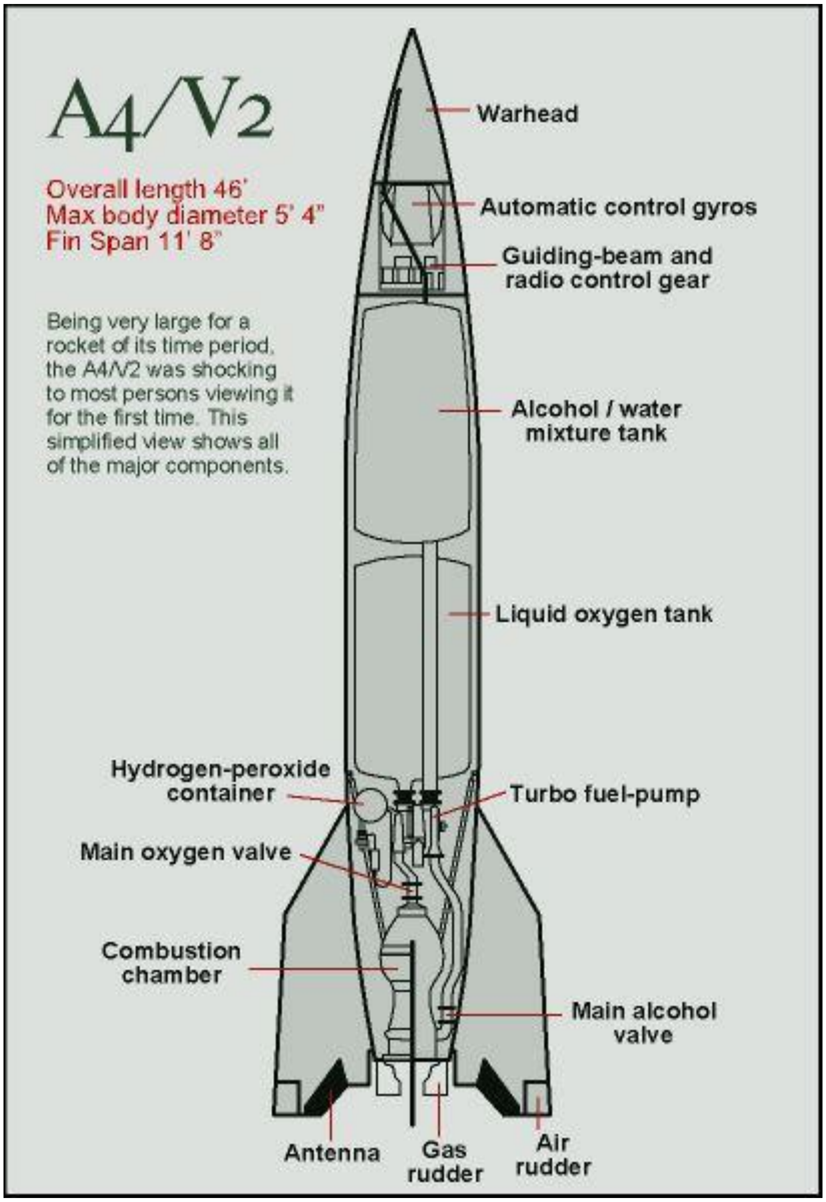
Spring Grove Area School District

Biology Team SLI Rocketry 2015-16 Proposal



Team Darwin

General Information

1. School Information

Name: *Spring Grove Area High School*
Mailing Address: Spring Grove Area High School
1490 Roth's Church Road
Spring Grove, PA 17362
Name of Team:

2. Adult Educators:

- Rosemary Cugliari
  Spring Grove Area High School Principal
  Phone number: (717) 225-4731 ext. 7060
  Email: Cugliarr@sgasd.org

- Brian Hastings
  Physics teacher, Rocket Scientist Club Coach
  Phone number: (717) 225-4731 ext. 7220
  Email: Hastingsb@sgasd.org

- Renee Bosak
  Biology teacher, Rocket Scientist Club Coach
  Phone number: (717) 225-4731 ext. 7242
  Email: EatonR@sgasd.org

3. Safety Officer:

- Brian Hastings
  Level two NAR Representative
  Phone number: (717) 225-4731 ext. 7220
  NAR 96571 SR

4. We are not part of a USLI team, we are a SL team.

5. Key Managers:

- Brian Hastings - Advisor and NAR representatives of students
- Renee Eaton - Advisor and Supervisor of students
- Mr. Sengia - Instructional Technology Specialist
- Josh Staley - Co-Captain and Student Safety Officer
- Adam - Co-Captain (Rocket Design Leader)

6. For Launch Assistance, Mentoring, and Reviewing our team will be working with the local NRA representatives along with MDRA (Maryland-Delaware Rocketry Association) for all questions and launches

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General Information

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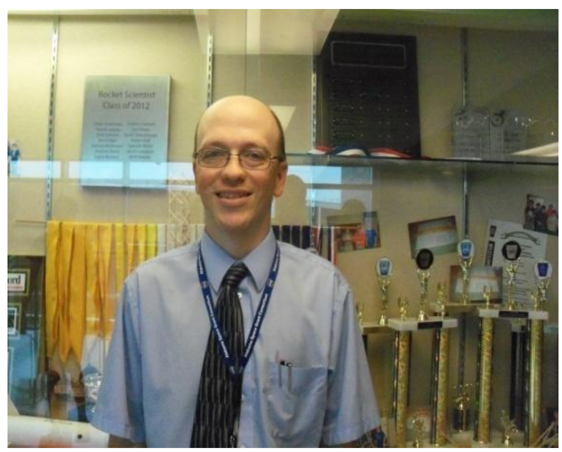
Team Members

Mrs. Bosak: Biology Teacher and Assistant Coach

I have been a Biology teacher at Spring Grove High School since 2009. Since then, I have coached the Marching Band and Junior High Track and Field and have advised the Gay-Straight Alliance, Science Fair participants, the Envirothon team, and the SLI team. In addition, I have been a member of the York Jaycees, a local community service organization, since 2009. I finished my Master's degree in Classroom Technology in 2013. In my spare time, I enjoy spending time with my friends and family, hiking, biking, reading, and training for 5K races and half-marathons. I am a NAR member and have a level 2 certification.

Brian Hastings: Instructor and Head Coach



I have been a teacher at Spring Grove for 19 years, teaching Physics 1, Physics 1 Honors, and AP Physics 1 and 2. I have an Honors B.A. in secondary education Physics, a masters in science education and 60 graduate credits past my Master's Degree. I have taught graduate courses to teachers and for the past 15 years have taught fast -paced high school physics for Johns Hopkins University's Center for talented youth program. As a Rocket Scientists' coach, I have started a Science Olympiad team, a Vex Robotics Team, Physics Olympics Team, and a Team America Rocketry Challenge Team. The Science Olympiad team has advanced to the state level each of the last ten years. We have been participating in TARC for 9 years and have advanced to Nationals each of the past 6 years, placing fourth overall at Nationals in 2012, and eighth at the Nationals in 2013. I am a NAR member and have a level 1 certification. Currently I am building a rocket for level 2 NAR certification.

Adam Cavanaugh 17 Senior: Co-Captain and Rocket Design Leader

Ever since my sophomore year, after my first physics class, I have been more interested in sciences than any other subject. I became a “rocket scientist” last year, my junior year, when I really got involved in our rocketry teams and our science Olympiad team at Spring Grove. My sophomore year intrigued by the rocketry teams at our school but didn’t join. My junior year our TARC team placed 8th in the national competition. I also helped with the Spring Grove SL team, but was not a member. It was a learning experience last year and this year is my chance to apply it all. Outside of school I am an involved youth member at my church and I am a boy scout. I also enjoy golfing and being out in nature. This year I am very much looking forward to being a member of the SL team and the other opportunities that come with this large task.

Josh Staley 18 Senior: Co-Captain and Student Safety Officer

I became interested in science when I joined the Envirothon team in 7th grade. I began taking part in Science Olympiad the following year and have made it to the State competition each year since joining the team. I started learning about rockets in my freshmen year when I took part in Team America Rocket Challenge. I have now had 2.5 years of experience in high powered rocketry and have been an NAR member for 1 year now. I am also a member of the Maryland Rocketry Association and am level 1 certified. I look forward to working with NASA and hope to have a successful year in the SL program.

Carson Buffalow 16 Sophomore: Electronics Bay

When I was in middle school, I was introduced to science Olympiad. I took great interest in this and enjoyed the science field as a whole. Now as a sophomore, I have found SL. I enjoy rockets and working as part of a team so I figured I would enjoy being a part of the Spring Grove team. I like to do graphic design and play lacrosse and am very creative and like to design things so I thought this would be the club for me. I am hoping to use this as an outlet to help me pursue my possible career in engineering and have a lot of fun doing it.

Hannah Sheffer 17 Senior: Budget and Funding Plan

As a student I have always been interested in Math and Science for as long as I can remember. I like being able to solve no matter the difficulty. Being my first year in SLI, I think it will be a new and exciting challenge for me. In addition to SLI I am a member of National Honor Society, a player on Spring Grove's Varsity Field Hockey Team, and President of German National Honor Society. Being a part of SLI will help me to gain more experience in the Math and Science field. I am looking forward to being a member of SLI. After high school I plan to go to college to further my career in Math and Science.

Tre Colbert 15 Sophomore: Chief of Introduction and Table of Contents and Interfaces and Integration

I have always found interest in engineering throughout my time at Spring Grove. It wasn't until the end of last year when I found SL. After speaking with my history teacher about potential engineering fields and colleges to go to she mentioned getting involved in SL to find out if I would have interest in aviation. I see SL as a great opportunity to learn about my own interests and to enhance my knowledge in the engineering field. I also see SL as a great resume builder for college. I have very much enjoyed the short amount of time I have spent in the program and hopefully I will learn a lot this year both from my instructors and returning team members so that I can better support the team in the years to come.

Sarah Staley 15 Freshman: Educational Engagement

I was in the TARC program last year and am excited to be a part of the 2015-2016 SL team. Over the last couple of years I have been to many SL launches for my siblings and I am thrilled to have the chance to be a part of the program this year. I am the vice president of my class and a member of the competition cheerleading squad, orchestra and the German American Partnership Program. I like being around people and working in groups to accomplish our goals. I hope to learn from my teammates and have a great year with the SL team.

Emily Edsall 15 Sophomore

The reason I joined Student Launch was because of my one friend. He talked me into joining with him. This will be my first year in this club as a sophomore. I hope it will be helpful and interesting. Other extracurricular activities that I am a part of our book club, piano, and I'm the treasurer of our school's language club.

