Spring Grove Area High School

SL Rocketry Team Proposal 2015

Project TreeTop

The Rocket Men of Spring Grove

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: The Rocket Men (TRM)

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

3. Safety Officer:

- Robert Dehate
  NAR Representative
  Phone number (cell): 978-766-9271
  NAR L3CC 75198
  TRA TAP 9956

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

5. Key Managers:

- Brian Hastings- Advisor and Supervisor of students
- Renee Eaton- Advisor and Supervisor of students
- Mr. Sengia- Instructional Technology Specialist
- Kyle Abrahims- Team Co-Captain (Electronics Bay Leader)
- Wyatt Nace- Team Co-Captain (Payload 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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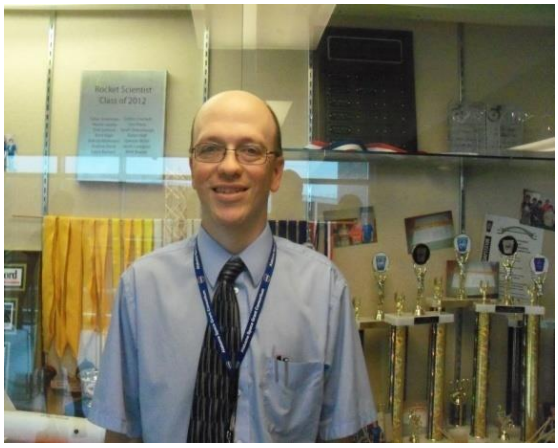
Team Members

Name: Brian Hastings

Position: Physics 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 Masters 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.



Name: Renee Eaton

Position: 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, and the Envirothon 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 1 certification. Currently I am building a rocket for level 2 NAR certification.

Name: Wyatt

Age: 17

Grade: 12

Position: Team Co-Captain and Payload Leader

In fourth grade, I participated in my first competition, Math 24, and became the champion for my school. I advanced through the county competition to the state competition, where I received a bronze medal. I became a “rocket scientist” at Spring Grove in eighth grade, when I joined Science Olympiad. I have been in Science Olympiad ever since, and we have advanced to the State competition every year since. My sophomore year was my first for both TARC and the SLP. In my first year with NASA I learned so much and being able to work with the top people in the field, I was able to prepare for becoming an Aerospace Engineer. These experiences taught me how to work with a team, working on a tight schedule, and leadership, among other things, and am ready for another year to work with NASA.

Name: Kyle

Age: 17

Grade: 12

Position: Team Co-Captain and Electronics Bay Leader

As a student I am involved in many activities throughout the school. I am a part of the Science Olympiad team that has made it to States' the past 5 years in a row including a 12th place finish in 2013. I am a part of TARC and am currently working with my team as a captain, and last year at my first nationals' was able to place a respectable 39th. This year I get to work with Wyatt and become a Co-Captain from our past experience with the SL Program in 2012 and good finishes in TARC. The Student Launch Program is a great experience for all of us and I plan to use the experience in my future clinical labs and use it to further my education in science. In the future I plan to get a bachelors' degree in Chemistry or Mechanical Engineering from either The University of Pittsburgh or Bucknell University.

Name: Josh (Budget and Funding plan)

Age: 16

Grade: 11

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 am also a member of the book club, German American Partnership Program, and I have played violin since 3rd grade. This year, I am looking forward to being a SL team member.

Name: David (Payload design and 3D modeling)

Age: 17

Grade: 11

SL is an excellent and great opportunity for me; I feel honored to be part of the program again it is truly a great opportunity to learn about the engineering field I would like to enter after high school. I will be able to contribute to projects like these in the future with great understanding of what I'm doing because this is after all our schools second year of working on such a project. I love this project and in the near future I hope it gets me where I want to go in life, thus launching me on my career path.

Name: Jake (Student Safety Officer)

Age: 18

Grade: 12

Position: Head Safety Officer and E-Bay Worker

I became a "Rocket Scientist" in 4th Grade by joining Envirothon. I have been doing Envirothon ever since then and was the captain of the team last year. Also last year I became a member of our Science Olympiad team, TARC team, and High powered rocketry team. In Science Olympiad we won the regional competition and advanced to the state competition. My TARC team qualified for Nationals and competed against 100 teams around the nation. Our high powered rocketry team launched a 38lb, 6in diameter rocket to an apogee of 5955 feet. All of these rocketry experiences have helped me develop my teamwork skills as well as learn many key concepts of engineering.

Name(s): Sarah H. and Sarah E. (Educational Engagement)

Age: 17

Grade: 12

Hoffman (Right): This is my first year participating in both Student Launch (SL) and Team America Rocketry Challenge (TARC). I am involved in other school activities including National Honor Society, the German-American Partnership Program, Spring Grove Choral Ensembles, Expressions, and Globetrekkors. My out-of-school activities include Midstate Ballet, Greater York Dance, and National Honor Society for Dace Arts. I dance pre-professionally over 20 hours a week. I got involved with the rocketry program because I loved physics class and I wanted to explore the engineering field before deciding on a college major. Math was always my favorite subject in school because it is black and white. The answer is either right or wrong; it is simple and precise. I think my involvement in SL and TARC will allow me to utilize my math skills, apply them to my life, and have fun in the process.

Eckersley(Left): As a student of Spring Grove Area High School, I have been involved in many extracurricular activities such as Student Launch Program, Team America Rocketry Challenge, Choir, Drama Club, International Thespian Society, National Honor Society, Administrative Technology Teaching, Symphonic Band, as well as dance outside of school. I had recently joined the SL program this year after joining TARC the previous year and making it to nationals with my team. In TARC, I am the team captain of an all girl team and I am the only girl involved in this year's Administrative technology Teaching. After school I plan on attending college majoring in Biology and following a pre-medical route.

Name: Gavin (Safety and Payload)

Age: 16

Grade: 11

Throughout my school career I was always interested in the sciences. It wasn't until 10th grade when my Physics teacher introduced the rocket programs at our school. I started my 10th grade year and I was quick to join again this year and take it to the next step by joining the SL team. My first year in TARC, Team America Rocketry Challenge, we made it to nationals and finished highest out of all the teams from our school. That year got me interested in all the science related clubs and activities and hope to expand my horizons even more this year.Other than SL and TARC, I'm on the soccer team which takes up a lot of my time in the fall season. I'm really looking forward to the opportunity to be on the Spring Grove SL team.

Facilities and Equipment

Description of Facilities/Personnel/Equipment/Supplies

a. Spring Grove High School:
b. Hours: Monday through Friday 7:25 A.M. until 2:30 P.M. and after school upon instructor availability.
    i. Room 135:
        1. Gravograph LS100 30W laser
        2. Structural Stress Analyzer 100
        3. Computers with Microsoft Office and Solidworks
    ii. Room 130
        1. AXYZ Automation INnc 2.2kW 18kRPM TypeB 12-2 CNC Router
        2. Compound Dewalt miter saw
        3. Framarbandsaw
        4. 24” Planer
        5. Paasche FABSF-6 spray booth
        6. Belt sander
        7. Drill press
        8. Oliver table saw
        9. Orbital sander
    iii. Room 131
        1. Lab Volt 5400 CNC Mill
        2. Lab Volt Automation 5500-B0 CNC Lathe
        3. EMCO Concept Mill
        4. General Model 480 Jointer
        5. Jet Benchtop drum sander
        6. Victor Metal Lathes
        7. Tennsmith sheet metal cutter
        8. Miller Spot Welder
        9. Baldor Grinder/buffer
    iv. Room 220
        1. Computers with Rocksim9 and Logger Pro
        2. Labquests
        3. Drill press
        4. Belt sander
        5. Reciprocating saw
        6. Circular saw
        7. Cordless drill
    v. Room 242
        1. Storage and workspace
    vi. Room 221
        1. Fume hoods
        2. Laptop cart with 28 IBM Thinkpads

c. Launch site: MDRA Launch field requires an MDRA member for supervision whenever one is free to supervise
d. Materials/Supplies
    i. There is an abundance of supplies in Room 220
    ii. All other needed supplies will be ordered at the appropriate time

