



MESA DAY CONTEST RULES 2017 - 2018

The MESA Machine: Ball Launch

- LEVEL:** Grades 6 and 7/8
- TYPE OF CONTEST:** Team
- COMPOSITION OF TEAM:** 2-3 students per Team
- NUMBER OF TEAMS:** Preliminary – As determined by your local MESA Center
Regional – 3 for 6th Grade; 3 for 7th/8th Grade per Center
- SPONSOR:** Ben Louie, Associate Director, USC MSP

OVERVIEW: Students will design and construct a device that utilizes three to six different sequential and dependent actions from three different energy/simple machine categories that will ultimately launch a vinyl kick ball the farthest distance in the least amount of time. Students must design their device to be transported by bus or car. **Participation logistics and limits and competition facilities may vary by host site. Advisors and students are responsible for verifying this information with their Center Director.**

An engineering notebook is a required component of this competition. The purpose of the Engineering Notebook is for students to more closely follow the practices of an engineer in the completion of their MESA Day project. The Engineering Notebook will encourage students to take a purposeful and sustained approach to building their devices. 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. The notebook should provide a written record of the thought and insight that a student put into their project, from initial ideas to the final completed project.

MATERIALS: For the device, all materials are legal with the exception of remote control devices, hazardous materials, or unsafe energy.

For the Engineering Notebook, any standard notebook, including but not limited to spiral and subject notebooks and composition books may be used. Notebook page size must be equivalent or greater than that of a composition book page (approx. 9.75" length x 7.5" width). Pocket sized notebooks, post it notes, flashcards, etc. cannot be used. Computer generated notebooks and/or pages are allowed.

The Host Center will provide the following:

- 2-inch vinyl kick ball / hacky sack weighing between 25 and 30 grams
- Safety goggles

GENERAL RULES:

- 1) The students' full name, school name, grade and MESA Center must be clearly labeled on the device. A 10% penalty in the score will be assessed for failing to properly label.
- 2) All parts of the device must fit into a 75 cm by 75 cm by 75 cm cube. No parts may extend outside of the defined cube at any time during inspection or during competition, except the single operation to initiate the device in Rule 3.
- 3) The device must be initiated by a single operation (e.g. pull a string, flick a switch, cut a string, push a button, etc.) provided by the team. The single operation **MUST** be performed outside of the *Safety Zone* and the *Landing Zone* (see Supplemental Section).
- 4) No human power may be used to add potential or kinetic energy for the entire operation of the device, including initiation.
- 5) The device must incorporate between three (3) to six (6) actions that are sequential and dependent upon the previous action. Each of the three to six actions **MUST** 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
 - b. Three (3) 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 (i.e. a free fall using gravity to a ramp using gravity will be counted as one action).
 - d. Use of energy/simple machines not listed will NOT be counted as actions or categories of energy/simple machines.
 - e. The action to initiate the device does NOT count as one of the three to six actions.
 - f. The sequence of actions must end with an action that launches the vinyl kick ball.
- 6) The device must be able to load the host supplied vinyl kick ball prior to the initiation of the device. No alterations to the vinyl kick ball are allowed.
- 7) The device must launch the vinyl kick ball within 60 seconds of the initiation of the device.
- 8) The device must have moving parts visible at all times once the device is initiated to verify actions and categories of energy/simple machines (see Rule 5).
- 9) All construction materials are acceptable, with the exception of remote control devices, explosives, caustic chemicals, or other hazardous materials that may cause personal injury or damage to host facilities.
- 10) The engineering notebook must contain the following sections with each section tabbed/labeled:
 - a. Proper Labeling
 - i. Proper labeling is required of each notebook. Students must have group member names, grades, school and MESA center on the inside cover of their MESA Engineering Notebooks.
 - b. Project Introduction
 - i. A one page introduction for the project. Students can write about why they chose the project that they are worked on and what challenges they expect to run into with this project. They may also briefly describe the project criteria and constraints. This introduction should be honest and genuine.

