

## MISSION POSSIBLE



See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.



1. **DESCRIPTION:** Prior to the competition, participants design, build, test, and document a Rube Goldberg®-like Device that completes required Start and Final Actions through a series of specific actions.

**A TEAM OF UP TO:** 2

**IMPOUND:** State & National only

**EYE PROTECTION:** C

**SET-UP TIME:** 30 minutes for points

**MAXIMUM RUN TIME:** 3 minutes

2. **EVENT PARAMETERS:**

- At State and National Tournaments, teams must impound their Device along with any tools or parts that they will use during their set-up time or run. **Electric outlet access will not be available.**
- All 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. Participants without eye protection will not compete.
- Each Device must pass a safety inspection before operation. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the Event Supervisor, otherwise they must receive only participation points.
- Event Supervisors will need their own eye protection (i.e.; safety glasses), meter sticks, stopwatches, and measuring tape.
- 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](http://www.soinc.org).

3. **CONSTRUCTION PARAMETERS:**

a. **General Requirements:**

- During operation, the Device's outer dimensions should be no greater than 60.0 cm (L) x 60.0 cm (D) x 60.0 cm (H). Devices with a dimension greater than 1 meter will not be allowed to run.
  - All actions used for scoring must be visible and/or verifiable. The top and at least two vertical walls must be open or transparent for viewing all actions. Actions must be consecutive. Parallel and/or dead-end actions will not count for points. Any action in the Device not designed to contribute to the completion of the Final Action will not count for points.
  - A standard, unmodified wooden or plastic golf tee must be placed into or attached to a "tee holder" somewhere in the Device for the Final Action. The golf tee may have any length, but the diameter must be no greater than 1.25 cm (½ inch). The tee may be glued or taped to the "tee holder" as long as the top 2.5 cm is above the top of the tee holder and completely free of glue/tape.
  - Each movable/adjustable physical object in the Device must be utilized by at most one assigned action. **An object at the end of one action may initiate the next action, but must not go beyond the initiation of the second action. (The initial golf ball may start the first action, as described, but must then remain at rest until it is moved in the Final Action.)**
  - Sensitive components (i.e.; springs/mousetraps, dominoes) may be set/placed just before starting the Device.
  - Use of electricity is prohibited except in action 3.c.x. Only commercial batteries, not exceeding 9 volts as labeled may be used. Multiple batteries may be connected in series or parallel as long as the expected voltage output across any two points does not exceed 9 volts as calculated using their labeled voltage. Teams must be able to show the Event Supervisors the labeled voltage. Non-complaint batteries must be removed prior to Device operation.
  - Candles, flames, matches, hazardous liquids, **lead objects (even if encased)**, gases, and hazardous materials (e.g., rat traps, combustible fuses, dry ice, liquid nitrogen) and unsafe handling of chemicals will not be permitted.
  - All golf balls in the Device must be standard and unmodified. They may have small nicks, scratches and ball marks due to normal use, but must otherwise retain all of their original material and structural integrity. They may be tied but must not be glued or taped. **If the golf ball is to start the next action, the actual golf ball (not what is holding or attached to the golf ball) must initiate the next action.**
- Start Action: (100 points) - Participants must drop a golf ball (3.a.viii.) into the Device from a point completely above the Device. The golf ball must fall into the Device and initiate the next action, **and come to rest.**
  - Scorable Actions: (50 points each) – Participants may have up to 12 scorable unique actions to count for points. Participants may attempt, none, some, or all of these actions in any order.
    - Use a 3:1 **or 1:3** ratio gear system to initiate the next action.



