MESA DAY CONTEST RULES
2019 – 2020

Wright Stuff Glider Competition

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 MESA launcher, flies through the air and lands on a target that is located 12.2 meters (40 feet) away directly in front of the launch area. The target will be marked as + symbol on the ground. The glider must be the original work of each team. Judges may ask questions to team members for verification. **Participation logistics, limits, and competition facilities may vary by host site. Advisors and students are responsible for familiarizing themselves with and confirming the competition logistics and facilities 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 demonstrate the use of the engineering design process within their project, i.e. thoughtful research, planning, analysis and evaluation. Teams that do not turn in an Engineering Lab Book will receive a 50% deduction in their overall score and will be ineligible to earn a 1st-3rd place medal. Teams with an incomplete lab book will receive a 20% deduction in the overall score. Refer to the Engineering Lab Book Grading Matrix for specifics on what constitutes a missing or incomplete lab book.

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

The Host Center will provide the following:

- 1 table for the launcher
- 2 tables for the impound station
- 1 table for the repair station
- Two official launchers as described in these rules; one launcher will serve as back-up. Each launcher will have a new spring and launch hook at the beginning of the contest.
- Safety goggles for group members and judges

OFFICIAL LAUNCHER:

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.
4) 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.
5) *The launch hook is made from steel wire with a 4.064 mm (0.160 inch) diameter. It is available from McMaster-Carr and is part Number 9594T13.*
6) 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.
7) Each host center will replace their launcher's tension spring and launch hook for all MESA Day events and will provide a new spring and launch hook before the start of the glider competition(s).
8) All glider launchers will include a safety feature that will be set in place before the launcher's spring (trigger) can be released.

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9) *Glider must be capable of resting on the launch hook in a hands-free position prior to launch. Failure to meet this requirement will result in a disqualification,*

