



Building and Designing a Model Rocket

By Eliana Mirkis

This year I decided to build and design a model rocket as my IMP project. I have always really enjoyed building model rockets from kits, so I thought it would be a really interesting project to build and design one from scratch. This project combines model building, creating 3D designs, some electronics, and a lot of problem solving.

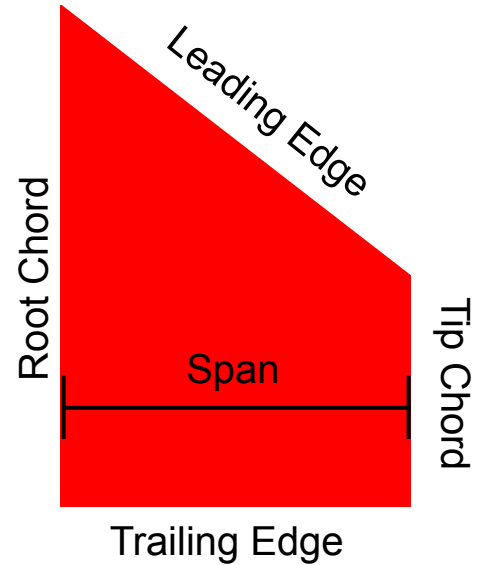
Soon after starting my project I realized that I would need some metric with which to measure the success of my launches. I decided to measure how high the model rocket goes. This meant that I would need some way to measure the height of the rocket, which would be easiest to do by putting an altimeter into the rocket. After doing some research, I found a company that sells kits to build altimeters for rockets. This was difficult to find because most altimeters are too large to fit in a model rocket.

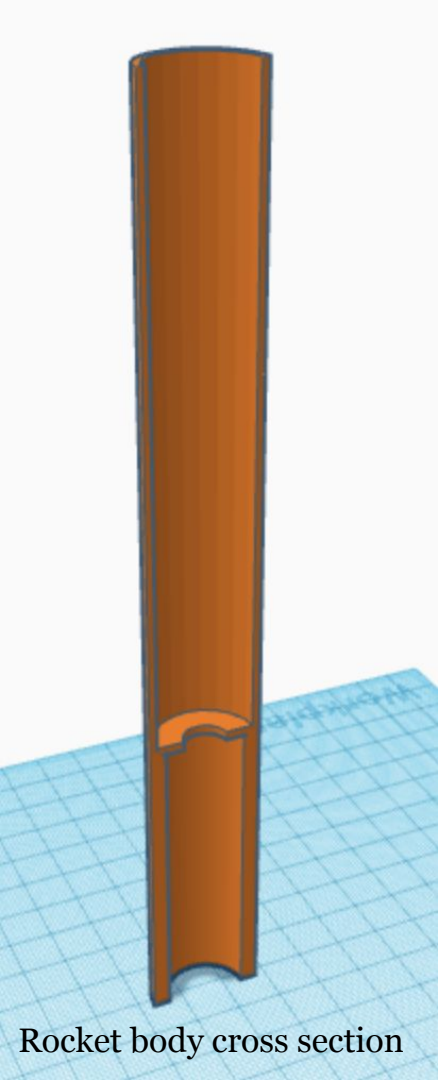
The body of the rocket would need to have three different inside diameters in different places. One diameter to fit the engine of the rocket, one narrower diameter to prevent the engine from going anywhere, and one to fit the altimeter. The section to fit the engine has to be slightly shorter than the length of the engine, so that it would stick out and not burn the model.

I had some issues with the fins of the rocket, as I could not figure out what shape they should be. In the end, I found a website online that had suggested proportions for different parts of the rocket in comparison to the diameter of the body. I decided to use four fins for higher stability.

Every part of the model rocket went through a lot of different versions. First, I had to change the inside and outside diameters of the body and nose cone of the rocket in order make the two fit together, and to make sure that everything, including the parachute, fit inside the rocket body. After all of this was done and I was preparing for the final launch, I realized that the altimeter cannot go inside the body of the rocket because there is no way to secure it, and because of the heat from the blast of the engine. This meant that I had to redesign the everything to allow the altimeter to go inside of the nose cone.

