Presentation Team:
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Overview

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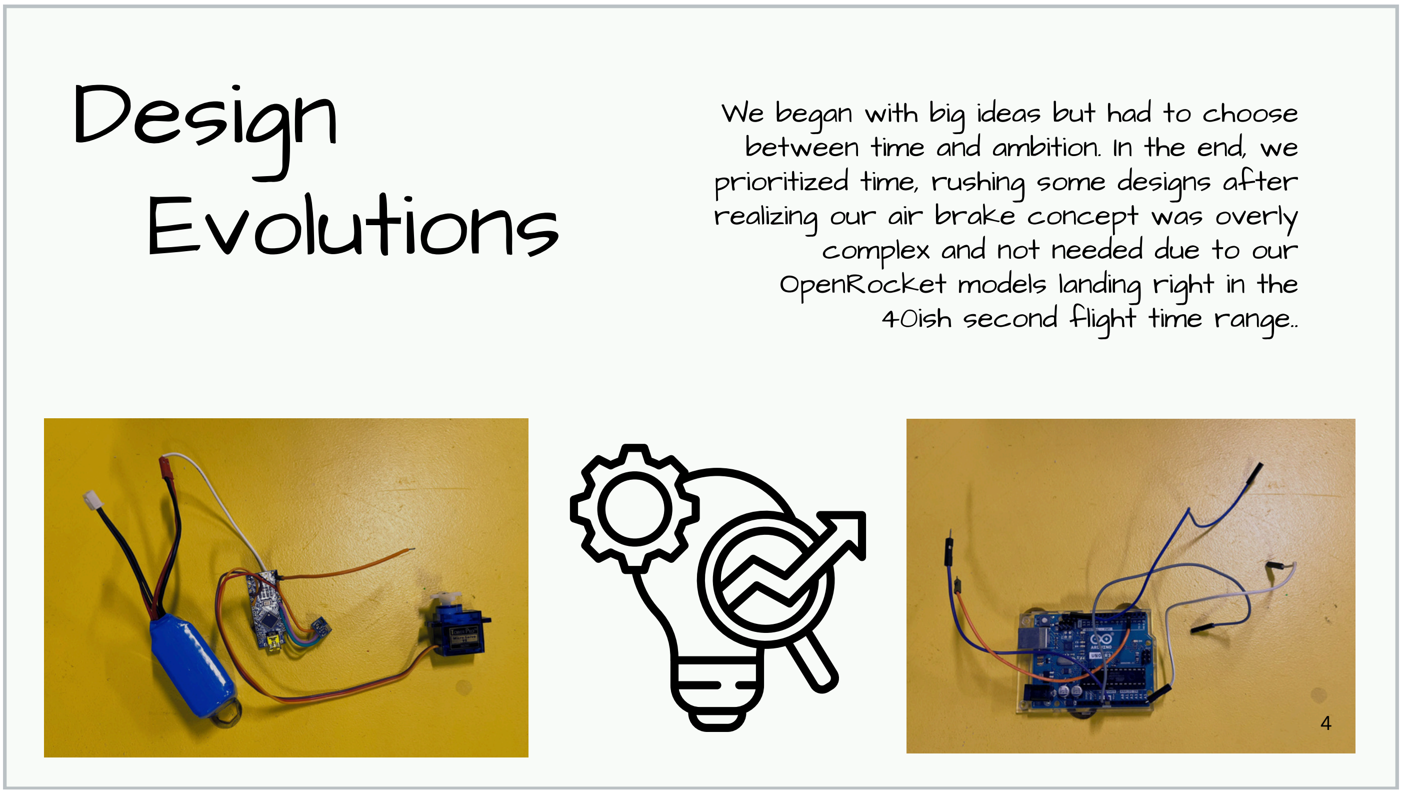
Hello! We are TeamTrueFire Rocketry Club — the only high school high-powered rocketry group in Florida. Our team is supported by our incredible mentor, Russell Finger, who holds certifications up to Level 2, with plans to pursue Level 3 in the coming year. Over the three years since our club began, several of our members have also earned their own Level 1 certifications.