- c. Daily Entries
 - i. At least ten daily entries will be required. Each entry must have the date of entry and be at least half a page long. They should answer the following questions:
 - What did you work on/discuss today?
 - What was the result of your work?
 - What do you need to do during your next meeting?
- d. Project Sketches
 - i. Notebooks must contain at least two distinct project sketches that should be placed towards the back or end of the completed notebook pages. The sketches should indicate a progression in the thinking and design of the device, and be detailed. Sketches must be larger than half a page, and can either be drawn on the notebook page directly or attached.
- e. Applied Mathematics
 - i. Notebooks must contain evidence of two (2) applied mathematics principles as it pertains to the project. This section **MUST** include the calculations for both the following:
 - Calculate the speed of your vinyl kickball by using $d = rt$.
 - Calculate the potential energy for each and every action using gravity as the category of energy/simple machines by using $PE = mgh$. Label the corresponding action for each calculation.

JUDGING:

- 1) Devices will be checked for specifications prior to the start of the competition. If devices are disqualified during the specification check, design changes will not be allowed.
- 2) Each device will be allowed two (2) non-consecutive launches.
- 3) Repairs are only allowed with replacement parts and materials.
- 4) Each device must be ready when called or team will forfeit that launch.
- 5) Each team will be given up to 90 seconds to prepare device, load vinyl kick ball, and verify to the judge the three to six actions and the three different categories of energy/simple machines.
- 6) One team member will be responsible for the initiation of the device and will indicate to the judge that the device is ready to launch. The team member must wait until the judge gives the "START" order.
- 7) Judge will record the following:
 - a. Time will be measured from the initiation of device (i.e. "START" order) to the time the device launches the vinyl kick ball to the nearest 00.01 seconds.
 - b. Distance will be measured from the *Launch Line* to the point where the vinyl kick ball initially lands or leaves the designated *Landing Zone*; measurement will be done perpendicular to the *Launch Line*. See Supplemental Section for competition area specifications.
- 8) If the device does not launch the vinyl kick ball within 60 seconds of the initiation of the device, the judge will declare a mistrial; team will receive zero (0) points for that launch.
- 9) Team members may not touch or interfere with the device once the initiation has been triggered.
- 10) The order of the competition will be randomly selected.
- 11) All team members and spectators must stand outside of the *Safety Zone* and the *Landing Zone* during each launch. Only judges are allowed inside *Safety and Landing Zones*.

SCORING:

- 1) Device points = 4 points for each sequential and dependent action. (max. of 24 points)

- 2) Distance-to-time ratio = distance in meters (00.000) divided by launch time in seconds (00.00).
- 3) Team Score = device points + distance-to-time ratio.
- 4) The best team score of the two launches will be used.
- 5) A deduction of 20% of the best team score will be assessed for a missing or incomplete engineering notebook.

AWARDS:

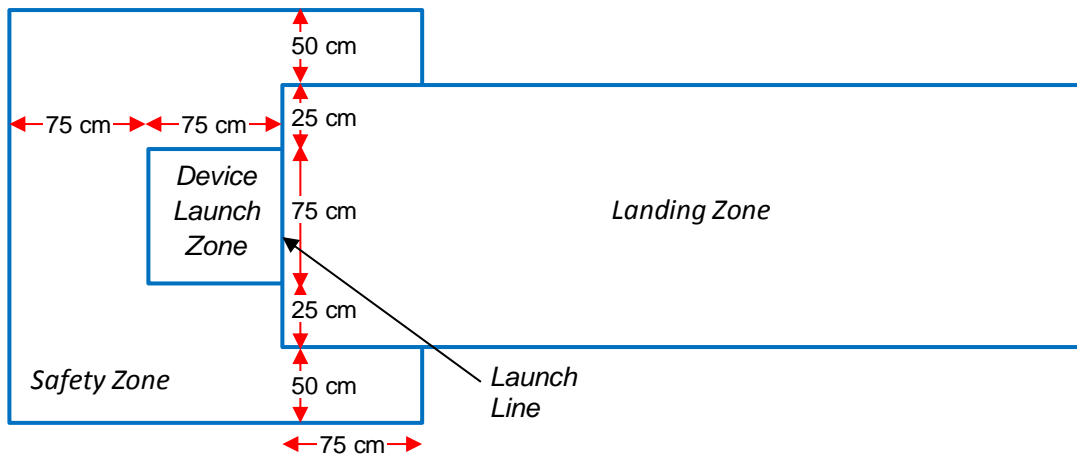
- Awards will be given per grade level: 6th grade and 7th/8th grade.
- Medals will be awarded for 1st, 2nd and 3rd place based on greatest team score.
- Ribbons will be awarded for Innovative Engineering Design.
- Only teams placing in the team score category will advance to Regional MESA Day.

