

MRS Hydrogen Fuel Cell Model Car Challenge November 28, 2005

A hands-on educational program in which 9th, 10th, 11th and 12th grade students can apply math, science, engineering, and creativity to construct and race model hydrogen powered cars

Sponsored by:
Materials Research Society
General Motors
U.S. Department of Energy
National Renewable Energy Laboratory

Information Packet

MRS Hydrogen Fuel Cell Model Car Challenge

Information Enclosed

INFORMATION:

- Pre-Registration Form
- Tentative Agenda
- Competition Rules & Regulations

CONTACT PERSON:

Linda Lung
National Renewable Energy Laboratory
Office of Education Programs
1617 Cole Blvd., MS 1713
Golden, CO 80401-3393
Phone: 303-275-3044
Fax: 303-275-3076
E-mail: linda_lung@nrel.gov

**ATTENTION!!!
HIGH SCHOOL TEACHERS AND
STUDENTS**

**You are invited
to compete in the first annual
MRS Hydrogen Fuel Cell Model Car Challenge**

The Hydrogen Fuel Cell Model Car Challenge is a hands-on educational program for 9th, 10th, 11th and 12th grade students. Student teams apply math, science, engineering, and creativity to construct and race model hydrogen powered cars.

Date and location: Monday, **November 28, 2005** at the Hynes Convention Center, in **Boston, Massachusetts**.

Who can compete? Any Massachusetts, Rhode Island, Maine or Connecticut high school student in grades 9 through 12. Teams are comprised of up to four students and a coach (usually a science or math teacher).

What is the Prize? The top three teams from the Fuel Cell Model Car Challenge will be awarded trophies.

Questions about the Fuel Cell Model Car Challenge?

Contact: Linda Lung

National Renewable Energy Laboratory (NREL)

Office of Education Programs

1617 Cole Blvd.

Golden, CO 80401

Phone: (303) 275-3044

Fax: (303) 275-3076

E-mail: linda_lung@nrel.gov

URL: <http://www.nrel.gov/education>

Pre-Registration Form Attached

MRS Hydrogen Fuel Cell Model Car Challenge Pre-Registration Form

Sponsors: Materials Research Society, General Motors, U.S. Department of Energy, and the National Renewable Energy Laboratory

Hydrogen Fuel Cell Model Car Challenge

Date: Monday, November 28, 2005

Time: 7:00 a.m. – 4:00 p.m.

Hynes Convention Center, in Boston, Massachusetts

Each high school can have one team participate in the Hydrogen Fuel Cell Model Car Challenge.

There are 30 spaces available for the Hydrogen Fuel Cell Model Car Challenge. Registration is on a first-come basis until all available spaces are taken.

High School Name: _____

School Address: _____

City, State, Zip: _____

School Tel. Number: () _____

School Fax Number: () _____

Teacher/Coach Name: _____

Home Tel. Number: () _____

E-Mail Address: _____

Please provide the e-mail address that we can contact you over the summer about the competition.

Please fax or mail this form by **Friday, October 14th, 2005 to:**

Linda Lung
National Renewable Energy Laboratory (NREL)
Office of Education Programs
1617 Cole Blvd.
Golden, CO 80401
Phone: (303) 275-3044
Fax: (303) 275-3076
E-mail: linda_lung@nrel.gov

NOTE: Further information about the competition, including a final agenda and team registration, medical, and associated consent forms, will be sent to all pre-registered schools in late summer.

MRS Hydrogen Fuel Cell Model Car Challenge November 28, 2005

Tentative Agenda

- 7:00 – 7:30 a.m. Team Registration and Continental Breakfast,
Hynes Convention Center, Plaza Level
- 7:30 – 8:00 a.m. Fuel Cells 101
The Basics of How a Fuel Cell Works
- 8:00 -9:30 a.m. Strategies for Building and Racing Fuel Cell Cars
- 9:30-2:30 p.m. Building Hydrogen Fuel Cell Model Cars and Lunch
- 2:30-3:30 p.m. Race Competition
- 3:30-4:00 **Awards Ceremony**
Yang T. Cheng – General Motors,
David Ginley - National Renewable Energy Laboratory

