Name ____SAMPLE____
Date _______________

Rocket Flight

The purpose of this lab was to test the concepts of rocket flight. I chose to focus my attention on the question of how does the weight of a rocket impact the distance the rocket will fly? I predict that the heavier the rocket, the less distance the rocket will fly. This is because a rocket with a great amount of mass will require much more energy, and because one of the constraints for this lab is the amount of energy produced, a heavy rocket will not have enough initial velocity to fly further than a lighter rocket that will be able to transform that same amount of energy into a greater flight distance.

Background Information:

Flight has been an object of great study for many years. People have been fascinated with the concept of flight. Attempts to fly have landed with mixed success over the past millennium. Flight is limited by the effects of Earth's gravitational attraction towards objects near its surface. It is this force that a rocket must overcome in order to fly. As my research question is driven by how a rockets weight will influence the distance traveled, I attempted to find a way to maximize my rockets flight.

From our previous studies on energy transformation and projectile motion I have a fair grasp on how my rocket will achieve flight. The mode of transport is created using an apparatus called a stomp pad. (see figure 1) The stomp pad includes a rocket platform that can be set at a specific angle for the rockets flight. I have left that angle at a fixed 40^o to eliminate any additional variables. Attached to the rocket platform is the rocket shaft which my rocket fits over. From the rocket shaft, a tube leads to the rocket bladder which is normally filled with air. When the rocket bladder is compressed, the stored potential energy of the air is transformed into kinetic energy. That kinetic energy is the energy used to propel the rocket off the rocket shaft and into flight.

When an object is thrown horizontally near the earth's surface, and it moves along a curved path under the force of gravity, the path followed by a projectile is called its trajectory. Projectile motion only occurs when there is one force applied at the beginning of the trajectory, after which there is no force in operation apart from gravity. That initial force was the compression of the rocket bladder from the energy generated by the 10lbs weight released from a height of 1 meter. This energy is a constant and therefore a variable that has been eliminated.

Experimental Procedure:

Material List:

Rocket Stomp Pad Apparatus	Scissors	Hotglue Gun
Posterboard Paper (2 sqft)	3 paper clips	Tape

Procedure:

1. Generate 3 initial designs that could eventually become prototype #1. List possible materials and think about the advantages and disadvantages of the design. This will include a rough sketch of each design. (see figure 2)
2. Complete a trade-off analysis of the different features to change. (see table 1)
3. Choose one design to create as prototype #1 and describe why you choose this design.
4. Using the materials listed, as well as figure 3, construct the prototype #1 rocket.
5. Record mass of the rocket.
6. Test the prototype #1 using a soft flight test. (launch under low energy load to test conceptual design)
7. Test and launch prototype #1 recording the distance the rocket successfully flew in meters. Repeat test twice and take the average distance.
8. Find the average launch flight of rocket. Record any observations and thoughts on the performance of prototype #1 flight.
9. Change the specific feature of the rocket that you are testing. This will be increasing the mass of the rocket. This will become prototype #2.
10. Record the mass of the rocket.
11. Test the prototype #2 using a soft flight test. (launch under low energy load to test conceptual design)
12. Test and launch prototype #2 recording the distance the rocket successfully flew in meters. Repeat test twice and take the average distance.
13. Find the average launch flight of rocket. Record any observations and thoughts on the performance of prototype #2 flight.

Data:

The initial test of prototype one occurred outside on a track. During the test there was very little wind that might have become a factor in testing of the prototype rocket. The first launch flight test achieved what would be the greatest distance the rocket would fly, at 25.35 meters. While in flight, the rocket appeared to fly straight and smooth in a near perfect projectile motion. On the launch test 2 the rocket did nearly the same distance and no additional observations were made.

Testing for prototype two was completed outside under a covered area that was open on three of the four walls. This day was slightly breezier and might account for the lack of performance of the rockets flight. On both launch tests, prototype two curved towards the right in an ununiformed flight pattern. Of course, the addition of weight to the nose cone area might have influenced the distance flown.

Data Table 1	Mass of rocket (g)	Launch Test 1 (m)	Launch Test 2 (m)	Average Launch Flight (m)	Launch Angle (degrees)
Prototype #1	*6.6 g*	*25.35 m*	*24.8 m*	*25.08 m*	*40^o*
Prototype #2	*10.5 g*	*23.5 m*	*23.8 m*	*23.65 m*	*40^o*

Analysis:

Conclusion:

My initial prediction of the heavier a rocket, the less distance the rocket will fly was reinforced by the testing of my two prototype rockets. Although my initial prediction was validated, there were potential uncertainties that would require additional research. To eliminate additional variables, I chose to keep the launch angle at a constant 40^o. I am curious if changing the launch angle might have led to a different conclusion, possibly from increasing the glide distance of the heavier rocket if angle at a greater slope. Also, I am curious how much of an influence the outdoor environment had on the flight of the rockets. There could be additional errors to account for in wind resistance as well as humidity levels, as one of the testing days was rainy.

The features that I chose to focus on where weight of the rockets. I was able to keep the rockets practically identical by creating a method of adding and removing mass without compromising the structure and form of the rockets. Even though my initial prediction was validated I still feel that this scientific research process has left me with additional questions that I would like to further study. One being, how did the outdoor testing environment impact the flight of my rockets? Also, is there a weight to distance ratio that is highly effective for the flight of a rocket?

Over the course of this experiment, I learned how effect a scientist can be when working as a team with fellow engineers. Having another view of a challenging situation was especially important in the success of this lab. On many occasions what I had been challenged by made simpler by my peers and the end product was a strong conclusion backed by data driven facts. This could only have occurred with minds of several individuals looking at challenges from different viewing angles.

Application:

As a student of eight grade science I am aware that I will be taking physical science classes' in the near future in high school. Taking a close look at the functions of our physical environment and familiarizing me with the processes of the scientific method will be highly beneficial when I fulfill additional science classes in the future. As I have an interest in working in the engineering field, this lab has allowed me to form a simple understanding of how a team of scientists go about brainstorming, creating, building, testing and rethinking new applications. The most important of those is the rethinking, taking the errors and failures that have occurred and learn from those. This will help to make me a better student and better scientist in the future.

Figure 1

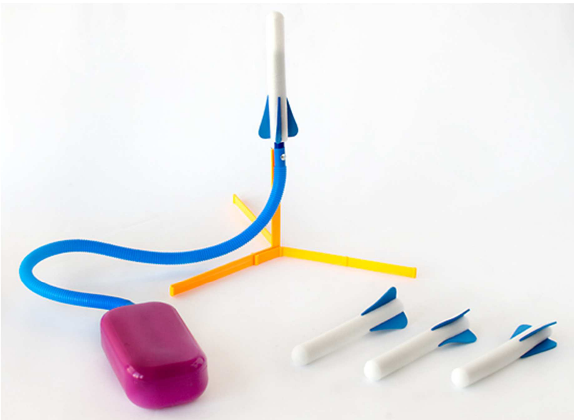

Figure 2

Design Sketch	Materials	Advantages
		Advantages * * Disadvantages * *
		Advantages * * Disadvantages * *
		Advantages * * Disadvantages * *

Table 1

Feature	Advantage	Disadvantage
Large Fins	Straighter flight path	Add extra weight
Triangular Fins	More Streamlined/ less weight	
Weight added to cone	More of a parabolic flight	Adds weight that may pull rocket down

Figure 3