St. Monica’s Rocketry Team

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Proposal for:

2023 NASA Student Launch

September 19, 2022

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II. Contact Information

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Student Safety Officer

John Paul Sebestyen
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Student Participants

St. Monica's Rocketry Team size of twenty members:
Terese Wilder, Adam Wilder, Adriel Lekovic, Amelia Lekovic, Ted Kelly, Mary Kelly, Peter Schwenk, Will Hopkinson, Blaise Seidman, Damien Seidman, Patrick Heffernan, Christopher Gawley, Lulu Gawley, Brian Daniels, Sullivan Bradley, John Paul Sebestyen, Danilo Lopez, Anna Johnston, Naomi Gawley, Jeriamah Shea, Vivienne Bournos

III. Students Hours Participating

Each sub team has met several times beginning in September to work on the NASA Student Launch. Design has met six times for a total of 14 hours. Recovery has met six times for a total of 14 hours. Payload has met seven times for a total of 15 hours. In addition, twelve of the team members have spent an average of 15 hours building high power rocket kits in order to achieve their high-power rocketry certification through the Tripoli Mentorship program. The team had planned to take the certification test and fly their level 1 rockets at the METRA club launch on September 3rd; however, because of dry conditions, that launch was cancelled. We hope to be able to become certified at the next METRA launch on October 1st.

IV. Design Review Timeslots

The times during the week that our team would be available for design reviews are:

Monday 3:30-4:30 p.m.

Tuesday 8:30-9:30 a.m.

Thursday 4:00-5:00 p.m.

V. Acronym Dictionary

AGL = Above Ground Level

APCP = Ammonium Perchlorate Composite Propellant

CDR = Critical Design Review

CG = Center of Gravity

CP = Center of Pressure

EIT = Electronics and Information Technology

FAA = Federal Aviation Administration

FN = Foreign National

FPS = Feet Per Second

FRR = Flight Readiness Review

HEO = Human Exploration and Operations

LCO = Launch Control Officer

LRR = Launch Readiness Review

MSDS = Material Safety Data Sheet

MSFC = Marshall Space Flight Center

NAR = National Association of Rocketry

PDR = Preliminary Design Review

PLAR = Post Launch Assessment Review

PPE = Personal Protective Equipment

RFP = Request for Proposal

RSO = Range Safety Officer

SLI = Student Launch Initiative

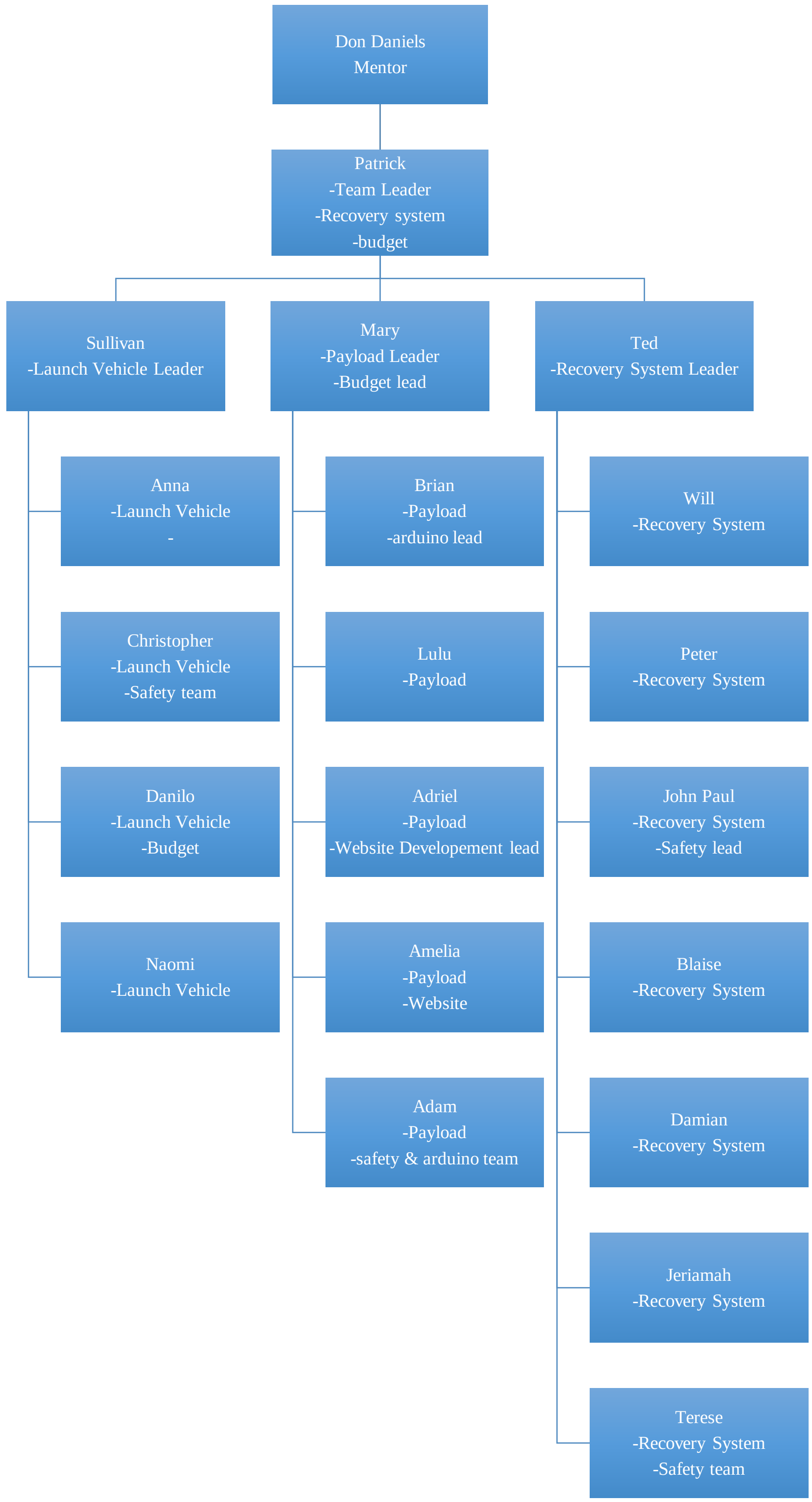
SME = Subject Matter Expert

SOW = Statement of Work

STEM = Science, Technology, Engineering, and Mathematics

TRA = Tripoli Rocketry Association

VI. Team Structure



VII. Team Descriptions

Design

The Design Team is responsible for designing, choosing materials, simulating rocket flights, motor selection and overall rocket build. Their efforts will heavily impact the overall rocket design. The Design Team will also perform simulations on various websites to help predict the speed, performance, and altitude of the rocket. The results of these simulations will help determine the choice of motor and design.

Recovery

The Recovery Team will handle the recovery system, which will control the descent rate, track the rocket, and measure its altitude. The recovery system will be using dual deployment, which will separate the rocket into two parts. The drogue parachute will be deployed first, soon after apogee (when the rocket reaches its highest altitude). The main parachute and will then deploy at a lower altitude, no lower than 500 feet. In addition to the two parachutes, the Recovery Team will also be adding a GPS inside the electronics bay to locate where the rocket lands. The recovery system will also require two altimeters so that, in case one altimeter dies in the air, there will still be a second altimeter to read. The recovery will be placed in the electronics bay, which will be located inside the coupler, in between the booster and sustainer.

Payload

The Payload Team's job is to design and execute an experiment that will travel with the rocket and return safely to the ground. The experiment will be able to fit inside the payload section of the rocket and the experiment is designed to return to the ground safely. The Payload Team will design the payload in compliance with NASA's requirements and will build it so that very few things can go wrong.

VIII. Facilities and Equipment

Facilities

Our meetings are held at the home of team mentor Don Daniels who has all the tools required in his workshop. We meet every Monday from 7 to 9 p.m. and every Saturday from 8 a.m. to 12 p.m. If we need to meet more often or at another time, Mr. Daniels allows us to use his workshop as long as an adult is present.

Necessary Personnel

Don Daniels	Team Mentor
Stephen Wilder	Team Mentor

Leanne Bradley	Payload Mentor
Eddie Lopez	Design Mentor
Steve Sebestyen	Recovery Mentor
Amy Heffernan	Document Mentor
Amy Kelley	Editorial Consultant, Budget Mentor

Equipment and Supplies

- Soldering station
- Drill press
- Hand tools
- Vacuum press
- Dremel
- Table saw
- Power sander
- Laptop computers
- Miter saw
- Prusa Mk2 3d printer
- 02 Monitor
- Algae sample
- Aquarium with bubbler
- Graduated cylinder

Software

- Microsoft Word
- Microsoft Excel
- OpenRocket
- RockSim
- Microsoft PowerPoint
- Wix
- On-Shape

IX. Safety

This section provides an overview of one of the most critical parts of the project: safety. The St. Monica's Rocketry team has a chief safety officer, John Paul Sebestyen, who is responsible for overall safety of the program as part of ensuring mission success. A safety plan has been developed to keep all onlookers and team members safe. The St. Monica's team has signed a safety agreement as part of our safety compliance program. The safety plan was also discussed with all the team members. The safety agreement is found on page 14 of this document.