Root: 2x diameter of body
Span: 1.5x diameter of body
Tip: 1x diameter of body

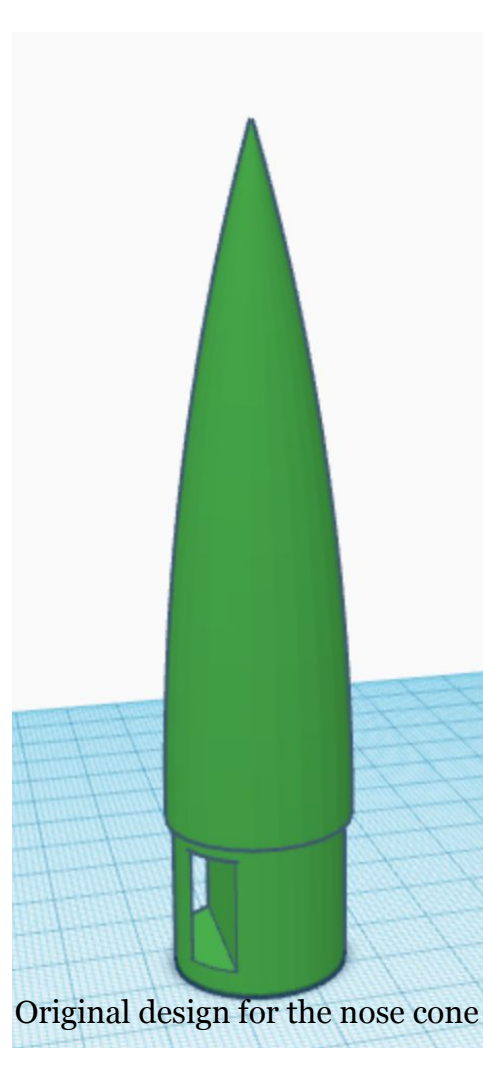




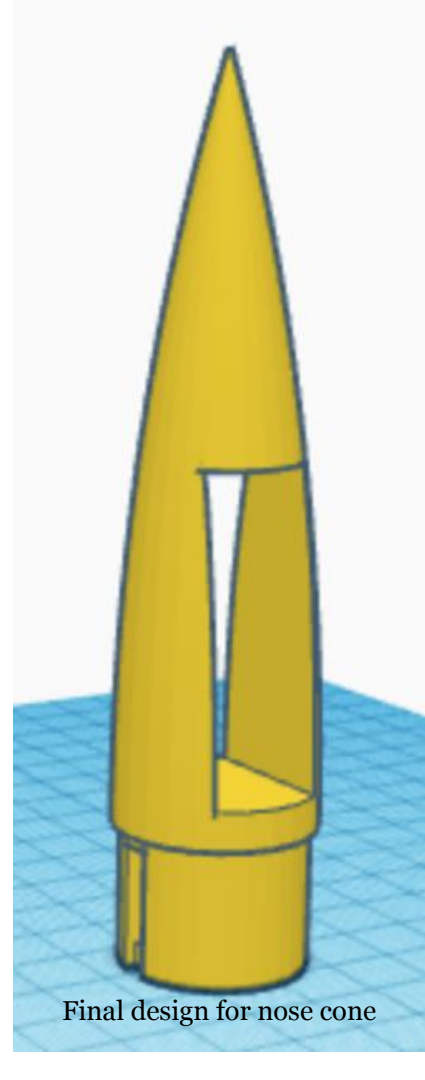
Rocket body cross section



Design for model rocket body



Original design for the nose cone



Final design for nose cone

Once I was done designing the parts of the model rocket, I started thinking about how I would make the parachute. I did not want to make my own parachute from scratch, because parachute material can be very finicky, and I was concerned that it would rip. I decided to use the parachute from a toy soldier. This created its own set of problems, as I needed to make sure the parachute fit in the rocket, and that it could slide out easily enough that it would be able to deploy properly.

