Fly Rocket Fly

“MEH”

Maximum distance: 210 yards

Purpose

How do you design a rocket that's fueled by water and is made out of a 2 liter soda bottle launch at a maximum distance? Can you make it out of another bottle size and modify it so that it launches similarly to a 2-liter rocket? In order for the rocket to go it's furthest distance, what's the best weight, amount of water needed, amount of pressure, best position for the wings and what's the best way for it to be aerodynamic?

Literature Review

Before we built our rocket, research had to be done in order to successfully build our first rocket. For a majority of our information we gathered from the “General Guidelines for Bottle Rocketry” and previous students rocket lab reports.

For every rocket there needs to be just an enough amount of weight in order for it to go its furthest. If it's too light it will easily be affected by any type of outside factor, if its too heavy it will weigh itself down and won't go as far. It was suggested that a perfect mass was in between about 350-400 grams, however, we found that our rocket went the furthest when the mass was 174 grams. The amount of weight you need also depends on how big your rocket is. Rockets with multi- tanks may need more weight bc it's twice the rocket. You can use a lot of different things for weight just as long as it's evenly distributed. Our first thought for the weight was hard drying clay, a golf ball and ping-pong balls for even distribution. We found that it's best to put the weight in the nose cone of the rocket.

For the nose cone, a majority of previous students said that a more spherical nose cone worked better than a pointed cone shaped one. To get the cone rounded some students, like the ones who made the “Hammerhead”, cut the top of a soda bottle off and the bottom off, and stuck a ball at the top where it fit perfectly over the whole to create a smooth rounded cone. This is what we based our cone off of.

There were many different and effective ways to make the fins. “The Violette 3000” had very different fins from most everybodys. That group used a box fin which was a three hexagonal wings that went around the rocket instead of attaching them straight out. Those fins were successful. Another type of fins are triangular or a trapezoid shape. A key aspect for your

fins is that they all have to be the same size and separated equally on the bottle so the rocket flies straight.

In order for your rocket to be successful you have to securely put together the fins, nose cone, weight, etc. For the structure of the rocket, some people have put two bottles together using a method call splicing. Splicing is basically combining the two cut bottles together with some type of enforcement; gorilla glue, super glue, duct tape, etc. To attach the wings use basically the same stuff for soliciting and then duck tap for more stability.

Testing and Development

Mission 5: Launch day 1 - 9/30/2016

Mission 5: Launch Day 1: Preparation

For our first official launch day we decided to just focus on the weights and nose cone design. For the base of our rocket we used one whole 2-liter soda bottle. For the nose cone we cut of the mouthpiece and about 2/3rds of the bottom of another 2-liter bottle. We sanded down where we cut the mouthpiece off and gorilla glued a golf ball inside the cut up bottle so that it pokes out a little and its perfectly rounded. We then sanded down the golf ball with the plastic from the cut mouthpiece so that it was even and smooth. For additional weight we used a hard-drying clay and to ensure that the clay was evenly distributed we put 3 ping pong balls in between all the clay. We attached the nose cone to the end of the base bottle with superglue then duck taped it. The weight of the rocket was 408.4 grams.

Mission 5: Launch Day 1: Results

	Distance	PSI
1st launch	26 yards	130
2nd launch	Blew up	130

On this launch day is was windy. On the first launch it did not blow up, so that was good, however it spun a lot due to it not having any wings. And then the second launch it blew up because there was a crack in it from the previous landing.

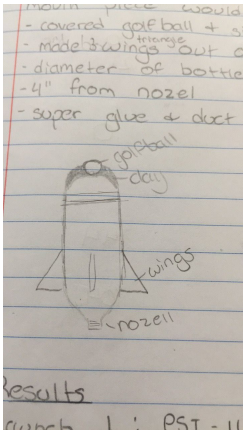
Mission 5: Launch Day 1: Recommendations

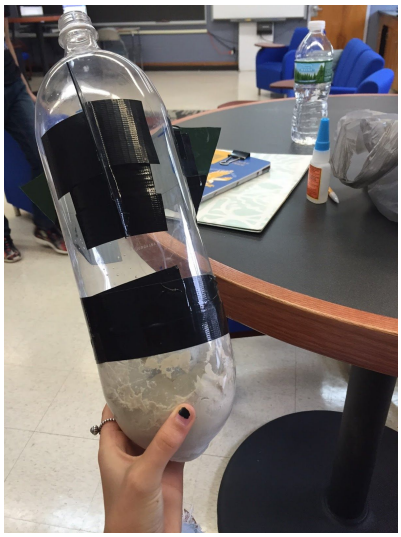
We learned a lot from just the first day. Wings are extremely important and without them it's just a big disaster. We also need to have a lighter nose cone and not use the ping pong balls, they didn't really do anything.