The safety officer, John Paul Sebestyen, will be responsible for safety during all phases of the endeavor, including the design of vehicle and payload, construction of vehicle and payload components, assembly of vehicle and payload, ground testing of vehicle and payload, subscale launch test(s), full-scale launch test(s), competition launch, recovery activities, and STEM engagement activities.The safety officer will monitor and review all hazards as necessary; potentially hazardous stages include, but are not limited to, assembly, launch and recovery. He will also update and maintain MSDS/chemical inventory data. The safety officer acknowledges that failure to comply with the safety requirements will result in the team not being allowed to launch their rocket. In addition, each subteam has their own safety officers.

The Recovery Ream safety officer is Terese Wilder.

The Payload Team safety officer is Adam Wilder.

The Design Team safety officer is Christopher Gawley.

Our safety program is outlined below:

Compliance

All federal, state, and local laws, including FAA regulations, will be followed by the team mentor, team leader, educator administrator and the team as a whole. The relevant federal safety code of applicable FAA Reg. Part 101: Subpar C-Amatuer Rockets and the NAR/TAR Rocket Motor Safety Plan have been reviewed by each team member and a printed copy of each is located in our red safety binder, which is located in our work area. The rules listed by NAR/TRA will also be followed by the team. The RSO and LCO at the launch site will have full cooperation from the team. All rules will be followed throughout the process from design all the way to the competition launch and recovery on the field or in the construction room.

Safety Briefing Plan

The location of all safety equipment will be reviewed with all team members at the first construction meeting. The proper use of all materials and tools will be demonstrated by Mr. Daniels. All safety regulations and warnings will be reviewed prior to each meeting with respect to all relevant materials, tools, and equipment used during that meeting. MSDS sheets, safety instructions, and all applicable laws will be kept in a red binder labeled “Safety, Laws, and Compliance” in the work area where all of the team members know where they are and can consult them when working with materials. The safety rules outlined below will be reviewed with the team at the beginning of each meeting.

During all construction, assembly, launch, and recovery the following safety rules will be followed:

- Personal protective equipment, including gloves and epoxy masks, must be used when working with epoxy. Also, all manufacturing instructions and safety guidelines will be followed when working with epoxy.
- When necessary, extra ventilation will be used, including, but not limited to, when working with epoxy, sanding fiberglass, and soldering iron.
- Supervision is not needed for non-powered hand tools.
- When using spray paint, personal protective equipment, including masks and clothes suitable for the use of paint, will be worn. The area in which we are using paint will be well ventilated. We will also follow all guidelines and instructions for using spray paint.
- When handling fiberglass, all safety requirements will be followed including the use of personal protective equipment including respirators, gloves, long sleeves, and safety glasses.
- High-powered tools (such as the tablesaw and miter saw) will be supervised directly by Mr. Daniels.
- There will be a fire extinguisher at all construction meetings and launches and first aid kit.

Before any flight:

- Acceptable descent rates specified for our recovery systems must be indicated by simulations.
- Prior to flight, checklists will be completed and signed off on by the safety officer.
- Exit rail speed of at least 52 FPS must be achieved in simulation flight.
- A stable flight and descent must also be achieved in simulation.
- Two body tube calipers (8 inches) – will be the minimum rocket stability margin.
- The thrust-to-weight ratio must be a minimum of 5-1 for stability.
- A non-flammable container in a well-ventilated area will be used to charge lithium polymer batteries.

X. St. Monica's Rocketry Team Safety Compliance Agreement

- I agree to ensure safety as the highest priority for all team members and spectators
- I will follow the rules of the National Association of Rocketry Model Rocket Safety Code.
- All instructions and safety guidelines will be followed in the construction of the rocket including the use of: tools, paint, materials, and glues.
- A range safety inspection of each rocket will be conducted before flying the rocket and we will comply with the safety inspections results.
- All directions given by the Range Safety Officer will be followed directly, and I understand that if there is some safety issue, he can deny the flight of our rocket.
- I agree that the failure to abide by any and all safety guidelines may result in my own termination from the group or my entire team.
- I agree that the Range Safety Officer can deny the flight of our rocket for safety issues.

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Sign William Hopkinson	Sign Naomi Gawley	Sign Brian Daniels
Print Peter Schwenk	Print Anne Johnston	Print Adam Wilder
Sign peter Schwenk	Sign anne Johnston	Sign Adam AW
Print Danilo Lopez	Print Teres Wilder	Print Edmund Kelley
Sign Danilo Lopez	Sign Terese Wilder	Sign Ed Kelley
Print Christopher J. Gawley	Print Vivienne Bournos	Print Mary Kelley
Sign Christopher Gawley	Sign Vivienne Bournos VB	Sign Mary Kelley
Print Blaise Seidman	Print Patrick Heffernan	Print Lulu Gawley
Sign Blaise Seidman	Sign Patrick Heffernan	Sign Lulu Gawley
Print John Paul Sebestyen	Print Sullivan Bradley	Print Amelia Lekovic
Sign John Paul Sebestyen	Sign Sullivan Bradley	Sign Amelia Lekovic

Jeremiah Shea
J. Shea

Print Adriel Lekovic
Sign Adriel Lekovic

Damian Seidman
Damian Seidman

Figure 1, Safety Compliance Agreement

XI. General Requirements

These are the general requirements below.

Requirements	How Satisfied
1.1 Students on the team must do 100% of the project including design, construction, written reports, presentations, and flight preparation except for assembling the motors and handling black powder or any variant of ejection charges or preparing and installing electric matches (to be done by the team's mentor.) Teams will submit new work. Excessive use of past work will merit penalties.	We will do all the work on the project except for areas that are dangerous. We will submit new work and will not use past work to excess.
1.2 The team will provide and manage a project plan to include, but not limited to the following items: project milestones, budget and community support, checklists, personnel assignments, STEM engagement events, and risks and mitigations.	Our team will submit and execute a plan including (but not limited to) milestones, budget and community support, checklists, people assigned to various aspects of the project, STEM presentations and safety.
1.3 The team shall identify all team members who plan to attend Launch Week Activities by the Critical Design Review (CDR). Team members will include: 1.3.1 Students actively engaged in the project throughout the year 1.3.2. One mentor (see requirements 1.13) 1.3.3 No more than 2 adult mentors	We will determine which team members are going to Launch Week by the Critical Design Review. The members who attend should be actively involved, and at least one mentor but not more than two adult mentors will attend.
1.4 Teams shall engage a minimum of 250 participants in Educational	We will engage a minimum of 250 people in Educational Direct Engagement STEM activities.

Requirements	How Satisfied
Direct Engagement STEM activities in order to be eligible for STEM Engagement scoring and awards.	
1.5 The team will establish and maintain a social media presence to inform the public about team activities.	Our team will establish and maintain a social media presence to tell people about our project. Our website is https://www.stmonicarocketryclub.com/.
1.6 Teams will email all deliverables to the NASA project management team by the deadline specified in the handbook for each milestone. In the event that a deliverable is too large to attach to an email, inclusion of a link to download the file will be sufficient. Late submissions of PDR, CDR, FRR milestone documents shall be accepted up to 72 hours after the submission deadline. Late submissions shall incur an overall penalty. No PDR, CDR, FRR milestone documents shall be accepted beyond the 72-hour window. Teams that fail to submit the PDR, CDR, FRR milestone documents shall be eliminated from the project.	We will email each deliverable to NASA by the deadline indicated in the handbook. We understand that if we are late we will be penalized.
1.7 Teams who do not satisfactorily complete each milestone review (PDR, CDR, FRR) shall be provided action items needed to be completed following their review and shall be required to address action items in a delta review session. After the delta session the NASA management panel shall meet to determine the teams' status	We will work hard to ensure that all milestones are satisfactorily completed by the due dates. If they are not, we will work hard to quickly address any outstanding items.

Requirements	How Satisfied
in the program and the team shall be notified shortly thereafter.	
1.8 All deliverables shall be in PDF format.	We will send all deliverables in PDF format.
1.9 In every report, teams will provide a table of contents including major sections and their respective sub-sections.	We will provide a table of contents including major sections and their respective sub-sections in every report.
1.10 In every report, the team will include the page number at the bottom of the page.	In every report, we will include the page number at the bottom of the page.
1.11 The team will provide any computer equipment necessary to perform a video teleconference with the review panel. This includes, but is not limited to, a computer system, video camera, speaker telephone, and a sufficient Internet connection. Cellular phones should be used for speakerphone capability only as a last resort.	Our team will provide computer equipment necessary to perform a video teleconference with the review panel. This includes, but is not limited to, a computer system, video camera, speaker telephone, and a sufficient internet connection. We will only use cell phones in an emergency.
1.12 All teams attending Launch Week will be required to use the launch pads provided by Student Launch's launch services provider. No custom pads will be permitted at the NASA Launch Complex. At launch, 8-foot 1010 rails and 12-foot 1515 rails will be provided. The launch rails will be canted 5 to 10 degrees away from the crowd on Launch Day. The exact cant will depend on Launch Day wind conditions.	We will use the launch pads provided by Student Launch.

