MESA DAY CONTEST RULES 2018 – 2019

(Version 10.31.18 / Updates denoted by *)

Wright Stuff Glider

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 – 1 for 6th Grade, 1 for 7th/8th Grade per Center

SPONSOR: Ana Rodarte, Interim Assistant Director, UC Santa Cruz MSP

OVERVIEW: Students will design and construct a glider that, when launched by the official supplied launcher, flies through the air and lands on a ground target located 12.2 meters (40 feet) directly in front of the launch area and marked by a "+". The glider must be the original work of the students. Judges may ask questions for verification. **Participation logistics, limits, and competition facilities may vary by host site. Advisors and students are responsible for verifying this information with their center director.**

An Engineering Lab Book is a required component of this competition. The purpose of the Engineering Lab Book is for students to more closely follow the practices of an engineer in the completion of their MESA Day project. The Engineering Lab Book 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 lab book should provide a written record of the thought and insight a student put into their project, from initial ideas to the final completed project. Teams that do not turn in an Engineering Lab Book will receive a 50% deduction in their overall score and will be ineligible to place. Teams with an incomplete lab book will receive a 20% deduction in the overall score. Please refer to the Engineering Lab Book Grading Matrix for specifics on what constitutes a missing or incomplete lab book.

MATERIALS*: **LEGAL**: Various materials may be used to build the glider; Materials are not limited to wood. Students should consider the strength of the material needed to withstand the force of the launcher.

ILLEGAL*:

- Hazardous materials (to be determined by the host center).

- Additional power source(s) (thrust, lift or stored energy that assists dynamic flight) may NOT be supplied. The only power source allowed is the official glider launcher.
- Remote control devices of any kind.

The Host Center will provide the following*:

- One table for the launcher, 2 tables for the impound station, and 1 table for the repair station.
- Two official launchers as described in these rules; one launcher will serve as the backup
- Safety goggles

For the Engineering Lab Book, three format options are available for submittal; please check with your local center director for the format required for your preliminary event. **Electronic submissions will be required at the Regional/State level.**

Electronic Lab Book
Teams use an electronic portal/application such as Google Docs to keep and maintain lab book. Access to such a lab book is then given to MESA Day staff and judges OR lab book is submitted electronically (e.g. PDF file) for review.

Printed/Written Pages
Teams record their lab book entries by hand or typed through a program like Microsoft Word. Printed/handwritten loose-leaf pages are then submitted (pages must all be well organized and clipped/stapled together).

Standard Lab Book
Teams use a standard notebook (composition books, spiral notebooks, subject notebooks, etc.). The lab book page size must be equivalent or greater than that of a composition book page (approx. 9.75" length x 7.5" width). Pocket-sized books, post it notes, flashcards, etc. cannot not be used.

***GENERAL RULES:**

1) The students' full name, school name, grade and MESA Center must be clearly labeled on the device. Failure to properly label will result in a 10% penalty deduction from the final score.
2) *Teams may only register/turn-in one glider for the competition.
3) *For the purpose of this competition, a glider is defined as a self-contained flying vehicle that remains intact during flight. The glider cannot have links of any kind with the ground that provide lift, propulsion or course guidance during the flight.
4) Glider parts that break off during LANDING are permissible but are not encouraged.
5) ***If parts of the glider break off DURING flight, the flight is considered a MISTRIAL. Flights that result in a mistrial are NOT eligible for points.**
6) The glider must contain an easily identifiable, prominent feature on the fuselage that adapts to the launch hook to allow for a smooth launch.
7) Any glider that alters or damages the launch hook will be DISQUALIFIED

8) The glider must have features to avoid being caught in the slot in the launch ramp. Wheels and skids must be positioned to avoid the slot.
9) The glider can be made from any materials. There are no restrictions on size or weight. The glider must be capable of being launched on the launch ramp by the hook and must have an identifiable fuselage, wing, and tail. Gliders without the required components will be disqualified.
10) *Remote-control devices of any kind may be used. Any devices that operate on the glider must be self-contained and may not provide any thrust to the glider.
11) *Additional power source(s) (thrust, lift, or stored energy that assists dynamic flight) may NOT be supplied. The only power source allowed is the official glider launcher.
12) *The decision of the judges regarding the location of the glider's first-touch point (landing location) is considered final and is not subject to debate. Digital media (photos and/video recordings) will not be accepted for arbitration purposes.

