

## Hydrogen Fuel Cell

In recent years there has been lots of talk about alternatives to the use of conventionally powered (fuelled) vehicles. Much of that discussion has centered on alternative fuels such as Ethanol, Bio-diesel, Compressed Natural Gas, Propane, Hydrogen, and others. If, as an instructor, you are trying to integrate some information on alternative fuels into your classes, ATech has a new item available that may be a useful teaching aid for that purpose.

ATech is now offering the Dr FuelCell<sup>®</sup> Model Car from Heliocentris. The Dr FuelCell<sup>®</sup> Model Car is a hydrogen-powered fuel cell car kit that operates using only safe, distilled water. It has two significant benefits as a learning aid: 1) the fuel cell on this trainer is reversible and 2) it offers a more hands-on approach to learning (this is always a good thing for automotive students). To say that the fuel cell is reversible simply means that it can either be used to convert water into hydrogen and oxygen (electrolysis) or it can produce electricity from the hydrogen and oxygen. It is more hands-on because students are actually involved in the extraction/conversion process and they can also run (race?) the vehicles using only the electric power generated by the fuel cell. The competitive learning environment should make for interesting class time.

**An examination of alternate fuels-** Students can produce hydrogen to study its properties, applications, advantages, disadvantages, etc. This provides a basis for comparison and an ideal springboard into learning about other alternative fuels such as CNG, propane, ethanol, and others.

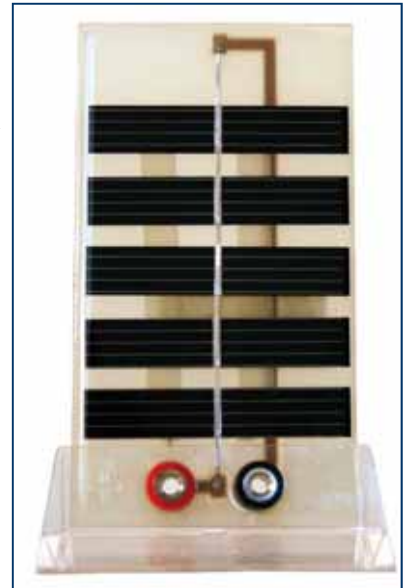
**Insight into future technologies-** Fuel cell vehicles are so high tech and advanced that they don't even exist in production cars. The kids in today's secondary and post-secondary schools are so technology savvy



*Reversible fuel cell with integrated gas storage cylinders*

that sequential fuel injection and electronic emissions controls don't necessarily impress them. However, a sufficiently advanced power system that is a complete departure from current applications may be enough to awaken a new interest in some potential future technicians. Who knows? You may well have a potential automotive systems designer or R&D engineer in your midst.

A study of solar technology can also be advanced by using the included solar panel to generate varying amounts of electricity from different frequencies and intensities of light (a study of light spectra?) as well as voltage and current measurements to calculate power output (Ohm's Law, anyone?).



*Solar Panel*

**Transduction-** It is a given that many different types of transducers are taught during the course of an automotive study. They typically include the most common conversions such as battery (chemical to electrical), alternator (mechanical to electrical), starter (electrical to rotating mechanical), etc. but these generally involve separate systems. In this application, students can experience numerous transductions in a single apparatus. Think about it. There is solar (photonics) to electrical, electrical to chemical, chemical to electrical, and electrical to mechanical. Conversions that occur on this small scale demonstrate the concepts which can then lead to a better understanding of larger automotive applications.

**Laws of Conservation of Energy-** With regard to the previous section on transducers, the losses involved in converting from one energy source to another can be determined and provide an understanding of the trade-offs involved in vehicle powertrain and body design. For

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## CAT Fall 2009 Conference Equipment Certificate

# Winners



Jason Norris, Instructor (Pasadena City College) and David Mitchell, Instructor/Program Developer (ATEch Training, Inc.)



