

Mag Lev – Division B

DESCRIPTION: Contestants will construct up to two self-propelled “vehicles” powered by electrical energy supplied by batteries. The energy supplied by the batteries will be used to turn up to two propellers and move the vehicle down a magnetic track while pulling a maglev sled. Students will collect data and develop a graph showing the relationship between the mass being pulled and the time required to reach the finish line

A TEAM OF UP TO: 2

IMPOUND: Yes

APPROXIMATE TIME: 5 minutes

EVENT PARAMETERS:

1. Prior to the competition, students will develop data charts and graphs to help them determine how quickly their car can travel to the finish line while pulling the mass of a maglev sled.
2. The vehicle(s), a copy of the data table and graph, and any equipment required by the students are to be impounded prior to the start of competition. The mass of the maglev sled will be a minimum of 50 grams and a maximum of 200 grams (in increments of 10 grams for Regionals, 5 grams for States, and 1 gram for Nationals). The exact mass of the maglev sled will be announced after impound has been completed.

CONSTRUCTION:

1. Vehicles will be made of any material chosen by the competitors, but must meet all specifications. The length of the car may not be any less than 4 inches and may not exceed 7 inches. The part of the vehicle that floats below the side rails of the track must fit on a standard maglev track (see below). There is no limit to the width of the vehicle that floats above the side rails of the track. Suggested materials for the car body are foamcore board, cardboard, Lexan, or Masonite. The material chosen for the vehicle may not damage the track in any way. The mass of the vehicle (including batteries) must be no less than 200 grams. Vehicles that do not meet these specifications will be ranked behind all that do. The car may not change in length during its run.
2. The vehicle will tow a maglev sled behind it (this sled will be provided by the event supervisor). Students must secure a screw eye (1/8" or larger) to the rear of their vehicle to allow the maglev sled to be attached. The length of the vehicle specified above includes the screw eye. See the following web page for information on the connection of the sled to the car:
<http://www.newyorkscioly.org/SOPages/COTResources.html>
3. Up to two 9-volt batteries (rated at 9 volts each) may be used in parallel, not in series, to power the car. No other energy may be stored or used in the running of the car.
4. The batteries will power up to two propellers affixed to the car.
5. Any magnets **except rare earth magnets** may be used on the vehicle, but they must be aligned so that the right side of the car, as it moves down the track, is the South Pole and the left side is the North Pole. It is recommended that students attach their magnets to their car with Velcro. This will allow them to easily make adjustments to the polarity of their vehicle (if necessary) at the competition. There is no limit to the number of magnets that may be used.
6. The motor must be a DC motor between 3 and 12 volts.
7. The vehicle must be 100% levitated as it moves down the track.
8. If a kit is used in the construction of the vehicle, the competitors **must** make a significant modification to the kit. See <http://www.newyorkscioly.org/SOPages/COTResources.html>

THE TRACK:

1. The track will be a standard maglev track as used in technology classes with a length of 8 feet and a vehicle track dimension of 2 9/16 inches. The track will be placed on a flat surface such as a table with enough room to allow a cushioned barrier to be placed 11 inches beyond the end of the track to prevent the vehicle from falling to the floor or colliding with something that will cause damage to the vehicle. The barrier should be at least 12 inches wide and 4 inches high.
2. Impact goggles must be worn during the testing time.
3. The track will not be electrified in any way.

THE COMPETITION:

1. Competitors will attach the maglev sled provided by the event supervisor using the screw eye at the rear of their vehicle (the maglev sled will have a length of 4 inches or less).
2. Before the first run the contestants will predict their vehicle's Travel Time. They may not change the prediction for the second run.
3. Competitors will place their vehicle and the sled on the track behind a line 12 inches from beginning of the track. They will place a pencil on the 12 inch line in front of their vehicle to keep it from moving. When ready they will turn on their motor and indicate to the judges that their vehicle is ready. They may not touch their vehicle after they have turned on their motor. The judge will give a countdown of “3, 2,1, launch”. On the word “launch” the competitors will release their vehicle by removing the pencil and step back from the track. At the same time the judge will start the clock. The judge will stop the

clock when the front of the vehicle crosses the end of the track. Photogates may be used if they are available. If a photogate is used the pencil must be placed behind the line to avoid triggering the photogate in advance.

4. Teams will be allowed two runs in the 5-minute time period. Both runs may be done with one vehicle or they may use different vehicles for each of the two runs.
5. If a vehicle fails to move after 5 seconds teams will be allowed to restart their vehicle with no penalty. They will be given a total of two restarts during the competition. If the vehicle fails to move on the second restart their car will be judged a “did not finish” for that run. No further restarts will be allowed on future runs. Vehicles judged “did not finish” for both runs will be ranked behind all those vehicles that were able to complete at least one run.
6. If a car moves only part of the way down the track and stops it will be judged a “did not finish” for that run. The distance it moved will be measured. If the vehicle fails to complete either run, this distance will be used to break ties with other vehicles that also fail to complete a successful run.
7. If during the first run any part of the vehicle falls off, the team will be ranked behind all others whose vehicles remain intact and complete one or both runs. If part of the vehicle falls off during the first run, the team will not be allowed a second run.
8. Teams may remove their vehicle from impound once their two runs are completed. Teams may not file an appeal after they have taken their vehicle from impound.

SCORING:

1. **Run Score:** The team with the fastest time receives 100 points. All other teams receive points determined by the following formula: $\text{Run Score} = (\text{fastest time recorded} / \text{this team's fastest time}) \times 100$
2. **Prediction Score:** $\text{Prediction Score} = ((\text{Predicted Time} - |\text{Predicted Time} - \text{Travel Time}|) / \text{Predicted Time}) \times 80$. The Travel Time used will be the time of the fastest run.
3. **Graph Score:** Students will turn in one sheet of paper with the data they have collected arranged in a table and a graph that is derived from that data. This sheet will receive points as follows:
 - a. 5 points for a completed data table
 - b. 5 points for a graph
 - c. 5 points if the graph matches the data table
 - d. 5 points for correct labeling: title, team name, x & y axis variables, & increments with units
4. **Final Score:** The final score for each team will be determined as follows:
$$\text{Final Score} = \text{Run Score} + \text{Prediction Score} + \text{Graph Score}$$
5. **Tie Breakers:** The 1st tie breaker will be the fastest Run Score. The 2nd Tie Breaker will be the faster of the second runs for each team. The 3rd tie breaker will be the best Prediction Score. The 4th tiebreaker shall be the farthest distance traveled. The 5th tiebreaker will be the mass of the car (lighter car wins).
6. **Tiers:** Teams will be ranked in the following tiers:
 - a. **Tier 1:** All teams that meet all construction requirements and complete at least one run in two attempts
 - b. **Tier 2:** All teams that meet all construction requirements but fail to complete at least one run intact
 - c. **Tier 3:** All teams that fail to meet construction requirements and complete at least one run
 - d. **Tier 4:** All teams that fail to meet construction requirements and do not complete at least one run

Diagrams of Competition Track and resources for this event may be found at <http://www.newyorkscioly.org/SOPages/COTResources.html>

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