

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 quickly and accurately as possible.

A TEAM OF UP TO: 2

IMPOUND: Yes

EYE PROTECTION: None

APPROXIMATE TIME: 8 minutes

2. **EVENT PARAMETERS:**

- 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 may bring data and a stand-alone calculator of any type along with non-electric tools which do not need to be impounded.
- 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:**

- 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.
- 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.
- The Vehicle's total mass must not exceed 2.000 kg.
- Electronic components and electric devices are not permitted.
- An approximately $\frac{1}{4}$ " round wooden dowel must be attached to the front of the Vehicle. When the Vehicle is placed flat on the floor, the dowel must be approximately perpendicular to the floor, extend to within 1.0 cm of the floor, and extend at least 20.0 cm above the floor. The dowel must be easily accessible by the Event Supervisor - no part of the Vehicle, except the wheels, may extend more than 0.5 cm beyond the front of the dowel. The dowel's front bottom edge will be the Vehicle's Measurement Point for distance measurements.
- The Vehicle and the Ramp, together, in the ready-to-run configuration, must fit within a rectangular box with a 50.0 cm x 50.0 cm base and a height of 100.0 cm.
- 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 during the run constitutes a construction violation.

4. **PRACTICE LOG:**

- The Practice Log must include 4 or more parameters (3 required and at least 1 additional) for 10 or more practice runs. The required parameters are: Target Distance, Vehicle Distance from Target, and Run Time. Each team must choose an additional 4th parameter beyond those required (e.g.; # of axle turns for braking, alignment angle) to test.
- Logs must be impounded and will be returned when the team is called to compete.

5. **THE COMPETITION:**

- 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.
- Teams have 8 minutes of Event Time to set up and start up to 2 runs. Vehicles in the ready-to-run configuration before the end of the Event Time will be allowed to complete a run.
- Electric tools must not be used except for the calculator (2.b.).
- 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-electric measuring devices to verify the Track dimensions during their Event Time.
 - f. Only non-electric 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. They may not touch/push the Vehicle, or the Ramp, to start it or hold it while actuating the release mechanism. 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. A Failed Run occurs for any run that does not occur in the 8 minutes, or if the time and/or distance cannot be measured for a Vehicle (e.g.; it starts before the Event Supervisor is ready, if it moves but does not cross the 0.5 m Line, or the participants pick it up before it is measured).
 - k. If the Vehicle does not move upon actuation of the release mechanism, it does not count as a run and the team may set up for another run but will not receive extra Event Time.
 - 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 9.00 m and 12.00 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. Two timing lines are marked with pieces of tape approximately 2.5 cm wide and at least 1.50 m long, at distances of 0.50 m and 8.50 m from the Start Point, centered on and perpendicular to the imaginary center line. The edges of the tape closest to the Start Point defines these lines.
 - e. A photogate timing system is highly recommended. See www.soinc.org for information. If used, the system will be installed at the 0.50 m Line and the 8.50 m Line with the beams at a height of 17.0 ± 2.0 cm. At least one manual timer should be used as a backup.
 - f. If no photogate system is available, 3 timers should be used along with a laser system (if available), with the middle time recorded as the official Run Time in seconds to the precision of the timing devices.
 - g. 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. The team with the lowest Final Score in the lowest number Tier wins. Each team's Final Score is their lower Run Score with the lower number Tier.
 - b. The Run Score for each run = 2 pts./cm x Vehicle Distance + 1 pt./sec x Run Time + Penalties.
 - c. The Vehicle Distance is the point-to-point distance from the Measurement Point to the Target Point in centimeters measured to the nearest 0.1 cm.

- d. The Run Time is the time it takes for the Vehicle to travel between the 0.50 m and 8.50 m Lines; it starts when the Vehicle's dowel reaches the 0.50 m Line and ends when it passes the 8.50 m Line. The Run Time is recorded in seconds to the precision of the timing device used. If the Vehicle passes the 0.50 m Line but stops before the 8.50 m Line, the Run Time will be recorded as 60.00 sec.
- e. Teams with incomplete Practice Logs will incur a Penalty of 250 points. Teams without impounded Practice Logs will incur a Penalty of 500 points. Practice Log Penalties do not affect Tier placement.
- f. Tiers: The highest number Tier will be applied when more than one is applicable:
 - i. Tier 1: Runs with no violations.
 - ii. Tier 2: Runs with any competition violations.
 - iii. Tier 3: Runs with any construction violations.
 - iv. Tier 4: Teams with 2 Failed Runs.
 - v. Tier 5: Teams that did not impound their Vehicle during the impound period.
- g. Tiebreakers in order: 1. Better non-scored run; 2. Faster time - scored run. 3. Lower Vehicle Distance - scored run.

SCORING EXAMPLE: A team's Vehicle stopped 28.6 cm from the Target Point. It made the run in 4.79 s without any penalties (Tier 1).

Vehicle Distance	28.6 cm x 2 pts./cm =	57.2 points
Run Time	4.79 s x 1 pt./sec =	4.79 points
+ Penalties	0 pts. =	0 points
Run Score		61.99 points

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Gravity Vehicle Video Download and the Problem Solving/ Technology CD; other resources are on the event page at soinc.org.

This event is sponsored by Lockheed Martin