1) Summary of PDR Report

Team Summary

Name: *Spring Grove Area High School*

Mailing Address: Spring Grove Area High School

1490 Roth's Church Road

Spring Grove, PA 17362

Name of Team: Team Darwin

Mentor: Brian Hastings

Level two NAR Representative

Phone number: (717) 225-4731 ext. 7220

NAR 96571 SR

Launch Vehicle Summary

Size and Mass: 82 in Length 4in Width 335.3 oz Mass

Motor: Cesaroni K1440 White Thunder

Recovery: 2 Parachutes

Drogue Chute- 24in Diameter by Fruity Chutes

Released at apogee from back half of electronics bay

Main Chute-72in Diameter by Fruity Chutes

Released at 700ft from nose cone and slows rocket to 17.6 ft/s

Payload Summary

Planaria Altitude Experiment

-The payload will test the effects that a rocket launch has on the growth of a planarian. The planaria have the capability to regrow if they are cut. The experiment will begin with planarian being cut in half. A control group of planarian will be kept separate from the rocket and will. The experimental group of planaria will be inserted into the nose cone. This group will each be placed into small tubes which will be held in place with foam that will have 4 holes drilled into it to keep the test tubes in place. After the flight the planarian in the experimental group will be compared to their control group counterparts in order to see what effects the flight had on them.

III) Vehicle Criteria

Part A) <u>Selection, Design, and Verification of Launch Vehicle</u>

Section 1

Our mission is to efficiently design, build, and launch a rocket to reach a height of 5,280 feet while improving as a team with improved skills and the opportunity to educationally engage students.

Our launch vehicle is designed to reach an altitude of about 5280 feet, but not exceed this height. The rocket design has three independent sections, which is less than the maximum of four independent sections as stated in the vehicle requirements section of the Statement of Work. The redundant recovery system will be capable of being set up within two hours of the time that the Federal Aviation Administration flight waiver opens. It will be able to remain in its launchready arrangement on the launch pad for at least one hour without it or any of its on-board components losing their capability to operate. The launch vehicle will be capable of being launched from either an 8 foot long 1 inch rail, or an 8 foot long 1.5 inch rail. The rocket will be able to be launched from a 12 volt DC firing system, which will be supplied by the Range Services Provider. It will not require any external circuitry or specialized equipment from the ground to initiate the launch, other than what will be provided by the range. The rocket will use an ammonium perchlorate composite propellant that is commercially available and has been approved by the National Association of Rocketry, Tripoli Rocketry Association, or the Canadian Association of Rocketry. The rocket and motor combination that we will use will not exceed an impulse of 2,560 Newton-seconds. The mass of the ballast in the final design to be flown in Huntsville will not be more than 10% of the rocket mass without the ballast. A full scale version of our rocket will be launched prior to the Flight Readiness Review in its final configuration. The full-scale version of the rocket will be identical to the design that was made prior to the launch, and is the same design that was approved by our safety officer. This flight should include the testing of the payload within the vehicle, but if not, mass simulators will be placed at the same approximate location of the payload. Either a full-scale motor or a motor that will closely simulate the predicted velocity and acceleration of the full-scale motor will be used during this flight as well. The vehicle at this launch will also be in its completely-ballasted arrangement as that of what will be flown down in Huntsville. This flight's success will also be documented on the flight certification form by a Level 2 or Level 3 flight observer and will also be recorded in the Flight Readiness Review. The components of the rocket launched during the full-scale flight will not be modified unless approved by the NASA Range Safety Officer. Lastly, the rocket will not use forward canards, forward firing motors, motors that eject titanium sponges, hybrid motors, or a cluster of motors or multiple stages.

There are several factors needed for mission success. The mission would be considered a success if the rocket reaches an altitude of at least 4500 feet and no higher than 5280 feet, since the team recognizes that there are still uncontrollable sources of error involved with this project. It would also be considered a success if it reaches the maximum acceleration so that the planarian undergo the largest force possible for a good test. The rocket must maintain a straight stable path and the rocket must also be recoverable within a 2500 foot radius of the launch pad for mission success. The mission will also be successful if the payload collects useable data and the launch is conducted safely without catastrophic failures.

Section 2

The recovery system should be able to deploy a 24 inch drogue parachute at apogee by initiating rocket body separation in the bottom of the electronics bay. It should be able to deploy a 72 inch main parachute at 700ft during the rocket's descent by initiating another rocket body separation in the front of the electronics bay between the nosecone and the front body tube. It should also be able to set off a second ejection charge in case the first ejection charge does not fire, or does not completely separate the sections of the rocket body. The recovery system shall be able to record the maximum altitude of the rocket and verbally output this reading. It should be capable of reading the voltage of batteries operating the electrical components and verbally outputting this reading to ensure its function. The recovery system shall be able to check for continuity within itself and its components, to ensure the correct operation of its electrical mechanisms. It is planned to be able to output a signal, perceptible by a tracking device, in order to foster rocket recovery. The system must be capable of separating parts of the rocket without damaging any of its parts. Most importantly, the system must make the rocket recoverable and reusable. The altimeters were selected for the recovery system (PerfectFlite StratoLogger) because they are capable of fulfilling all of these requirements.

The propulsion/ motor retention system should be able to boost the rocket and its components to an altitude of 5280 feet. At the same time, the systems intention is to facilitate ignition by being capable of being ignited by a simple ignition system. It should be able to retain the motor throughout the duration of the flight, and facilitate the removal/addition of a motor. The motor chosen to fulfill the task of propelling the rocket to one mile was selected because it is commercially available, and is capable of boosting the rocket to this exact height given the design specifications of the rocket. This motor was chosen as well because of its high impulse and the force that it will be able you exert on our payload planarian. The rocket airframe is going to house all parts of the rocket needed for launch. It should also provide rigid stability to the rocket as a whole. The airframe will be smooth and aerodynamically sound with little air resistance. This system should also be able to provide the needed strength to survive the landing and make the rocket reusable, provided a functioning recovery system. The rocket airframe should also maintain the intended flight path with minimal deviation from its simulated path. G10 FR4 fiberglass was chosen to complete this task because of its strength and rigidity. Although fiberglass is a heavier material it will perform well under any impact. The fins will also be made from G10 FR4 fiberglass because they are capable of withstanding the high velocities that the rocket will reach, while remaining impervious to the high intensity of heat being expelled from the rocket motor.

Section 3

Subsystems;

Recovery Subsystem

The recovery system is required to achieve mission success. It is comprised of one 72 inch main parachute, one 24 inch drogue parachute, 2 nylon shock cords of different lengths that are surrounded by Kevlar shock cord protector sleeves on the ends closest to the electronics bay, 4 U-bolts (Secured to the bulkhead on the payload in the nosecone, both sides of the electronics bay, and on the bulkhead in the bottom body tube), and a 3.9 inch diameter, 12 inch long electronics bay that we will design ourselves. The electronics bay will contain two PerfectFliteStratoLogger altimeters and four batteries (two to power the altimeters and two as back-up batteries for the altimeters). It will also house the tracking device that will transmit a signal for us to be able to the quickly and successfully recover of the rocket. On the outside of the electronics bay there will be a total of four ejection charges, one on both ends of the electronics bay for each of the altimeters. This is to ensure that the rocket is recovered in the event of altimeter failure. The Electronics Bay will also contain two threaded metal rods with wingnuts to secure the components of the Electronics Bay within it. The metal rods span the entire length of the Electronics Bay in order to keep it together while also supporting the altimeter and its components.

Propulsion and Motor Retention Subsystems

The propulsion system is comprised of a 2.952” G10 FR4 fiberglass tube acting as a motor mount tube. The motor mount tube is centered within the 3.9” inner diameter of the rocket body tube with two ½ inch thick plywood centering rings. The back end of the centering ring is placed a 1/2 inch in from the base of the rocket body. This allows for more epoxy to secure the motor mount in position. There is half of a threaded motor retainer attached with epoxy to the motor mount tube. The motor retainer is made from aircraft-grade aluminum. One half of the motor retainer is attached to the motor mount, while the other half screws over the top of the motor retainer. The motor retainer will not interfere with the expulsions from the motor, and will secure the motor into the motor mount of the rocket for the duration of the flight.

Rocket Airframe Subsystem

The rocket airframe design is comprised of a nose cone, 2 pieces of body tubing, and fins. The plastic nose cone is conical in shape, and is smoothed to reduce drag. The body tube is made of G10 FR4 fiberglass tube. The fiberglass will be sanded by the manufacture, Public Missiles Limited, and then will be painted by our team members. The fins will be cut from G10 FR4 fiberglass sheets. Fiber glass provides the extra strength that is needed during the high velocities that the rocket will undergo and will remain intact after impacts with the ground. The fiberglass is also fire retardant and will ensure that the exhaust from the rocket motor does not melt the fins. This fiberglass is also very smooth, causing very little drag.

Section 4

The recovery system we will be using consists of two PerfectFliteStratoLogger altimeters, a 72 inch main parachute, a 24 inch drogue parachute, 3/8 inch eye bolts, and 2 pieces of shock cords. The altimeters contain two outputs to deploy a drogue chute at apogee and a main chute which can be programmed to deploy in between 100 feet and 9,999 feet. We will be programming the altimeters to deploy the main chute at 700 feet. Each altimeter can record apogee, temperature, and battery voltage. This can be recorded at a rate of 20 samples per second. Later, this data can be downloaded to a computer after the conducted experiment. Data will not be lost, even if the power source is disconnected from the altimeter. The altimeters come equipped with special reverse polarity protection to prevent premature ejection charge firing if a battery is connected backwards. The altimeter can operate for three seconds after a battery is disconnected, adding security to the successful recovery of the rocket. A voltmeter connected to the altimeter will read battery at the startup of the device to ensure that batteries are functioning properly and all circuitry is connected. The device has been tested in a simulation, and has operated properly in 100+ mph winds. This ensures that a false triggering of the mechanism should not occur due to incorrect barometric readings. One altimeter can be programmed to delay firing at apogee, to prevent over pressurizing with concurrent ejection charge firing in the redundant altimeter setup. The altimeters also run on a low current, enabling them to function in their armed state for weeks on just a standard 9 volt battery. The main parachute is a 72 inch toroidal shape Iris Ultra Parachute made by Fruity Chutes. The shroud lines composed of heavy duty tubular nylon and are tested to withstand 400lbs of force. There is a swivel attached to the parachute shroud lines which is capable of withstanding 1500 lbs. of force. This main parachute is designed to slow a 28lb rocket to a terminal velocity of 20 feet per second, which should then slow ours down to less than 20 ft/s since ours is less then 28lbs. The drogue chute is a 24 inch elliptical parachute with a drag coefficient of 1.5. The shroud lines are composed of heavy duty tubular nylon tested to withstand forces of up to 220lbs. There is a swivel at the end of all of the shroud lines that is tested to withstand forces of up to 1000lbs. There are also 3/8 inch closed eyebolts secured inside of the rocket airframe to tie the shock cord to and then secure the parachutes to. The metal weld will ensure that the eyebolt does not open and release the shock cord. The capability of these components to withstand large amounts of force should make them excellent components of the recovery system, as we expect a maximum force of 250lbs to be exerted on these components during separation, with the 4200lb test shock cord absorbing a majority of the force. The rocket airframe meanwhile, shall perform based on the stability of the rocket and its ability to maintain rigidity, shape, and strength during flight. The rocket tube itself is made to withstand supersonic flights, extreme heat, and moderate impact.

