York College of Pennsylvania
NASA Student Launch 2018 Team Proposal

The Aurora Project

441 Country Club Road
York, PA 17403

General Information

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Team Leaders:

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Team Mentor:

Brian Hastings
NAR Representative
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NAR L3CC: 96571

Addressing Point 1.6: For Launch Assistance, Mentoring, and Reviewing our team will be working with the local NAR representatives along with MDRA (Maryland-Delaware Rocketry Association) members for all questions and launches.

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Meet the Team

Advisers

Dr. Tristan Ericson

Dr. Ericson is an assistant professor of mechanical engineering at York College of Pennsylvania. He earned his undergraduate degree from York College of Pennsylvania and his doctorate from Ohio State University in 2012. His research interests include vibrations of multi-body systems, non-linear dynamics, and gear dynamics. He also has had past experience with model rocketry and is excited to work with this group of students. Dr. Ericson currently resides in York with his family.

Dr. William Kreiger

Dr. Krieger is a professor in the life sciences at York College of Pennsylvania. He teaches Earth Science, Earth and Space, and Astronomy courses at the college and has been teaching at York for over 25 years. He is an advocate for future educators and loves to help young students in achieving their goals. Dr. Kreiger resides in York with his family.

Team Lead

Kyle A.

Kyle is a full-time sophomore mechanical engineering major at York College of Pennsylvania who has competed on some of the biggest stages on the national model rocketry circuit. An avid model rocketry builder since age 10, he was a member of the Spring Grove Area High School team from 2011-2015 that competed in both the Team America Rocketry Challenge and the NASA Student Launch Initiative. In 2015, he captained his Team America Rocketry Challenge team to an 8th place national finish out of over 1000 teams nationwide. In 2015, he was also the captain of the Spring Grove Area High School team that won the altitude championship in the high school division of the NASA Student Launch Program. He brings a wealth of knowledge to the team from these previous endeavors and hopes to continue his success at York College.

Adam C. (Payload Lead)

Adam is a full-time sophomore mechanical engineering major at York College of Pennsylvania who also has national model rocketry experience. He has 3 years of model rocketry experience including in 2016 when he was the captain of the Spring Grove Area High School NASA Student Launch Team. He has knowledge of electrical circuitry and is a valuable asset to the team as well as building a research payload.

Saumil P. (Secretary / Electronics Bay)

Saumil is a sophomore mechanical engineering major from Tremonton, Utah. He is the secretary of the NASA Student launch club here at YCP. He chose mechanical engineering because engineering is in every aspect of our lives and engineering is one of the only fields where failure is not the end. Engineers learn from their failures and the more they fail, the closer they are to the solution. He has always enjoyed learning about aerospace related topics and that is exactly what interested me in this club. He really enjoys learning more about rockets and this club has taught him a lot.

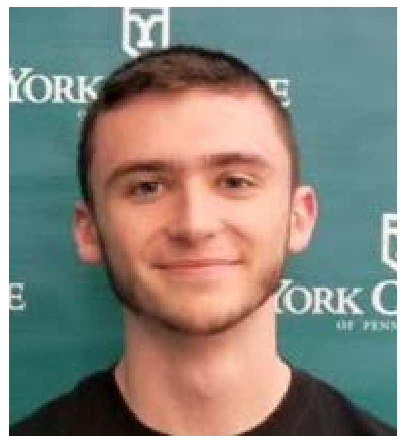
Tanner M. (Payload / Facilities Manager)

As a student of York College, Tanner is studying mechanical engineering. His extracurricular activities include ultimate frisbee, carpentry, and drawing among other things. The reason Tanner joined the NASA SL club is because for years he has had a fascination with the aerospace industry. When I saw that he could be a part of that community he jumped at the opportunity. Also, he really enjoys building whether it's carpentry or something else, and this is a great experience to do more. Lastly, being an engineering student it gives Tanner the opportunity to practice his skills and develop as a professional.

Jacob V.B. (Electronics and Safety Officer)

Jacob is a sophomore student at York College of Pennsylvania studying mechanical engineering. Jacob is the designated safety officer for the club as well. Jacob's previous engineering experience comes from being a member of his high school's First Robotics club where he loved making and building parts. This will be Jacob's first year being a part of a rocket club he hopes to learn as much as he can and be able to use what he learns this year in his future career.

Daniel K. (Mechanical Work)



Daniel is a mechanical engineering major from Long Island, New York. Daniel chose mechanical engineering because he enjoys designing and making parts and pieces to cars, and machines. He loves making things and seeing how they work and how they could also be potentially improved. He became interested in this club because he always thought that rockets and the idea of space travel was cool and fascinating. He knows that we come nowhere near to space, but the idea of making a rocket and putting it together and then having it launch sounded awesome and something that he wanted to be a part of!

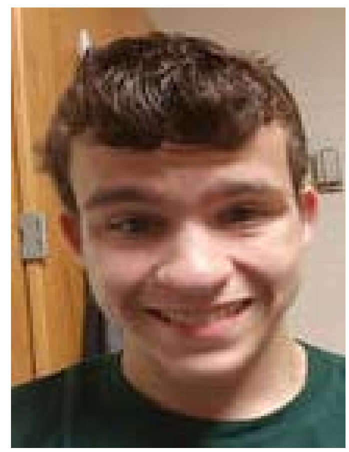
Blake P. (Educational Engagement)

Blake is a freshman majoring in Mechanical Engineering. In his free time, he enjoys reading, driving, working on cars, and computer programming. He has done hobby model rocketry for several years and is excited to learn more advanced rocketry techniques and participate in a high-level competition.

Benjamin S. (Budget / Rocket Integration)

Benjamin is a sophomore mechanical engineering major from Navarre, Ohio. Ben chose to be a mechanical engineer because his uncle and father are engineers. Their careers and their work has always fascinated him and has pushed him into the field of engineering. He chose mechanical for its diversity throughout all the disciplines of engineering and he plans to pursue a career in mechanical design.

Vincent R.



My name is Vincent Ruggiero and I am going for a major in mechanical engineering. I am from Berlin, New Jersey. I chose mechanical engineering because of a love I have for understanding moving pieces in everyday objects combined with a skill for mathematics. I was in a robotics club in high school so building things from scratch with a goal in mind has always been fun for me, and I'm eager to continue with a harder challenge in college.

