Team Triton FRR

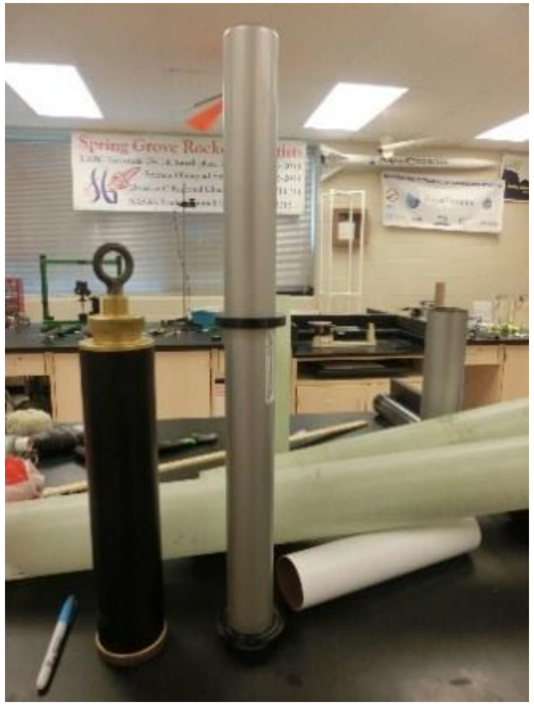
- Members: Sarah, Lacey, Lindsey, Emily, Zach, Adam, Josh and Melody

Changes Since CDR

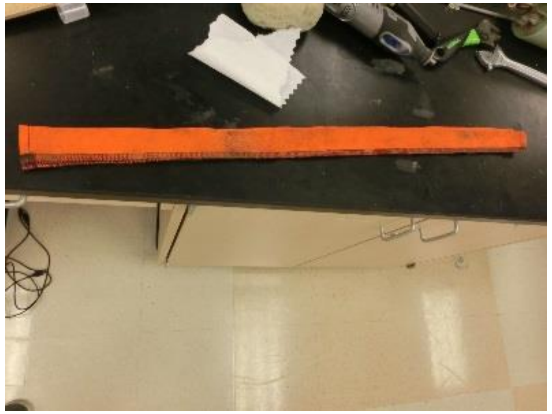
- Went from 50’ of 1’’ tubular nylon shock cord to 50’ of ½ tubular Kevlar
- A key switch was installed on the bulkhead of the payload.
- We have requested to change the motor from the CTI K510 to the CTI K711
  - Thus to increase the thrust to weight ratio
  - But due to the delay in getting approval from CTI..
  - We formally request to sue an Aerotech 75mm 2 grain K1000 motor instead of the k711
  - We are changing this because we are afraid we wont get approval in time for our launch on March 11th
  - We have tested this motor on February 11th
    - It flew at 5455 ft and its 4oz lighter than the final configuration

Changes since CDR

- We have switched from a K510, to a K1000 motor to increase the thrust weight to ratio.
- We have also changed the Nylon shock cord to a Kevlar shock cord because the kevlar is heat resistant, stronger, and less bulky.
- We switched our drogue chute from a 24in to a 15in to decrease the descent time in order to decrease the drift distance.



Motor Casing(Aerotech K1000 left, CTI K711 right)



Heat Shield(Shock cord)

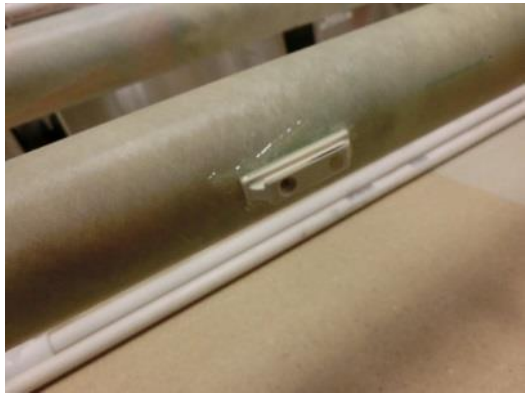
Heat Shield(Parachute)

Shock Cord(Kevlar)

Structural Elements

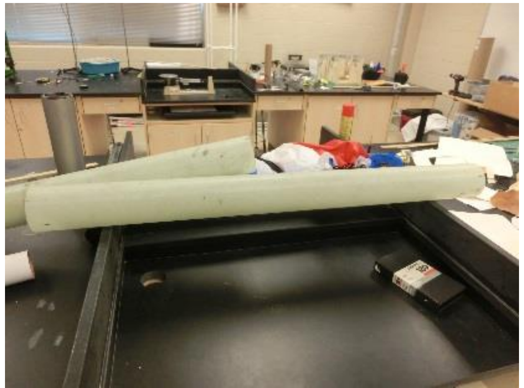
- Launch Lugs: They guide the rocket along the launch rail
- Body Tube Sections: These are the main structure of the rocket
- Nose Cone: This reduces the drag on the rocket and allows it to fly straight
- Fin Can: This provides stability for the rocket and reduces drag
- Parachutes: These slow the rocket to a reasonable speed during descent.
- Shock Cord: These limit the separation of the sections
- Motor Retainer: This holds the motor in place

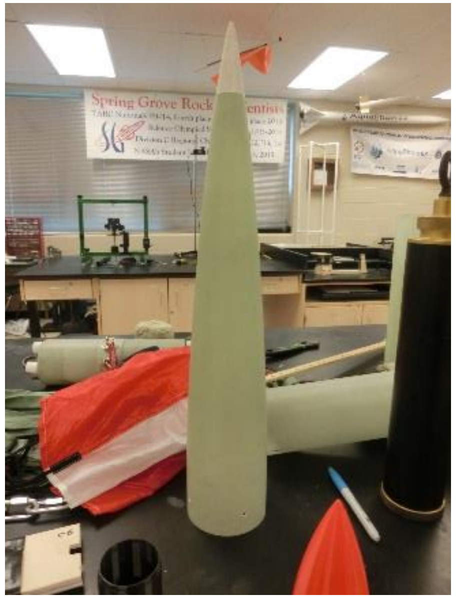
Structural parts

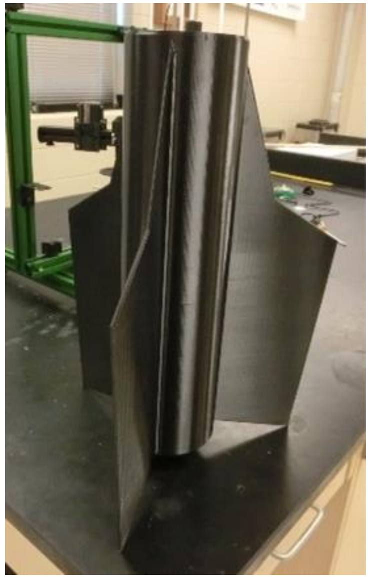


/|\ /|\
_____________ Launch Lugs________/

____
Body tube sections / \
\|/ \|/



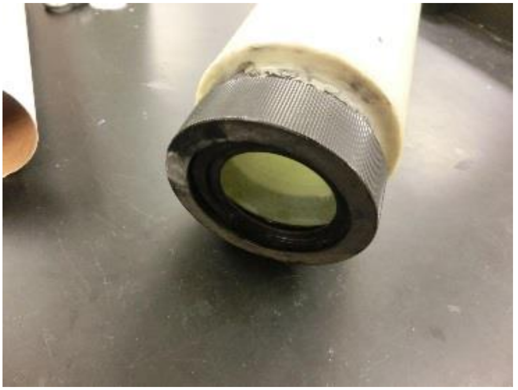




/\ Drogue chute /\ Main chute
| | | |
Nose cone \/ Fin can \/

Sub Scale Rocket

/|\
______________ Full Scale Rocket
___________________Motor Retainer + Cap_______________
/ | \
\|/ \|/ \|/



Electrical Elements

- Key Switches: Allow the rockets to be armed and disarmed
- Altimeter: Tracks the altitude and speed of the rocket as well as well as controls the parachute ejections
- Ejection Wells: Holds the black powder until it is ignited by altimeter

