SGASD

Spring Grove Rocket Scientists

Team Tesla -2016 SLI Proposal

Spring Grove Area High School, Spring Grove, PA

9/11/2015

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General Information

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1. School Information

Name: *Spring Grove Area High School*

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

Name of Team:

2. Adult Educators:

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

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

- Renee Bosak

  Biology teacher, Rocket Scientist Club Coach

  Phone number: (717) 225-4731 ext. 7242

  Email: BosakR@sgasd.org

3. Safety Officer:

- Brian Hastings

  Level two NAR Representative

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

  NAR 96571 SR

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

5. Key Managers:

- Brian Hastings- Advisor and Supervisor of students
- Renee Bosak- Advisor and Supervisor of students
- Mr. Sengia- Instructional Technology Specialist

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

Team Members

Name: Brian Hastings

Position: Physics Instructor and Head Coach

I have been a teacher at Spring Grove for 20 years, teaching Physics 1, AP Physics 1 , and AP Physics 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 (CTY) program. As a Rocket Scientists' coach, I have started a Science Olympiad team, a Vex Robotics Team, Physics Olympics Team, a Team America Rocketry Challenge Team and a high powered rocketry team. The Science Olympiad team has advanced to the state level each of the last ten years. We have been participating in TARC for 10 years and have advanced to Nationals each of the past 6 years, placing fourth overall at Nationals in 2012, eighth at the Nationals in 2013 and 8th and 13th at the Nationals in 2015. I am a NAR member and have a level 2 certification with over 15 level 2 flights. Currently I am building a rocket for level 3 NAR certification. Last year our NASA SL team took the altitude award for being closest to the target altitude of a mile. We were only 11ft off. We look forward to the opportunity to participate in the program again this year.

Gavin Black 17 Senior:

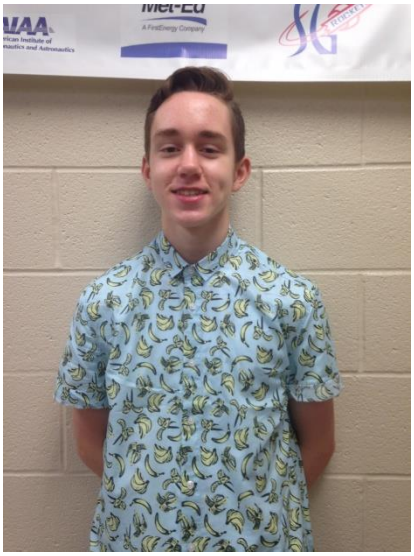
Co-Captain and Payload Leader

Throughout my high school career I've always gravitated towards the sciences. It wasn't until my sophomore year when my Physics teacher introduced me to the rocket programs at our school. I joined TARC my sophomore year and it quickly became a big part of my life we made it to nationals and placed in the top 50 in the nation. Going into my junior year I heard that SLI was coming back to the high school level and I immediately joined. It was a huge time commitment but that made it all the more satisfying when we took the national altitude award at the launch in Alabama. Now I'm heading into my senior year as the captain of one of my schools teams and I couldn't be more excited. Other than SLI I've played varsity soccer for all four years of high school and I'm involved in science Olympiad. After high school I plan to attend college and further my education with a degree in biochemistry or chemical engineering.

David Williams 18 Senior:

Co-Captain, Student Safety Officer, Head of 3D design, and Ebay Leader.

I became a "rocket scientist" in the 7th grade when I first competed in our school's science Olympiad competition I then went on to compete in TARC, Physics Olympics, Pumpkin Chunkin, and eventually the SLI program during my junior year. SLI is an excellent opportunity which I am honored to be a part of again. SLI allows students the unique chance to learn more about completing difficult projects in a team setting thus providing invaluable experience. I hope to follow my love of rocketry into my career path and possibly into space itself.



Josh Snyder 15 Sophomore: Chief of Introduction and Table of Contents

My freshman year is when I really started to get involved with rocketry. I joined TARC and our team placed 8th in the nation. That was an incredible experience for me and this year I have decided to join SLI too, along with TARC again as well. Aside from rockets, I love playing the drums and am in the jazz band, concert band, marching band, pep band, drum line, and our school's musical. I'm also the treasurer of the hackey sack club. I am really excited to be part of a SLI this year and hope to learn a lot and place well in Huntsville.

