

“The effect of mass & shape of the nose cone, size and number of fins on the horizontal distance the rocket travels.”

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 mass & shape of the nose cone, size and number of fins on the horizontal distance the rocket travels.

Score: 3 – *The title correctly states the independent variable and the dependent variable and is NOT worded as a QUESTION.*

Comments: Very clear. This is a design experiment, which means the students are testing multiple independent variables during multiple controlled experiments. Students will then apply what they have learned from those experiments to design and test an “optimal” or “best” design.

B. Question

- **Question 1:** How will the rocket’s size of fins affect the horizontal distance that the rocket travels?
- **Question 2:** How will the number of fins on the rocket affect the horizontal distance that it travels?
- **Question 3:** How will the shape of the nose cone of the rocket affect the horizontal distance that it travels?
- **Question 4:** How will the mass of the nose cone affect the horizontal distance the rocket travels?

Score: 3 – *The question states the independent variable and the dependent variable, and is testable.*

Comments: All 4 questions are testable, and correctly state the independent and dependent variable.

C. Hypothesis

- **Hypothesis 1:** If the size of the fins are smaller then the rocket will fly further because the smaller the fins on the rocket, the less aerodynamic drag is created. Aerodynamic drag is the force that acts upon a solid moving object that moves in a free stream flow. Model rockets with smaller fins will have the least resistance to aerodynamic drag. Thus when creating the fins it is very important to have the least amount of surface area to flow around the rocket.
- **Hypothesis 2:** If there are four fins on the rocket then it will fly the farthest because it will cause the least amount of aerodynamic drag. Aerodynamic drag is how much the air resists the rocket flying through, and it will slow down faster and descend, therefore traveling less. With four fins the rocket would be more stable as it glides through the air, prolonging flight time.
- **Hypothesis 3:** If the shape of the nose cone is parabolic then the horizontal distance of the rocket will be the furthest because the parabolic shaped nose cone has the least amount of surface area present. As a model rocket flies air molecules collide each molecule affects the speed and direction the rocket will travel. When creating the nose cone it is very important to have a nose cone with the least amount of surface area to flow around the rocket.
- **Hypothesis 4:** If the rocket’s nose cone has a low mass then the horizontal distance the rocket will travel will increase because with a lower mass the nose cone would not be able to weigh the rocket down. With no weight on the rocket the rocket would be able to travel further.

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: Each of the 4 hypotheses have scientific concepts to support their because statements.

D. Background Research (found throughout the project especially within the hypothesis and discussion/conclusion sections)

Score: 3 – *Background research is accurate, 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) attempts to support the “because” portion of the hypothesis OR (3) support the “scientific reasoning” of the discussion/conclusion.*

Comments: The background information accurately supports the investigation.

E. Investigation Design (ID)

Score: 2 – *Four of the 5 components of the ID are stated correctly, OR more than one IV is changing at a time or there are not multiple trials.*

Comments: The ID for fin size (IV #3) includes all 5 components, but the fins not only change size, but they also change shape, which means there are two IVs being tested in this part of the experiment. For the students to receive full points for this section they would have needed to change only the size of the fins, but retain the same shape for all levels of the IV. There is also some confusion on the ID because of a copy and paste error. Only Independent Variable #3 (fin size) & #4 (number of fins) were visible on the project board so this is all that was graded.

F. Procedure

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

Comments: The students' procedure is very clear and consistent across all four variables.

G. Data/Results

Score: 1 – *Few parts of the Data/Results section are complete and accurate or data analysis is not attempted.*

Comments: There seems to have been an Excel graphing error because the numbers in the data tables for mass of the nose cone and size of fins do not match the numbers in their graphs. Additionally, students could have added captions explaining trends/patterns for each graph, and included more detail in their data analysis to improve their score.

Ha. Discussion/Conclusion: Scientific Explanation

Score: 3 – *A scientific explanation consisting of a statement that makes an overall claim addressing the original investigation question AND supports the claim with evidence and relevant, accurate data from the investigation AND contains relevant scientific concepts AND uses words, phrases and clauses that clarify and connect the relationships between claim, evidence and science concepts AND demonstrates an understanding of the topic.*

Comments: All five parts of the scientific explanation are present and accurate.

Hb. Discussion/Conclusion: Reflection

Score: 3 – *Conclusion contains thoughtful, relevant, and reasonable reflections including states whether the hypothesis was or was not supported AND a description of possible sources of error AND suggested solutions to these sources of error AND “Next Steps” determined as a result of this investigation.*

Comments: All four parts of the reflection are present and accurate.

I. Literature Cited

Score: 1 – *Few parts of the Literature Cited are complete and accurate.*

Comments: Bibliography is missing but there is in-text citation in their hypothesis.

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)	2	x 2	= 4
F. Procedure	3	x 2	= 6
G. Data/Results	1	x 3	= 3
Ha. Discussion/Conclusion: Scientific Explanation	3	x 2	= 6
Hb. Discussion/Conclusion: Reflections	3	x 1	= 3
I. Literature Cited	1	x 2	= 2
		Total weighted score	= 42 (54 max)
	Final Score (%) =	=Total weighted score/54 x 100	= 78 %