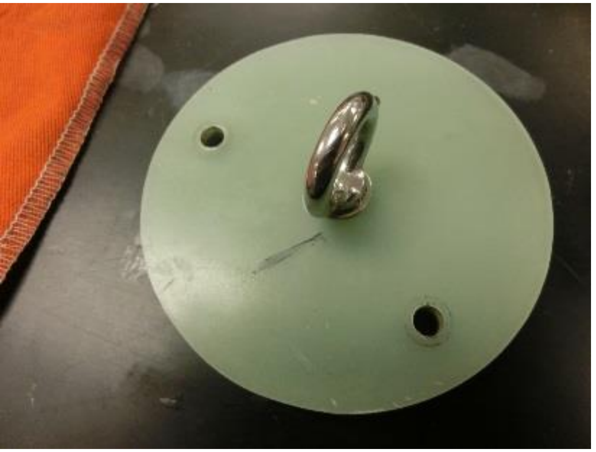
Electronics Bay

All-Thread Rods

Quick Links

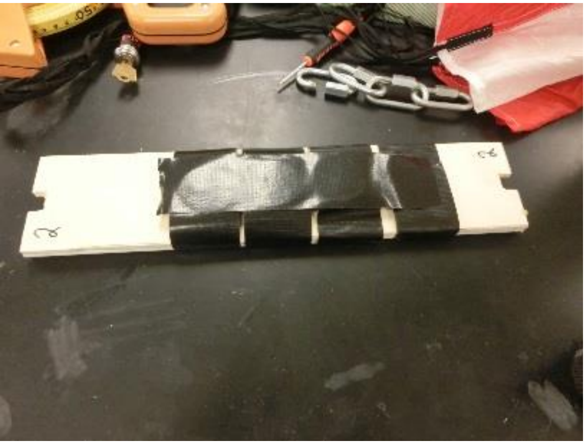
Key Switches

Ejection Wells for Drogue

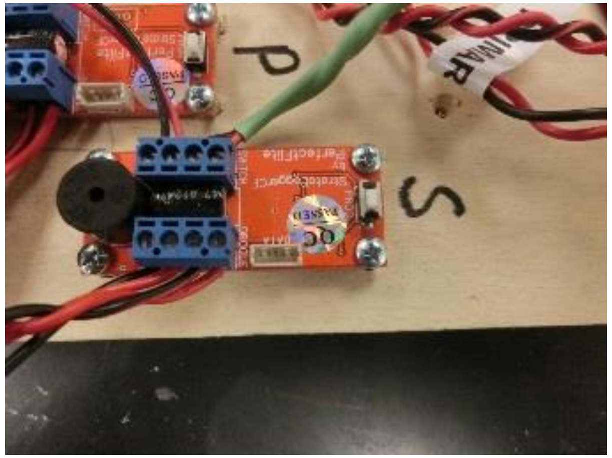


End Cap of Payload

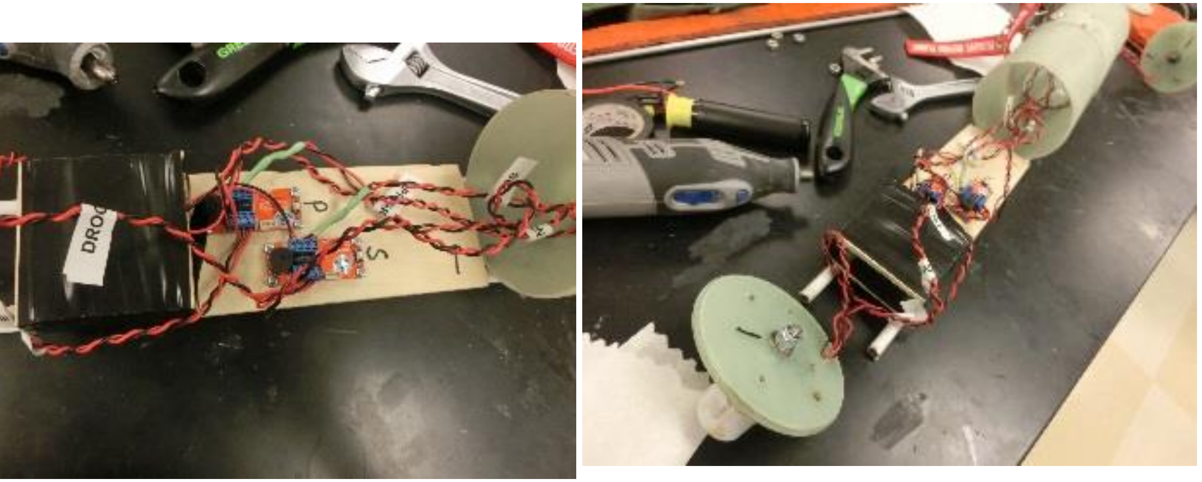
Ejection Wells for Main



Simulated Payload



Altimeters(Primary and Secondary)



Wiring of the Electronics Bay

Electronics Bay

Construction Process

- Cut body tubes to length
- Work on Electronics bay
- Electrical assembly and wiring
- Attach shock cords and parachutes
- Prepared payload
- Prepared rocket motor

Flight Reliability

- The rockets have proven design and are expected to reach the desired altitude.

Subscale Flight Results

Flight conditions were 45 degrees Fahrenheit , overcast, and wind of about

10 mph

Predicted altitude of 2,403 ft

Actual altitude was 2,303 ft

4.2% difference

Subscale Flight Results

The success of the subscale flight had proven the design and recovery subsystem to be successful.
The success of the subscale flight allowed us to continue with the same design and use the same design for the recovery subsystem.

Recovery System

Structural Elements

- Held together by shear pins, which will allow sections to separate
  - Connects back body tube to the electronics bay, and the nose cone and payload to the front body tube.
- It is also held together by pop rivets, which will hold sections together
  - At connections between the front body tube and the electronics bay, and as well as the connection between the nose cone and the payload.
- Within the rocket, sections are held together by shock cord.
  - Shock cord is attached to bulkheads via quick links in the payload, electronics bay, and an eyebolt on the motor casing

Electrical Elements

- Two Perfectflite altimeters
- Two 9-Volt Batteries
- Two key switches outside of the elrctronics bay

The key switches are turned, providing power to the altimeters via the 9-Volt batteries

Redundancy Features

- Redundancy exists within the recovery subsystem
- A primary and secondary altimeter
- One 9-Volt battery per altimeter
- Two key switches; one arms the primary altimeter, one arms the secondary altimeter

Parachute Sizes and Descent Rates

- 15 inch Elliptical drogue ejects at apogee, and slows rocket to 132.25 ft/s by 600 ft

- 72 inch Iris Ultra main ejects at 600 ft, and slows rocket to landing speed of 16.71 ft/s

