GRAVITY VEHICLE C

1. **DESCRIPTION**: Teams design, build, and test one vehicle and ramp that uses the vehicle's gravitational potential energy as the vehicle's 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 **EVENT TIME:** 8 minutes

2. **EVENT PARAMETERS**:
   a. Each team must bring and impound a single vehicle and ramp, a practice log, and any additional/spare parts. Teams may also bring counterweights to secure the ramp.
   b. Teams may bring a stand-alone calculator of any type, data, and non-electric tools for their vehicle which do not need to be impounded.

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. The ramp must include a release mechanism that holds the vehicle in place without any contact by the competitors in the ready-to-run configuration.
   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. Electric/electronic components and devices are not permitted.
   e. An approximately ¼" round wooden dowel must be attached to the front of the vehicle approximately perpendicular to the floor. The dowel must extend at least 20.0 cm above the floor. **When the vehicle is placed flat on the track**, the dowel must extend to within 1.0 cm of the track's surface and be easily accessible by the Event Supervisor. The front bottom edge of the dowel will be the vehicle's Measurement Point for distance measurements.
   f. 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.
   g. All parts of the vehicle must move as a whole; no anchors, tethers, tie downs, or other separate pieces are allowed. The only parts allowed to contact the floor during the run are wheels/treads, drive string(s), and any parts already in contact with the floor in the ready-to-run configuration. Pieces falling off during the run is a construction violation.
   h. 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.

4. **PRACTICE LOG:**
   a. Teams must record the target distance, distance from target, and run time of at least 10 practice runs while varying at least one vehicle parameter (e.g., starting height of the vehicle) for each run.
   b. Logs must be impounded and will be returned when the team is called to compete.

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 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.
   c. In the ready-to-run configuration, **only** the ramp must be behind the Start Line.
   d. Teams may adjust their vehicle or ramp (e.g. change vehicle mass, distance, directional control) within their Event Time, though 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/non-electronic measuring devices to verify the track dimensions during their Event Time.

e. 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 the **2.000** kg maximum limit.
f. 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.
g. 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.
h. Teams must start the vehicle using any part of an unsharpened #2 pencil with an unused eraser, supplied by the Event Supervisor to actuate the release mechanism on the ramp. Competitors must not use the pencil to touch any part of the vehicle to start the run. Competitors must also not touch the vehicle, the release mechanism, or the ramp to start the run. Once they start a run, the participants must not follow their vehicle and wait until called by the Event Supervisor to retrieve their vehicle.
i. 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 go at least 0.50 m, or the participants pick up it before it is measured).
j. If the vehicle does not move upon actuation of the trigger, it does not count as a run and the team may set up for another run but will not receive extra time.
k. A team filing an appeal must leave their vehicle in the competition area.

6. **<u>THE TRACK</u>**:
   a. The track will be on a smooth, level, and hard surface.
   b. The Start Point will be marked on a piece of tape approximately 2.5 cm wide, on the edge of the tape closest to the Target Point. The tape should extend at least 0.50 m on either side of the Start Point, so that the tape is perpendicular to the imaginary center line connecting the Start and Target Point. The timing lines are marked with pieces of tape approximately 2.5 cm wide and at least 1.50 m long, 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.
   c. 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 State 0.25 m, and for Nationals 0.05 m. The Target Distance will be chosen by the Event Supervisor and will not be announced until the impound period is over.
   d. 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.
   e. If no photogate system is available, 3 timers should be used along with a laser system, with the middle time recorded as the official Run Time in seconds to the precision of the timing device.
   f. 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. **<u>SCORING</u>**:
   a. The team with the lowest Final Score in the highest tier wins. Each team's Final Score is their lower Run Score with the higher tier.
   b. The Run Score for each run = 1 pt./cm x Vehicle Distance + **2** pts./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 30.00 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 (from highest to lowest)**; the lowest 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 that did not impound their vehicle during the impound period.
   v. Tier 5: Teams with 2 Failed Runs.
g. Ties must be broken by this sequence: 1. Better non-scored run; 2. Faster time on the scored run. 3. Lower Vehicle Distance on the scored run.

SCORING EXAMPLE: At a competition, a team's vehicle stopped 28.6 cm from the Target Point. It made the run in 4.79 s.

	Vehicle Distance	28.6 cm x 1 pt./cm =	28.6 pts.
	Run Time	4.79 s x 2 pts./s =	9.58 pts.
+	Penalties	0 pts. =	0 pts.
	Run Score		38.18 pts.

Recommended Resources: All reference and training resources including the **Problem Solving/Technology CD** are available on the Official Science Olympiad Store or Website at http://www.soinc.org