Our team includes students from 8th through 12th grade, with our youngest member having already been with the club for two years.

The Suncoast Science Center has been our home from day one. We are proud to be one of their clubs — they provide us with funding, workspace, and access to passionate, STEM-focused volunteers. In return, we work hard to bring in donors, generate headlines, and shine a spotlight on their mission.

We meet every Wednesday from 3:30 PM to 6:00 PM to design, prototype, and build our American Rocketry Challenge (ARC) rockets. Alongside our ARC team, we have a dedicated group working on a high-altitude rocket — aiming to reach 12,000 feet and break 1,000 mph on ascent. Sometimes the TARC team lends a hand when needed, but the high-altitude group operates independently.



Being that this is our first year participating in TARC, we jumped straight into designing and modeling our rocket right after registration. At the time, we thought we had plenty of time to explore a bunch of innovative ideas that might help us later in the competition — but we quickly realized that was a big oversight.

Keeping everyone aligned with the rulebook ended up putting a bit of a damper on some of our more out-of-the-box thinking. One by one, each idea got shut down — whether it made the rocket too heavy, unbalanced, or just didn't make sense within the design constraints.

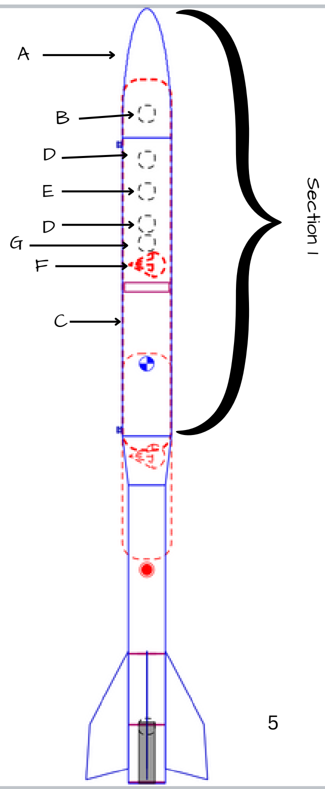
Eventually, we landed on the idea of using airbrakes positioned just below the nose cone to extend flight time. Based on our OpenRocket simulations, we were coming in just shy of 40 seconds — not a terrible oversight, but we read that in the later rounds, especially in the semi-finals and finals, target flight times can vary. So we figured if there was a spot we could reliably minimize points, it was worth planning ahead.

For our qualification flights, we ultimately decided to scrap the airbrakes.

The pictures on this slide show the electronics setup, fully coded and ready to be implemented in the rocket. The only component missing from the setup on the left is three additional servos, which would've been used to pivot out the airbrake "legs" from the rocket's body, disrupting its aerodynamics just enough to slow it down.

Parts List: Section 1

	Part	Material	Mass (g)
A	Nose Cone	PLA	75
B	Altimiter	Electronics	10
C	Upper Body Tube	Cardboard	66.7
D	Eggs	2x Egg	120
E	Packing Foam	Foam	9
F	Parachute	Nylon	113
G	Screws	Metal	21



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This is the upper stage of the rocket laid out detailed with part description, the material it is made of, and how heavy it weighted.

One of the most challenging parts of this process was finding the right dimensions for the body tube, length/width, and the nose cone, curvature/height.

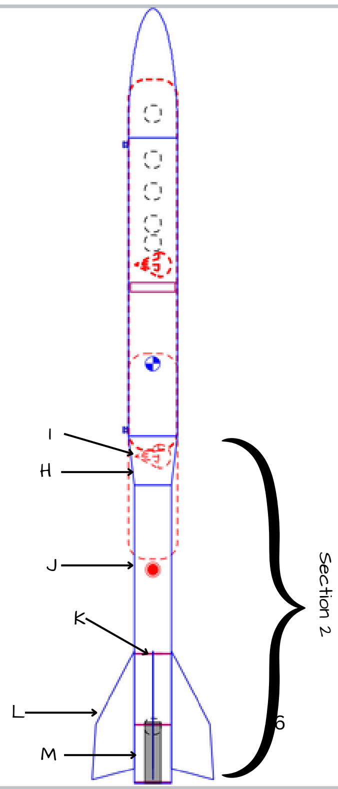
Using Fusion 360 & OpenRocket throughout our design process it allowed us to create different designs, adjust measurements, and simulate flight performance before physically building anything. This save us time all around.

