2024-2025
First Nations Launch
Competition
Advisor Handbook

REVISED: 1/7/2025
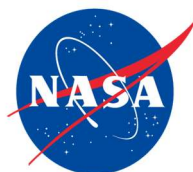
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- Handbook questions

First Nations Launch 2024 - 2025 Program Calendar

Zoom Presentations and Meetings: *https://zoom.us/j/99258659434*

All times listed in Central Time
Central Daylight Savings Time (CDT): March 10, 2024 – November 3, 2024
Central Standard Time (CST): November 3, 2024 – March 8, 2025
Central Daylight Savings Time (CDT): March 9, 2025 – November 2, 2025

September 2024

2	Announcement of Opportunity
17	Informational Meeting @ 4:00 pm CDT (Zoom)

October 2024

4	Visit FNL Booth #1437 at the AISES Conference
7	Launch 2 Learn Registration w/Non-Binding Notice of Intent (NOI) to Compete Due (Level 1 Rocket Certification Workshop @ Carthage College, Nov. 2-3, 2024)
8	Proposal Webinar @ 4:00 pm CDT (Zoom)
15	Informational Meeting @ 4:00 pm CDT (Zoom)
22	TRA/NAR Mentor Webinar @ 4:00 pm CDT (Zoom)
24	Non-binding Notice of Intent to Compete Due* (Moon/Mars)
	Proposal Due* (Moon/Mars)
	Early Bird Registration* (Gateway)
28	Award Announcement (Moon/Mars/Gateway)
29	Kick-off Meeting @ 4:00 pm CDT (Zoom) (Moon/Mars)
30-1	Proposal Virtual Discussions (Zoom) (Moon/Mars)

November 2024

02-03	L2L Level I Rocket Certification Workshop @ Carthage College (registration required)
05	Challenge Parameters Webinar @ 4:00 pm CDT (Zoom)
11	Award Acceptance Material Due* (Moon/Mars)
	Preliminary Budget Due* (Moon/Mars)
12	Introduction to RockSim Webinar @ 4:00 pm CST (Zoom)
19	Project Management Webinar @ 4:00 pm CST (Zoom)

December 2024

02	**PDR Milestone (Moon/Mars)**
	Report Due* (Moon/Mars)
	Flysheet Due* (Moon/Mars)
	RockSIM Due* (Moon/Mars)
03	Structures Webinar @ 4:00 pm CST (Zoom)
09	Notice of Intent to Compete Due* (Gateway)
	Request for Virtual Rocketry Workshop Due*
09-13	PDR Virtual Presentations (Zoom) (Moon/Mars)
16	Award Announcement (Gateway)

January 2025
07   Kick-off Meeting @ 4:00 pm CST (Zoom) (Gateway)
08   Launch 2 Learn Kit Reveal @ 4:00 pm CST (Zoom)
13   Award Acceptance Material Due* (Gateway)
14   Gateway Project Management Webinar @ 4:00 pm CST (Zoom)
17-18   Launch 2 Learn Rocket Certification Virtual Workshop (Registration Required)
21   Avionics/Altimeters Webinar @ 4:00 pm CST (Zoom)
27   **Critical Design Review (CDR) Milestone**
        CDR Report Due* (Moon/Mars)
        Flysheet Due*(Gateway/Moon/Mars)
        RockSim Due* (Gateway/Moon/Mars)
        Budget Due* (Gateway/Moon/Mars)
        Budget Due* (Gateway/Moon/Mars)
        Flight Demo Due* - *Upload rocket demo flight video on Facebook and/or X and add link to Team Application*

February 2025
03   Final Requests to Change to Different Competition Challenge Due *
03-07   CDR Virtual Presentations Continued (Zoom) (Gateway/Moon/Mars)
11   Recovery Webinar @ 4:00 pm CST (Zoom)
17   Patch Design Entries Due*
        Final Motor Selection Due* (Gateway/Moon/Mars)
        Official Team Roster & Lodging List Due* (Gateway/Moon/Mars)
        Team Bio Due* (Gateway/Moon/Mars)
        Team Photo Due* (Gateway/Moon/Mars)
        All Team Member Registration on WSGC Website & FNL Application Due* (Gateway/Moon/Mars)
18   Advisor/Mentor Meeting @ 4:00 pm CST (Zoom)
26-28   Gateway Interim Review (Zoom)

