



# TECHNOLOGY CHALLENGE

## OVERVIEW

Participants design, fabricate, and demonstrate the application and control of mechanical, fluid, and electrical power by designing a "Rube Goldberg device" that applies power and energy principles. Evaluation is based upon exact one-minute duration from the release of the golf ball to final activation; application of mechanical, fluid, and electrical energy principles; and craftsmanship.

## PURPOSE

Demonstrate the use of critical thinking skills to select appropriate applications of energy and power, to select appropriate materials for the fabrication of their solution, and to demonstrate the application of their solution.

## ELIGIBILITY

Entries are limited to one (1) team of two (2) members per chapter.

## TIME LIMITS

- A. Entries must be started and completed during the current school year.
- B. Set-up and demonstration times are assigned during check-in.
- C. Set-up lasts no longer than ten (10) minutes.
- D. Demonstration lasts five minutes for each team.
- E. Check out occurs at the same time for all conference events.

Rube Goldberg, a US cartoonist who lived from 1883-1970, was famous for drawings of complicated inventions designed to solve simple problems. His name applies to any contraption that is more complicated than the problem itself.

## ATTIRE

Casual dress as described in Competitive Events Attire is the minimum requirement.

## PROCEDURE

- A. Check-in
  - 1. Participants check in the device and register for a demonstration time at the time and place stated in the conference program.
  - 2. The device should be ready for demonstration when checked in, except for battery installation and fluid power preparation.

**B. Demonstration**

1. Team members report to the event area fifteen (15) minutes before their demonstration time to set up and test the device. Both team members must be present during the demonstration. If additional time is needed to set up, the set-up monitor consults with the event coordinator.

Team members distribute information about the device to the three (3) evaluators (see Regulation G below).

Each team member individually demonstrates the operation of the device during a timed trial. The demonstration starts and ends on the judge's signal.

4. Timing begins when the participant activates the golf ball release and stops when the light is shut off.

5. The team member who is demonstrating resets the machine for the next demonstration.

6. The team member with the best operation time demonstrates the operation for the third time.

7. Should a device fail during one (1) of the three (3) demonstrations, repairs are allowed at the discretion of the event coordinator.

8. Only team members are allowed to repair or check the operation of the device after it has been checked in. Team members may not leave the contest area to collect tools or parts for repair.

9. Team members must follow the event coordinator's instructions. On site variation may cause changes in demonstration and set up requirements.

C. The device is placed on static display after the demonstration and should not be operated during display.

D. No more than two (2) team members pick up their entry from the display area at the time and place stated in the conference program.

**REGULATIONS****A. Power source and power application regulations**

1. Safety considerations are paramount. No device is permitted to be demonstrated if unsafe conditions are obvious or become apparent during the demonstration.

2. Fluid power is limited to the use of air or un-tinted water.

3. Flammable liquids are not permitted.

4. Wet cell batteries are not permitted.

**B. Power generation is limited to the following sources:**

1. Electrical power as supplied by up to six non-rechargeable D cell batteries. The dry cells are NOT to be altered in any manner.

2. Fluid inside the cube that moves to collect or apply power, such as compressed air or elevated water.

3. Air pressure is not to exceed 45 psi. Participants must supply a standard tire stem outlet for judges to check pressure.

**C. Physical regulations**

1. The device must fit inside a two-foot cube.

2. The device may not weight more than 45 pounds.

- D. Release
1. A golf ball is held stationary until the participant activates a mechanical release to start the ball moving.
  2. Pulling a string, pushing a button or moving a lever is appropriate. Simply dropping the golf ball into a tube is not appropriate.
  3. A movement of fluid to activate the mechanical release is also appropriate. Turning up a bottle of water is not appropriate, but turning a valve that releases the water to activate the mechanical release is appropriate.  
The release must be inside the 2' cube.
- E. There must be continuous motion from activation of the release mechanism until the light is shut off.
1. The golf ball may be in motion.
  2. Fluid may be in motion.
  3. A mechanical device may be in motion.
  4. An electrically powered device may be in motion.
  5. The participant may not touch the device until directed by the evaluator.
- F. Light activation
1. One (1) or more of the D cell batteries powers the light.
  2. The golf ball may come to rest on the switch or pass the switch to activate or shut off the light.
- G. Participants prepare a written description for use by evaluators of the time during the demonstration each of the applications of power takes place, and of which application-mechanical, fluid, or electrical is being demonstrated.

## EVALUATION

- A. All three (3) demonstration times are recorded.
- B. The total time of all demonstrations is scored by the following:
1. Total time of 180 seconds or less: score = total time - 110
  2. Total time of 180 seconds or more: score = 70 - [2 x (total time - 180)]
- C. Points are awarded for each of the following:
1. Demonstration of application of mechanical power
    - a. Two (2) points one time if mechanical power is demonstrated
    - b. Three (3) points one time if mechanical power affects the path of the golf ball (The test is whether there is a second path that would direct the golf ball in a different direction for five (5) or more seconds.)
  2. Demonstration of application of fluid power
    - a. Two (2) points one time if fluid power is demonstrated
    - b. Three (3) points one time if fluid power affects the path of the golf ball (The test is whether there is a second path that would direct the golf ball in a different direction for five (5) or more seconds.)
  3. Demonstration of application of electrical power
    - a. Five (5) points one time for the activation of the light between twelve (12) and fifteen (15) seconds after the release is activated.
    - b. The light is shut off by the action of the golf ball at sixty (60) seconds.
    - c. The time continues to run if the light is not shut off.

