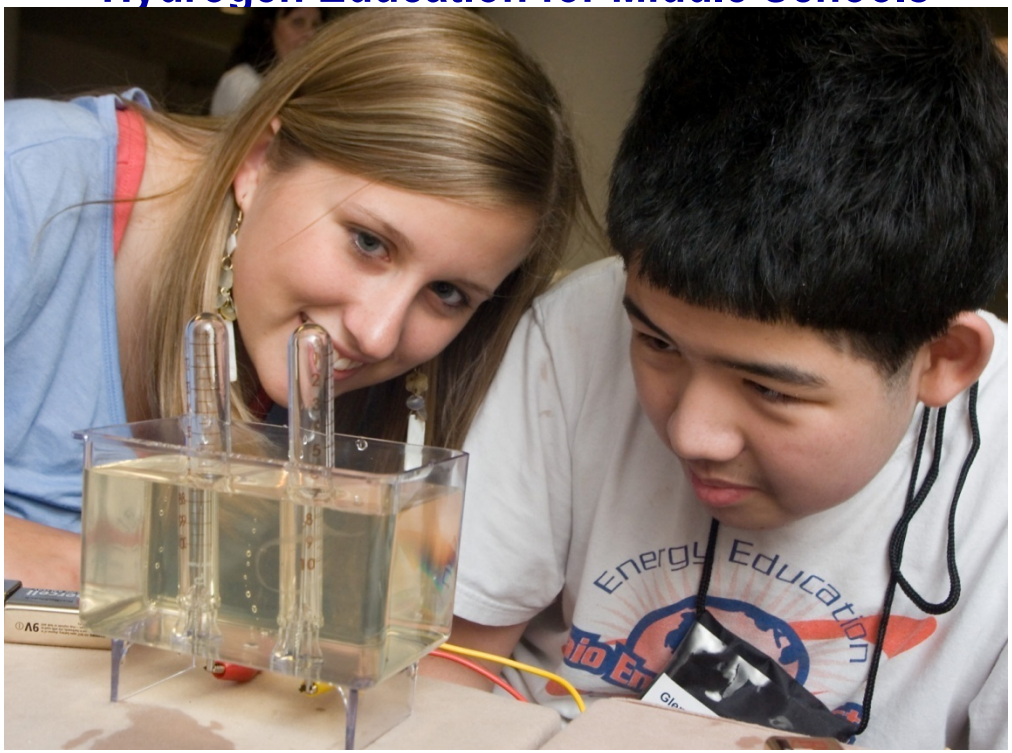
2008 DOE Hydrogen Program Review

H_2 Educate!

Hydrogen Education for Middle Schools



National Energy Education Development

Mary Spruill, Executive Director

June 12, 2008

DOE Hydrogen Program

Project Number ED7

This presentation does not contain any proprietary or confidential information

H_2 Educate Overview

Timeline and Budget

- Project Period: April 2004 – April 2009
- 100% complete with revised scope (5,000 teachers trained to date)

- Total project funding
  - **$900,000 (Program Zeroed)**
  - **$600,000 (Matching Funds)**
- FY04 $300,000
- FY05 and FY 06 $0
- FY08 $150,000

Special Thanks to our Partners

- U.S. Department of Energy Hydrogen, Fuel Cells, Infrastructure and Technologies Program
- Sentech, Inc.
- U.S. Fuel Cell Council
- National Hydrogen Association
- Los Alamos National Laboratory
- NYSERDA
- NADA Scientific
- Virginia Department of Mines, Minerals and Energy and the Virginia Legislature
- State Energy Offices
- Pacific Gas and Electric Company
- BP
- DC Energy Office
- General Motors
- Sacramento Municipal Utility District

