



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

**APPROXIMATE TIME:** 40 minutes

2. **EVENT PARAMETERS:**

- a. 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.
- b. 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.
- c. At State and National Tournaments, teams must impound their Device, Action Sequence (ASL), any tools or parts that they will use during their set-up time or run. Electric outlet access will not be available.
- d. Event Supervisors will need their own eye protection (e.g., safety glasses), meter sticks, stopwatches, and measuring tape.
- e. 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. During operation, the Device's outer dimensions should be no greater than 60.0 cm x 60.0 cm x 100.0 cm, in any orientation.
- b. 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.
- c. 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.
- d. Sensitive components (e.g., springs/mousetraps, dominoes) may be set/placed just before starting the Device.
- e. Use of electricity is prohibited anywhere in the Device.
- f. Candles, flames, matches, hazardous liquids, lead objects (even if encased), gasses, hazardous materials (e.g., rat traps, combustible fuses, dry ice, liquid nitrogen), and unsafe handling of chemicals will not be permitted.

4. **DEVICE OPERATION:**

- a. Start Action: (100 points) Participants must drop an unaltered golf ball, with nothing attached to it, into the Device from a point completely above the Device. The golf ball must fall into the Device and initiate the next action.
- b. Scorable Actions: (50 points each) Participants may have up to 12 scorable unique actions (4.d.i. through 4.d.xii.) to count for points at a tournament. Simple machines required in the actions must be used as the simple machine name implies. For example, a wedge must be "wedged" against an object rather than used as a gate. An axle must turn a wheel or vice-versa for it to be considered a wheel & axle.
- c. The scorable actions may be attempted in any order. Other non-scorable actions may be inserted between those that could count, but the inserted actions will not count for points.
- d. Each of the actions below may be attempted only once for points in the Device.
  - i. Rotate a wheel & axle to raise an object at least 10 cm vertically before the raised object initiates the next action.
  - ii. Push a wedge to separate two touching marbles so that one moves 20 cm horizontally from its spot and then initiates the next action.
  - iii. Remove a wedge that is keeping a golf ball from rolling, so that the golf ball rolls at least 20 cm horizontally to initiate the next action.
  - iv. Push or pull an object up an inclined plane with an IMA of at least 2 so that the object is vertically raised at least 10 cm before it initiates the next action.
  - v. Use a 3<sup>rd</sup> class lever to raise an object 10 cm vertically before the object initiates the next action.