2. Description of Computer Equipment/WebEx required supplies
    a. Conference rooms 50 and 51
        i. Laptop computers
        ii. USB web camera
        iii. Cisco speakerphone
        iv. School network connection

WebEx/connectivity Instructor Contact Information:
Instructional Technology Specialist: Mr.Sengia
Email: Sengiaj@sgasd.org
Phone number: (717)-225-4731 ext.7060

3. The Spring Grove SL Team will implement the Architectural and Transportation Barriers Compliance Board Electronic and Information Technology (EIT) Accessibility Standards (36 CFR Part 1194) Subpart B- Technical Standards 1194.21 (a-l), 1194.22 (a-p), and 1194.26 (a-d).http://ecfr.gpoaccess.gov/cgi/t/text/textidx?c=ecfr&tpl=/ecfrbrowse/Title36/36cfr1194_main_02.tpl

Facilities Available to All Students:

In room 220, Mr. Hastings' room, we can work and plan most of our project. It has numerous computers with Logger Pro and Rocksim 9. There is also a drill press, belt sander, and multiple VernierLabQuests. We have original labquests and have a few new LabQuest 2's. In the room there is also a Craftsman reciprocating saw, a circular saw and cordless drill.

*This room as mentioned above will be our main home for working on the rocket, its construction, and writing of the many papers we must write. Mr. Hastings, as our main mentor, is willing to stay after many late nights to help us work on the project.

Safety

Equipment Safety

Framar Band Saw

Before operating the band 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 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 to the right of the machine, because if the blade breaks, an injury may occur. 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 break 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. Also make sure 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 your eyes are covered by safety glasses. 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 working properly 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 so that the table can be replaced. Wait for the blade to stop before leaving the machine. If an should injury occur 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 sawdust 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 kick back 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 sawdust 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 run the risk of coming 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 sand paper 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 could become caught in the bit. Also, obtain instructor permission before using the drills and ensure that safety glasses are covering your eyes. Replace the bit while the power is off, installing the bit properly and making 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 clamped securely and drill with even pressure. Never carry any corded tool by the power cord. If injury occurs during usage of the electric drills, turn off the drill, 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.

Powermatic Drill Press

Before operating the drill press, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the bit or machine. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Replace the bit while the power is off, installing the bit properly and making sure the chuck is tightened and the chuck key is taken out. Firmly secure the material that you are drilling with vices or clamps. Adjust the table to avoid drilling into it and pick the correct size bit that is properly sharpened. If the drill becomes stuck turn off the machine and inform an instructor. Select the proper speed for the material. If an injury occurs during usage of the drill press, 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.

CNC 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 bit or machine. Also, obtain an

instructor's permission to use the router and ensure that safety glasses are covering your eyes. Turn on the sawdust collection system. Make all adjustments while machine is off. Materials must be firmly secured before the project is run through the router. A person needs to be with the machine during the entire operation. Check to make sure that the spindle rotation, speed, and depth of cut are all correct before starting the machine. Only clean the machine while it is off and make sure that all set up tools are cleared from the table. If an injury occurs during usage, 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.

Oliver Table Saw

Before operating the table saw, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in blade. Also, obtain an instructor's permission to use the table saw and ensure that safety glasses are covering your eyes. Turn on the sawdust collection system. Make all adjustments to the blade or guide 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. The miter gauge it for cross cutting and the fence is for ripping. Use extra caution while using a dado cutting head. Always use a push stick when your hand could come close to the blade and have another person at the other end of the table to catch the material that was just cut. Do not leave the table until the blade stops. If an injury occurs during usage of the table 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.

Powermatic Belt Sander

Before operating the belt sander, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in machine. Also, obtain an instructor's permission before using the machine and ensure that safety glasses are covering your eyes. Make all adjustments while the machine is off. Check that there is adequate tension in the belt and that it is not torn before turning on the machine. Keep the material on the table at all times. Keep fingers away from the sand paper. If an injury occurs during the usage of the sander, turn off the machine, inform an instructor of the injury. The instructor will then have any students in the room go out into the hallway. This will ensure that the students do not interfere with the injured person, instructors, or medical personnel that will be helping the student.

Powermatic Disc Sander

Before operating the disc 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 before using the sander 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 the material on the table at all times. Keep fingers away from the sand paper. If an injury should occur during usage, 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.

Powermatic Drum Sander

Before operating the drum 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 before using the sander and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Use the proper drum for the radius that is being sanded. Keep the material that you are sanding on the table at all times. Keep fingers away from the sand paper. If an injury occurs during usage, 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.

Craftsman Reciprocating Saw

Before operating the reciprocating 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 before using the saw and ensure that safety glasses are covering your eyes. Make all changes with the power off and the plug disconnected from its power supply. Firmly secure all material to a work bench or table. Allow the motor to reach its full speed before cutting through the material. Hold the saw with both hands while you are using it. If an injury occurs during usage, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the room sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Craftsman Circular Saw

Before operating the circular 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 before using the saw and ensure that safety glasses are covering your eyes. Make all changes with the power off and the plug disconnected from its power supply. Firmly secure all material to a work bench or table. Before cutting, ensure that the cut line is not above the table. At least one person must be holding the material being cut off, as long as that piece is large enough for a person to hold it. Allow the motor to reach its full speed before cutting through the material. Hold the saw with both hands while using it. If an injury occurs during usage, 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.

CNC Lathe (EMCO Concept Mill 55, Lab Volt 5400 CNC Mill, a Lab voltAutomation 5500-Bo)

Before operating the lathe, remove all jewelry, confine long hair, and remove or roll up long sleeves along with any article of clothing that could become caught in the bit. Also, obtain an

instructor's permission before using the lathe and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. The material that you intend on cutting must be firmly secured before the project is run through the lathe. A person needs to be with the machine during the entire operation. Check to make sure that the spindle rotation, speed, and depth of cut are all correct before starting the machine. Only clean the machine while it is off .If an injury occurs during the usage of the lathe, 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.

Victor metal lathes

Before operating the lathes, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the work. Also, obtain an instructor's permission before using the lathe 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 of the material to a machine. Use the proper speed for the task at hand. Use the correct, sharpened tools. If an injury occurs during usage, 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.

Paasche FABSF-6 spray booth

Before using the spray booth, turn on the ventilation system and wear proper protection. Use the correct spray for the material and do not inhale toxic fumes. If an injury occurs during usage, 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.

Miller Spot Welder

Before operating the welder, put on proper clothing, welding mask, gloves, and apron. Obtain an instructor's permission before using the welder. Do not look at the welding torch unless you are wearing a welding mask. Ensure that the proper solder is being used and that the materials are secured. If an injury occurs during usage, 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.

Baldor grinder/buffers

Before using the grinder and buffers, put on safety glasses, check that the spark shield is intact, and obtain an instructor's permission to use it. Keep hands away from the spinning wheel. Adjust the tool rest to the proper height and always use it. If an injury occurs during its usage,

turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside I the hallway to avoid being in the way of instructors and medical personnel helping the student.

Tennsmith Sheet metal cutter

Before operating the sheet metal cutter, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the cutter. Also, obtain an instructor's permission before using the cutter and ensure that safety glasses are covering your eyes. Do not attempt to cut any material thicker than what the machine is rated for. Make sure that the material and blade are free from debris. If an injury occurs during usage, inform 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.

Gravograph LS100 30 watt laser/engraver/cutter

Before operating the laser, ensure that the laser is focused, the vent fan is on, and the right speed and power are selected for the material you intended on cutting or engraving. Obtain an instructor's permission before using the laser. Never look directly into the laser. Stay at the laser throughout the entire process. If the machine cuts an area that you didn't want cut or malfunctions, turn off the machine and alert an instructor immediately. If an injury occurs during usage of the laser, 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.