Drawings and Schematics of the as built Electrical and Structural Assemblies

Schematic of Inside Electronics bay

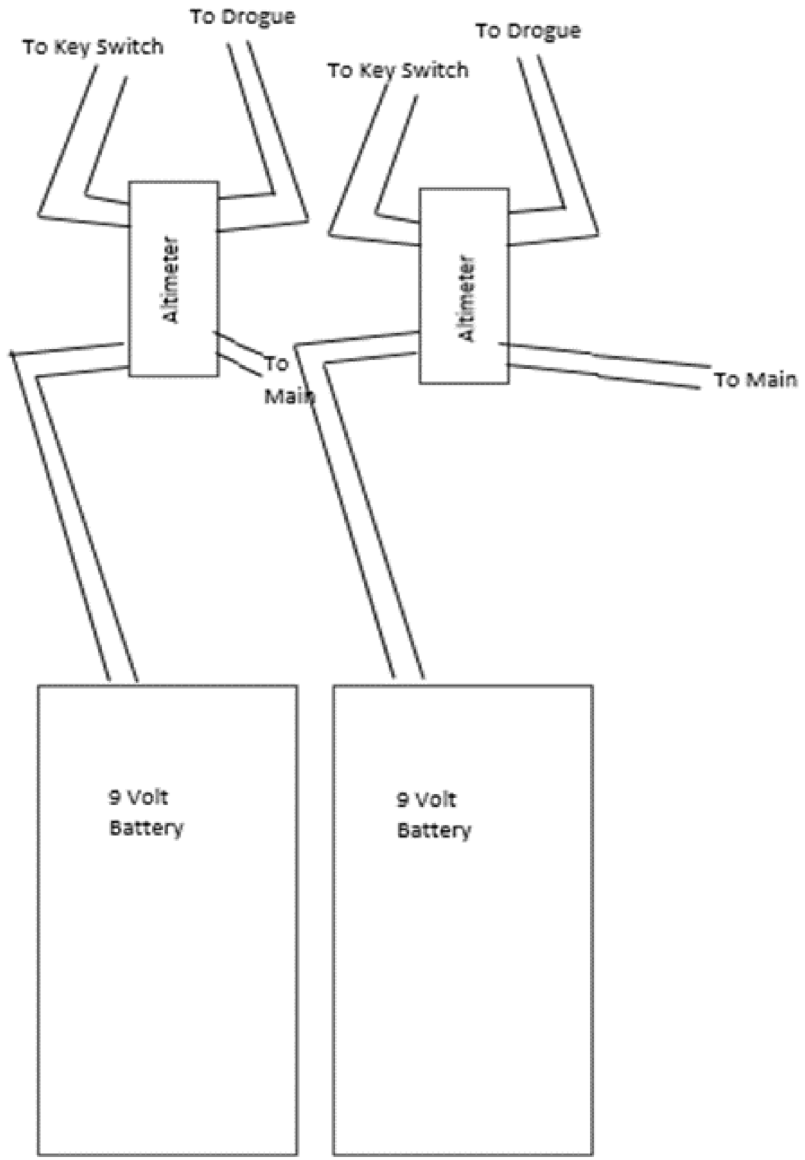
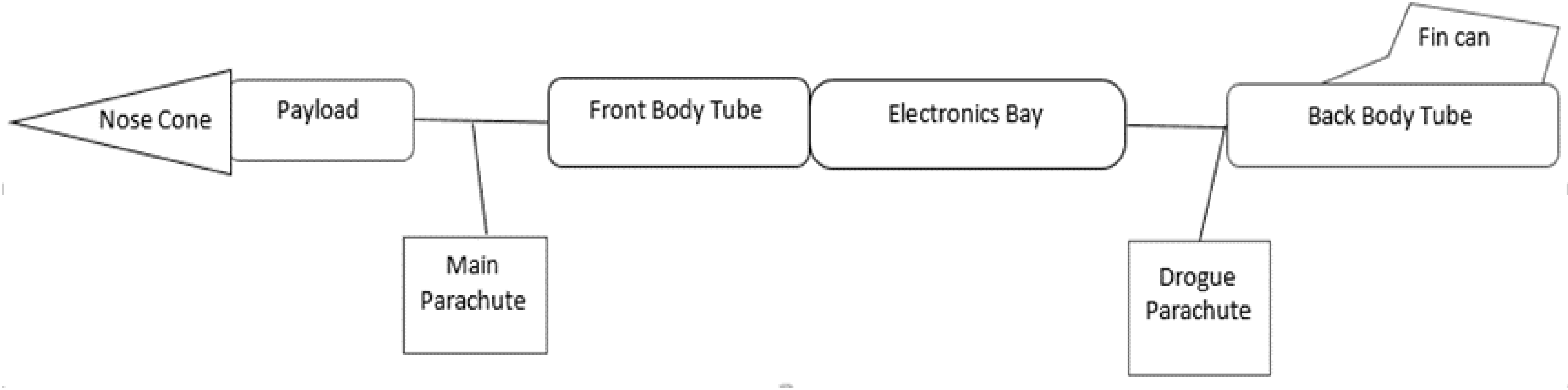


Diagram of Rocket Components



Rocket Locating Transmitters

- AT2B Communication Specialists Inc. tracker
  - Operating Frequencies of 222.470 and 223.530
  - Wattage of 50 milliwats
  - Range of about 5 miles

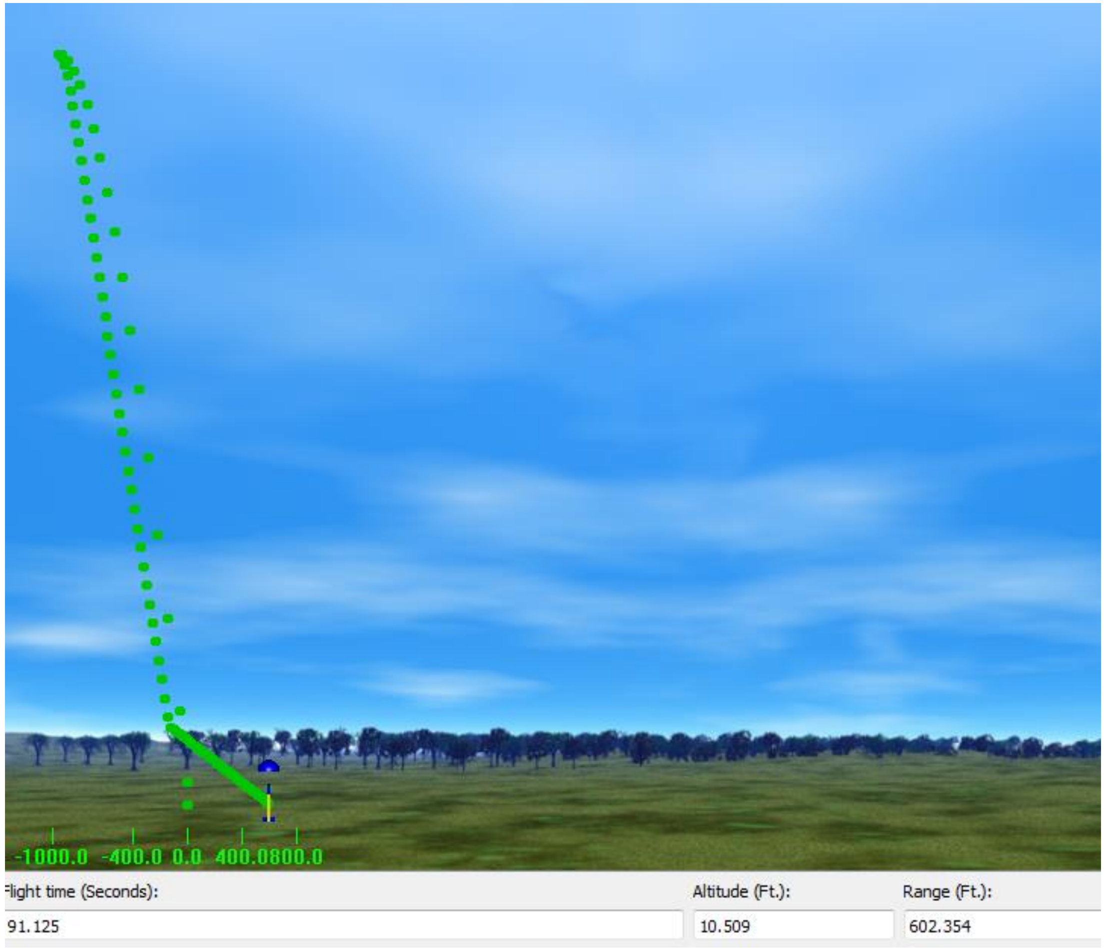
Recovery Subsystem Sensitivity

- The Recovery Subsystem has no additional features that will be affected by an electromagnetic field
- Perfectflite Altimeter is only affected by air pressure
- Payload not expected to be affected by an electromagnetic field

Mission Performance Criteria

- Our mission is to launch a rocket to an altitude of one mile while testing the effects of G-forces on a Non-Newtonian fluid. In order for our mission to be successful, our rocket must reach an altitude of one mile, and safely return.