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4. Rube Goldberg device bonus
    - a. Ten (10) points are awarded one time if the device has consecutive actions. For example, a fan is activated and a flag is raised, and the flag waves in the air moved by the fan. The motion of the golf ball would have to activate the fan and raise the flag in two (2) separate acts.
    - b. The action must result in action above the 2' cube.
  5. The final act
    - a. The golf ball or a device released, activated, or triggered by the golf ball, pops a balloon.
    - b. The popping or absence of the inflated balloon shuts off the light.
    - c. Time concludes when the light goes off.
  6. One (1) to ten (10) points for craftsmanship
  7. Demonstration stops at ninety (90) seconds.
- D. A twenty (20) point penalty is deducted for:
1. Conduct unbecoming a TSA member
  2. Touching the device during the demonstration
  3. Fluid leaks
  4. Any part of the device moving outside the 2' cube, such as the golf ball falling off the track and rolling out of the cube. (An exception here is the Rube Goldberg device bonus as described above.)
  5. Devices extending outside of the 2' cube before the demonstration
- E. Devices are NOT tested or the demonstration is stopped if:
1. Participants fail to appear for the demonstration.
  2. The device contains unsafe fabrication or power usage, such as wet cells, air pressure over 45 psi, altered dry cells, etc.
  3. There are devices extending outside of the 2' cube more than a total of 4" in any dimension before the demonstration.
  4. In performing a repair, the participant attempts to modify the device.
  5. A team member demonstrates conduct unbecoming a TSA participant.
  6. Judges are unable to determine the psi of a device.

# TECHNOLOGY CHALLENGE

## EVENT COORDINATOR INSTRUCTIONS

### PERSONNEL

- A. Event coordinator
- B. Assistants for check-in, two (2)
  - 1. Places team registration number on device
  - 2. Assists at demonstrations
  - 3. Assists with placement of device
- C. Preparation area personnel, three (3)
  - 1. Time monitor for checking in teams at appointed times
  - 2. Technical monitor for watching and evaluating set-up according to the rules
  - 3. Guide for directing participants as they return devices to static display area
- D. Evaluators
  - 1. Evaluators for timing the demonstration, three (3)
  - 2. Recorder to record the times on official rating form
- E. Assistants for check-out, two(2)

### MATERIALS

- A. Coordinator' box, containing:
  - 1. Event guidelines, one (1) copy each for coordinator and evaluators
  - 2. Official rating forms
  - 3. List of entries, with finalist report
  - 4. List of evaluators/assistants
  - 5. ID tags or stick-on tabs to number entries
  - 6. Results envelope
- B. Stop watch accurate to three places
- C. Computer with spreadsheet or calculator for determination of final results
- D. Tables for display and storage
- E. Tables for demonstration
- F. Tables and chairs for evaluators

### PROCEDURE

- A. Upon arrival at the conference, report to the CRC room and check the contents of the coordinator's box. Review the event guidelines and check to see that enough evaluators/assistants have been scheduled.
- B. Inspect the area(s) in which the event is being held for appropriate set-up, including room size, chairs, tables, outlets, etc. Notify the event manager of any potential problems.

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- C. Check in the entries at the time stated in the conference program. Anyone reporting who is not on the entry list may check in only after official notification is received from the CRC chairperson. Late entries are considered on a case-by-case basis and only when the lateness is caused by events beyond the participant's control. Requirements for attire do NOT apply during check in.
  - D. Secure the entries in the designated area.
  - E. One (1) hour before the event is scheduled to begin, meet with your evaluators/assistants to review time limits, procedures, and regulations. If questions arise that cannot be answered, speak to the event manager before the event begins.
  - F. Evaluators independently review the entries, then tally and turn in their rating forms.
  - G. For participants who violate the rules, the decision either to deduct twenty (20) points or to disqualify a participant must be discussed and verified with the evaluators, event coordinator, and a CRC manager. Secure the initials of the event coordinator and manager on the rating form.
  - H. Evaluators average their (3) scores to determine the ten (10) finalists. Ties are broken by the smallest range of times during the demonstrations.
  - I. Ensure that all rating forms have been completed before the evaluators are dismissed.
  - J. Complete and submit the finalists report, which includes a ranking of the ten (10) finalists, and all related forms in the results envelope to the CRC room.
  - K. Manage security and the removal of materials from the area during the time stated in the conference program.

TECHNOLOGY CHALLENGE							
2004 OFFICIAL RATING FORM				HIGH SCHOOL			
TEAM/SCHOOL ID #							
<b>EVALUATIVE CRITERIA</b>							
Demonstration times							
Total time of 180 seconds or less: score = total time - 110							
Total time of 180 seconds or more: score = 70 - [2 x (total time -180U Demonstration 1							
Demonstration 2							
Demonstration 3							
Mechanical power (5 pts.)							
Application ..... 2 pts.							
Affecting path of golf ball ..... 3 pts.							
Fluid power (5 pts.)							
Application ..... 2 pts.							
Affecting path of golf ball ..... 3 pts.							
Electrical power (5 pts.)							
Application ..... 5 pts.							
Rube Goldberg bonus..... 10 pts.							
Craftsmanship ..... 5 pts							
SUBTOTAL ..... 100 pts							
Rules violation (must be initialed by event coordinator and manager)..... minus 20 pts							
TOTAL ..... 100 pts							
Evaluator's comments/notes:							
I certify these results to be true and accurate to the best of my knowledge.							
Evaluator's signature_____							