1. Safety Plan:

Before any work is done on the rocket, a second mandatory safety meeting will take place to re-inform students of the NAR safety code. When handling potentially hazardous materials, students will be required to read the Materials Safety Data Sheet (MSDS) on the hazardous material. This will be done before they can work with the material. Team members are to handle the material according to the Materials Safety Data Sheet, including, but not limited to, the handling and storage of the material.

The SL rocket will be constructed in the Spring Grove Area High School. Students will have quick access to the following safety materials: Sellstrom SM Z87+FF Safety Goggles, Splash Aprons, Emergency Eye Wash Stations, Emergency Body Wash Stations, Cantflame Fire Blankets, BFPE type ABC Dry Chemical Fire Extinguishers regularly serviced by Dale E. Ness Inc., and Simplex Fire Alarms. In all rooms where rockets will be assembled and prepared, there are fire detection and suppression systems present. There are also sprinklers in all rooms. We also plan on using nitrile gloves and respirators as the MSDS sheets suggest. These will be used for the handling of potentially hazardous materials.

We have appointed a construction safety officer who is required to certify that all materials and building procedures are in conformance with the NAR High Power Rocketry Safety codes. This construction safety officer has also been appointed as our range safety officer. He will also

certify that the launch facility, rocket engine components, and environmental conditions are within safety regulation requirements. Our Safety Officer will be Robert DeHate. Mr. DeHate will be responsible for the safety and handling of the rocket motors. He is also responsible for the safety of all of the Spring Grove SL participants while he is handling a motor. In addition, he will oversee the construction of the project and will ensure that the Safety Plan is being followed throughout the entire project. Mr. DeHate is NAR Level 3 certified. Therefore, he will also be responsible for the ordering and storage of our rocket motors. Our student safety officer will be Jacob Guinn. He will oversee and make sure there is an emphasis on safety during construction, assembly, and launching of the rocket.

We will incorporate safety as an integral part of the design. The rocket will also be safely inspected and checked throughout the construction. The student safety officer will emphasize safety throughout the entire construction. In addition to the safety plan, we will be following the NAR High Power Safety Code guidelines as outlined below:

Risks	Probability of Risk *(1-10)	Impact on Project Progress	Mitigations
The payload may get lodged in rocket 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 properly installed.
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 the ground material to prevent flame up.
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 aware of limbs and fingers when using this tool.
Injury could occur during Exacto knife	5	A small injury could occur, possibly	The team will carry the knife in cautious

usage.		delaying the rocket-building progress.	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, open flame, and the indoor magazine.
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.
Electrocution during electrical outlet usage	1	Minor or severe injury could occur.	The team will only use electrical outlets if hands are dry and static free. The team will keep fingers away from prongs.
Adhesion to materials or self	4	Minor injury and very minor delay of rocket progress could occur.	The team will exercise proper caution when handling adhesive material and will not use too much of the material.
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 the walking path is 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 personal 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.
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 a 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 body tube that is used and double-check that the components of the payload are properly wired and attached.
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 advanced. 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	3	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	2	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, and be aware of surroundings.
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.

*Probability is rated on a scale of 1 to 10, where 1 represents a low probability that the risk will present a problem and a 10 represents a very high probability that the risk will present a problem. Risks that are rated at ten or close to ten will be dealt with as soon as possible and handled according to the mitigation and/ the best way to handle the problem.

2. Procedures for NAR/TRA Personnel to Perform:

Robert DeHate is our Level III NAR mentor as well as our safety officer. He will be certifying that the rocket motors that we are using are certified and safe for launch. He will also be ensuring that the engine reload kits are certified and safe for us to use. Mr. DeHate will also be overseeing the construction of the rocket to ensure that the rocket will only be constructed out of light-weight materials such as paper, wood, rubber, plastic, fiberglass, or, if necessary, ductile metal. He will visit occasionally to inform team members about better construction methods and how to build safely.

Mr. DeHate will verify that the rocket engines and engine reload kits are not broken upon delivery. He will also store the engines and reload kits in a locked Type 4 magazine that meets the requirements of NFPA 1127. He will verify that no sources of fire or heat are within 15 feet of the locker and 25 feet of the rocket motors when they are being used. Mr. DeHate will keep an inventory of the engines and reload kits and an adult supervisor will also ensure the completion of the above steps by the safety officer.

Mr. DeHate will be responsible for controlling the inventory of all engines and rocket motor reload kits. When ready for use, he will also update the inventory of the rocket motors and reload kits to ensure that there are no missing supplies. Engines and reload kits that are not used for flight, but have been checked out for use, will be returned to Mr. DeHate and accounted for in the inventory. Engines and reload kits will be documented with the launch location for that particular motor or reload kit, the date and time it was used in a flight, and the number of the flight. Mr. DeHate will also be ensuring that safety equipment for hazardous materials and handling procedures for hazardous materials are being followed based on the Materials Safety Data Sheets for those materials.

3. Plan for Briefing Students:

Students will be required to participate in an introductory meeting, including reading of the NAR High Power Rocketry Safety Code to all members of the team. Team members shall also be required to attend more meetings covering the safety codes of the NFPA and FFA. During the meetings, NAR High Power Rocketry Safety Code shall be reviewed again. Examples from past experience will be used to put the discussions in perspective. Materials will be shown to all team members and they will be told of the hazards of the materials before they are able to use them.

Meetings will be held prior to launches as well. In these meetings, safety codes will be reviewed, team members will be made aware of the hazardous equipment, and team members will be informed of how to avoid other accidents. Team members will be informed on what safety equipment to use while using hazardous materials.

4. Methods for Including Necessary Caution Statements:

In order to ensure that cautionary statements are included in plans, procedures, and other working documents, we plan to post warning signs on the entrances of the room in which the indoor magazine will be placed. Cautionary statements will be placed on the entrance of room 220 to ensure that participants are aware that hazardous materials are being stored in the vicinity as well. To ensure hazardous adhesives and accelerants are handled with care, warnings will be posted on the door of the cabinet where they are stored to notify users of the risks involved with these materials. We plan on posting the Materials Safety Data Sheet for the motors being used outside of the room in which it will be stored for team members to read before entering the room. In the planned documents we also plan to include detailed plans of our safety plan and any other plans to keep everyone safe such as securing the launch site and reading all postings' on machines and launch fields. During construction and assembly of rocket team members will be required to use Personal Protective Equipment. Team members will be required to wear Sellstrom SM Z87+FF Safety Goggles during construction. The will also be informed at safety meetings on how to use emergency eyewash eyewash and ABC Dry Chemical Fire Extinguishers. When handling hazardous materials team members will use nitrile gloves.

5. Plan for Complying with Laws:

In order to comply with federal, state, and local laws regarding unmanned rocket launches and motor handling, the Spring Grove SL team shall launch its rocket so that it stays in a suborbital trajectory. The team shall also launch the rocket so that it does not cross into the territory of a foreign country, and the rocket shall be unmanned. The rocket shall be launched in a manner that does not create a hazard for any persons, property, or other aircraft. The team rocket shall also be subject to any additional operating limitations necessary to ensure that air traffic is not adversely affected, and to ensure that public safety is not jeopardized.

To ensure further compliance with FAA regulations, the team shall also avoid launching the rocket at any altitude where clouds or other obscuring phenomena of more than five-tenths coverage prevail. This shall include not launching the rocket at any altitude where the horizontal visibility is less than five miles and not launching the rocket into any cloud. The rocket shall not be launched between sunset and sunrise without prior authorization from the FAA and will not be launched within 9.26 kilometers of any airport boundary without prior authorization from the FAA. The team shall not launch the rocket in controlled airspace.

The Class 2 rocket shall not be launched unless the team observes that there are appropriate separation distances between the launch site and any person or property that is not associated with the operations. The separation should not be less than one-quarter the maximum expected altitude or 457 meters (1,500 ft.), unless a person of at least eighteen years old is present and is charged with ensuring the safety of the operation, and has final approval from authority for initiating high-power rocket flight and unless reasonable precautions are provided to report and control a fire caused by rocket activities.

