



MECHANICAL ENGINEERING

OVERVIEW

Teams will design and build a "Rube Goldberg" mechanical device. This device will contain three (3) subsystems within a larger system. Each subsystem will contain all six (6) simple machines in a fun and inventive way. The final solution is open-ended to maximize creativity. The transfer of energy in the device will travel a specific path from start to finish for a minimum of seven (7) seconds per board. The device must be self-powered utilizing kinetic energy. The device must be capable of repeated demonstrations without long setup times. Semifinalists participate in a presentation/interview.

ELIGIBILITY

One (1) team of three to six (3-6) members per chapter is allowed to participate; one (1) entry per team.

TIME LIMITS

Semifinalists will be allowed:

1. Two (2) minutes for setup
2. One (1) minute to reset subsystems
3. Five (5)-minutes for an oral presentation
4. Two (2) minutes for a question and answer session
5. One (1) minute for the removal of presentation items

LEAP

A team LEAP Response is required for this event and must be submitted at event check-in (see LEAP Program).

ATTIRE

TSA competition attire is required.

PROCEDURE

Pre-conference

- A. Teams must:
 1. Identify and understand the use of subsystems within a larger system.
 2. Research and identify an engineering design process chosen as part of the event entry (Rube Goldberg mechanical device) for completion of the system.
 3. Research and gather information about the uses and purposes of the six (6) simple machines.
 4. Brainstorm ideas for possible solutions.
 5. Design and construct three (3) subsystems that can be joined together into a system to build the device.
 6. Prepare an oral presentation to further explain the team's research and solution.



Preliminary Round

1. Participants check in their entry and LEAP Response at the time and place stated in the conference program, with no more than three (3) team members at event check-in.
2. Requirements at check-in:
 - a. Documentation
 - b. Three (3) subsystems
 - c. Team LEAP Response
3. Entries are independently reviewed by judges. Neither students nor advisors are present at this time.
4. A list of twelve (12) semifinalist teams (in random order) will be posted.

Semifinal Round

1. Semifinalists will sign up for a presentation/interview time.
2. The LEAP Response will be judged for semifinalist teams.
3. All entry materials must be picked up by no more than three (3) team members at the time and place stated in the conference program.
4. Ten (10) finalists will be announced during the conference award ceremony.

REGULATIONS

Preliminary Round

- A. Documentation materials (comprising a "portfolio") are required and must be secured in a clear front report cover.
 1. The report cover must include the following single-sided, 8½" x 11" pages, in this order:
 - a. Title page with the event title, the conference city and state, the year, and the team/chapter ID number; one (1) page
 - b. Identification and explanation of engineering design process; up to six (6) pages
 - c. Explanation of usage of simple machines in each subsystem
 - d. System instructions for users
 - e. Sketches with simple machine identification labels- one(1) sketch per subsystem; three (3) pages
 - f. Bill of Materials with receipt verification for purchased items; recycled items are encouraged and should be included in this section
 - g. Project safety verification
 - h. Photographic verification of work
 - i. Plan of Work log (see Forms Appendix), maximum of three (3) pages
- B. Mechanical system:
 1. Must consist of three (3) separate subsystems
 2. Each subsystem must be placed on a 12" x 24" base, with no overhang.
 3. The completed system (all three [3] subsystems joined together) cannot be larger than 36" x 24" x 24", with no overhang.
 4. Starting and ending positions must be identified.
 5. Each subsystem must contain all six (6) simple machines and cannot be a replica or duplicate of any other subsystem used.

6. Each subsystem must be able to be reset in one (1) minute or less.
7. The sides of each subsystem may not be made of a solid wall.
8. Funnels cannot be used as screws.
9. The bases of each subsystem must touch each other when joined together to form the completed system.
10. The cost of items used in the total system must not exceed ten dollars (\$10.00), with the exception of the bases for each system.
11. All three (3) bases must use the same material with the same thickness.
12. Bases for each system may be made from any of the following materials:
 - a. wood
 - b. plastic
 - c. cardboard
 - d. foam
 - e. foam board
13. No batteries or any type of electrical power may be used in the entry.

Semifinal Round

- A. Teams are limited to three (3) team members, one (1) member from each subsystem construction; each member must be an active participant in the presentation.
- B. Time limits:
 1. Two (2) minutes for set up
 2. One (1) minute to reset subsystems
 3. Five (5) minutes for the presentation
 4. Two (2) minutes for a question and answer session
 5. One (1) minute for the removal of presentation items
- C. The LEAP Response:
 1. Teams document the leadership skills the team has developed and demonstrated while working on this event, and on a non-competitive event leadership experience.
 2. Find the specific LEAP Response regulations in the LEAP Program section of this guide, and on the [TSA website](#).

