

# Northeast Science Bowl Regional: March 1, 2008

## Model Hydrogen Fuel Cell Car Race Competition Rules

### Purpose

The University of Connecticut's School of Engineering is very interested in ensuring that all students understand the hydrogen economy and how a fuel cell works. The United States depends on an educated work force to succeed in an increasingly dynamic, technologically complex and competitive environment. The hydrogen fuel cell car competition engages students to design, build and race model hydrogen-powered cars steered by guide wires. Each 2-3 member team is provided a fuel cell kit. Students are encouraged to use math and science principles, together with their creativity, in a fun, hands-on educational program that stimulates enthusiasm for science at a crucial stage in their education.

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. All educators know that most 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.

The goals of the program are as follows:

- Present science concepts in a fun and exciting way.

- Give students a chance to interact with engineers and scientists.

- Stimulate creative thinking through a hands-on design project.

- Help students to experience the satisfaction of creating a working machine and the excitement of entering it in a competition.

The objective of the hydrogen fuel cell car competition is to design and build a vehicle that will complete a race in the shortest possible time. The fuel cell enables you to produce hydrogen from a solar cell, a 4-6 volt DC power source. During the race the hydrogen and oxygen will be used to produce electricity to power the car.

Teams use a fuel cell kit to design and build a hydrogen powered vehicle that will race on a 10-meter course. **The winner of the competition will be the team whose vehicle is the top finisher in a series of head-to-head, double-elimination rounds.** Just after lunch preliminary rounds will give all of the teams practice and time to tweak their cars as well as establish the teams advancing to the championship round. Awards will be given to the top two fastest cars.

**NOTE: All cars must be built by the students on the day of competition with limited assistance from the coach or other adults. Please remember this is a student competition. Each team will receive a fuel cell and a motor which must be used. Students may bring raw materials and any tools they wish to use in the construction of their car. We will supply a variety of materials and tools, enough to construct a complete, serviceable car.**

## Race Components

There are two components to the race:

1. **Speed race:** Heats will be run in a series of head to head double elimination rounds until the top three cars have been identified. Student teams will be provided a fuel cell, motor, valves and some tubing. The rest of the car design and components will be up to the creativity and ingenuity of the students. They will need to design the chassis, gear train, wheels, axles, hydrogen and oxygen gas collection system and electrical connection wires. Yeah, this is the most important one.
2. **Hydrogen knowledge:** Students must be able to answer a series of inquiry-based questions that test their knowledge of fuel cell and hydrogen technologies.

## Materials.

1. The vehicle must be the team's design and can be altered at any time using materials provided to the team in addition to any and all materials you bring with you provided the car is within the guidelines detailed below.
2. The motor provided, or one of **identical** specifications must be used on the car and no other.

## Vehicle Specifications

1. The vehicle must be safe to contestants and spectators, e.g., no sharp edges, projectiles, etc.
2. The vehicle must fit within the following theoretical box dimensions: 30cm. by 60cm. by 30cm.
3. Your high school's (or team) name must be visible from the side on the body of the car. A 3cm. by 3cm. space must be left for the assigned car number. (Optional)
4. Energy Source: We will provide each team with a 6 volt battery or similar source for the electrolysis procedure. The electrolysis must be completed 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. **Capacitors are allowed but can not be charged before the race director gives the "start your engines" command. Coaches, please give your students a safety lesson wrt capacitors before allowing them on the vehicles.**
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. No radio control is permitted in the cars. Lane changing or crossing will result in disqualification.



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.

## Track Specifications

1. The length of the race course is 10 meters over flat terrain. Race lanes are at least 60 cm. wide.
3. The guide wire will be located in the center of the track (1 cm above the track surface before it is “attached” to your car)
4. The track is a hard, flat, smooth surface such as a tennis court or running track. A large sheet of rolled material, i.e., plastic, rubber, heavy paper, roofing paper (half-lap), or hardwood taped or bolted together may be used to cover an uneven surface.

## Race Conduct

1. **Charging Station:** Each team will be provided with its own 6V battery.
2. **Race Day Electrolysis Procedure:** Distilled water will be provided to all teams for the electrolysis process. There is no time limit on the electrolysis procedure – 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. There will be a repair table set up in a designated area to help facilitate quick repairs to the cars. Teams that are scheduled to race in the next heat will be given priority in the repair area.
4. At race time, the vehicle will be placed behind the starting line with all its wheels in contact with the ground. No more than two team members will be allowed in the start area.
5. An early start or push start may result in disqualification or a re-run of the heat. The determination will be left to the race judges.
6. Two/Four cars will be racing concurrently in one/two separate races. Cars will race in a head to head competition with one other vehicle. One car will advance to the No Loss and one car will in the Challenger’s Bracket. All cars will race until they have lost two races. All vehicles will be started when the official signal is given. The winner of the heat will be the first vehicle to cross the finish line or the car farthest down the track when the race is called.
7. One team member must wait at the finish line to catch the vehicle.
8. Team members may not accompany or touch the vehicle on the track during the race. Vehicles stalled on the track may be retrieved after the end of the race has been declared by the head Judge.
9. The vehicle and team member must remain at the finish line until the order of the race has been established.
10. Lane changing or crossing will result in disqualification.
11. Challenges must be made before the race judges begin the next heat. All challenges must come from the team members who are actively competing and directed to the head judge. The decisions of the race judges are final.
12. Judges **will** inspect cars prior to the final heat or at anytime during/after heats.