

Colorado Middle School Electric Battery Car Competition

The Electric Battery Car Competition is a classroom-based, hands-on educational program for 6th, 7th, and 8th grade students. Student teams apply math, science, and creativity to construct and race model lithium-ion 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 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

The Colorado competition will use preliminary time trials before progressing to a double elimination tournament for the finals. Each team will have three time trials to achieve their fastest time. Any car that does not finish in 40 seconds will be considered a Did Not Finish (DNF). Only the fastest 16 teams will progress to the double elimination tournament. In the event of a tie, to qualify for the double elimination tied teams will have a race off.

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 Electric Battery car competition: **Speed and Design.**

Speed Race: 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.

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: model PKZ3052

Only the authorized Mabuchi motor supplied with the panel 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. **Decals:** Decals of the sponsor organizations (provided at the regional competition) must be visible from the side on the body of the car. A 2 cm by 4 cm space must be left for the assigned car number.

4. The vehicle must be designed to carry a payload of 1 full cylindrical salt container: height: 13.5 cm, diameter of 8.3 cm and mass of 737g (+ or – 1%).
5. The salt container may not be part of the vehicle's structure and must be easily and rapidly removed or reinserted. The following materials are examples of items you can use to hold the salt container on the chassis: rubber bands, string, zip-ties, structured compartment, velcro, etc.
6. The salt container will be supplied at the starting line and must remain unaltered. The salt containers will be reused for each race.
7. If the salt container falls from the vehicle during the race, this will result in a Did Not Finish (DNF).
8. Energy Source: NREL will provide the batteries for the competition.
9. **Steering:** A guide wire attachment, referred to as an eyelet, must be attached to the car. Examples of possible designs are shown below (Appendix A). 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.
10. **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. The top sixteen cars with the fastest times will advance to the final competition to race for first, second, and third place.
6. The judges will note the official time on the heat card (see [Appendix B](#)). If the car does not finish the race, it will be noted as a Did Not Finish (DNF) on the heat card.
7. At least one but no more than two members must wait at the finish line to catch the vehicle.
8. 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.
9. The vehicle and team member must remain at the finish line until the time of the race has been noted on the heat card.
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 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**.

Appendix A



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NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

Electric Car Competition



Car #1

Sample Middle School

Team: The Tigers

Time Trial	Heat	Lane	Time	
1	A	1	5.05	Fastest Overall Time: <div style="border: 1px solid black; padding: 5px; display: inline-block; font-size: 1.5em; font-weight: bold;">5.05</div>
2	F	6	5.33	
3	K	4	5.25	

Round	Heat	Lane	Time	
1				Fastest Overall Time: <div style="border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div>
2				
3				
Finals				