Engineering Lab Book

The Engineering Lab Book must contain the following sections with each section divided/labeled:

a) **Proper Labeling**: Proper labeling is required of each lab book. Students must have group member's names, grades, school, and their MESA center on the inside cover or front pages of their lab book.
b) **Identify the Problem**: Clearly state the challenge being worked on, talk about the constraints, limits of your projects, and how to solve the problem.
c) **Explore**: Research the work others have done on this subject. You will need to cite and describe 5 resources.
d) **Design**: Brainstorm at least 3 ideas (sketches). Using your 3 sketches, choose 1 and create a plan (min. 5 sentences) to build your prototype and generate a list of materials.
e) **Create**: Using the plan from the Design step, build your prototype and provide a picture of your finished work (this is not the final iteration of your glider).
f) ***Try It Out**: Conduct 3 trials for your glider. Measure the results of the trials using the performance criteria, and provide evidence of at least 2 appropriate math concepts.

Use of mathematical concepts/equations: MESA has provided a set of equations to help you along the way. While these equations are not mandatory to use, they should provide a roadmap to completing the math concepts.

1. Final Velocity = $\frac{\text{2 x displacement of glider}}{Time} - Initial\ Velocity$
2. *Force (F) = mass (m) x acceleration (a)→ F = ma*

Applicable Math Concept/equation (state concept/equation): Calculating Final Velocity

Both final and initial velocity are measured in meters per second (m/s), time is measured in seconds (s), and displacement is measured in meters (m). To find the final velocity, we can rewrite the equation for displacement.

How to rewrite the Displacement Formula.

Step 1: $Displacement\ of\ Glider = \left(\frac{Final\ Velocity + Initial\ Velocity}{2}\right)\ x\ Time$

Step 2: 2 x Displacement of Glider = (Final velocity + Initial Velocity) x Time

Step 3: $\left(\frac{2\ x\ Displacement\ of\ Glider}{Time}\right) = Final\ Velocity + Initial\ Velocity$

Step 4: $\left(\frac{2\ x\ Displacement\ of\ Glider}{Time}\right) - Initial\ Velocity = Final\ Velocity$

Rewritten Formula: Final Velocity = $\left(\frac{2\ x\ Displacement\ of\ Glider}{Time}\right) - Initial\ Velocity$

Since your glider is starting at rest, the initial velocity will be 0 m/s, the time will be the time of your flights duration, and the displacement will be how far your glider traveled.

Example: If your glider traveled 7 meters in 5 seconds. What was the final velocity of your glider?

Rewritten Formula: Final Velocity = $\left(\frac{2\ x\ Displacement\ of\ Glider}{Time}\right) - Initial\ Velocity$

Step 1: Plug in known Variables: Final Velocity = $\left(\frac{2\ x\ 7\ meters}{5\ seconds}\right) - 0\ \left(\frac{meters}{second}\right)$

Step 2: Solve for Final Velocity: Final Velocity = $\left(\frac{14 meters}{5\ seconds}\right) \rightarrow Final\ Velocity = 2.8\ \left(\frac{meters}{second}\right)$

Applicable Math Concept/equation (state concept/equation): Calculating Force

Force is measured in Newtons (N), mass is measured in kilograms (kg), and acceleration is measured in meters per second squared (m/s^2). The mass of the glider is calculated by weighing it. The formula for force is denoted above and the formula for acceleration is:

$$Acceleration = \left(\frac{Final\ Velocity - Initial\ Velocity}{Time}\right)$$

Since the glider will be at rest, the initial velocity will be 0 meters/second. The time will be the amount of time that it takes your glider to hit the ground (first touch point). You can use the formula denoted above to calculate final velocity. Using the final velocity form the previous example, we know that the final velocity is 2.8 meters per second (m/s). We also know that the time it took to achieve this velocity is 5 seconds. Given that the initial velocity is zero, we can now calculate acceleration (a).