Mission 6: Launch Day 2 - 10/4/2016

Mission 6: Launch Day 2: Preparation

We started from scratch and got two new bottles to work with. We did the same thing with the base bottle and nose cone except we didn't use any ping pong balls and we used less clay. Before we attached the nose cone to the base bottle we let the clay dry completely so it would harden. For the fins we decided on three triangular shaped ones made out of plastic we got from the plastic pots. We put the wings about 4.6 inches apart and about 4 inches from the bottle. We superglued the wings on then duck taped them. The weight was 274.9 grams.





Mission 6: Launch Day 2: Results

	Distance	PSI
1st launch	144 yards	110

We only had time for one launch this time, however we noticed a big change that proved that wings are very necessary. After the launch the nose cone was dented but the wings were still intact and good.

Mission 6: Launch Day 2: Recommendations

This launch day proved to us that wings are important, it keeps the rocket flying straight. We should evenly distribute the clay a little more next time and try to find a way to make the wings more sturdier, they were a little wobbly.

Mission 7: Launch Day 3 - 10/6/2016

Mission 7: Launch Day 3: Preparations

We kept the same base bottle and we made a new nose cone, the same way except we made it shorter to that there isn't a lot of empty space between them. And we didn't add as much clay as last time. We used the same wings. The weight was 174 grams.

Mission 7: Launch Day 3: Results

	Distance	PSI
1st launch	210 yards	95

There was some wind on this launch day. Impact there was a tiny dent in the nose cone.

Mission 7: Launch Day 3: Recommendations

We found that launching it at a lower pressure was good with the little amount of weight. For the next launch we should try keeping it at a lower angle and try raising the pressure and see if that makes the rocket fly further. We also found that the less space between the base bottle and the nose cone is best because the weight is more even across the rocket and on the impact from landing it doesn't dent or damage as easily. For the wings we should try to put the further back on the rocket for more control.

Mission 8: Launch Day 4 -10/13/2016

Mission 8: Launch Day 4: Preparations

We decided to do something different with the wings. We were going to keep the same shape but try putting the bottom half of them in the rocket so they are more stable during flight. I cut slits every 4.6 inches on the bottle the same length of the wings and stuck about 1 cm of the wing in the slit. Then I super glued them and then duck taped them. The nose cone stayed the same.

Mission 8: Launch Day 4: Results

The slits weren't tight enough and it blew up on the launcher. It was not good.

Mission 8: Launch Day 4: Recommendations

Don’t split the bottle next time, or find a better way to seal the slits.

Mission 9: Launch Day 5 - 10/19/2016

Mission 9: Launch Day 5: Preparations

We started from scratch considering our rocket blew up completely. We got two new bottles. For the base bottle and the wings we went back to securing the wings on the bottle. This time we used a political sign for the wings so they were a little thicker, which was better for attaching them to the bottle, and still super light. It was a lot easier securing them to the bottle with super glue and duck tape. We did the same thing with the nose cone but we used less clay

and made an even smaller space between the nose cone and the base bottle. The weight was 143 grams.

Mission 9: Launch Day 5: Results

	Distance	PSI	Launch Angle
1st launch	154 yards	110	41
2nd launch	146 yards	130	41
3rd launch	123 yards	90	42

On this day it was windy. All three of the launches, each time our rocket went straight up really high and dove back down. On the second launch it was very wobbly due to a damaged fin but on the landing it fixed itself.

Mission 9: Launch Day 5: Recommendations

We should try and have just a little bit longer nose cone because this one was a little too short and didn't cover the base bottle all the way around, causing it to not be as aerodynamic.

Mission 10: Launch Day 6 - 10/25/2-16

Mission 10: Launch Day 6: Preparation

We made a whole new rocket with everything the same except we hot glued the wings on, followed by duck tape and it worked a lot better and made them more sturdy. It weighted 149 grams.

Mission 10: Launch Day 6: Results

	Distance	PSI	Angle
1st launch	192 yards	115	40
2nd launch	162 yards	--	--
3rd launch	110 yards	--	--

During this launch day my partner and I had to leave after the first launch for WAC so we don't have the specific details.

Mission 10: Launch Day 6: Recommendations

We should launch the same rockey and try changing the angles and water levels. The weight was the same as well.