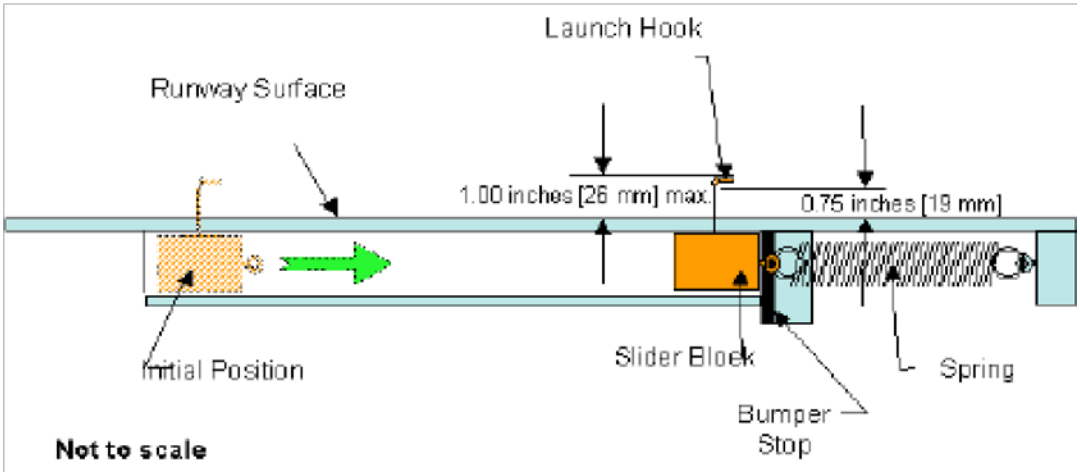

Figure 1: Launch Device – Side View

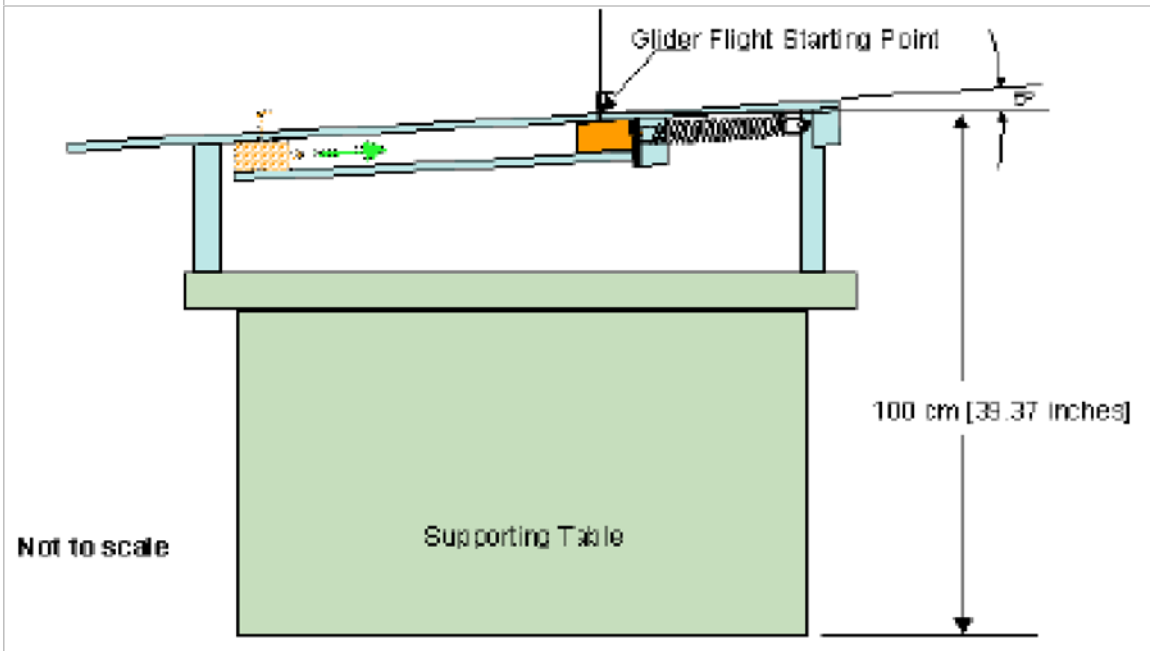

Figure 2: Launch Device Set-up – Side View

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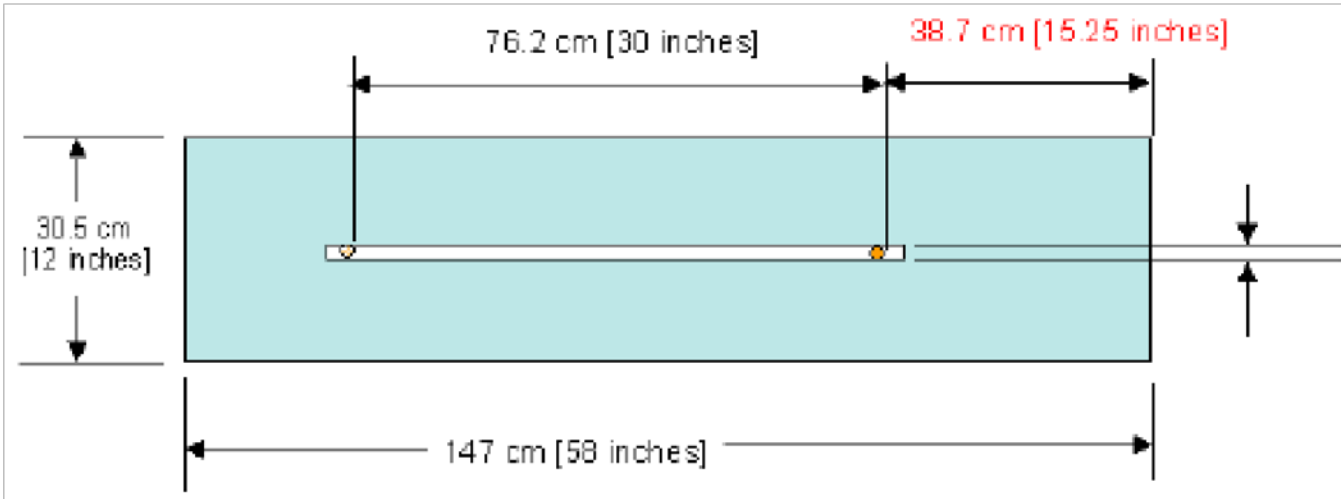

Figure 3: Launch Device – Top View

GENERAL RULES:

1) The students' full name, school name, grade level, and MESA Center must be clearly labeled on the glider. Failure to properly label the glider will result in a 10% *penalty deduction added to 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 connects with the launcher's hook to allow for a smooth launch.* ***Please identify the adaptation with a bright red circle.***
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) *Gliders can be made from several materials. There are no restrictions on size or weight. The glider MUST be capable of being launched by the official launcher's hook and MUST have the following identifiable features: a fuselage, wing(s), and tail. Gliders without all required features will be DISQUALIFIED.*
10) Remote-control (electronic) devices of any kind ***may not*** be used. If mechanical devices are used, these devices must be self-contained and may not provide any thrust to the glider.

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11) Additional power source(s) may NOT be used. For example, sources that provide thrust, lift or stored energy that assists dynamic flight. 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 spot) is considered final and is not subject to debate. Digital media (photos and/or video recordings) will not be accepted for arbitration purposes.

JUDGING:

General Specifications:

1) Judges will inspect each glider model prior to the start of the competition in order to confirm that all of the specifications are met. Teams who do not pass the specification checks (pre-judging) will have an opportunity to compete ONLY if they meet the four conditions listed below:

   a. Accept an automatic "Mistrial" and forfeit a score for Launch # 1.

   b. Make the needed repairs/modifications to the model in order for the glider to meet the proper specifications; glider MUST be competition-ready when called for Launch #2.

   c. Make ALL repairs/modifications within the official competition repair station/area.

   d. Failure to adhere to any of a, b, or c will result in the disqualification being upheld.

2) Repairs and modifications that meet the general specifications can be made to a glider after it submitted as long as the lead judge is informed before any change is made. If changes are made during the contest, all teams and projects MUST be competition-ready when the called up by the judge for their turn launch.