Section 5

Requirement	Design Feature to Satisfy the Requirement	Verification of Requirement
1.1 The vehicle shall deliver the science or engineering payload to an apogee altitude of 5,280 feet above ground level.	The mass of the vehicle, the air resistance on the vehicle during flight, and the stability of the rocket were designed with the impulse of the selected motor to keep the launch vehicle at one mile above ground level under perfect launch conditions.	This requirement has already been verified on a rocket design program, but it will also be tested and verified during the full scale rocket launch to take place prior to the FRR.
1.2 The vehicle shall carry one commercially available, barometric altimeter for recording the official altitude used in scoring	The rocket will carry at least one barometric altimeter, a PerfectFliteStratoLogger altimeter, inside the electronics bay. The altimeter will give us an accurate reading of our official altitude.	This requirement has already been verified when we designed the electronics bay to house an altimeter for each end of the electronics bay. The 2 altimeters will give an accurate reading of our altitude.
1.3 The launch vehicle shall be designed to be recoverable and reusable.	The rocket has a recovery system designed to deploy a drogue chute at apogee and a larger chute at 600 feet that will provide the rocket with a ground-hit velocity of less than 20 ft/s, which should prevent any	The rocket recovery system has been verified to deliver the rocket safely to the ground by a rocket design program. This will also be verified during the tests with the scaled down model rocket. This shall accurately

	damage to the rocket.	depict how the rocket will recover during a launch.
1.4 The launch vehicle shall have a maximum of four independent sections.	The rocket contains less than four independent sections as designed by a rocket design program. The shock cord shall be tested prior to the launch to determine how strong it is, and how much force it is able to withstand. All sections of the rocket not tethered with a shock cord will be secured by other means (such as epoxy).	The rocket design has been analyzed by a level 2-certified NAR representative, and will be inspected by a level 2-certified NAR representative after the rocket has been constructed in its final configuration to ensure that the rocket does not contain more than four independent sections.
1.5 The launch vehicle shall be limited to a single stage	The rocket contains only a single stage engine as designed in the rocket design program and designed in the teams personal designs.	The design of the rocket has been analyzed b a level 2-certified NAR representative and shell be inspected by a level 2-certified NAR representative to be sure that the launch will be limited to a single stage.
1.6 The launch vehicle shall be capable of being prepared for flight at the launch site within 2 hours, from the time the Federal Aviation Administration flight waiver opens.	The rocket will be comprised of easy-assembly components, including body tubes that slide onto the electronics bay to hold them together, a recovery system that can be assembled and armed quickly, payload electronics that are preassembled in the nosecone, and a reloadable motor for quick construction.	The design has been analyzed by a level 2 NAR representative to make sure that the rocket has a sound design that will require little assembly at the launch site. This will be tested during the scale test launch to make sure that all components can be prepared for launch within the 2 hour time restriction.
	The rocket will require little assembly at the time that flight waiver opens.	
1.7 The launch vehicle shall be capable of remaining in launch-ready configuration at the pad for a minimum of 1 hour without losing the functionality of any critical	The recovery system is designed to contain switches that can arm the recovery system, and nine volt batteries are attached to ensure that the recovery	The recovery system will be tested to see if the electronics can last longer than 1 hour in the on position. If not, a back-up battery will be wired into the

on-board component.	system can operate properly for over one hour.	recovery system electronics.
1.8 The launch vehicle shall be capable of being launched by a standard 12 volt direct current firing system.	The rocket will use commercially available igniters which will be able to operate on a standard 12 volt DC current.	The igniters will be tested for their reliability when supplied with a 12 volt DC current from a standard firing system.
1.9 The launch vehicle shall require no external circuitry or special ground support equipment to initiate launch (other than what is provided by the range).	The launch vehicle will operate off of standard ignition systems, and will be self-containing all other components needed to initiate launch, including a motor.	The scale model rocket launch and full-scale rocket launch will be conducted using standard ignition and launch ground systems. The rocket design has been reviewed by a Level 2 NAR representative to confirm that the rocket design does not require specialized equipment on the ground or circuitry on the outside of the rocket airframe.
1.10 The launch vehicle shall use a commercially available solid motor propulsion system using ammonium perchlorate propellant which is approved and certified by the National Association of Rocketry, Tripoli Rocketry Association, and/or the Canadian Association ofRocketry	The motor being used will be a Cesaroni K1440 White Thunder, which is commercially available. This motor uses an ammonium perchlorate propellant.	The motor we are using has been tested and approved by the Canadian Association of Rocketry and the National Association of Rocketry.
1.11 Pressure vessels on the vehicle shall be approved by the RSO and shall meet the proper criteria.	The design of the rocket meets all of the requirements and criteria regarding to pressures and will be confirmed by the RSO before each launch to ensure that we are correct with the measurements.	The design of the rocket has been analyzed and inspected by a level 2-certified NAR representative to ensure that the specs are met that have been set by NASA to ensure that the rocket has a safe flight that is able to be scored.
1.12 The total impulse provided by a SLI launch	The maximum total impulse capable of being produced	The impulse of the Cesaroni K1440 White

vehicle shall not exceed 2,560 Newton-seconds.	by the Cesaroni K1440 White Thunder is 2368 newton-seconds	Thunder has been tested by the NAR and CAR.
1.13 All teams shall Successfully launch and recover a subscale model of their rocket prior to CDR.	The team will successfully design, launch and recover subscale model of the rocket by the time of submitting the CDR.	The launch and recovery of the subscale model of the rocket will be verified by the level 2-certified NAR representative to ensure that it has been a successful design, launch, and recovery and to verify that the rocket function properly according to the design before submitting the CDR
1.14 All teams shall successfully launch and recover their full scale rocket prior to FRR in its final flight configuration.	The full scale launch testing prior to launch at Huntsville will be responsible for fulfilling this requirement.	The successful launch and recovery will be verified and documented by an NAR Level 2 or 3 observer on the flight certification form and the FRR Package.
1.15.1 The vehicle shall not utilize forward canards.	N/A	The vehicle design will not include the usage of forward canards.
1.15.2 The vehicle shall not utilize forward firing motors.	N/A	The vehicle design will not include the usage of forward firing motors.
1.15.3 The vehicle shall not utilize motors which expel titanium sponges.	N/A	The vehicle design will not include the usage of motors which expel titanium sponges.
1.15.4 The vehicle shall not utilize hybrid motors.	N/A	The vehicle design will not include the usage of hybrid motors.
1.15.5 The vehicle shall not utilize a cluster of motors, either in a single stage or in multiple stages.	N/A	The vehicle design will not include the usage of a cluster of motors in a single or clusters in multiple stages.

The Team Mentor will be overseeing most of the rocket design and construction to ensure that the rocket is being built properly. At the same time, he will also be verifying the compliance of the rocket with the Statement of Work, along with the Team Advisors, Mr. Hastings and Mrs. Bosak. The rocket design has already been verified. When construction on the rocket begins, most of the other requirements will be verified. The rest of the requirements will be verified before traveling to Huntsville, Alabama. Requirements regarding the use of commercially available products and the materials used by the companies within these products have been verified. Also, the requirements of the vehicle ensuring the compatibility of the rocket with launch equipment supplied in Huntsville have already been verified.

Section 6

Risks	Probability of Risk *(1-5)	Impact on Project Progress	Mitigations
The payload may get lodged in nosecone such that it comes down with the rocket and yields no usable data.	2	We will need to redesign, rebuild, or reload the payload. This would delay the progress of construction.	The team shall ensure that the payload is designed so that it will be easily removable so that data can continue to be taken.
The rocket parachute does not deploy and rocket returns unsafely to the ground.	3	We lose a rocket and must build another one, losing work time and time to launch.	The team will carefully insert the parachute and make sure there is enough heat shields to protect our parachutes from any flames.
Injury could occur while using coping saw.	2	A leave of absence of a team member could occur due to minor or severe injury and possibly delay the rocket-building progress.	The team will be very careful and aware of limbs and fingers when using this tool.

Injury could occur during Exacto knife usage.	5	A small injury could occur, possibly delaying the rocketbuilding progress.	The team will carry the knife in cautious matter, cut away from oneself, and be aware fingers when using this tool.
Accidental combustion of rocket materials	3	In addition, possible injury and a delay of rocket-building progress could occur.	The team will keep 25 feet away from electrical outlets and open flames when using combustible rocket materials
Allergic reactions to chemicals involved in rocket production	2	Minor or severe chemical burns of team members and possible delay of rocket progress could occur.	The team will make all students aware of each other's allergies and stay away from possible allergens that could affect the team members
Electrocution during electrical outlet usage	1	Minor or severe injury could occur.	The team will only use electrical outlets when necessary and only if hands are dry and static free. The team will keep fingers away from prongs.
Adhesion to materials or self	4	Minor injury and minor delay of rocket progress could occur.	The team will exercise proper caution when handling adhesive material being sure not to come in contact with the adhesives and using proper methods to rid ones skin of the material if they come in contact
Injury during laser engraver usage	2	Possible combustion of rocket materials could lead to reordering of materials and delay progress.	The team will make sure the laser is on the proper power, speed, and focus settings, and ensure that the exhaust fan is on.

Injury during drill press usage	2	Severe injury and delay of progress could occur.	The team will keep clothing, hair, and body parts away from the drill bit and use safety glasses.
Tripping and falling hazards	3	Minor or severe injury, delay of rocket progress could occur.	The team will make sure any walking paths are clear and keep clutter off of floor.
Abrasions and bruises caused by belt sander	2	Minor injury and delay of progress.	The team will keep hands and clothing away from the sandpaper.
Burning caused by soldering iron usage	2	Minor injury and delay of progress.	The team will use soldering iron in a proper manner and use safety gear.
Premature ignition of rocket motors	2	Possible minor or severe injury, the need to reorder rocket motors, and delay of rocket progress.	Ensure that only the proper level certified personnel handle the rocket motors and installations as well as reloads.
Team estrangement because of lack of cooperation	1	Delay of rocket progress.	The team will talk calmly and will not fight with one another. The team will respect each other and themselves.
Going over-budget	5	Delay of rocket progress due to the need for more time to fundraise	The team will carefully use all materials, order only the parts needed, keep track of materials, and use the budget wisely. The team will be diligent in fundraising endeavors.
Misuse or mishandling of hazardous materials	2	Minor or severe injury, leave of absence for team member affected, and delay of progress	The team will follow all safety code regulations, laws, and instructions very carefully

Unforeseen rocket design complications	4	Delay of rocket design and rocket building progress	The team will design a stable rocket based on the locations of the center of pressure and center of gravity. The team will also have an NAR representative check rocket design.
Unforeseen payload design complications	3	Delay of payload design and production.	The team will design a payload that will be effective for the size nosecone that is used and double-check that the components of the payload are properly secured and insulated
Complications during transportation of participants and materials to SL or practice launch sites	3	Delay of rocket progress due to rocket repairs or cancellation of practice flights because of extensive damage.	The team will make sure that the launch date is known in advanced and that all specifications are planned out well in advance. The team will pack the rocket well and make sure it is secure during transportation.
Accidental partial or complete destruction of building site	2	Damage to work environment, additional expenditures for repairs, possible progress delay.	The team will ensure that safety guidelines from NAR and the MSDS are being followed.
Team communication failure	4	Rocket/payload may be built incorrectly or too many of one part may be made, causing a slight to major delay of progress or loss of material.	Every team member will have access to other members' email addresses and have the ability to talk during the school day.
Shortage of rocket building materials	2	Major delay due to the need to order new material and wait for it to ship.	The team will double-check all materials before ordering and enforce a checklist while parts are being used.