Zeb Hollinger 15 Sophomore:

Chief of Introduction and Table of Contents

Throughout my first year of school I joined the Tarc team as quickly as I could because the topic sparked my interest. During my first year I have learned so much and ended taking away a trophy for 8th in the nation for Tarc. Little did I know, once you join the rocket club there's no way out of it. That is why this school year i have decided to slap SLI onto my list of fun extra curricular activities. Besides the rockets and all I spend the rest of my time on sports and other outdoor games. My sophomore year I will be playing football and lacrosse for our school. On top of that I will be starting varsity on our disc golf team and the hacky sack team. This year will be a huge opportunity for me to learn as much as i can in order to continue the legacy that SGHS has built in its rocket clubs.

Kory Trout 17 Senior: Technical Design

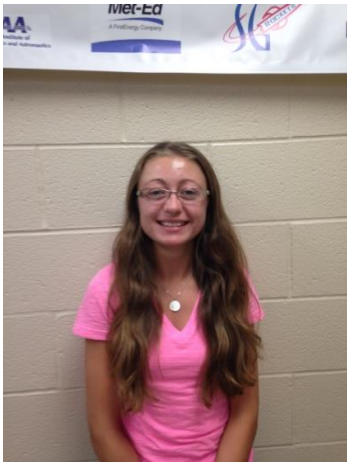
Though science isn't my favorite subject, I've always found a passion in exploring and learning all I could about the different kinds of sciences. In my sophomore year, I was introduced to TARC through my physics teacher. I had no experience or knowledge in rocket building, but I quickly learned through the help of my team mates and other students. Our team spent countless hours planning, building, and launching our rockets, providing a unique learning experience. This year I plan to enhance and share my knowledge of rocketry with other students and make our school proud. In my free time, I enjoy spending time with friends and family and working as a cashier. I plan to pursue a degree in criminal justice or law after High School.

Ben Silar 15 Sophomore: Safety

All the way from 6th grade I was always interested in science. The SL team really caught my interest as a great opportunity to further my engineering education. After I get out of high school I plan on going to college and majoring in engineering. I love learning new things and having hands on experiences that will benefit me in the long run. I enjoy challenges and being put to the test. When I was younger I was always liked building contraptions and testing them out to see if it was successful. If it wasn't successful it would be back to the drawing bored. When it actually worked the feeling of success was phenomenal. I wanted the feeling of success again so I joined the team.

Katie Garner 17 Senior: Project Plan

My TARC experience includes my junior year of high school, and was quite happy with how our rocket turned out even though our team didn't make it to nationals. I am interested in Student Launch Initiative because of how well the teams from Spring Grove have done in previous years, and I wish to contribute my skills to the team and create a supportive and motivated team for another great year! The opportunities within SLI allow students to cooperate in a friendly environment and yet compete against each other in a way that builds teamwork. I cannot wait to participate in this year's SLI program!



Rebekah Silar 17 Senior: Educational Engagement

This is my first year participating in the Student Launch Program. Besides SL, I am involved in many things, including the marching band, color guard, percussion ensemble, Tri-M Music Honor Society, National Honor Society, and the drama club. I also enjoy tutoring in physics after school. I began my Rocket Scientist adventure by participating in Envirothon in sixth and seventh grade. I was later introduced to the other science programs at Spring Grove in tenth grade when I took physics. Physics is by far my favorite subject and it has inspired me to get involved in more science programs, such as the Student Launch Program. Being involved in the SL Program will also help prepare me for my future goals in life. I want to attend college to become a secondary education physics teacher and help educate, encourage, and inspire students to participate and love STEM.

Mrs. Bosak: Biology Teacher and Assistant Coach

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

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
            1. Compound Dewalt miter saw

2. Framarbandsaw
3. 24” Planer
4. Paasche FABSF-6 spray booth
5. Belt sander
6. Drill press
7. Oliver table saw
8. 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 Rocksim 9 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

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

  Router

  Before operating the router, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the router or router bit. Also, obtain an instructor's permission to use the machine and ensure that safety glasses are covering your eyes. Ensure that the power switch is in the off position before plugging in the router. Then, check to make sure that the bit is firmly secured in the chuck and that the piece being worked on is firmly secured. 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 kickback always exists. If injury occurs during usage of the sander, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Dewalt Compound Miter Saw

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

Jointer

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

Electric Drills

Before operating the drill, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that 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 vises 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 setup 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 workbench 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 workbench 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 volt Automation 5500-B0)

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 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 SLI 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 Mr. Hastings. Mr. Hastings 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 SLI 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. Hastings is NAR Level 2 certified. Therefore, he will also be responsible for the ordering and storage of our rocket motors. Our student safety officer will be Josh Staley. 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:

*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.

