# ROLLER COASTER

**See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.**

1. **DESCRIPTION:** Prior to the competition, teams design, build, and test a Roller Coaster track to guide a ball/sphere 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:** B **APPROX. TIME:** 12 minutes

2. **EVENT PARAMETERS:**
   a. Participants must bring and impound one Roller Coaster (a track that guides a ball/sphere), at least one ball/sphere, non-electronic tools, spare parts, and **appropriate Logs** before the start of the competition.
   b. Participants may bring and impound additional balls/spheres, but only one will be used during a given run.
   c. Participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection, if time allows.
   d. The Event Supervisor will provide an unsharpened #2 pencil with an unused eraser, all measurement tools for scoring purposes, and timers.
   e. If the device is deemed unsafe, it will not be allowed to run until safety concerns are resolved to the Event Supervisor's satisfaction.
   f. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**
   a. The Roller Coaster must be designed so that the ball/sphere will travel from a Start Line to a Finish Line in as close to the given Target Time as possible.
   b. At all times during the competition the device, excluding the ball/sphere, must be no larger than 30.0 cm wide x **80.0** cm long x **50.0** cm high sitting flat.
   c. **The track may be enclosed except for the upper ½ of the loop if included in the device.**
   d. The ball/sphere must be visible at all times.
   e. **Funnels are allowed.**
   f. The ball/sphere must be held in the ready-to-run position by an unsharpened #2 pencil held only in the participant's hand. The pencil is provided by the Event Supervisor. The ball/sphere is released when the participant removes the pencil from the track.
   g. The ball/sphere must travel using only its own gravitational potential energy available at the ready-to-run position. No added energy by use of stored potential energy is allowed (e.g., no springs, rubber bands, magnets, or elevators).
   h. There must be exactly one clearly labeled Start Line and one clearly labeled Finish Line running perpendicular to the direction of ball/sphere travel on the track designated before the Target Time is released.
   i. The Start Line and the Finish Line must be **marked on the track and labeled** and their relative positions **to each other** must not change after impound.
   j. The device must include a mechanism that safely stops the ball/sphere after it crosses the Finish Line.
   k. Magnets, electrical, and electronic devices may not be used for any part of the Roller Coaster.
   l. Gaps: The device may contain Gap(s) in the track to earn a Gap Score. Gaps are defined as an open span without support or guidance that the ball/sphere must pass to continue its run.
      i. Gaps must have a horizontal span of at least 5.0 cm from the end of the track that the ball/sphere leaves measured to the closest part of the track the ball/sphere lands on.
      ii. The beginning and the end of each Gap must be clearly labeled and must have a physical edge that is at least 0.5 cm above any surface below to earn points; these physical edges will be the measurement boundaries of the Gap
      iii. The ball/sphere must travel completely unsupported in the air to earn points.
      iv. T**he track must continue at least 10 cm in the same direction from the end of the gap before it curves, hits a wall or has a change in direction.**
      v. Up to 2 distinct, clearly labeled Gaps may be included to earn points.
      vi. Bouncing a ball/sphere off a surface does not count as part of a Gap; a Gap may not end with the ball/sphere hitting a wall.

m. Loop: The device may contain one Loop in the track to earn a Loop Score. A Loop is defined as a continuously concave section of track which appears to self-intersect at a Point of Intersection (POI).
   i. The Loop begins and ends when the ball/sphere reaches the POI.
   ii. The height of the Loop is defined as the vertical distance from the POI to the highest inside point of the Loop.
   iii. The POI and highest inside point of the Loop must be clearly labeled for the Loop to count for points. The two sections of track at the POI must touch and have a clearly labeled point that the Event Supervisor can measure from.
   iv. The ball/sphere must remain in contact with the track as it traverses the Loop. When the ball/sphere is in contact with the highest point of the Loop, the ball/sphere must be completely unsupported from below.

4. **DATA LOGS: (There is a 50-point bonus for having a complete Data Log as described below.)**
   a. Teams must submit a Data Log along with their device. The Data log must include the following:
      i. The submitted Data Log must contain recorded data for 10 or more test runs covering parameters/observations prior to the competition.
      ii. The required parameters are:
         (1) Run time, in seconds,
         (2) The gap and loop score(s), in centimeters, if attempted, and
         (3) Qualitative or quantitative **descriptions** on an aspect of the device that, once modified, changes the time of the run.
   b. **The team name and team number for the tournament must appear on the Data Log**.
   c. All numerical values should be labeled with standard units (e.g., SI or English) appropriate to the dimension being measured or be considered incomplete. SI units should be the default standard.
   d. Logs will be returned to teams after inspection.