Requirements	How Satisfied
1.13 Each team shall identify a "mentor." A mentor is defined as an adult who is included as a team member, who will be supporting the team (or multiple teams) throughout the project year, and may or may not be affiliated with the school, institution, or organization. The mentor shall maintain a current certification, and be in good standing, through the National Association of Rocketry (NAR) or Tripoli Rocketry Association (TRA) for the motor impulse of the launch vehicle and must have flown and successfully recovered (using electronic, staged recovery) a minimum of 2 flights in this or a higher impulse class, prior to PDR. The mentor is designated as the individual owner of the rocket for liability purposes and must travel with the team to Launch Week. One travel stipend will be provided per mentor regardless of the number of teams he or she supports. The stipend will only be provided if the team passes FRR and the team and mentor attend Launch Week in April.	We have an adult mentor, Don Daniels, who is a member in good standing of NAR.
1.14 Teams will track and report the number of hours spent working on each milestone.	We will track and report the number of hours spent working on each milestone.

XII. Technical Design and Requirements

Launch Vehicle:

Our team decided to base our design on the Wildman Extreme rocket kit from wildmanrocketry.com. The other rocket kits we considered were the Interceptor AAD-98 from

Wildman Rocketry; Mega Initiator, also from wildmanrocketry.com; and the Little John kit from madcowrocketry.com. Our team decided to build using the Wildman Extreme as a base because our team lacks experience with high-powered rocketry and this is a proven design. (In 2018, our team decided to base their work on the same kit but for other reasons.) We intend to use fiberglass for the body tube and nose cone with 8-inch couplers between each section. We decided to use fiberglass for the rocket because it is easy to work with and it is less expensive than carbon fiber. We decided not to use cardboard because although it is cheap it will not be strong enough for our purpose. We decided not to use blue tube because it is hard to work with, it is expensive, and it is heavy.

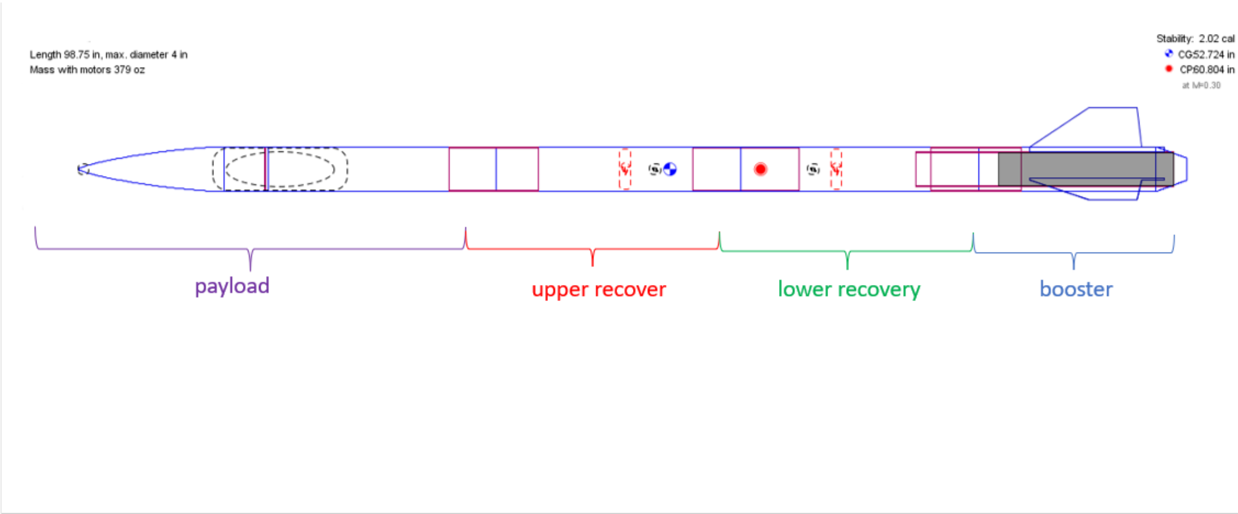


Figure 2, Launch Vehicle

Payload:
Our payload will be a scientific experiment testing how G forces affect the oxygen production of algae. It will be contained in the foremost section of the rocket. This section will be made from fiberglass and styrofoam in the interior to protect the payload equipment.

Forward Recovery:
The forward recovery tube will contain an IFC 84-inch parachute that is high in drag from Fruity Chutes. The second section of the rocket will be made from fiberglass, and the electronics bay will be placed between the forward and aft recovery sections which will contain the GPS tracker and altimeters.

Aft Recovery:
The third section will also be a fiberglass body tube from Wildman. This tube will carry a nylon drogue parachute from Rocketman, and an electronics bay which will house the required redundant altimeters and tracker.

Propulsion

In order to select a motor, we utilized Trustcurve.org and narrowed our choices down to five motors. This section will have a 75 mm motor mount that we can adapt to 54 mm if necessary.

Vehicle Requirements	
Requirements	**How Satisfied**
2.1 The vehicle will deliver the payload to an apogee altitude between 3,500 and 5,500 feet above ground level (AGL).	We will design our rocket to fly between 3,500 and 5,500 feet AGL - no higher or lower.
2.2 Teams shall declare their target altitude goal at the PDR milestone.	We will declare our target goal at the PDR .
2.3 The launch vehicle will be designed to be recoverable and reusable. Reusable is defined as being able to launch again on the same day without repairs or modifications.	We will design our vehicle so that it can be recovered and reused.
2.4 The launch vehicle will have a maximum of four (4) independent sections.	We will have a rocket with four sections which will all be tethered together.
2.4.1. Coupler/airframe shoulders which are located at in-flight separation points will be at least 2 airframe diameters in length. (One body diameter of surface contact with each airframe section).	We will have 2 airframe diameters in length.
2.4.2. Nosecone shoulders which are located at in-flight separation points will be at least ½ body diameter in length.	N/A Our nose cone is not a point of separation.
2.5 The launch vehicle will be capable of being prepared for flight at the launch site within 2 hours of the time the Federal Aviation Administration flight waiver opens.	We will construct our rocket to be ready to fly within 2 hours.

Vehicle Requirements	
Requirements	**How Satisfied**
2.6 The launch vehicle and payload will be capable of remaining in launch-ready configuration on the pad for a **minimum** of 2 hours without losing the functionality of any critical on-board components, although the capability to withstand longer delays is highly encouraged.	We will prepare the rocket to be able to stay on the pad for at least 2 hours. However, we will aim to make it capable of longer wait times.
2.7 The launch vehicle will be capable of being launched by a standard 12-volt direct current firing system.	We will make sure our rocket is able to be launched by a standard 12-volt firing system.
2.8 The launch vehicle will require no external circuitry or special ground support equipment to initiate launch (other than what is provided by the launch services provider).	We will not use external circuitry to initiate launch.
2.9 The launch vehicle will use a commercially available solid motor propulsion system using ammonium perchlorate composite propellant (APCP) which is approved and certified by the National Association of Rocketry (NAR), Tripoli Rocketry Association (TRA), and/or the Canadian Association of Rocketry (CAR).	We will use NAR, TRA, CAR approved ammonium perchlorate composite propellant (APCP) for our rocket.
2.9.1. Final motor choices will be declared by the Critical Design Review (CDR) milestone.	We will declare our final motor choice by the CDR milestone.
2.9.2. Any motor change after CDR shall be approved by the NASA Range Safety Officer (RSO).	We will not change the motor after it has been approved by CDR. If we do, we will need approval from NASA's RSO.
2.10 The launch vehicle will be limited to a single motor propulsion system.	Our launch vehicle will be limited to a single motor propulsion system.
2.11 The total impulse provided by a High School or Middle School launch vehicle will not exceed 2,560 Newton-seconds (K-class).	We will not exceed 2,560 Newton-seconds for our launch vehicle.

Vehicle Requirements	
Requirements	**How Satisfied**
2.12 Pressure vessels on the vehicle will be approved by the RSO and will meet the following criteria:	We will have the pressure vessels approved by RSO.
2.12.1. The minimum factor of safety will be 4:1 with supporting design documentation included in all milestone reviews.	We will have our design include a minimum 4:1 safety factor and we will have documentation of the safety of the design included in the milestone review.
2.12.2. Each pressure vessel will come with a pressure relief valve that sees the full pressure of the tank and that will be capable of withstanding the maximum pressure and flow rate of the tank.	If a pressure vessel is included in our rocket we will also include a pressure relief valve.
2.12.3. The full pedigree of the tank will be highly described, including the application for which the tank was designed and the history of the tank as well.	We will include the information for the tank.
2.13. The launch vehicle will need a minimum static stability margin of 2.0 at the point of the rail exit.	The final design will include a stability margin of at least 2.0.
2.14. The launch vehicle will include a minimum thrust to weight ratio of 5.0 : 1.0.	Our team's rocket will have a minimum 5:1 thrust ratio.
2.15. Any structural protuberance on the rocket will need to be located aft of the burnout center of gravity.	There will not be any structural protuberances on the rocket.
2.16. The launch vehicle will be required to accelerate to a minimum velocity of 52 fps at rail exit.	Our rocket design will be capable of accelerating to an exit velocity of at least 52 fps.