Commitment complications among team members	3	Loss of time or team member if the complication is too great.	The team will make sure all team members make this their first priority and plan accordingly.
Inhalation of dangerous fumes	2	Minor to severe injury, time lost taking student to ER, delay of progress.	The team will wear proper safety gear, exercise proper use of fume hoods if needed, and be aware of surroundings when dangerous fumes are being produced.
Accidental ingestion of rocket materials	1	Minor to severe injury, delay of progress, possible loss of material.	Only experienced students should work with dangerous materials under proper supervision.
Motor ignition delay	3	Launch delay, loss of motor if it does not ignite, minor to severe injury if motor ignites while personnel are approaching rocket.	The team will only use commercially available and Range Safety Officer approved igniters.
Rocket catches fire on the launch pad	2	Possible loss of rocket, minor to severe injuries if fire is not properly extinguished.	The team will bring a fire extinguisher suitable for the needs of the fire and according to the MSDS of the motors being used.
Cancellation of launch due to poor conditions	4	Delay of testing.	The team will plan multiple days to launch, be flexible in scheduling practice launches, and practice patience.

Motor ignition failure	3	Delay of launch testing and rocket progress.	The team will ensure that commercially available igniters and motors are used and follow the NAR High Power Safety Code, which outlines what to do during motor ignition failure.
Premature Detonation of Black Powder Charges	2	Partial destruction of rocket and/or premature parachute deployment.	All black powder will be handled by professionals and the team will check that the charges are set for the correct time.
Team members becoming sick before or during the trip to Huntsville.	3	Loss of manpower and possible loss of team leaders and/or safety officer	Team members will be well informed and be able to cover multiple rules in the project if needed.
Pieces of the rocket falling off of the rocket during launch	2	Damage to the rocket and danger of injury to the people and processions on the ground.	Check all aspects of the rocket before launch and delay launch if repairs are needed.
Cancellation of Huntsville due to unforeseen causes	1	Ending of the program for this year or the event being held at a later date.	Follow through with the current program and launch separately.

Section 7

We are confident that we have all of the parts needed to finish and mature the design to the finished state before FRR. Because we have built many rockets in years' past, many small parts and tools needed to build a rocket of this scale are already available to us. These components include epoxy, hardener, drills, saws, couplers, duct-tape, wooden bulkheads, nosecones, some altimeters, many metallic pieces needed (all thread, eye-bolts, U-bolts, nuts, etc.), and more. Delays on shipment orders could have an impact on how fast the rocket could be built, but we have already planned to order all of the major rocket components directly after the PDR is turned in, so if any delays should occur, they will not be long enough to impact any rocket progress very significantly. We have selected our manufacturers' based on past experience of their reliability, their ability to ship parts out efficiently, and all with little to no damage to the items. Planarian for the payload, exact length fiberglass body tube, fiberglass fin material, a new nose-cone, new quick-links, new eye-bolts, and new shock cord material have been or will be ordered and shipped, or made, in the near future to continue our work on the subscale and then full-scale rocket. We are confident that we have all of the parts and materials available to us in order to finish the rocket and work hard on the design and progress.

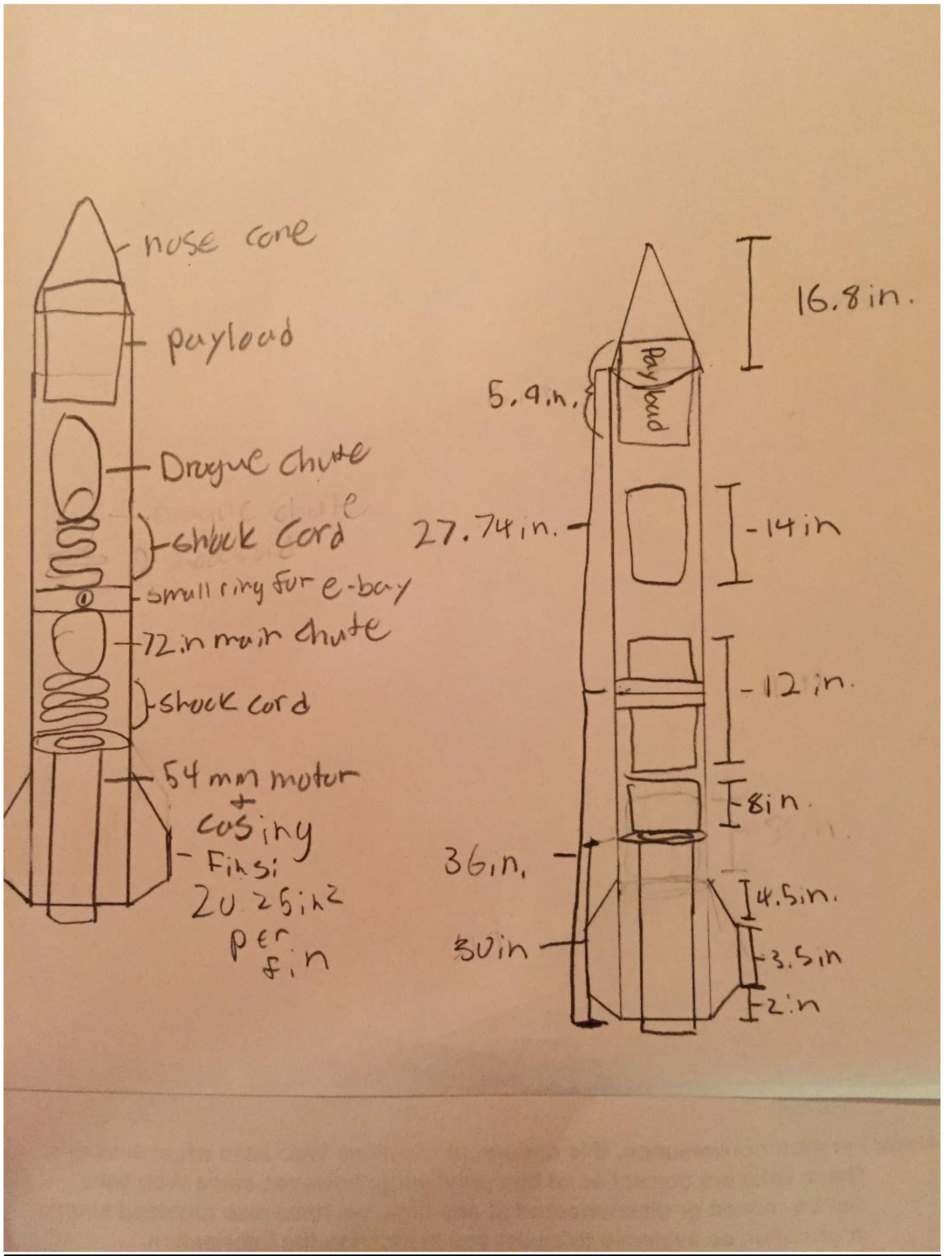
Section 8

We plan on manufacturing our rocket, payload, and other non-ordered parts during or after school. Students will be staying after school and building these pieces on a regular basis to ensure we can complete it by the launch dates. We will use check lists to ensure that the rocket is being built properly and that it is being done so efficiently. If a check list is posted, then students will know what pieces are due by what date. Then, we will have our project manager and mentors look over the work that was done to ensure that all that was done is up to the standards that it needs to reach, and that everything is in the correct place. We have access to a structural analyzing machine that can test up to 1000lbs. With this, we will test the structural strength of the bulkhead, fins, and the centering rings. The bulkheads and centering rings will be manufactured from half inch plywood and the fins will be cut from G-10 FR4 fiberglass sheets. We chose these materials because we believe that they will perform the best under the stress they will undergo. To test the electronics, in the electronics bay, which lead to the ejection charges attached to the altimeters, we will be holding scale launches. This will show us if everything is working properly and if not we will know what is wrong with it. When the rocket is complete we will disassemble it, mass all the parts again, and update the simulation. We will run the simulation again with the corrected mass to see the results. We will keep our results and checklists hanging in a spot so that every member of the team will be able to see the progress. Static testing will also occur to make sure that the black powder charges are sufficient to launch and that when the black powder ignites, it is enough to knock the rocket parts off of each other.

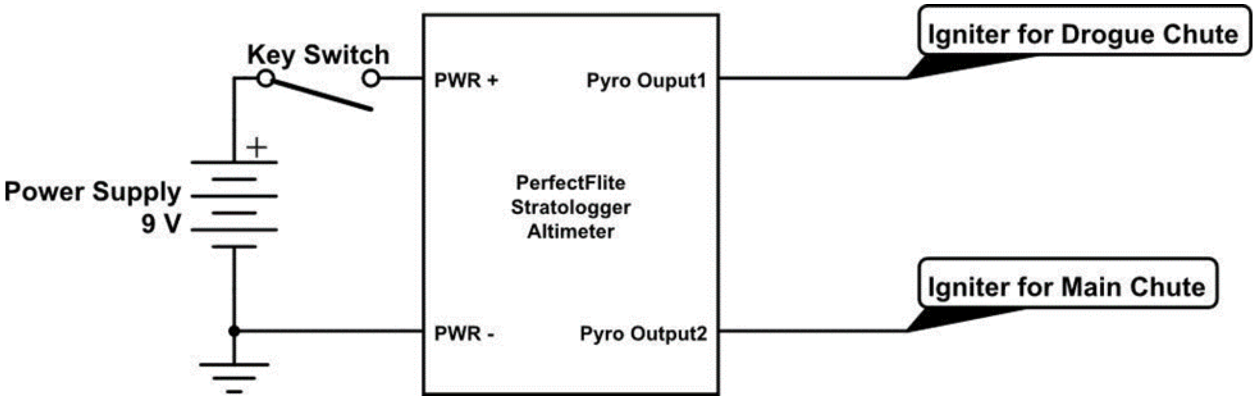
Section 9

We are very confident that our design is very mature along in the process. With a fairly significant amount of past experience in the rocket field, we understand what methods can work and what can result in a major failure. With a good solid design, sound structural components, and a good array in size of fins on the rocket, we feel that if we had to build our rocket now, it would fly on fairly straight path and reach the target altitude of I mile AGL. As far as the maturity of our rocket goes, we are pretty well along and do not have many changes left that are necessary to make. Our length and weight are accurate in our design leaving our design close to being final.

Section 10



Section 11



Here is the schematic for the recovery system/electronics bay. There will be a 9-volt battery connected to a StratoLogger Altimeter. The altimeter will then be connected to two separate igniters that will be placed above and below the electronics bay housing. Ejection charges will be placed onto these igniters. The entire system then will be grounded to the chassis of the electronics bay. For redundancy, there will an additional altimeter and two additional igniters and ejection charges to ensure the separation of the rocket. These altimeters will be armed on the outside of the rocket before launch using two separate electronic key-switchs that will be wired up to the altimeter to allow for the arming of the altimeters and accurate deployment of the payload and parachutes.