One thing worth noting is the CG or Center of Gravity spot that this program gives users, denoted with the blue and white center symbol. As well as the CP or Center of Pressure denoted as the Red circle. Being it is required for most flight inspections, it makes it easy to premark it out for any officials if they do ask.

Parts List: Section 2

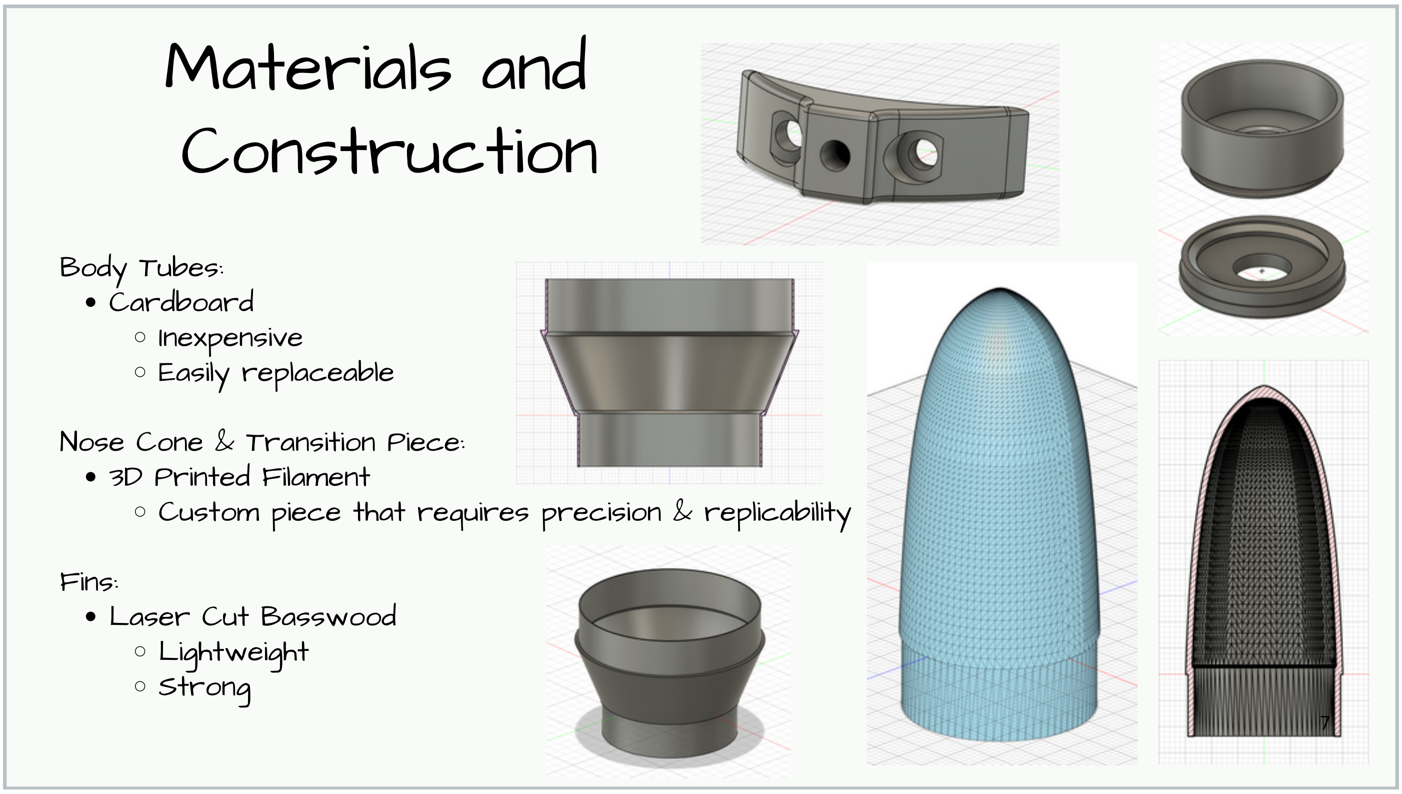
	Part	Material	Mass (g)
H	Transition Piece	PLA	30
I	Parachute	Nylon	11.3
J	Lower Body Tube	Cardboard	24.7
K	Engine Fin Ring	Basswood	0.906
L	Fins	Basswood	44.5
M	Motor	F32-4T	64