March 2025
03   Reimbursements Due* (First payout) (Gateway/Moon/Mars)
04   Build & Assembly Techniques Webinar @ 4:00 pm CST (Zoom)
17   **Flight Readiness Review (FRR) Milestone**
        FRR Report Due* (Moon/Mars)
        Flysheet, RockSim, Educational Outreach Forms Due* (Gateway/Moon/Mars)
        TRA/NAR Team Membership Information Form Due - email to cengberg@carthage.edu
24-28   FRR Virtual Safety Inspection (Zoom) (Gateway/Moon/Mars)

April 2025

08	Launch Operations Webinar @ 4:00 pm CDT (Zoom)
09-11	Final Virtual Safety Inspections with Tripoli Rocketry Association (Zoom) (Gateway/Moon/Mars)
15	Advisor/Mentor Meeting @ 4:00 pm CDT (Zoom)
21	Oral Presentations PPT Due* (Gateway/Moon/Mars)
24	Teams Arrive in Kenosha, Wisconsin
25	Welcome Breakfast/Competition Kick-off @ 8:00 am CDT - Carthage College, Kenosha, WI
	Team Workday, Motor Build Workshop, Breakout Sessions, Final Safety Inspections of Rocket, Oral Presentations
26	Launch Day @ 7:30 am – 3:00 pm CDT – Richard Bong Recreational Park, Kansasville, WI
	Closing Banquet @ 6:30 pm CDT – Carthage College
27	Launch Rain Date
30-04	Student Launch Initiative (Next Step Award 2024)

May 2025

12	Final Reimbursements Due*
	Post Launch Assessment Review (PLAR) Report Due* (Gateway/Moon/Mars)
	2-3 Team Project Photos Due*

June 2025

02	Notification of Winners
TBD	RockOn! 2025 @ Wallops Flight Facility (Next Step Award 2025)

Summer 2025

TBD	Grand Prize Trip to a NASA Center (Moon/Mars Grand Prize Winners)

April 2026

TBD	Student Launch 2025 (Next Step Award 2025)

*Document submissions shall be uploaded to the WSGC application website by the team lead.
Submissions received after 11:59 pm CDT/CST will be considered late.*

Schedule subject to change.

Acronym Dictionary

AGL = Above Ground Level

AISES = American Indian Science and Engineering Society

APCP = Ammonium Perchlorate Composite Propellant

CDR = Critical Design Review

CG = Center of Gravity

COTS = Commercial off-the-Shelf (i.e., store bought)

CP = Center of Pressure

EIT = Electronics and Information Technology

FAA = Federal Aviation Administration

FNL = First Nations Launch

FPV = First Person View

FRR = Flight Readiness Review

GPS = Global Positioning System

HPR = High-Power Rocketry

LCO = Launch Control Officer

LRR = Launch Readiness Review

MSDS = Material Safety Data Sheet

NAR = National Association of Rocketry

NASA = National Aeronautics and Space Administration

NASNTI = Native American Serving Non-Tribal Institution

NFPA = National Fire Protection Association

PDR = Preliminary Design Review

PLAR = Post Launch Assessment Review

PPE = Personal Protective Equipment

RPM = Revolutions per Minute

RSO = Range Safety Officer

SME = Subject Matter Expert

SOW = Statement of Work

STEM = Science, Technology, Engineering, and Mathematics

TCU = Tribal Colleges and Universities

TRA = Tripoli Rocketry Association

WSGC = Wisconsin Space Grant Consortium

Glossary

NASA Space Grant Consortium

The mission of the NASA Space Grant Consortium is to enhance higher education opportunities for students seeking to pursue careers in the fields of science, technology, engineering and math (STEM); to enrich and improve STEM Education at diverse pre-college, college, university and community learning centers; and to provide public outreach for NASA missions, and thereby strengthen the future workforce for NASA and our nation. Each state has a Space Grant Office – to find your state's host institution and specific programs (or funding support), see https://www.nasa.gov/stem/spacegrant/home/Space_Grant_Consortium_Websites.html.