David Lopez, Instructor (Fullerton College) and David Mitchell, Instructor/Program Developer (ATEch Training, Inc.)

instance, the potential energy in sunlight can be compared to the output of the solar cell. Then how much energy, in the form of hydrogen, can be produced from the solar cell energy, and how much electrical energy will that hydrogen generate via the fuel cell? Finally, what is the amount of mechanical energy, from the drive motor, that can be derived from the electricity produced? Following these exercises, students will quickly begin to understand the factors of heat, friction, and mechanical losses. It will then become clearer why the brake horsepower (BHP) from a vehicle's wheels is only about 25% as great as the potential energy originally contained in a gallon of gasoline.

**Energy density-** Invariably any discussion of alternate fuels is going to get around to the subject of how much energy (BTUs) is contained in a gallon of each of the different alternate fuels being advocated (or Gasoline Gallon Equivalent, GGE, for gaseous fuels). It is also a major factor when considering the amount of energy needed to produce the fuel in question. A starter here might be 'How many BTUs are in a GGE of hydrogen?' How many in a gallon of gasoline, or methane, or ethanol? What is the energy yield as compared to the production energy consumption? This could be a practical math problem where they see real world application and that they could actually enjoy solving. It also proves that doing math doesn't really make their brains hurt.

**Combustion chemistry-** As instructors we have all shown the stoichiometric combustion process to students only to watch their eyes glaze over. However, what if we gave them the conversion chemistry for gasoline, and had them find, calculate, and compare the combustion properties of hydrogen (answers in the book) to CNG or Ethanol to those of gasoline? Asking the question "What is the maximum Carbon Dioxide (CO<sub>2</sub>) that can be generated from a GGE of hydrogen?" might produce some interesting answers. An increased understanding of air/fuel ratios, and emissions requirements, would certainly be a benefit of this exercise. By the way, these chemistry exercises are no more likely to cause permanent cerebral damage than the math of the previous section.

Does all of this math, chemistry, and energy stuff sound like a bit much for students to comprehend? Certainly not. Remember, students will always rise to the level of expectation. While there are never any guarantees in education, this is one more tool which can aid instructors in doing what they do best...teach the next generation. I have worked with this kit personally and believe it will be a valuable addition to any automotive program.

