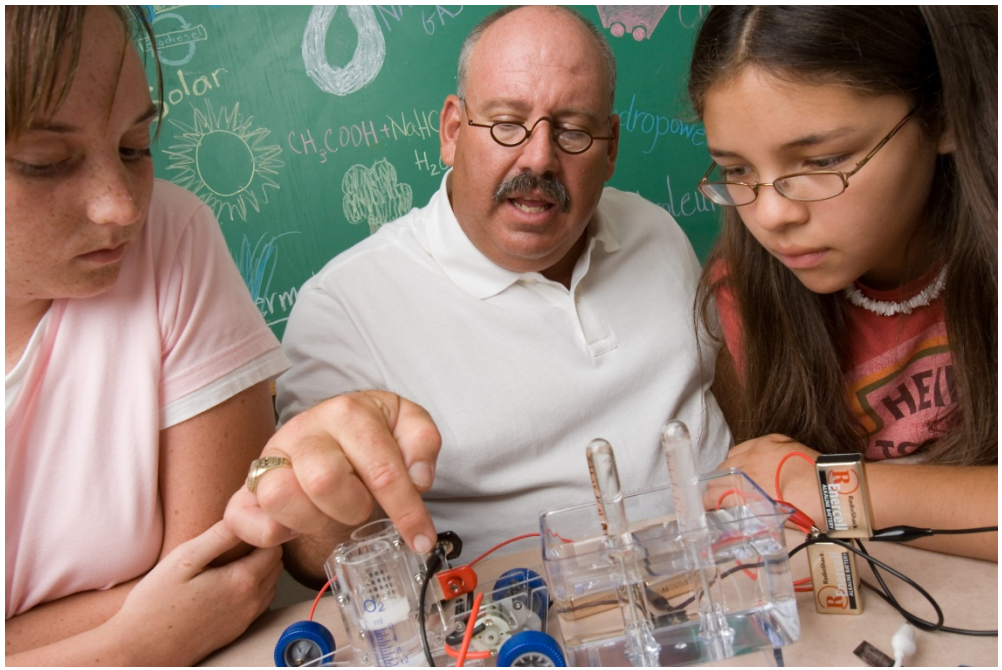
2012 DOE Hydrogen Program Review

H_2 Educate!

Hydrogen Education for Middle Schools



DOE Hydrogen Program

Project Number ED017

Mary Spruill, Executive Director

National Energy Education Development

May 17, 2012

This presentation does not contain any proprietary , confidential or otherwise restricted information

H_2 Educate Overview

Timeline and Budget

- Project Period: April 2004 – October 2011
- 100% complete with revised scope (9,000 teachers trained to date)

- Total project funding
  - **$900,000**
- FY04 $300,000
- FY05 and FY 06 $0
- FY08 $150,000
- FY09 $150,000
- FY10 $150,000
- FY11 $150,000

Special Thanks to our Partners

- U.S. Department of Energy Hydrogen, Fuel Cells, Infrastructure and Technologies Program
- U.S. Fuel Cell Council
- National Hydrogen Association
- Los Alamos National Laboratory
- NYSERDA
- BOCES – Long Island
- NADA Scientific
- Virginia Department of Mines, Minerals and Energy and the Virginia Legislature
- Virginia Clean Cities
- National Association of State Energy Offices
- Pacific Gas and Electric Company
- BP
- DC Energy Office
- General Motors
- Science Museum of Virginia
- South Carolina Hydrogen & Fuel Alliance
- USC Columbia Fuel Cell Collaborative
- Idaho National Laboratory
- Idaho State Department of Education

Challenges and Opportunities

- Demand too great for available resources
- Moving ahead beyond the end of the grant.
- Good news? Local investment moves the project forward at greater speed.