Flight Profile Simulations



Altitude Predictions

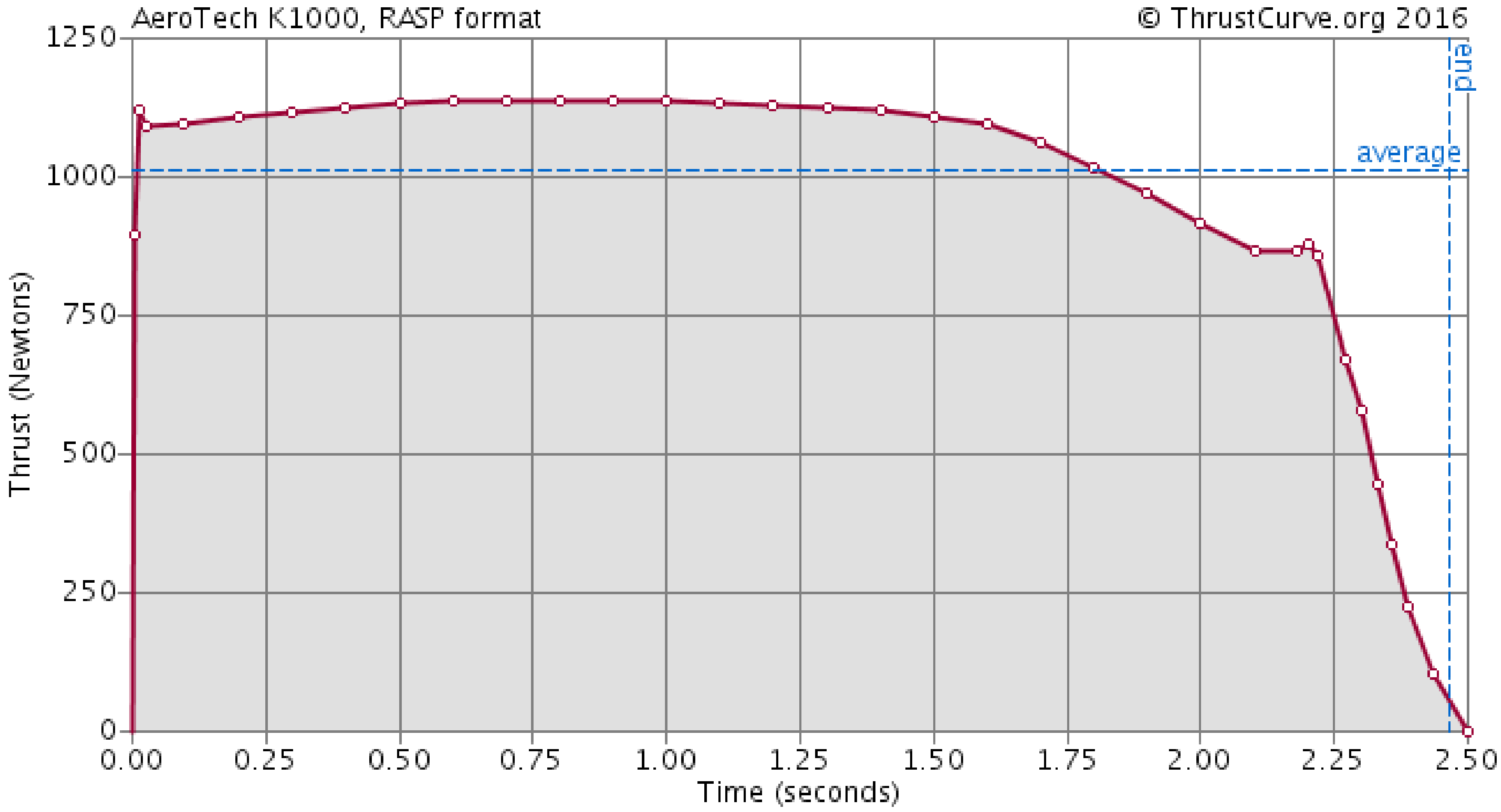
- The predicted result of the full scale flight was that the rocket would apogee at about 5580 feet.

Engines loaded	Max. altitude Feet	Max. velocity Feet / Sec	Max. acceleration Feet/sec/sec	Time to apogee	Velocity at deploym Feet / Sec	Altitude at deploym Feet
[K1000T-P-None]	5582.74	708.66	1942.29	18.12	10.95	5582.73

Component Weights

Item	Weight
Nose Cone	71.96 oz
Body Tube	59.20 oz
Shock Cord	29.20 oz
Electronics Bay	41.10 oz
Main Chute	12.80 oz
Drogue Chute	2.30 oz
Fin Can	28.20 oz
Payload	16.30 oz

Motor Thrust Curve



Drag Assessment

- The main parachute will create a drag force of 727.12 Newtons
- The drogue parachute will create a drag force of 95.04 Newtons

Scale Model Results

- Flight conditions were 45 degrees Fahrenheit , overcast, and wind of about 10 mph
- Predicted altitude of 2,403 ft
- Actual altitude was 2,303 ft
- 4.2% difference
- Very stable flight, dual deployment worked as planned

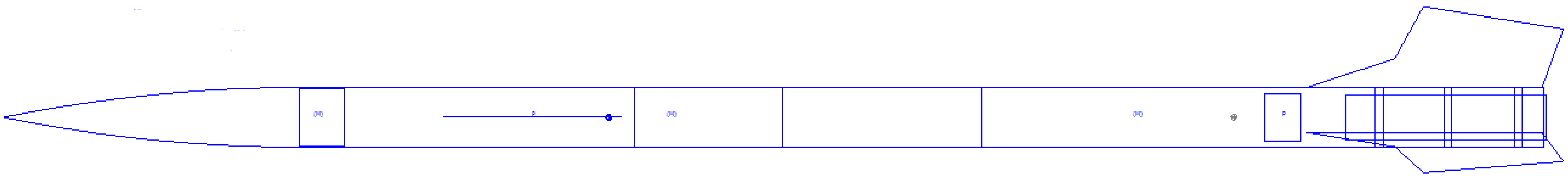
Predicted vs. Actual Data

- The predicted result of the full scale flight was that the rocket would apogee at about 5520 feet.
- The actual result of the full scale flight was that the rocket would apogee at BLANK feet.

Two-Dimensional Model

The Trident
Length: 105.3067 In. , Diameter: 4.0000 In. , Span diameter: 14.8812 In.
Mass 365.4906 Oz. , Selected stage mass 365.4906 Oz.
CG: 54.7824 In., CP: 83.0638 In., Margin: 7.07 Overstable
Engines: [K1000T-P-None,]

The Trident
Length: 105.3067 In. , Diameter: 4.0000 In. , Span diameter: 14.8812 In.
Mass 274.6602 Oz. , Selected stage mass 274.6602 Oz.
CG: 40.8772 In., CP: 83.0638 In., Margin: 10.55 Overstable
Shown without engines.



Kinetic Energy

- We will be controlling the kinetic energy by the use of a 72 inch FruityChutes parachute and a 15 inch FruityChutes parachute.

