

## ROLLER COASTER B 2016

1. **DESCRIPTION:** Prior to the competition, teams design, build, and test a roller coaster track to guide a vehicle that uses gravitational potential energy as its sole means of propulsion to travel as close as possible to a target time.

**A TEAM OF UP TO: 2**   **IMPOUND: Yes**   **EYE PROTECTION: #2**   **EVENT TIME: 8 min**

2. **SAFETY PARAMETERS:** Competitors must wear eye protection during set-up and testing. Teams without proper eye protection must be immediately informed and given an opportunity to obtain eye protection if time allows (if not, teams must not be allowed to compete and are scored as a no-show).
3. **EVENT PARAMETERS:**
  - a. Roller Coasters, which consist of the tracks, a base, and up to 5 spherical vehicles (e.g. marbles, ping-pong balls, etc.) to travel on the track, must be designed so that a vehicle will travel from a Starting Point to a Finish Line as close to a Target Time as possible. The exact Target Time is between 25s and 45s (in 5s intervals for regional, 2s intervals for state, and 1s intervals for national tournaments) and must be chosen by the Event Supervisor (ES) and will be revealed to each team once their 8 min begins. The same Target Time will be used for all teams at the tournament.
  - b. Teams must bring a Roller Coaster and any tools (e.g. levels and shims).
  - c. The ES provides an unsharpened #2 pencil with an unused eraser, all measurement tools and timers.
4. **CONSTRUCTION PARAMETERS:**
  - a. The tracks must be built on a base smaller than 80.0cm x 80.0cm, and 6.0cm or thinner.
  - b. The tracks must fit within the area defined by vertically extending the boundary of the base and within 100.0 cm above the top of the base.
  - c. At every point on the track, the vehicle must be removable by hand from the track in a direction perpendicular to the direction of the vehicle's travel.
  - d. The vehicle must be held in the ready-to-run position by a #2 pencil with an unused eraser provided by the ES and is released when the pencil is removed perpendicular to the track.
  - e. The vehicle must travel using only its own gravitational potential energy available at the ready-to-run position.
  - f. The vehicle must travel on all parts of the tracks at most once.
  - g. There must be exactly one clearly labeled Finish Line running perpendicular to the direction of vehicle travel on the track. The Finish Line position may be adjusted between runs.
  - h. A mechanism that safely stops the vehicle must be part of the Roller Coaster after the Finish Line.
  - i. Commercially available track (e.g. Hot Wheels, Brio track, or Space Rail), magnets, magnetic, electrical, and electronic devices must not be used for any part of the Roller Coaster.
  - j. Gap Bonus: The Roller Coaster may be constructed with an unlimited number of Gaps. Gaps are defined as an open span without track that the vehicle must pass to continue its run. Gaps must have a horizontal span of at least 5.0 cm where the vehicle travels completely unsupported and without track underneath to earn bonus points. Up to 5 distinct Gaps may earn bonus points and must be clearly labeled.
  - k. Competitors must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on [www.soinc.org](http://www.soinc.org)
5. **COMPETITION:** Teams filing appeals must leave all impounded materials with the ES.
  - a. The Roller Coaster (track, base, up to 5 vehicles), tools, spare parts, data, and calculating devices must be impounded before the start of the competition.
  - b. Only the competitors and ES will be allowed in the impound and event area. Once the competitors enter the event area, they must not leave the area or receive outside assistance, materials, or communications.

- c. After retrieving their device from the Impound Area, teams must be given 8 minutes to set up their Roller Coaster and complete up to two runs. All runs will be completed with the Roller Coaster resting on the ground and students are responsible for leveling their Roller Coaster to account for the floor. Time used by the ES for measuring must not be included in the 8 minutes. Roller Coasters in the ready-to-run configuration before the end of the 8 minute time period will be allowed to complete a run.
  - d. Teams may make adjustments to their Roller Coaster (e.g. level the Roller Coasters, move the Finish Line, etc.) before each run.
  - e. Prior to each run, the ES must verify that the timekeepers and competitors are ready. 3 timekeepers is suggested to be used with the middle time recorded as the Run Time, in seconds to the precision of the timing device used. The ES will then count aloud “1, 2, 3, Go”. The team must remove the pencil in the direction perpendicular to the track to start the run on the word “Go”.
  - f. If the vehicle does not move upon actuation, it does not count as a run and the team may request to set up for another run, but must not be given additional time.
  - g. Timing begins on the word “Go” and ends when any of the following happens:  
The front of the vehicle crosses the finish line
    - i. 1 minute has elapsed since the word “Go”
    - ii. The vehicle travels outside the base perimeter
    - iii. The vehicle stops moving. A vehicle may pause briefly, but if movement is not begun within 3 seconds, timing is stopped and 3 seconds are subtracted from the run time.
  - h. A team’s 8 minute time is paused when the vehicle stops to allow for the ES measurements. Timing resumes when the ES tell the competitors they can set up for their 2nd run.
  - i. A Failed Run occurs if the second run does not occur in the 8 minutes or if the time cannot be measured (e.g. it starts before the ES is ready).
6. **SCORING:** High score wins.
- a. Run Score = Height Score + Time Score + Gap Bonus - Time Penalty
  - b. Height Score = 100 - height, in cm, of the highest part of the tracks measured from the top of the base rounded up to the nearest cm.
  - c. Time Score = Run Time x 2
  - d. Gap Bonus = 1 point for each whole cm measured horizontally where the vehicle travelled completely unsupported and without track underneath for up to 5 competitor specified Gaps. Points are only awarded if the vehicle successfully reaches the other side of the track.
  - e. Time Penalty = 1 point for each whole second beyond the target time.
  - f. Tiers: Teams are ranked using the single run that gives them the best overall rank.
    - i. Tier 1: A run with no violations.
    - ii. Tier 2: A run with only competition violations.
    - iii. Tier 3: Any run with any construction violations.
    - iv. Tier 4: Any teams with Roller Coasters not impounded during the impound period.
    - v. Participation Points: Competitors cannot start any run within the 8 min or have two Failed Runs
  - g. Ties are broken by this sequence: 1. Biggest Gap Bonus for an individual gap, 2. Highest Height Score, 3. Highest Time Score.
7. **SCORING EXAMPLE:** A Roller Coaster 78.5 cm high has a run where the vehicle reached the Finish Line in 28.34 sec and the Target Time being 35 sec. The run has 3 Gaps: 8.3 cm, 5.3 cm, 5.9 cm.

|        |       |   |       |   |    |   |       |
|--------|-------|---|-------|---|----|---|-------|
| Height | Score | = | 100   | - | 79 | = | 21    |
| Time   | Score | = | 28.34 | x | 2  | = | 56.68 |

$$\begin{array}{r} \text{Gap} \\ \text{Time} \\ \text{Run Score} \end{array} = \begin{array}{r} \text{Bonus} \\ \\ 21 \end{array} + \begin{array}{r} 8 \\ \\ 56.68 \end{array} + \begin{array}{r} 8 \\ \\ 18 \end{array} - \begin{array}{r} \text{Penalty} \\ \\ 0 \end{array} = 95.68$$