Relevance
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 - 8th year -- Expand program for new localities and workshops.
- 4th - 8th year -- Continue to evaluate effectiveness and usability of materials
- 4th – 8th year -- Expand financial resources for workshops

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 - Eight 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, FL, KY, DC, CT, OR, VA, ID, TN, NV, and SC. H_2 Educate is also part of summer professional development efforts – 2 weeks of teacher training with over 200 educators
- Measured success.
- National Science Teachers Association Outreach
- State Science Teachers Association Outreach
- National Association of State Energy Officials Outreach

Implementation continued

In Year Eight we:

- Continued annual revision of H2 Educate Teacher and Student Guides.
- Expanded H2 Educate Workshops
- Provide resources online
- Integrated H2 Educate into regularly scheduled workshops
- Provided background for Clean Cities Community Education Efforts

What do teachers and students need to know?

•Hydrogen can be 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 can power almost anything, from laptops to cars to homes.

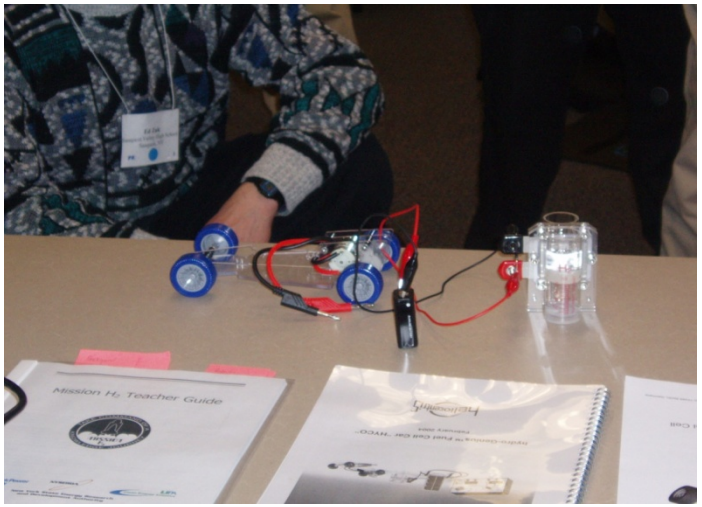
• Just like gasoline and other fuels, hydrogen can be used safely.

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

•Hydrogen is an energy carrier.

Alignment - National and State Standards

- Aligned to state standards in all 50 states.
- Aligned to Technology Standards and other STEM initiatives where those standards exist
- Expanded reach into the Technology Education market
- Workshops planned as a science/CTE teacher partnership for attendees.



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 hydrogen education?

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 K-12 workshops through the Commonwealth's Department of Education and public education sessions and materials through the Virginia Department of Mines, Minerals and Energy.
- National Labs like INL are funding the delivery of H_2 Educate Workshops and curriculum with great success.
- Use of program resources by other labs: LANL, NREL
- Materials integrated into NEED programming and training each year.

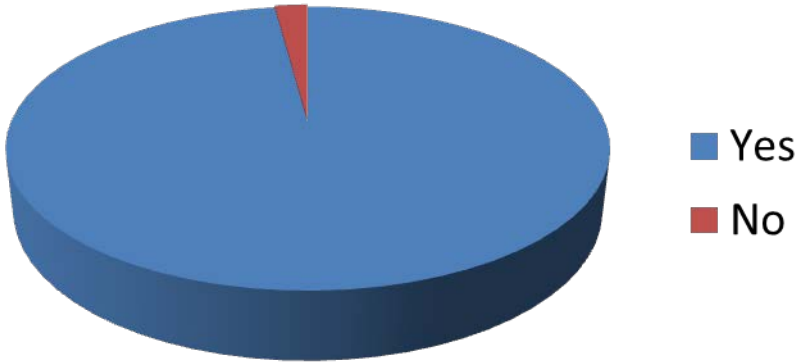
Progress/Results

- Evaluation of the pre/post hydrogen assessment shows the following average results:
  - **Pre: 33% correct**
  - **Post: 86% correct**
- NEED is working with other DOE hydrogen grant recipients to maximize impact of funding.
- Interest in hydrogen curriculum and materials remains high – workshops over capacity in all instances with substantial waitlists.
- Increased activity of districts integrating H_2 into Career and Technical Education curriculum along with science.
- Completed a 6 year survey of all participants who have attended a H2 Educate workshop and received curriculum. Data is being compiled.