H_2 Educate Objectives

- 1st year - Collaborate to develop, design, and deliver a first-class, comprehensive middle school hydrogen education program including: Training, Classroom Materials, technical and best-practices exchange, and evaluation.
- 1st year - Design a program to link hydrogen science and technology and the concept of a hydrogen economy to the classroom.
- 2nd and 3rd year – Deploy materials via teacher training and other professional development outreach opportunities.
- 2nd and 3rd year – Provide technical support for schools that entered the program in year one and two. Collect data and evaluate for year two revisions.
- 2nd and 3rd year – Work to expand the reach of the program with new partners able to support training workshops at the local level.
- 4th year -- Expand program for new localities and workshops.
- 4th year -- Continue to evaluate effectiveness and usability of materials
- 4th year -- Expand financial resources for workshops

H_2 Educate Future Work

- Renewed DOE funding provided funding for up to 10 workshops in target regions nationally:
  - Florida
  - Texas
  - South Carolina
  - New Mexico
  - Northern California
  - Illinois
  - New England
  - District of Columbia

- Using partner support from state energy offices, private industry, and trade associations, extending the reach of the workshops is possible.
- It should be noted that NEED's program was created and launched in year one. Subsequent years are expansions of delivery of workshops and materials.
- Not as far along in 2008 as hoped due to funding delays.

H_2 Educate Future Work

- NEED actively seeks new partnerships and has an interest in working with organizations similarly engaged in hydrogen education. To date, there have been minimal opportunities for such outside of partnerships with private industry and associations. Current collaboration work with Clean Cities, State Energy Offices, and Fuel Cell organizations/companies (automotive and distributed generation) has provided for expanded reach.
- Additional collection of data continues including the use of pre/post knowledge surveys of adults (teachers) attending workshops and of students using the materials in classrooms.
- Of note are anecdotal responses from educators noting student knowledge increase and interest in careers in hydrogen.

Implementation

In Year One we:

- Asked and Evaluated: “What do you want to know about hydrogen, and what would your students want to know?”
- Surveyed: Consider the national and state education standards and develop the program to meet classroom needs.
- Created: Have educators create the program and secure technical support to assist and trouble-shoot.

In Years Two - Four we:

- Deployed: Move beyond the pilot project to one-day teacher training workshops hosted throughout the country as resources allowed. States reached: OH, MI, WV, CA, PA, IL, NY, MA, NM, TX, IL, IN, and VA. H_2 Educate is also part of summer professional development efforts – 12 weeks of teacher training with over 1,000 educators
- Measured success.
- Improved the supply chain of materials and adopted new H_2 car kits for the H_2 Educate hands-on kits.

Implementation continued

Also in Year Four we:

- Completed expansions to NEED's solar, wind, and hydropower curriculum to include the generation of renewable hydrogen.
- Continued annual revision of H2 Educate Teacher and Student Guides.
- Expanded the hydrogen section of the EIA Kid's Page.

What do teachers and students need to know?

•In a "hydrogen economy," hydrogen is used to power our cars, homes, and businesses.

• Hydrogen can be made from abundant and diverse resources found right here in the United States.

• Fuel cells use hydrogen to generate electricity -- the only byproducts are water and heat (no pollutants or other emissions).

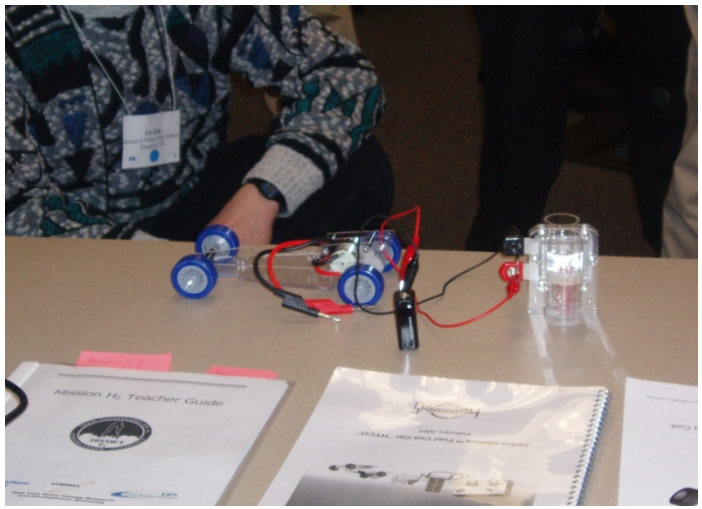
• Fuel cells can power almost anything, from laptops to cars to homes.