*David Mitchell, Instructor/Program Developer*

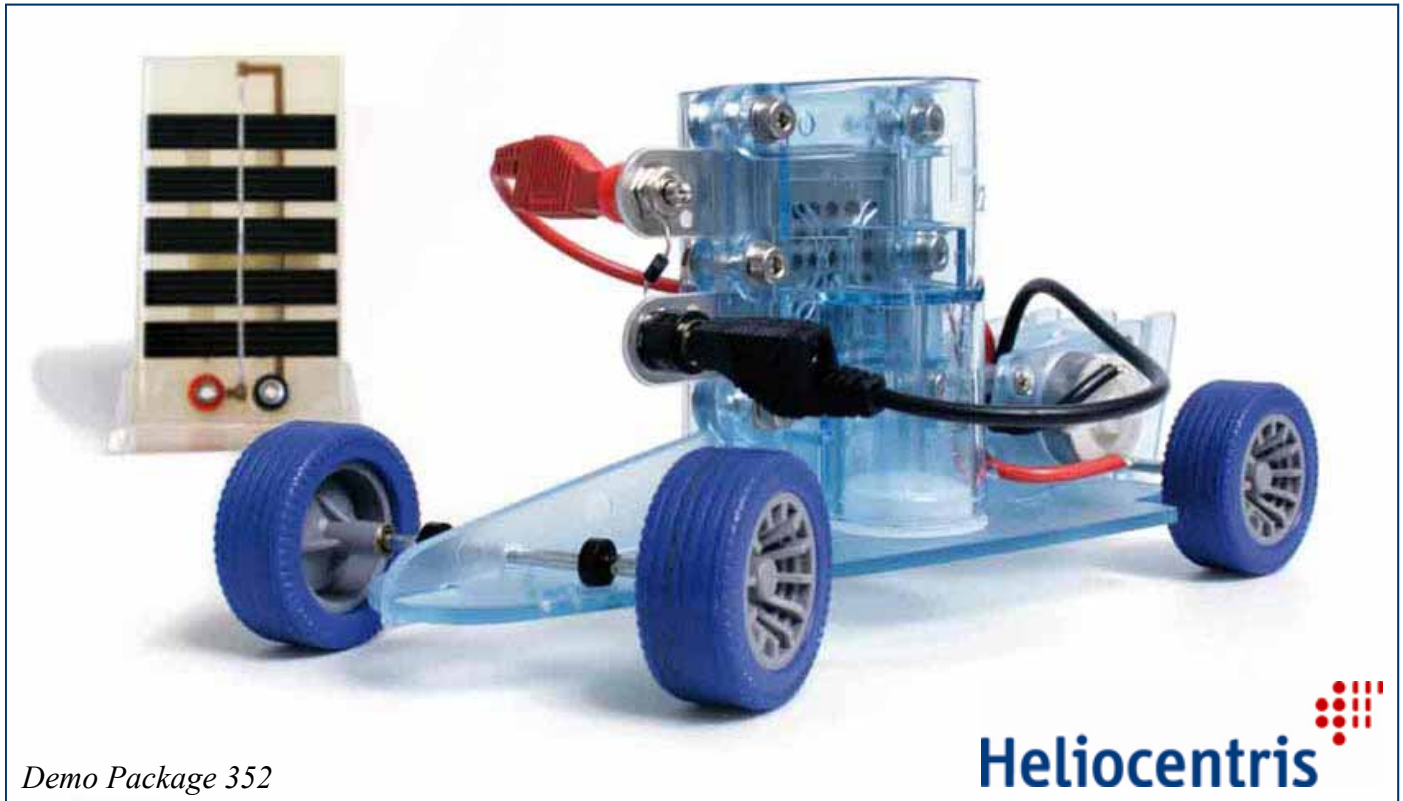
We're just back from the Fall California Automotive Teachers conference in Cypress, CA., and it was a big success. Congratulations go out to Marty Orozco and all of the members of the Cypress College automotive crew who worked tirelessly to make sure everything went as planned. The comments we heard from attendees and vendors alike were positive and the seminars were well received.

ATEch was privileged to once again be invited to exhibit at the conference and were happy to be able to provide two giveaway prizes at the end. This year's prizes were a pair of \$1000.00 certificates good toward the purchase of ATEch trainers, software, etc. The winners of those certificates are David Lopez of Fullerton College and Jason Norris of Pasadena City College. Congratulations to both of you, and we look forward to working with you soon.

If you are a member of CAT and couldn't make it to this conference, we hope to see you during the Spring meeting at Yuba College in Marysville, CA. 'Til next time...

# Model Car with Reversible Fuel Cell

## Dr FuelCell® Model Car



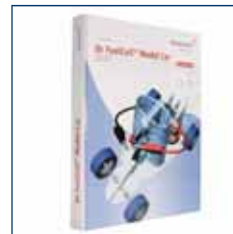
Demo Package 352

**Heliocentris**

The Dr FuelCell® Model Car integrates the subject of renewable energies, in an uncomplicated manner, into secondary level instruction. Its pre-configured experiments make learning science fun.

### Details:

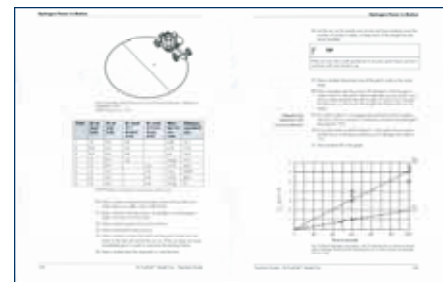
- Ready to use immediately; no additional materials required
- Quick class preparation with experiment materials that can be copied and printed
- Robust design and exceptional quality
- Variable setups– fuel cell, solar operation and hybrid
- Hands-on teaching of renewable energies
- Correlation with US National Science Education Standards
- Extensive features
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Preview of Teacher's Guide

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