Drift

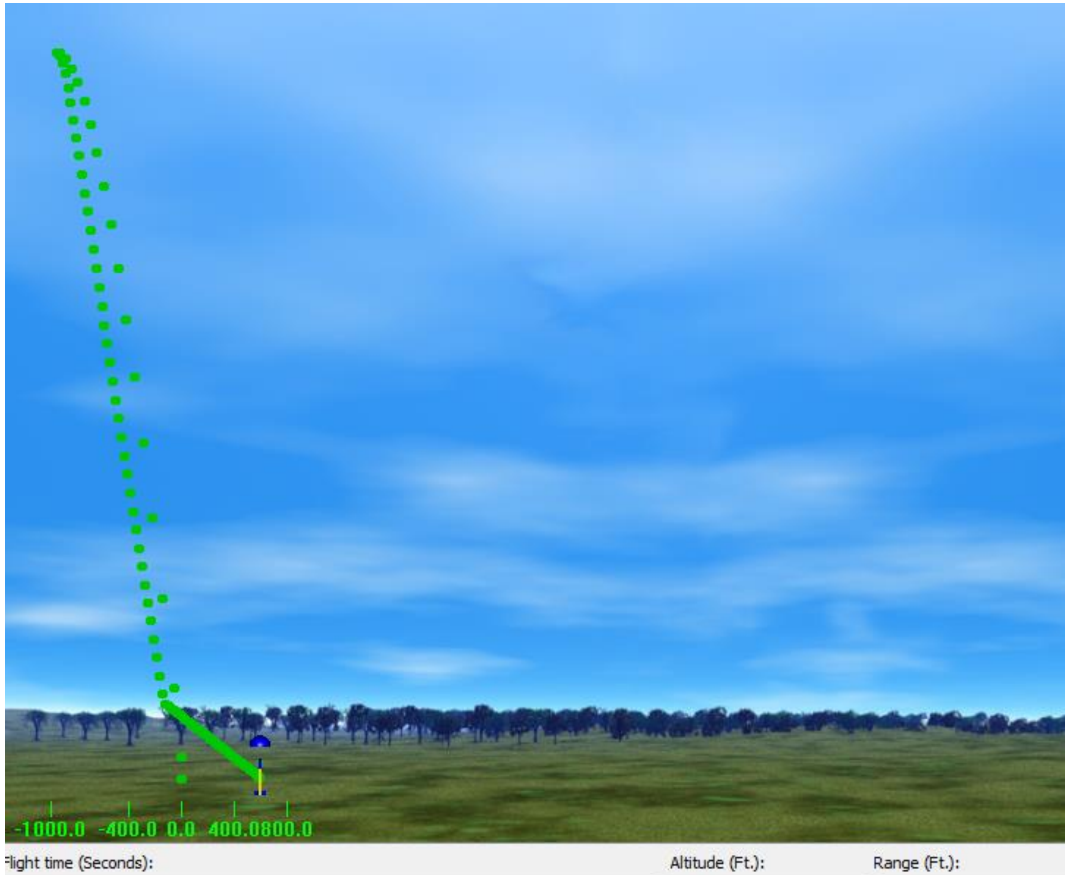
Wind Speed (mph)	Drift Distance (ft)
0.0	0.00
5.0	64.88
10.0	130.27
15.0	633.12
20.0	916.17

Full Scale Launch Conditions

- Sunny, about 40^{o} F, 10-15 mph wind, and partly cloudy

Simulation of Launch Day

Results	Engines loaded	Max. altitude Feet	Max. velocity Feet / Sec	Max. acceleration Feet/sec/sec	Time to apogee	Velocity at deploym Feet / Sec	Altitude at deploym Feet
	[K1000T-P-None]	5493.83	707.77	1942.32	17.96	57.08	5493.83



Drag Coefficient of Full Scale

- Under no parachute, the drag coefficient was about 0.72
- Under the drogue parachute, the drag coefficient was about 1.10
- Under the main parachute, the drag coefficient was about 2.20

Payload

This year we are testing a colloids (oobleck) reaction to the G-forces acting on it during accent.

Oobleck properties:

- Solidifies when pressure is acting on it
- Liquidities when no pressure is aliped to the matter

Payload Design

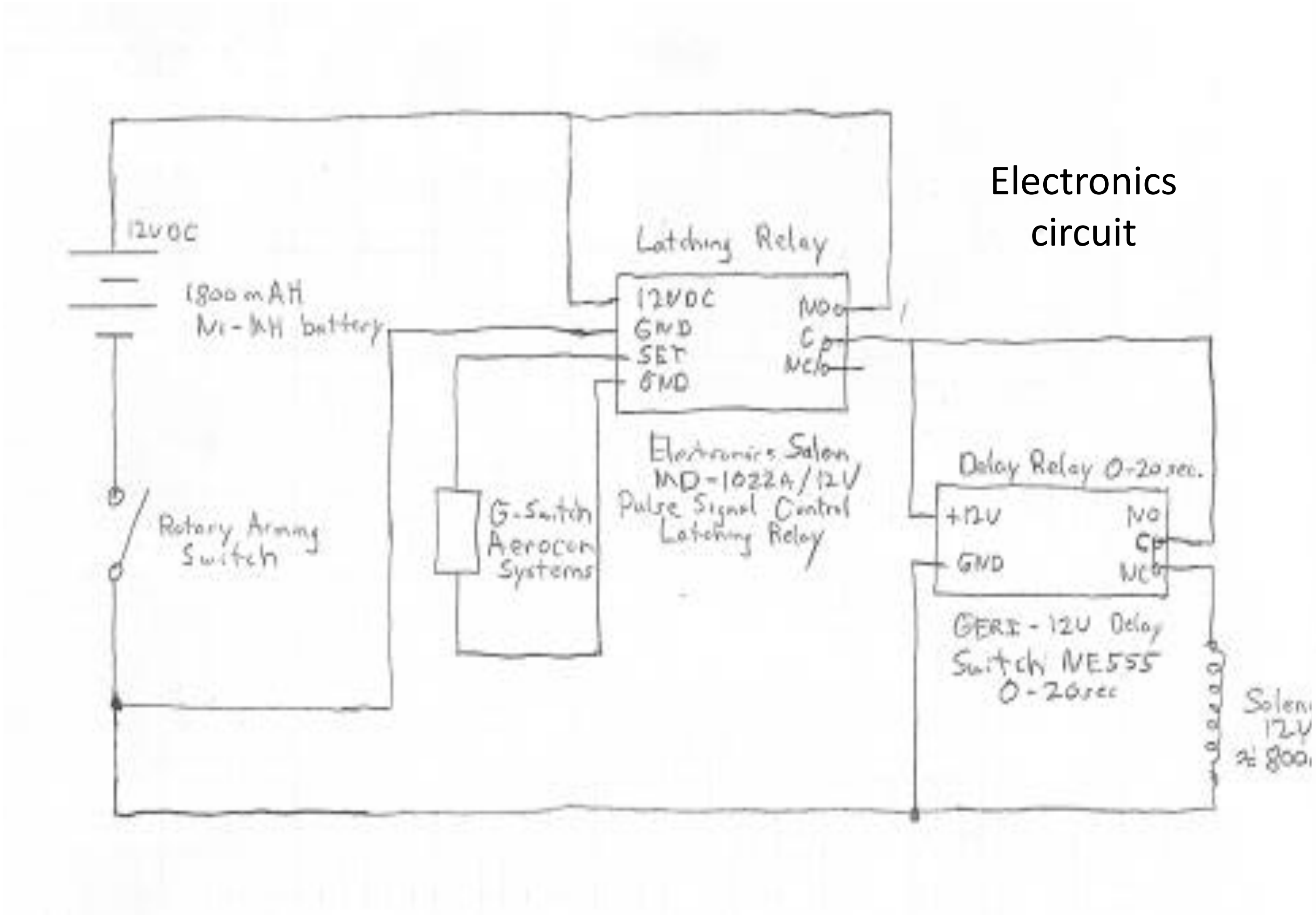
The final configuration will include a NI-MH battery, rotary arming switch, G-switch, latching relay, a timer, two test tubes and a solenoid. When the rocket comes off the launch pad, the G-switch will close sending power the latching relay which will then send power to a timer adjusted to match the vertical ascent time or less. The timer will send power to the solenoid to open the path between the two test tubes. The oobleck in the top test tube will either drain to the bottom or stay in the top tube. The solenoid valve will then close when the timer stops and the data will be collected when retrieved. If room cameras in the rocket will add to the data collected in this experiment by visually showing what happens to the colloid when G-forces are applied.

