Colorado Hydrogen Fuel Cell Car Competition

Overview

The Colorado Hydrogen Fuel Car Competition is a classroom-based, hands-on educational program for 6th, 7th, and 8th grade students. Student teams apply math, engineering, science, and creativity to construct and race a model Hydrogen Fuel-powered car.

The primary goals of the programs are to:

- Generate enthusiasm for science and engineering at a crucial stage in the educational development of young people;
- Improve students' understanding of scientific concepts and renewable energy technologies; and
- Encourage young people to consider and prepare for technical careers at an early age.

Program description:

- Students use mathematics and science principles together with their creativity in a fun, hands-on educational program.
- Using engineering principles, students get 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.
- Students work together on teams to apply problem solving and project management skills.

The car competition challenges students to use scientific know-how, creative thinking, experimentation, and teamwork to design and build high-performance model Hydrogen Fuel Cell vehicles.

Rules

Competition Structure

Speed Race: Student teams will be provided a Hydrogen Fuel Cell, motor, electrolyzer, and battery pack. Students must use the unaltered Hydrogen Fuel Cell and motor that were provided in the kits as the only method of driving the car. The rest of the car design and components will be up to the creativity and ingenuity of the students. All cars must be designed and built only by the students with limited assistance from the coach, parents or **other non-team** student members. Any car that does not finish in 40 seconds will be considered a Did Not Finish (DNF).

The top 16 fastest cars after all of the timed trials are completed will compete in the final “head-to-head” race to determine first-, second-, and third-place winning teams.

NOTE: **This is a student competition!** All Hydrogen Fuel Cell cars must be built by the student with limited assistance from the coach or other adults. On race day, only team members are allowed to update and fix their cars.

Design Component: Each car will be judged on the merits of quality craftsmanship, unique concept, and overall aesthetics, including appearance, engineering innovation, and originality of materials used.

Materials:

1. The Hydrogen Fuel Cell sold by Numeridian is the only Hydrogen Fuel cell that may be used. Fuel cells cannot be shaved, drilled, or delaminated. Only the authorized motor, fuel cell, electrolyzer, and battery pack supplied with the fuel cell may be used. Motors may not be re-wound or disassembled. Any other fuel cells and motors may not be used in the competition. All parts mentioned here must be used without modification. Only one Hydrogen Fuel Cell and one motor are allowed per car.

2. The hydrogen storage container must be of your own design. **Teams cannot use the storage device that was supplied in the teacher kit.** If you use the device from the teacher kit, your team will be disqualified. Parts from the teacher kit are for training purposes only—not for the competition. Students are only allowed to use the parts in the student kit.

3. The remainder of the vehicle must be your own design and can be made from any other material.

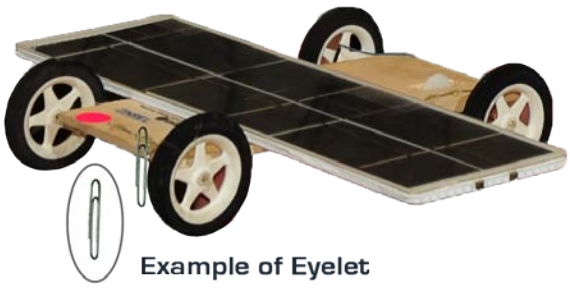
Vehicle Specifications:

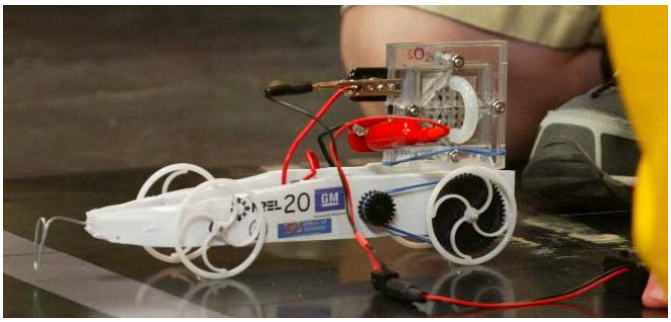
1. **Race Specifications:** The vehicle must be safe to contestants and spectators, e.g., no sharp edges, projectiles, etc. The vehicle cannot exceed the following dimensions: 20 cm wide by 40 cm in length by 20 cm in height. Decals of the sponsor organizations (provided at the Regional competition) must be applied and visible from the side, top, or front of the body of the car. A 2 cm by 4 cm space must be left for the assigned car number and sponsors. An on/off switch can be incorporated into the car design, if desired.