Risks	**Probability of Risk *(1-10)**	**Impact on Project Progress**	**Mitigations**
We may fail to get valuable data from the rocket.	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 handled and deal with any design flaws.
The rocket parachute	3	We lose a rocket and	The team will

does not deploy and rocket returns unsafely to the ground.		must build another one, losing work time and time to launch.	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 usage.	5	A small injury could occur, possibly delaying the rocket-building progress.	The team will carry the knife in cautious matter, cut away from oneself, and be aware fingers when using this tool.
Accidental combustion of rocket materials	3	In addition, possible injury and a delay of rocket-building progress could occur.	The team will keep 25 feet away from electrical outlets, 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 made.
Complications during transportation of participants and materials to SLI 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 advance and that all specifications are planned out well in advance. The team will pack the rocket

			well and make sure it is secure during transportation.
Accidental partial or complete destruction of building site	2	Damage to work environment, additional expenditures for repairs, possible progress delay.	The team will ensure that safety guidelines from NAR and the MSDS are being followed.
Team communication failure	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.

2. <u>Procedures for NAR/TRA Personnel to Perform:</u>

Brian Hastings is our Level II 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. Hastings will also be overseeing the construction of the rocket to ensure that the rocket will only be constructed out of lightweight 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. Hastings 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. Hastings 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. Hastings 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. Hastings 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. Hastings 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 and ABC Dry Chemical Fire Extinguishers. When handling hazardous materials team members will use nitrile gloves.

5. <u>Plan for Complying with Laws</u>:

In order to comply with federal, state, and local laws regarding unmanned rocket launches and motor handling, the Spring Grove SLI 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 SLI 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 SLI 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. <u>Plan for Motor Handling and Storage</u>:

Rocket motors will be purchased through our NAR level II certified representative, Brian Hastings. All motors will be stored within a Type 4 magazine and access will be granted solely to our NAR representative. Mr. Hastings 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.

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

Spring Grove SLI 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.

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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 SLI 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- Rocket and Payload Design

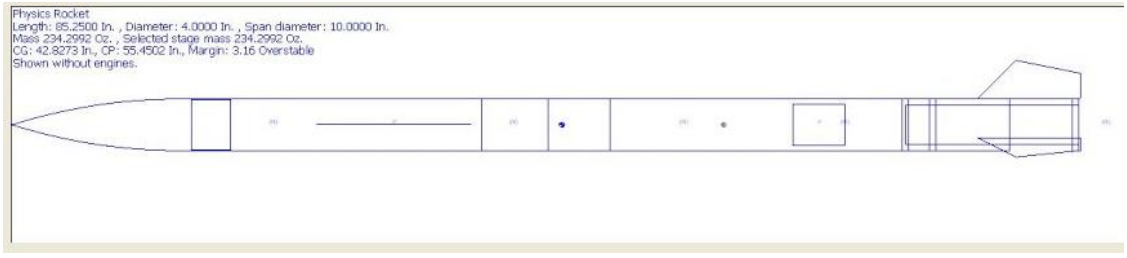
A) Vehicle Dimensions, Material Selection, and Construction Methods

