# MESA DAY CONTEST RULES
# 2019 – 2020

# Wright Turn Glider Competition

**LEVEL:** Grades 9/10 and 11/12

**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 9th/10th Grade, 1 for 11th/12th 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, makes a right turn, and lands on a target located 12.2 meters (40 feet) away and to the right of the launcher. The target will be designated as + on the ground. The glider must be the original work of each team. Judges may ask questions 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: 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 place. 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.

**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) (thrust, lift or stored energy that assists dynamic flight) may NOT be supplied. 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.
- 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. 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 4.064 mm (0.160 inch) diameter. It is available from McMaster-Carr and is part Number 9594T13.*
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 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).
7) All glider launchers will include a safety feature that will be set in place before the launcher's spring (trigger) can be released.

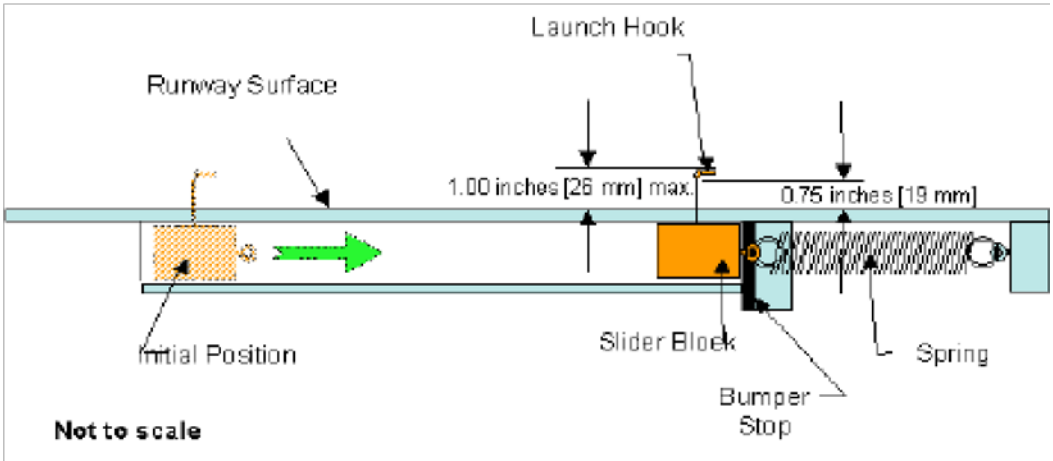



Figure 1: Launch Device – Side View

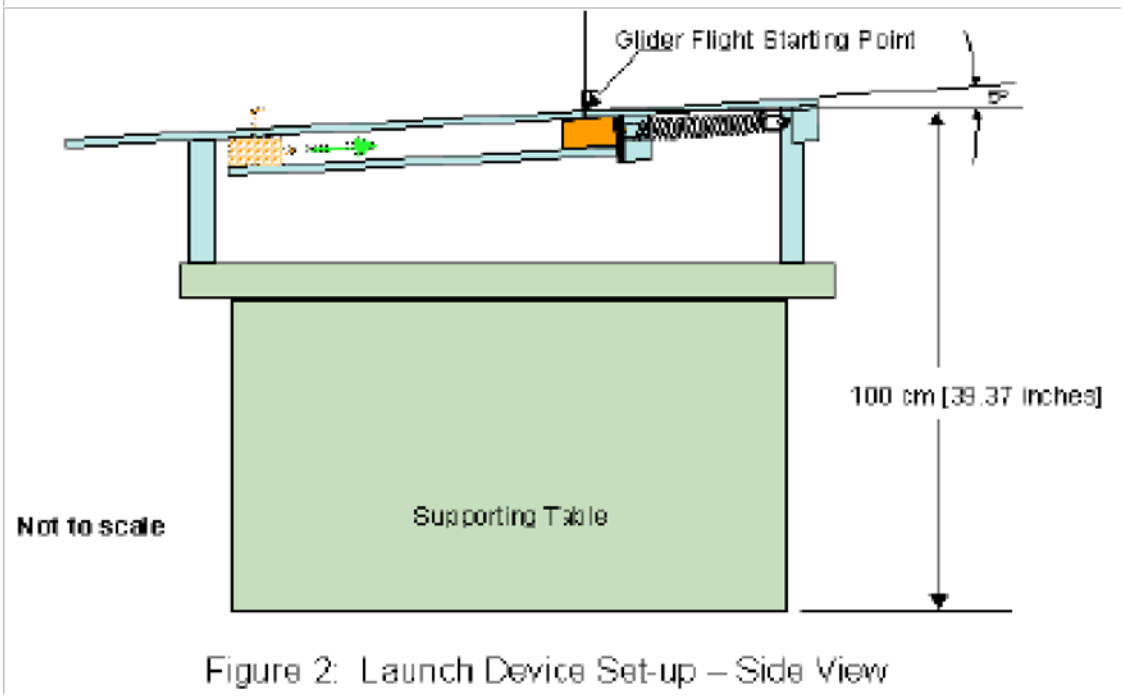



Figure 2: Launch Device Set-up – Side View

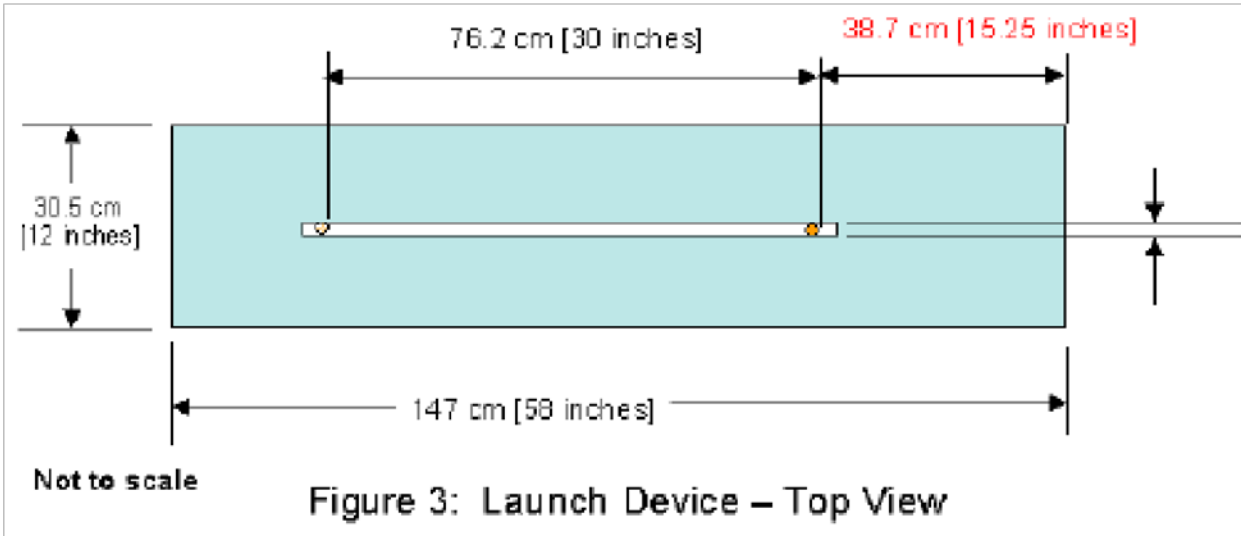



Figure 3: Launch Device – Top View

**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 any 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) *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,*
11) 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.
12) 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.
13) 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/or video

recordings) will not be accepted for arbitration purposes.