Fuel Cell Model Car Challenge Rules

The Department of Energy (DOE) and General Motors (GM) are very interested in ensuring that all students understand the hydrogen economy and how a fuel cell works. General Motors depends on an educated work force to succeed in an increasingly dynamic, technologically complex and competitive environment. The fuel cell model car challenge engages 9th, 10th, 11th and 12th grade students to design, build and race model hydrogen-powered cars steered by guide wires. Each team is provided a fuel cell car kit. Students are encouraged to use math and science principles, together with their creativity, in a fun, hands-on educational program.

Hands-on design has a different feel from textbook problem solving or even traditional science labs. There is no single correct answer; any number of solutions developed by students can work. DOE and GM have found that students are excited about generating ideas in a group and then building and modifying models based on these ideas. Students can see for themselves how changes in design are reflected in car performance. Teachers/coaches will have the opportunity to guide their students through a process similar to those used by professional design engineers.

Program Objective

The objective of the Hydrogen Fuel Cell Model Car Challenge is to use the materials provided to design and build a hydrogen fuel cell model car on site.

Speed Race: To build a vehicle that will complete a 10 meter straight and horizontal race in the shortest possible time using the energy provided by the hydrogen as its only means of propulsion.

Teams will construct their hydrogen fuel cell cars onsite using a variety of materials and supplies. The fuel cell and motor from the original kit must be used. Other materials and supplies will be provided to each team to build their fuel cell car. Materials include: various containers for gas storage collectors, various types of wheels, two axles, various gears, 6 alligator clips, electrical connection wires, and different chassis bodies such as balsa wood or foam core. Hand and power tools will be supplied at the competition site. Using only the materials provided, competitors will build a fuel cell powered car. Teams **cannot** bring any additional car parts or components to the competition.

Materials

- 1) All teams will be provided with a fuel cell and motor

Hydrogen Fuel Cell Specifications

- 1 Reversible Fuel Cell
- Electrolyser mode: 1.5-1.8V
- Fuel Cell mode .4W
- 4 x 5 x 4 cm
- 150 grams
- **Motor**
- 280 Mabuchi motor
- **Materials**
- 4 press fit hose barbs
- 2 feet 1/8" silicon tubing

- 4 tube couplings
- 18" black wire (18 gauge)
- 18" red wire (18 gauge)
- Instructional Manual

2) Additional pieces can be selected from a variety of parts. This includes gas storage options, wheels, gears and chassis.

3) Except for the fuel cell and the motor, pieces can be modified. However no outside components can be used.

Vehicle Specifications

1) The vehicle must be safe for contestants and spectators (e.g., no sharp edges, projectiles, etc.).

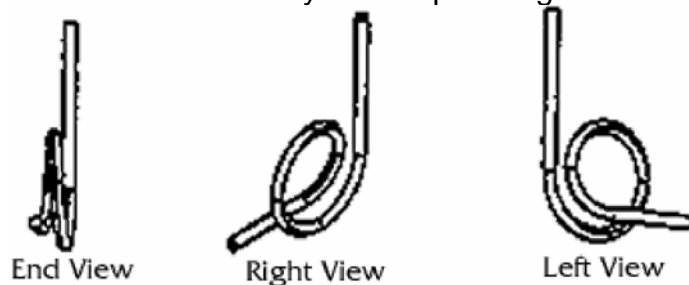
2) The vehicle cannot exceed the following dimensions: 20 centimeters wide x 40 centimeters long x 40 centimeters high, including fuel tanks.

3) Decals of sponsoring organizations (provided by NREL, [GM, MRS, DOE, NREL logos]) must be visible on the side of the car's body. A space of 1 inch x 1 inch must also be available on the side of the car where an assigned vehicle number can be placed.

4) Energy Source: The electrolysis to charge the gas tanks will be completed in a designated charging area prior to the start of the race. The only energy source permitted on the vehicle is the fuel cell with the hydrogen that was produced from the electrolysis procedure.