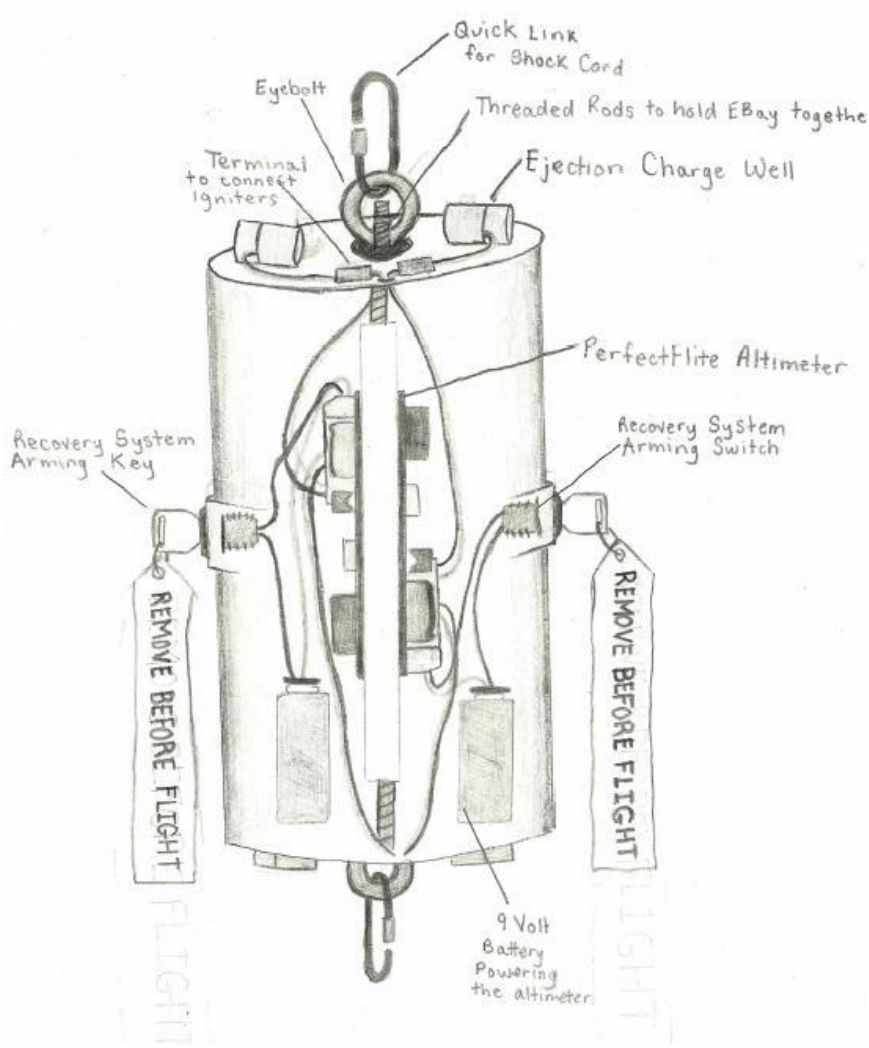
The rocket is planned to be 63.75 inches in length. The overall mass of the rocket will be 284 ounces, including the weight of the engine. The rocket has three fins that are 120 degrees from each other each with a trapezoidal design, stretching 8 inches in length by an average of 3 inches tall. There will be two PML body tubes. The top tube is 27.75 inches long and the bottom tube is 36.0 inches long. In between the two pieces will be a small 2.0 inch ring which is part of the electronics bay which will have the key switches on it. We plan on buying our body tube sections 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 type of tubing is a very strong, making it much stronger than cardboard. This tube is also wrapped in fiberglass, which 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. By purchasing our tubes from Public Missiles Ltd., the fiberglass reinforced body tubing will help prevent zippering when the parachute is deployed. The shock cord will also be long enough to help prevent zippering at ejection. The fins will be constructed from a 3D printed ABS material that

will be a single piece, acting as a removable fin bracket anchored by 3-6 anchor points on the rear body tube. The ABS material was selected because of our experience creating fin brackets with this material in previous years. With this ABS fin bracket, we will be able to quickly and easily replace damaged fins on landing. We will also be using West System 105 Epoxy Resin and 205 Quick Hardener to join parts of the rocket, except for the fin bracket. West Systems Epoxy was chosen because of its superior bond strength and because of its relatively low fume output. For the altimeter, we plan on using a PerfectFlite Stratologger altimeter. 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. One will be our main altimeter and the other one will be our redundant altimeter in accordance to NASA's safety specifications. If the first charge fails to ignite, the second altimeter will be delayed up to 4 seconds. This allows us to ensure the body sections are separated safely. An internal coupler will be installed, that is long enough to provide enough friction to keep the rocket body tubes together and stable during flight yet loose enough to allow the departure of the electronics bay and bottom tube at apogee.

B. Altitude

The Cesaroni K510 classic rocket motor should deliver a designed 2486 Newton-seconds of impulse. With this motor, our calculated point of apogee is planned to be 5,974 feet. With our mass, this should be the motor of choice for us as we have planned 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 5,974 feet height drops to 5,250 feet, just under the target height.