**JUDGING:**

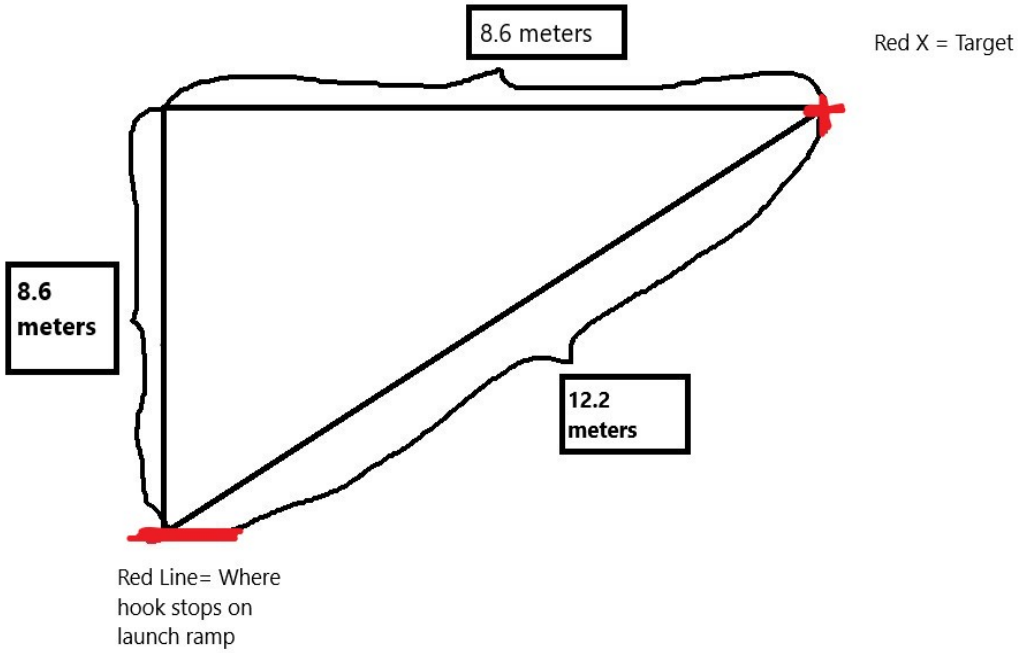
General Specifications:

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.

**Target and Launch**

1) The target is located at a distance of 8.6 meters (28 feet 2 inches) in front of the position where the hook stops on the launch ramp and 8.6 meters (28 feet 2 inches) to the right of the position where the hooks stops on the launch ramp for a total distance of 12.2 meters (40 feet) from 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 and will be marked with a dot at exactly 12.2 meters (40ft).



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 duration of the flight will be timed to the nearest 100th of a second by the time keepers. The flight ends when the first part of the glider touches the ground. Official observers will carefully note where the glider first touches down (wheel, skid, or other feature) using 2 different colored 2-inch pieces of masking tape (different colors per trial) as indicators.
4) The decision of the observers on the location of the tape marking the touchdown point is final and not subject to debate. *Each team will remove their glider from the contest area immediately after judges have marked the first touch point.*
5) After completion of the first trial, the contestant will be asked to place their entry in an impound (an area designated by contest officials) or a repair station, where repairs and alterations can be made under supervision. During repairs/alterations, new parts cannot be added to the glider, but repairs or 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.
6) The distance between the target center (middle of the "+" sign) and the glider's first touch-point (middle of colored tape) 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.
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 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. 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. 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 touchpoint will be measured to the nearest 2 cm (0.75 inches).
10) 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
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: $9^{th}/10^{th}$ grade and $11^{th}/12^{th}$ grade.
- Equal medals will be awarded in case of a tie.
- Only the first-place teams from each group (i.e. $9^{th}/10^{th}$ and $11^{th}/12^{th}$) advance to Regionals.

**ATTACHMENTS/APPENDIX:**

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

**WRIGHT TURN 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*

*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.**

**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. Lift Equations = $Lift\ Coefficient\ x \frac{\text{Air Density x velocity squared}}{2}\ x\ wing\ area$
2. *Aspect Ratio* = $\frac{\text{Wing Length}}{Wing\ Width}$

*Applicable Math Concept/equation (state concept/equation)*: Calculating Power

The lift coefficient can be calculated by multiplying the angle of attack (in this case 0.087 thanks to the launcher) by 2pi (3.14159); so, the lift coefficient is 0.547. The standard air density is 1.2754 kg/m$^3$. The velocity is calculated by dividing the distance traveled in the time it takes your glider to travel that far. All this is multiplied by the wing area. Wing area will vary based on shape. Please follow this link to use the appropriate formula.