Payload Housing

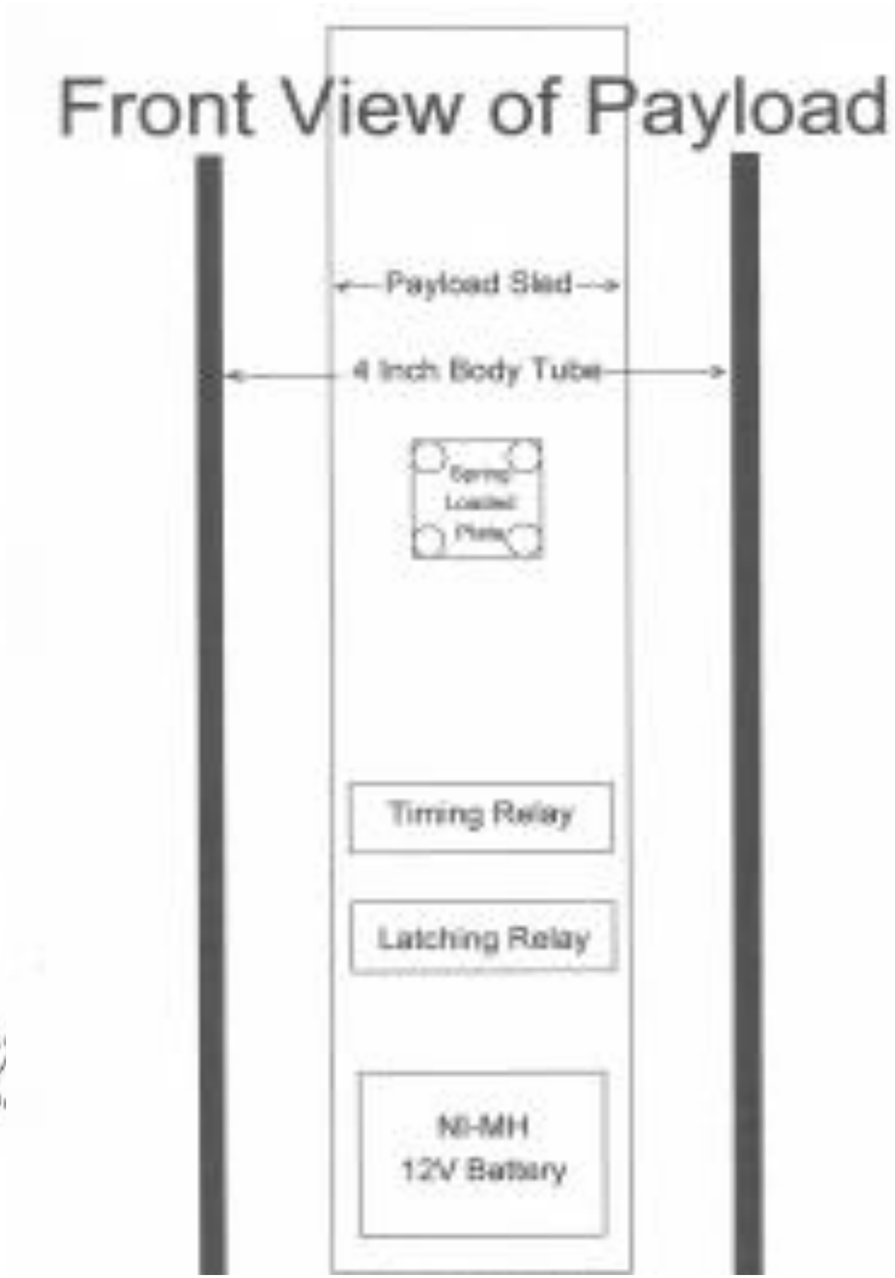
The experiment will be housed in separate compartment, similar to the ebay housing, in the nose cone and extended out to the rockets body.

- 14 inches and will be glued to the nose cone
- Sheer pins will be used to hold the experiment housing to the body tube and will break during ejection
- Mounted on one of the fiberglass caps
- This cap will have a U-bolt screwed on the outside of the cap, connected with a quick link to the main parachute
- A wooden piece (the sled) will be secured perpendicular to the inner part of the disk/cap allowing the solenoid valves to be removable