• Just like gasoline and other fuels, hydrogen can be used safely.

• Fuel Cells can play a key role in disaster relief and recover and provide distributed generation and emergency power.

Alignment - National and State Standards

- Continued alignment to national and state standards – many states are currently in revision
- Aligned to Technology Standards and other STEM initiatives where those standards exist
- Expanded reach into the Technology Education market



Progress/Results

- In 50% of the time estimated, the team created the middle school H_2 Educate learning module, designed one-day workshops and began delivery of teacher training.
- All partners have the same end goal: Provide as many modules as possible to the middle school community. To date, demand exceeds supply due to available resources. NEED is working with other DOE hydrogen grant recipients to maximize impact of funding.
- In the NY program, higher level fact sheets were created for the general public.
- In Virginia, the Appropriations Committee funded several workshops through the Commonwealth's Department of Education.
- Utilities like PG&E and SMUD are funding the delivery of H_2 Educate Workshops with great success.
- Joint workshops – i.e. Wind and Hydrogen and Solar and Hydrogen are in the works.

Progress/Results

- Evaluation of the pre/post hydrogen survey nets the following average results:
  - **Pre: 5 out of 15 correct**
  - **Post: 13 out of 15 correct**
- NEED is working with other DOE hydrogen grant recipients to maximize impact of funding.
- In the NY program, higher level fact sheets were created for the general public.
- In Virginia, the Appropriations Committee funded several workshops through the Commonwealth's Department of Education.
- Interest in hydrogen curriculum and materials remains high – workshops over capacity in all instances and with substantial waitlists.

Measure Success

CATEGORY	4	3	2	1
Scientific Concepts	Written explanation illustrates an accurate and thorough understanding of scientific concepts underlying the simulation.	Written explanation illustrates an accurate understanding of most scientific concepts underlying the simulation.	Written explanation illustrates a limited understanding of scientific concepts underlying the simulation.	Written explanation illustrates inaccurate understanding of scientific concepts underlying the simulation.
Drawings/Diagrams	Clear, accurate diagrams are included and make the simulation easier to understand. Diagrams are labeled neatly and accurately.	Diagrams are included and are labeled neatly and accurately.	Diagrams are included and are labeled.	Needed diagrams are missing OR are missing important labels.
Summary	Summary describes the skills learned, the information learned and some future applications to real life situations.	Summary describes the information learned and a possible application to a real life situation.	Summary describes the information learned.	No summary is written.
Procedures	Procedures are listed in clear steps. Each step is numbered and is a complete sentence.	Procedures are listed in a logical order, but steps are not numbered and/or are not in complete sentences.	Procedures are listed but are not in a logical order or are difficult to follow.	Procedures do not accurately list the steps of the experiment.

Collect quantitative and qualitative data to improve, re-assess, and expand programs