The Spring Grove SL team shall give the FAA and ATC facility nearest to the place of intended operation the following information no less than 24 hours before and no more than three days before beginning the operation:

a) The name and address of the event launch coordinator, whose duties include coordination of the required launch data estimates and coordinating the launch event;

b) Date and time the activity will begin;

c) Radius of the affected area on the ground in nautical miles;

d) Location of the center of the affected area in latitude and longitudinal coordinates;

e) Highest affected altitude;

f) Duration of the activity;

g) Any other pertinent information requested by the ATC facility.

The Spring Grove SL team shall also research state and local laws regarding rocketry in order to ensure compliance with all laws associated with rocketry in the vicinity of the rocket launch site. The team shall also be in compliance with all rules and regulations regarding rocket launch sites, rocket motor storage, and rocket launch safety described in NFPA 1127.

6. Plan for Motor Handling and Storage:

Rocket motors will be purchased through our NAR level II certified representative, Robert DeHate. All motors will be stored within a Type 4 magazine and access will be granted solely to our NAR representative. Mr. DeHate will be responsible for the safe transportation and construction of the rocket motor reloads. Any use of the motor will be under his supervision at all times.

7. Team Agreements: All team members read and signed a copy of the agreement below.

Spring Grove SL Team Agreements:
As a team member:
1. I agree to comply with all applicable local, federal and state laws.

2. I agree to use of airspace laws of Federal Aviation Regulations 14 CFR, Subchapter F, Part 101, Subpart C.

3. I agree to handle and use low explosives according to the Code of Federal Regulation 27 Part 55: Commerce in Explosives.
25

4. I also agree to follow all fire safety regulations according to NFPA 1127 “Code for High Power Rocket Motors.”

5. I will follow the NAR High Power Rocketry Safety Code.

6. I agree to read the Material Safety Data Sheet and follow all of its instructions. I will be aware of the hazards that are involved with the materials that we are using in our project. This includes, but is not limited to, the rocket motor.

7. I will use safety equipment in accordance to its safety regulations during the construction of the rocket.

8. I will obey all instructions given by the project manager and supervisors.

9. I agree to work with my team members in a constructive manner in order to make a safe environment for all team members to work together.

10. I am committed to working on this team until the completion of our project.

11. As a team member, I promise to show up to 75 percent or more of all meetings and do my work when I am assigned and do my work to the best of your own ability.

As a team:
A. We agree that there will be range safety inspections for each of our rockets before they are flown. Upon inspection, we will comply with the determination of the safety inspection.

B. We agree that The Range Safety Officer has the final say on all rocket safety issues. Therefore, The Range Safety Officer has the right to deny the launch of any of our rockets for safety reasons.

C. We agree that if our team that does not comply with the safety requirements we will not be able to launch our rocket.

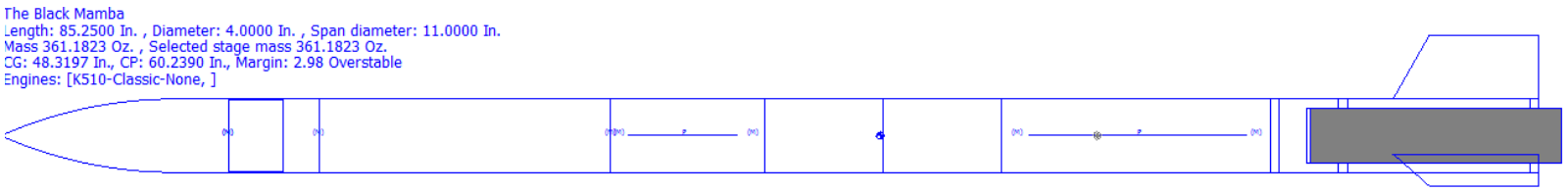
I agree to the Spring Grove SL Team Agreements above. I understand that any violation of these rules will result in consequences including getting taken off the team.
Name: _____ Signature: _____ Date:_____

Technical Design

Proposed rocket and Payload Design

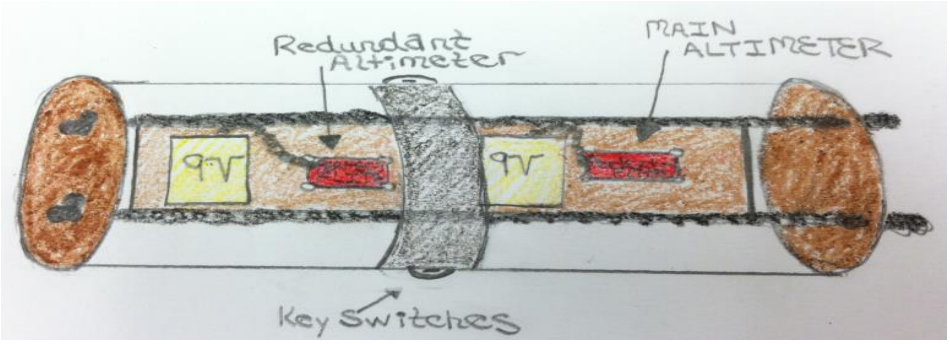
A) Vehicle Dimensions, Material Selection, and Construction Methods

The rocket is planned to be 85.25 inches in length. The planned mass of the rocket will be 361.18 ounces, with the engine loaded in it. The margin of the rocket is 2.98 cal. This is calculated by the rocket design program, Rocksim. In the program, the stability margin is a bit over stable, but sample calculations with added epoxy and hardware masses in the rear of the rocket have shown a decrease in the stability margin to 2.79 cal, within the stable limit, making it a stable rocket. The rocket has three fins that are 120 degrees from each other each with a trapezoidal design that stretches 8 inches long by 3.5 inches tall with an 8.25 inch diagonal creating a surface area of 20 square inches. There are two PML body tubes. The top tube is 35.25 inches long and the bottom tube is 35.25 inches long. In between the two pieces will be a small 2.0 inch ring that is part of the electronics bay which will have the key switches on it.



We plan on buying our Body Tubes from Public Missiles Ltd. The part number for this tube is FGPT-3.9. This tube is a typical resin impregnated spiral wrapped and heat cured tube. This tube is a very strong tube; making it much stronger than cardboard. This tube is also wrapped in fiberglass. By wrapping the body tube in fiber glass, it makes the tube even stronger than a normal PML tube. The fiberglass covered tube can also withstand and resist more heat. The body tube's inner diameter is 3.9 inches. The Public Missiles Ltd. body tube was also chosen because it can withstand high velocities. This tube requires little preparation for a launch. By purchasing our tubes from Public Missiles Limited, the fiberglass reinforced body tubing will help prevent zippering when the parachute is deployed. Zippering is when the rocket is going too fast, and as a result the shock cord cuts through the body tube. The shock cord will also be long enough to help prevent zippering at ejection. The fins shall be constructed from .1875 inch G10 FR4 fiberglass. The fiberglass is fire retardant and an electrical-grade. It is a dielectric fiberglass laminate epoxy resin sheet combined with a glass fabric substrate. The G10 FR4 sheets were selected because of their high impact, mechanical, fiberglass bond strength at high temperatures, and their resistance to the heat energy by our motor. These fins will brace the impact to the ground and keep the back end held together during landing. With this high strength fiberglass we should not have to worry about trying to replace fins if the rocket lands on a hard surface. We shall also be using West System 105 Epoxy Resin and 205 Quick Hardener to join parts of the rocket. West Systems Epoxy was chosen because of its superior bond strength and because of its relatively low fume output. It was also chosen because West System's is low odor and provides a strong bond. As for the altimeter, we plan on using a PerfectFlite*Stratologger* altimeter. It is also affordable for this project. This altimeter can handle

up to two pyrotechnic outputs, measures acceleration and also has barometric sensors. Inside of the electronics' bay there will be two of these altimeters' on which one will be our main altimeter and the other on will be our redundant altimeter. If the first charges fail to go off for some reason, the second altimeter will be delayed up to 4 seconds after the first so that we make sure the parts are blown apart.



