MESA DAY CONTEST RULES 2026-2027

(DRAFT)

MESA Machine: Ball Throw/Launch

LEVEL: High School (HS)

DIVISION(S): Grades 9/10 and Grades 11/12

COMPOSITION OF TEAM: 2-3 students per team

NUMBER OF TEAMS: Preliminary – Determined by your local MESA center
Regional – # of teams per division at the discretion of each region (Northern, Central, LA/Central Coast, and Southern)

SPONSORS: University of Southern California MESA College Prep

OVERVIEW: Students will design and construct a complex machine that utilizes four to eight different sequential and dependent actions from designated categories of energy/simple machines that will ultimately in the greatest amount of time throw/launch 2 ½ inch stress balls to land inside the Targets. **Participation logistics, limits, and competition facilities may vary by host site. Advisors and students are responsible for verifying this information with their local MESA center.** Students should take into consideration the transportation of projects; competition ready projects must be transported safely to the competition site.

RESOURCES: MESA Machine 2026-27 Online Modules

LAB REPORT: An **engineering lab report** is a required component of this competition that is meant to clearly demonstrate and illustrate evidence of the application of the Engineering Design Process in the MESA project. The purpose of the Engineering Lab Report is for students to better understand the process an engineer goes through in the creation of a project. MESA projects are not designed to be completed in a single class period or day, but to be the result of thoughtful research, planning, analysis and evaluation. Keeping a lab report throughout the design process will help to keep a designer on track, using a logical progression of planning, in order to develop their project efficiently.

For the Engineering Lab Report, **electronic submission will be required**. Teams should use an electronic portal/application such as Google Docs to keep and maintain a lab report. Access and permission to the lab report must then be given to MESA Day staff and judges OR lab report is submitted electronically (e.g., PDF file, WORD file) for review. **Please check with your local MESA center for the deadline and submission platform to submit your team's lab report for local and for**

regional events. See "MESA Day 26-27 Engineering Lab Report Guidelines" at https://mesa.ucop.edu/.

MATERIALS: For the complex machine, all materials are legal with the exception of hazardous materials or unsafe energy.

The Host Center will provide the following:

- 9 (nine) OFFICIAL - 2.5 inch basketball stress balls (orange color) or equivalent per trial
- 2 (two) Home Depot 5-Gallon Orange Homer Buckets or equivalent
- Safety goggles

GENERAL RULES:

1) The students' full name, grade level, school name, and MESA center must be clearly labeled on the machine. A 10% penalty in the team score will be assessed for failing to properly label.
2) The complex machine must be initiated by a single operation of pulling a string provided by the team; the string or cord may be any type, thickness, material, etc. The pulling of the string MUST be performed outside of the *Safety Zone* (see Attachments/Appendix).
3) All parts of the complex machine (i.e., the MESA Machine) must fit into a 50 cm by 50 cm by 50 cm cube (i.e., the *Machine Zone*). No parts, including moving parts such as marbles and levers, may extend outside of the *Machine Zone* at any time during inspection or during competition, except the parts for the single operation to initiate the machine in Rule 2.
4) No human or other assistance, interference, aid, etc. may be used for the entire operation of the complex machine (i.e., the machine must do all the work) AFTER the initiation of pulling the string.
5) The complex machine must incorporate between four (4) to eight (8) actions that are sequential and dependent upon the previous action. Each of the four to eight actions MUST **only** use one of the following listed categories of energy/simple machines:
    a) Categories of energy/simple machines, **which MUST be safe and not cause personal injury or damage to host facilities**, are LIMITED to the following:
        i) Gravity (e.g., free fall, ramps, etc.)
        ii) Springs or rubber bands (e.g., tension springs, bungee cords, torsional springs, mousetrap, etc.)
        iii) Levers or pulleys (e.g., seesaw, bottle opener, tongs, fixed pulley, movable pulley, compound pulley, etc.)
        iv) Electronics (e.g., DC motors, circuit boards, generators, sensors, etc.) - electrical power will NOT be provided
        v) Pressured fluids (e.g., air or water)
    b) Four (4) different categories of energy/simple machines listed above MUST be used.
    c) Sequential and dependent actions MUST use a different category of energy/simple machines (e.g., free fall using gravity to a ramp using gravity will be counted as one action, a circuit board using electronics to a DC motor using electronics will be counted as one action, etc.).
    d) Each of the four (4) to eight (8) actions MUST be clearly identified/labeled as "1", "2", "3", "4", etc. next to the corresponding action with a marker, masking tape, label or similar. A separate 10% penalty in the team score will be accessed for failing to label actions.