New Members (As of 9/12/17)

Cassidy V. (Freshman Crew)

Joseph R. (Freshman Crew)

Facilities and Equipment

Facilities

York College of Pennsylvania Kinsley Engineering Center:

a. Hours: *Shop Access*: Monday through Friday 6 AM to 4 PM
   Computer Labs and Class Rooms: 24-hour access
    i. Room 128:
        1. Agilent Oscilloscope:
           Used to induce a clock in electrical components.
        2. Agilent Dual output DC power supply:
            a. Used to power electrical components while building them.
    ii. Room 133:
        1. Wind tunnel:
            a. Used for testing rocket parts aerodynamics and air flow.
    iii. Room 135:
        1. Dimension Print 3-D printer:
            a. Use for printing plastic computer designed parts.
        2. Tinius Olsen 50ST Structural Stress Analyzer:
            a. Use to test how different materials will handle flight stress.
        3. Instron Compression tester:
            a. Used to test how different materials will compress during launch.
        4. Computers with Microsoft Office and Solidworks' Programs
    iv. Room 138:
        1. Bridgeport manual mill:
            a. Allows the team to mill metal to the appropriate dimensions and tolerances required by design.
        2. HAAS CNC mill:
            a. Gives the team the ability to design parts on the computer and have them cut out of stock.
        3. HAAS CNC lathe:
            a. Used to make circular parts designed on the computer out of stock.
        4. Wilton 20-inch drill press:
            a. Used to put holes in parts or other material.
        5. DoAll Band saw:
            a. Used to cut large pieces of kinds of material.
        6. Hardinge manual lathe:
            a. Used for cutting or milling circular material and treading parts.
        7. Clausing manual lathe:
            a. Used for cutting and milling circular material.

8. DeWalt 16-inch Planer:
    a. Used to smooth large wood planks.
9. Stopsaw 36-inch table saw:
    a. Used for cutting various lengths of wood.
10. DeWalt handheld drills:
    a. Used for putting fasteners into and drilling material.
11. Bridgewood 15-inch bandsaw:
    a. Used for cutting small wood pieces and intricate designs.
12. DeWalt chop saw:
    a. Used for cutting large lengths of wood.
13. Bosch wood CNC machine:
    a. Used for cutting wood parts designed on the computer.

YCP Garage located .2 miles from Campus:

a) Hours: 24-hour access via key entry
b) Used for storage and as workspace
    1. Belt sander:
        a. Used for smoothing wood surfaces and taking small amounts of material off parts.

Description of Computer Equipment:

Every computer in the Kinsley Engineering Center contains Microsoft office, Solidworks, C ++, Python, and Matlab software that can be used for our project.

Launch Site:

MDRA Field: Higg's Farm in Price, MD

1. MDRA Launch field will be used for all sub-scale and full-scale testing.

Materials/Supplies

1. Supplies will be ordered on an as is needed basis. Basic rockets supplies' such as body tubes, couplers, key switches, and switches have already been ordered and have arrived on campus. The majority of electrical supplies needed such as wire, Arduinos', breadboards, exc., are available for use in the Kinsley Engineering Center. The rest of our supplies will be available and ordered from vendors that Kyle is familiar with such as Animal Motor Works and Apogee Components.

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.

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.

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.

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.

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.

CNC Lathe (HAAS Concept Mill)

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.

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.

1 - Safety Plan:

Before any work is done on the rocket, a 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 York College of Pennsylvania Kinsley Engineering Center and in the York College owned garage. Students will have quick access to the following safety materials: Sellstrom SM Z87+FF Safety Goggles, Splash Aprons, Emergency Eye Wash Stations, and BFPE type ABC Dry Chemical Fire.

Our student safety officer will be *Jacob van Brunt*. 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, the team will pay attention to the following risk assessment to ensure a high amount of safety:

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 built properly and 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 usage.	7	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.
Adhesion to materials or self	6	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 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.
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 key switches are armed before igniter is installed and that safety is primary concern out on the launch pad.
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	3	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	8	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. Testing will be done in large amounts to ensure that the payload will work correctly and properly while in Huntsville.

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.
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 with MDRA.

1.1 – NRA / TRA Personnel Plan:

We have appointed a 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 during our practice launches with MDRA. He will also certify that the launch facility, rocket engine components, and environmental conditions are within safety regulation requirements. Our Safety Officer will be Brian Hastings.

Mr. Hastings along with Kyle Abrahims (Team Captain) will be responsible for the safety and handling of the rocket motors, along with safe motor storage. They are certified L3 and L2 respectively by the National Association of Rocketry. They are also responsible for the safety of all of the York College participants while they are handling a motor.

In addition, Mr. Hastings will oversee the construction of the project and will ensure that the Safety Plan is being followed throughout the entire project. Mr. Hastings will also be in charge of handling any hazardous materials and briefing students if they require assistance.

1.2 - Plan for Briefing Students:

Students will be required to participate in an introductory meeting, including a 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. 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. These meetings will be held prior to launches. 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.

1.3 - 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 entrance to the garage in which the indoor magazine will be placed. Cautionary statements will be placed on the entrance of the garage 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 in a cabinet inside the garage in which it will be stored for team members to read while working.

In the planned document’s, 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 including being required to wear Sellstrom SM Z87+FF Safety Goggles during construction.

1.4 – Plan for Complying with Local, State, and Federal Laws

In order to comply with federal, state, and local laws regarding unmanned rocket launches and motor handling, the York College of PA NASA Student Launch 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. That includes aerial assessment to make sure that no planes are in the vicinity and will be flying overhead during launch.

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 will be ensured because we will only launch our flight vehicle at MDRA launches with MDRA personnel. 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 York College NASA 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 if we plan to launch on our own in our area:

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 York College NASA 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.

1.5 - Plan for Motor Handling and Storage:

Mr. Hastings (NAR Mentor) along with Kyle Abrahims (Team Captain) will be responsible for the safety and handling of the rocket motors, along with safe motor storage. They are certified L3 and L2 respectively by the National Association of Rocketry. They are also responsible for the safety of all of the York College participants while they are handling a motor.

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

1.6 - Knowledge and Understanding of Safety from All Team Members:

Inspection for every rocket will be made before any attempt of a launch. Before each launch the rocket must go through a safety inspection. The safety inspection will be done by Kyle (Team Lead) as well as Brian Hastings and MDRA representatives. If a team member doesn’t comply, they will be removed from the area so that the inspection will be done properly.