TARGET & LAUNCH:

1) The target is located at a distance 12.2 meters (40 feet) from where the hook stops on the ramp. The target is 100cm (39.4 inches) below from where the hook stops on the launch ramp. The target is marked by a + symbol on the ground and will be marked by a dot at exactly 12.2 meters (40ft).

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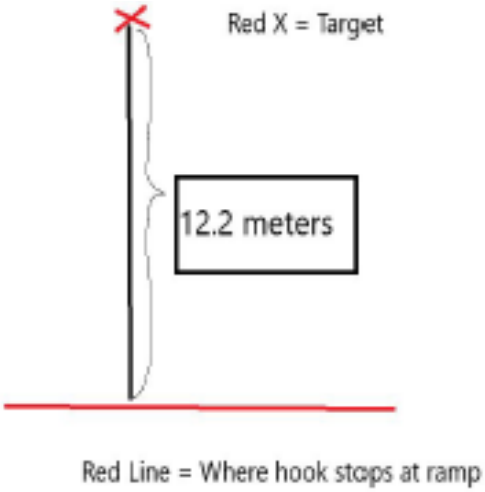

2) Each team will have two non-consecutive opportunities to launch their glider (at the discretion of the host center). Team will be given a 2 minute window to set-up their glider. A *5-second* countdown will be given prior to pulling the release pin to initiate flight.
3) The glider's first-touch point (contact with any object) will be marked by the specified colored Post-it flags. Each trial will have a specific color assigned in order to help the judges 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 flag of a different color from the first trial. Judges will indicate the glider's first-touch point on the object/ground by placing the center of the post-it note on that spot. The specified Post-it flag for this contest can be purchased at Office Depot (Item #265333).
4) *Each team is responsible for removing their glider from the contest area and returning the model to the designated impound area/ repair area immediately after each launch and after the judges have marked the first- touch point.*
5) New parts cannot be added to the glider after the specification checks are completed, but repairs/alterations can be made to existing parts including using glue or tape to affix pieces that have broken off. All repair materials and tools MUST be turned in by the team when registering and be supplied by the team. All work done in the designated repair area will be supervised by a judge.
6) The distance between the target center (middle of the "+" symbol) and the glider's first touch-point (middle of the Post-it flag) will be measured to the nearest 2 cm (0.75 inches).
7) Only team members can hold and repair their glider. The impound and repair station areas will be supervised by a judge.
8) Both trials 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 a 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

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3) Final Score = Best launch + possible 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: 6th grade and 7th/8th grade.
- Equal medals will be awarded in case of a tie.
- Only the first-place teams from each group (i.e. 6th and 7th/8th) advance to Regionals.

ATTACHMENTS/APPENDIX:

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

WRIGHT STUFF GLIDER
SPECIFICATION CHECK LIST AND SCORE SHEET

- ☐ Glider does not use remote controls
- ☐ Glider not require/utilize an additional power source
- ☐ Glider is capable of self-sustained flight without links to the ground for lift, propulsion or guidance
- ☐ Glider includes a feature that adapts to launch hook on official launcher

Scoring

Launch #1 Distance from the + target = _____

Launch #2 Distance from the + target = _____

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

Since the deductions from the Engineering Lab book will be added to the final score, the following will serve as an example of how judges will factor in deductions on MESA Day.

Team 1's best launch is 10cm from the target and they turned in their engineering lab book and all competition related materials are properly labeled.

- *Best Launch = 20 cm from target*
- *Deductions = None*
- *Final Score = 20 cm*

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Team 2's best launch is 20cm from the target and they did not turn in their engineering lab book and their glider is not properly labeled.

- *Best Launch = 20 cm from target*
- *Deductions = 50% for missing lab book (+10), 10% for improper labeling (+2). Total deductions = 12cm.*
- *Final Score = 20cm from target + 12cm deductions = 32 cm from Target*

FINAL SCORE: _____

ENGINEERING LAB BOOK SUBMISSIONS:

There are three format options available for submittal; please check with your center director about the format required for your preliminary event. **Electronic submissions will be required at the Regional/State level.**

Submission Format Options:

Electronic Lab Book
Teams can convert their lab book entries into a PDF file and email the attachment to the appropriate MESA staff and volunteers.

Teams can also use an electronic portal/application such as Google Docs to keep and maintain their lab book. Advisors and students are responsible for providing all Google-related document sharing access with MESA staff and volunteers.

Printed/Written Pages
Teams can record their lab book entries by hand or typed through a program like Microsoft Word. Printed/handwritten loose-leaf pages MUST be well organized, clipped, or stapled together BEFORE being turned in.

Standard Lab Book
Teams can 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, or flashcards cannot not be used.**

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ENGINEERING LAB BOOK MATH CONCEPT:

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 = $\left(\frac{14 meters}{5\ seconds}\right) \rightarrow Final\ Velocity = 2.8\ \left(\frac{meters}{second}\right)$

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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).

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

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

No 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.

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MESA DAY 2019-20

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

Student 1 Name: _____ Grade: _____

Student 2 Name: _____ Grade: _____

Student 3 Name: _____ Grade: _____

School Name: _____ Center Name: _____

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%)

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