$$a\ = \left(\frac{Final\ Velocity - Initial\ Velocity}{Time}\right)$$

$$a\ = \left(\frac{2.8\ \left(\frac{m}{s}\right) - 0\ \left(\frac{m}{s}\right)}{5\ seconds}\right) \rightarrow a = \left(\frac{2.8\ \left(\frac{m}{s}\right)}{5\ seconds}\right) \rightarrow a = 0.56\ (m/s\verb|^|2)$$

Now we can calculate the force being used to calculate the glider.

Example: If your glider weights 0.453592kg (1 pound) and has an acceleration of 0.56(m/s^2), calculate the force being used to move the glider.

Force = mass (kg) x acceleration (m/s^2) = Force = 0.453592kg x 0.56 (m/s^2) = 0.25N → Force = 0.25N.

g) **Make It Better**: After conducting all 3 trials, identify a minimum of 5 modifications you will make to your glider and build the final competition-ready project.

***JUDGING:**

General Specifications:

1) * Devices will be checked for specifications prior to the start of the competition. Teams that are deemed disqualified after this initial check will still have an opportunity to compete under ALL of the following conditions:
   a. Accept an automatic "Mistrial" and therefore no score for Launch #1.
   b. Make repairs/modifications as necessary to bring the device to proper specifications and be ready to compete when called for Launch #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 the disqualification being upheld.
2) *Teams that aren't disqualified but wish to make repairs and modifications may do so, but they MUST be ready to compete when called for Launch #1.

Official Launch Device:

1) The official launcher consists of a tension spring, a launch platform and a launch hook.
2) The tension spring is an 11" spring with a 0.17 pound per inch spring rate. It is available from McMaster-Carr and is Part Number 9640K243. It will be stretched 30.0 inches from its final position. The estimated tension load in the spring at the start of launch is 5.87 pounds. After launch the final length of the spring is 1.25". In the final position, the spring has a load of 0.77 pounds. In the completely relaxed state, the spring has a preload of 0.73 pounds. The spring has an outer diameter of 1.00" and a wire diameter of 0.062 inches. The mass of the spring is 170 grams.
3) The launch platform has an overall surface size of 30.5 cm (12 inches) in width and 147 cm (58 inches in length. The surface is hard and smooth and made from ¼" thick composite board or comparable material. A slot runs down the middle of the platform that is 5/35 mm (0.2 inches) wide and is 8cm (31.5 inches) long. The end of the slot is located 30.5 cm (12 inches) from the end of the launch ramp. The launch ramp is angled at 5 degrees above horizontal. The height of the ramp at the point where the hook stops moving is 100 cm (39.4 inches) above the target.
4) The launch hook is made from steel wire with a 3.4 mm (0.135 inch) diameter. It is available from McMaster-Carr and is part Number 9594T14.
5) The hook is screwed into a glide block mounted underneath the launch ramp. The mass of the hook and glide block is 35 ± 2 grams.
6) Each host center will replace their launcher's tension spring for MESA Day and will provide a new spring before the start of the glider competition(s).
7) All glider launchers will include a safety feature that will be set in place before the launcher's spring (trigger) can be released.