If the range safety officer sees any problems with the rocket or if the rocket doesn’t meet the inspection list, then they will have the right to deny any launch of that rocket. The failed rocket must go back through inspection and pass before that rocket can then be launched. If a team member doesn’t have correct equipment or clothing when working on the rocket, then they will also not be allowed to participate in the launch of the rocket until they have meet the safety requirements.

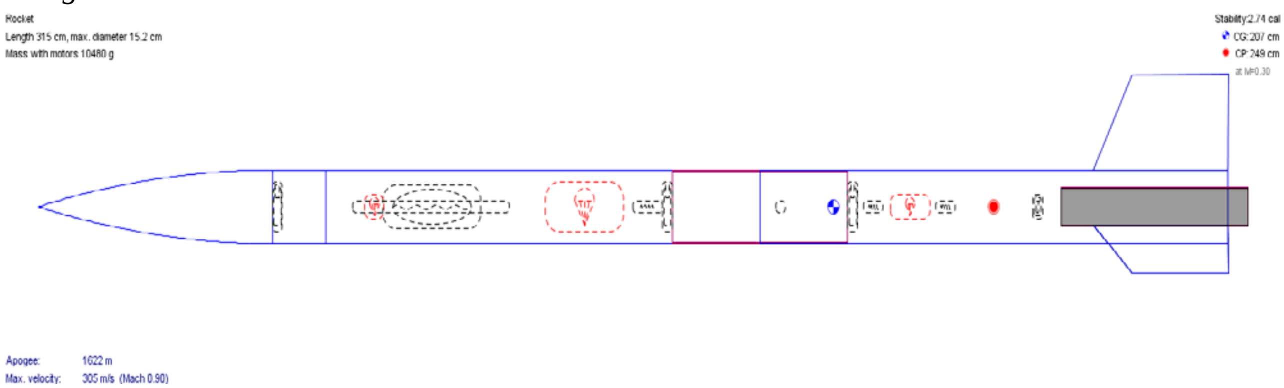
This brief 2 paragraph statement was read by all students on the team and a signed attachment will be uploaded, stating that they have read and understand this part, before the PDR is uploaded.

Technical Design

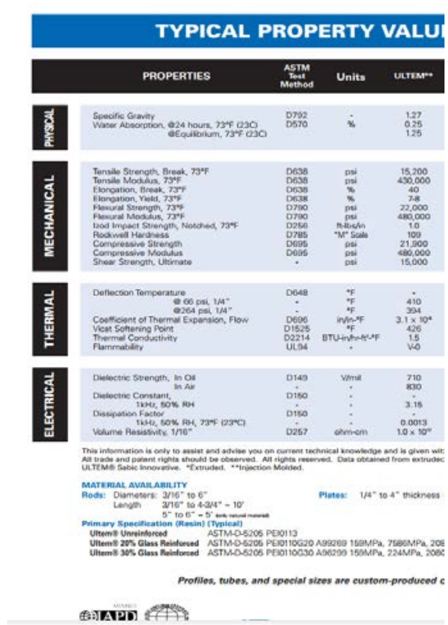
TD. 1 - Vehicle Dimensions, Material Selection, and Construction Methods

The proposed rocket will be 124 inches in length counting the nose cone and fin system. The planned mass of the rocket will be 10,480 grams or just over 23.1 pounds with our proposed engine loaded in it. The stability margin of the rocket is calculated to 2.74 cal. This is calculated by the rocket design program, Open Rocket, as well as hand done by equations found in the Introductory Guide to Rocketry. Both calculation methods have our stability margin being slightly over stable. Although, some quick sample calculations with added epoxy and 3-D plastic in the rear of the rocket have shown a decrease in the stability margin to 2.59 cal, within the stable limit, making it a stable rocket.

Figure T.1



The proposed rocket has three fins that are 120 degrees from each other each with a trapezoidal design that stretches 14 inches long by 8 inches tall with an 8.90 inch diagonal creating a surface area of 96 square inches. The fin system on this rocket will utilize an Ultem plastic 3-D printed fin-can system. Kyle implemented this type of system while with Spring Grove Area High School and wants to continue to use it while at York College. The fin can system will be designed as one solid piece on Solidworks. The component is currently being worked on and designed to ensure the utmost accuracy as well as to ensure that no problems will occur with the tolerances of the fillets during printing. Ultem is valued and used because of its cost efficiency and relative strength and ability to hold up to physical stresses; tensile strength.



TYPICAL PROPERTY VALU

	PROPERTIES	ASTM Test Method	Units	ULTEM**
PHYSICAL	Specific Gravity	D792	-	1.27
	Water Absorption, @24 hours, 73°F (23C)	D570	%	0.25
	@Equilibrium, 73°F (23C)			1.25
MECHANICAL	Tensile Strength, Break, 73°F	D638	psi	15,200
	Tensile Modulus, 73°F	D638	psi	430,000
	Elongation, Break, 73°F	D638	%	40
	Elongation, Yield, 73°F	D638	%	7-8
	Flexural Strength, 73°F	D790	psi	22,000
	Flexural Modulus, 73°F	D790	psi	480,000
	Izod Impact Strength, Notched, 73°F	D256	ft-lbs/in	1.0
	Rockwell Hardness	D785	"M" Scale	109
	Compressive Strength	D695	psi	21,900
	Compressive Modulus	D695	psi	480,000
	Shear Strength, Ultimate	-	psi	15,000
THERMAL	Deflection Temperature	D648	°F	-
	@ 66 psi, 1/4"	-	°F	410
	@264 psi, 1/4"	-	°F	394
	Coefficient of Thermal Expansion, Flow	D696	in/in-°F	3.1×10^{-5}
	Vicat Softening Point	D1525	°F	426
	Thermal Conductivity	D2214	BTU-in/hr-ft²-°F	1.5
	Flammability	UL94	-	V-0
ELECTRICAL	Dielectric Strength, In Oil	D149	V/mil	710
	In Air	-	-	830
	Dielectric Constant,	D150	-	-
	1kHz, 50% RH	-	-	3.15
	Dissipation Factor	D150	-	-
	1kHz, 50% RH, 73°F (23°C)	-	-	0.0013
	Volume Resistivity, 1/16"	D257	ohm-cm	1.0×10^{17}

This information is only to assist and advise you on current technical knowledge and is given wit
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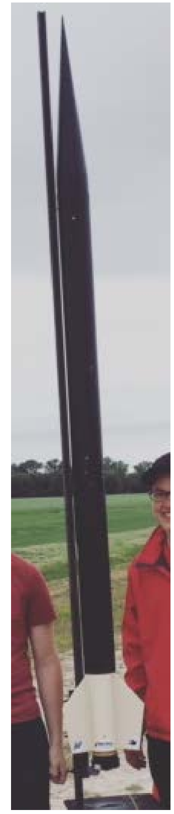
ULTEM® Sabic Innovative. *Extruded. **Injection Molded.