Vehicle Requirements	
Requirements	**How Satisfied**
2.17. All teams will successfully complete a launch and recover a subscale model of their rocket prior to CDR.	Prior to CDR, a subscale model identical to the full-scale rocket will be required to be built, launched, and recovered successfully as a trial for the full-scale vehicle.
2.17.1. The subscale model should resemble and performance identical as possible to the full-scale model.	The subscale model will be built, launched, and recovered with a performance similar as the full-scale vehicle
2.17.2. The subscale model will contain an altimeter capable of recording the model's apogee altitude.	The subscale model will use the same altimeters as will be used in the full-scale vehicle.
2.17.3. The subscale rocket will be a newly constructed rocket, designed and built specifically for this year's project.	We have new ideas and will build a new rocket.
2.17.4. Proof of a successful flight shall be supplied in the CDR report.	We will have proof of a successful launch.
2.17.4.1. Altimeter flight profile graph(s) OR a quality video will be required to show successful launch and recovery events as deemed by the NASA management panel are acceptable methods of proof.	We will take quality video or altimeter flight profile graphs during the launch and recovery events.
2.18. All teams will complete demonstration flights as outlined below.	We will have demonstration flights before the rocket's official flight.
2.18.1. Vehicle Demonstration Flight—All teams will successfully launch and recover their full-scale rocket prior to FRR in its final flight configuration. The rocket flown shall be the same rocket to be flown as their competition launch. The purpose of the Vehicle Demonstration Flight is to validate the launch vehicle's stability, structural integrity, recovery	We will do successful test flights before the official flight, which means all hardware functions properly like the drogue chute at apogee, functioning tracking devices and main chute at the intended lower altitude, etc.

Vehicle Requirements	
Requirements	**How Satisfied**
systems, and the team's ability to prepare the launch vehicle for flight. A successful flight is defined as a launch in which all hardware is functioning properly (i.e. drogue chute at apogee, main chute at the intended lower altitude, functioning tracking devices, etc.). The following criteria shall be met during the full-scale demonstration flight:	
2.18.1.1. The vehicle and recovery system will have functioned as designed.	We will do a successful test flight with our recovery system.
2.18.1.2. The full-scale rocket shall be a newly constructed rocket, designed and built specifically for this year's project.	We may not reuse rockets, and our full-scale rocket must be newly constructed, designed and built specifically for this year's project.
2.18.1.3. The payload does not have to be flown during the full-scale Vehicle Demonstration Flight. The following requirements still apply:	(Information)
2.18.1.3.1. If the payload is not flown, mass simulators will be used to simulate the payload mass.	We must use simulators if the payload is not flown to stimulate the payload mass.
2.18.1.3.2. The mass simulators will be located in the same approximate location on the rocket as the missing payload mass.	We must make sure the mass simulator is located in approximately the same location on the rocket as the missing mass on the payload.
2.18.1.4. If the payload changes the external surfaces of the rocket (such as camera housings or external probes) or manages the total energy of the vehicle, those systems will be active during the full-scale Vehicle Demonstration Flight.	We will make sure external surfaces on the rocket must be active during Vehicle Demonstration Flight if the payload changes.

Vehicle Requirements	
Requirements	**How Satisfied**
2.18.1.5. Teams shall fly the competition launch motor for the Vehicle Demonstration Flight. The team may request a waiver for the use of an alternative motor in advance if the home launch field cannot support the full impulse of the competition launch motor or in other extenuating circumstances.	Our normal launch field has an FAA waiver only up to 2500 feet. We will either seek this permission or we will look for a field further away to conduct this flight in order to use the competition motor for the vehicle demonstration flight.
2.18.1.6. The vehicle shall be flown in its fully ballasted configuration during the full-scale test flight. Fully ballasted refers to the maximum amount of ballast that will be flown during the competition launch flight. Additional ballast may not be added without a re-flight of the full-scale launch vehicle.	We will make sure that there is a full-scale ballast during test flight, and no added ballast without a re-flight on a full-scale launch vehicle.
2.18.1.7. After successfully completing the full-scale demonstration flight, the launch vehicle or any of its components will not be modified without the concurrence of the NASA Range Safety Officer (RSO).	We must not make any modifications after completing a full-scale demonstration without the concurrence of the RSO.
2.18.1.8. Proof of a successful flight shall be supplied in the FRR report.	In our FRR report we provide proof of a successful flight.
2.18.1.8.1. Altimeter flight profile data output with accompanying altitude and velocity versus time plots is required to meet this requirement. Altimeter flight profile graph(s) that are not complete (liftoff through landing) shall not be accepted.	We must make sure that the altimeter flight profile is complete through liftoff and landing. We must also make sure that the altimeter flight profile data output is accompanied by altitude and velocity versus time plot is shown to meet this requirement.
2.18.1.8.2. Quality pictures of the as landed configuration of all sections of the launch vehicle shall be included in the FRR report. This includes but not limited to nosecone, recovery system, airframe, and booster.	We must take pictures as it lands on ALL sections of the vehicle in the FRR report.

Vehicle Requirements	
Requirements	**How Satisfied**
2.18.1.9. Vehicle Demonstration flights shall be completed by the FRR submission deadline. No exceptions will be made. If the Student Launch office determines that a Vehicle Demonstration Re-flight is necessary, then an extension may be granted. THIS EXTENSION IS ONLY VALID FOR RE-FLIGHTS, NOT FIRST TIME FLIGHTS. Teams completing a required re-flight shall submit an FRR Addendum by the FRR Addendum deadline.	We must do our Vehicle Demonstration flight completed by the FRR submission, if given a required re-flight then you shall submit an FRR Addendum by the FRR Addendum deadline.
2.19.2. Payload Demonstration Flight—All teams will successfully launch and recover their full-scale rocket containing the completed payload prior to the Payload Demonstration Flight deadline. The rocket flown shall be the same rocket to be flown as their competition launch. The purpose of the Payload Demonstration Flight is to prove the launch vehicle's ability to safely retain the constructed payload during flight and to show that all aspects of the payload perform as designed. A successful flight is defined as a launch in which the rocket experiences stable ascent and the payload is fully retained until it is deployed (if applicable) as designed. The following criteria shall be met during the Payload Demonstration Flight:	We will make sure that we fly and recover the completed payload prior to the Payload Demonstration Flight deadline. We also understand that the rocket must be the same rocket flown in the competition launch.
2.19.2.1 The payload shall be fully retained until the intended point of deployment (if applicable), all retention mechanisms shall function as designed, and the retention mechanism shall not sustain damage requiring repair.	The payload will not contain a deployment system and all retention mechanisms will function as designed and will not need repair.
2.19.2.2. The payload flown shall be the final version	Our team will fly the final version of the payload.

Vehicle Requirements	
Requirements	**How Satisfied**
2.19.2.3. If the above criteria are met during the original Vehicle Demonstration Flight, the additional flight and FRR Addendum are not required.	We plan to conduct our payload demonstration flight at the same time as the vehicle demonstration flight.
2.19.2.4. Payload Demonstration Flights shall be completed by the FRR Addendum deadline. NO EXTENSIONS WILL BE GRANTED.	We will complete payload demonstration flights by the FRR addendum deadline.
2.20. An FRR Addendum will be required for any team completing a Payload Demonstration Flight or NASA-required Vehicle Demonstration Re-flight after the submission of the FRR report	
2.20.1. Teams required to complete a Vehicle Demonstration Re-Flight and failing to submit the FRR Addendum by the deadline will not be permitted to fly a final competition launch.	If our team is required to complete Vehicle Demonstration Re-Flight and we fail to complete the FRR addendum by the deadline we will not fly.
2.20.2. Teams who successfully complete a Vehicle Demonstration Flight but fail to qualify the payload by satisfactorily completing the Payload Demonstration Flight requirement will not be permitted to fly a final competition launch.	Our team will complete the payload demonstration flight requirement.
2.20.3. Teams who complete a Payload Demonstration Flight which is not fully successful may petition the NASA RSO for permission to fly the payload at launch week. Permission will not be granted if the RSO or the Review Panel have any safety concerns.	If our team fails to complete the Payload Demonstration Flight, we will petition the RSO for permission to fly the payload during launch week.
2.21. The team’s name and Launch Day contact information shall be in or on the rocket airframe as well as in or on any section of the vehicle that separates during flight and is not tethered to the main airframe.	The team’s information will be included on or in the rocket’s airframe.

