GRAVITY VEHICLE

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

1. **DESCRIPTION:** Teams design, build, and test one Vehicle and Ramp that uses the Vehicle's gravitational potential energy as its sole means of propulsion to reach a target as accurately as possible.

   A TEAM OF UP TO: 2 **IMPOUND:** Yes

   EYE PROTECTION: None **EVENT TIME: 10** minutes

2. **EVENT PARAMETERS:**
   a. Each team must bring and impound one Vehicle, one Ramp, alignment devices (if used), a Practice Log, and additional/spare parts as well as counterweights used to secure the Ramp. Teams from the same school may share a Ramp if it is compatible with their Vehicle.
   b. Teams may bring data and a stand-alone calculator of any type along with **non-electronic** tools which do not need to be impounded.
   c. Teams 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. All propulsive energy must come from the gravitational potential energy of the mass of the Vehicle. The entire Vehicle must start from an elevated, non-horizontal position on the team's Ramp. A release mechanism must be included as part of the Ramp to hold the Vehicle in the ready-to-run configuration until triggered by the participants.
   b. Conversion of the Vehicle's gravitational potential energy is permissible, but any additional sources of kinetic energy must be in their lowest energy state in the ready-to-run configuration. Pre-loaded energy storage devices may be used to operate other Vehicle functions (e.g., braking system) as long as they do not provide kinetic energy to propel the Vehicle.
   c. The Vehicle's total mass must not exceed 2.000 kg.
   d. Electronic components and electric devices are not permitted.
   e. **A jumbo paperclip (i.e. the large ones) must be attached to the front of the Vehicle and bent so that ONE end of it is pointing down toward the surface of the Track between 1/2" and 3/4" above it. The paperclip must not be cut or shortened. The paperclip must clear the ⅜" dowel placed across the Track. The end of the paperclip must be easily accessible by the Event Supervisor - no part of the Vehicle, except the wheels, may extend more than 0.5 cm beyond it. It will be the Vehicle's Measurement Point for distance measurements.**
   f. The Vehicle and the Ramp including the release mechanism, in the ready-to-run configuration, must completely fit within an imaginary rectangular box with a 50.0 cm x 50.0 cm base and a height of 100.0 cm. A starting pencil used as part of the release mechanism may extend beyond the dimensions of the imaginary box. A sighting/aiming device, if left on the Ramp or Vehicle in the ready-to-run configuration, must fit within the imaginary box.
   g. All parts of the Vehicle must move as a whole; no anchors, tethers, or other separate pieces are allowed. The only parts of the Vehicle allowed to contact the floor during the run are wheels/treads. Pieces falling off the Vehicle or Ramp during the run constitutes a construction violation.

4. **PRACTICE LOG:**
   a. The Practice Log must include 3 or more parameters (2 required and at least 1 additional) for 10 or more practice runs. The required parameters are the Target Distance and the Vehicle Distance from Target. Each team must choose an additional 3rd parameter beyond those required (e.g., # of axle turns for braking, alignment angle) to test. Logs must include the Team name and number.
   b. Logs must be impounded and will be returned when the team is called to compete.
   c. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
      i. **Information about the tool hardware, software, materials, and supplies used**
      ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
      iii. **Descriptions of how the team constructed the final device from the tool created components**

5. **THE COMPETITION:**
   a. Only participants and the Event Supervisors will be allowed in the Impound and Track areas. Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication.
   b. Teams have 10 minutes of Event Time to set up and start up to 3 runs. Vehicles in the ready-to-run configuration before the end of the Event Time will be allowed to complete a run.
   c. **Electric/electronic** tools must not be used except for the calculator (2.b.).
   d. In the ready-to-run configuration, the Vehicle and Ramp must be entirely behind the Start Line. The Vehicle and Ramp must remain at the starting position without being touched.
   e. Teams may adjust their Vehicle or Ramp (e.g.; change the Vehicle's mass, distance, directional control) within their Event Time; the Event Supervisor may re-verify that the Vehicle and Ramp meets specifications prior to each run. Timing is paused during any measurements made by the Event Supervisor. Timing resumes once the participants pick up their Vehicle or begin making their own measurements. Teams may use their own **non-electronic** measuring devices to verify the Track dimensions during their Event Time.
   f. Only **non-electronic** sighting/aiming devices are permitted. If placed on the Track, they must be removed before each run. If placed on the Vehicle or Ramp, they may be removed at the team's discretion. Sighting and aiming devices left on the Vehicle during its run must not cause the Vehicle's mass to exceed 2.000 kg.
   g. Teams must not roll the Vehicle on the floor of the Track on the day of the event without tournament permission. If permitted, only participants may be present.
   h. Substances applied to the Vehicle or Ramp must be approved by the Event Supervisor prior to use and must not damage or leave residue on the floor, Track and/or event area. Teams may clean the Track during their Event Time but it must remain dry.
   i. Teams must start their Vehicle by using any part of an unsharpened #2 pencil with an unused eraser, supplied by the Event Supervisor, to actuate a release mechanism on the Ramp. The pencil may be used as all or part of the release mechanism and can extend outside of the dimensions defined in 3.f. While actuating the release mechanism, teams must not touch or push the Vehicle nor the Ramp. Actuating the release mechanism must not impart additional energy to the Vehicle. Once they start a run, teams must not follow their Vehicle and must wait until called by the Event Supervisor to retrieve their Vehicle.
   j. If the vehicle does not move upon actuation of the release mechanism, it does not count as a run. The team may continue to work on their device in order to attempt 3 runs within the Event Time.
   k. A Failed Run can occur if the Vehicle starts before the Event Supervisor is ready, if its distance cannot be measured (e.g., the participants pick it up before it is measured), or if the team pushes the vehicle down the track. If a team has a Failed Run, any Construction and/or Competition violations must be recorded for that Run as well. A team having only one successful run during the 10 minute Event Time will be assessed a Failed Run for a 2nd run score. If the Vehicle does not move during the Event Time, the team will be assessed 2 Failed Runs.
   l. Teams filing an appeal must leave their Vehicle, Ramp, and Practice Log in the event area.