Total Mass: 572g



This is the lower stage of the rocket, including the fin can, motor, the transition, and its respective parachute.

Detailed list adding up each component we included to give us the most accurate flight results without having to physically test it ourselves, all through the OpenRocket simulation program as previously described.



This slide shows our finalized 3D models and an explanation of the materials used for the rocket.

We chose cardboard for the body tubes mainly to keep weight and cost low — and in case of a lost or failed flight, it wouldn't be a big setback.

3D printing made a huge difference in how quickly we could iterate. If something in the flight sims wasn't working, we could easily tweak the model and reprint it. That flexibility helped us lock in better results.

One part worth mentioning is our custom motor retainer. It screws in to securely hold the motor during descent — which fixed an issue we ran into early on, when a press-fit motor popped out on landing during a low-altitude test. Since every component has to be recovered for the flight to count, we knew that had to be addressed.

The transition section, shown on the left, was designed to stay connected only to the lower stage. It was friction-fit to the top, so when separation occurred, it wouldn't interfere.

Motor Selection and Testing

Aerotech F30-8FJ

- Initial motor choice
- Fell very short of the required altitude

Aerotech F42-4T

- Was tested as a potential upgrade, however all of our supporting upgrades such as the motor retainer and centering rings could not be adjusted in time before our final launch day

Aerotech F32-4T

- Final motor choice
- Still fell short of altitude requirements but this is where we would start iterating next.

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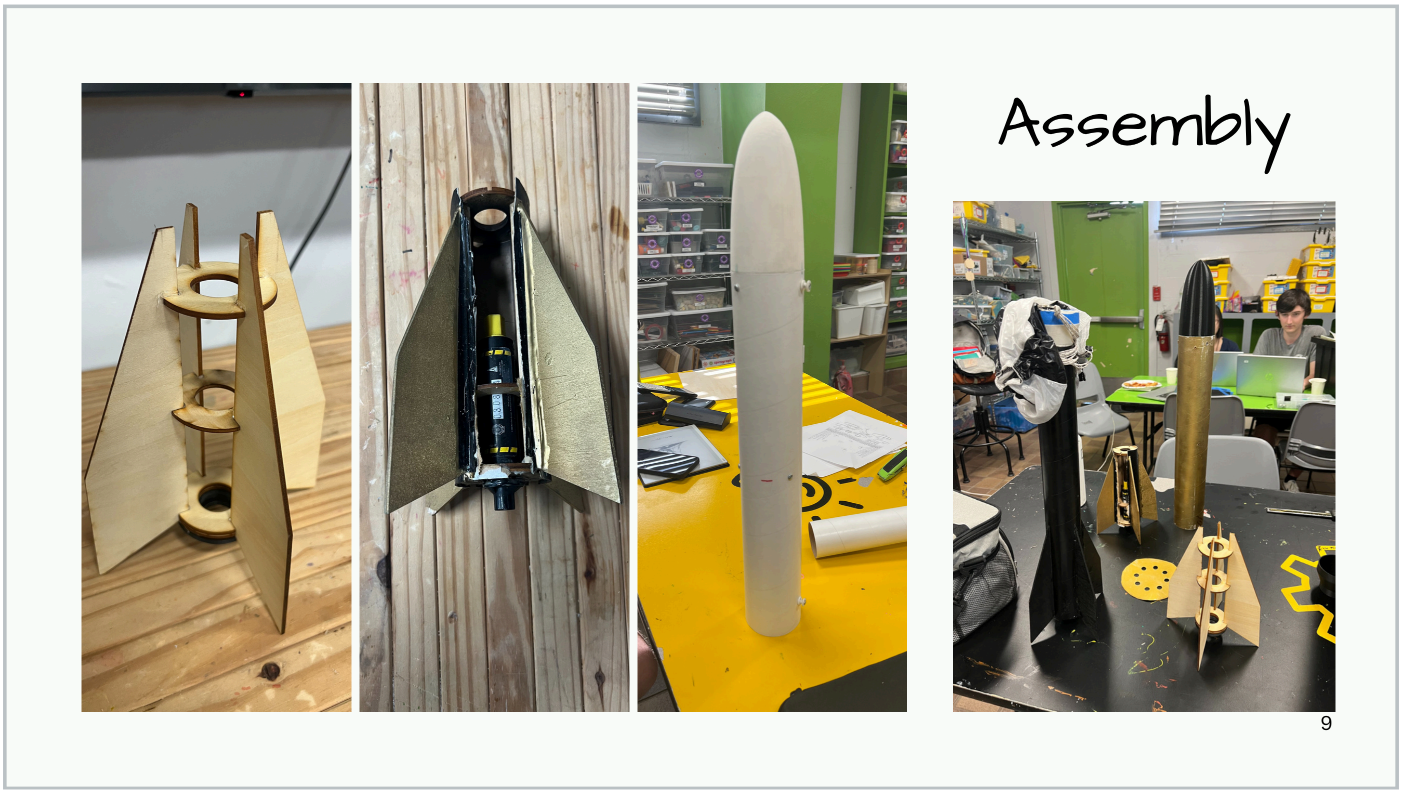
This picture shows the motor and size we ended up using. Described is our thought process when picking out and going through our motor options. We started with an impulse that would best fit with our programs model for required altitude, then the delay came second to that. Once we had an ideal impulse range we looked at what was most widely available and easiest to obtain.