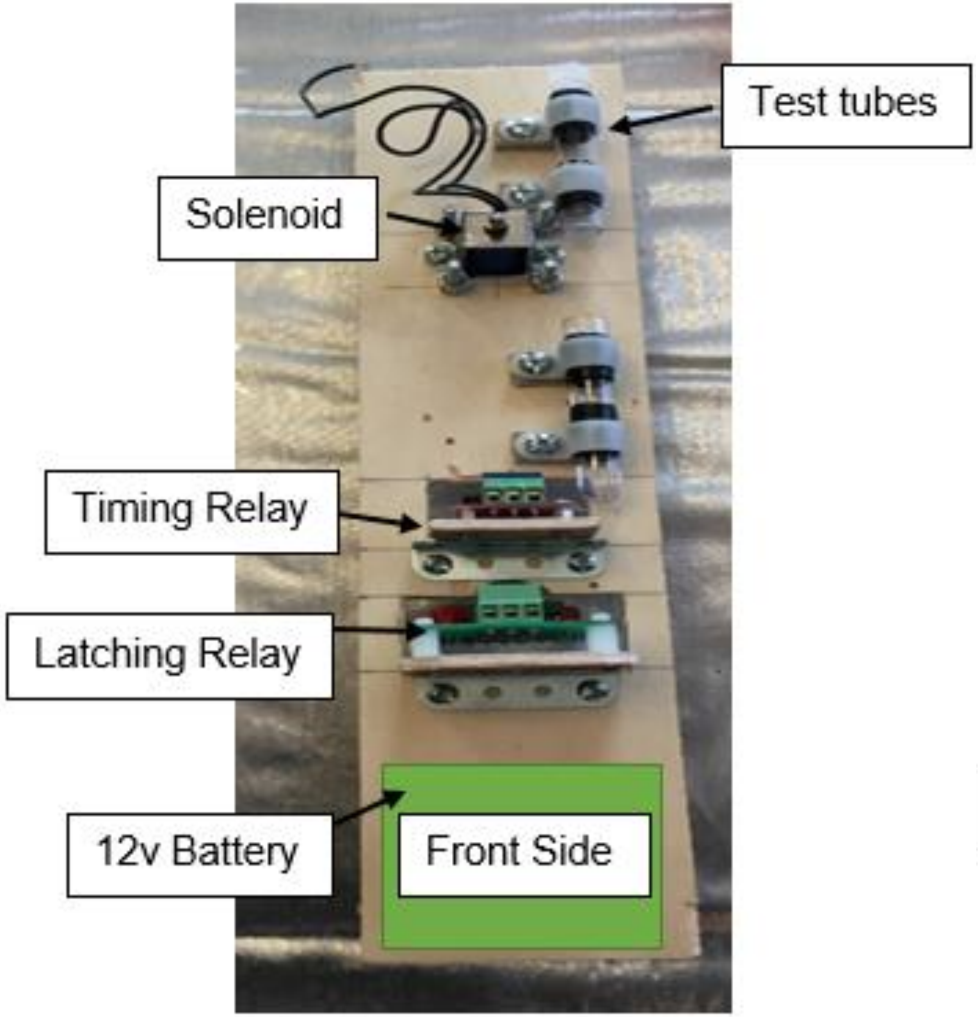
Payload Drawlings

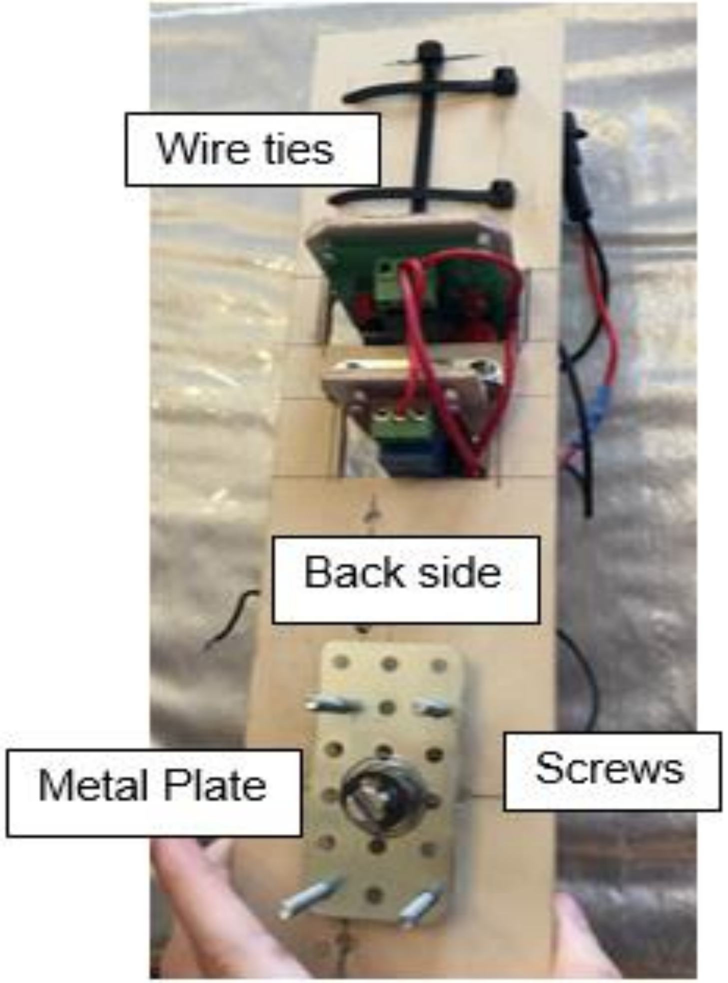


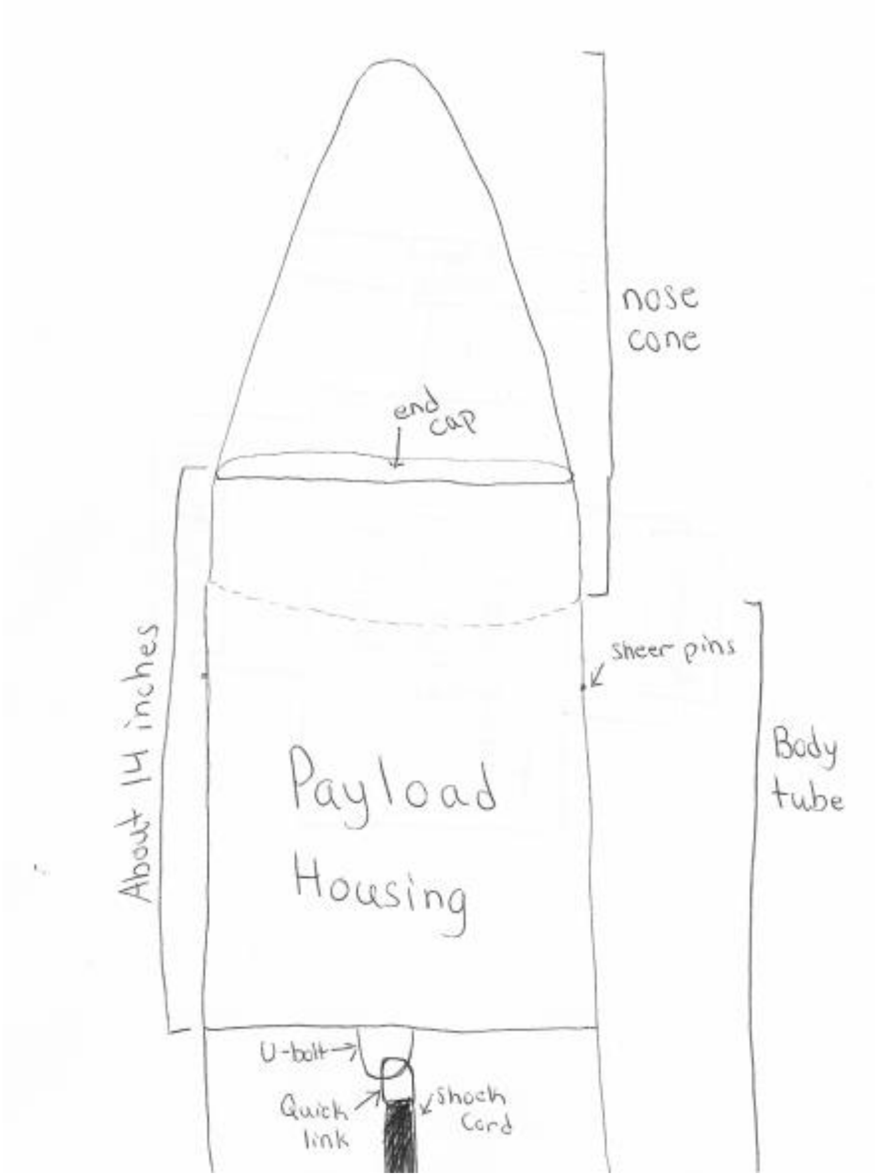
Electronics circuit

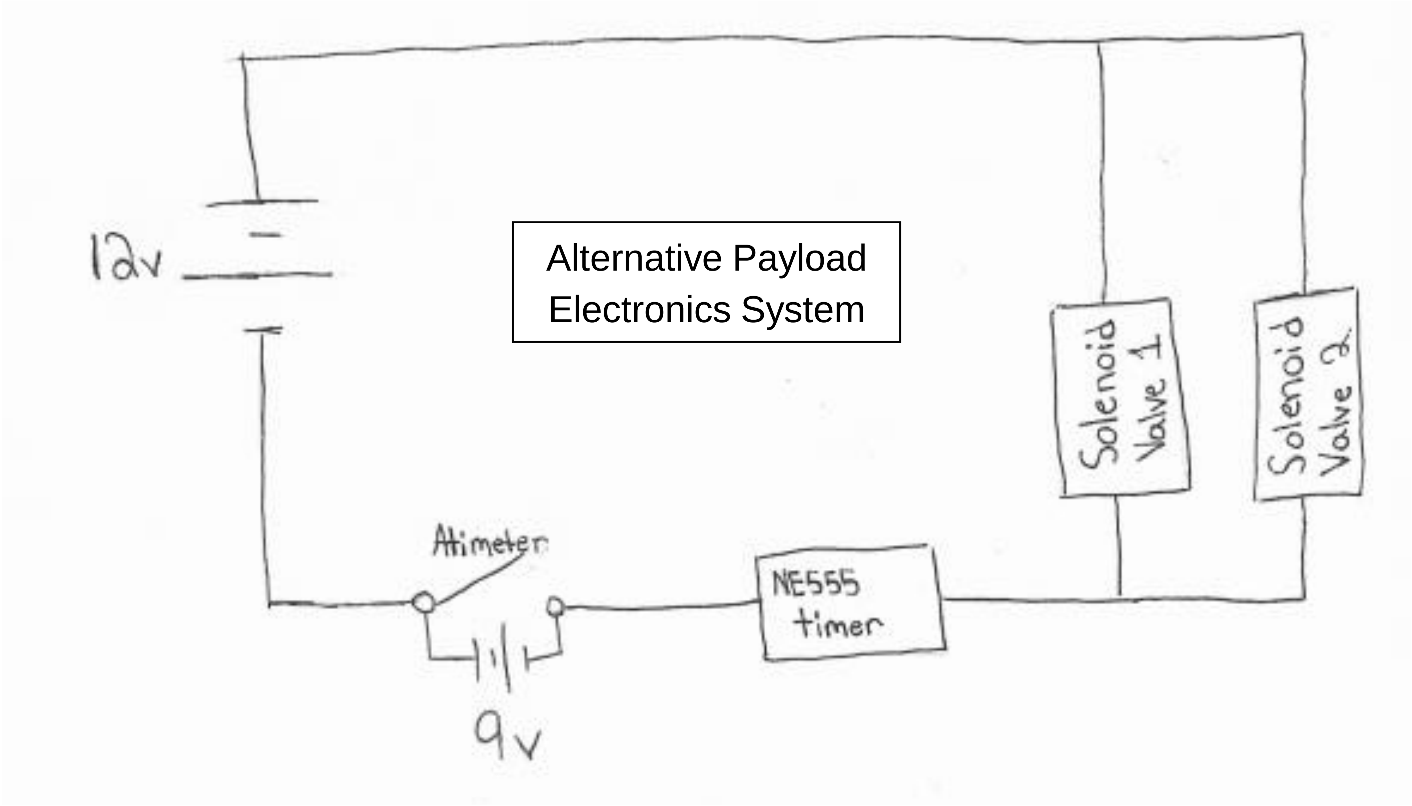


Pictures of Payload









Alternative Payload Electronics System

Challenges and solutions

Challenge	Solution
Keeping the oobleck mixed.	**Mix the two parts cornstarch and one part water to make the the colloid within an hour or less before the rocket is taken out to the payload. This will keep the colloid mixture from separating and losing its properties.**
The motor selection will determine the length of the of time the rocket accelerates effecting the time of our experiment	We can use RockSims to get an estimation on the time of our rockets acceleration, so we can then set the timer for our experiment.
Determine the optimum dimeter of our test tubes.	If the test tubes are too big and the colloid might solidify under the G-forces, causing the colloid to drop to the bottom test tube. If the test tube is too small then the colloid might stay in a solidified state casing not change during the rockets accent. We can solve this by trial and err or by placing a small ring in the top test tube so when the solenoid valve opens the colloid either turns into a liquid and flows through the hole, or the colloid stays in the top tube do to a solid state of matter.
Getting all electronics to work together at the same time.	In order to insure that all electronics work together at the same time the electronics will be test prior to flight. We also have two of each electronics (solenoid valve and camera) in the nose cone, if in the event that one of the electronics fails to work we have a back up to collect the data.
Creating a rocket that won't go over 5280 feet.	Design the rocket to fly one mile high or slightly over under perfect conditions. This is accounted for the highly probable that the rocket will weigh 25 percent more than calculated values. Therefore in experimental launches you will have consider all factors like air resistance (that will cause drag) and modify as needed.