ATTACHMENTS/APPENDIX:

- Competition Area Specifications
- Recommended Equipment
- Inspection & Score Sheet for The MESA Launcher
- Engineering Notebook Requirement Rubric

Competition Area Specifications:

- *Device Launch Zone* is 75 cm by 75 cm and centered along a 125 cm wide *Landing Zone*.
- *Safety Zone* is 2.25 meters by 2.25 meters and centered to the *Device Launch Zone*.
- *Landing Zone* is 1.25 meters wide by at least 10 meters long.



Recommended Equipment

- 2 inch vinyl kick balls / hacky sacks
- Measuring tape (metric)
- Blue painters tape to outline the *Device Launch Zone*, *Safety Zone*, and *Landing Zone*
- 1 stop watch to record launch time
- 3 safety goggles (required)

INSPECTION AND SCORE SHEET FOR THE MESA MACHINE

Middle School – Grades 6 and 7/8

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

Student Names: _____ Grade: **6** or **7/8** (circle one)

School: _____ MESA Center: _____

List three to six actions of device

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

List corresponding category of energy used (see Rule 5)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Section below to be completed by Judges

INSPECTION LIST:	YES	NO
All parts of device fit into 75 cm x 75 cm x 75 cm	<input type="checkbox"/>	<input type="checkbox"/>
Device is initiated by a single operation performed outside of <i>Safety</i> and <i>Landing Zones</i>	<input type="checkbox"/>	<input type="checkbox"/>
Device incorporates three (3) to six (6) actions that are sequential and dependent upon the previous action (do not count action to initiate device as one of the three to six)	<input type="checkbox"/>	<input type="checkbox"/>
Three (3) different categories of energy/simple machines used	<input type="checkbox"/>	<input type="checkbox"/>
Device able to load vinyl kick ball prior to the initiation of device	<input type="checkbox"/>	<input type="checkbox"/>
No remote control devices, hazardous materials, or unsafe energy are used	<input type="checkbox"/>	<input type="checkbox"/>
Device labeled properly (students' full name, school name, grade and MESA Center)	<input type="checkbox"/>	<input type="checkbox"/>

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

LAUNCH 1

of sequential and dependent actions (*see Rule 5*): _____ x 4 =

Distance (00.000 meters): _____ ÷

Launch Time (00.00 seconds): _____ =

Device Points: _____ + **Distance/Time Ratio:** _____

Mistrial (reason): _____

TEAM SCORE: = _____

LAUNCH 2

of sequential and dependent actions (*see Rule 5*): _____ x 4 =

Distance (00.000 meters): _____ ÷

Launch Time (00.00 seconds): _____ =

Device Points: _____ + **Distance/Time Ratio:** _____

Mistrial (reason): _____

TEAM SCORE: = _____

Device Labeling Penalty (10% of best of two launch Team Scores) - _____

Engineering Design Notebook Penalty (20% of best of two launch Team Scores) - _____

Final Team Score (best of two launches) _____

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Engineering Notebook Requirement Rubric

Please use this rubric to assess notebook entries. An incomplete or missing notebook will lead to a 20% deduction from the total team score.

Criteria		YES	NO
1	Is the notebook properly labeled? <i>(Names, Grades, School, MESA Center)</i>		
2	Does the notebook contain a one page introduction to the project? <i>(On the first page of the notebook)</i>		
3	Are there at least 10 dated entries in the notebook?		
4	Is each entry at least half a page long?		
5	Are there at least two distinct project sketches included?		
6	Is there evidence of the following two (2) applied mathematics principles? - Calculate the speed of the vinyl kickball by using $d = rt$. - Calculate the potential energy for <u>each and every action</u> using gravity as the category of energy by using $PE = mgh$. Label the corresponding action for each calculation.		
TOTAL			

Does the notebook meet the requirement? (circle one) **YES** **NO**
Notebooks must meet ALL 6 criteria to fulfill this requirement