Example:

The wings on your glider are rectangular with a length of 3 meters and a width of 2 meters. Calculate the lift of your glider if it traveled 7 meters in 6 seconds.

$$Lift = Lift\ Coefficient\ x \frac{\text{Air Density x velocity squared}}{2}\ x\ wing\ area$$

$$Lift = (0.547)x \frac{1.2754(\text{kg}/(\text{ms}^3)\ \text{x}\ \left(\frac{7\text{meters}}{6\text{second}}\right)^2}{2}\ x\ (3\ \text{meters x}\ 2\ \text{meters})$$

$$Lift = (0.547)x \frac{1.2754\ \text{kg}/(\text{m}^3)\ \text{x}\ \left(\frac{7\text{meters}}{6\text{seconds}}\right)^2}{2}\ x\ (3\ \text{meters x}\ 2\ \text{meters})$$

$$Lift = (0.547)x\ 1.24\ \text{kg}/(\text{ms}^2)\ x\ (3\ \text{meters x}\ 2\ \text{meters})$$

$$Lift = 0.678(\text{kg}/(\text{ms}^2)\ x\ (3\ \text{meters x}\ 2\ \text{meters})$$

$$Lift = .0678 \frac{\text{kg}}{\text{ms}^2}\ x\ (6\ \text{m}^2)$$

Lift = 4.07 $kg\frac{\text{m}}{\text{s}^2}$

*Applicable Math Concept/equation (state concept/equation)*: Calculating Aspect Ratio

An Aspect Ratio (AR) is written as follows 3:2. To calculate aspect ratio, simply measure the wing length and wing width. Afterwards, divide the length by the width.

$$Aspect\ Ratio = \frac{\text{Wing Length}}{Wing\ Width}$$

Example:

If your wing width is 3 meters and your wing length is 27 meters after measuring, what is your gliders Aspect Ratio?

$$AR = \frac{\text{Wing Length}}{Wing\ Width}$$

$$AR = \frac{3\ \text{meters}}{27\ meters} \rightarrow AR = \frac{1\ \text{meter}}{9\ meters} \rightarrow AR = 1:9$$

# 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.**

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?**<br>*(Names, Grades, School, MESA Center)* | | |
| 2 | **Identify the Need** *(at least 2 sentences for each)*<br>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**<br>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**<br>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%)

# High School: 9th/10th Wright Turn Glider
# Official Scoring Sheet

Student 1 Name: _____
Student 2 Name: _____
Student 3 Name: _____

School Name: _____ Center Name: _____

| **Specifications Check List:** | **Yes** | **No** |
|---|---|---|
| Does the glider contain a feature that adapts to the launch hook?<br>Rule #2: Section: Rules | | DQ |
| Does the glider contain a feature that prevents it from getting caught in the "slot" of the launch ramp?<br>Rule #4: Section: Rules | | Can result in DQ |
| Are the contestants' names, school name, and center are clearly visible on the glider?<br>*(if information is provided on a tie-on label—student MUST launch glider with label attached.)*<br>Rule #5: Section: Rules | | -10% penalty |
| Will stored energy be used after the initial launch? (thrust, motors, batteries, etc.)<br>Rule #7: Section: Rules | DQ | |
| **Overall Specification Check** | **Pass** | **Fail** |

| **Engineering Lab Book** | Yes | No |
|---|---|---|
| Is this considered an incomplete lab book?<br>*(Engineering Lab Book Rubric- Page 10)* | -20% | |
| Is this considered a missing lab book?<br>*(Engineering Lab Book Rubric- Page 10)* | -50% + Cannot place | |

## Performance Test:

Measure to the nearest 2cm (0.75inches)

| **Distance to Target's Center & Glider's 1st Touch-point w/ ground or other obstruction:** | **If the launch is disqualified or considered a mistrial, please indicate it below:** |
|---|---|
| 1st Launch: | DISQUALIFICATION MISTRIAL |
| 2nd Launch: | DISQUALIFICATION MISTRIAL |

| **Reasons for Glider Disqualification(s):** | **Reasons for Launch Mistrial:** |
|---|---|
| Glider altered or damaged the launch ramp "hook" | Glider part(s) broke-off during flight |
| The glider must be capable of being launched on the launch ramp by the hook and must have an identifiable fuselage, wing, and tail. | |

| **Hang Time (needed for tie-breaker)** |
|---|
| 1st Launch Hang Time: |

| 2nd Launch Hang Time: |
|---|

**Longest Hang Time: _____seconds**