EVALUATION

Evaluation is based on:

1. The effectiveness of the documentation and the performance of the system.
2. The participants understanding of simple machines, the engineering design process, the effectiveness of the device, and the content and quality of the LEAP Response (semifinalists only).

Refer to the official rating form for more information.

STEM INTEGRATION

This event has connections to the STEM areas of Science, Technology, Engineering, and Mathematics.



CAREERS RELATED TO THIS EVENT

This competition connects to one or more of the careers below:

- Engineer
- Multimedia designer
- Product designer
- Small business owner

MECHANICAL ENGINEERING CHALLENGE EVENT COORDINATOR INSTRUCTIONS

PERSONNEL

- A. Event coordinator
- B. Judges:
 - 1. Preliminary round, two (2) or more
 - 2. Semifinal round, two (2) or more
- C. Assistants, two to three (2-3)

MATERIALS

- A. Coordinator's packet, containing:
 - 1. Event guidelines, one (1) copy for the coordinator and each judge
 - 2. TSA Event Coordinator Report
 - 3. List of judges/assistants
 - 4. Stick-on labels for identifying entries
 - 6. Results envelope with coordinator forms
- B. Display tables for entries
- C. Tables and chairs for event coordinator and judges
- D. Tables and chairs for team presentations, as needed
- E. Stopwatches

RESPONSIBILITIES

- A. At the conference:
 - 1. Attend the mandatory event coordinator's meeting at the designated time and location.
 - 2. Report to the CRC room and check the contents of the coordinator's packet.
 - 3. Review the event guidelines and check to see that enough evaluators/assistants have been scheduled.
 - 4. 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.
 - 5. At least one (1) hour before the event is to begin meet with judges and assistants to review time limits, procedures, regulations, evaluation, and all other details related to the event. If questions arise that cannot be answered, speak to the event manager before the event begins.
- B. Check-in:
 - 1. Check in the entries at the time stated in the conference program.
 - 2. Anyone reporting who is not on the entry list may check in only after official notification is received from the CRC.
 - 3. Late entries are considered on a case-by-case basis and only when the lateness is caused by events beyond the participant's control.
 - 4. Requirements for attire do NOT apply during check-in only on registration day.
 - 5. Secure the entries in the designated area.
 - 6. Each entry must include the participant's identification number in the upper right-hand corner of the entry.

C. Preliminary round:

1. Judges independently assess the entries to determine twelve (12) semifinalists.
2. Decisions about rules violations must be discussed and verified with the judges, event coordinator, and CRC manager to determine either
 - to deduct twenty percent (20%) of the total possible points in this round or
 - to disqualify the entry
3. Judges determine the twelve (12) semifinalists.
4. Review and submit the semifinalist results and all related items/forms in the results envelope to the CRC room for posting.
5. Manage the pick-up of non-semifinalist entries.

D. Semifinal round:

1. Prepare a list of standard interview questions (five to ten [5-10]) to be asked of all semifinalists.
2. At least one (1) hour before the semifinalist presentation/interviews are scheduled to begin, inspect the area(s) in which the interviews will be held for appropriate set-up, including room size, chairs, tables, outlets, etc.
3. Meet with judges to review time limits, procedures, and regulations. If questions arise that cannot be answered, speak to the event manager before the event begins.
4. Check-in semifinalists at the time stated in the conference program; confirm with the teams their order of presentation and semifinalist interview procedure.
5. Judges independently review the semifinalist presentation/interviews.
6. Decisions about rules violations must be discussed and verified with the judges, event coordinator, and CRC manager to determine either
 - to deduct twenty percent (20%) of the total possible points in this round or
 - to disqualify the entry
7. Judges determine the ten (10) finalists and discuss and break any ties.
8. Review and submit the finalist results and all related items/forms in the results envelope to the CRC room for posting.

E. If necessary, manage security and the removal of materials from the area.



Participant/Team ID# _____

MECHANICAL ENGINEERING

2018 & 2019 OFFICIAL RATING FORM

MIDDLE SCHOOL

Go/No-Go Specifications

Before judging the entry, ensure that the items below are present; indicate presence with a check mark in the box. If an item is missing, leave the box blank, and place a check mark in the box labeled ENTRY NOT EVALUATED. If a check mark is placed in the ENTRY NOT EVALUATED box, the entry is not to be judged.