   e) Use of energy/simple machines not listed will NOT be counted as actions or categories of energy/simple machines.
   f) The action to initiate the machine does NOT count as one of the four (4) to eight (8) actions.
   g) The sequence of actions must end with an action or actions that throw/launch the official 2.5 inch stress balls.
      i) Official stress balls may not be used in any action other than the action that throws/launches the balls.
6) The complex machine must throw/launch the official 2.5 inch stress balls within 90 seconds of the initiation.
   a) Balls may be thrown/launched one at a time, in groups, or all at once.
   b) 9 (nine) official 2.5 inch stress balls will be given per trial; not all 9 balls have to be used.
   c) Stress balls may NOT be altered or modified in any manner.
7) The complex machine must have moving parts visible at all times to verify actions and categories of energy/simple machines (see General Rule 5).
8) All construction materials are acceptable, with the exception of explosives, caustic chemicals, or other hazardous materials that may cause personal injury or damage to host facilities.
9) Digital media (e.g., photos, video recordings, etc.) will not be accepted for judging purposes. **All judging decisions are final.**
10) The complex machine and lab report must be the original work of the students. Judges may ask questions to confirm authenticity.

JUDGING:

1) Machines will be checked for specifications prior to the start of the competition. Teams that do meet specifications after this initial check will have an opportunity to compete if they meet ALL of the following conditions:
   a) Accept an automatic "Mistrial" and therefore no score for Trial #1.
   b) Make repairs/modifications as necessary to bring the device to proper specifications and be ready to compete when called for Trial #2.
   c) Make repairs/modifications only in the designated area as indicated by the judges.
   d) Failure to adhere to any of a, b, or c will result in disqualification.
2) Teams that meet the specification check but wish to make repairs and modifications may do so, but they MUST be ready to compete when called for Trial #1.
3) Modifications and repairs are allowed during the competition; however, the team must provide all parts, materials, and supplies. During each trial, machines will be rechecked for the number of actions and corresponding categories of energy.
4) Each team will be allowed two (2) non-consecutive trials.
5) Each team must be ready within 1 minute of being called, or the team will forfeit that trial.
6) Each team will be given up to 120 seconds (2 minutes) to prepare the machine, make ready the official 2.5 inch stress balls, and **verify the machine actions** (i.e., each action) to the judge.
7) One team member will be responsible for the initiation of the machine (i.e., pulling of the string); the entire body, including hands and fingers, of the member must be outside of the *Safety Zone* (this is to ensure the safety of the student). The designated member will indicate to the judge the machine is ready. The team member must wait until the judge gives the "START" order.
8) Judge will record the following:
   a) For **machine points**, the number of actions will be determined by those that are executed (i.e., only actions that work will be counted).
   b) For **time points**, time will be measured to the nearest 00.01 seconds from the initiation of

the machine (i.e., "START" order) to the end of the last ball thrown/launched.

c) For **target points**, points will be given for 2.5 inch stress balls with a **final resting position** inside the Targets at the end of the trial. See Attachments/Appendix for competition area specifications.

9) If the machine does not throw/launch the official 2.5 inch stress balls within 90 seconds of the initiation of the machine, the judge will only award points for the number of actions executed up to the 90 seconds limitation (i.e., points will be given for Machine Actions and zero (0) points will be given for both Machine Time **and** Target).
10) Team members may not touch, assist, aid or interfere with the machine once the string is pulled.
11) The order of the competition will be randomly selected.
12) All team members and spectators must stand outside of the *Safety Zone* during each trial. Only judges are allowed inside the *Safety Zone*.

