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-electric 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. An approximately ¼" 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.
   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.

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 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-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. 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 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. 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 Measurement Point to the Target Point in centimeters measured to the nearest 0.1 cm.

e. **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.**
f. **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.**
g. **Two or more teams tied with 2 Failed Run scores, without Competition or Construction Violations, will remain scored as ties. Other ties are possible.**
h. Tiebreakers in order: **1. Better Vehicle Distance of the 2 scored runs; 2. Better Vehicle Distance of the non-scored run.**

SCORING EXAMPLE:

A Vehicle does 3 runs in the allotted time.
The 1st run has 2 Competition Violations and a Vehicle Distance of 57.8 cm.
The 2nd run has a Competition Violation and a Vehicle Distance of 143.9 cm.
The 3rd run has no Violations 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 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 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

GENERAL RULES

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

GENERAL RULES, CODE OF ETHICS, AND SPIRIT OF THE PROBLEM

The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect - see Science Olympiad Pledges. Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage). Failure by a participant, coach, or guest to abide by these codes, accepted safety procedures, or rules below, may result in an assessment of penalty points or, in rare cases, disqualification by the tournament director from the event, the tournament, or future tournaments.

1. Actions and items (e.g., tools, notes, resources, supplies, electronics, etc.) are permitted, unless they are explicitly excluded in the rules, are unsafe, or violate the spirit of the problem.
2. While competing in an event, participants may not leave without the event supervisor's approval and must not receive any external assistance. All electronic devices capable of external communication as well as calculator applications on multipurpose devices (e.g., laptop, phone, tablet) are not permitted unless expressly permitted in the event rule or by an event supervisor. Cell phones, if not permitted, must be turned off. At the discretion of the event supervisor, participants may be required to place their cell phones in a designated location.
3. Participants, coaches and other adults are responsible for ensuring that any applicable school or Science Olympiad policy, law, or regulation is not broken. All Science Olympiad content such as policies, requirements, clarifications/changes and FAQs on www.soinc.org must be treated as if it were included in the printed rules.
4. All pre-built devices presented for judging must be constructed, impounded, and operated by one or more of the 15 current team members unless stated otherwise in the rules. If a device has been removed from the event area, appeals related to that device will not be considered.
5. Officials are encouraged to apply the least restrictive penalty for rules infractions - see examples in the Scoring Guidelines. Event supervisors must provide prompt notification of any penalty, disqualification or tier ranking.
6. State and regional tournament directors must notify teams of any site-dependent rule or other rule modification with as much notice as possible, ideally at least 30 days prior to the tournament.

COVID-19 PANDEMIC RULES MODIFICATIONS

The COVID-19 pandemic requires that some general modifications be made to the Event Rules listed in this manual in order to permit Science Olympiad competitions to continue in a way that reflects best public health, disease prevention, and personal safety practices. The modifications listed here will be in effect for all Science Olympiad competitions, regardless of level (e.g., Invitational, Regional, State, National), or type (e.g., In-Person, Satellite SO, mini SO). As the pandemic is evolves, these modifications may be amended or rescinded according to local conditions. If changes are made, the Tournament Director for the affected tournament will make an announcement to all participating teams as soon as possible.

1. **If not already allowed, each individual participant can have a personal set of reference materials (e.g., binders, single sheets of paper), calculator, or other academic resource as specified in the specific event rule for use during the competition to facilitate social distancing, isolation, and to prevent resource sharing. Personal sets of resource materials must meet all the criteria established in the specific event rule. This does not apply to Recommended Lab Equipment for Division B or Division C Chemistry Events or tool kits for Build Events.**
2. **Given local conditions, participants may not be able to be in the same location as their partner during competition. Tournaments will allow designated partners to compete from separate locations and competing teams will only need one device for Build or Hybrid with Build Events.**
3. **At the discretion of the Tournament Director, portions of Hybrid Events containing hands-on activities as well as Build and Lab Events may be dropped from the tournament or be conducted as trial events.**
4. **At the discretion of the Tournament Director and Event Supervisors, completion time may be used as a tiebreaker for Core Knowledge and other events where a written or online test is used.**

CHEMISTRY RECOMMENDED LAB EQUIP.