The altimeter that I bought gives you all of the parts you need for the altimeter, along with an instruction manual, and has you solder it together, before connecting to it via wifi. The first issue I ran into with the altimeter was that I did not have the passcode that you need in order to be able to connect to it. This meant that I had to go through very slow process of ordering another part from egg timer rocketry and having to get it set up. Once I had gotten the part to retrieve the password, I had a lot of difficulty setting it up, something that Mr. David was eventually able to help me with.

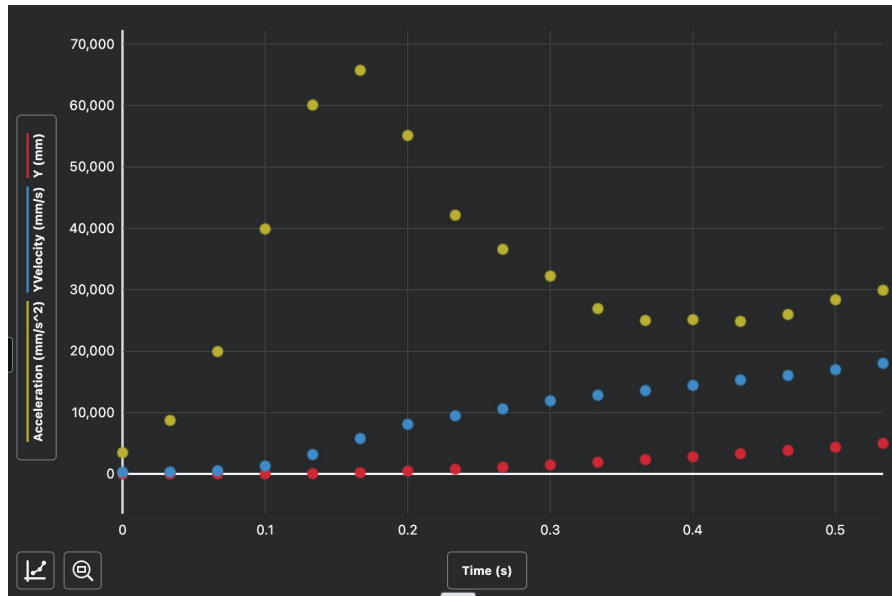
Once I had all of the parts and the altimeter of the rocket ready I decided to do a test launch in which I would not include the altimeter. I did this because I could reprint the entire rocket, but I only had one altimeter and I needed to make sure that nothing would go wrong before I putting the altimeter in the rocket. We did the launch at Leonards field. During the launch, the elastic band that connected the nose cone to the body of the rocket disconnected from the body of the rocket. We were only able to retrieve the body of the rocket, because the nose cone with the parachute of the rocket were blown of to the side were we could not find them. To fix this problem I decided to tie the elastic band to the nose cone in the same place as I tied the parachute.

As I prepared for the full launch of the rocket, we tried to connect to the altimeter with the password that we now had. We found that the altimeter was not properly communicating with us. We were able to connect to the altimeter, but once we were connected we were unable to retrieve any information with it. By the time we found this out it was right before the launch was about to happen and we did not have enough time to contact Eggtimer Rocketry and find what the problem was, so I decided to film the start of the launch and use vernier video analysis to see what information about the launch I could find out.

Despite all of the many issues I had preparing for the launch, the launch itself went well. One of our concerns had been the rocket getting blown away and landing somewhere where it shouldn't be landing, but the rocket landed around 20 feet away from us, fully intact. Another concern that we had had is that the parachute to the rocket would either not deploy or not properly expand. During the launch, the parachute did deploy properly, but for some reason did not fully expand. It did however expand enough that it was not a safety hazard to anyone.



Vernier Video analysis



Because I could not use the altimeter, I decided to use vernier video analysis to find the starting velocity and acceleration.

Thank you to Ms. Alexis for being my IMP mentor, keeping me on track, and helping me figure out what the next step was every time I had an issue. Thank you to Mr. David for helping me with the tech part of my IMP project, as well as helping me 3D print things.



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Science**