Wisconsin Space Grant Consortium (WSGC)

The host Space Grant Consortium, located at Carthage College in Kenosha, WI. https://spacegrant.carthage.edu/

First Nations Launch (FNL)

One of many programs created and hosted by WSGC. It is the only high-power rocketry competition dedicated to support American Indian and Indigenous students. First Nations Launch is a NASA Artemis Student Challenge. https://spacegrant.carthage.edu/first-nations-launch/

American Indian Science and Engineering Society (AISES)

AISES is a national nonprofit organization focused on substantially increasing the representation of Indigenous peoples of North America and the Pacific Islands in science, technology, engineering, and math (STEM) studies and careers. https://www.aises.org/

Tripoli Rocketry Association (TRA)

A national non-profit organization (similar to AISES) whose mission is to promote the sport of high-power rocketry and ensure its continued safety and success. TRA usually promotes larger high-power rocket launches. Local chapters or 'prefectures' exist across the country, which hold monthly meetings and launches when permissible. http://www.tripoli.org/

National Association of Rocketry (NAR)

A national non-profit organization (similar to AISES) whose mission is to promote the sport of high-power rocketry and ensure its continued safety and success. NAR usually promotes smaller low-power rocket launches. Local chapters exist across the country, which hold monthly meetings and launches when permissible. https://www.nar.org/

Federal Aviation Association (FAA)

The organization that regulates the airspace above the United States, and determines the laws that govern safe high-power rocketry among other things (such as private and commercial airplanes, rockets, drones, rotorcraft etc.). TRA and NAR organizations must understand and adhere to the regulations set forth by the FAA. TRA and NAR can also petition changes to those regulations. https://www.faa.gov/

WSGC Technical Advisor

The primary technical advisor of First Nations Launch (the Wisconsin Tripoli Prefect and Launch Weekend RSO).

Team Advisor (Faculty Advisor)

Usually an educator (faculty or staff at the institution), responsible for administrative duties for the team, providing support for the students (securing a workspace, securing financial support, keeping students on task, ensuring team meets deadlines), and liaising with FNL – does not need to have a STEM or technical background, but encouraged. The Team Advisor will also assist in coordinating team travel for Launch Weekend.

Team Mentor

Not necessarily affiliated with the school, this person is TRA or NAR certified and experienced with building and flying high-power rockets. The Team Mentor should be a local individual, who can visit the school and assist with and monitor the build. If a local mentor is unavailable, a Team Mentor may assist a team virtually. Team mentor may also facilitate any static testing, flight testing (at a local TRA or NAR field) and hazardous materials procurement and handling (motors, energetics). The Team Mentor is strictly a volunteer role. Mentors may apply for a $500 travel stipend to attend the First Nations Launch competition in Kenosha, WI.

High-Power Rocketry

A hobby similar to model rocketry. The major difference is that higher impulse range motors are used. The National Fire Protection Association (NFPA) definition of a high-power rocket is one that has a total weight of more than 1,500 grams (3.3 lb.) and contains a motor or motors containing more than 125 grams (4.4 oz) of propellant and/or rated at more than 160 Newton-seconds (40.47 lbf·s) of total impulse, or that uses a motor with an average thrust of 80 newtons (18 lbf) or more. https://en.wikipedia.org/wiki/High-power_rocketry

Avionics Bay

Usually the section of the rocket that houses the altimeters (or electrical devices) that control the recovery subsystem for the vehicle. Electronics that are used for tracking may also be housed in the avionics bay. Electronics that are used for payload/challenge control, or deployment or sampling are usually not a part of the avionics (they would be referred to as payload/challenge electronics), even if they are housed in the same area as the vehicle avionics. Payload/challenge electronics would have their own electrical circuit and power source.

Payload

Used to describe the 'cargo' that the rocket vehicle is designed to carry. A conventional payload would integrate inside of the rocket tube, usually behind the nose cone. An unconventional payload could consist of external hardware that is used to control the vehicle, or alter its appearance.

Challenge

This term is used to describe all of the parameters of the particular challenge for the year. There are four (4) general challenge categories, which are rotated within a four-year cycle:

1. Avionics Challenge - the focus would be on an electronics payload/challenge integrated into the rocket.
2. Payload Challenge - the focus would be on a 'payload/challenge' contained within the rocket.
3. Stability Challenge - the focus would be on controlling or modifying the stability of the rocket.
4. Structure Challenge - the focus would be on the airframe and construction of the rocket.

See the Challenge Requirements Section of this Handbook for Challenge details for current competition.