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 600 feet. 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 a slow descent of the rocket to a ground impact velocity of approximately 17.3 ft/s. The deployment of the parachutes will occur with the use 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 4 seconds, the redundant altimeter will set off an additional charge in the event the first charge did not fully separate the rocket. As the rocket slows its descent at 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 at apogee. According to simulations on Rocksim, the recovery system even with a wind speed of 25 miles per hour should allow the rocket to be within a landing range of three-eighths of a mile, with an average of less than a quarter of a mile. These are exceptional landing sites given the height and length of our rocket.

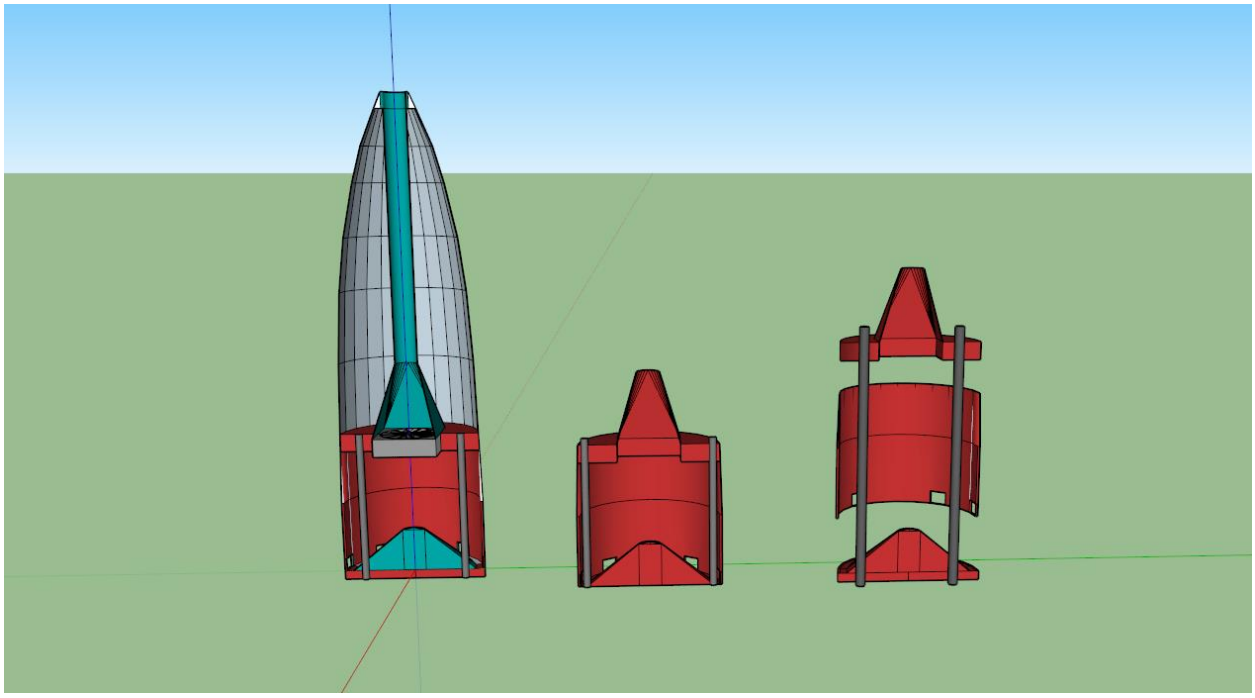
D. Motor Selection

The proposed engine is a Cesaroni Technology Inc. K510 classic motor that is 2.95in in diameter and 13.78 inches in length. The K510 motor was selected because Cesaroni is a reliable rocket motor supply company. This motor provides the proper impulse to propel the rocket to the one mile mark as well as being affordable with our proposed budget. With our mass, this is our motor of choice given that we have planned in the design an increase in mass of the rocket by 10%. As a back-up motor, we plan on using the K-661 Blue Streak Motor with 2,430 N/S 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 5280 ft.