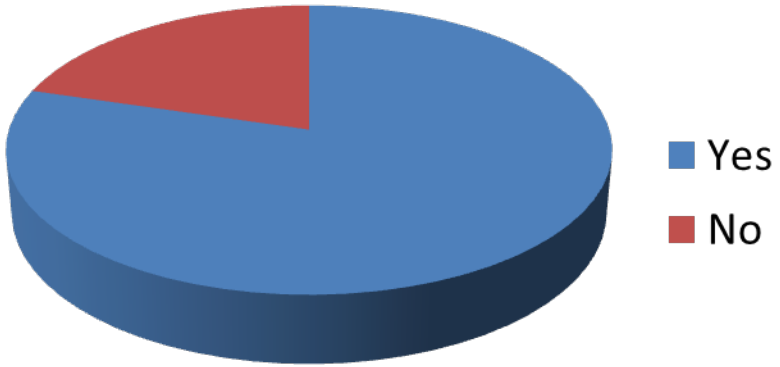
Accomplishments and Progress

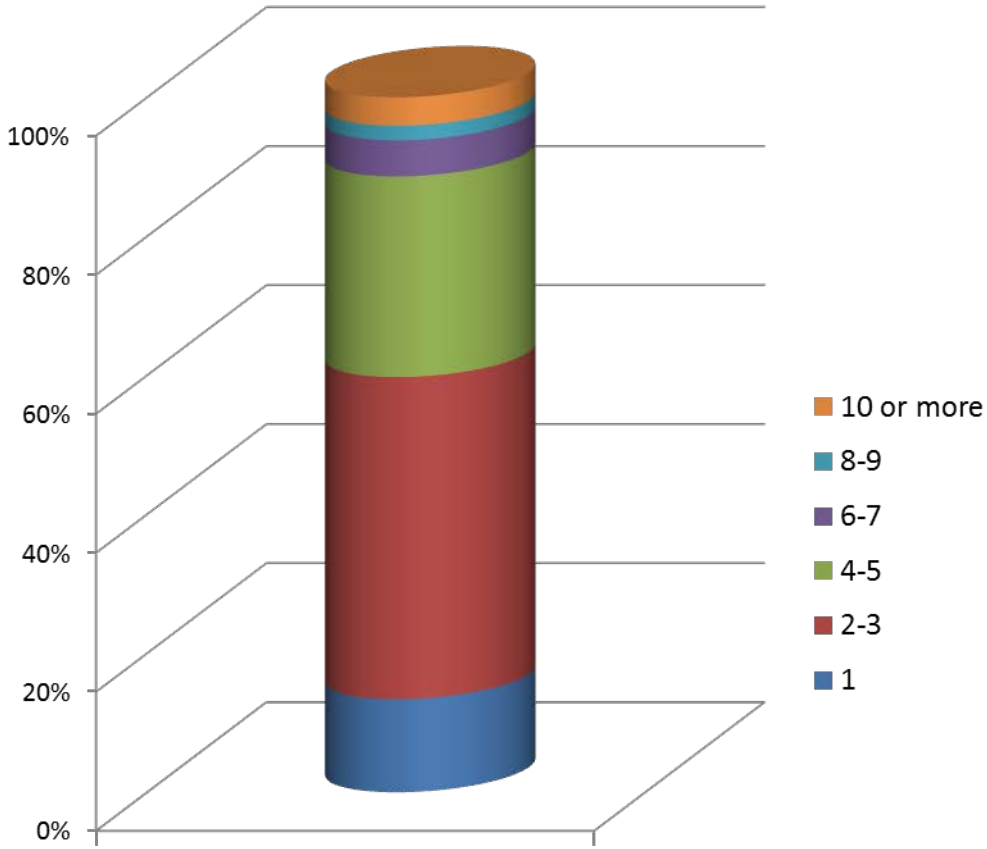
Preliminary Survey Results

Are your students more aware of new hydrogen technologies after using the H2 Educate curriculum?