- ii. Rotate a wheel and axle to raise a golf ball (3.a.viii.) at least 10 vertical cm, so that the golf ball at the end of the lift initiates the next action. **(This can be wheel to axle or axle to wheel in direction.)**
  - iii. Knock over in series, four free-standing, standard, non-magnetic, commercial dominos with the fourth domino in the sequence initiating the next action.
  - iv. Add **plain** water to a container to raise a golf ball (3.a.viii.) at least 5 cm so that the golf ball rolls out of the top of the container and initiates the next action.
  - v. Rotate a screw to move a wingnut threaded on the screw at least 2 horizontal cm. After moving at least 2 horizontal cm the wingnut must contact an object which initiates the next action.
  - vi. Push or pull a golf ball (3.a.viii.) up an inclined plane with an ideal mechanical advantage (IMA)  $\geq$  2. After rising at least 10 vertical cm, the golf ball must initiate the next action.
  - vii. Use a Pulley (system) with an ideal mechanical advantage (IMA)  $\geq$  2 to lift a golf ball (3.a.viii.). After rising at least 10 vertical cm, the golf ball must initiate the next action.
  - viii. Use a 3<sup>rd</sup> class lever to raise a golf ball (3.a.viii.) at least 5 vertical cm. After rising at least 5 vertical cm, the golf ball must initiate the next action.
  - ix. Pull a wedge from under a golf ball (3.a.viii.) so that it rolls. After rolling 20 cm in any direction, the golf ball must initiate the next action.
  - x. **Start a stationary fan (using no more than 9V)**, which uses moving air to push a floating object. After moving at least 10 horizontal cm on water, the floating object must initiate the next action.
  - xi. Push a wedge between two golf balls that are touching so that one golf ball moves. After moving at least 20 cm in any direction, the golf ball(s) (3.a.viii.) must initiate the next action.
  - xii. Start a pendulum so that after running for at least 10 seconds, it initiates the next action.
- d. Final Action:
- i. After all other planned scorable actions have been attempted, the golf ball from the Start Action in 3.b. must be moved at least 20 horizontal cm from its original resting position and placed on the golf tee (as described in 3.a.iii.) so that it stays on the tee for at least three seconds. (250 points) To get the points, the ball must only be touching the tee and nothing else.
  - ii. If the part of the Device that delivered the ball to the tee is then automatically moved away so the ball is clearly unobstructed in all directions, an additional 150 points will be awarded. The ball must stay on the tee and no part of the Device (except the tee and tee holder) can be within 10 cm of the ball in any direction. This can occur after timing stops. **If this part of the device goes outside the original dimensions, the dimensions (and scoring) will be changed to allow for this action. If this change exceeds the dimension limits, penalties will be assessed.**
- e. Action Sequence List (ASL):
- i. Two Action Sequence Lists (ASLs) must be submitted to the Event Supervisor at impound for States & Nationals. At Regional Tournaments, ASLs should be provided to Event Supervisors just prior to the start of competition.
  - ii. An ASL is a written documentation of all the actions within the Device. Its purpose is to allow the Event Supervisor to follow along the chain of events while the Device is running.
  - iii. Each scorable action in 3.c. may only earn points once in the ASL. Other non-scorable actions may be incorporated into the Device but must contribute to the completion of the Final Action, receive no points and be listed on the Action Sequence List (ASL).
  - iv. All scorable and non-scorable actions must be numbered in the Device, and correspondingly numbered in the ASL.
  - v. An example of an ASL can be found on [www.soinc.org](http://www.soinc.org).
4. **THE COMPETITION:**
- a. The Target Operation Time is 60 seconds at Regionals/Invitationals, 61 to 90 seconds at State, and 91 to 120 seconds at Nationals. For State and National tournaments, time will be announced after impound is over and at setup. The target time will be the same for all teams at State and Nationals.
  - b. Timing and scoring begin when a participant drops a golf ball (3.b.) into the Device. Timing and scoring (with the exception of 3.d.ii.) stop when the golf ball from the Start Action touches the golf tee or after 180 seconds has elapsed, whichever comes first.
  - c. Participants may designate a timer, an action taking over 10 seconds that does not use electricity or springs for power, to be eligible for bonus points. **This timer may be one of the scorable actions.**
    - i. A 1-point bonus will be awarded for every full second the timer runs before the Target Operation Time. The timer may run past the Target Operation Time but will not receive points for the duration after the Target Operation Time.



- ii. The timer must successfully initiate the next action for any bonus points to count.
  - iii. For State/National tournaments, the team must demonstrate how this timer is adjusted to account for the increased length of Target Operation Time for the bonus points to count.
  - d. If the Device stops, jams, or fails, the participants will be allowed to adjust it to continue operation up to three times. An adjustment may consist of multiple physical touches and is only completed once the Device runs again on its own. Obvious adjusting only to stall or impact operation time will result in disqualification.
  - e. If a participant completes a scorable action or makes an adjustment that leads directly to the completion of that action, then that action will not count for points, even if it is part of the Final Action.
  - f. If an action starts out of the ASL order, all actions skipped in the listed sequence, even if completed, earn zero (0) points.
  - g. The Supervisor will review with teams the data recorded on the scoresheet.
  - h. Teams filing an appeal must leave their Device and ASLs in the event area.
5. **SCORING:**
- a. High score wins.
  - b. Award 25 points for each of the following (100 points maximum):
    - i. The ASLs are submitted on time at Device impound for State and National tournaments
    - ii. The ASLs are legible and use the format specified on [www.soinc.org](http://www.soinc.org)
    - iii. The ASLs are 100% accurate of intended scorable and non-scorable actions
    - iv. The scorable & non-scorable actions within the Device are labeled as in the ASLs
  - c. Award 50 points for each of the following:
    - i. Participants use no more than 30 minutes to set up their Device
    - ii. The first time each unique action in 3.c. is successfully completed as described
  - d. Award 100 points for completing the Start Action
  - e. Award 250 points for completing the Final Action as described in 3.d.i.
  - f. Award 150 points for moving parts of the Device away from the golf ball as described in 3.d.ii.
  - g. Award 4 points for each full second (rounded down) of operation up to the Target Operation Time
  - h. Award 1 point per full second that a non-spring timer runs before the Target Operation Time if all conditions are met and the next action is initiated by the timer
  - i. Award 0.1 point for each 0.1 cm that the Device dimensions are under 60.0 cm in each axis. The maximum score awarded for each dimension is 30 points, for a total of 90 points
  - j. Award 75 points for a Device that has no adjustments during operation
  - k. **Teams failing to impound their device on-time will be ranked after all teams that impounded on-time.**
  - l. Teams receive only participation points for impounding a Device but not competing, unsafe Devices, **Devices with a dimension greater than 1 meter**, or Devices that are remotely timed/controlled.
6. **PENALTIES:**
- a. Deduct 2 points for each full second (rounded down) that the Device operates past the Target Operation Time up to 180.0 seconds (whichever occurs first).
  - b. Deduct 25 points:
    - i. For each dimension of the Device that exceeds 60 cm
    - ii. If the top and 2 vertical walls are not open or transparent
    - iii. For each time the Device is adjusted during operation, up to 3 times. If the Device stops or fails after the third adjustment, scoring stops and the operation time will be scored as 180 seconds.
  - c. Deduct 50 points if any solid or liquid leaves the measured dimensions of the Device.
  - d. Deduct 150 points:
    - i. For each spring timing action in the Device that takes longer than 10 seconds
    - ii. For any use of electricity in the Device except action 3.c.x.
7. **TIEBREAKERS:**

