 Flow/Current ■ Photoelectric Effect ■
 Energy, Work, and Power ■ Energy
 Source

Geology & Earth Science
 Metals ■ Rocks and Minerals ■ Use of
 Natural Resources ■ Renewable and
 Nonrenewable Resources ■ Solar Energy

**Technology/Engineering
 Education**
 Iterative Design ■ Building Prototypes ■
 Optimization ■ Communications

Society
 Ethics and Impact of Uses of
 Nanotechnology

Language Arts
 Public Speaking ■ Writing a Scientific
 Paper

Materials World Modules

An Inquiry & Design Based STEM Education Program
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