Vehicle Requirements	
Requirements	**How Satisfied**
2.22. All Lithium Polymer batteries will be sufficiently protected from impact with the ground and will be brightly colored, clearly marked as a fire hazard, and easily distinguishable from other payload hardware.	All lithium polymer batteries will be labeled brightly and clearly colored correctly for easy detection from other payload hardware and will be sufficiently protected from ground impact.
2.23.1. The launch vehicle will not utilize forward firing motors.	Our launch vehicle will not utilize forward firing motors.
2.23.2. The launch vehicle will not utilize motors that expel titanium sponges (Sparky, Skidmark, Metal-Storm, etc.)	Our launch vehicle will not utilize motors that expel titanium sponges.
2.23.3. The launch vehicle will not utilize hybrid motors.	Our launch vehicle will not use a hybrid motor.
2.23.4. The launch vehicle will not utilize a cluster of motors.	Our launch vehicle will not utilize a cluster of motors.
2.23.5. The launch vehicle will not utilize friction fitting for motors.	The launch vehicle will not utilize friction fitting for motors.
2.23.6. The launch vehicle will not exceed Mach 1 at any point during flight.	We must make sure that the rocket does not exceed Mach 1.
2.23.7. Vehicle ballast will not exceed 10% of the total unballasted weight of the rocket as it would sit on the pad (i.e. a rocket with an unballasted weight of 40 lbs. on the pad may contain a maximum of 4 lbs. of ballast).	We will make sure that the ballast does not exceed 10% of the total unballasted weight of the rocket.
2.23.8. Transmissions from onboard transmitters, which are active at any point prior to landing, will not exceed 250 mW of power (per transmitter).	We will make sure that the transmissions from the onboard transmitters do not exceed 250 mW of power (per transmitter).
2.23.9. Transmitters will not create excessive interference. Teams will utilize unique frequencies, handshake/passcode systems, or other means to mitigate interference caused to or received from other teams.	We will make sure that transmitters do not create excessive interference, and we will use unique frequencies, handshake/passcode systems or other methods to mitigate interference.

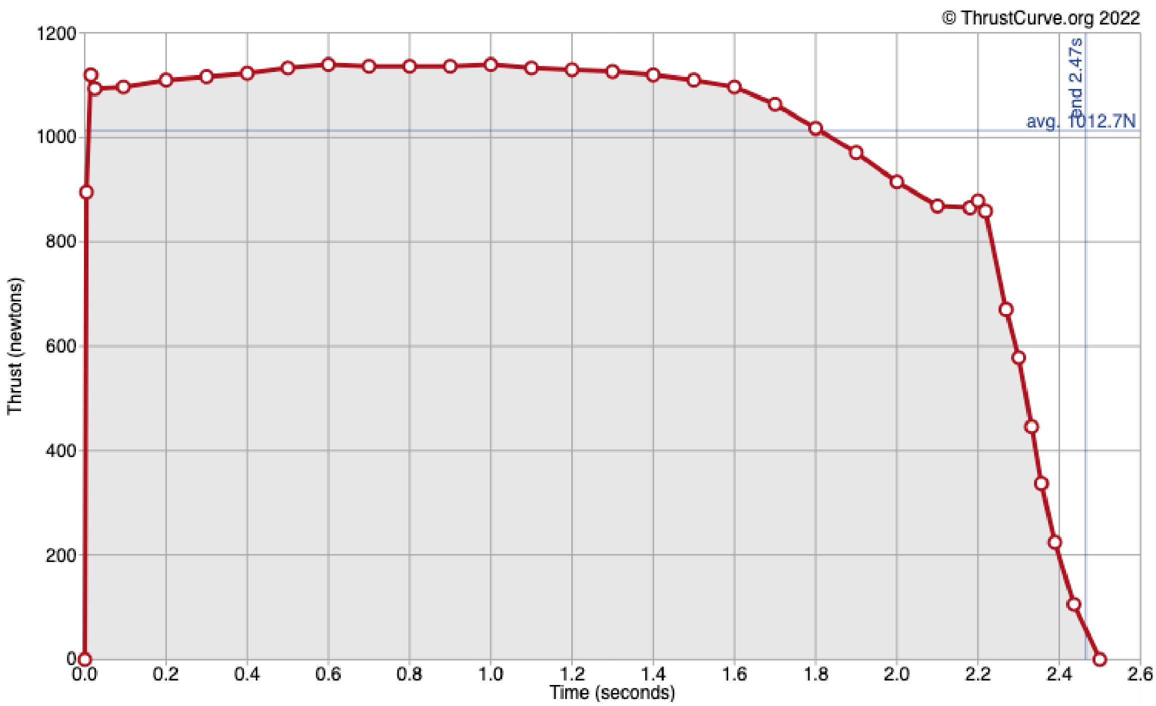
Vehicle Requirements	
Requirements	**How Satisfied**
2.23.10. Excessive and/or dense metal will not be utilized in the construction of the vehicle. Use of lightweight metal will be permitted but limited to the amount necessary to ensure structural integrity of the airframe under the expected operating stresses.	We will not use excessive and/or dense metal in the construction of the vehicle.

Propulsion

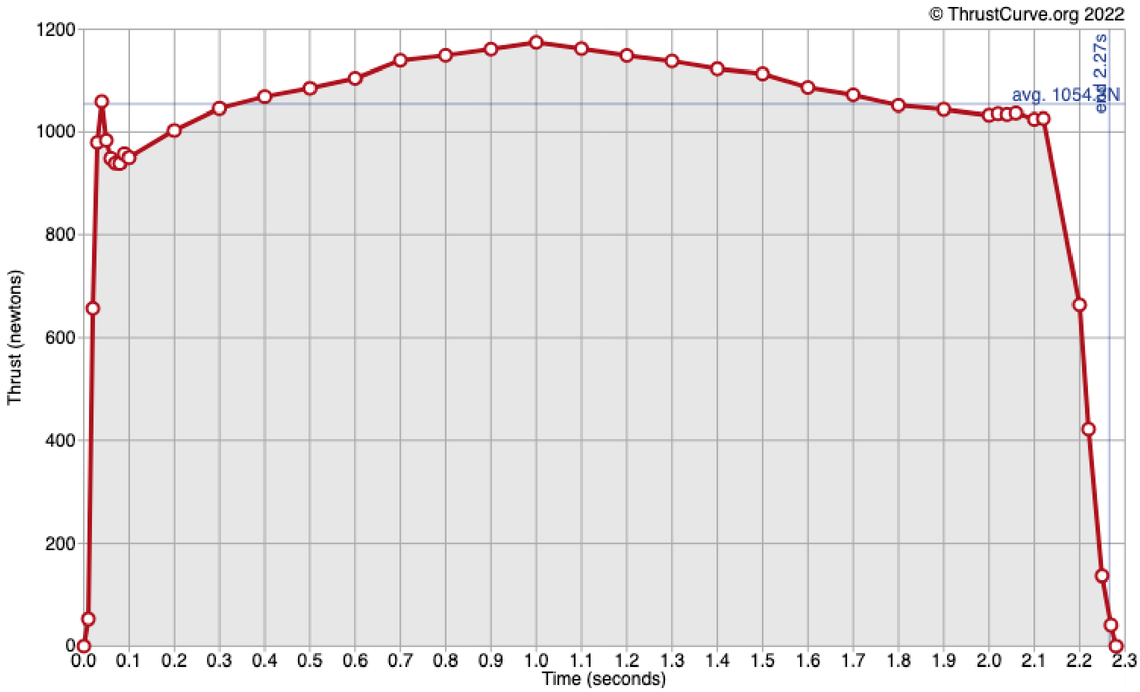
Utilizing Thrustcurve.org we narrowed down our motor choices to five motors. Our design is still preliminary and there is also a limited availability of motors due to current manufacturing/supply chain conditions, so we are not prepared to select the final motor at this time. With a diameter rocket of 4 inches, dry weight of 20 lbs, coefficient drag of 0.75 and a launch guide rail of 96 inches, one motor that simulated well was the Cesaroni K1440 with a thrust-to-weight ratio of 13.4, rail exit velocity (fps) of 81, and altitude (ft) of 4,074. However, there are several other motors that would work well if that one is unavailable:

1. The Cesaroni K1083 has a thrust-to-weight ratio of 9.9, rail exit velocity (fps) 58, and altitude (ft) of 3,980.
2. The AeroTech K1000T has a thrust-to-weight ratio of 9.3, rail exit velocity (fps) of 60, and an altitude (ft) of 3,980.
3. The Aero Tech K1800 has a thrust-to-weight ratio of 15.3, rail exit velocity (fps) of 80, and an altitude (ft) of 3,911.
4. The last motor we are considering is the Cesaroni K2000, with a thrust-to-weight ratio of 18.0, rail exit velocity (fps) of 79, and an altitude (ft) of 3,765.