SCORING:

1) **Machine Action Points** (maximum of 24 points)
   a) 3 points for each sequential and dependent action executed
2) **Machine Time Points** (maximum of 24 points)
   a) 1 to 29.99 seconds = 6
   b) 30 to 59.99 seconds = 12
   c) 60 to 90 seconds = 24
3) **Target Points** (maximum of 27 points)
   a) 2 points for Target 1
   b) 3 points for Target 2
4) Team Points = Machine Action Points + Machine Time Points + Target Points
5) Final Team Score = (Team Points - Penalties) + Engineering Lab Report Points
6) **TIEBREAKER:** if there is a tie, the lightest machine will be the winner.

AWARDS:

- Teams who do not submit an Engineering Lab Report will NOT be eligible for any awards.
- Awards will be given per division: Grades 9/10 and Grades 11/12.
- Medals will be awarded for 1st, 2nd, and 3rd place based on the highest Final Team Score.
- Ribbons will be awarded for Innovative Engineering Design.
- Only teams that place in the Team Score category will advance to Regional MESA Day; please check with your MESA center to determine the number of teams that advance to Regional MESA Day.

ATTACHMENTS/APPENDIX:

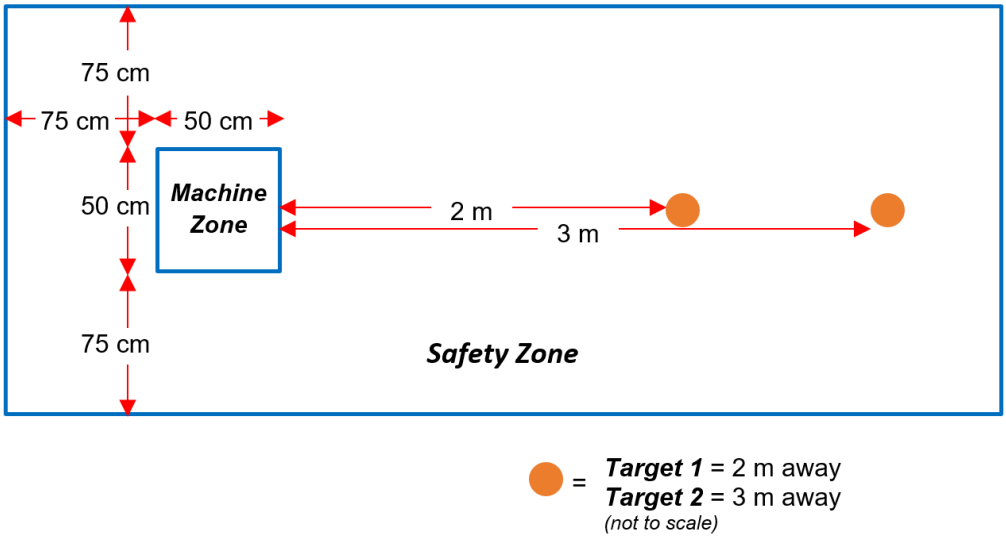
- A: MESA Machine 2026-2027 Online Modules
- B: Competition Area Specifications
- C: Recommended Equipment
- D: Judging Recommendations
- E: MESA Machine Specifications Checklist
- F: Inspection & Score Sheet for The MESA Machine

A: MESA Machine 2026-2027 Online Modules

- Learn about the project, get clarifications on competition rules, and consider important science and mathematical concepts (includes Judging Resources)

B: Competition Area Specifications

- *Machine Zone* is 50 cm by 50 cm.
- *Safety Zone* is 2 meters by 5 meters.
- *Target 1* is a Home Depot 5-Gallon Bucket or equivalent **2 meters** from and centered to the *Machine Zone*; the front edge of the bucket is 2 meters away from the *Machine Zone*.
- *Target 2* is a Home Depot 5-Gallon Bucket or equivalent **3 meters** from and centered to the *Machine Zone*; the front edge of the bucket is 3 meters away from the *Machine Zone*.



C: Recommended Equipment

- Scale to weigh machines
- Measuring tape (metric)
- Blue painter's tape to outline the *Machine Zone* and *Safety Zone*
- Official 2.5 inch basketball stress balls (orange color)
- 2 Home Depot 5-Gallon Orange Homer Buckets with tissue paper lining bottom of buckets
- 1 stop watch to record trial time
- 3 safety goggles (required)

D: Judging Recommendations

At least three (3) judges are recommended with the following roles:

- 1 = Lead Judge / Machine Monitor 1 to determine number of actions executed; judge may request the help of one team member to verify number of actions executed and to determine the last ball thrown/launched.
- 1 = Machine Monitor 2 to judge no parts extending outside of the *Machine Zone*.
- 1 = Time Keeper
- Additional judges can assist with competition management (e.g., flow of teams, instructions, etc.)

