Completed Rubric for Exit Project Titled

"The effect of fin size, the mass of the nose cone, the size of the fins, and the shape of the nose cone on the horizontal distance of a straw rocket."

This project was evaluated using the point scale of 0-1-2-3. The project was evaluated based on the visible information in the project photograph; some more information may have been on the additional sheets.

A. Title
Title: The effect of fin size, the mass of the nose cone, the size of the fins, and the shape of the nose come on the horizontal distance of a straw rocket.
Score: 3 – *The title correctly states the independent variable and the dependent variable and is NOT worded as a QUESTION.*
Comments: The title is correctly worded. However, the incorrectly stated "the size of the fins", when they probably meant "number of fins". It also should have said "horizontal distance *traveled*."

B. Question
Question:

- How does the mass of the nose cone affect the horizontal distance of the rocket's flight?
- How does the size of the fins affect the horizontal distance of the rocket's flight?
- How does the number of fins affect the horizontal distance of the rocket's flight?
- How does the shape of the nose cone affect the horizontal distance of the rocket's flight?

Score: 3 – *The question states the independent variable and the dependent variable, and is testable.*
Comments: All four questions correctly state the independent and dependent variables. In addition, the dependent variables are measurable.

C. Hypothesis
Hypothesis:

- If the mass of the nose cone is greater, then the horizontal distance of the rocket's flight distance may decrease because the same amount of force is being used to move a greater mass, resulting in reduced acceleration. Since Isaac Newton's second Law of Motion states that force is equal to mass times acceleration, (F=ma), as mass increase with the same force applied, acceleration would be decreased.
- If the size of the fins were too small, then there would be less of a horizontal distance traveled because the fins won't be able to provide the necessary stability to keep a rocket in flight. If the size of the fins were too big, then the horizontal distance of the rocket's flight would be smaller because there would be more mass to be moved by the same amount of force.
- If there are four fins on the rocket, then it will fly the farthest because there will be less weight and air resistance than a six-finned rocket. On the other hand, a rocket with four fins will have more stability than a rocket with two or no fins because two fins would mean the fins must be parallel to the ground to glide and no fins mean that the rocket wouldn't have a stable flight.
- If the nose cone's shape is parabolic, then the rocket will fly the farthest because this shape of the nose cone would allow the rocket to puncture air much more efficiently. This is because the parabolic shape reduces aerodynamic drag. If it was flat, there would be too much drag, and if it was totally pointy, it wouldn't fly well because the shape still provides a significant amount of aerodynamic drag.

Score: 3 – *The hypothesis (1) predicts the effect that changing the independent variable will have on the dependent variable, AND (2) explains the reason for the prediction using scientific concepts ("because…").*
Comments: All hypothesis correctly state how changing the independent variable will affect the dependent variable and has a strong scientific concept to support it.

D. Background Research (found throughout the project especially within the hypothesis and discussion/conclusion sections)
Score: 3 – *Background research is accurate and complete, containing MANY relevant, well-chosen facts, definitions, concrete details, quotations, scientific concepts, or other information and examples that (1) provide information on the IV & DV; defining them and explaining the relationship between them AND (2) support the "because" portion of the hypothesis AND (3) support the "scientific reasoning" of the discussion/conclusion.*
Comments: This section contains plenty of relevant, appropriate information.

E. Investigation Design (ID)
Score: 3 – *All 5 components of the ID are stated correctly and explicitly, AND only one independent variable (or IV) is allowed to change at a time, AND there are multiple trials.*
Comments: This investigation includes an appropriate IV for each portion of investigation (mass of nose cone, size of fins, number of fins, and shape of nose cone). It also states the correct DV horizontal distance traveled), levels of IV, number of trials, and constants.

F. Procedure
Score: 3 –*The procedure is (1) a step-by-step description of how the investigation was done AND (2) uses precise language and scientific vocabulary to describe both the sequence of actions taken and materials used AND (3) is sufficiently detailed to enable the reader to replicate the investigation AND (4) is consistent with the Investigation Design Diagram (IDD) and is an appropriate test of the hypothesis.*
Comments: The procedure accurately states all of the above for all four parts of the investigation.

G. Data/Results
Score: 3 – *Data table(s) and graph(s) (1) are accurate and include labels (titles, axes with units of measure) AND (2) address the hypothesis and have been chosen to clearly address the original question AND (3) data analysis identifies and accurately summarizes trends or patterns in the data.*
Comments: The students' choice of line graphs allows the reader to see if there was any variation across trials. However, there dots should not be connected, since this is not a change over time.

Ha. Discussion/Conclusion: Scientific Explanation
Score: 2 – *Three or four parts of the Scientific Explanation are complete and accurate.*
Comments: The scientific explanation contains no scientific concepts. While this information is stated in the Hypothesis and Background Research section, it should be restated here. The students also do not address why the rocket with no fins did not support their hypothesis. For example, they could have mentioned that adding fins to rockets helps with stabilizing the rocket, but does not help it fly farther. In fact, the rocket with no fins probably went the farthest because it weighted the least.

Hb. Discussion/Conclusion: Reflection
Score: 2 – *Two or three parts of the Reflections are complete and accurate.*
Comments: The students acknowledged the sources of error but did not address how to solve them. For example, they stated that the air blowing from the open windows may have increased the aerodynamic drag. They should have also stated that this could have been solved by closing the window.

I. Literature Cited
Score: 2 – *Most parts of the Literature Cited are complete and accurate. Bibliography is present but references are not cited in the text of the investigation.*

Comments: There are no citations throughout the project. Also, the students did not include a link for the last two websites listed.

Project Section	Score (0-3)	Weight	Weighted Score
A. Title	**3**	x 1	**= 3**
B. Question	**3**	x 1	**= 3**
C. Hypothesis	**3**	x 2	**= 6**
D. Background Research	**3**	x 2	**= 6**
E. Investigation Design (ID)	**3**	x 2	**= 6**
F. Procedure	**3**	x 2	**= 6**
G. Data/Results	**3**	x 3	**= 9**
Ha. Discussion/Conclusion: Scientific Explanation	**2**	x 2	**= 4**
Hb. Discussion/Conclusion: Reflections	**2**	x 1	**= 2**
I. Literature Cited	**2**	x 2	**= 4**
		Total weighted score	**= 49 (54 max)**
	Final Score (%) =	**=Total weighted score/54 x 100**	**= 91 %**