MATERIAL AVAILABILITY
Rods: Diameters: 3/16" to 6" **Plates:** 1/4" to 4" thickness
Length 3/16" to 4-3/4" – 10'
5" to 6" – 5'
Primary Specification (Resin) (Typical)
Ultem® Unreinforced ASTM-D-5205 PEI0113
Ultem® 20% Glass Reinforced ASTM-D-5205 PEI0110G20 A99269 159MPa, 7586MPa, 20
Ultem® 30% Glass Reinforced ASTM-D-5205 PEI0110G30 A96299 159MPa, 224MPa, 206

Profiles, tubes, and special sizes are custom-produced c

http://www.sdplastics.com/ensinger/ultem.pdf

The fin can system will be one solid piece that is printed in one session. The fin can system will be the exact diameter of the outside of the body tube. The base will be around 0.25 inches thick and made to a curvature at the front and rear to decrease drag. The fins will be made to chamfer with the cylinder and will be one connected piece that is attached to the base. An example of this type of fin system is seen here as launched on a rocket designed by the team this past July of 2017.



Drag Reduction

The team will also focus a significant amount on drag reduction. In our case, we are dealing with parasite drag, also known as non-lifting drag. It is known that as velocity increases, the stagnation pressure and the rear pressure due to the momentum of air all increase. To reduce drag on our rocket, we are going to maintain as streamline as design as possible to reduce unnecessary drag. We are also planning to develop a drag reducer, kind of like an under-body diffuser on a car that may help to decrease our rocket's drag. The purpose for this is to counteract the effects of the V-max motor that we plan to use. With such a short burn time, the effects of V-max motors are often a decrease in altitude compared to simulations because the rocket has a longer flight time and distance with no power (impulse) to propel it. With this possible reduction, we can aim to hit a mile, with a V-max motor that we are trying to use.

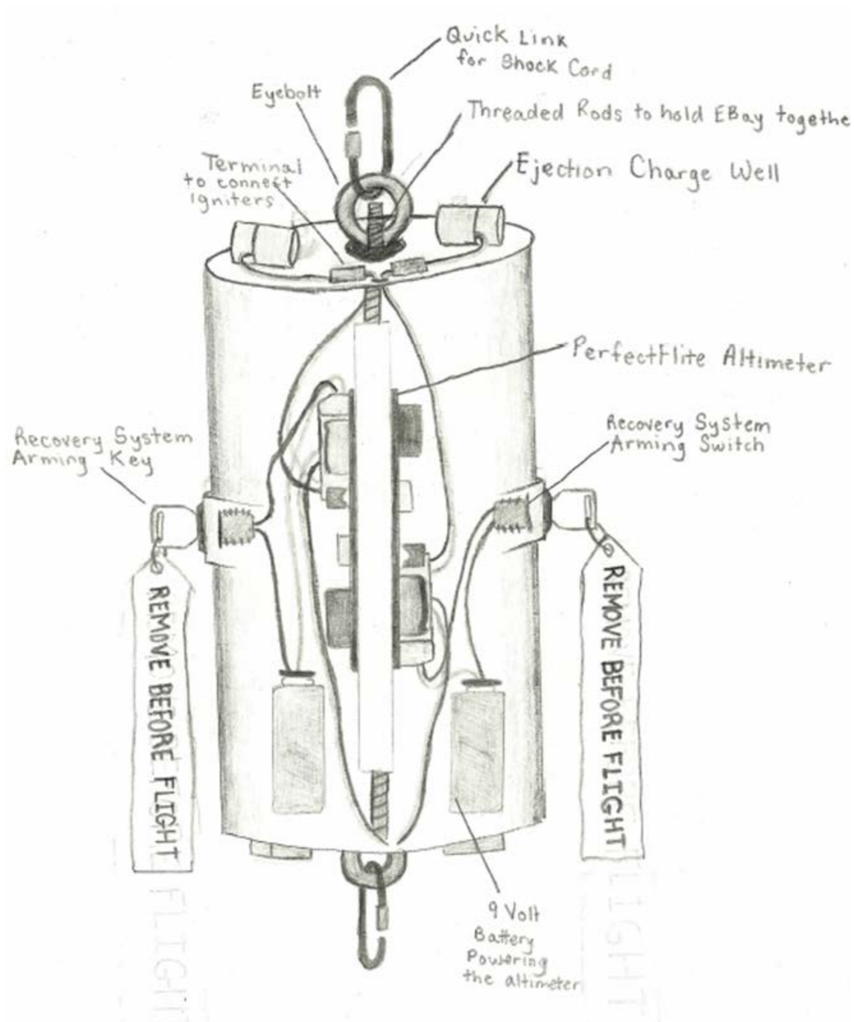
On the rocket airframe, there are two PML body tubes. The top tube is going to be 50 inches in length and the bottom tube is going to be 48 inches in length. In between the two pieces will be a small 2.0 inch ring that is part of the electronics bay which will have the key switches on it.

We plan on buying our Body Tubes from Public Missiles Ltd. The part number for this tube is CFAF-6.0-PRM-60. This tube is a carbon fiber tube that they produce for high speed model rockets. This tube is a very strong tube; making it much stronger than cardboard. The Public Missiles Ltd. body tube was chosen because it can withstand high velocities. The reason that we have decided to purchase tubes, rather than wrap our own carbon fiber is due to lack of experience with the faculty here, and also to decrease the amount of parts that need to be ordered. By purchasing our tubes from Public Missiles Limited, the carbon fiber body tubing will also 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 nose cone will also be purchased from Public Missiles Limited for the same reason as mentioned above. The shock cord used will made in house using 1" tubular nylon which is able to withstand tension forces of over 1,000 pounds. Our parachutes we plan on using are ALS-Series Parachutes by Medichutes. These parachutes were selected for being strong, durable, and made to withstand high pressures and forces. They were also selected because the maker is local and is helping to support a local university team. They also provide more drag for their size compared to common hemispherical parachutes.