Safety

- Facilities and Equipment
- Safety Equipment
- Safety Plan
- Procedures for NAR/TRA Personnel to Preform
- Plan For Briefing Students
- Method for Handling and Storage
- Team Agreement
- Our safety officers is Melody B.

Safety and Environment

- Potential failures in the proposed rocket (changes since CDR)
- Parachute deployment failure
  - Attaching the parachute protection pocket to shock cord
- Potential environmental factors that could damage the payload:
- Gusts of wind
- High humidity
- Rain
- Wet landing surfaces such as ponds or lakes

Launch Operations Procedures

- Recovery Preparation
- Motor Preparation
- Setup on launcher
- Igniter installation
- Launch procedure
- Troubleshooting
- Post-flight inspection

Testing

- Sub-scale
  - Successful and stable
  - The mass was not changed
  - The motor was not changed
- Ejection Charge for full scale rocket
  - Too energetic drogue charge
  - Shock cord was too short on the drogue as well
  - Shock cord was lengthened and the drogue charge reduced
  - Overall the test was successful

Testing cont.

- 1st Full-Scale Launch weekend
  - Didn’t use a payload or replacement mass
  - Trust to weight ratio was low
  - Height was high
- 2nd Full-Scale Launch weekend
  - Tested three different motors, K711, K560, K1000
  - Simulated payload that was 16oz
  - All three launches were successful

Requirements Compliance

- Verification of all plans is needed in the form of a checklist
- We will launch our rocket numerous times to ensure safety and ability
- We will have a set of minimal requirements in the checklist to once again ensure safety and ability of our project

Funding

- Cotton Candy
- Roctopi
- Bonus Books
- Paint night
- Avon
- Nuts about Granola
- We have raised 16,000

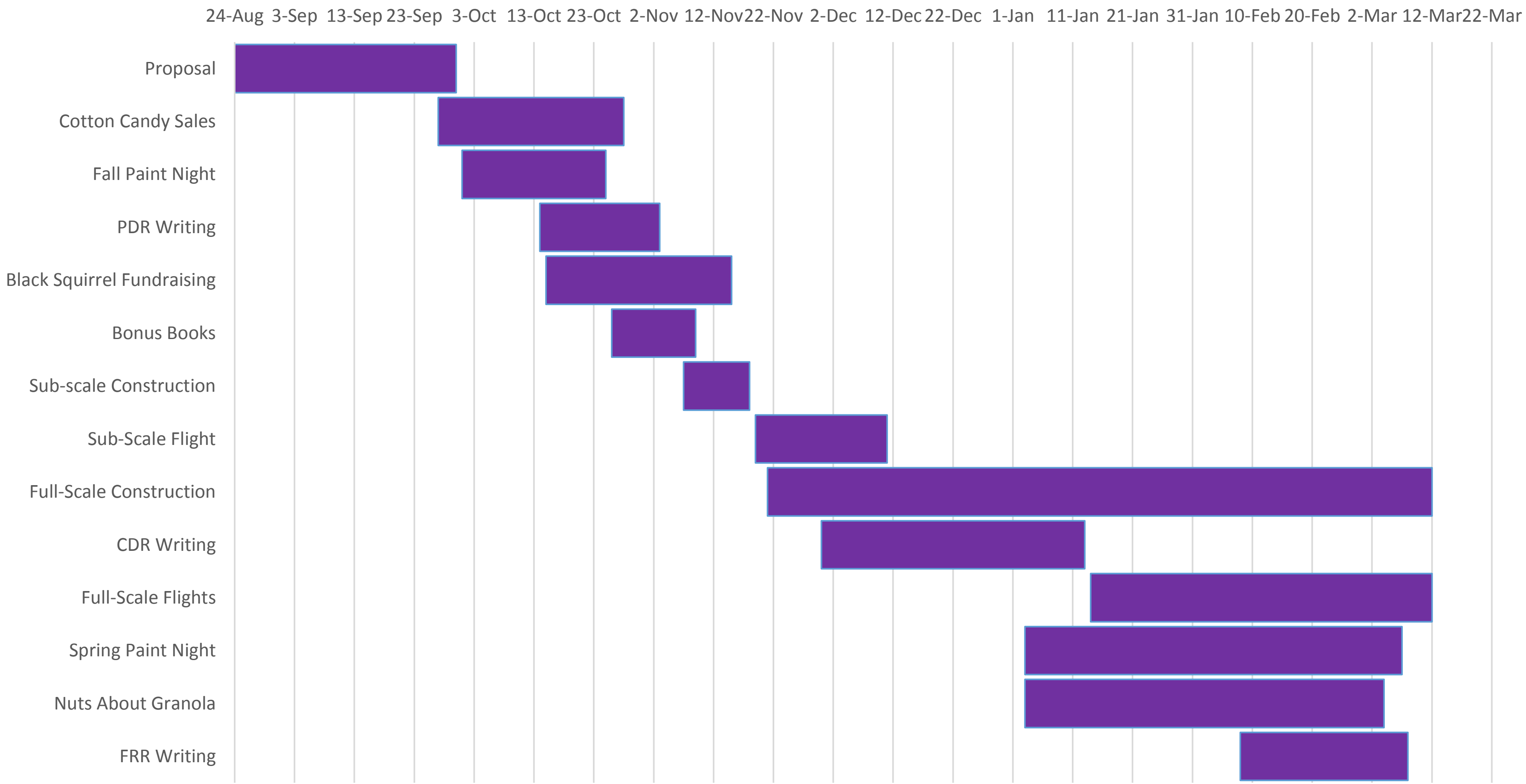
Grants and Donations

- TE Connectivity for $7,500
- Pennsylvania Space Grant Consortium for $2,500
- National Association of rocketry (NAR) Cannon Award for $500
- Engineering Society of York for $1,000
- Hanover Rotary for $1,000
- M&T Bank for $1,250
- Spring Grove Educational Fund for $1,000
- Rutter's for $250 and another donation for $100.

Budget

- It went up $4500 because we had to change and add some new materials.

Gant Chart


24-Aug
3-Sep
13-Sep
23-Sep
3-Oct
13-Oct
23-Oct
2-Nov
12-Nov
22-Nov
2-Dec
12-Dec
22-Dec
1-Jan
11-Jan
21-Jan
31-Jan
10-Feb
20-Feb
2-Mar
12-Mar
22-Mar
Proposal
Cotton Candy Sales
Fall Paint Night
PDR Writing
Black Squirrel Fundraising
Bonus Books
Sub-scale Construction
Sub-Scale Flight
Full-Scale Construction
CDR Writing
Full-Scale Flights
Spring Paint Night
Nuts About Granola
FRR Writing

Education

- Elementary students will receive a more basic understanding of the Tark and SLI programs we have here at Spring Grove Area High Schoo

- intermediate and middle school students will receive a more in-depth educational experience of the TARC and SLI programs to get them interested in carrying on into the SLI and TARC programs when they reach the h