E: MESA Machine Specification Checklist

This checklist is provided **ONLY** as a reference for teams to "pre-inspect" their MESA Machines to ensure they meet the rules specifications. Teams may check-off each of the following items after comparing their competition-ready MESA Machine with the rules. **This checklist will NOT be used by judges.**

- ☐ 2026-2027 rules are used.
- ☐ Engineering Lab Report is properly labeled with team members' full names, grade level, school name, and MESA Center.
- ☐ MESA Machine is properly labeled with team members' full names, grade level, school name, and MESA Center.
- ☐ The machine is initiated by a single operation of pulling a string (provided by the team) outside the Safety Zone.
- ☐ All parts of the machine, including moving parts, fit into a 50 cm by 50 cm by 50 cm cube.
- ☐ Incorporates 4 to 8 actions that are sequential and dependent upon the previous action.
- ☐ 4 different categories of the **listed categories of energy/simple machines** are used.
- ☐ No hazardous materials or unsafe energy are used.
- ☐ Each action uses alternating categories of energy/simple machines.
- ☐ Each of the actions are labeled as "1", "2", "3", etc. on the MESA Machine.
- ☐ The last action or last set of actions of the machine are able to throw/launch the official stress balls.

F: INSPECTION AND SCORE SHEET FOR THE MESA MACHINE

High School – Grades 9/10 and Grades 11/12

Copies of this inspection and score sheet will be provided by the MESA Day Host Center.

Student Names: _____. Grade: **9/10** or **11/12** (circle one)

School: _____. MESA Center: _____.

List four to eight actions of machine	List corresponding category of energy used (see Rule 5)
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.

Section below to be completed by JUDGES

INSPECTION LIST:	YES	NO
All parts of the machine fit into 50 cm x 50 cm x 50 cm	☐	☐
Machine is initiated by pulling a string outside of the Safety *Zone*	☐	☐
Machine incorporates four (4) to eight (8) actions (see Rule 5)	☐	☐
Machine uses four (4) different categories of energy/simple machines (see Rule 5)	☐	☐
No hazardous materials or unsafe energy are used	☐	☐
Machine labeled properly (students' full name, grade, school name, and MESA center)	☐	☐
Each Machine Action clearly identified/labeled (1, 2, 3, 4, etc.)	☐	☐
Engineering Lab Book Submitted (teams who did not submit will NOT be eligible for awards)	☐	☐

Machine Weight: _____. **Innovative Engineering Design (ranking – 1, 2, 3, etc.):**_____

TRIAL 1					
Machine Actions		**Machine Time**		**Target** *(inside Target)*	
# of actions executed *(see Rule 5 – max. of 8)*	x 3	1-29.99 sec = 6 30-59.99 sec = 12 60-90 sec = 24	> 90 s = 0 points	**Target 1**	x 2 =
				Target 2	x 3 =
Points		+ Points		+ Points	

Trial 1 Mistrial (reason): **TRIAL 1 TEAM PERFORMANCE SCORE: =** _____.

TRIAL 2					
Machine Actions		**Machine Time**		**Target** *(inside Target)*	
# of actions executed *(see Rule 5 – max. of 8)*		1-29.99 sec = 6 30-59.99 sec = 12 60-90 sec = 24		**Target 1**	x 2 =
	x 3		> 90 s = 0 points	**Target 2**	x 3 =
Points		+ Points		+ Points	

Trial 2 Mistrial (reason):

TRIAL 2 TEAM PERFORMANCE SCORE: = _____.

FINAL TEAM SCORE (best of two trials)

Best of two trial Team Scores (max score of 75)	
Machine Labeling (names, grade level, school, center) Penalty (10%)	-
Machine Action (i.e., 1, 2, 3, 4, etc) Labeling Penalty (10%)	-
Subtotal	=
Engineering Lab Report Points (0 to 25 points)	+
Final Team Score	

*Teams who did not submit an Engineering Lab Report will **NOT** be eligible for any awards.*