Section 12

Mass Estimate

The total mass of the rocket is estimated to be 335.33 oz. This mass has been determined based on manufacture mass data, density estimates and volume, and additional mass has been added to the rocket based on the estimated amount of epoxy that will be used to secure components of the rocket together. The mass estimate is about 75% accurate, because many of the rocket components have had masses based on manufacture-supplied data. However, exact mass growth because epoxy application has not been tested and the estimated mass of the epoxy may not be as large as it should be for a 2500% mass growth. We are expecting that the mass of the rocket will change, and possibly even grow. As we begin more strength tests and epoxy mass testing for the size of this rocket. We expect the mass of the rocket to grow at least 55.0 oz, however we could see a growth in the mass of the rocket of as much as 80.0 oz. to 110.0 oz. We are not expecting a decrease in the mass of the rocket as the design matures into a final product, because mass estimates were calculated as close as possible to their expected values, and the mass of the rocket is expected to increase as a direct result of underestimating the mass of epoxy, the payload and nosecone, recovery system electronics bay, and smaller, yet functional, components within the rocket such as washers for eyebolts.

Parts	Mass (oz.)

Total System Mass	**336.0**
Nose Cone	12.0
Bulkhead for Top Half	6.0
Top Body Tube	48.0
Main Parachute	18.0
E-Bay and Components (bulkheads, batteries, altimeters, etc.)	64.0
Bottom Body Tube	48.0
Inside Bulkhead for Payload	6.0
Outside Bulkhead for Payload	6.0
Other materials for payload (all thread, tubes, water, etc.)	32.0
24 inch Drogue Parachute	12.0
Bulkhead for Bottom Half	6.0
Motor Mount Tube	24.0
Lower Centering Ring	4.0
Middle Centering Ring	4.0
Upper Centering Ring	4.0
Fins	28.0
Total Shock Cord and U-Bolts	30.0
Mass With Motor	**402.76**
Motor Mass	66.76

Recovery Subsystem

In our rocket recovery system design will have 2 parachutes connected to shock cord. Each shock cord will have one end connected to an end of the electronics bay. Our shock cord in the bottom half of our rocket will have our drogue parachute connected in the middle of the shock cord and the ends will be connected to the bottom of the electronics bay and the bulkhead above our motor. Our shock cord in the front half of our rocket will have the main parachute connected in the middle of the shock cord and the ends will be connected to the top of our electronics bay and to the bulkhead on our nosecone/payload. Our altimeters in the electronic bay will trigger 2 separate ejection charges with one on each end of our electronics bay. One altimeter will be our main altimeter which will fire an ejection charge at apogee to eject our drogue parachute, as well as fire our ejection charge at 600ft to eject our main parachute. The second altimeter is a redundant altimeter that will fire after 3 seconds to ensure that we have separation of our vehicle parts. The first ejection charge fired from the main altimeter will eject the back half of the rocket off away from the electronic bay. The second ejection charge fired from the main altimeter as well and will eject our nose cone out from the rest of our rocket pulling out the main parachute thus deploying our main parachute. The main parachute is projected to slow the rocket's descent to a rate of 17.6 ft/s. The front body tube will be onto the electronics bay with plastic pop rivets to ensure that the front body tube is not ejected away from the electronics bay as well. The nose cone housing the payload will be suspended by the shock cord from one side of parachute, while the electronics bay and body tube piece will be suspended by the shock cord on the other side of the parachute. The electronics bay will then also be suspended by the drogue parachute from the other end, and the back body tube section of the rocket will also be suspended by the other end of the shock cord attached to the drogue parachute. As mentioned previously in the report our main parachute will be a 72 inch Iris Ultra parachute by Fruity Chutes and our drogue parachute will be a 24 inch parachute also made by Fruity Chutes. There will be 2 key switches on the outside of the rocket used to turn the power to the altimeters off and on thus being able to arm them from the outside of elections bay and ultimately outside of the rocket. They will be able to function properly for many hours after being armed because we use a 9 volt battery to power each altimeter. This way we will not have to worry about any delays while the rocket is armed and on the launch pad waiting to be fired.

Inside of our rocket we will have the shock cord for each parachute connected to 2 separate U-bolts at different points in our rocket. For our 72 inch main parachute it will be connected to a piece of shock cord in the front half of the rocket that runs between the electronics bay and nose cone. The end of the shock cord attached to the electronics will be tied onto a U-bolt on the top of our electronics bay. The other end of the shock cord will be connected to the U-bolt on the end of our payload and nose cone combo. The main parachute will be attached to this shock cord close to the middle of the shock cords length. For our 24 inch drogue parachute it will be connected to a piece of shock cord in the back half of our rocket that runs between our electronics bay and the bulkhead at the end of our motor. One end of the shock cord will be connected to the bottom end of our electronics bay on a U-bolt and the other end will be connected to a U-bolt that will be connected to the bulkhead at the end of our rocket motor.

Mission Performance Predictions

Section 1

In order for this project to be successful the following criteria must be met. It must successfully launch and deploy both parachutes. The rocket must be within 10% of our target altitude of 1 mile or 5280 feet. The payload must survive and be able to provide usable data. We must be able to use that data to draw a meaningful conclusion to our experiment. Lastly no onboard systems or parts must break or malfunction during the course of the launch.

Section 2

- This is an accurate measure of the thrust over time graph for the Cessaroni K-1440 White Thunder motor made by Cesaroni Technology Incorporated.

- So at 0 miles per hour, the calculated height of the rocket is 5, 406 feet, but multiplying by the percent mass increase and you end up with the rocket reaching 5,101 feet, under the target altitude, but very close to the actual. At 20 miles per hour that will drop to 4,957 ft.

- Motor: Cesaroni K1440 white thunder, 2364 Ns of Impulse. This will bring out 402.1 oz. rocket to an altitude of 5,406 ft and we can expect that the actual weight of the rocket will be heavier and therefore will bring the altitude at or below the mile mark.

Section 3

- Stability Margin : 2.63
- Center of Gravity (CG): 49.2 in from nose cone
- Center of Pressure (CP): 53.5 in from nose cone

Section 4

With the 72 inch parachute, the rocket should have a slowed descent of 17. 6 ft/s. With this velocity, the nose cone is calculated to have 10.6 ft-lbf of Kinetic Energy at the moment that the rocket hits the ground. The electronics bay housing the altimeter and tracking device as well as the front bod tube should hit the ground with 49.6ft-lbf of Kinetic Energy. The last section of the rocket (the bottom half) should have 60.92 ft-lbf at the time it hits the ground. The total kinetic energy of the rocket is 120.92 ft-lbf when it hits the ground.

Section 5

Because all components of the rocket are being tethered to each other, the drift distance for all components is relatively the same. With no wind, the rocket drifts 211 feet from the launch pad. With a 5 mph horizontal wind, the rocket is estimated to drift 492 feet from the launch pad. With a 10 mph horizontal wind, it is calculated that the rocket will drift 873 feet from the launch pad. With a 15 mph wind, the rocket is calculated to drift 1,204 feet from the launch pad. With a 20 mph wind, the rocket should only drift 1,790 feet from the launch pad, ensuring that even under the most extreme launching conditions allowed by the NAR (in reference to wind speed), the rocket will stay within the 2000 foot radius of the launch pad.

Interfaces and Integration

The payload will be located in the nose cone and will eject with the nose cone and main chute at 700ft. It contains tubes that will contain the planarian and these tubes will be placed into foam that will have 4 holes drilled into it for the test tubes. Insulation and other mechanisms may be put into place if needed for the survival of the planarian.

The body tubes of the rocket will be made out of fiberglass. The rocket will be 82in long and 4in in width. The mass will be 402.1oz with a center of gravity at 42.9in from the tip of the nose cone. The center of pressure will be located at 53.5in as well the fins will be made out of fiberglass. These fins will be "through the wall" fins as they will bonded into slits cut into the rocket. These fins will be in a trapezoidal shape with a 10in base and 3.5in top. The Electronics Bay will be located in the middle of the rocket. This will be put into a fiberglass body tubing that will work most like a coupler tube. It will be 3.9in in diameter and 12in long in order for it to fit inside of the rocket. There will then be a 2in piece of fiberglass tubing in the middle of the Electronics Bay that will slide on the outside. This will be epoxied in place to make it secure, because the key switches will be placed through this piece of fiberglass. The Electronics Bay will fit into the back half of the rocket similar to a coupler tube and will be held into the front half of the rocket with plastic pop rivets. This will make sure that the main parachute will eject out of the nose cone and not split at the Electronics Bay from both sides.

We do not have any interfaces between the launch vehicle and the ground launch system.

The rocket will have small pieces of 10-10 launch lugs epoxied onto 2 places on the body of the rocket. These will then be lined up with and slid onto a 10-10 rail. There is an electronic control pad that will then send out an electric current the will start an igniter that will then launch the rocket.

Safety

Preliminary Checklist for Final Assembly and Launch Procedure

- ❑ Ebay
  - ❑ All batteries have a fully charged
  - ❑ All altimeters are working
  - ❑ Wiring is correct and has no breaks/shorts
  - ❑ All part are secure and fit together
  - ❑ External key switches work
  - ❑ Ebay is airtight when fully assembled
  - ❑ Ejection charges are assembled correctly
  - ❑ Fits inside body tubes without being too tight or too loose
  - ❑ Shear pin holes line up
- ❑ Payload
  - ❑ 8 planaria placed in test tubes with adequate water
  - ❑ 4 test tubes are loaded into our ebay
  - ❑ The end of the payload is securely attached
- ❑ Recovery System and Shock Cords
  - ❑ Nose cone is properly connected to the first parachute and ebay
  - ❑ Ebay is properly connected to the second parachute and back half of the rocket
  - ❑ Drogue Parachute is folded currently
  - ❑ Main Parachute is folded currently
  - ❑ Heat shielding for the shock cords and parachutes is in place
- ❑ Motor Assembly
  - ❑ Motor is assembled properly by our NAR safety officer
  - ❑ Motor fits inside motor mount
  - ❑ Motor retainer is in place
- ❑ Body and Airframe
  - ❑ Necessary number of shear pins and pop rivets inserted correctly
  - ❑ All parts fit together,
  - ❑ There is no issues with the airframe
- ❑ Launch Procedures

- ❏ Place rocket on launch rail without damaging rocket
- ❏ Place rail in launch position
- ❏ Check if altimeters are functioning correctly and remove keys to the keyswitches
- ❏ Insert ignitor correctly
- ❏ Attach wires to ignitor
- ❏ Check continuity before launch

Section 1

Team and Student Safety Officers

Our team safety officer for this project is our NAR representative and mentor Mr. Hastings. Our student safety officer is Josh Staley. For more information look at the bios at the front of the PDR. The responsibilities of these two individuals is that the construction, assembly, and final launch procedures follow safety rules and guidelines and ensure the safety of the project as a whole. Other responsibilities include being responsible for the handling of hazardous materials and retrieval of the rocket post-launch.