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

Each team may bring any or all of the items listed below for use in Division C Chemistry Events requiring laboratory equipment. Teams not bringing these items will be at a disadvantage as Event Supervisors will not provide Recommended Lab Equipment. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

Item & Expected Use	Likely to be used in:			
	Chemistry Lab	Forensics	Environmental Chemistry	Materials Science
Box - Containing all of the kit materials	X	X	X	X
10 ml Graduated Cylinder - Measuring volumes	X		X	
25 ml Graduated Cylinder - Measuring volumes	X		X	
100 ml Graduated Cylinder - Measuring volumes	X		X	
50 ml Beakers - Doing reactions, developing chromatograms	X	X	X	X
100 ml Beakers - Doing reactions, developing chromatograms	X	X	X	X
250 ml Beakers - Doing reactions, developing chromatograms	X	X	X	X
400 ml Beakers - Doing reactions, developing chromatograms	X	X	X	X
50 ml Erlenmeyer Flasks - Doing reactions	X		X	
125 ml Erlenmeyer Flasks - Doing reactions	X		X	
250 ml Erlenmeyer Flasks - Doing reactions	X		X	
Test Tubes - Mix Chemicals, heat chemicals	X	X	X	X
Test Tube Brush - Clean Test Tubes	X	X	X	X
Test Tube Holder - Holds test tubes for heating	X	X	X	
Test Tube Rack - Hold Test Tubes	X	X	X	X
Spot Plates - For semi-micro scale reactions, testing solubility, pH	X	X	X	
Petri Dishes - Doing reactions, developing chromatograms	X	X	X	X
Slides - To put hairs, crystals, or fibers on for use with a microscope		X		
Cover Slips - To cover & prevent items from coming off slides		X		
Droppers - Add small amounts of liquids to reactions	X	X	X	X
Spatulas or spoons - Getting small amounts of solids out of containers	X	X	X	X
Metal Tongs, Forceps, or Tweezers – Holding & retrieving objects	X	X	X	X
Stirring Rods - Stirring mixtures	X	X	X	X
Thermometer - Determining the temperature of a solution	X	X	X	
pH or Litmus paper - Test acidity or alkalinity of solution	X	X	X	
Hand Lens - Magnification of small items for identification		X		
Flame Loop – For identification of ions in a compound		X		
Cobalt Blue Glass – To filter out any sodium that might contaminate flame test from hands		X		
Filter Paper - Filter solids from liquids	X		X	
Funnel - Hold Filter Paper	X		X	
9V battery - Electrolysis	X		X	X
Alligator Clip Wires - Connecting meters to metals	X		X	X
Nail - Electrolysis	X		X	X
Piece of Cu metal - Electrolysis	X		X	X
Piece of Zn metal - Electrolysis	X		X	X
Multimeter - Measuring current, voltage, and resistivity	X		X	X
9V or less Battery Conductivity Tester - Determining ionic strength of solution	X	X	X	X
Calipers-mechanical, not digital - Measuring lengths very precisely	X			X
Paper Towels - Cleaning	X	X	X	X
Pencil - Writing, Marking Chromatogram		X		
Ruler - Measuring lengths		X		
Magnets – For extraction and identification of iron filings	X	X	X	X

CALCULATOR CLASS DESCRIPTIONS

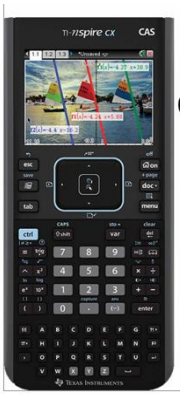
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

The following document was prepared to offer some guidance to teams as they select calculators for use in different Science Olympiad events. By no means are the calculators listed here inclusive of all possible calculators; instead they are offered as common examples. The decisions of the event supervisors will be final.