As stated above, the fins shall be constructed from Ultem plastic and printed on either a Makerbot 3-D printer or on a printer located at a local manufacturing company.

Within the electronics bay, we plan on using PerfectFlite*Stratologger* altimeters. These altimeters can handle up to two pyrotechnic outputs as well as measure acceleration, and they have been reliable in past experience. 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 electronics bay must be assembled in a specific way, in order to limit any interference with other components of it. The key switches, which will be ordered from Digikey Electronics, on the outside ring of the E- Bay have a long section protruding into the center of the E-Bay. In order to



eliminate interference with these key switches, two precautions must be taken. First, the key switches must not be placed 90 degrees from each other. Instead, pairs of key switches will be placed next to each other, with the center of both pairs at 180 degrees to each other. This will allow for the protruding part of the key switches to not interfere with the sled or altimeters which must come down into the E-Bay by sliding it down the two all thread rods.

Other components include U-Bolts that connect the shock cord to the rocket body or bulkhead. These will be ordered from Lowe's for easy accessibility and also be rated for at least a load of 1,000 pounds.

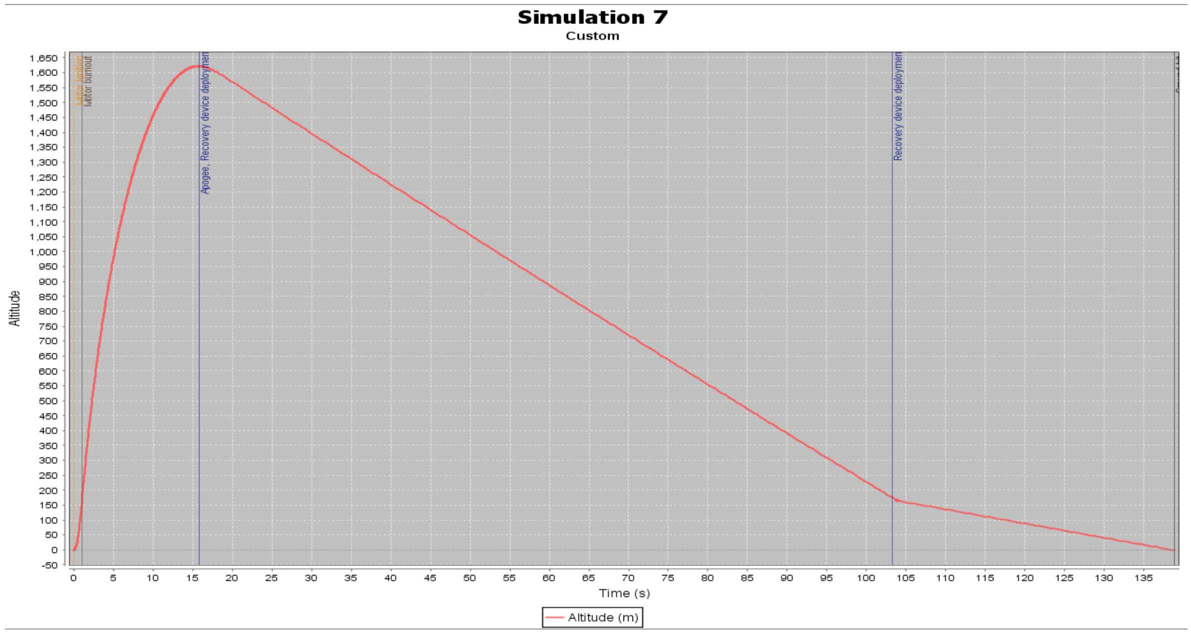
When it comes to rocket construction, the rocket shall be constructed only under the supervision of an adult advisor, and when needed a Range Safety Officer (ROC) or the Team Mentor. Rocket parts shall be handled accordingly to their Materials Safety Data Sheets.

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 **1.6.** Along with construction, we also 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.

T.2 – Altitude

The Cesaroni L3220-P V-max rocket motor should deliver 3300 Newton-seconds of impulse over a burn time of 1 second. With this motor, our calculated point of apogee was planned to be 5,321 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 5%, due to added supports, epoxy weight, and clay weight.** Given this weight increase, our projected 5,321 feet height drops to 5,055 feet if you take altitude and weight to be proportional, just under the target.

Because of the quick burn-time of this motor, it needs to be ensured that we take our time to build everything properly and as strong as we can. If this motor does not end up working, we can use an L 645-P motor made by Cesaroni as well which puts out 3,419 Newton-seconds of impulse. We can compensate and make this motor work if the change proves necessary which makes it nice knowing that we have a back-up plan.



Simulation via OpenRocket

T.3 - 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 an 84 inch diameter main chute from Medichutes with a Cd of 1.6. This will ensure to slow the descent of the rocket to a ground hit velocity of approximately 18 ft/s. We calculated our velocity using the drag equation where p = density of air, Cd = coefficient of drag, A = chute surface area, and Fd = force of drag:

$$F_D = \frac{1}{2} \rho C_d A v^2$$

We can then set the force of drag equal to the force of the rocket downward as shown in a free-body diagram and then solve for the velocity:

$$F_G = F_D$$

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 2-3 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.

According to simulations on OpenRocket, 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.

T.4 - Motor Selection

The proposed engine is a Cesaroni Technology Inc. L 3200 P V-Max motor that is 2.95in in diameter and 19.13 inches in length. The Cesaroni motor was selected because Cesaroni is a reliable rocket motor supply company. The L 3200 motor provides the proper impulse to propel the rocket a mile high in proportion to our weight, in this case being 3300 Ns of Impulse. Cesaroni motors are also affordable with our given budget.

Because of the quick burn-time of this motor, it needs to be ensured that we take our time to build everything properly and as strong as we can. If this motor does not end up working, we can use an L 645-P motor made by Cesaroni as well which puts out 3,419 Newton-seconds of impulse. We can compensate and make this motor work if the change proves necessary which makes it nice knowing that we have a back-up plan.