5) Steering: An eyelet must be attached to the bottom front of the car. An example of a possible design is illustrated below. A guide wire, 1 cm.

(+/- .05 cm) from the surface of the track, will go through the attached eyelets on the car, serving as the steering mechanism, and keeping the car in its lane. The vehicle must be easily removed from the guide wire, without disconnecting the guide wire. This is the only allowable method of steering the car. Lane changing or crossing will result in disqualification. **Warning:** Stubborn cars that don't track the wire can be the biggest reason some cars do not win. Setting the car down straight isn't enough. Student teams must consider this carefully in their planning.



Glue the eyelet to the bottom of your car near the front (or use two eyelets--one near the front and one near the rear). The guide wire will pass through the eyelet to keep your car in its lane.

6) Attach the eyelet to the bottom of your car near the front (or use two eyelets—one near the front and one near the rear). The guide wire will pass through the eyelet to keep your car in its lane.

7) All vehicles will be inspected by a race official prior to the beginning of the race to ensure that they meet the above vehicle specifications (see inspection checklist). Vehicles that meet these requirements will be given a green sticker that will be placed on the vehicle. Vehicles that do not meet these specifications may be modified and re-inspected. All vehicles that participate in the race events must have a green sticker. Race officials may

re-inspect the vehicles at any time during the race and remove the green sticker if a vehicle has been modified in a way that it fails to meet the vehicle specifications.

SPEED RACE

Track Specifications

- 1) The length of the race course is 10 meters over level terrain.
- 2) Racing lanes must be at least 60 centimeters wide.
- 3) A guide wire will be located in the center of each lane of the track and will not be more than 1.5 cm above the track surface.
- 4) The track will be a hard, smooth, level surface such as the Plaza Level of the Hynes Convention Center in Boston, Massachusetts. A large sheet of rolled material (e.g., plastic, rubber, heavy paper, roll roofing [half-lap], or hardwood taped or bolted together) may be used to cover an uneven surface. In the case of the convention center, if the surface is smooth, painter's tape will be used to mark the lanes on the floor. The tape is easily removed from surfaces and leaves no tape residue.



Conduct of the Race

- 1) **Charging Station:** The fuel cell must be charged at the charging station using a provided energy source, such as an AC adapter.
- 2) **Race Day Electrolysis Procedure:** Before the scheduled race start, all teams must report to the designated charging station with their fuel cell car. Distilled water will be provided at the charging station for the electrolysis process. There is no time limit on the electrolysis procedure—a team may report to the charging station as early or late as necessary; however, teams must be ready to start their race at the specified time. The only energy source permitted on the vehicle is the fuel cell with the hydrogen that it produced from the electrolysis procedure.

- 3) The speed race competition is made up of two to four competing teams. Heats will be run as a series of double elimination rounds. For example, four teams will race in the first heat. The top two winning teams will advance to the winner's bracket and the two losing teams will advance to the challenger's bracket. Any team losing two races is eliminated.
- 4) At race time, vehicles will be placed behind the starting line with all wheels in contact with the ground.
- 5) At the start of the race, the student at the starting line will connect the leads of the fuel cell to the electric motor. The student must lift the drive wheels off the race course until the signal has been given to start the race.
- 6) An early or push start will result in disqualification or re-running the race. The race officials will determine if a student is disqualified or if the race must be rerun.
- 7) The race will start when the official signal is given. At the signal the drive wheels will be placed in contact with the race course and the car released. The vehicle to cross the finish line first or is the furthest down the track is the winner.
- 8) One member of each team must wait at the finish line to catch the vehicle.
- 9) Team members may not accompany or touch the vehicle while it is racing on the track. Vehicles stalled on the track may be retrieved after the end of the race has been declared.
- 10) Vehicles and team members must remain at the finish line until the winning order of the race has been established.
- 11) Vehicles that change or cross lanes will be disqualified (at the discretion of the race officials).
- 12) All decisions of the race officials are final.
- 13) Officials have the option to inspect cars prior to the final heat or at any time during/after the heats are completed.