Do you teach the provided materials in the classroom?

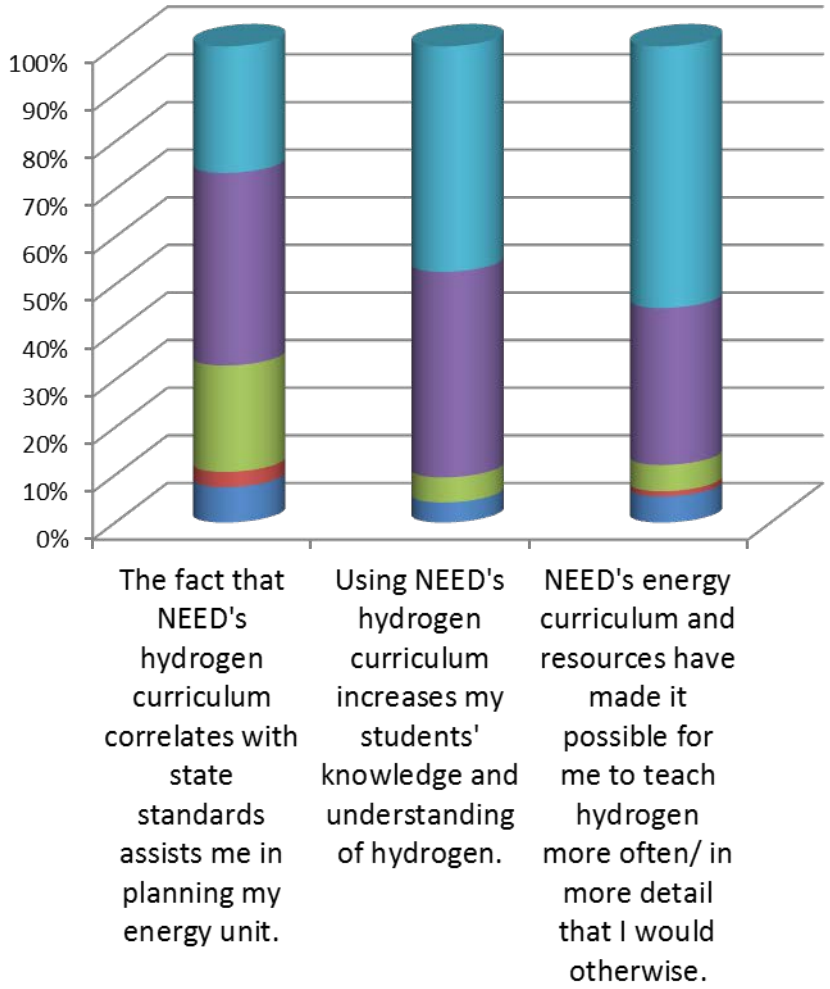


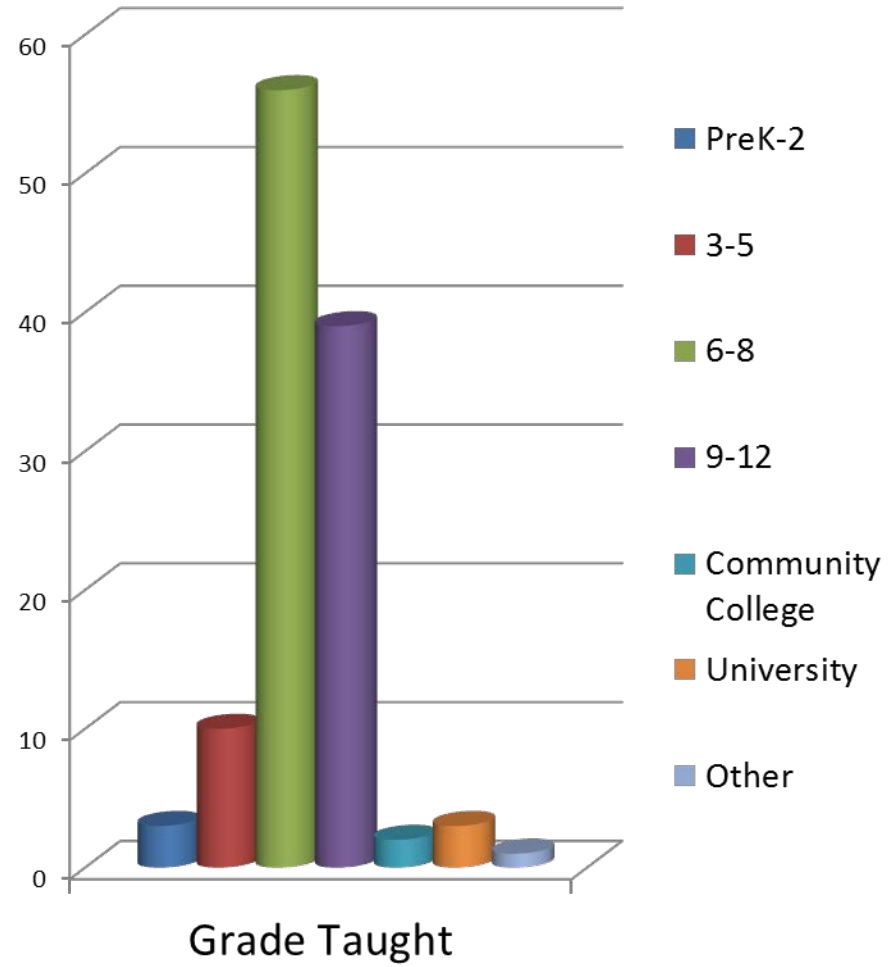


How many class periods did/do you spend teaching about hydrogen?

Accomplishments and Progress

Preliminary Survey Results





H_2 Educate Future Work

- DOE funding expired in October 2011.
- NEED will continue to maintain the materials and hands-on kits, integrating H_2 training into the exiting activities.
- 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.

Support of DOE Hydrogen Program

- Curriculum continues to demonstrate the need for hydrogen production from a variety of fuels.
- Classroom activities showcase hydrogen 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 9,000 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.
- Expanded NEED's Transportation portfolio with additional hydrogen transportation materials.

Collaborations
Innovative Outreach

- H_2 Educate Teacher and Student Guides loaded to partner websites and others
- H_2 Educate Teacher and Student Guides loaded to the NEED website.
- Workshops at the National Science Teachers Association Conferences – Chicago, Nashville and Dallas (2005), Anaheim(2006), St. Louis (2007), Boston (2008) and New Orleans (2009).
- Workshops hosted as part of PG&E's Solar Schools initiatives – reaching over 300 teachers annually and connecting renewable generation to hydrogen and fuel cells
- Currently considering curriculum to assist schools with Fuel Cell installations
- National Energy Conference for Educators Nashville, 2009, National Energy Conference for Educators Dallas, 2010, National Energy Conference for Educators Denver 2011.
- Partnered with UTC on activities and training for Greensburg, KS and its fuel cell application.
- In a partnership with PECO, H2 Educate training for West Chester, PA CTE teachers.
- Recently received a NASA grant to teach solar science and solar energy with a special section on hydrogen.
- Workshops hosted in partnership with Idaho National Laboratory reaching 100+ teachers annually.
- Inclusion of H2 Educate in a new NEED authored Fundamentals of Energy course for the Kentucky Department of Education to be used in all CTE programs statewide.

Questions? Want to Participate?

- Contact Mary Spruill mspruill@need.org or 800-875-5029.

- Materials are available at www.need.org. PDFs may be provided by request.