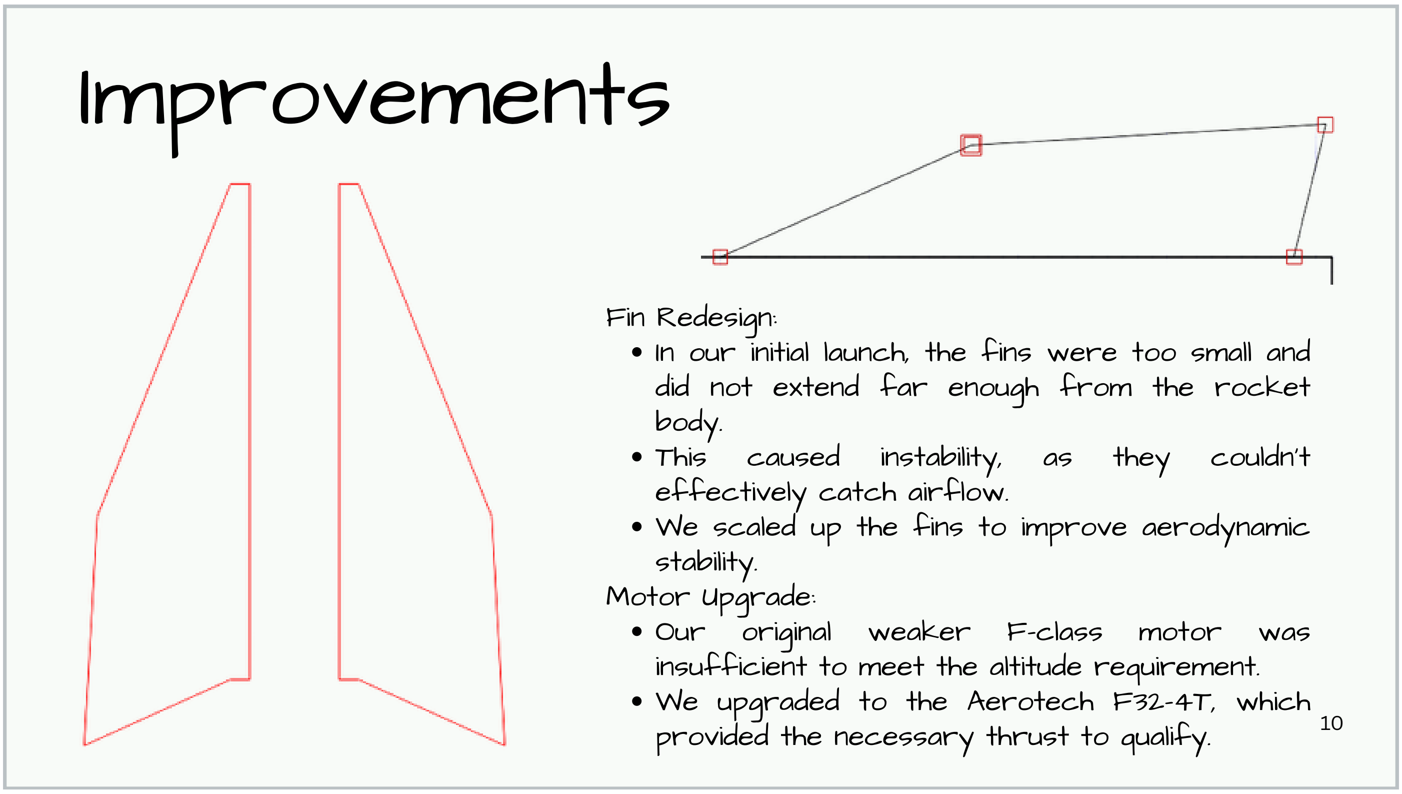
Working left to right, these images show the progression of our rocket build and prep.