E. Payload

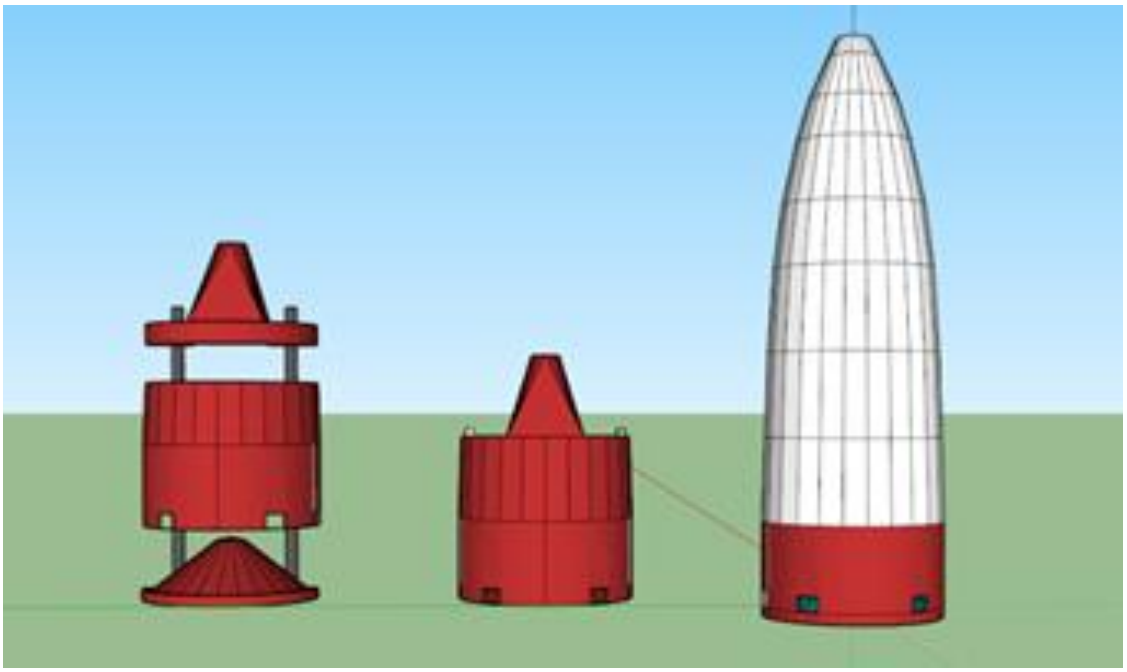
This year's payload for the Spring Grove SLI team will test the rate at which airflow through a turbine will generate a current. The payload will have a fan (likely a modified computer fan) placed into a 3d printed chamber and then wired to an ammeter lower in the 3d printed payload to measure and record current generated. A relationship

between air speed and current generation will then be established and a formula derived from the recorded data as a function of time over generation during ascent. The airflow for the turbine will be generated by the rocket on its way up to apogee. The turbine we will be using will be a small computer fan because it already has a small motor attached to it in a small form factor easily incorporated into the 3d payload bay. A small tube will be placed directly above the turbine in the nose cone and will run directly to the tip of the nose cone so air can flow to the turbine. The tube running from the tip of the nose cone towards the fan will have a funnel inverted over the turbine to maximize airflow. this is represented by the blue section of the 3d model.



Approximately 3 inches below the base of the payload within the front body tube we will place a bulkhead to seal off the payload from the rest of the rocket. Small spill holes will be pre 3D printed just above the base plate of the payload. these exhaust ports will allow the air somewhere to escape after passing through the turbine. The complete payload should be an estimated 10 inches when it's completed, however the top half of the 3d printed payload will insert into the base of our nose cone; the smaller size of this payload will make it easier for the nosecone to eject off the rocket when the parachute

deploys. Because the payload will be half in the nose cone and half in a small section of body tube near the nose cone. It will be inserted in the nose cone and pop riveted in place before each launch to ensure a safe firm fit within the nosecone and thus prevent any pieces to separate during flight while still providing the ability to disassemble and adjust components within the payload itself.



This screenshot shows a side view of the nosecone and payload. You can see two pieces of all thread running through the payload baseplate the whole way up through the air chamber and finally through the upper intake plate, these pieces of all thread will be responsible for holding the payload together while allowing for disassembly of said payload. The cone shaped peak on the payload baseplate serve to direct the airflow back out of the payload and the rocket itself. The cone on the bottom bulkhead directs the airflow out of the spill holes at the base of the payload to keep any pressure from building up within the body of the rocket and to lower the amount of drag created by the intake of air through the nose cone.. In this screenshot you can see the way that the payload will fit together and the way it fits in the nose cone. If all goes smoothly the payload should work as an extension of the nose cone. In this picture you can more clearly see the spill holes 3D printed into the bottom of the payload air chamber section.