The nose cone is from Mad Cow Rocketry and it is their 4" Plastic Short Ogive Nose Cone. This is the perfect nose-cone as it's' weight is only 6.5 ounces compared to some 13 ounces on longer nosecones. The nose cone is 9.5 inches in length. The rocket shall be constructed only under the supervision of an adult advisor, and when needed a Range Safety Officer (ROC) or the Team Mentor. Rocket parts shall be handled accordingly to their Materials Safety Data Sheets. This will ensure that any potentially hazardous materials are used correctly and safely. For mounting the fins we plan on 3-D printing high tensile strength plastic brackets that connect the fin to the body tube. These connectors will be made to the exact curvature of the rocket so that a precise tight fit is secured. These brackets will be pre-made with holes for small bolts and then connected on one side to the body tube and one side to the fin. This small change will allow us to save added mass from plentiful amounts of epoxy on the body tube. This will also eliminate the added mass from the fins as they will not have to go through the body tube and connect to the motor mount. They will only be connected on the outside of the tube, allowing for easier transport and movement as the fins can be removed. The bracket system, used previously by some USLI teams, was also chosen due to the lack of space between the 2.95in motor tube and main body tube for the 6 normal fillets for through-the-wall fins.

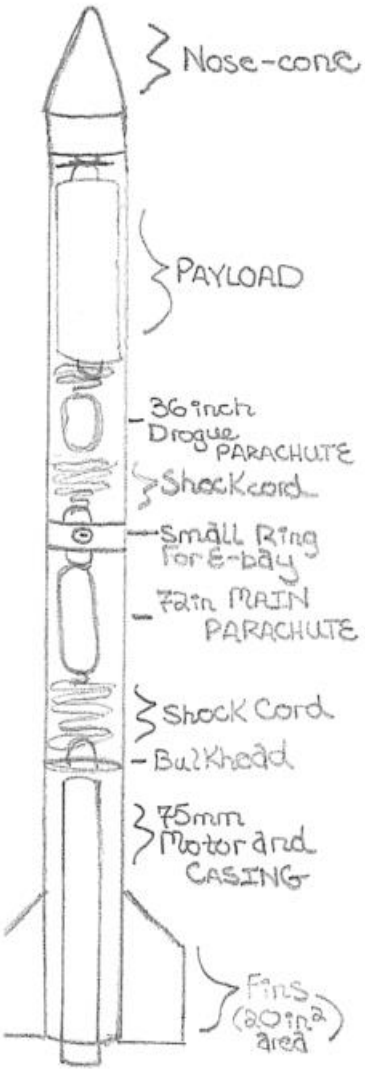
The rocket components shall either be secured or placed within the rocket so that minimal to no shifting occurs during the flight. The shock cords will be fastened within the rocket so that each component of the rocket is connected in series. The shock cord will be connected to stainless steel quick links and then the quick links will be tied to U-bolts on numerous bulkheads. This will provide a strong connection between the shock cords and the parachutes as their will there will be a large force upward on the parachute. This large force is due to the coefficient of friction that the parachutes are made with of **2.2.** Our parachutes we plan on using are the Iris Ultra Parachutes made by Fruity Chutes. These parachutes were selected for being strong, durable, and made to withstand high pressures and forces. They also provide more drag for their size compared to common hemispherical parachutes. We plan to prevent the high

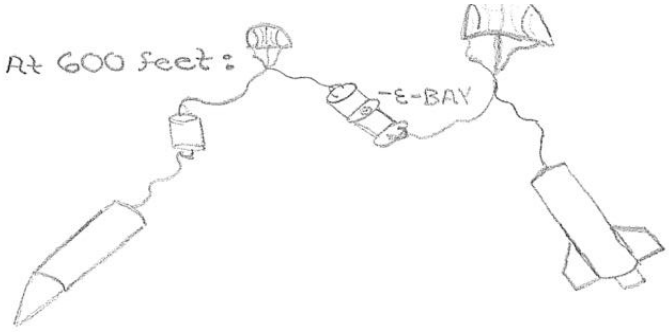
acceleration during ejection from affecting the components of the rocket by testing and selecting the proper ejection charge size for our rocket. A coupler shall be installed so that it is long enough to provide enough friction to keep the rocket body tubes together and stable during flight, but loose enough to allow the departure of the electronics bay and bottom tube at apogee. Between the top and bottom tube there is the deployment.

B. Altitude

The Cesaroni K510 Classic rocket motor should deliver 2486 Newton-seconds of impulse. With this motor, our calculated point of apogee was planned to be 6,046 feet. With our weight this should be the motor of choice for us as **we planned in the design on an increase in weight of the rocket by 15%, due to added supports, epoxy weight, and clay weight.** Given this weight increase, our projected 6046 feet height drops to 5,140 feet, just under the target.

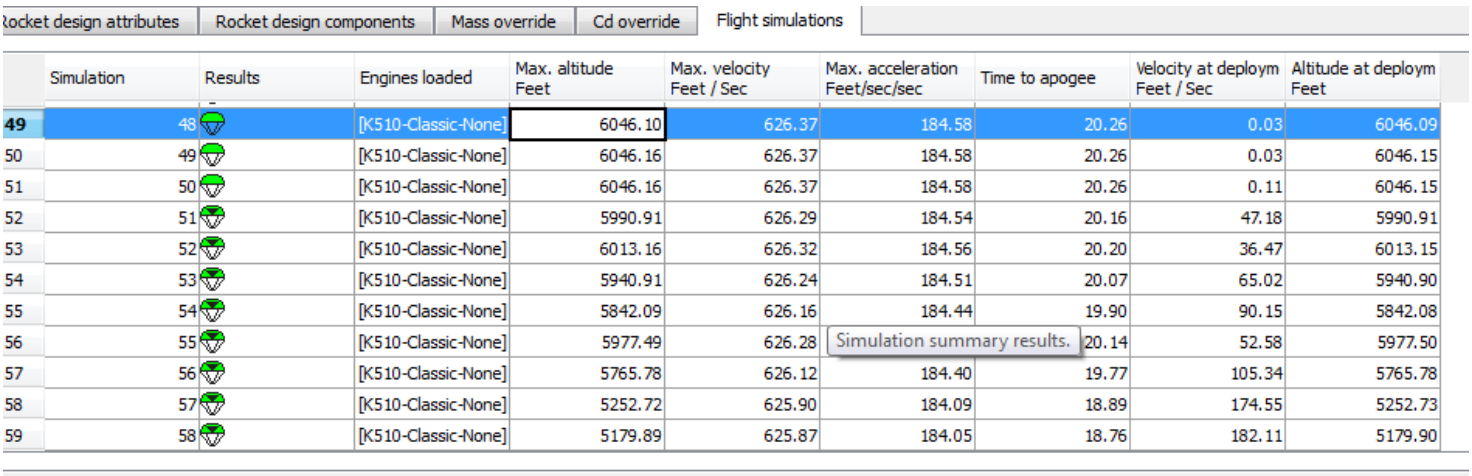
C. Recovery System





The recovery system for the launch vehicle shall employ a dual-deployment system, with a drogue chute deployed at apogee and a main chute deployed around 600feet. The drogue chute is proposed to be a 36 inch parachute that will slow the rate of acceleration from apogee to deployment of the main chute. We plan on using a 72 inch diameter main chute from Fruity Chutes. This will ensure to slow the descent of the rocket to a ground hit velocity of approximately 17.6 ft/s. The deployment of the parachutes will be deployed with the help of a PerfectFlite altimeter. This altimeter measures acceleration and barometric

pressure. The altimeter will be connected to an ejection charge system through two pyrotechnic outputs. There will also be an arming switch within the rocket for the pyrotechnic charges. The arming system will be accessible from the outside of the rocket airframe. The altimeter and other recovery system components run electrically, and will be able to function properly for one hour after arming the device. It won't receive interference from any other rocket component, including the payload. At apogee there will be an ejection charge for the drogue chute from the first altimeter. After a delay of about 4 seconds, the redundant altimeter will put off a similar charge just in case the first one did not fully separate the rocket. As the rocket slows on its descent, at about 600 feet above ground level, the main ejection charge will go off, releasing the main parachute from the back half. This will separate the rocket into three parts, the front half, the electronics bay, and the back half with both parachutes deployed as well as the payload as apogee.