First is the early mock-up of the bottom fin can section. You can see the laser-cut design coming together with centering rings used to support and align everything.

Next is that same fin can, cut away from the rest of the lower stage and opened up as a demo piece. We use it to teach and give others outside the club a look into how our internal structure works — it's a great way to explain what we do without just pointing at a finished rocket.

The third photo shows the upper stage right after paint prep. The nose cone is bolted in, and the parachute mounting point is installed just past the halfway mark — you can see the faint lines we used for placement and alignment.

Finally, on the far right, is everything laid out and assembled the day before launch. We used that time to double- and triple-check each component, walk through the full launch procedure, and make sure we had backup plans and tools ready in case anything came up.



The top right image shows our initial fin design in OpenRocket. Based on simulations, the thinner fins would have given us an estimated 40 to 70 feet more in altitude. Looking back, it might've been worth building a full prototype with those fins just to test the real-world difference in stability.

But at the time, we didn't have any local launch sites or consistent access to testing opportunities — so we chose to play it safe and go with the more stable option.

The bottom left image shows our updated fin design. These are wider and include an extra lip, allowing them to slot into the body tube and be glued internally. That way, we didn't have to rely on hot glue fillets on the outside, which could've negatively impacted aerodynamics, potentially even worsening the flight altitude after adding wider fins.

In the end, this new design worked really well — it gave us the stability we wanted and held up great across all our test flights never failing or braking once.

Setbacks

Tampa Bay Rocketry Association - Tampa, FL:

- Our closest launch site 'home base' exchanged property owners at the end of 2024 resulting in the field closing and TBRA no longer having a location to launch. Forcing us to travel 2-3 times as far for every launch

First Launch - Palm Bay, FL:

- A wildfire broke out nearby, leading authorities to shut down the launch site before we could complete our second flight.

Second Launch Attempt - West Palm Beach, FL:

- The FAA unexpectedly closed the airspace due to President Trump's visit to his Mar-A-Lago estate, canceling all launches for the day.

In late 2024, the Tampa Bay Rocketry Association faced a major setback, they lost access to their primary launch grounds due to a change in property ownership. Putting us without a nearby launch site. This forced us to travel 2–3 times farther for each launch every time.

Our first attempt in Palm Bay was cut short when a nearby wildfire broke out (no, we did not start the fire). We managed to complete one successful flight, but authorities closed the site before we could launch our second rocket. While disappointing, this experience taught us to avoid simple errors like this from happening again.