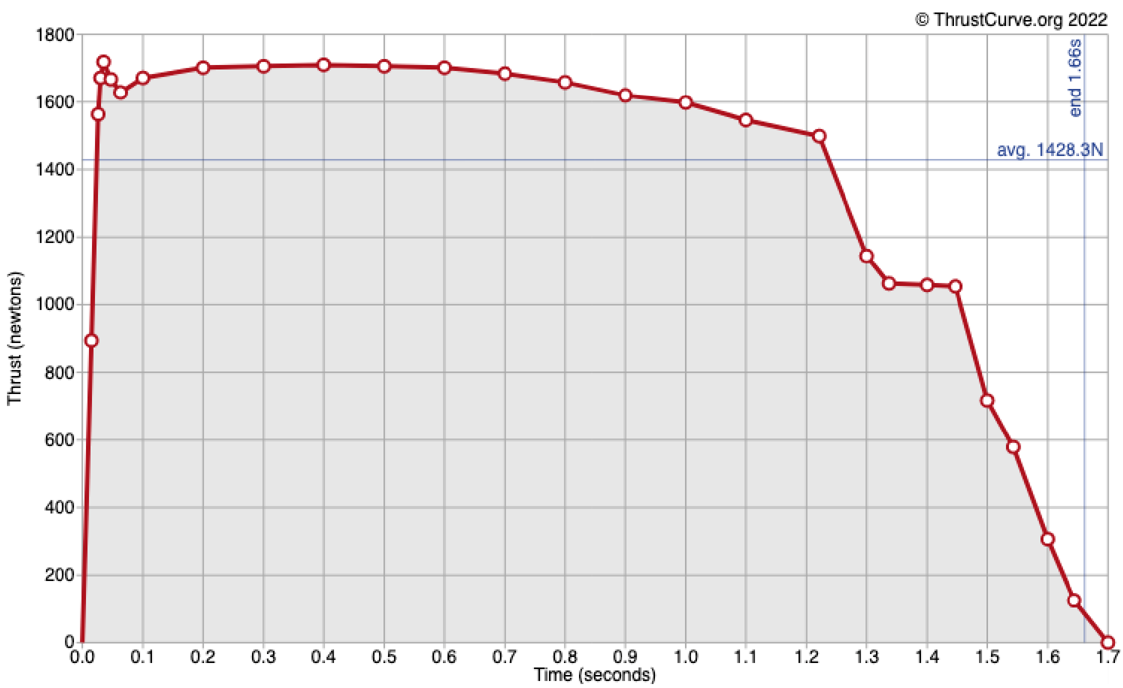
Motor	Manufacturer	Thrust to Weight	Rail exit velocity (fps)	Altitude (ft)
K1000T	AeroTech	9.3	60	3,980
K1085	Cesaroni	9.9	58	3,752
K1440	Cesaroni	13.4	81	4,074
K1800	AeroTech	15.3	80	3,911
K2000	Cesaroni	18.0	79	3,765



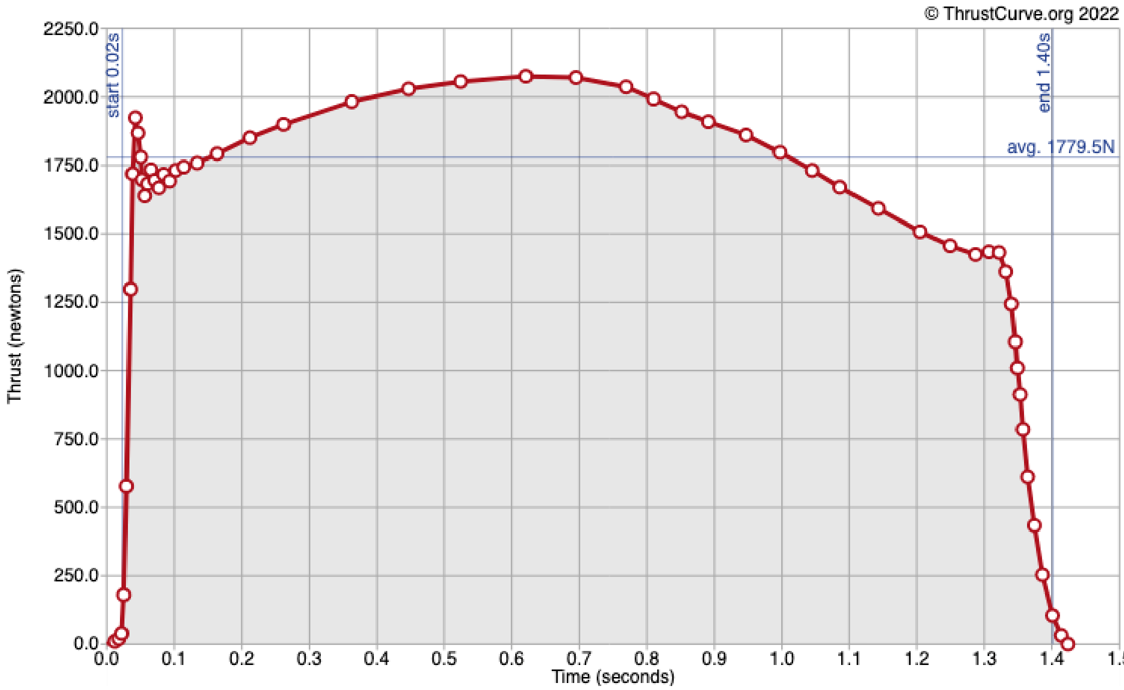
K1000 Thrust Curve



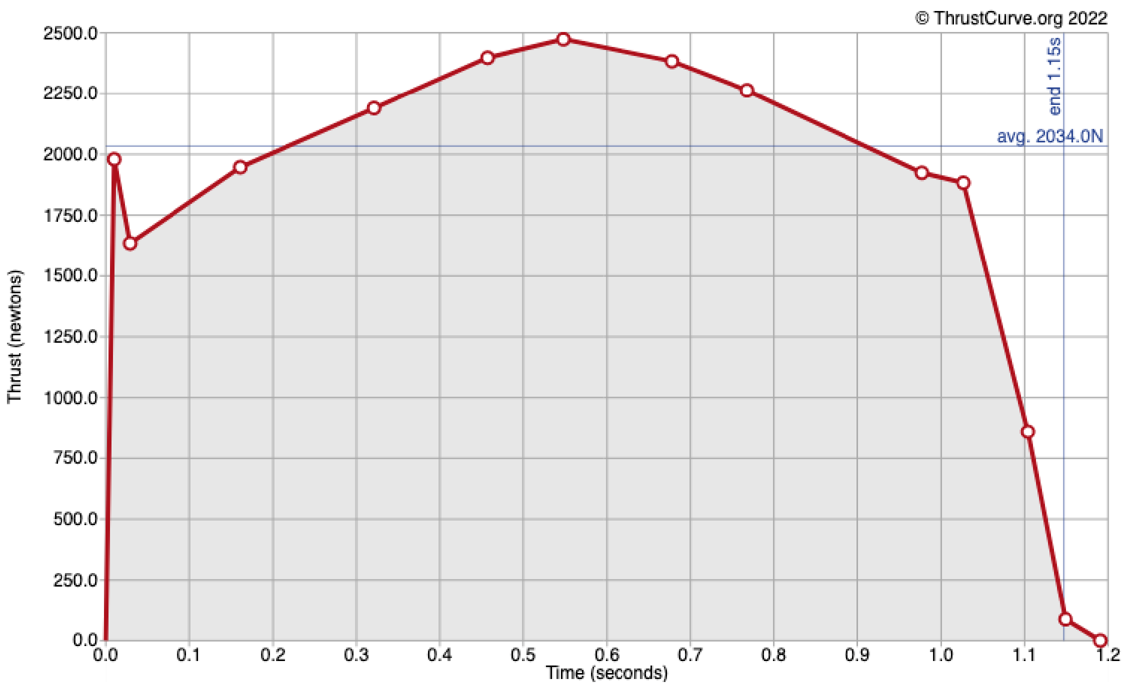
K1085 Thrust Curve



K1440 Thrust Curve



K1800 Thrust Curve



K2000 Thrust Curve

Figure 3, Thrust Curves

XIII. Recovery System

The recovery system is very important to rocketry. The majority of flights that fail do so because of the recovery systems. To land the rocket safely, we will be using a dual-deployment method. This means deploying first a small parachute, and later a larger one that will land the rocket. The small parachute is called a drogue, and the larger one a main. After the rocket reaches apogee it will begin to freefall, and the small drogue parachute will be deployed to slow down the rocket until the main is deployed. The 7-foot main is deployed over 500 feet and will slow the rocket down to the extent that it will be under the 75 IBF kinetic energy maximum. The reason the drogue is deployed prior to the main is the drogue slows down the rocket, but not enough to get it to be below the maximum IBF and if it were bigger, it could catch thermals or cross winds and blow the rocket outside of the area deemed the landing zone. Recovery is very electronics-dependent. For the recovery system, we will be using one StratoLoggerCF altimeter and one Missileworks RRC3 altimeter, two screw switches and two lithium polymer batteries. The altimeters measure the latitude and deploy the parachutes when the correct altitude is reached. We will have a Featherweight 9PS tracker so that if the parachutes cause the rocket to drift away from where we can see it, we will still be able to recover the rocket.