Section 2

Rocket Design Failure Modes

Possible failures in the rocket design include all of the following. Failure of the adhesives used to constructing the rocket and failure of centering rings and bulkheads. The airframe is unable to withstand the forces acting on it, failure of connecting points (u-bolts, o-rings, etc…) and possible expansion of fiberglass used making the rocket unusable. To combat adhesion failure we will be using a high-strength slow-curing epoxy that will be able to withstand the forces placed on it and be able resist changes in temperature that can make it more prone to failure. We will be using centering rings and bulkheads that and made to withstand the necessary stressed and have been tested to confirm that. Both are unlikely to happen provided that there are no errors in construction but if it did take place then the outcome would be almost certain integrity failure and danger of flying parts coming down. The airframe is made of fiberglass which has been proven to provide strength and be resistant to failure. Failure of the airframe is unlikely and would result in failure of the rocket and out of control flight trajectory. The connecting pieces that we are using are rated well above the projected stresses to be placed on them and have not failed in any prior test. This is unlikely to occur and would result in the rocket returning in multiple pieces and possible falling debris. Lastly to offset the possible expansion of the fiberglass due to heat we will not be making our motor mount out of fiberglass and have confirmed that the fiberglass that we will be using is resistant to expansion at the projected temperatures of our launch dates. We will also keep the rocket out of direct sun when working and use a light paint. This is unlikely to occur and would result in being unable to fly as the parts would no longer fit together.

Section 3

Payload Integration Failure Modes

The possible payload integration problems that we may experience is the the bulkhead may not fit into the body tube properly and the shock cord may not be able to attach to the payload properly. To mitigate this we will be using a dremel tool to trim the bulkhead down to the current size and we will be using u-bolts and quick links that we know are compatible.

Section 4

Launch Operations Failure Modes

Failures that may arise in the launch operations are the ejection charges not being set off or set off at the wrong attitude, having an ejection charge that is not powerful enough to break apart the rocket to provide a safe decent and eject the parachutes. To help prevent motor failure we will ensure that our NAR representative properly build or rebuilds the motor as well as using the proper launch mechanisms though we cannot be absolutely certain that this will not occur. To mitigate ejection charges not being set off or off correctly we will redundantly wire the system so that there is a backup if one altimeter, battery or other component fails as well having multiple ejection charges. We will use the proper amount of black powder in our ejection charge so that it will be able to eject both the back half and the nose cone as well as successfully ejecting the parachutes

Section 5

Hazards

Hazards over the course of this project are split up between chemical hazards, construction machines/tools hazards and rocket subsystem hazards.

Chemical hazards
Materials that are hazardous to personal epoxy, epoxy hardener, black powder, spray paint and fiberglass. All such materials are harmful if consumed, inhaled and placed in sensitive areas such as your eyes. They can also act as an irritant while working with them. Included below are material safety data sheets for the before mentioned products.

Materials Safety Data Sheets

Z-Poxy Resin

http://web.mit.edu/rocketteam/www/usli/MSDS/Z-Poxy%20Resin.pdf

Z-Poxy Hardener

http://web.mit.edu/rocketteam/www/usli/MSDS/Z-Poxy%20Hardener.pdf

Krylon Spray Paint

http://www.krylon.com/document/SDS/en/US/724504018179

Goex Black Powder

http://www2.epa.gov/sites/production/files/2015-05/documents/9530608.pdf

Construction Machines/Tools Hazards

Injury that may occur due to the incorrect use of the tools provided include but are not limited to hair, clothing, and/or jewelry getting caught in the machines resulting in severe bodily harm to the user. Injuries may include severe bruising, burns, the tearing of skin, flesh and/or vital organs, the spraining, braking and/or shattering of bones, small chance of partial or complete dissection of limbs, and extremely small chance of partial decapitation. Abrasions, bruises and paper cuts may result from using hand tools.

In order to minimize the chance of injury all participants will sit through a series of safety briefings. They will be instructed on the correct use and procedures before operating any tools and will be given demonstrations in their correct use as well as being told examples of their incorrect use. We will identify as many hazards as possible when using each machine and lastly will will always have a senior member and one of our mentors supervise anyone who is using the machines and tools. The proper procedure for machine usage can be found below.

Framar Band Saw

Before operating the bandsaw, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the blade or the band saw. Also, obtain an instructor's permission to use the machine and ensure that safety glasses are covering your eyes. When cutting, make sure adjustment knobs are tight; the upper blade guard should be around one eighth of an inch above the material being cut. Do not force any material through the blade, attempt to cut a radius smaller than the blade will allow, and do not back out of long cuts. Keep fingers on either side of the cut line, never on the line. If necessary, use a push stick or scrap block to guide the material through. Do not allow bystanders to stand at the right of the machine, because if the blade breaks, it may hit them. Never leave the machine until the blade has come to a complete stop. If an injury should occur during the usage of the band saw, stop the machine, step on the brake to stop the blade quickly, inform an instructor of the injury,and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Router

Before operating the router, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the router or router bit. Also, obtain an instructor's permission to use the machine and ensure that safety glasses are covering your eyes. Ensure that the power switch is in the off position before plugging in the router. Then, check to make sure that the bit is firmly secured in the chuck and that the piece being worked on is firmly secured and that the intended path of the router is free of obstructions. Hold the router with both hands and apply constant pressure. Never force the router or bit into the work. When changing bits or making adjustments turn off the router and unplug it from its power source. If an injury should occur during usage of the router, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Delta Radial Arm Saw

Before operating the saw, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the blade. Also, obtain an instructor's permission to use the radial arm saw and ensure that safety glasses are covering your eyes. Make all needed adjustments, such as adjusting the blade guard and kickback fingers, while the power is off. Test to see if leaf guards are properly working and that the blade does not extend past the edge of the table. Always firmly hold materials against the fence and pull the blade completely through the material and return blade behind the fence before removing the material and starting another cut. If too much of the table is cut away then the instructor must be notified for the table to be replaced. Wait for the blade to stop before leaving the machine. If injury occurs during usage of the saw, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Planer-Surface Sander

Before operating the sander, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the machine. Also, obtain an instructor's permission to use the sander and ensure that safety glasses are covering your eyes. Turn on the saw dust collection system. Check all material for loose knots, nails, staples, or any other loose, foreign objects. Never force a material through the planer; after insertion the machine will automatically feed it through. The operator should wait on the other side of the machine to receive the material. Select a proper machine depth and speed for the material being used. Never attempt to plane more than an eighth of an inch of material in one pass. Do not look into the machine at surface level or try to clean debris while the machine is turned on. Always stand to the side, because the possibility of kickback always exists. If injury occurs during usage of the sander, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Dewalt Compound Miter Saw

Before operating the saw, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the blade. Also, obtain an instructor's permission to use the saw and ensure that safety glasses are covering your eyes. Make all changes to the saw and saw blade while the power is off and the plug is disconnected from its power supply. Hold the material firmly against the fence and the table. Allow the motor to reach its full speed before attempting to cut through the material. Make sure that all guards are functioning properly. If injury occurs during usage of the Miter Saw, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Jointer

Before operating the jointer, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that may become caught in the blade. Also, obtain an instructor's permission to use the jointer and ensure that safety glasses are covering your eyes. Turn on the saw dust collection system. Make all changes or adjustments to the jointer while the power is off. Use a push stick or scrap block if your hands could come within two inches of the blade. Do not attempt to take off more than one eighth of an inch at a time. The minimum length of material that can be cut with the jointer is double the size of the blades. If injury occurs during usage of the jointer, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Hand Sanders

Before operating the hand sanders, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the machine. Also, obtain an instructor's permission to use the hand sanders and ensure that safety glasses are covering your eyes. Replace the sandpaper while the sander is off and unplugged. Only use sand paper that is in good condition and properly installed. Place the material that you intend on sanding on a flat surface and sand slowly over a large area. Wait for the sander to stop oscillating before placing it on a secure resting surface. Never carry any corded tool by the power cord. If injury occurs during usage of the hand sanders, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Electric Drills

Before operating the drill, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that may become caught in bit. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Replace the bit while the power is off, install the bit properly and make sure the chuck is tightened and the chuck key is taken out. Never drill without first marking the hole with an awl. Ensure the material is clamp securely and drill with even pressure. Never carry any corded tool by the power cord. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Powermatic Drill Press

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in bit. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Replace the bit while the power is off, install the bit properly and make sure the chuck is tightened and the chuck key is taken out. Firmly secure material with vises or clamps. Adjust the table to avoid drilling into the table and pick the correct bit and properly sharpened. If drill becomes stuck turn of machine and inform instructor. Select proper speed for the material. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

CNC Router

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in bit. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Turn on the saw dust collection system. Make all adjustments while machine is off. Material must be firmly secured before the project is run. A person needs to be with the machine during the entire operation. Check the spindle rotation, speed, and depth of cut are all correct before starting the machine. Only clean machine while it is off and make sure all setup tools are cleared from the table. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student..

Oliver Table Saw

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in blade. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Turn on the saw dust collection system. Make all adjustments while machine is off. Gullets of the blade must clear the top of the material. Never use the miter gauge and the fence at the same time, miter gauge for cross cutting and fence for ripping. Use extra caution while using a dado cutting head. Always use a push stick when your hand may come close to the blade and have another person to catch the material that was just cut. Do not leave the table until the blade stops. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Powermatic Belt Sander

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in machine. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Check that there is adequate tension in the belt and that it is not torn. Keep material on the table at all times. Keep fingers away from sandpaper. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Powermatic Disc Sander

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in machine. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Check that the disc was properly installed and that it is not torn. Keep material on the table at all times. Keep fingers away from sandpaper. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Powermatic Drum Sander

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in machine. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Use proper drum for the radius that is being sanded. Keep material on the table at all times. Keep fingers away from sandpaper. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Craftsman Reciprocating Saw

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in blade. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all changes with the power off and plug disconnected from the power supply. Firmly secure all material to a workbench or table. Allow the motor to reach its full speed before cutting through the material. Hold saw with both hands while using. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Craftsman Circular Saw

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in blade. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all changes with the power off and plug disconnected from the power supply. Firmly secure all material to a workbench or table. Before cutting; check that the cut line is not above the table. At least one person must be holding the material being cut off. Allow the motor to reach its full speed before cutting through the material. Hold saw with both hands while using. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

CNC Lathe (EMCO Concept Mill 55, Lab Volt 5400 CNC Mill, a Lab volt

Automation 5500-B0)

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in bit. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Material must be firmly secured before the project is run. A person needs to be with the machine during the entire operation. Check the spindle rotation, speed, and depth of cut are all correct before starting the machine. Only clean machine while it is off .If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Victor metal lathes

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in work. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all changes with the power off. Center the material so that it will not spin off center. Firmly secure all material to a machine. Use proper speed for the task at hand. Use the correct and sharpened tools. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Paasche FABSF-6 spray booth

Before use turn on ventilation system and wear proper protection. Use the correct spray for the material and do not inhale. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Miller Spot Welder

Before operation put on proper clothing, welding mask, gloves, and apron. Obtain instructor permission. Do not look at the welding torch unless wearing a welding mask. Ensure the proper solder is being used and materials are secured. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Baldor grinder/buffers

Before use put on safety glasses, check the spark shield is intact, and obtain instructor permission. Keep hands away from spinning wheel. Adjust the tool rest to the proper height and always use it. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Tennsmith Sheet metal cutter

Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in work. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Do not attempt to cut material thicker than the machine is rated for. Make sure the material and blade are free from debris. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Gravograph LS100 30 watt laser/engraver/cutter

Before operation; ensure that the laser is focused, the vent fan is on, and the right speed and power are selected for the material. Obtain instructor permission before use. Never look directly into the laser. Stay at the laser throughout the entire process. If machine cuts unwanted area or malfunctions turn off and alert instructor immediately. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Section 6

Environmental Concerns

Our project this year will have minimal impact on the environment and present fex environmental hazards. The use of our motor and the black powder ejection charges will produce small amounts of harmful gases that in small enough concentrations that they are harmless. The major concern is if we lose the rocket and are unable to recover it. In that case the rocket contains several hazardous compounds that could greatly harm any plants and animals that come into contact with it. The rocket also has a payload of planaria which is not natural to our launch location. Lastly the rocket is made of parts that will not easily decompose and will therefore present a long term hazard to plants and wildlife. To minimize this we will be placing a tracker on the rocket that we have used before and have confirmed that it works effectively as well as bringing a long pole in case it gets caught on something. The planaria are in tightly sealed thick plastic test tubes that would have a very difficult to break and will guarantee that known of the planaria escape

The environment can affect the rocket in several ways. Wind can change the trajectory and attitude of the rocket, rain can hurt electronics, landing in a body of water or wet area can damage electronics, humidity can slow the velocity of the rocket, high temperatures can cause the fiberglass to expand and make launching impossible and decrease battery life, cold can kill off our planaria and ruin our scientific experiment, and direct sun for too long can cause electronics to fail.