- vi. Operate a pulley system with IMA of 3 to raise an object at least 10 cm vertically before the object initiates the next action.
  - vii. Use a marble to knock over a series of 3 dominoes so the last domino moves another marble to initiate the next action.
  - viii. Use a 2<sup>nd</sup> class lever to raise an object 10 cm vertically before the object initiates the next action.
  - ix. Use a single marble to hit a chain of 5 touching marbles so that the last marble moves at least 10 cm horizontally before it initiates the next action.
  - x. Use water to raise a golf ball via flotation at least 5 cm before the golf ball rolls out of the container to initiate the next action.
  - xi. Use falling marbles to turn a paddlewheel. The wheel must make at least one full revolution **before** the paddlewheel triggers the next action.
  - xii. Use an Archimedes screw to raise a marble 20 cm vertically before the marble triggers the next action.
- e. Participants may designate one sand timer, an action taking over 10 seconds, to be eligible for bonus points. This timer must not be one of the scorable actions.
- i. A 1 point bonus will be awarded for every full second the sand timer runs before the Target Operation Time and before it initiates the next action. The timer may run past the Target Operation Time but will not receive points for the duration after the Target Operation Time or after it starts the next task.
  - ii. The timer must successfully initiate the next action for any bonus points to count.
  - iii. If the Sand Timer is activated or touched by a participant or if he/she activates the next action, no points will be awarded for the timer.
  - iv. 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.
- f. Final Action:
- i. After all other planned scorable actions have been attempted, the Device releases a golf ball attached to the end of a string that forms a pendulum. To count, the pendulum must swing from the release point, swing, and strike a release button/mechanism that raises a STOP Sign completely above the Device. The STOP Sign must be cardboard or poster board, oriented vertically, red and square or octagonal. It must be at least 15 cm high and 15 cm wide.
  - ii. If the entire sign is vertical and completely higher than the entire Device, 250 points will be awarded. If the sign is only partially above the Device, only 125 points will be awarded.
  - iii. No part of the sign will be allowed to be the outer boundary of the Device prior to the release button being activated.
  - iv. If the golf ball strikes the release button/mechanism at the end of its swing, 3 points will be awarded per cm of the shortest straight line distance between the golf ball starting point and the release button/mechanism.
- g. Two printed copies of an Action Sequence List must be given to the Event Supervisor at the time of check-in (Regionals)/impound (State and National). The list must indicate the Start and the action initiated by the golf ball, any scorable actions to be attempted, the Sand Timer (if one is included), the action that releases the golf ball pendulum, the straight line distance between the golf ball starting point and the release button/mechanism in cm. The format should be the same as the one posted on the Science Olympiad website. Everything required in the ASL should also be labeled at the proper places within the Device.
- ## 5. 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, teams will be told the target time at the start of their setup. The target time will be the same for all teams at State and Nationals.
  - b. Timing and scoring begin when a participant drops the golf ball into the Device. Timing stops when the golf ball pendulum strikes the STOP Sign release button/mechanism, or after 2 x the Target Time has elapsed, whichever comes first.
  - c. Teams that have a time of twice the Target Time will receive no (zero) points for running time. No negative scores will be given for time.
  - 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. 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. Participants will not be allowed to touch the Device to release the golf ball pendulum or anything after that point
  - g. The Supervisor will review with teams the data recorded on the scoresheet.
  - h. Teams filing an appeal must leave their Device and ASL in the event area.
6. **SCORING:**
- a. High score wins.
  - b. Award 50 points if participants use no more than 30 minutes to set up their Device.
  - c. Award 25 points if 2 printed copies of the ASL are presented at the proper time.
  - d. Award 25 points if ASLs are in proper format.
  - e. Award 25 points if the original actions in the ASL are properly labeled in the Device.
  - f. Award 25 points if all scorable actions are included and are accurate.
  - g. Award 50 points the first time each unique action in 4.d. is successfully completed as described.
  - h. Award 100 points for completing the Start Action
  - i. Award 250 points for completing the Final Action as described in 4.f. or 125 points if partially completed.
  - j. Award 3 points for each cm of the shortest straight line distance from the golf ball starting point to the STOP Sign release button/mechanism if the golf ball on the pendulum strikes the release button/mechanism.
  - k. Award 2 points for each full second (truncated down) of operation up to Target Operation Time. Devices running twice the Target Time will receive zero time points for the run.
  - l. Award 1 point per full second that a sand timer runs before the Target Operation Time and initiation of the next action, if all conditions are met, and the next action is initiated by the timer.
  - m. Award 0.1 point for each 0.1 cm that the Device dimensions are under 60.0 cm for 2 dimensions and 100 cm for the third dimension. The maximum score awarded for each dimension is 30 points, for a total of 90 points. (Only at in-person tournaments.)
  - n. Award 75 points for a Device that has no adjustments during operation.
  - o. Teams failing to impound their Device on-time will be ranked after all teams that impounded on-time.
  - p. Teams receive only participation points for impounding a Device but not competing, unsafe Devices, Devices with a dimension greater than 110 cm, or Devices that are remotely timed/controlled.
7. **PENALTIES:**
- a. Deduct 2 points for each full second (truncated rounded down) that the Device operates past the Target Operation Time up to 2 x the Target Time seconds.
  - b. Deduct 25 points:
    - i. For each dimension of the Device that exceeds its limit of 60 or 100 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 2 x the Target Time in seconds. In this case zero points will be awarded for time.
  - c. Deduct 50 points if any solid or liquid leaves the measured dimensions of the Device.
  - d. Devices that use electricity within the Device will not be allowed to run.
8. **TIEBREAKERS:**
- Ties are broken as follows: a) Fewest penalty points; b) Smallest overall dimensions (L+D+H) of the Device.
- Recommended Resources:** The Science Olympiad Store ([store.soinc.org](http://store.soinc.org)) carries a variety of resources to purchase; other resources are on the Event Pages at [soinc.org](http://soinc.org).