Ties are broken as follows: a) Fewest penalty points; b) Smallest overall dimension (L+D+H) of the Device.

**Recommended Resources:** The Science Olympiad Store ([store.soinc.org](http://store.soinc.org)) carries the Mission Possible Video and Problem Solving/Technology CD; other resources are on the event page at [soinc.org](http://soinc.org).

This event is sponsored by Ace Hardware Science

**GENERAL RULES**

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://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](http://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.**



**For Event Supervisors Only - Do Not Post**  
**CHEMISTRY RECOMMENDED LAB EQUIP.**

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://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 B Chemistry Events. 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:			
	Crime Busters	Can't Judge a Powder	Food Science	Potions and Poisons
<b>Box</b> - Containing all of the kit materials	X	X	X	X
<b>10 ml Graduated Cylinder</b> - Measuring volumes		X	X	X
<b>25 ml Graduated Cylinder</b> - Measuring volumes		X	X	X
<b>100 ml Graduated Cylinder</b> - Measuring volumes		X	X	X
<b>50 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>100 ml Beakers</b> - Doing reactions, developing chromatograms		X	X	X
<b>250 ml Beakers</b> - Doing reactions, developing chromatograms		X	X	X
<b>400 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>50 ml Erlenmeyer Flasks</b> - Doing reactions		X	X	X
<b>125 ml Erlenmeyer Flasks</b> - Doing reactions		X	X	X
<b>250 ml Erlenmeyer Flasks</b> - Doing reactions		X	X	X
<b>Test Tubes</b> - Mix Chemicals, heat chemicals	X	X	X	X
<b>Test Tube Brush</b> - Clean Test Tubes	X	X	X	X
<b>Test Tube Holder</b> - Holds test tubes for heating	X	X	X	X
<b>Test Tube Rack</b> - Hold Test Tubes	X	X	X	X
<b>Petri Dishes</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>Spot Plates</b> - Doing reactions in semi-micro scale, testing solubility, pH	X	X	X	X
<b>Slides</b> - To put hairs, crystals, or fibers on for use with a microscope	X			
<b>Cover Slips</b> - To prevent items from coming off slides	X			
<b>Droppers</b> - Add small amounts of liquids to reactions	X	X	X	X
<b>Spatulas or spoons</b> - Getting small amounts of solids out of containers	X	X	X	X
<b>Stirring Rods</b> - Stirring mixtures	X	X	X	X
<b>Thermometer</b> - Determining the temperature of a solution		X	X	X
<b>Metal Tongs, Forceps, or Tweezers</b> - Holding objects, retrieving objects from liquids	X	X	X	X
<b>pH or Litmus paper</b> - Test acidity or alkalinity of solution	X	X	X	X
<b>Hand Lens</b> - Magnification of small items for identification	X	X		
<b>9V or less Battery Conductivity Tester</b> - Determining ionic strength of solution		X	X	X
<b>Paper Towels</b> - Cleaning	X	X	X	X
<b>Pencil</b> - Writing, Marking Chromatogram	X	X	X	X
<b>Ruler</b> - Measuring lengths	X	X	X	X
<b>Magnets</b> - For extraction and identification of iron filings	X	X	X	X



# For Event Supervisors Only - Do Not Post CALCULATOR CLASS DESCRIPTIONS

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://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.



PROG Button

EXE Button



**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](http://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](http://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