Mission 11: Launch Day 7 - 10/27/16

Mission 11: Launch Day 7: Preparations

We kept the same rocket as the previous launch day. We are going to test and see the results.

Mission 11: Launch Day 7: Results

	Distance	PSI	Angle
1st launch	134 yards	135	40
2nd launch	174 yards	135	40

We went in early this day because it was snowing and very cold.

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Use the same rockey and try testing the water levels and angles because we never got to today.

Mission 12: Launch Day 8 - 10/31/2016

Mission 12: Launch Day 8: Preparations

Were using the same rocket as the past two times. We are happy with the design of it. Were going to test specific stuff today. The weight is the same, 149 grams.

Mission 12: Launch Day 8: Results

	Distance	PSI	Angle	Water level
1st launch	198 yards	135	45	½ liter
2nd launch	193 yards	135	45	¼ liter
3rd launch	127 yards	135	55	⅓ liter

4th launch	130 yards	135	47	½ liter

In every launch, all the rockets went extremely high but not that far.

Mission 12: Launch Day 8: Recommendations

We should make a new rocket, this one is starting to fall apart with all of the launches. Maybe we should try a bouncy ball instead of a gold ball and see what happens.

Mission 13: Launch Day 9 - 11/2/2016

Mission 13: Launch Day 9: Preparations

We used the same nose cone structure but instead of a golf ball we used a bouncy ball. And the wings were the same material and were attached the same way as well. We finally found a name for our rocket, “MEH”, because it's Maddy, Emily, Hannah and because our rocket isn't anything special, it's just meh. The weight is 148 grams.

Mission 13: Launch Day 9: Results

	Distance	PSI	Angle	Water Level
1st launch	178 yards	135	45	½ liter
2nd launch	Blew up	--	45	--
3rd launch	199 yards	135	45	½ liter
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In our second launch the rocket blew up because the thread were bent on the rocket but somehow when it blew up it fixed itself and we were able to continue to launch.

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We have to fix the nose cone for the next launch day and also use a different type of glue other than hot glue because it melted the bottle.

Mission 14: Launch Day 10 - 11/4/2016

Mission 14: Launch Day 10: Preparations

We made a new base bottle with the same wings and we made a new nose cone with the same structure. We secured the bouncy ball this time with gorilla glue rather than hot glue again. The weight of the rocket was 148 grams.

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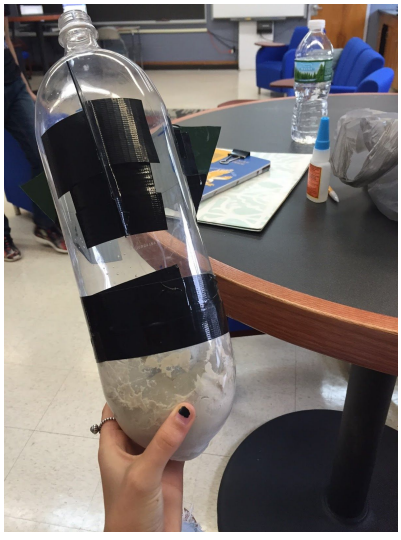

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Rocket Day Conclusion

The most important lesson I learned from testing and development is the importance of each component. Without the wings the rocket just spins out of control and has no direction. If there isn't enough weight the wind or literally anything can throw it off course and with too much weight will just sink it down and it won’t go far. And most importantly you have to make sure your base bottle is water tight and does not leak or else it won't launch of the launcher. All of these failures made us know what to do in order to have a successful launch.

Our final Rocket design is very similar to the previous rockets. We used a 2-liter base bottle and attached the wings to the bottle with hot glue and duck tape about 4.6 inches apart. The nose cone was what changed the most. We still used the top half of another 2-liter bottle and cut off the mouthpiece of it and then stuck the bouncy ball in the opening so it's a smooth rounded surface. We secure the bouncy ball with gorilla glue. Then we attached the cone to the base bottle with super glue and then duck tape for reinforcements.

Launch Team

On Rocket day my role was with communications. I was out in the field with Maddy and Emily. Emily had the rangefinder and would find out the distance of the rockets by measuring the distance from us to the launcher, then from us to where the rocket had landed if it went over our heads and we added those two distances up to get the final distance the rocket traveled. I had a walkie-talkie which was connected to 4 other walkie-talkies. Many who was out further than us would stand with a large flag where the rockets had landed. I talked to Many to help line Emily up between the rocket and the launcher. I also reported the distances back to Leah who kept records of all the rocket's distances.