Rocket design attributes | Rocket design components | Mass override | Cd override | Flight simulations

	Simulation	Results	Engines loaded	Max. altitude Feet	Max. velocity Feet / Sec	Max. acceleration Feet/sec/sec	Time to apogee	Velocity at deploym Feet / Sec	Altitude at deploym Feet
49	48		[K510-Classic-None]	6046.10	626.37	184.58	20.26	0.03	6046.09
50	49		[K510-Classic-None]	6046.16	626.37	184.58	20.26	0.03	6046.15
51	50		[K510-Classic-None]	6046.16	626.37	184.58	20.26	0.11	6046.15
52	51		[K510-Classic-None]	5990.91	626.29	184.54	20.16	47.18	5990.91
53	52		[K510-Classic-None]	6013.16	626.32	184.56	20.20	36.47	6013.15
54	53		[K510-Classic-None]	5940.91	626.24	184.51	20.07	65.02	5940.90
55	54		[K510-Classic-None]	5842.09	626.16	184.44	19.90	90.15	5842.08
56	55		[K510-Classic-None]	5977.49	626.28	Simulation summary results.	20.14	52.58	5977.50
57	56		[K510-Classic-None]	5765.78	626.12	184.40	19.77	105.34	5765.78
58	57		[K510-Classic-None]	5252.72	625.90	184.09	18.89	174.55	5252.73
59	58		[K510-Classic-None]	5179.89	625.87	184.05	18.76	182.11	5179.90

According to simulations on Rocksim, the recovery system, even up to speeds at the maximum 25 miles per hour, should allow the rocket to be within a range at landing of three-eighths of a mile, with an average at less than a quarter of a mile. These are exceptional landing sites given the height and length of our rocket.

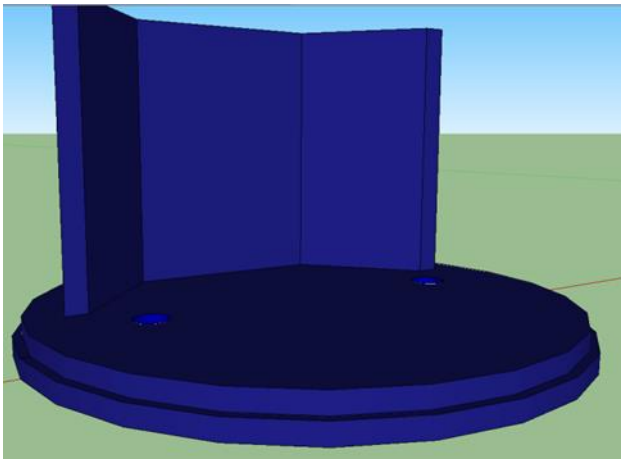
D. Motor Selection

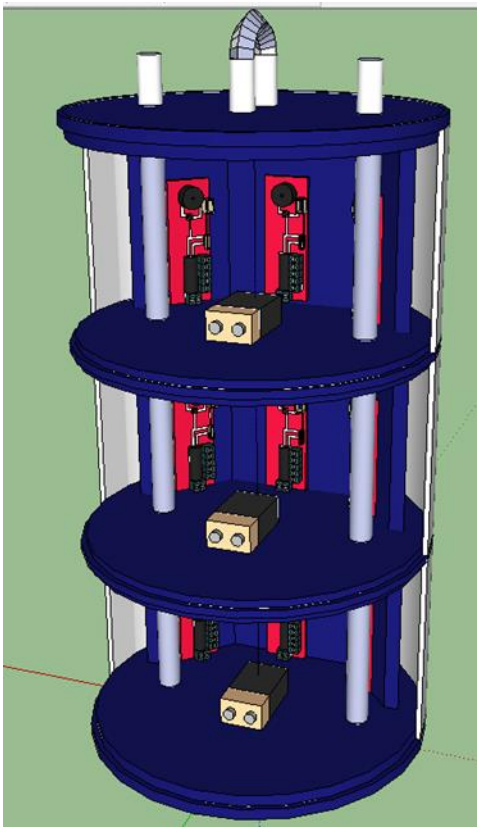
The proposed engine is a Cesaroni Technology Inc. K510 Classic motor that is 2.95in in diameter and 13.78 inches in length. The Cesaroni motor was selected because Cesaroni is a reliable rocket motor supply company. The K510 motor provides the proper impulse to propel the rocket a mile high. The Cesaroni K510 Classic rocket motor should deliver 2486 Newton-seconds of impulse. Cesaroni motors are also affordable with our given budget. With our weight this should be the motor of choice for us as we planned in the design on an increase in weight of the rocket by 10%. Given this weight increase, our projected 6046 feet height drops to 5,290 feet, just near the target. As a back-up motor, we plan on using the K-661 Blue Streak Motor with 2,430 NS of impulse which should also be in our selected range if we want to try a different motor for testing. The projected height in RockSim is also normally a bit high, so it was

important to design a rocket that is simulated in RockSim to reach a height a bit higher than the planned 5280ft.

E. Payload

The payload will test the variance and effect of hole size on Perfectflite Stratologger altimeters. The payload will fit inside the body tube, directly below the nose cone. The payload will be 13 inches long, and the exterior will be a 3.78 inch phenolic coupler tube. The payload will be split into three sections, each divided by a bulkhead. Within each section will be three Stratologgers and one 9 volt battery. A U-bolt will be attached to the lowest bulkhead, which will be attached to the drogue parachute to be deployed at apogee. The payload will be completely sealed until it is ejected, at which point it will take data. The payload will have four half-inch bulkheads, which will be 3D printed with holes for the all thread precut. The bulkheads will have lips, so that the coupler tube will slide into the lips. The awl thread will run through the entire payload, making the disassembly of the payload easier. The awl thread will screw on both ends, tightening the fit and keeping all parts in place. This, along with the prefabrication of the lips, should create a sealed container for the altimeters to function correctly. The payload will be split into three separate sections, each of which will contain one 9 volt battery and three altimeters. These altimeters will be fastened onto “walls”, which are 3D printed onto the bulkheads. The altimeters in each section will be wired in parallel to one of three 9 volt batteries, one battery in each section. This arrangement will be ground tested to ensure that each altimeter receives the proper current from the battery. The 9 volt battery will be fastened to a bulkhead by a 3D printed “case”, which will secure it to the bulkhead while providing space for the altimeters to be wired to the battery.





Each section will be identical, except for the size of the port holes. Perfectflite recommends a single port hole size of .0914” for a coupler tube (diameter of 3.78”) and a length of four inches. We will use a 3/32” (.0938”) inch hole as our middle “standard” value. We will also test a 5/64” (.0781”) and a 7/64” (.1094”) hole to see how a larger and smaller hole affects both accuracy and variance among the altimeters. The recommended size was found in Perfectflite’s Stratologger manual, which provided an equation for ideal single port size.

Single Port, hole size = Diameter * Diameter * Length * 0.0016

With a 3.78” diameter coupler tube and four inch segments, the calculated diameter is .0914”. The nearest drill bit is 3/32”, the most ideal bit size available to us. Each altimeter will be connected to a 9 volt battery, and after the launch each altimeter will be individually read. This step will be easy, since the payload is easy to break apart.

