MISSION POSSIBLE

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

1. **DESCRIPTION:** Participants design, build, test, and document a Rube Goldberg®-like device that completes a required action through an optional 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:**
   a. 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.
   b. Each device must pass a safety inspection before operation.
   c. Devices with potential hazards or safety concerns will not be permitted to run unless safety concerns are resolved to the satisfaction of the Event Supervisor; otherwise they must receive only participation points.
   d. Event Supervisors will need meter sticks, stopwatches, balance/scale, and measuring tape.

3. **CONSTRUCTION PARAMETERS:**
   a. During operation, device dimensions can be no greater than 60.0 cm (D) x 60.0 cm (W) x 60.0 cm (H).
   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.
   c. Any action in the device not designed to contribute to the completion of the Final Action will not count for points. Parallel and dead-end actions are not allowed **and will not count for points**.
   d. Each movable/adjustable physical object in the device must be utilized by at most one assigned action.
   e. 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).
   f. Energy devices (i.e., springs/mousetraps) may be set prior to starting the device.
   g. **Use of electricity is limited to Scorable Actions ii., v., xi. and raising the Final Action platform**.
   h. Only commercial batteries, not exceeding **9** volts as labeled, may be used to energize each of the Device's electrical circuits. 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. All energy storage devices must be contained in the device. **Non-compliant batteries must be removed prior to device operation**.
   i. **Arduinos, Raspberry Pis, or Programmable components are not allowed**. Timers must not be powered by electricity or springs. A timer is defined as a scorable or non-scorable action that takes longer than 10 seconds.
   j. **Candles**, flames, **matches**, **cell phones**, hazardous liquids, gases, materials (e.g., rat traps, lead objects, combustible fuses, **dry ice**, **liquid nitrogen**, **flammable gas**), and unsafe handling of chemicals are not permitted.
   k. Students 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. **THE COMPETITION:**
   a. **Start Action** (100 points) – **From completely above the device, the participants must drop an unaltered Ping-Pong ball into the device, causing a standard, unmodified golf ball to move, starting the next action**.
   b. **Scorable Actions** (50 points each) – Participants may have up to 12 scorable unique actions to count for points.
      i. Use **vinegar and baking soda** to inflate a balloon so that the **unguided** balloon strikes an object that originally was at least 20 cm away from the balloon causing **the object to initiate the next action**.
      ii. Use an endothermic action that initiates the next action as a result of the reduction in temperature.
      iii. **Drop two effervescent heartburn relief tablets into water so the reaction triggers the next action**.
      iv. Add water **to a container to raise a golf ball located in the same container at least 5 cm so that the golf ball rolls out of the top of the container and initiates the next action**.
      v. Use an infrared beam where the transmitter and receiver are at least 20 cm apart to initiate the next action.

vi. **Push or pull an object with a mass ≥ 500 g at least 10 vertical cm up an inclined plane with an IMA ≥ 2 before the object initiates the next action**.
vii. Use a pulley system with an ideal mechanical advantage (IMA) of at least **3** to lift an object with a mass ≥ 500 g at least 10 vertical cm before the object initiates the next action.
viii. Use the mechanical advantage of all 3 classes of levers in sequence to initiate the next action.
ix. **Use gravity to clearly rotate a screw at least two full rotations so that it operates as a screw converting rotational force into linear force and moves an object at least 2 cm before that object initiates the next action. The screw must be marked so its rotational movement is clearly visible**.
x. Launch an unmodified US quarter out of the top boundary of the device, so that it falls back into the device and initiates the next action. When the device is in the ready to run position, the quarter must be heads up. After the quarter is launched out of the device, lands back in, **and initiates** the next action the quarter must be tails up.
xi. **Use electricity to directly or indirectly break a string or fishing line so that the breaking of the line initiates the next action.**
xii. **Remove a magnet from a surface so that a magnetic object falls due to the removal of the magnetic force. That object must initiate the next action.**