Payload

Section 1

Payload Concept

Our payload this year will be a biological payload testing to see how the acceleration of the rocket effect the rate at which a type of aquatic called planaria are able to regrow half there body. Planaria are a type of aquatic flatworm that live in a wide variety of saltwater and freshwater habitats around the world. They are distinctive because of the ability to regrow parts of their body and/or split into two different separate individuals. This has made them the subject of many studies in aging and tissue/organ growth/repair research. It was because of this trait that we decided to make them the basis of our payload this year. The acceleration of the rocket will act as a stressor for the planaria they are carrying. We can then see how that stress affects the growth process and the tissue repair.

Section 2

Scientific value

The objective of our payload is to see how the acceleration of the rocket affects the regrowth rate of planaria. We can then use this as an analog to see of how stress affects the growth and development of an organism and evaluate how it affects tissue repair.

Our success criteria is if we can show a definitive difference or no difference in the regrowth process between a planaria that is subjected to the rocket's acceleration and one that has not. The planaria must survive the launch in order for us to obtain valuable data and we must have at least 2 successful launches in order to provide enough data to draw a useful conclusion.

In order to complete the objectives of our payload we will be using cameras that are set up to take 2 pictures a day and will allow us to see the progression of the regrowth process. We will be using these to record both the control and the experimental group. This will give us an accurate way to compare the differences between the two groups. The experimental group will be placed in our payload onboard the rocket, recovered and then observed using the cameras. The control group will stay on the ground and then observed using the cameras and act as our baseline. Both the experimental and the control group will be placed in one of our payloads and kept in the same environment. The only difference is the experimental payload will be the placed on the rocket and the control will not. The independent variable is the acceleration the planaria is subjected to and the dependent is the length of regrowth time and visual observations of that process. Our control variables include cutting both groups at the same time, subjecting them to the same conditions, giving both groups the same amount of nutrients and water with the same qualities, and using the same species and type of planaria.

In this experiment if we are able to obtain relevant data in order to satisfy our objectives so long as the planaria do not die and the rocket is not lost. In order to make experimental error small enough to gain a reasonable conclusion we need to complete at least 2 launches and preferably 3. This will give us at least 8 members in the control group and 8 members in the experimental group.

Section 3

Design

Our payload for this year will be located in the nose cone of our rocket. It will consist of an internal bulkhead with all thread running through it and connecting it to a second bulkhead at the back of the nose cone. We will fill the area between the two bulkheads with a type of insulation. Our current choice is to use expanding foam but we can experiment with different types if this does not work. We will have 4 cavities in the insulation that will firmly hold our test tubes that contain the planaria. We will have a second payload that is an exact copy of the one placed on the rocket that is for our control.

Verification requirement	Status
Planaria survive Rocket Launch	Pending
At least 2 successful launches	Pending
Gain useful data from at least 16 planaria in two groups	Pending

We need the planaria to survive, the test tubes to remain intact and the all threads to remain intact in order to have a successful launch Our payload will be connected to the rocket via a u-bolt and quicklick that is then connected to the shock cord. We are able to reuse this payload as many times as needed do not have any complex instruments that we must account for.

Project Plan

Timeline:

· August 7, 2015: Request for Proposal (RFP) goes out to all terms

· September 11, 2015: Electronic copy of completed proposal due to project office by 5pm · October 2, 2015: Awarded proposals announced

· October 7, 2015: Kickoff and PDR Q&A

· October 23, 2015: Team web presence established

· November 6, 2015: Preliminary Design Review (PDR) reports, presentation slides, and flysheet posted on the team website

· November 9-20, 2015: PDR video teleconferences ·November 10, 2015: Team Darwin's teleconference · November 14, 2015: Yankee Candle fundraiser due · November 18, 2015: Nuts About Granola fundraiser due · November 20, 2015: Paint Night registration due · November 21-22: Proposed November Subscale Launch

· November 30, 2015: Paint Night at Spring Grove High School for fundraising · December 4, 2015: CDR Q&A

· December 23, 2015: Bonus Book fundraising ends

· January 15, 2016: Critical design review (CDR) reports, presentation slides, and flysheet posted on the team website

· January 19-29, 2016: CDR video teleconferences

· January 31, 2016: Rocket Real Estate finalized (sponsors) · February 3, 2016: FRR Q&A

· February 28, 2016: Final donations sent in from GoFundMe or PayPal

· March 14, 2016: Flight Readiness Review (FRR) reports, presentation slides, and flysheet posted to team website.

· March 17-30, 2016: FRR video teleconferences

· April 13, 2016: Teams travel to Huntsville, AL; Launch Readiness Reviews (LRR) · April 14, 2016: LRR's and safety briefing

· April 15, 2016: Rocket Fair and Tours of MSFC · April 16, 2016: Banquet; launch day

· April 17, 2016: Backup launch day

· April 29, 2016: Post Launch Assessment Review (PLAR) posted on the team website · May 11, 2016: Winning team announced

Team Schedule

There are two different types of gatherings: meetings and sessions. Discussions will be lead by the Team Captain and Co-Captain. All members will discuss and comment on the tasks at hand. Sessions will be work time for the members of the team. This work includes typing and editing the proposals, building the rocket, discussing any changes, and planning fundraising for the program. An advisor will be at the sessions to supervise and assist the team. There may also be short briefings, general meetings, bonding sessions, work sessions, and construction sessions.

Meetings:

An informal and short meeting will be held before a work session. Jobs and tasks will be given including the time they must be completed and turned in to the advisor.

Formal meetings will be conducted according to a strict agenda, discussing all the tasks that need to be completed and the due dates of such tasks. Updates and changes to ongoing projects will be discussed and compared. Questions, comments, or concerns can be brought about by the members or advisors of the team. The purpose of the formal meetings is to ensure tasks are getting accomplished and make everyone aware of what needs to be done.

Briefings will be short, clear, and concise. They will be used to efficiently inform all of the members of the team. These short meetings will go over what has been completed and the progress on other ongoing tasks. Any changes or modifications to the schedule, budget, fundraising program, and proposals will be announced. These changes or modifications will be the majority of discussion at the briefings.

Sessions:

Sessions will be to talk about any problems that have slowed down or stopped the progress of a certain aspect of the project. Personal problems of the members that inhibits their ability to work or work well may be discussed. These problems may not involve the project at all but affects a member's ability to work or attend meetings. The other members can assist to finish the pieces of the project or tasks a member is having difficulty with. These meeting may help to relieve stress surrounding the program or surrounding personal issues. This time will allow team members to grow, to understand one another, and to help each other. Sessions will help the team work more cooperatively and efficiently. Without the sessions, the project may seem more stressful and massive for the team as a whole.

Bonding sessions will also be held to help the team grow together. These particular sessions will improve the bonds between the team members and the advisors. Watching science based movies, genres as specific as aerospace, or any other activities may be held to help relationships within the team grow. A friendly and open environment is necessary to have a pleasurable experience throughout the course of the program. A healthy atmosphere is crucial to a successful and exciting end result.

Work sessions will be strictly for working on the reports and proposals due throughout the course of the year. This will allow time for any questions or clarifications from the members and advisors. The progress on all tasks will be checked and the due dates on those tasks will be restated. Any projects that have been completed will be accounted for. Also, the time allotted for work sessions allows for the two teams to discuss any concerns, to compare progress, and to assist each other in any way.

Construction sessions will be sessions used for the building of the rocket or any parts of it such as the payload. Specific parts will be assigned to pairs of team members to ensure the rocket is built efficiently and correctly. The grouping of team members will hopefully prevents any mistakes or accidents from occurring during construction. If anything does happen, the other member is there to help. The construction sessions will be supervised by at least one adult advisor in case any assistance is needed. All team members must abide by all of the safety rules, including the operation of tools or any other task, for the safety of the entire team.

Meeting Times, Session Times, and Proposed Schedule:

General meetings will be held when the majority of the team is able to meet. They will typically be prior to work sessions or before/after school hours. Formal meetings will be held every Wednesday around 2:50pm. Directly following the formal meetings, a work or construction session will be held. More work or construction sessions may be held depending on how much work has been accomplished and how much still needs to be completed. Construction sessions will begin once that point in the project has been reached. As previously said in the section on Sessions, a partner must be present to ensure safety while working on a certain task. Briefings will be held before school or an email may be a substitute to inform and update all members of the team. Group sessions and team bonding will be planned on whatever day works the best for the team. Team

Budget:

Item:	***Cost (In Dollars):***
Travel to Huntsville	6000.00

Food for All Trips:	2354.00
Practice Trips to Maryland	840.00
Lodging in Huntsville	3600.00
Nose Cone	19.95
Body Tubes	450.00
Fast-Hardener	44.99
Resin	85.00
Shock Cords	47.80
Large Parachute	188.00
Small Parachute	113.00
Centering Rings	60.00
Bulkheads	70.50
Motor Casing	149.95

Couplers	100.00
Motor Mount Tube	9.95
Engine Retainers	72.76
U-Bolts	15.84
Quick-Links	14.88
Altimeters	120.00
Batteries for E-BAY	25.46
Wires	30.78
All-Threads	6.40
Key-Switches	106.68
Subscale Rocket	500.00
Fly Nuts	15.00

Battery Holder	6.60
G10 Fiberglass (Fins)	55.00
West Systems Epoxy	70.00
Soda Bottle Preforms	18.95
Ward's Science Planaria	120.00
Expanding Insulating Foam (Payload)	18.99
Animal Motorworks Accelerometer	85.00
Cesaroni K1440 (Motors)	948.00
Misc. Parts	100.00
Total	***$16463.48***

Funding Plan:

Since Spring Grove's NASA Student Launch Initiative is not a school funded project, other ways of funding must be sought out. To raise the money to fully and successfully complete this project our team intends to carry out several fundraisers, seek out donations, and look for possible sponsors/grants. All of our alternatives for funding will be completed and approved during the course of the year. Every small amount we can earn adds up to make a substantial difference at the end of the year. Fundraisers that are currently going on include a Yankee Candle sale (information is located at www.yankeecandle.com),the sale of Bonus Books (information is located at www.bonusbook.com),and the sale for Nuts About Granola (located at fundraising@nutsaboutgranola.com).A cotton candy stand has been and will be set up at local sporting events to help raise money and awareness for the program. Donations are always accepted. A donation jar will be seen at all of the events our team takes part in. New ideas are always being welcomed and brainstormed.