T.5 - Payload

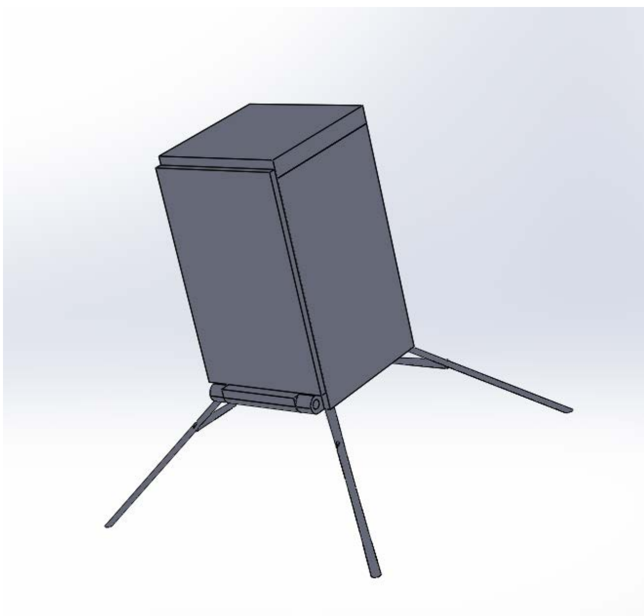
For our payload design we decided to go with experiment option 2, the deployable rover, because with the team that we have built at York College we feel that we are best suited to perform well with this option over the other 2. For our payload we have decided to propose 2 ideas for our design, leaning more towards one, but hoping for some feedback on which will be the better design for our project. Because of the intricate detail and design work needed to complete one of the payloads, we felt that this would be the best option, and allow the engineering design process to lead us to the best design before the preliminary design proposal. For our payload designs the major difference is that with one design our payload will be a containment system that is ejected from the rocket at the same time as the point as the main parachute and will fall on its own parachute. For the other payload design the containment will be attached to the nosecone of the rocket and will stay attached to the main parachute and the body of the rocket by shock cord and will remain as part of the body through the duration of the flight.

Here we have completed a basic engineering morph chart which goes into details about how we are going to accomplish the overall tasks which each specific design:

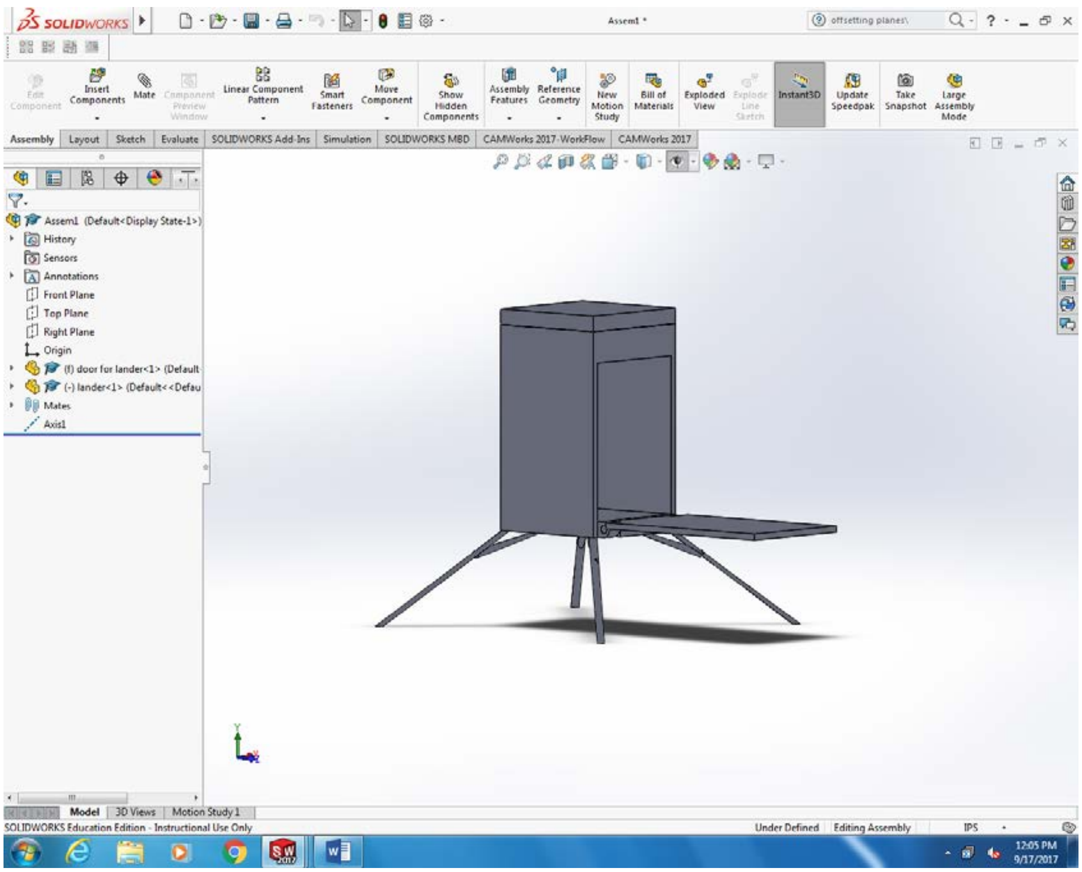
Solutions / Subfunctions	1 (Lander)	2 (Mass System)
Deployment from Internal Structure of the Rocket	At 600 feet during the ejection of the main parachute	On ground after launch flight
Trigger Release of Deployable Rover	Electronic via Controller on Ground	Electronic via Controller on Ground
Movement of at least 5 feet	Arduino Powered Vehicle	Arduino Powered Vehicle
Deployable Solar Panels	Mechanical opening via chain driven front and rear axle	Electronic opening via timed spring system
Device to Control Landing Orientation	Parachute on top of lander, and spring loaded legs that fold out during flight to ground from 600 feet.	Weighted mass system that should increase odds of payload section landing in correct orientation on ground