c. **Final Action** (250 points) – **The device must raise a perfectly square platform that is between 5.0-10.0 cm on each side, a vertical distance of at least 20.0 cm before it becomes the highest point of the device. The platform must be a single surface that is hard, non-tacky, and smooth with no lip on any of its edges. On the platform must be a freestanding, upright standard 9V battery which is not attached to the platform or any other part of the device. The action is complete when the top surface of the platform and the battery are above the entire device and movement stops. Only the battery can be supported by the platform and this action may not count as the timer.**
d. **Two** Action Sequence Lists (ASLs) must be submitted to the Event Supervisor at impound. The ASLs must be legible, neat, and an accurate documentation of each intended scorable and non-scorable action of the device's operation. Scorable and non-scorable actions must be numbered and documented in the ASLs and correspondingly labeled in the device. Scoring will be based only on the Scorable Actions listed in the ASLs. Example ASLs may be found on the event page at soinc.org.
e. The Target Operation Time is 60.0 seconds at Regionals/Invitationals, 61.0 to 90.0 seconds at State, and 91.0 to 120.0 seconds at Nationals. For State/Nationals the time will be announced at setup and will be the same for all teams.
f. Timing and scoring begin when a participant **drops the Ping-Pong ball into the device**. Timing stops when **the platform stops moving** or when 180.0 seconds elapse, whichever comes first. **If the device stops after 3 touches or the platform never stops moving, the time will be scored as 180.0 seconds**.
g. Participants must designate **a timer,** an action taking over **10.0** seconds that does not use electricity or springs for power, **to be eligible for bonus points**.
i. **A 1-point bonus will be awarded for every full second the timer operates before the Target Operation Time. The timer must run for at least 30 seconds to earn points. 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 start the next Scorable 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.
h. If the device stops, jams, or fails, the participants will be allowed to "**touch**/adjust" the device up to three times to continue operation. **A single "touch" may consist of multiple touches and ends once the device runs again on its own**. Obvious stalling will result in disqualification.
i. If a participant completes a scorable action or makes an adjustment that leads directly to the completion of the action, then that action will not count for points, even if it is part of the Final Action.
j. If an action starts out of ASL order, all actions skipped in the listed sequence, even if completed, earn zero pts.
k. The supervisor will review with teams the data recorded on the scoresheet.

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.
   ii. The ASLs use the format specified on 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 action in **4.b.** is successfully completed as described.
d. Award 100 points for completing the Start Action.
e. Award 250 points for completing the Final Action **if the battery is freestanding and untouched at the end of the run. If the battery tips on a side, but still remains on the platform, only award 150 points if all other requirements are met. If the battery falls off the platform, no Final Action points will be awarded.**
f. Award 2 points for each full second (rounded down) of operation up to the Target Operation Time.
g. Award 1 point per full second that a non-electrical or non-spring timer runs before the Target Operation Time if all conditions are met and the next action is initiated by the timer.
h. 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 will be 90 points.
i. Award 75 points for a device that has no touches.
j. Teams receive only participation points for impounding a device but not competing, unsafe devices, or devices that are remotely timed/controlled.

6. **PENALTIES:**
   a. Deduct 1 point 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 60.0 cm, **excluding the Final Action**
      ii. **if the top and 2 vertical walls are not open or transparent**
      iii. for each **touch/adjust up to 3 times. If the device stops after the third touch, it will not be allowed to be touched/adjusted and the time will be scored as 180.0 seconds.**
   c. Deduct 50 points for the first solid or liquid that leaves the measured dimensions of the device, **excluding 4.b.x. and the Final Action**
   d. Deduct 150 points for each:
      i. electrical or spring timing action in the device that takes longer than 10.0 seconds, except raising the Final Action platform
      ii. **action where electricity is used where it is not allowed. The action will also not count for points.**
   e. Devices impounded after the deadline will be scored after devices impounded on time.

7. **TIEBREAKERS:**
   a. Ties are broken as follows:
      i. Fewest penalty points
      ii. Smallest overall dimension (L+D+H) of the device

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

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