5. **THE COMPETITION:**
   a. The Roller Coaster, ball(s)/sphere(s), tools, spare parts, data/notes, and Data Log must be impounded before the start of the competition.
   b. Only the participants and Event Supervisor will be allowed in the impound and event areas during the competition. Once the participants enter the event area to compete, they must not leave the area or receive outside assistance, materials, or communications.
   c. The exact Target Time is between 30 s and 60 s (in 5 s intervals for Regional, 2 s intervals for State, and 1 s intervals for National tournaments) and will be chosen by the Event Supervisor. The Target Time will be the same for all teams at the tournament and will be revealed **just before the team sets up the device**.
   d. After retrieving their device from the Impound Area, teams will be given 8 minutes to set up their Roller Coaster and complete up to two scorable runs. Participants may make as many practice runs as they want during the 8 minutes.
   e. Participants may adjust their Roller Coaster (e.g., modify the track, add/remove parts of track, swap the ball/sphere, leveling) before each run. **They are not allowed to change the start and finish lines. Any materials that change the dimensions of the device (e.g. shims for leveling, etc.) added by the participants are considered part of the device.**
   f. Time used by the Event Supervisor for measuring will not be included in the 8 minutes. A scorable run that begins before the end of the 8-minute time period will be allowed to run to completion.
   g. Prior to conducting a scorable run, the participants must place the Event Supervisor provided #2 pencil on the Start Line of the device. The ball/sphere must be placed completely **before** the Start Line.
   h. A scorable run must be declared prior to the start of a run. Participants may not touch the device during a scorable run.
   i. Prior to each scorable run, the Event Supervisor will verify that the timekeepers and participants are ready. Three timekeepers are suggested with the median time recorded as the Run Time, in seconds to the precision of the timing device. The Event Supervisor will then count aloud “3, 2, 1, Go”. On the word “Go” the participants will remove the pencil from the track such that the pencil does not exert a force on the ball/sphere.

j. On the word "Go", the pencil is removed so that it does not exert a force on the ball/sphere and timing begins. Timing ends when any of the following happens:
   i. The ball/sphere completely crosses the Finish Line.
   ii. Twice the Target Time has elapsed since the word "Go".
   iii. The ball/sphere travels outside the boundary of the device.
   iv. The ball/sphere stops moving. The ball/sphere may pause briefly, but timing stops if movement does not begin within 3 seconds.

k. **The Run Time, defined as the time the ball/sphere moved in the device before stopping or leaving the device, will be recorded for all runs. If the ball/sphere fails to cross the Finish Line on a scorable run this Run Time will be used in the place of the Time Score. Teams will still receive scores for Height. They may alos receive points for the Gap(s) and Loop, only if the Gap(s) and/or Loop are successful before timing stops.**

l. The Roller Coaster's height will be measured at the conclusion of each scorable run.

m. The Event Supervisor will review with teams the data recorded on their scoresheet.

n. Teams filing appeals must leave all impounded materials with the Event Supervisor.

6. **SCORING:**

a. Highest Final Score wins. The higher of the 2 Run Scores is used as the Final Score.

b. Run Score = Height Score + Time Score + Gap Score + Loop Score + Bonus Score(s)

c. Height Score = 2 x (**50 -** Roller Coaster height). The Roller Coaster height is measured in whole cm from the highest part of the Roller Coaster to the floor or the table (if used), rounded down.

d. Time Score = Track Time - Time Penalty
   i. Track Time = 5 points for every full second of Run Time within the device up to the Target Time.
   ii. Time Penalty = 5 points for every full second of Run Time past the Target Time up to the 2 x the Target Time.

e. Gap Score = 4 points for each whole cm measured horizontally from the end of the track the ball/sphere leaves, to the closest part of the track the ball/sphere lands on. Points are only awarded if the ball/sphere successfully reaches the track on the other side of the Gap ( meeting 3.m.).

f. Loop Score = 6 points for each whole cm of the height of the Loop, measured vertically from the POI to the highest inner point of the Loop. Points are only awarded if the ball/sphere successfully completes the Loop and fulfills all requirements in (3.l.).

g. The following bonuses may be applied to a Run Score:
   i. **Teams will receive 150 points if the ball/sphere successfully crosses the Finish Line.**
   ii. Teams with a complete **Practice** Log submitted at impound will receive a 50-point Bonus.
   iii. Teams will receive one point for each full cm. their device is under 80 cm. in length.

h. Tiers:
   i. Tier 1: A run with no violations
   ii. Tier 2: A run with any construction or competition violations
   iii. Tier 3: A team with a Roller Coaster or ball/sphere not impounded during the impound period

i. Participation points are awarded to teams who cannot start any run within the 8 minutes or have unresolved safety issues.

j. Ties are broken in this order:
   i. Highest Gap Score for an individual gap
   ii. Highest Loop Score
   iii. Highest Height Score
   iv. Highest Time Score

**Recommended Resources:** The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase for this event; other resources are on the Event Pages at soinc.org