Design A

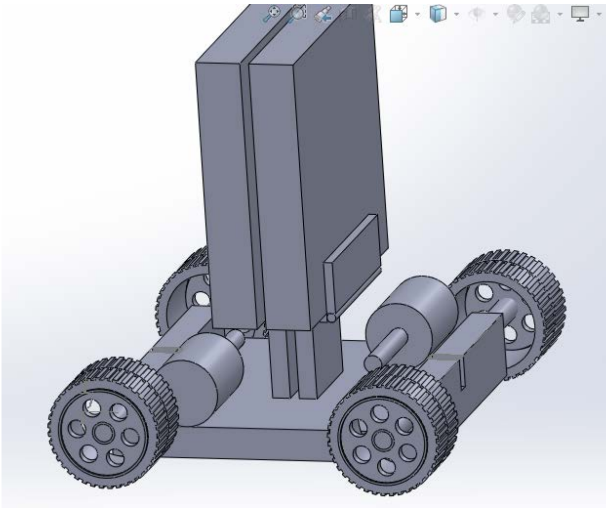
For our first payload design we have decided to go with a design similar to a moon lander with our rover contained inside of the lander. For our containment design we will be 3D printing a box with one side of the box left open to install a door. The top and bottom of the box will be thicker than the sides of the box to ensure strength where we will be installing landing gear and a U-bolt. On the bottom of the box we will be self-designing and building a spring loaded landing gear system to give us extra stability when landing on the ground. These legs on the bottom of our box will be about 5 inches in length and will extend out to about 30 to 45 degrees under the bottom of the box.



Using this system it will allow us to have more stability when reaching the grounds. This box will be exit the rocket when the main parachute it deployed. The payload will be packed inside the rocket in between the nosecone and the main parachute so that when the ejection charge on the electronics bay goes off it will force out the main parachute at the same time as the payload. To ensure that the legs of our landing system don't get tangled up with the shock cord of the main parachute we will use a chute release by Jolly Logic. This will allow us to hold the legs all together compressing the springs and at a defined height it will release, thus releasing the legs out to their deployment state. The top of the box will also be made thicker so that it will be strong enough to hold the rest of the box and the contents of the box to a U-bolt that will then attach to shock cord and to a small parachute.



Since the payload as a whole, including the box, landing gear, and rover should weigh about 3 pounds we will use a 15 or 18 inch parachute for this to ensure a safe descent rate for our payload. On the box of our payload we will have a large, hinged door that will take up most of one side of the box and when released will act like a ramp for the rover to drive down and reach ground level. This door will be spring loaded so there will be a spring mechanism on the inside of the door and DC powered lock release on the outside to let the door open, on command, at ground level, with a remote we will have at the launch site. When the door is released and opens up it will either flip a switch or close circuit so that a connection is made that will power the rover to travel the required distance. This wiring on the rover will be programmed via Arduino power boards. Then on the top of the rover we will mount 2 solar panels on hinges, perpendicular to the top of the rover once it has traveled the required distance it will release the solar panels to unfold and start collecting sunlight, creating power.

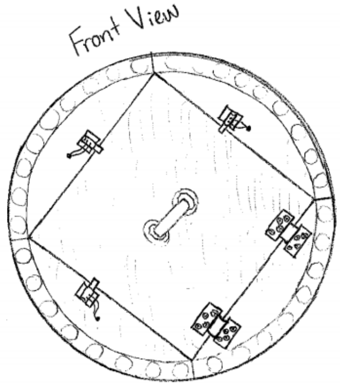


Proposed Rover Design

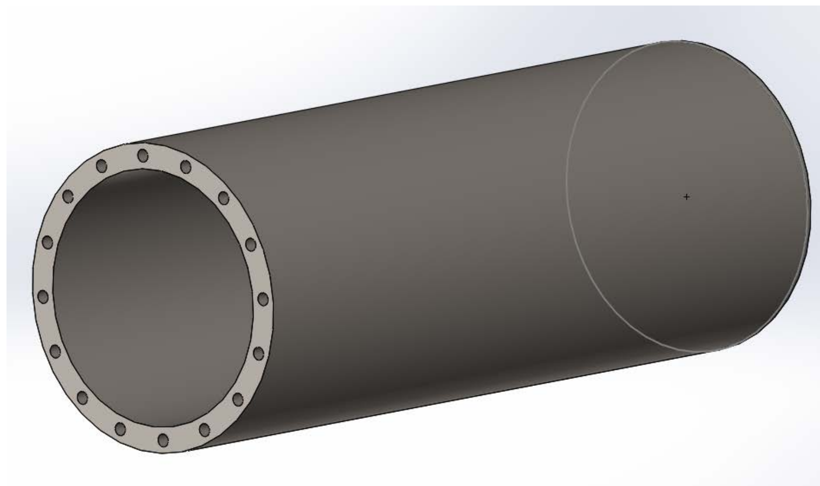
Design B

For our second design, we would attach the payload and nosecone together creating a piece in which the rover would be stored. The nose-cone and body tube assembly would now be ejected together at 600 feet after launch. The opening would then be a bulkhead and door assembly on the back of the body tube that could then be opened.

The rover would be inside of this weighted mass system and come out of a similar opening as pictured here:



To help with the orientation of the payload, a weighted mass system would be used. Essentially we could move 0.25” rods of steel within this mass weight system to give us a side with a slightly higher mass. In theory, the side with a higher mass should be facing downward based on equilibrium and the rover should be in the correct orientation. This system would be made to the exact inner diameter of the body tube. It would then be screwed into place and ensured not to move.



These are just two payload ideas that need some more work and idea collaboration to make one better than the other.

T.6 - Major Requirements

The York College of PA 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 York College of PA 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.

For our payload, the rover will be able to land on its own and autonomously drive at least 5 feet after landing. With our proposed design, a set of solar panels should also be able to be folded out.

T.7 - 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.
Autonomous Control of the Rover	We will consult carious electrical engineers and electrical engineering faculty to make sure that we are able to build the rover so as to function properly.
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 10 -15 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 strong fin system.	We will perform many stress tests on the fin can system we are using on the rocket and perfect the design.
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

The NASA Student Launch club at York College of PA has planned several STEM outreach events for this year. Young students are the next generation that will carry on our work in STEM fields and it is our responsibility to educate them about rockets. Our goal this year is to get as many students interested in building rockets as possible. In the future, we plan to run the following events:

1. *Field trip to the Roundtown Elementary in York*: We plan to visit the Roundtown elementary school located in York county around late September. Once there we will be educating students on how rockets work and how to build one. We will try to get the students to engage by having them build stomp rockets.
2. *York College of PA Fall Fest*: We will be running our own booth at the Fall Fest with a rocket demonstration.
3. *York College of PA Accepted Students Day*: We will be running our own booth with a built rocket for demonstration purposes. We plan to get future students here at YCP to be interested in NASA Student Launch.
4. *Collaboration with York Country Day School*: With York Country Day School, we plan to educate the students in grades 7-9 on our project. We will also be offering a rocketry building workshop in which they can build and launch their own small rocket with the assistance of YCP Rocketry Students.
    a. *YCDS TARC Team:* It is also in action to begin a TARC team at York Country Day. This will be a mentorship type activity for the team and will also create a bond between York Country Day and York College.