Rail Size and Rail Button Size
There are various ways to attach a high-power rocket to a launch rail (and there are various launch rail types), which is dependent on the size and weight of the rocket. In FNL we require the use of rail buttons. These rail buttons come in two sizes – 1010 rail button (considered small, for use with a 6-foot, 1 in^2 rail) or a 1515 rail button (considered large, for use with a 10-foot, 1.5 in^2 rail). Ensure your simulations are configured correctly to account for the proper rail button size.

Rail Exit Velocity (Launch Guide Departure Velocity)
This parameter is important to monitor during simulations, as this value will affect the rocket stability in flight. There is a minimum value to be attained in order to maintain a stable flight (52 feet per second). Meeting the rail exit velocity requirement in simulations (and in flight) can be done by modifying the weight, shape, and features (such as rail buttons) of your rocket. Refer to Notes and Suggestions, Technical Note 2.g. for launch rail length.

Thrust-to-Weight Ratio
This parameter is important to monitor during simulations, as this value will affect the rocket stability in flight. The standard minimum thrust-to-weight ratio is 5-to-1 (written 5:1). This means the motor selected should provide 5 times the amount of average thrust when compared to the weight of the fully loaded rocket. It is easiest to use the (average) motor thrust in pounds to determine your estimated thrust-to-weight ratio.

Time-to-Apogee
This parameter is important to understand during simulations, as this will be used to set motor ejection delay during your flight. It also is an indicator that your simulations are working correctly, as time to apogee should be in the 10 – 15 second range.

Statement of Work (Engineering Parameters)

Design, Development and Launch of a Reusable Rocket and Payload/Challenge: Statement of Work

Activity Name: WSGC First Nations Launch
Governing Office: Carthage College, Wisconsin Space Grant Consortium

About the Program

NASA Wisconsin Space Grant Consortium's First Nations Launch (FNL) National High-power Rocket Competition is a NASA Artemis Student Challenge that provides an opportunity for students attending a Tribal College or University, a Native American-Serving Nontribal Institution (NASNTI), or who are active members of an American Indian Science and Engineering Society (AISES) collegiate chapter at a non-TCU/NASNTI university/college to design, build, and fly a high-power rocket to be launched at a competition at the Richard Bong State Recreational Area in Kansasville, WI.

Purpose

The Wisconsin Space Grant Consortium (WSGC) First Nations Launch (FNL) competition offers Tribal Colleges and Universities (TCU), Native American Non-Tribal Institutions (NASNTI) as well as active American Indian Science and Engineering Society (AISES) college chapters the opportunity to demonstrate engineering and design skills through direct application in high-power rocketry. The competition requires teams of undergraduate students to conceive, design, fabricate and compete with high-power rockets. FNL is a 'First Step' experience designed for students with no prior experience working with high-power rockets. Rocket motors and dimensions are restricted by competition parameters so that knowledge, creativity, and imagination of the students are challenged. The end result is a great aerospace learning experience unique to the Native American communities.

The purpose of First Nations Launch is to support the innovative, visionary projects that are student-led and designed to fully realize WSGC's goal of assisting in training the next generation of aerospace professionals.

Eligibility

Wisconsin Space Grant Consortium seeks proposals from TCUs, NASNTIs, as well as colleges/universities with active collegiate AISES chapters to conduct the WSGC First Nation Launch (FNL) during the 2023-2024 academic year.

Notice of Intent (NOI) to participate will be accepted from any TCU, NASNTI, or collegiate AISES chapter. Following the proposal acceptance, teams will complete a series of design reviews, which are discussed further in the Program Milestones section of this handbook.

FNL Challenges

Teams may choose to compete in any challenge. There are no restrictions or requirements for team eligibility. However, WSGC recommends new teams, teams with all new members, and non-engineering school teams enter the Gateway or Moon Challenges, while experienced teams and engineering school teams enter the Mars Challenge.

The requirements to compete in FNL for 2024-2025 are as follows. Review the linked division handbooks for specific division challenge parameters.

Gateway Challenge: Gateway Challenge Handbook

Teams shall design and construct a dual deploy high-power rocket from a list of possible kit combinations. There is no payload/challenge associated with this challenge, with focus being on the safe and complete selection, simulation, procurement, assembly/fabrication, and flight of the kit rocket. The flight shall be stable and reach an apogee between 2200' - 2800' AGL. The rocket should satisfy all other technical requirements as outlined in the following Requirements sections.