Recovery Requirements	
Requirement	**How Satisfied**
3.1. The full-scale launch vehicle will stage the deployment of its recovery devices, where a drogue parachute is deployed at apogee, and a main parachute is deployed at a lower altitude. Tumble or streamer recovery from apogee to main parachute deployment is also permissible, provided that kinetic energy during drogue stage descent is reasonable, as deemed by the RSO.	Our launch vehicle will contain both a drogue parachute which will come out during apogee and a main parachute which will come out at an altitude of above 500 feet.
3.1.1. The main parachute shall be deployed no lower than 500 feet.	The main parachute will be deployed prior to the rocket reaching 500 feet.
3.1.2. The apogee event may contain a delay of no more than 2 seconds.	The delay element will have a delay of less than 2 seconds.
3.1.3. Motor ejection is not a permissible form of primary or secondary deployment.	Motor ejection will not be used for primary or secondary deployment.
3.2. Each team will perform a successful ground ejection test for all electronically initiated recovery events prior to the initial flights of the subscale and full-scale vehicles.	A ground ejection test will be completed before the initial flights of the subscale and full-scale vehicles.

Recovery Requirements	
Requirement	**How Satisfied**
3.3. Each independent section of the launch vehicle will have a maximum kinetic energy of 75 ft-lbf at landing. Teams whose heaviest section of their launch vehicle, as verified by vehicle demonstration flight data, stays under 65 ft-lbf will be awarded bonus points.	We have calculated our rockets kinetic energy and using the Fruity Chutes Iris 7-foot parachute our 20 pound rocket will come in under the allowed 75 ft-LBF.
3.4. The recovery system will contain redundant, commercially available barometric altimeters that are specifically designed for initiation of rocketry recovery events. The term "altimeters" includes both simple altimeters and more sophisticated flight computers.	We will use the Perfectflight Strattologger CF and the Missleworks RRC3 as our altimeters.
3.5. Each altimeter will have a dedicated power supply, and all recovery electronics will be powered by commercially available batteries.	We will use LiPo batteries as dedicated power supplies for each altimeter and all recovery electronics
3.6. Each altimeter will be armed by a dedicated mechanical arming switch that is accessible from the exterior of the rocket airframe when the rocket is in the launch configuration on the launch pad	We will be using a screw switch which will be easily accessible from the exterior of the rocket while it is sitting on the launch pad.
3.7. Each arming switch will be capable of being locked in the ON position for launch (i.e. cannot be disarmed due to flight forces)	We will use screw switches that are capable of being locked into the ON position by turning the screw.
3.8. The recovery system, GPS and altimeters, electrical circuits will be completely independent of any payload electrical circuits.	The recovery systems, GPS and altimeters, electrical circuits will be separate from the payload electrical circuits.
3.9. Removable shear pins will be used for both the main parachute compartment and the drogue parachute compartment.	We will use removable shear pins in the main and drogue parachute compartments.
3.10. The recovery area will be limited to a 2,500 ft. radius from the launch pads.	We will make calculations to ensure the recovery area is limited to 2500 feet radius from the launch pad.

Recovery Requirements	
Requirement	**How Satisfied**
3.11. Descent time of the launch vehicle will be limited to 90 seconds (apogee to touch down). Teams whose launch vehicle descent, as verified by vehicle demonstration flight data, stays under 80 seconds will be awarded bonus points	We will make sure the descent time of the rocket from apogee to touch down is under 90 seconds
3.12. An electronic GPS tracking device will be installed in the launch vehicle and will transmit the position of the tethered vehicle or any independent section to a ground receiver.	We will install a Featherweight GPS tracker in our launch vehicle and will transmit the location of the tethered vehicle to a ground receiver.
3.12.1. Any rocket section or payload component, which lands untethered to the launch vehicle, will contain an active electronic GPS tracking device.	Each component that is untethered to the launch vehicle will contain an active Featherweight GPS tracking device.
3.12.2. The electronic GPS tracking device(s) will be fully functional during the official competition launch.	Our GPS will be fully functioning during the official competition launch.
3.13. The recovery system electronics will not be adversely affected by any other on-board electronic devices during flight (from launch until landing).	Our recovery system electronics during the flight won't be adversely affected by any other on-board electronic devices.
3.13.1. The recovery system altimeters will be physically located in a separate compartment within the vehicle from any other radio frequency transmitting device and/or magnetic wave producing device.	We will have separate compartments for the altimeters that will be separate from any other radio frequency transmitting devices as well as being separate from any magnetic wave producing devices.
3.13.2. The recovery system electronics will be shielded from all onboard transmitting devices to avoid inadvertent excitation of the recovery system electronics	Our recovery system electronics will be shielded from all onboard transmitting devices.
3.13.3. The recovery system electronics will be shielded from all onboard devices which may generate magnetic waves (such as generators, solenoid valves, and Tesla coils) to avoid inadvertent excitation of the recovery system.	All recovery system electronics will be shielded from any onboard devices that might generate magnetic waves.
3.13.4. The recovery system electronics will be shielded from any other onboard devices which may adversely affect the proper operation of the recovery system electronics	All recovery system electronics will be shielded from other onboard devices which may adversely affect the proper

Recovery Requirements	
Requirement	**How Satisfied**
	operation of the recovery system electronics.

XIV. Payload

Scientific Goal

It takes seven years for astronauts to reach Mars, so maintaining a self-sustaining food supply during the journey is a difficult problem, as is maintaining energy and oxygen needs during that time. Algae can be used to make biofuel under the right circumstances, as well as serve as a food source and to produce oxygen. We researched different algae and then chose Spirulina because it is heat tolerant and it is also a super food that humans can eat. (The FDA classifies Spirulina as a safe food. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3136577/#sec1title.) We will use a vessel that fits a liquid spirulina sample and an oxygen sensor.

The experiment will determine whether Spirulina can survive the gravitational force on the rocket being launched one mile high. The tank we will use will hold approximately .33 pounds of sample. We will have a control sample of algae which will be stationed on the ground. The conditions of the test sample and the control sample of algae will be kept the same. For example, the algae in the control and test group will have the same vessel, the same amount of liquid sample and be kept in the same temperature and same lighting. The vessel will have to be watertight and flexible in the rocket. We will design the vessel to have enough CO_2 for eight hours once we seal the vessel. We will seal both containers at the same time and transport them both to the launch pad, but only the test group will go in the rocket. We will calculate the g-forces with the data from the altimeter. After we have launched and retrieved the test sample, we will compare the oxygen production of the test sample and the control sample. The scientific goal of this experiment is to see if the gravitational forces have any effect on the Spirulina algae. We will determine this by measuring oxygen production.

Technical Challenges and Solutions

We have many new members who are unfamiliar with rocketry, or this is their first exposure to rocketry. Also, we must learn new software as many of us have not worked with Microsoft programs. We will remedy this by listening to our mentors and following NASA's guidelines and rules. All the deadlines have also created new challenges, but we plan to accomplish them on time.

Even though algae is very temperature tolerant, we will have to insulate the rocket to ensure that the algae will not die from extreme heat building up on the launch pad or while waiting for retrieval. Before all of this, we will have to master how to grow and care for algae to produce a success and reliable experiment. To add onto that, programing the Arduino will also be challenging due to the fact that the team is unfamiliar with programming the device. Another challenge would be that we may not get noticeable results from the algae; however, we plan to monitor the algae a few days post flight to see how it dealt with the gravitational forces. Also, if the algae die, we may not know what the cause of their death really was. For instance, even though we will have tested the devices in the payload, when this tube is in the rocket, we will have no way of knowing if it was pressure, temperature, or contamination that caused the algae to die.

Experiment Requirements	
Requirements	**How Satisfied**
4.4.1. Black powder and/or similar energetics are only permitted for deployment of in-flight recovery systems. Energetics shall not be permitted for any surface operations.	Our experiment does not require any energetics or deployment systems.
4.4.2. Teams shall abide by all FAA and NAR rules and regulations.	We will abide by all FAA and NAR rules and regulations.
4.4.3. Any secondary payload experiment element that is jettisoned during the recovery phase will receive real-time RSO permission prior to initiating the jettison event, unless exempted from the requirement the CDR milestone by NASA.	This requirement does not apply to our experiment.
4.4.4. Unmanned aircraft system (UAS) payloads, if designed to be deployed during descent, will be tethered to the vehicle with a remotely controlled release mechanism until the RSO has given permission to release the UAS.	Our payload does not require a UAS.
4.4.5. Teams flying UASs will abide by all applicable FAA regulations, including the FAA's Special Rule for Model Aircraft (Public Law 112-95 Section 336; see https://www.faa.gov/uas/faqs).	Our payload does not require a UAS.
4.4.6. Any UAS weighing more than .55 lbs. shall be registered with the FAA and the registration number marked on the vehicle.	Our payload does not require a UAS.