Part F: Major Requirements

The Spring Grove Area High School Rocket design for the launch vehicle is designed and intended to reach an altitude of 5,280 feet above ground level and not exceed that limit. During the flight, the vehicle is designed and made to remain under mach 1 for the entire flight going up and returning safely back to Earth. This rocket is designed to contain a recovery system and proper components to make the rocket recoverable and reusable. The rocket is also designed to only contain four independent sections all tethered together which is exactly the legal limit. The launch vehicle shall be constructed before reaching a launch site, so that the rocket is capable of being prepared for flight within two hours from the time the FAA flight waiver opens. The rocket is going to contain the proper components needed to keep the rocket in launch-ready configuration for one hour without losing any functionality of any onboard components that are critical to the safety and success of the launch. The launch vehicle shall also contain components which would make it compatible with either an eight foot 1010 or a 1515 rail. The vehicle will also be capable of being launched with a standard 12 volt DC current firing system. It won't need external circuitry or special ground support equipment to initiate its launch. The vehicle will make use of a commercially available solid fuel motor propulsion system which uses an ammonium perchlorate composite propellant approved by the NAR, TRA, and the CAR. The vehicle shall contain no more ballast than 10% of the unballasted vehicle mass. The final rocket design will be flown and recovered in full scale prior to the FRR. The successful flight of the full-scale rocket shall be documented on the flight certification form by a Level 2 or 3 NAR/TRA observer, and then documented in the FRR. After successful completion of the full-scale flight, the rocket and its components will not be altered without the concurrence of the NASA Range Safety Officer (RSO). All of our launch vehicles won't, in any way employ forward canards, forward firing motors, titanium sponges, hybrid motors, or a cluster of motors.

The launch vehicle of Spring Grove Area High School has been designed to deploy two separate recovery systems. The first of those two recovery systems is designed to deploy at apogee and consists of a small, drogue parachute. The secondary recovery system, that deploys at a much lower altitude consist of a larger, main chute. This deployment is necessary to reduce the speed of the falling rocket to a safer landing speed. All sections of the vehicle shall have a kinetic energy less than 75 foot pounds of force. The vehicle has also been designed to land within 2500feet of the launch pad, assuming a 15 miles per hour wind, ensuring the safety of those outside of the 2500foot radius of the launch pad. The recovery system circuits have also been designed to be completely separate from the payload's electrical circuits. The recovery system of the rocket has also been designed to include commercially available altimeters. The altimeter contained within the recovery system has also been designed by the manufacture to be armed from the outside of the rocket airframe with an arming switch. The altimeter shall have a power supply reserved for the use of the altimeter only. The arming switch for the altimeter will also be capable of being locked in the ON position for the entire duration of the launch. The arming switch for the altimeter must be less than six feet above the base of the rocket. The main parachute compartment and the drogue parachute compartment shall also contain removable shear pins. During flight a functional electronic transmitting device is intended to be placed inside the rocket. It will be used to track all of the components of the

rocket. The recovery system electronics have also been incorporated into the rocket design in a way that no other onboard electronic devices adversely affect the recovery system. The recovery system will use low-current, commercially available electric matches to ignite all onboard ejection charges. The electronic ignition system for ejection charges won't use a flashbulb. In addition, a rear ejection parachute design will not be used.

Part G: Technical Challenges and Solutions

Technical Challenge	Solution
The recovery system electronics interfering with the payload electronics.	The payload will be designed so that it won't emit radio or magnetic waves. This will prevent the recovery system from failing.The payload will be separated from the recovery system so that it will not cause inadvertent failure or excitation of the recovery system electronics.
Creating a rocket that won't go over 5280 feet.	Design the rocket to fly one mile high or slightly over under perfect conditions. This is accounted for due to the highly probable case that the rocket will weigh 25 percent more than calculated values. Therefore in experimental launches you will have factors, such as air resistance, that will cause drag.
Designing a rocket that can house a payload and chutes that won't get stuck or tangled during deployment	Design the rocket so that the ejection charges effectively deploy the parachutes and also the payload. Place them in the correct order, or place, in the rocket so that they are successfully deployed.
Designing a protection system for the mass weight.	We will perform many stress tests on the case we are using inside the rocket and perfect the design. The team will also make sure to pack the weight correctly so that it has no tendency to fall off during flight.
Designing an external access to switch connected to the altimeter to ignite the ejection charges	Consult a Level 2 or Level 3 NAR/TRA representative on the procedure needed for the particular ejection system that was chosen. We should have safe access to the switch on the altimeter that ignites the ejection charges. It shouldn't affect the recovery system or the flight of the rocket.

Educational Engagement

In order to spread awareness of all science programs at Spring Grove, we first plan to hold presentations to both our intermediate and middle schools from grades 5 to 8 to inform them of our project, the basics of a rocketry, and how to get involved in the rocketry teams when they reach the high school. We will take extra time to go over extra details about the Student Launch Program and spread awareness of STEM programs. This portion will go over ways to get involved now and in their future, in our high schools' many science clubs and groups, especially Team America Rocketry Challenge and The Student Launch Program. If we present to both schools, over 1,000 children would be involved.

To obtain feedback, we will give small surveys to all children who were involved in our presentations. These surveys will ask how well the presentation was given, how interested the student is in joining a rocket club, and if they are interested in joining our rocketry workshop.

Below is an example of a survey which will be given to students after the presentation on the SL Program. From this survey, we can take the data and look over it to find what we can improve on in our presentation, and also so that we can reach out and contact those students who are interested in the program:

Student Launch Project Survey Form

Date of Presentation- _____.
Grade Level of Student- _____.

(Rate the following Questions on a scale of 1-5) (5-strongly agree, 1-strongly disagree)

Did the presentation make you interested to learn more about rocketry?_____.

During the presentation did you learn new things about rocketry?_____.

After the presentation are you now interested in joining the TARC or SLP team in the future?
_____

Do you know the goal of Spring Grove's SLP team? _____

Do you understand the TARC program? _____

Was the presentation organized around a central theme? _____

Did you understand all of the topics explained by the presenters? _____

Comments:

Another idea is to use kits of small rocket parts donated by Aqua Phoenix, where upon, we would hold a workshop for children to get involved in rocketry. The rocket kits include body tubes, nose cones, and 2 oz. bottles of super glue, bulk heads, motor centering rings, wings, air resistance tubes, sandpaper, motors, ruler, shock cord, twine, solar igniters, bags, and scissors. Every team member of the Student Launch program would lead a small group, where the member will guide the children through the basics of rocket-building. The groups would then launch their small rockets, further spreading rocketry awareness.

Another possibility is to make a Team America Rocketry Challenge group for the middle school. This will allow interested students who are of younger age to work and learn in a safe working environment and express their interests in STEM at a young age.

Along with this we will contact local television stations and newspapers. They would then make short segments on our project, further spreading awareness of our rocketry programs. Along with this we plan to go to home football games to set up a table and spread awareness about our project. This idea allows us to go in many different directions including going to many different events spreading our ideas and lessons. (Not limited to home sports games, museum visits, back-to-school nights, and many others) Through this way and many others', we should be able to spread our word to a younger generation and bring STEM to the forefront in our local community.

Project Plan

1.Timeline and Team Schedule

September 2014

11 Request for Proposal (RFP) is successfully received from NASA

October 2014

6 Electronic copy of completed proposal is delivered to NASA officials

17 Conformation of acceptance of completed proposal

18 – 31 The team will have meetings twice a week to work on PDR documents and presentation.

31 Team has a working website and meetings are occurring frequently

November 2014

3 Safety Briefing for our team

4 Review completed PDR prior to posting on website

5 Preliminary Design Report (PDR) report, presentation slides, and flysheet posted on the team Website by 8:00 a.m. Central Time

6 Practice PDR presentation

7-21 PDR video teleconferences

January 2015

3 Subscale Launch for our team in Price, Maryland

4-16 Team meetings to work on CDR documents and presentation.