Then, during our second launch attempt in West Palm Beach, we were once again pushed away with an unpredictable roadblock: the FAA closed the airspace due to President Trump's visit to Mar-a-Lago. This forced us to cancel the launch entirely.

Our Rocket: Wildfire

Our rocket was aptly named Wildfire after the fire that stopped us from launching.

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Context for this slide is the progression of the Wildfire, from left to right as everyone was rushing over to see what was going on, showing how wide and large the smoke cloud was getting.

The drought index wasn't even low enough to stop launches but the fire marshal blamed it on the area, and put us out of business. It ended up burning around twenty acres and it took about twelve firetrucks to contain and extinguish the fire. The white smoke on the right was the firemen starting to take action.

Flight Testing - February 9th

Location: Suncoast Science Center

- Flight Time: 35.85 seconds
- Apogee: 373 feet
- Outcome: Unsuccessful
    - Flight had more horizontal distance than vertical distance.

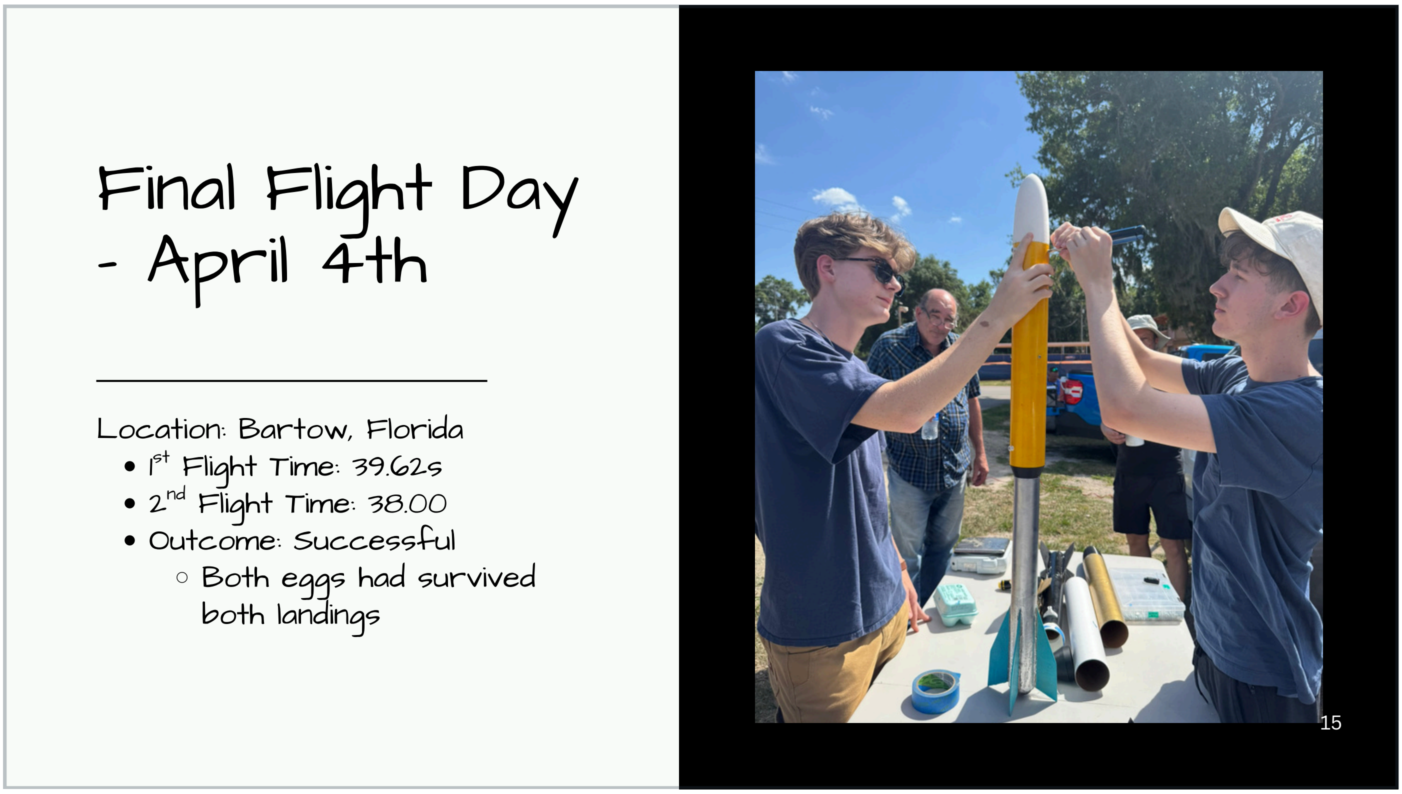
On our first flight test, we launched at the Suncoast Science Center on February 9th. While the flight was disappointing—gaining more horizontal distance than vertical—it provided us with data for future iterations. The rocket's short and unstable flight showed the need for changes. We realized we needed to elongate and widen the fins to improve stability and upgrade the motor to meet the altitude requirements. Despite being an unsuccessful flight, it was an important learning experience that set the stage for future tests. It was a good baseline.

