MESA DAY CONTEST RULES
2018 – 2019
(Version 10.31.18 / Updates denoted by *)

Wright Turn Glider

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 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 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**: Any 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.

The Host Center will provide the following:

- Official launcher described in these rules
- Appropriate safety launch table and safety goggles

***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. 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? $AR = \frac{\text{Wing Length}}{Wing\ Width}$ $AR = \frac{\text{3 meters}}{27\ meters} \rightarrow AR = \frac{\text{1 meter}}{9\ meters} \rightarrow AR = 1{:}9$

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.

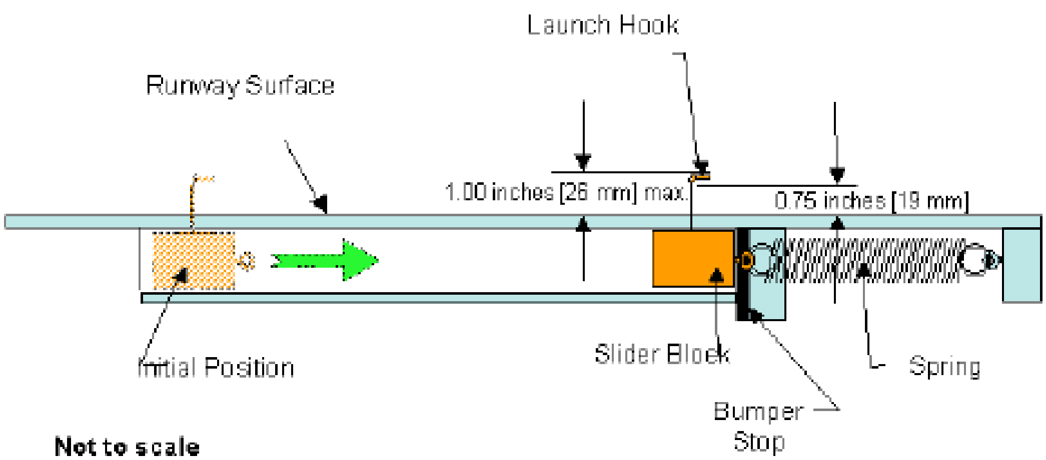


Figure 1: Launch Device – Side View

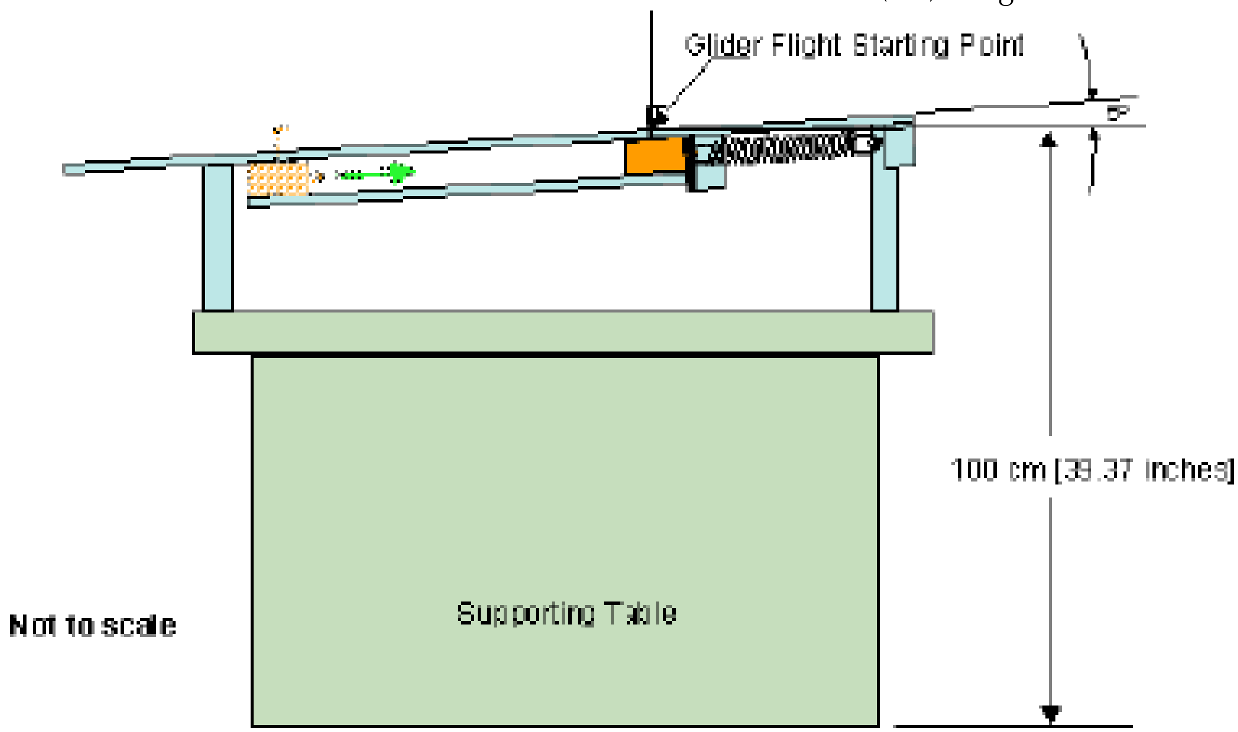


Figure 2: Launch Device Set-up – Side View

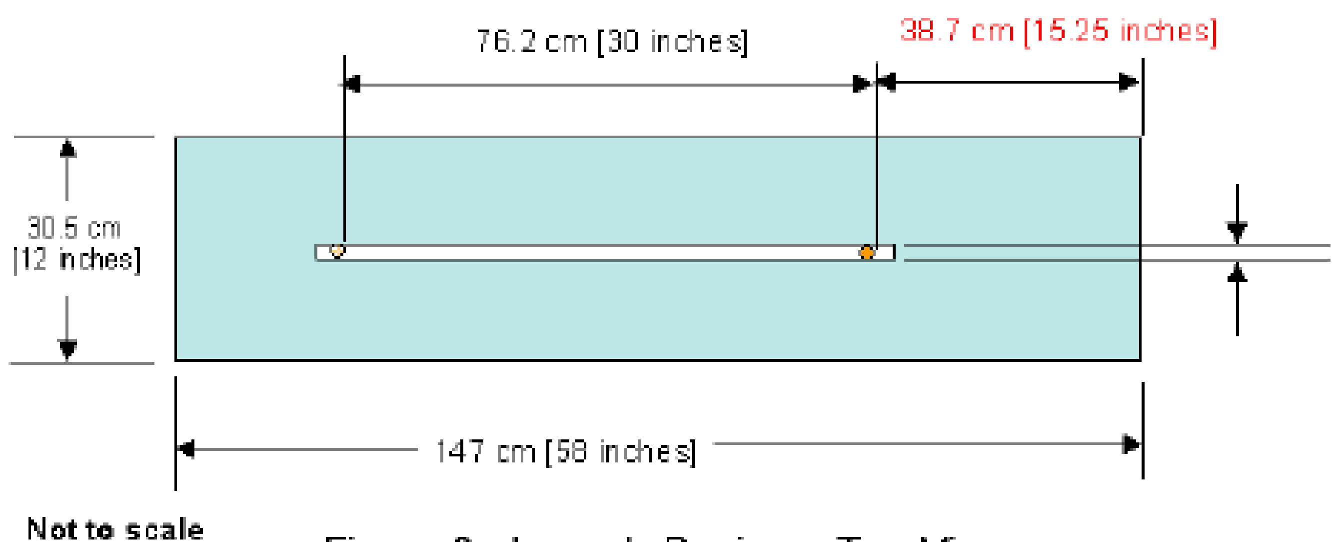
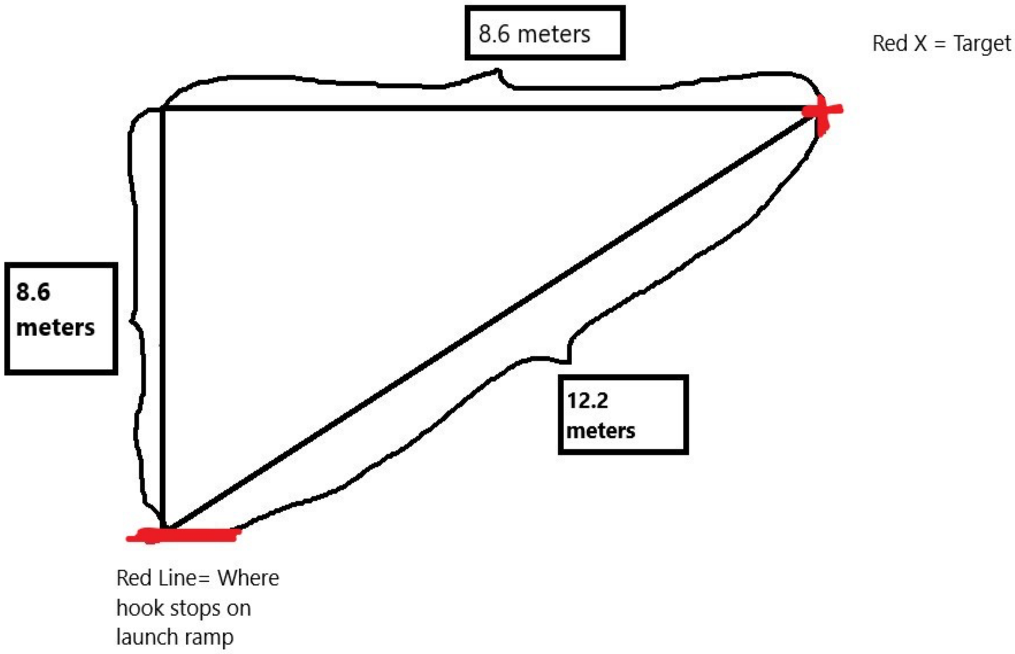


Figure 3: Launch Device – Top View

*Target and Launch:

1) The target is located at a distance 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 hook stops on the launch ramp. The total distance is 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 wherein each leg is 3cm wide and 20cm long comprised of black plastic tape.



2) Each team shall have 2 opportunities to land their glider the closest to the target. The launches may not be consecutive depending on schedule limitations. The team will be given a 2 minute window to set-up their glider. A 30-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. The team will then remove their glider from the contest area.
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.
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). In case of a tie, the longer flight duration (hang-time) will be used as a tie-breaker. If the entries are still tied, equal medals will be awarded.
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: $9^{th}/10^{th}$ grade and $11^{th}/12^{th}$ grade.
- For the preliminary competition, only the first place teams from each grouping (i.e. $9^{th}/10^{th}$ and $11^{th}/12^{th}$) will advance to the regional competition.

ATTACHMENTS/APPENDIX:

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

WRIGHT TURN GLIDER
SPECIFICATIN 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