Community Support:

To help gain support, our team will be contacting local television stations such as FOX 43 of the FOX Corporation and WGAL 8 in the Susquehanna Valley. Contacting such stations has been done in the past in addition to also contacting radio stations from our area including 107.7 and 105.7.. Also, we are planning to contact local newspapers. All of these examples will help to spread the word about the Spring Grove Rockets and our program. A brief bit of information summarizing our project will be sent to all of the organizations contacted asking if they are willing to help spread awareness of our club. An SLI website will also be constantly updated to help notify the public of the project and any updates. Presentations will be made to our intermediate and middle schools about our project and what we do. We hope this will help to make the kids more aware of and more excited about the possibilities that SLI provides. Signs and posters will also be made. These posters will then be hung around the schools and local businesses to help encourage the program and raise donations for the projects.

Sustainibility Plan:

We intend to keep our SLI club together now and into the future. This will be accomplished through a combination of many activities and elements. We intend to maintain all of our current relationships with local businesses and sponsors by sending them regular reports, maintain an active dialogue with them, and using their feedback to improve upon our program. Our current relationships are with several certified NAR members, Advanced Application Design and the Engineering Society of York. To keep a steady stream of new members coming into the club, we will primarily recruit new members from our TARC teams who have had past experience in rocketry. However, anyone who wants to join and is willing to put in the work will be welcome. We will be using a combination of announcements, posters, and our website to get the word to potential club members. We intend to engage the students of Spring Grove Area School District in our club and our mission through a series of assemblies and workshops. Lastly we intend to keep a steady stream of funding coming in through fundraisers, donations and sponsors/grants. All of these aspects will help to ensure that our club is maintained well into the future. We also plan to:

a) Avoid safety hazards is to have team members and supervisors read the all operation manuals for the tools and products that will be handled during the completion of our project before proceeding with any of such devices or products, while following the enclosed safety plan.

b) Address if a team member is comfortable with using a tool at any time or not.

c)Raise enough funds for our project we will be holding public outreach programs for funding and support we will be contacting local businesses for grants such as our local power company's (MetEd's)

d)Stay on budget, we will keep track of all funds being used and track whether the prices of materials are within the projected coast by researching for the best pricing of the materials. If going over budget is inevitable, due to rising prices of materials, we will raise more funds from companies using our progress on the project to incite sponsorship from more companies and businesses.

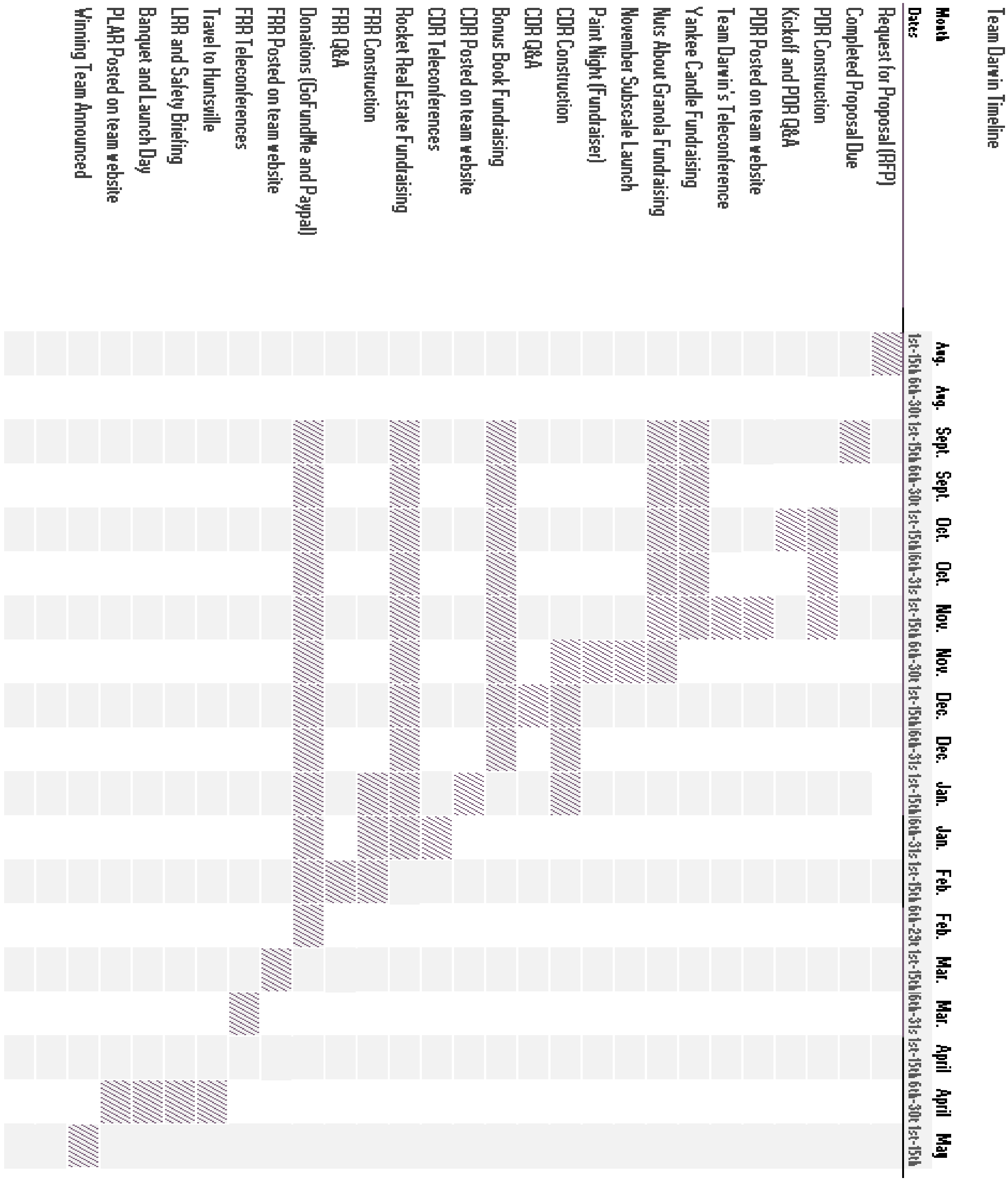
e)In order to make it to Huntsville, we want to work with people, local businesses, and corporate sponsors in and around the Spring Grove area. We plan on spreading awareness of our rocketry programs at Spring Grove to every adult and student in the area, to accomplish this we would like to create hands-on learning experiences for kids in our community to explore and learn more about the rocketry field.

f)We will also be holding public out-reach and funding programs at school and local events to help with awareness of our project to get the attention of adults of our community.

g)We hope to have small groups work together and build small scale rockets, each group will have an SL member directing the group to help teach the students to build the small rocket. If feasible, we may launch the said rockets (if they are deemed safe to fly). We want to provide fun hands on experience for our students so more students will be interested in joining TARC and potentially even SL in the future.

h)In order to spread public awareness, we are planning to contact television stations, such as FOX and our local news channels, to see if they are interested in making a short segment on the SL program of Spring Grove High School. We will also contact local radio stations such as 107.7 and 105.7 to see if they are interested in speaking on behalf of our program here at Spring Grove.bonding also includes any excursions the team takes together.

GANTT Chart


Team Darwin Timeline
Month
Dates
Aug.
Aug.
Sept.
Sept.
Oct.
Oct.
Nov.
Nov.
Dec.
Dec.
Jan.
Jan.
Feb.
Feb.
Mar.
Mar.
April
April
May
Request for Proposal (RFP)
Completed Proposal Due
PDR Construction
Kickoff and PDR Q&A
PDR Posted on team website
Team Darwin's Teleconference
Yankee Candle Fundraising
Nuts About Granola Fundraising
November Subscale Launch
Paint Night (Fundraiser)
CDR Construction
CDR Q&A
Bonus Book Fundraising
CDR Posted on team website
CDR Teleconferences
Rocket Real Estate Fundraising
FRR Construction
FRR Q&A
Donations (GoFundMe and Paypal)
FRR Posted on team website
FRR Teleconferences
Travel to Huntsville
LRR and Safety Briefing
Banquet and Launch Day
PLAR Posted on team website
Winning Team Announced

Educational Engagement

Involving and educating our community about what we do in SLI is very important to the continuation of this program and STEM programs offered in the high school as well. Without the approval of our community we would never get the chance to take part in a once in a lifetime opportunity to fly our SLI rocket down in Huntsville Alabama. As a group we diligently work to prove that the SLI team is a program that affects our members positively for years. In turn we have received respect and support from our community and we wish to keep this positive relationship going on for the future SLI teams.

This year we plan to hold similar events as the members of the 2014 SLI team did last year to educate the younger students of Spring Grove. By focusing on the younger grade levels we have the opportunity to spark the imagination of these kids and hopefully inspire them to join one of the programs offered in the high school. We will achieve this by holding presentations in the middle, intermediate, and elementary schools to inform the students of what we do in SLI, why they should care, and how they can join when they come to the high school. These presentations help keep our STEM programs going by motivating the younger Spring Grove students to join and continue this positive program.

NASA would like us to focus on students in grades 5 through 9 specifically. In addition to the presentations, we would like to hold a rocket building workshop for these age groups. Our workshop will give the students a chance to experience rocketry first hand, by allowing them to assemble their very own in a safe and educational environment. Rocket designs will be created by members of the 2015 SLI team to ensure the students safety and the ability of the rocket to fly with little to no complications. These students will be working in groups of 3 to 4 along with a mentor from the SLI team to assist the students in the building of their rockets. Before the workshop, the students will attend a brief seminar where they will learn the basics of rocket designing and how the rockets they are building (previously designed by a member of the SLI team) were constructed. By doing this rocket building workshop we will help widen the students' knowledge of the rocketry process, and enhance their experience with the SLI team positively.

As mentioned above, SLI team members will be assisting in the workshop by showing the students how to properly use tools and inform them about safety precautions throughout the building process. Following the workshop, students will be able to launch their rockets. This will hopefully inspire them to continue with their interest in STEM programs. After the rocket launch, students will be encouraged to ask questions and give comments about the SLI and rocketry programs. They will also be able to see a more in depth look at what the SLI team does.

Students will be able to enroll in this workshop, by filling out a signup sheet after our presentations held at their schools, and will bring home a consent form for their guardian or parent to sign. There will also be a meeting prior to the workshop for these students and parents to get more information about the project.

Conclusion

We now have moved beyond the beginning and continued to advance our project design and overall plan. Our current focus is to improve our documentation and begin work on the subscale rocket. We will continue to move forward with our current plan and will look forward to the presentation.