Flight Testing - March 8th

Location: Palm Bay, Florida
- Flight Time: 48.5 seconds
- Outcome: Did not qualify
  - Secondary parachute failed to deploy

Second Launch Attempt:
- Canceled due to a nearby wildfire.
- Police shut down the launch site for safety, preventing further launches.

For our second flight test, we drove three hours to Palm Bay, Florida. While our first flight wasn't completely successful, with the second parachute not deploying, it was still helpful. This failure led us to put a little more research into a different parachute folding technique we continued to use in later flights. As we were going to attempt a second flight, a wildfire broke out (it was not caused by us) causing the launch site to get shut down by the local fire marshal.



For our final flight test, we only drove an hour and a half to Bartow, Florida. This launch was especially critical, as it was our last opportunity before the qualification deadline, April 7th. Fortunately, two of three flights were successful. They met the required altitude and duration, and both eggs survived the landings. It was a strong finish to all our testing and preparation, giving us the results we needed to move forward. Now we hope this small success will be enough to get us to through to the next round.

Flight Data

Flight #	Date	Mass (g)	Apogee (ft)	Duration (s)	Score	Comments
1	3/8	590	656	48.63	N/A	Second parachute did not deploy
2	4/4	585	698	39.62	98.9	Successful
3	4/4	571	672	38.00	133.0	Successful

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This slide shows the key data from our three most recent test flights.

One of the flights had a partial recovery due to the parachute in the bottom fin can section getting stuck. It caught on some internal hardware that was holding our 3D-printed parachute retainer in place. The other two flights were clean and successful.

If we were to make adjustments moving forward, I'd suggest increasing the motor size and adding some thickness to the nose cone to rebalance the added weight in the lower stage. As long as we dial in the delay correctly using OpenRocket, we could keep our near-perfect flight durations — without sacrificing stability or recovery.

One other thing we noticed: one of our parachutes started to burn slightly after repeated flights. So adding a fire blanket might be a smart move — though we'd need to be careful it doesn't create another snag point during stage separation.

Lessons Learned

Lessons Learned:

- Teamwork is Essential
- Time Management is Important
  - Towards the end of the challenge we faced a lot issues concerning time management including working on the presentation and the marketing competition.

Changes Made:

- Preparedness
  - After the first launch, we realized that there were many things we needed to change in order to efficiently launch
- Time Management

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Since this was our first time participating in the American Rocketry Challenge, we learned a lot. Our biggest challenge was time management as many of the team members go to different schools and participate in various extracurriculars. One major thing we had to learn was the importance of working outside of our regular 2 hour weekly meetings. During the last few weeks of the competition, several changes were made regarding launch prep and team member roles, ensuring the best use of our dwindling time. A few extra hours, and a few late night put us where we needed to, completing everything on time including our launches, presentation, and marketing competition.

How to connect with us!!!

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The Citizen Scientists League Inc.
DBA Suncoast Science Center

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