XV. Project Plan

Figure 4, Project Plan

XVI. Budget

Summary

Expense Budget Summary		
Budget item	**Amount**	**Comment**
Full scale rocket and payload	$ 1,055	Includes payload and electronics
Subscale rocket	350	Do not need electronics or recovery
Motors	770	
Huntsville travel/lodging	12,270	
Educational engagement	350	
Fundraising	900	
Website	220	
Other	400	
Total	$16,315	

Huntsville Trip

Huntsville Trip				
Budget item	**Price**	**Quantity**	**Total**	**Comment**
Hotel/Lodging	$150/night	6 nights	$ 4,770	5 rooms for 25 people per night
Vehicle	$0	3	0	Parents/Chaperone vehicle
Gas/Tolls	$500	3 vehicles	1,500	From Ridgefield to Huntsville and back
Food for 25 people	$40/day	6 days	6,000	Breakfast free/lunch $15/ Dinner $25
Total			$12,270	

Full Scale Rocket and Payload Expense

Booster				Total	
Description	Unit	Unit Price	Quantity	Price	Comments
G12 4" fiberglass airframe	1 foot	$ 23.35	2	46.70	Booster, Exterior Body Tube
G12CT-4.0 Coupler	1 inch	2.86	8	22.88	
G12-3.0 3" fiberglass airframe price per foot	1 foot	22.56	1	22.56	75mm motor mount
FCR4.0-3.0 - Centering Ring 4" TO 75MM fi	1 each	7.70	3	23.10	
3/16 G10 Fiberglass sheet	1 each	30.00	2	60.00	fins
Hardware		10.00	1	10.00	
Paint/Glue		5.00	1	5.00	
			TOTAL	$ 190.24	

Lower Recovery				Total	
Description	Unit	Unit Price	Quantity	Price	Comments
G12 4" fiberglass airframe	1 foot	$ 23.35	2	$ 46.70	Booster, Exterior Body Tube
3.9" G10 Coupler	1 each	2.86	8	22.88	
Rocketman drogue balistick 2 feet	1 each	84.00	1	84.00 *	
18x18 nomax	1 each	25.00	1	25.00 *	
Harness: 3/16" tubular kevlar - 25 ft long, 3	1 each	45.00	1	45.00 *	
Paint/Glue		5.00	1	5.00	
			TOTAL	$ 228.58	

Electronics Bay				Total	
Description	Unit	Unit Price	Quantity	Price	Comments
FBP4.0 98MM Fiberglass airframe bulk plat	1 each	$ 6.60	2	$ 13.20	
FCBP4.0 -4 INCH fiberglass coupler bulk plate	1 each	6.60	2	13.20	
3.9" G10 Coupler	1 inch	2.86	9	25.74	
Featherweight GPS Tracker/Receiver	1 each	165.00	1	165.00 *	
Stratologger CF Altimeter	1 each	69.95	1	69.95 *	We already have this part
Missile works RRC3	1 each	79.99	1	79.99 *	We already have this part
Screw Switch	1 each	3.90	2	7.80	
Charge Holder (3.0g) - pair	1 each	1.32	2	2.64	
Turnigy 300mah 3s 70c	1 each	6.60	2	13.20	
Hardware		10.00	1	10.00	
Paint/Glue		5.00	1	5.00	
			TOTAL	405.72	

Foward Recovery				Total	
Description	Unit	Unit Price	Quantity	Price	Comments
G12 4" fiberglass airframe	1 foot	$ 23.35	2	$ 46.70	Booster, Exterior Body Tube
3.9" G10 Coupler	1 inch	2.86	8	22.88	
FBP4.0 98MM Fiberglass airframe bulk plat	1 each	6.60	1	6.60	
FCBP4.0 -4 INCH fiberglass coupler bulk plate	1 each	6.60	1	6.60	
Fruity Chutes 84 inch Iris ultra compact	1 each	407.97	1	407.97 *	
18x18 nomax	1 each	25.00	1	25.00 *	
Harness: 1/2" Flat kevlar - 25 ft long, 2 loop	1 each	45.00	1	45.00 *	
Hardware		10.00	1	10.00	
Paint/Glue		$ 5.00	1	5.00	
			TOTAL	$ 575.75	

Payload				Total	
Description	Unit	Unit Price	Quantity	Price	Comments
G12 4" fiberglass airframe	1 foot	$ 23.35	2	$ 46.70	
FNC4.0-4.5-1-VK-FW-MT -Nosecone	1 each	93.50	1	93.50	
Paint/Glue		5.00	1	5.00	
Payload Adruino Parts		$ 456.79	1	456.79	This is just a placeholder
			TOTAL	$ 601.99	

TOTAL COST	$ 2,002.28
***Components we already have**	$ (946.91)
TOTAL ADJUSTED COST	$ 1,055.37

XVII. Fundraising

In addition to traditional fundraising efforts such as seeking donations and sponsorships, we will utilize several other methods of raising money.

We will use scrip fundraising programs to raise money through everyday purchases such as groceries, gas, dining out and entertainment. We will raise an average of 6 percent from money spent through RaiseRight and AmazonSmile.

We will also participate in a free ongoing sneaker recycling program through Gotsneakers.com. Each prepaid shipping bag holds 12 pairs of shoes with the potential of $84 per bag depending on the condition of the shoes.

We will contact restaurant and entertainment venues such as JJ Stack's, Chipotle and others to join their fundraising programs through which they donate a percentage of their proceeds for a set time; we will encourage our supporters to patronize these venues and we will get a cut of the money spent.

We will also hold a cinema fundraiser at the Ridgefield Playhouse, charging $10 per ticket for a theater that seats 250 people. (We will show our promotional video before the movie we choose.) We will also rent a bowling alley and host a karaoke night as well. We will reach out to IBM, Danbury Aviation, Mother of Divine Grace School, Raytheon, Xlink, Antiques Restore, and others for sponsorships and donations.

Income from goods and services will come from selling coffee through givingbean.com (40% profit) bake sales, 50/50 raffle at all of our events and on our website.

We will use social media and personal requests to promote funding from family and friends by promoting our Givegosend crowdfunding account and rocketry website, which will include information on all of our campaigns and will round out our fundraising efforts.

Fundraising Proposal:

- Scrip Fundraising $5,000
- Business Fundraising Proceeds $3,500
- Business Sponsorship and Donations $3,000
- Personal Donations $3,000
- Raffle Tickets $1,500
- Income for Good and Services $3,000
- GiveSendGo $2,000
- Total $21,100

XVIII. STEM Outreach

Our team has been participating in rocketry for nine years. We have primarily The America Rocketry Challenge (TARC). Members of the St. Monica's team completed NASA’s 2018 student launch. The goal of St. Monica's Rocketry Team is to reach over 250 people and teach them about, and interest them in, science and rocketry. We will be presenting at various schools, and we will bring rockets we have built to show the audience. We will be presenting to the following schools: Cardinal Kung Academy; Imago Dei; and Regina Pacis Academy. When presenting, we will have a large team presence at each school, except for one school, at which we will show a video presentation covering the same material as our live presentation.

Our website https://www.stmonicarocketryclub.com/ provides a strong social media allowing people to follow along with our journey.

XIX. Risks

Payload Risk Plan

Risk	Proposed Mitigation
Algae contamination	Obtain samples from a lab source that certifies the sample against contamination
Loss or death of spirulina sample prior to flight due to improper handling or care	Fully acquaint all team members on proper handling and care of spirulina
Extreme temperature on sample during flight	Insulation of payload
Container leakage	Make sure container has no leaks or tears and test container under pressure before flight
The shifting liquid spirulina sample may impact the flight path of the rocket	Use a safe volume of liquid spirulina sample
Sensor failure	Check Arduino data after flight, and if it measures zero, we can tell that the sensor failed
Liquid damage to electronics	Make sure container has no leaks or tears and test container under pressure before flight and protect electronics with various waterproof containment.

Propulsion

Risk	Proposed Mitigation
Debris and smoke shooting out from rocket	Review all relevant safety protocols and checklists prior to launch. Only have first class certified individuals on the launch pad
The rocket could come apart/blow up	Make sure trained individuals follow the checklist for motor safety
Unexpected wind can throw the rocket off course	Check wind level before launch

Recovery

Risk	Proposed Mitigation
Recovery system does not deploy	Double check deployment system, and correct any wiring needed
Early/late deployment	Double check wiring and calculations
Rocket catches fire	Ground test, and usage of other wires needed
Wrong sized parachute	Double check calculations and change parachute if necessary

Workshop Risks

Risk	Proposed Mitigation
Fire or heat coming into contact with flammable material or skin	Review all relevant safety protocols and checklists prior to working with fire/flammable materials/heating elements. Use extreme caution when working with fire or heat and have an adult present. Have a fire extinguisher available.
Breathing in toxic fumes from various sources	Use an approved respirator when exposed to chemicals in the workshop
Cuts from tools while working on rocket	Review all proper safety protocols and tool instructions prior to using the tools. Only use tools you have been trained in using and with proper adult supervision. Have a first aid kit available in case of accidents.

Risk	Proposed Mitigation
Improper disposal of various materials (ie. plastic, old batteries, wires etcetera)	Proper disposal of all materials
Dust or debris from cutting tools irritating eyes	Wear proper safety goggles when using cutting tools