Assessment Criteria for Activities:

The event will be considered successful if:

1. Students engage in STEM team activities
2. Students learn about our club and about the exciting possibilities STEM offers
3. Children get hands on experience trying to solve a problem by going through the engineering design process
4. Students learn the basics of rocketry
5. The students have fun and enjoy the activity

We want to get students excited about the STEM fields and most importantly about building rockets. We also want them to learn critical thinking by solving problems using the engineering design process and finally we want the students to have FUN!

Project Plan

P.1 – Schedule / Timeline

Date	Event
August 2017	
31	Year Planning and regroup
September 2017	
20	Proposal Due by 5PM
21	Rocket Final Design Plans
28	Construction Begins on Payload
October 2017	
6	Construction (Payload)
6	Awarded Proposals Annouched
12	Kickoff and PDR Q + A
13	Construction (Sub-Scale Rocket)
18	Wind Tunnel Testing
20	Construction
27	Construction
November 2017	
2	Construction
3	PDR and subsequent documentation is due
6 - 9	PDR Teleconference
9	Construction
16	Construction
23	Construction
30	Construction

December 2017	
6	CDR Q + A
7	Construction
14	Construction
14	Sub-Scale Rocket is Complete
14-19	Educational Engagement Activities Begin
21	Construction
28	Construction
January 2018	
4	Construction
11	Construction
12	CDR and subsequent documentation is due
18	Construction
18-24	CDR Presentation
24	Full-Scale Rocket nearing completion
25	Construction
February 2018	
1	Construction
7	FRR Q + A
8	Construction
15	Construction
22	Construction
March 2018	
1	Construction
5	FRR and subsequent documentation is due

8	Construction
8-15	FRR Presentation
15	Construction
22	Construction
29	Construction
April 2018	
5-9	Huntsville Launch Week
27	PLAR Due

P.2 – Budget

COSTS

Hardware / Tools	PRODUCT A	Product B
Jb Weld Epoxy	$6.99	
3/4" PVC SCH40 Slip Cap (6)	$2.94	
Play Doh Weight	$3.00	
Dustpan w/ Brush	$3.00	
Gloss Black Paint Can (2)	$2.50	
Scott Towels (10)	$26.00	
Xacto Knife (2)	$12.98	
Bernzo Electrical Solder	$8.27	
Butane Refill for Soldering Gun	$4.98	
Bernzo Solder Tool	$27.99	
Shapie 5 pack	$4.98	
Dymo160 Label Maker	$19.98	
Wet/Dry Vac	$29.97	
6 ft Table (2)	$77.76	
10 X 10 Canopy	$89.00	
PVC Pieces to make rocket stands (48)	$60.13	
3/4" U-Bolt (6)	$5.88	
1" U-Bolt	$7.80	
Threaded Rod (36" X 5/16"X18)	$10.52	
5/16" Hex Nuts (100 count)	$8.57	
5/16" Washers (100 count)	$9.95	
14 Gauge Wire (50 ft.)	$8.87	
12 Gauge Wire (100 ft.)	$19.87	
Dremel Accessories	$36.61	
Dewalt 30 piece Maxfit Set	$12.97	
Energizer Batteries 9V 6-pk (4)	$51.94	
Dremel 12V Max Cordless Rotary Tool	$99.00	
Milwaukee M18 Drill/Driver (2)	$258.00	

Rocket Parts	PRODUCT A	Product B
1/4" Quick Links (12)	$47.28	
Nylon Shear Pins (20 pack) (5)	$15.50	
Removable Plastic Rivets (10 pack) (6)	$22.26	
1010 Rail Buttons (2)	$7.00	
1515 Rail Buttons (4)	$20.00	
Aero Pack 75mm Motor Retainer-P	$47.08	
G5000 Rocketpoxy - 8 oz. package	$12.00	
30 in. Shock Cord Protector (5)	$64.75	
18 in. Nome Black Parachute Covering (4)	$41.96	
ALS 84 inch Advanced High Power Parachute (3)	$506.22	
Body Tubes	$800.00	
Parachutes	$500.00	

Indirect Costs	PRODUCT A	Product B
Travel to Practice Launches	$1,000.00	
Travel to Huntsville, AL	$4,000.00	
Lodging in Huntsville, AL	$3,800.00	
Food for All Trips	$2,500.00	

P.3 - Funding Plan

As of right now we have already obtained a few sources of funding. The Pennsylvania Space Grant Consortium has donated $7,500 towards the Student Launch project. This initial money will help pay for the parts and transportation required for the subscale flight as well as construction of the full scale rocket. Any funds left over will continue to help pay for the trip to Huntsville.

We also have been applying to numerous other grants including a Walmart Local Grant worth $2,500 and a York College Great to Greater Fund for up to $5,000. We are waiting to hear back from those sources.

We also will be doing numerous fundraisers, many of which we have already begun. The main one will be a raffle auction event during one of our accepted student's day.

We also plan on selling rocket space for our full-scale rocket to be launched in Huntsville. This will be sold through the Christmas season, possibly raising around $1000 - $1500 dollars for our project.

Further efforts will be made to fundraise for the complete projects. More fundraisers will be occurring until the completion of the project. We are actively searching for and applying to grants, and we have contacted dozens of local businesses with hopes of a donation, sponsorships, or any type of monetary donation. We have already received a donation of $50 from one of these local businesses: NTM Engineering. With all of these fundraisers, grants, and donations, we will be able to raise enough to pay for the completion of the 2017 - 2018 SL project.

P.4 - 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 sending them regular reports, maintain an active dialogue with them and taking their feedback into account. Our current relationships are with several certified NAR members and The PA Space Grant Consortium. Now in keeping a steady stream of new members coming into the club we will primarily recruit new members engineering classes at York College. We will be using a combination of announcements, posters, and our website to get the word to potential club members. 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
- 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.
- 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.
- 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 York College of Pennsylvania. 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 York College.