



# Colorado Middle School Car Competition

## *Electric Battery Division*

The Colorado Middle School Car Competition is a classroom-based, hands-on educational program for 6<sup>th</sup> – 8<sup>th</sup> grade students. Student teams apply math, science, and creativity to construct and race model lithium-ion powered cars.

### **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 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 electric battery vehicles.

## **Rules**

### **Competition Structure:**

For the Colorado competition, NREL will invite teams to run three time trials per car. Each school will register for a 30-minute time slot to complete their time trials and achieve their fastest time. Any car that does not finish in 40 seconds will be considered a Did Not Finish (DNF). The time trials will be timed live and we will video record the races for verification or in case of a tie.

Student teams must use the lithium-ion battery materials listed below as the only method of powering the car. The rest of the car design and components will be up to the creativity and ingenuity of the students.

**Note: This is a student competition!** All cars must be designed and built by the students with limited assistance from the coach, other adults, and non-team members.

There are two different components to the competition: **Speed and Design.**

**Speed Race:** The top three fastest cars after all the timed trials are completed will determine first-, second-, and third-place winning teams.

**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 materials that must be used include:

- E-flite 3.7V 150 mAh, 25c, Lithium Polymer Battery
- Mabuchi 280 motor
- Battery connector wire 1S UMX (EFLU3052)

*(Only the authorized Mabuchi motor may be used. Motors may not be re-wound or disassembled.)*

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

3. An on/off switch must be incorporated into the car design. The switch may be purchased or crafted from readily available materials such as aluminum foil, paperclips, fasteners, etc.

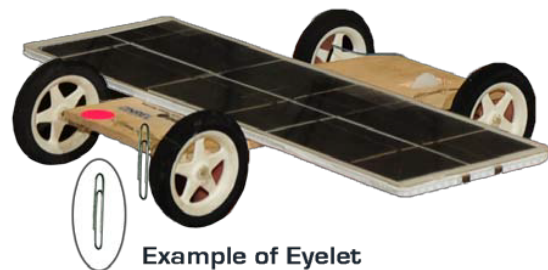
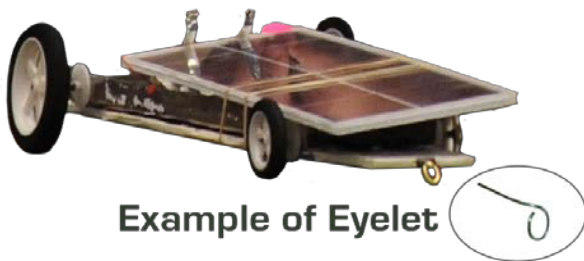
### **Vehicle Specifications:**

1. The vehicle must adhere to all parameters, be structurally sound, and safe to contestants and spectators (e.g., no sharp edges, projectiles, etc.).

2. **Size:** The vehicle must not exceed the following dimensions: 30 cm (11.8 inches) by 60 cm (23.6 inches) by 30 cm (11.8 inches).

3. **Weight:** The vehicle must weigh a minimum of 750 g. If vehicles do not meet the minimum weight requirement, NREL will provide an assortment of weights that participants can attach to their vehicles.

4. **Energy Source:** NREL will provide the lithium-ion batteries for the competition.
5. **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, will serve as the steering mechanism, and will keep 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 DNF. Those cars whose run was interfered with will be allowed an additional opportunity to run.
6. **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.



### **Track Specifications:**

1. The race lane is 60 cm wide and 20 meters long. The track will be a black neoprene rubber material.
2. 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.
3. 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.
4. An early start or push start will result in a DNF for that heat.
5. All vehicles will be started when the official signal is given. Each car will have three timed speed trials.

6. At least one but no more than two members must wait at the finish line to catch the vehicle.
7. 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.
8. NREL will provide judges, who will use stopwatches to time each vehicle. If the car does not finish the race, it will be noted as a DNF on the scoreboard.
9. The vehicle and team member(s) must remain at the finish line until the official time of the race has been noted.
10. 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.
11. 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/area through the duration of the races. Teams will be disqualified if the coach interferes with the race.
12. Judges may inspect cars at any time before, during, or after heats.

### **Awards:**

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

Additionally, one spirit award is given to the team from both the solar and battery competitions that displays excellent sportsmanship as voted on by all judges and volunteers.

**Appendix A**