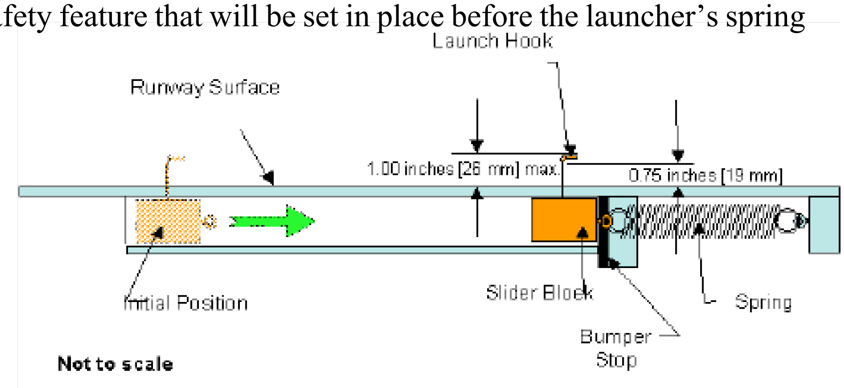


Figure 1: Launch Device – Side View

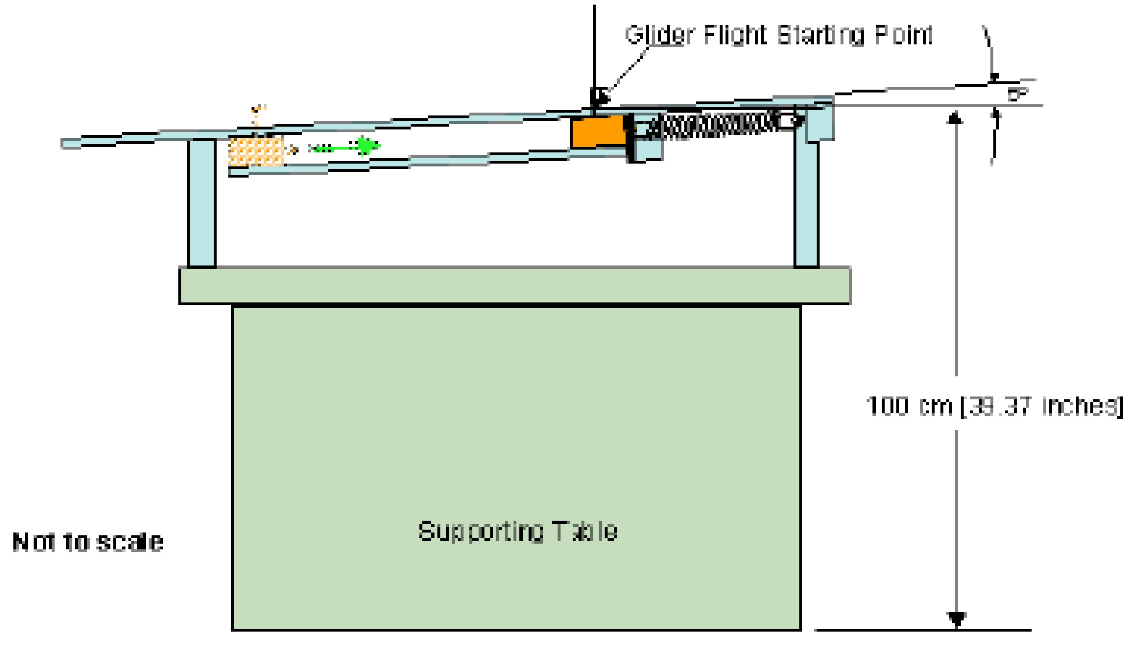


Figure 2: Launch Device Set-up – Side View

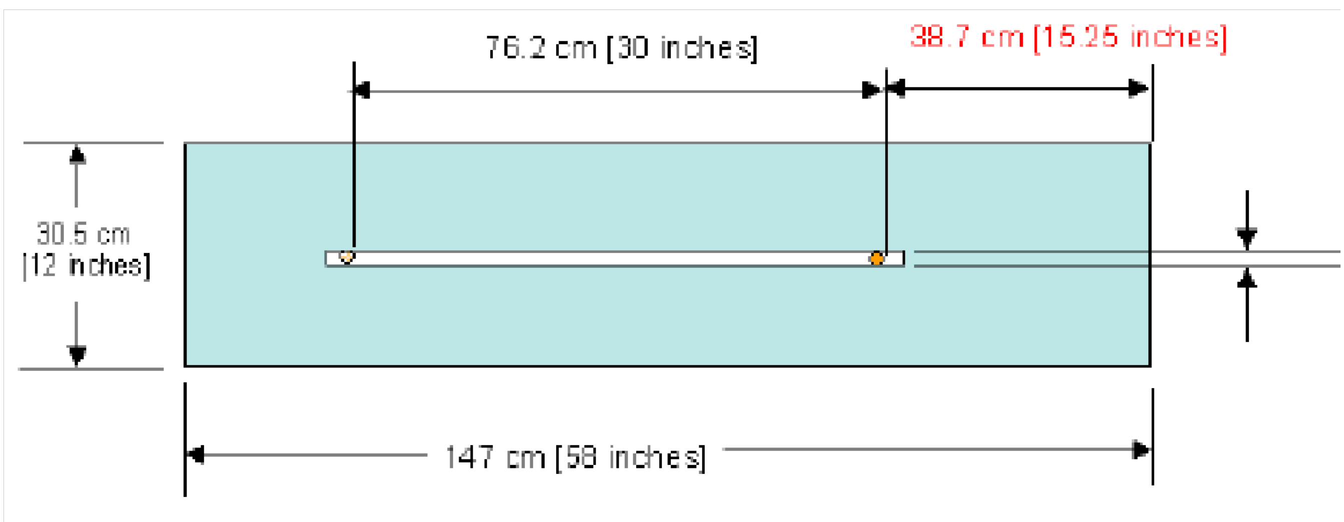
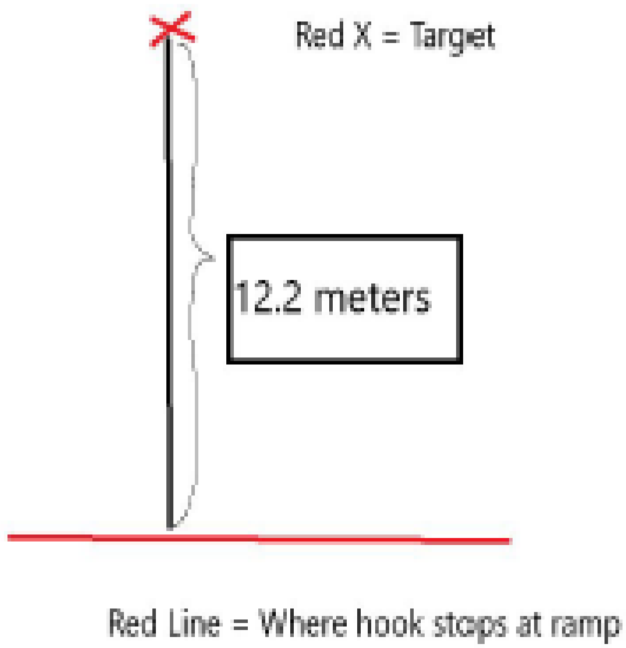


Figure 3: Launch Device – Top View

<u>*Target and Launch:</u>

1) The target is located at a distance 12.2 meters (40 feet) in front of the position where the hook stops on the launch ramp. The target is 100cm (39.4 inches) below the position where the hook stops on the launch ramp. The target is a "+" sign wherein each leg is 3cm wide and 20cm long comprised of black plastic tape.