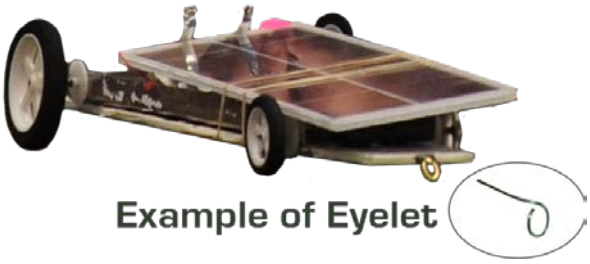
2. **Energy Source:** The electricity needed for the electrolysis procedure will be provided by the battery pack that was included in the fuel cell kit. The electrolysis will be completed at the starting line prior to the start of the race. The only energy source permitted on the vehicle is the fuel cell with the hydrogen that was produced from the electrolysis procedure. The solar cell that was provided in the teacher kit can be used to supply the electricity for electrolysis.

3. **Steering:** A guide wire attachment, referred to as an eyelet, must be attached to the car. Examples of possible designs are shown below. A guide wire such as a fishing line will be no more than 1.5 cm from the surface of the track, will go through the attached eyelet 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 a Did Not Finish (DNF). Those cars whose run was interfered with will be allowed an additional opportunity to run.

4. **Guide Wire:** The eyelet must be used for steering only and must be directly hooked onto the guide wire. Any guide wire attachment or eyelet used should not support the vehicle such as a grooved spool located on top of the car guiding the car down the track. All wheels must be in contact with the track. The guide wire must be attached to the car throughout the course of the race. If the car disengages from the guide wire, this will result in a DNF.







5. **Race Track:** The length of the race course is 10 meters over flat terrain. Race lanes are at least 60 cm wide. The guide wire will be located in the center of the track and will not be more than 1.5 cm above the track surface. At the Regional competition, the track will be a black neoprene rubber material.

Regional Race Conduct :

1. **Charging Station:** The battery pack received in the fuel cell kits must be used to supply the electricity needed for the electrolysis procedure. Teams will be provided three sets of batteries for the races, including practice runs. The solar cell that was provided in the teacher kit can be used to supply the electricity for electrolysis.

2. **Race Day Electrolysis Procedure:** Before the scheduled race start, teams must report to the starting line to charge their cars. Distilled water will be provided at the starting line for the electrolysis process. Teams will be given **three minutes** to charge their cars at the starting line.

3. **Repairs:** There will also be a repair table set up 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. There will be a 3-minute time limit for repairs.

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 will result in a DNF for that heat.

6. All vehicles will be started when the official signal is given. Each car will have three timed speed trials. The top 16 cars with the fastest times will advance to the final competition to race for first, second, and third place.

7. The judges will note the official time on the heat card (see Appendix A). If the car does not finish the race, it will be noted as a Did Not Finish (DNF) on the heat card.

8. At least one but no more than two members must wait at the finish line to catch the vehicle.

9. Team members may not accompany or touch the vehicle on the track. Vehicles stalled on the track may be retrieved after the end of the race has been declared by the Lead Judge.

10. The vehicle and team member must remain at the finish line until the time of the race has been noted on the heat card.

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, not the coach, parent, or coordinator, and all challenges need to be directed to the Lead Judge. The decisions of the race judges are final.

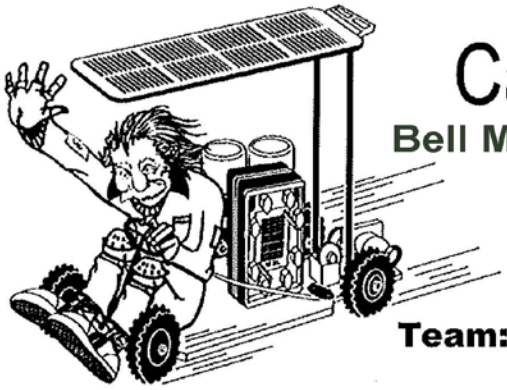
12. Only competing students and race officials may be in the race area. All others including coaches, parents, coordinators, and non-competing students must remain in the spectator stands through the duration of the races. Teams will be disqualified if the coach interferes with the race.

13. Judges may inspect cars at any time before, during, or after heats.

Awards at Regionals:

Awards will be given for the **three** fastest cars and for the **three** best designs.

Appendix A – Heat Card Sample



Car #: 1

Bell Middle School

Team: ***Team A***

Hydrogen Fuel Cell Car Competition

Heat	Lane	Time
1	A	6"56
6	E	6"42

Round	Lane	Time
1	I	6"32
Heat		W / L
2	C	7"11
Heat		W / L
3		DNF
		W / L
Final		5"78