The placement of this payload is vital to the experiment, without easy access to the nosecone there would be no way for us to get airflow to the turbine in the payload and back out of the rocket to reduce as much drag as possible thus allowing the rocket to reach the mile mark. The placement is also important when it comes to deploying the parachutes, last year the placement of the payload made it very difficult for the main chute to come out. This year the payload is smaller and won't be held into place so tightly allowing for easier deployment.

F. Vehicle 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 manufacturer 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.

G. Technical Challenges and Solutions

Challenge	Solution
Creating a rocket that won't	Design the rocket to fly one mile high or slightly over under perfect

go over 5280 feet.	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 in our elementary, intermediate and middle schools for grades 1 through 8 to inform them of our project, the basics of rocketry, and how to get involved in the rocketry teams when they reach the high school level. We will be sure to spend time going over extra details about the Student Launch Program and spreading awareness of all STEM programs. This portion will go over ways to get involved now and in the future with our high schools' many science clubs and groups, especially Team America Rocketry Challenge and The Student Launch Program. Presenting to all the schools will involve over 2,000 children.

To obtain feedback and interest, we will give small surveys to all children, grades 5 through 8, who were involved in our presentations. For intermediate and middle school students, 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 attending our rocketry workshop. For elementary students, there will be a verbal survey given to the students asking how much they enjoyed the presentation and if they would be interested in joining a rocket club when they reach the high school level. Their answers will be recorded by a show of hands and a count of how many enjoyed the presentation and would like to participate in the future will be taken.

Below is an example of a survey which will be given to students in grades 5 through 8 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-_____.

Please answer the following questions

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:_____

Last year the SL team hosted a rocket building workshop. This was highly successful with fourteen students in grades 7 and 8. They were able to construct their own rocket and launch it when the rocket was completed. All of these students expressed an interest to later join Team America Rocketry Challenge. Kits of small rocket parts, donated by Aqua Phoenix, were used for the workshop. We would like to hold another workshop for children to get involved in rocketry this year. 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 will 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 after their assembly, further spreading rocketry awareness.

Another possibility is to make a Team America Rocketry Challenge team 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 these actions we will contact local television stations and newspapers. They can then make short segments on our project, further spreading awareness of our rocketry programs. We also plan to go to home football games and continue to set up a table and sell cotton candy to help fundraise and spread awareness about our project. This allows us to go in many different directions, such as going to many different events to spread our ideas and lessons with the community. (Including but not limited to, home sports games, museum visits, back-to-school nights, and many other opportunities.) Through this we will be able to reach many other people we cannot just by giving presentations in the schools. We will be able to spread our word to a younger generation and bring STEM to the forefront in our local community.

I. Project Plan:

Timeline:

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

- September 11, 2015: Electronic copy of completed proposal due to project office by 5pm
- October 2, 2015: Awarded proposals announced
- October 7, 2015: Kickoff and PDR Q&A
- October 23, 2015: Team web presence established
- November 6, 2015: Preliminary Design Review (PDR) reports, presentation slides, and flysheet posted on the team website
- November 9-20, 2015: PDR video teleconferences
- December, 2015: CDR Q&A
- January 15, 2016: Critical design review (CDR) reports, presentation slides, and flysheet posted on the team website
- January 19-29, 2016: CDR video teleconferences
- February 3, 2016: FRR Q&A
- March 14, 2016: Flight Readiness Review (FRR) reports, presentation slides, and flysheet posted to team website.
- March 17-30, 2016: FRR video teleconferences
- April 13, 2016: Teams travel to Huntsville, AL; Launch Readiness Reviews (LRR)
- April 14, 2016: LRR's and safety briefing
- April 15, 2016: Rocket Fair and Tours of MSFC
- April 16, 2016: Banquet; launch day
- April 17, 2016: Backup launch day
- April 29, 2016: Post-Launch Assessment Review (PLAR) posted on the team website
- May 11, 2016: Winning team announced

Team Schedule:

As far as get-together's go, there are two types: meetings and sessions. The meetings will be discussions conducted by the Team Captain and Co-Captain with the entire, including 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, briefing, group sessions, bonding sessions, work sessions, and construction sessions.