- Portfolio is present
- Three (3) subsystems are present
- Completed LEAP Response is present
- ENTRY NOT EVALUATED

Criterion Performance Levels

CRITERIA	Minimal performance 1-4 points	Adequate performance 5-8 points	Exemplary performance 9-10 points
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Evaluators: Using minimal (1-4 points), adequate (5-8 points), or exemplary (9-10 points) performance levels as a guideline, record the scores earned for the event criteria in the column spaces to the right. The X1 or X2 notation in the criteria column is a multiplier factor for determining the points earned. (Example: an "adequate" score of 7 for an X1 criterion = 7 points; an "adequate" score of 7 for an X2 criterion = 14 points.) A score of zero (0) is acceptable if the minimal performance for any criterion is not met.

Static Entry (70 points)

Portfolio (X1)	Portfolio is missing three (3) or more components, and it is unorganized; it is messy and of low quality.	Portfolio has most components, is somewhat organized, and exhibits some quality.	All components are included and there is clear evidence of quality and organization.
Engineering Design Process (X2)	The description of the engineering design process is unclear, unconvincing, and lacks project details.	The description of the engineering design process includes some project details and explanation of steps in the design process.	The description of the engineering design process includes a full explanation of each step in the process; the description is defined, and detailed.
Subsystem sketches (X1)	Only one (1) or two (2) CAD drawings/sketches of the model are included with little to no labeling.	Three (3) or more CAD drawings/sketches of the model are included and are labeled.	High quality CAD drawings/sketches of the model are provided and appropriately labeled.
Bill of Materials (X2)	A Bill of Materials is included, but materials and/or prices are missing.	A Bill of Materials is included with no missing materials or prices.	A Bill of Materials is included; it includes all components and is organized by subsystem.
Six (6) Simple Machines (X1)	One (1) or more subsystems do not contain all six (6) simple machines.	All subsystems use all six (6) simple machines in traditional ways.	All subsystems use all six (6) simple machines in multiple creative ways.

STATIC ENTRY SUBTOTAL (70 points)

Rules violations (a deduction of 20% of the total possible points) must be initialed by the evaluator, coordinator and manager of the event. Record the deduction in the space to the right.

Indicate the rule violated: _____

PRELIMINARY SUBTOTAL (70 points)

Record scores in the column spaces below.



Semifinal Presentation/Interview (95 points)

CRITERIA	Minimal performance 1-4 points	Adequate performance 5-8 points	Exemplary performance 9-10 points
Organization (X1)	Participants seem unorganized and unprepared; an illogical explanation of the solution is given.	Participants are generally prepared; explanation of the solution is communicated and generally organized.	The presentation/interview is logical, well organized, and easy to follow; the solution is communicated in a concise manner.
Knowledge (X2)	Participants seem to have little understanding of the concepts in their project; answers to questions are vague.	Participants exhibit a general understanding of the concepts in their project.	Participants show clear evidence of a thorough understanding of the concepts in the project.
Articulation (X1)	The presentation/interview is full of illogical thoughts that lack clarity, and/or there is insufficient information provided that describes the project.	The presentation/interview is somewhat logical, easy-to-follow, and/or there is sufficient information provided that describes the project.	The presentation/interview is clear, concise, and there is ample information provided that describes the project.
Delivery (X1)	The team is verbose and and/or uncertain; participants' posture, gestures, and lack of eye contact diminish the presentation/interview.	The team is somewhat well-spoken and clear; participants' posture, gestures, and eye contact are adequate.	The team is well-spoken and distinct; participants' posture, gestures and eye contact result in a polished, natural, and effective presentation/interview.
Creativity of presentation (X2)	The presentation lacks imagination, originality, and detail.	The presentation is generally effective, innovative and convincing.	The presentation is inspiring, inventive, resourceful, and convincing.
Team Participation (X1)	The majority of the delivery is made by one (1) member of the team; the partner(s) may be disengaged from the presentation.	All team members generally are engaged in the process, although one (1) member may take on more responsibility than others.	All team members are actively involved in the presentation and responses to interview questions; there is a shared responsibility among the team members.
LEAP Response (10% of the total event points)	The team's efforts are not clearly communicated, lack detail, and are unconvincing; few, if any, attempts are made to identify and incorporate the SLC Practices	The team's efforts are adequately communicated, include some detail, are clear, and are generally convincing; identification and incorporation of the SLC Practices are satisfactory.	The team's efforts are clearly communicated, fully-detailed, and convincing; identification and incorporation of the SLC Practices are excellent.

SEMIFINAL PRESENTATION/INTERVIEW SUBTOTAL (95 points)
Time Deductions
A five (5)-point deduction will be incurred for any time infraction.
Rules violations (a deduction of 20% of the total possible points) must be initiated by the evaluator, coordinator and manager of the event. Record the deduction in the space to the right.
Indicate the rule violated: _____

SEMIFINAL SUBTOTAL (95 points)
TOTAL SCORE (165 points)

Comments:

I certify these results to be true and accurate to the best of my knowledge.

Evaluator
 Printed name: _____ Signature: _____