Completed Rubric for Exit Project Titled

"The effect of the different sizes of a balloon on the balloon car distance."

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 the different sizes of a balloon on the balloon car distance
Score: 3 – *The title correctly states the independent variable and the dependent variable and is NOT worded as a QUESTION.*
Comments: This title states both the independent variable (different sizes of a balloon) and the dependent variable (balloon car distance). The student could clarify that it is the circumference of a balloon.

B. Question
Question: How will the sizes of the balloon effect the balloon car distance?
Score: 3 – *The question states the independent variable and the dependent variable, and is testable.*
Comments: This question correctly states the independent and dependent variable. In addition, the dependent variable is testable. However, it could have been better worded as "What is the effect of balloon circumference on balloon car distance?"

C. Hypothesis
Hypothesis: If the size of the balloon effects the distance the balloon powered car travels then the car powered by the bigger balloon will travel further than the car powered by the smaller balloons. This is because according to the article "Balloon Powered Car", Newton's Third Law of Motion stated that for every action, there is an equal and opposite reaction. This means that the amount of air in the balloon will exert the same amount of force on the car. Also, according to the article "Newton's Laws of Motion", Newton's Second Law of Motion states that a greater force create a greater acceleration in an object with the same mass. This suggests that the more air in the balloon, the faster the car will travel reaction is the air being released out of the balloon and the reaction will be pushing the air. So, the more air the more reaction it will have.
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: This hypothesis predicts how changing the size of the balloon will affect the distance the car travels and is well supported using scientific concepts. The student does a good job of stating how newton's Third Law explains the amount of force on the car. It is unnecessary to use newton's Second Law of Motion, since the student is measuring neither mass more acceleration. The student also should make the connection that a larger circumference means that there is more air in the balloon.

D. Background Research (found throughout the project especially within the hypothesis and discussion/conclusion sections)
Score: 2 – *Background research is accurate, containing SOME relevant, well-chosen facts, definitions, concrete details, quotations, scientific concepts, or other information and examples that (1) provide information on the IV & DV AND (2) attempts to support the "because" portion of the hypothesis OR (3) attempts to support the "scientific reasoning" of the discussion/conclusion.*
Comments: As previously mentioned, Newton's Second Law is not applicable in this investigation, since neither mass nor acceleration is being measured. The student is measuring if the car goes further, not faster. Therefore that is not valid scientific reasoning for explaining why more air in the

balloon makes the car go further. Additionally, the student can look at potential and kinetic energy as a means of explanation.

E. Investigation Design (ID)
Score: 3 – *All 5 components of the investigation's design (or ID) are stated correctly, AND only one IV is changing at a time AND there are not multiple trials.*
Comments: All 5 components of the ID are stated clearly and correctly. The student is testing four levels of the IV for five trails, and lists the constants.

F. Procedure
Score: 2 – *The Procedure accurately and completely satisfies two or three of the above. (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 student does a good job of clearly describing how to conduct the trails and measure the car. However, while the materials are listed, there are no instructions or steps on how to build the car or where to find out how to replicate the experiment by building the same car. It seems like it could be a little tricky to get the exact same measurements as the student tested. While it is unclear why those precise measurements were chosen, they are consistently 12.7cm circumference apart from one another. The student also needs some more details about what type of floor they did the trails on, the type of balloon, and how many balloons were used. The procedure is consistent with the IDD and an appropriate test of the hypothesis.

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 data is accurately displayed. The student could clarify in the table that the size of the balloon is the circumference. Additionally, the graph should state that the distances are the averages. One other thing that the student should note is the drastic difference in results of the 38.1 circumference trails. They point out in the discussion section that their balloon in Trial 1 "was not working anymore", so one can assume this is why. The student does a good job of pointing out the primary trend that an increase in balloon circumference means an increase in the distance the car traveled.

Ha. Discussion/Conclusion: Scientific Explanation
Score: 2 – *Three or four parts of the scientific explanation are complete and accurate ((1) makes an overall claim addressing the original investigation question AND (2) supports the claim with evidence and relevant, accurate data from the investigation AND (3) contains relevant scientific concepts AND (4) uses words, phrases, and clauses that clarify and connect the relationship between the claim, evidence and science concepts AND (5) demonstrates an understanding of the topic.)*
Comments: In the future, the students do not need to create separate sections for the discussion and conclusion, since it seems redundant. While their claim is accurate, the student uses acceleration to explain why the cars go further. Again, acceleration is not being measures so that is not necessarily the case in this investigation. The students use evidence from their investigation to support their claim that the balloons with more air would travel a further distance.

Hb. Discussion/Conclusion: Reflection
Score: 3 – *Conclusion contains thoughtful, relevant, and reasonable reflections including: 1) states whether the hypothesis was or was not supported AND 2) a description of possible sources of error AND 3) suggested solutions to these sources of error AND "Next Steps" determined as a result of this investigation.*

Comments: This student presents some good reflections about the sources of error in their experiment and how to make improvements. It sounds like it was tricky to get the cars to go in a straight line and this caused their car to crash into the walls. It could also be helpful for consistent results to use a new balloon for each trial. While the student points out this interfered with the data, the data they collected still demonstrated a trend of increasing distance. The students should expand on what types of design they might want to test and why.

I. Literature Cited
Score: 3 *A sufficient number of credible sources are listed in the bibliography in an appropriate format that allows the reader to locate the resource AND are cited in the text of the hypothesis, background research, conclusion, and other sections as appropriate AND include books, articles, scholarly websites, or personal communication with knowledgeable experts/scientists.*
Comments: Literate cited is complete and cited throughout various sections of the project.

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	**2**	x 2	**= 4**
E. Investigation Design (ID)	**3**	x 2	**= 6**
F. Procedure	**2**	x 2	**= 4**
G. Data/Results	**3**	x 3	**= 9**
Ha. Discussion/Conclusion: Scientific Explanation	**2**	x 2	**= 4**
Hb. Discussion/Conclusion: Reflections	**3**	x 1	**= 3**
I. Literature Cited	**3**	x 2	**= 6**
		Total weighted score	**= 48 (54 max)**
	Final Score (%) =	**=Total weighted score/54 x 100**	**= 89%**