6. **THE TRACK:**
   a. The Track will be on a smooth, level, and hard surface. Refer to soinc.org for a diagram of the Track.
   b. The Start Point is marked on a piece of tape approximately 2.5 cm wide, on the edge of the tape closest to the Target Point. This front edge will be the Start Line. The tape should extend at least 0.50 m on either side of the Start Point, perpendicular to the imaginary center line connecting the Start and Target Point.
   c. The Target Point will be marked on a piece of approximately 5.0 cm by 2.5 cm tape. The exact Target Distance from the Start Point to the Target Point will be between **2.00** m and **5.00** m. At Regionals the interval will be 0.50 m, for States 0.25 m, and for Nationals 0.05 m. The Target Distance will be chosen by the Event Supervisor and will be announced after the impound period is over.
   d. **A single ⅜" hardwood round dowel will span the Track 1.00 m from the Start Line perpendicular to the imaginary center line connecting the Start and Target Point. The dowel must extend at least 0.50 m on either side of the Start Point. The dowel must be securely taped and/or weighed down at its ends to hold it in place.**
   e. At the Event Supervisor's discretion, more than one Track may be used. If so, the team may choose which Track they use, but must use the same Track for both runs.

7. **SCORING:**
   a. Each team's Final Score is the sum of their 2 best Run Scores out of their 3 runs + any Final Score Penalties. Low score wins.
   b. The Run Score for each run = Distance Score + Run Penalties
   c. The Distance Score = 1pt./cm x Vehicle Distance. The Distance Score for a Failed Run is 2500 points.
   d. The Vehicle Distance is the point-to-point distance from the **Vehicle's** Measurement Point to the Target Point in centimeters measured to the nearest 0.1 cm.
   e. **The Time Score for each run is the time it takes from when the Gravity Vehicle begins to move down the ramp until it comes to a complete stop recorded to the nearest 0.1 s. The Time Score will be used as a tiebreaker.**
   f. Run Penalties:
      i. Competition Violation: 1500 points added to each Run Score that has 1 or more Competition Violations.
      ii. Construction Violation: 3000 points added to each Run Score that has 1 or more Construction Violations.
   g. Final Score Penalties:
      i. Incomplete Practice Log: 250 points added to the team's Final Score.
      ii. Missing or not Impounded Practice Log: 500 points added to the team's Final Score.
      iii. Vehicle Not Impounded: 10000 points add to the team's Final Score.
   h. Two or more teams tied with 2 Failed Run scores, without Competition or Construction Violations, will remain scored as ties. Other ties are possible.
   i. Tiebreakers in order: **1. Better Vehicle Distance of the 2 scored runs; 2. Lower Time Score of the Better Vehicle Distance of the 2 scored runs; 3. Better Vehicle Distance of the non-scored run.**

SCORING EXAMPLE:

A Vehicle does 3 runs in the allotted time but the team's Practice Log is incomplete.
The 1st run has 2 Competition Violations, a Time Score of 4.3 s and a Vehicle Distance of 57.8 cm.
The 2nd run has a Competition Violation, a Time Score of 3.9 s and a Vehicle Distance of 143.9 cm.
The 3rd run has no Violations, a Time Score of 4.1 s and a Vehicle Distance of 87.5 cm.

1st run's Run Score:	57.8 pts + 1500 pts	= 1557.8 pts
2nd run's Run Score:	143.9 pts + 1500 pts	= 1643.9 pts (highest **number of** points, not counted in Final Score)
3rd run's Run Score:	87.5 pts	
Final Score	= 1st run's Run Score + 3rd run's Run Score + Incomplete Practice Log = 1557.8 pts + 87.5 pts + 250 pts = 1895.3 pts	

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

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