Meetings:

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

The more formal meetings will have a considerable and strict agenda to discuss everything that needs to be done. This will include the 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/or concerns and can discuss them during these more 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 with team members, they can discuss how they feel about something else another team member has done, or if something another has done that has upset them in some way in order to best resolve the issue at hand. The sessions will allow the 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. The sessions will be more serious than the others, and are largely going to influence the project as we need everyone to be working at their best cooperatively. Not having this will make the project more stressful not only for those directly having problems, but for the entire team as well.

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 help build relationships outside of the project. We will do various activities such as watching movies about science in general as well as more specifically aerospace, and other group favorite movies that we can watch together. As stated earlier, we need to have an open and friendly environment and atmosphere within our teams and these sessions and/or 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 and all of the reports needed throughout the project. This will present the opportunity for team members to ask others questions about their part and allows for clarification if need be. This will also be used as a progress check to see what needs to be done and see what has been completed. It will give the chance for the two teams to work together and assist as needed within the time being.

Construction sessions will be used later in the project to actually build the tangible rocket itself. Team members will be paired to work on building specific parts of the rocket or payload. This prevents mistakes and accidents from happening and builds progress within itself. The partners are in case an accident does happen, so that the other partner will be there ready to help if needed. Construction will have adult supervision, so partners can inform them immediately if something requires attention or assistance. Both team members must read and abide by all safety rules regarding the operation of tools, for both their safety and their partner's.

Meeting Times, Session Times, and Proposed Schedule:

Meetings and sessions will be held on several different dates; general meetings will be held every day when the team is capable of meeting together, typically before work sessions and before/after school hours. Formal meetings will be mandatory meetings that will be ideally held once a week from about 3:00pm to 5:00pm. Briefings will also be mandatory, as they are ideally held every Friday from 3:30pm to 4:30pm. Group sessions will be held every other week on the day that is more convenient for the team at the time. Work sessions will be held during any of the available times after school, allowing for convenience for each team member. Construction

sessions, once that point in the project 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 later on in the project to assure that we stay on schedule. Partners must be present during the 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 in case any of the aforementioned issues arise.

I. **Budget:**

Item:	*Cost (In Dollars):*
Travel to Huntsville	6000.00
Food for All Trips:	2354.00
Practice Trips to Maryland	840.00
Lodging in Huntsville	3600.00
Nose Cone	19.95
Body Tubes	399.80
Rocket Mount	4.99
Fast-Hardener	43.94
Resin	84.96
Shock Cords	47.80
Large Parachute	188.00
Small Parachute	113.00
Centering Rings	55.88
Bulkheads	70.54
Motor Casing	149.95
Reload	531.80
Reload	265.90
Couplers	74.00
Motor Mount Tube	9.95
Engine Retainers	72.76
U-Bolts	15.84

Quick-Links	14.88
Altimeters	1119.03
Batteries for E-BAY	25.46
Materials 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
Battery Holder	5.6
Total:	16,943.48

I. 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 which 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 includes "Nuts About Granola" (information is located at (www.nutsaboutgranola.com), selling cotton candy at locale sporting events, Bonus Books (information is located at www.bonusbook.com), and we are currently brainstorming other options to continue to fundraise 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.

I. Community Support:

To publicize our project, our team will be contacting local television stations like FOX 43 of the FOX Corporation and WGAL 8 in the Susquehanna Valley like we have done in previous years as well as contacting local radio stations like 107.7 and 105.7. Lastly we will contact local newspapers to spread the word of the Spring Grove Rockets. We will be sending each of these kinds of organizations information about us and asking if they were willing to spread awareness

about our club. We will also be using our own SLI 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 to help get the kids more into and aware of the great possibilities that SLI provides. We also intend to create posters to put around our school and local businesses to promote and encourage sponsorship and donations.

I. Sustainability Plan:

We intend to keep our SLI 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:

a. Avoid safety hazards is to have team members and supervisors read the all operation manuals for the tools and products that will be handled during the completion of our project before proceeding with any of such devices or products, while following the enclosed safety plan.
b. Address if a team member is comfortable with using a tool at any time or not. · 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)
c. 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.

d. 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.
e. 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.
f. We hope to have small groups work together and build small scale rockets, each group will have an SLI 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 SLI in the future.
g. 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 SLI 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.