16 Critical Design Report (CDR) report, presentation slides, and flysheet posted on the team Website by 8:00 a.m. Central Time

20 Practice CDR presentation.

21-31 CDR video teleconferences

February 2015

1-4 CDR video teleconferences

5-27 Built full scale rocket including payload. Test ejection charges at ground level.

28 Full Scale Launch in Price MD.

March 2015

7 Full Scale Launch in Price MD

8-15 Work on FRR documents and presentation.

16 Flight Readiness Review (FRR) report, presentation slides, and flysheet posted on the team Website by 8:00 a.m. Central Time

17 Practice FRR presentation.

18-27 FRR video teleconferences

April 2015

3 Pack rocket, tools and all parts for Huntsville trip

6 Teams Travel to Huntsville, AL

7 Launch Readiness Review (LRR)

8 LRR and safety briefing

9 Rocket Fair and Tours of MSFC

10 Mini/Maxi MAV Launch day, Banquet

11 Middle/High School Launch Day

12 Backup launch day

29 Post-Launch Assessment Review (PLAR) posted on the Team Website by 8:00 a.m. Central Time

Team Schedule

As far as gatherings go, there will be two types: meetings and sessions. The meetings will be discussions conducted by the Team Captain and Co-Captain with the entire team, including advisor supervision and comments from them. Sessions will only be for team members to allow them to work without advisor help as a team, though an advisor will supervise them. The schedule will include general and formal meetings, briefings, group sessions, bonding sessions, work sessions, and construction sessions.

Meetings

At general meetings, tasks will be assigned and when they need to be completed. These meetings will be informal and short, and will be held prior to the work that is going to be done that day.

Formal meetings will have a formal agenda to discuss everything that needs to be done. This can include progress on certain tasks or problems that have come up throughout the course of the week. Team members and advisors can share their thoughts and discuss them as a team. Team members and advisors can also ask any general questions about the project and discuss them during these formal meetings.

Briefings will be informative meetings consisting of a collective report of all work that has been completed and progress on any unfinished tasks. These will be used to inform the team of any changes to the project's budget, schedule, fundraising, and other changes rather than focusing on what needs to be done.

Sessions

Sessions will be somewhat of a counseling type of meeting. These will be used to address personal problems and challenges that have come up during the completion of the project. Team members may share personal problems that are outside of the project that are affecting their ability to work well, or explain problems that are preventing them from attending meetings. Other team members can then help in completing their part of the project. Since these are only held amongst team members, they can discuss how they feel about something else another team member has done, or if something another has done has upset them in some way in order to resolve the issue. As previously stated, these sessions can be somewhat compared to counseling sessions. They will allow team members to get help in solving personal affairs and dealing with problems within or outside of the project to relieve as much stress as possible. These will help the team understand what is going on with other team members and grow together and help each other. These sessions will be more serious than others, and are largely going to influence the project as we need everyone to be working at their best and cooperatively. Not having this will make the project more stressful not only for those directly having problems, but for the entire team as well.

As part of our effort to make our team grow together and cooperate well, special bonding sessions will be held to improve the bond between team members and advisors. These are designated to helping build relationships outside of the project. We will do various activities such as watching movies about rocketry and aerospace, and other group favorite movies that we can all watch together. As stated earlier, we need to have a friendly atmosphere in our team, and these sessions and activities are crucial to that kind of team development and maintaining a pleasurable experience for all involved.

Work sessions will be used for working on any of the reports needed throughout the project. This will present the opportunity for team members to ask others questions about their part and get clarification if needed. This will also be used as somewhat of a progress check to see what needs to be done and what has already been done. It will also give the chance for the team to work together and assist as needed.

Construction sessions will be used later in the project to actually build the rocket. Team members will be paired up with another to work on building specific parts of the rocket or payload. This will prevent mistakes and accidents from happening. If something were to happen, a partner will be right there to readily help. Construction will also have adult supervision, so partners can inform them immediately if something were to require attention or assistance. Both team members must read any safety rules associated with tools before operating them for their own safety and their partner's. This will also allow for teamwork between members during construction.

Meeting Times, Session Times and Proposed Schedule

Meetings and sessions will be held on several different dates. General meetings will be held every day the team is capable of meeting and work together, typically before work sessions. Formal meetings will be mandatory meetings that will ideally be held once a week from 3:00 p.m. to 5:00 p.m. Briefings will also be mandatory meetings that will ideally be held every Friday from 3:30 p.m. to 4:30 p.m. Group sessions will be held every other week on the day that is most convenient day. Work sessions will be during any of the available times after school. Construction sessions, once that point has been reached, will be held once or twice a week with Friday being our official construction day. Extra days will be assigned as needed to make sure we stay on schedule. Partners must also be present during construction sessions for a team member to be able to do any work on their designated task. These construction sessions will also be under close supervision by an adult so that if anything happens someone will be there to attend to the problem or injury.

2. Budget

Item	Cost
Travel to Huntsville	$6000.00
Food for all trips (8 team members, 2 advisors, 1 NAR Rep.)	$2354.00
Practice Trips to Maryland	$840.00
Lodging in Huntsville	$3600.00
Nose Cone	$19.95
Body Tubes	$399.80
Rocket Mount	$4.99
Fast-Hardener	$43.94
Resin	$84.96

Shock Cords	$47.80
Large Parachute (72 inch)	$188.00
Small Parachute (36 inch)	$113.00
Centering Rings	$55.88
Bulkheads	$70.54
Motor casing (75mm, 2 Grain Casing)	$149.95
Reload 1-K661	$531.80
Reload 2-K510	$265.90
Couplers	$74.00
Motor Mount Tube	$9.95
Engine Retainers	$72.76
U-bolts(8)	$15.84
Quick-Links	$14.88
Altimeters	$1119.03
9-Volt Batteries for E-BAY	$25.46
G-10 Fiberglass for fins	$70.38
Wires	$30.78
All-Threads	$6.40
Key-Switches	$106.68
Subscale Rocket	$500.00
3D Printer Filament	$21.22
Camera	$99.99
9-Volt Battery Holder	$5.60
Total	$16,943.48

3. Funding Plan

In order to receive the necessary funds on order to successfully complete this project our team intends to cover the costs through a combination of fundraisers, donations and sponsors/ grants. All of these actions will be completed and then sent to our financial advisor for approval. Our club will be taking part in fundraisers throughout the year to help finance our endeavor. Current fundraisers that will be taking part will be Nuts About Granola (information is located at http://www.nutsaboutgranola.com/), selling cotton candy at locale sporting events, Bonus Books (information is located at http://www.bonusbook.com/), and we are currently working with two other ideas that are not yet official. Our clubs are currently accepting all donations and bring donation jars to all the events that we are planning to take part in. Our current sponsors are the Spring Grove Education Fund who has donated $5,000, the Engineering Society of York who has donated $1,000 and Advanced Application Design has donated $500. Those are current partners and we have the contact information for 15 other companies and organizations that may be interested in sponsoring our team. Our club will be contacting them after our projects approval. Our current funding total is $5,500

4. Community Support

To publicize our project, our team will contact two local television stations FOX 43 of the FOX Corporation and WGAL 8 in the Susquehanna Valley. We will also contact local radio stations like 107.7 and 105.7. Lastly we will contact local newspapers. We will be sending each of these organizations information about us and asking if they were willing to spread awareness about our club. We will also be using our own SL website to notify the public about the project and to post updates. We plan on making presentations to both our middle school and intermediate school about our project and the clubs offered at our high school. We also intend to create posters to put around our school and local businesses to promote and encourage sponsorship and donations.

5.Sustainability Plan

We intend to keep our SL club together now and into the future through a combination of many plans and elements. We intend to maintain all of our current relationships by send them regular reports, maintain an active dialogue with them and taking their feedback into account. Our current relationships are with several certified NAR members, Advanced Application Design and the Engineering Society of York. Now in keeping 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 but we are willing to accept anyone who wants to join and is willing to put in the work. 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 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. This will all ensure that our club is maintained well into the future. We also plan to:

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

- 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.
- 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.
- 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.