Rubrics for student assessment

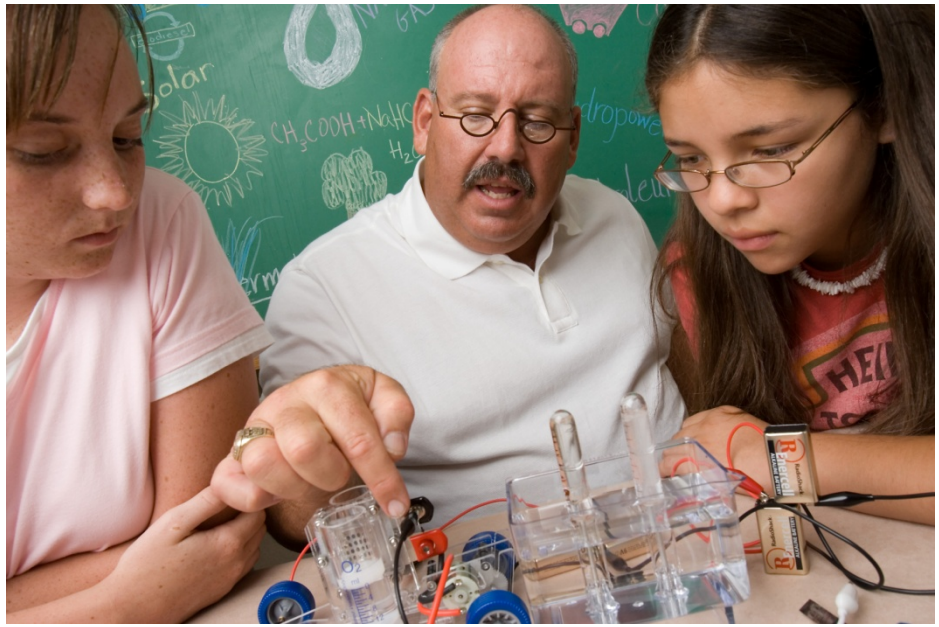
Pre and Post Data from participating schools and workshops shows a 60% increase in student and teacher knowledge.

Post workshop data indicates that educators are implementing the program in class, materials are appropriate for middle school and elementary/secondary as well, that materials are easy to implement and equipment is sturdy and high quality.

Big question: Are we reaching teachers effectively and improving energy education?

Challenges and Opportunities

- Demand too great for available resources
- Moving ahead in spite of limited financial resources.
- Good news? Local investment moves the project forward at great speed.



Support of DOE Hydrogen Program

- Curriculum continues to demonstrate the need for hydrogen production from a variety of fuels.
- Classroom activities showcase the hydrogen economy from both a transportation and electrical generation perspective and consider current hydrogen use and future hydrogen capability.
- Deployment of hydrogen education materials and workshops in strategic regions allows for greater discussion of hydrogen issues.
- Workshops provide opportunities for media events, public dialogue, and presentation of DOE research.
- Integration of hydrogen curriculum and research into other NEED/DOE efforts

Forward Progress

Since project inception, we have:

- Worked with other hydrogen partners to maximize reach of programs and materials – i.e. working with infrastructure grantees to provide educational resources.
- Continued incorporation of materials and programming into NEED's existing training initiatives.
- Annually updated materials with new data and provide major changes to educational community.
- Delivered maximum number of hands-on resources to classrooms leveraging resources to do so.
- Reached over 5,000 teachers.
- Provided hydrogen education experiences to analysts and economists from the Energy Information Administration and field trips to Shell's fueling station in Washington, D.C. as well as Ride and Drives with GM in DC, Richmond, and Norfolk.

Innovative Outreach

- Expansion of hydrogen information and activities to the EIA Kid's Page www.eia.doe.gov/kids (350,000 users per month)
- H_2 Educate Teacher and Student Guides loaded to partner websites and others
- 4 workshops in New York State supported by NYSERDA, program renewed
- Workshops at the National Science Teachers Association Conferences – Chicago, Nashville and Dallas (2005), Anaheim(2006), St. Louis (2007) and Boston (2008).
- 6 workshops in Virginia supported by the Virginia Department of Mines, Minerals and Energy and the Virginia Legislature
- Workshops hosted as part of PG&E's Solar Schools initiatives – reaching over 200 teachers annually and connecting renewable generation to hydrogen and fuel cells
- Currently considering curriculum to assist schools with Fuel Cell installations

Questions? Want to Participate?

- Contact Mary Spruill mspruill@need.org

or 800-875-5029.

- Materials are available at www.need.org. Camera ready can be provided to interested parties for reproduction.

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Putting Energy into Education