2) Each team will have two non-consecutive opportunities to launch their glider (at the discretion of the host center). Teams will be allowed 2 minutes to set-up their glider on the launcher.
3) *Teams will be given a 30-second countdown prior to the judge pulling the launcher's release pin (releasing the trigger).
4) *Each team will remove their glider from the contest area immediately following their launch.
5) *Gliders will be impounded when not being repaired or launched. The impound is a designated area for students to leave their gliders while they wait for their non-consecutive trials.
6) *Teams have access to a repair station, where repairs and alterations can be made. All repair materials and tools MUST be turned in by the team at registration and must be supplied by the team.
7) *Only team members can hold and repair their glider. The impound and repair station areas will be supervised.
8) *The glider's first-touch point (contact with any object) will be marked by colored pieces of post-it notes. Each trial will have a specific color assigned in order to identify each trial. All flights during the first trial will use the same color post-it. The flights during the second trial will be marked by a post-it of a different color. Volunteers will indicate the glider's first-touch point on the object/ground by placing the center of the post-it note on that spot. Post-it notes can be purchased at Office Depot (Item #265333).
9) *The distance between the target's center (middle of the "+" sign) and the glider's first touch-point will be measured to the nearest 2 cm (0.75 inches).
10) *Both launches will be timed (to be used as the tie-breaker only). Times will be recorded, at a minimum, to the nearest hundredth second. The timing of the flight ends when any part of the

glider comes in contact with any object. In case of a tie, the longer flight duration (hang time) will be used as the tie-breaker. The glider with the longer single flight time will be the winner of the tie.

SCORING:

1) Launch #1 = Distance from the "+" target after first launch
2) Launch #2 = Distance from the "+" target after second launch
3) Score of the best launch= ________ minus possible deductions (50% for a missing lab book, 20% for an incomplete lab book, and/or 10% for improper labeling)
4) Final Score = Best launch – deductions (50% for a missing lab book, 20% for an incomplete lab book, and/or 10% for improper labeling

AWARDS:

- Awards will be given per grade level: 6^{th} grade and $7^{th}/8^{th}$ grade.
- For the preliminary competition, only the first place teams from each grouping (i.e. 6^{th} and $7^{th}/8^{th}$) will advance to the regional competition.

ATTACHMENTS/APPENDIX:

- Wright Stuff Glider Specification Checklist and Score Sheet
- Engineering Lab Book Grading Rubric

WRIGHT STUFF GLIDER
SPECIFICATION CHECK AND SCORE SHEET

- ☐ Glider does not use remote controls
- ☐ Glider does not require/utilize any additional power source(s)
- ☐ Capable of self-sustained flight without links to the ground for lift, propulsion or guidance
- ☐ Device includes a feature that adapts to launch hook of official launcher

Scoring

Launch #1 Distance from the "+" target = ___________________
Launch #2 Distance from the "+" target = ___________________

Score of the best launch= ________ minus possible deductions (50% for a missing lab book, 20% for an incomplete lab book, and/or 10% for improper labeling)

FINAL SCORE: ______________

MESA DAY 2018-19

Engineering Lab Book Requirement Rubric

Please use this rubric to assess lab book entries. Projects with missing lab books will receive a 50% reduction in their overall score and will be ineligible to place. Incomplete lab books will receive a 20% deduction in the overall score.

Criteria		Yes	No
1	**Is the lab book properly labeled?** *(Names, Grades, School, MESA Center)*		
2	**Identify the Need** *(at least 2 sentences for each)* State what the challenge being worked on is. What are the limits/constraints? How do you think you can you solve it?		
3	**Explore**: Research (cite/reference 5) sources, gather, and use materials.		
4	**Design**: Brainstorm at least 3 ideas (sketches, drawings or pictures). Select one, create a prototype plan (min 5 sentences), and provide a list of materials.		
5	**Create**: Build a prototype, describe the building of the prototype (min 5 sentences), and include a final picture of the prototype.		
6	**Try it Out** Conduct at least 3 trials. Measuring each trial result using specific performance criteria (distance traveled, time, etc.). Providing evidence of the use and application of at least 2 appropriate mathematical concepts in the tests.		
7	**Make Better** Evaluate results by listing at least 5 ways your project can be improved		

TOTAL		

Is this considered an **incomplete** lab book – missing 1 or 2 criteria listed? ....**NO** **YES** (-20%)
Is this considered a **missing** lab book – missing 3 or more criteria listed? .....**NO** **YES** (-50%)

Please refer to the Grading Matrix for specifics on missing and incomplete lab books