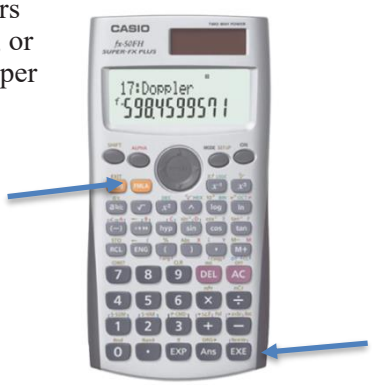
Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators
are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators can often be found at dollar stores.

Class II - Stand-alone non-programmable, non-graphing calculators look like the calculator to the right or simpler. There are hundreds of calculators in this category but some common examples include: CASIO FX-260, Sharp EL-501, and TI-30X.

Class III- Stand-alone, programmable, graphing calculators and **stand-alone non-graphing, programmable calculators,** often look like the calculator shown on the right. Some examples are: Casio 975 0/9850/9860, HP 40/50/PRIME, and TI 83/84/89/NSPIRE/VOYAGE.



To identify a stand-alone non-graphing, programmable calculators Are look for the presence of the 'EXE' button, the 'Prog' button, or a 'file' button. Examples include but are not limited to: Casio Super FXs, numerous older Casio models, and HP 35S. A calculator of this type with the buttons labeled is shown to the right.



Class IV - Calculator applications on multipurpose devices (e.g., laptop, phone, tablet, watch) are not allowed unless expressly permitted in the event rule.

EYE PROTECTION GUIDE

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

This resource was created to help teams comply with the Science Olympiad Policy on Eye Protection adopted on July 29, 2015 and posted on the Science Olympiad Website (soinc.org).

Participant/Coach Responsibilities: Participants are responsible for providing their own protective eyewear. Science Olympiad is unable to determine the degree of hazard presented by equipment, materials and devices brought by the teams. Coaches must ensure the eye protection participants bring is adequate for the hazard. All protective eyewear must bear the manufacturer's mark Z87. At a tournament, teams without adequate eye protection will be given a chance to obtain eye protection if their assigned time permits. If required by the event, participants will not be allowed to compete without adequate eye protection. This is **non-negotiable**.

Corresponding Standards: Protective eyewear used in Science Olympiad must be manufactured to meet the American National Standards Institute (ANSI) standard applicable at its time of manufacture. The current standard is ANSI/ISEA Z87.1-2015. Competitors, coaches and event supervisors are not required to acquire a copy of the standard. The information in this document is sufficient to comply with current standards. Water is not a hazardous liquid and its use does not require protective eyewear unless it is under pressure or substances that create a hazard are added.

Compliant Eyewear Categories: If an event requires eye protection, the rules will identify one of these three categories. Compliance is simple as ABC:

CATEGORY A

- Description: Non-impact protection. They provide basic particle protection only
- Corresponding ANSI designation/required marking: Z87
- Examples: Safety glasses; Safety spectacles with side shields; and Particle protection goggles (these seal tightly to the face completely around the eyes and have direct vents around the sides, consisting of several small holes or a screen that can be seen through in a straight line)

CATEGORY B

- Description: Impact protection. They provide protection from a high inertia particle hazard (high mass or velocity)
- Corresponding ANSI designation/required marking: Z87+
- Example: High impact safety goggles

CATEGORY C

- Description: Indirect vent chemical/splash protection goggles. These seal tightly to the face completely around the eyes and have indirect vents constructed so that liquids do not have a direct path into the eye (or no vents at all). If you are able to see through the vent holes from one side to the other, they are NOT indirect vents
- Corresponding ANSI designation/required marking: Z87 (followed by D3 is the most modern designation but, it is not a requirement)
- Example: Indirect vent chemical/splash protection goggles

Examples of Non-Compliant Eyewear:

- Face shields/visors are secondary protective devices and are not approved in lieu of the primary eye protection devices below regardless of the type of vents they have.
- Prescription Glasses containing safety glass should not be confused with safety spectacles. "Safety glass" indicates the glass is made to minimize shattering when it breaks. Unless these glasses bear the Z87 mark they are not approved for use.

Notes:

1. A goggle that bears the Z87+ mark and is an indirect vent chemical/splash protection goggle will qualify for all three Categories A, B & C
2. VisorGogs do not seal completely to the face, but are acceptable as indirect vent chemical/splash protection goggles