FNL Gateway 2024
Flight Profile
Altitude 2200' - 2800' AGL
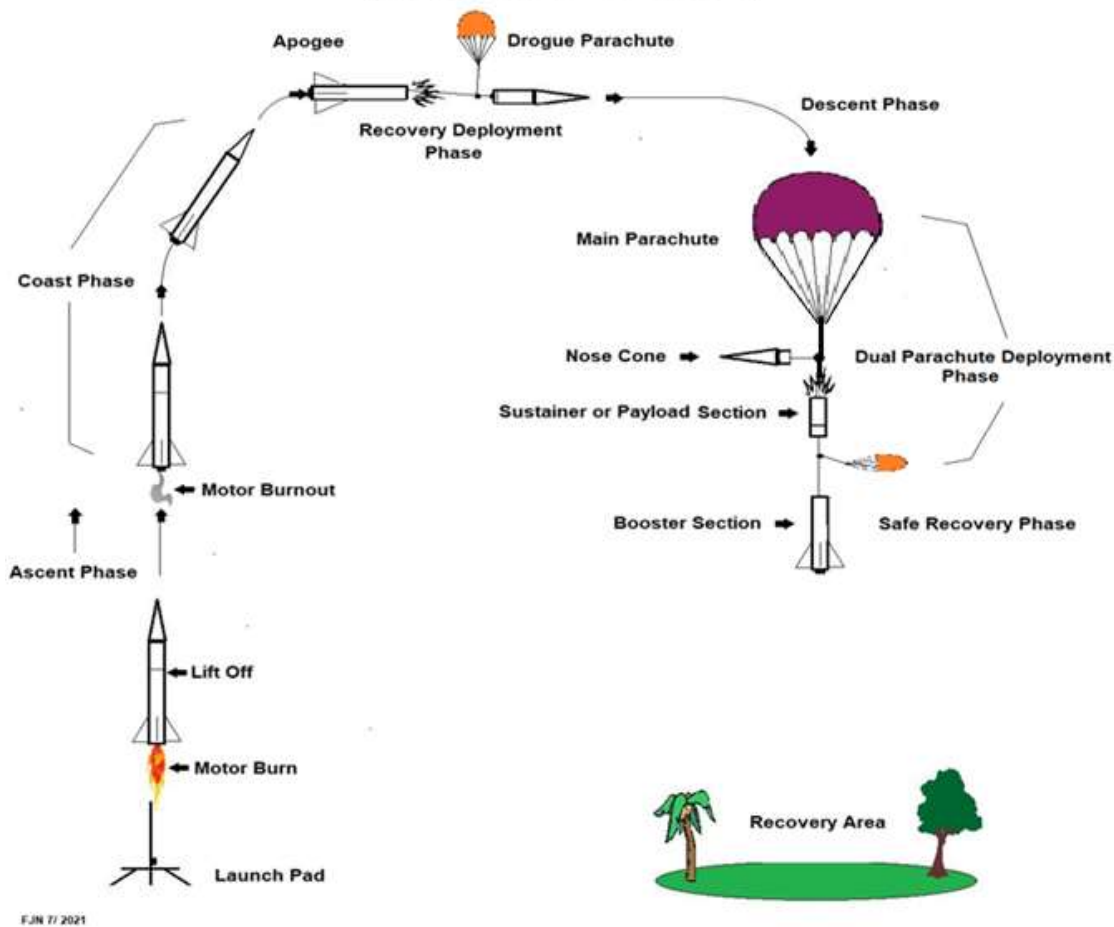
Moon Challenge: Moon Challenge Handbook

Teams shall design and construct a dual deploy high power rocket with a minimum diameter of 4" and will include a selection of 2 of 4 possible sensors integrated into the rocket. The rocket flight shall be stable and reach an apogee between 3,000' – 4,000' AGL. The rocket must satisfy all other technical requirements as outlined in the requirements section of the competition handbook.

FNL 2025 Moon Flight Profile Example
Not to Scale

Drogue

4000 ft.

Altitude Bracket

3000 ft.

Main Rocket Fuselage

4000 ft.

Altitude Bracket

3000 ft.

Descent of main fuselage profile under Drogue

Sensors must be recording during flight

Deployment of Main Parachute

Dual Deployment Phase

Payload

GPS/RF Signal

Drogue Chute

Powered Ascent

Launch

Rocket Recovery Area
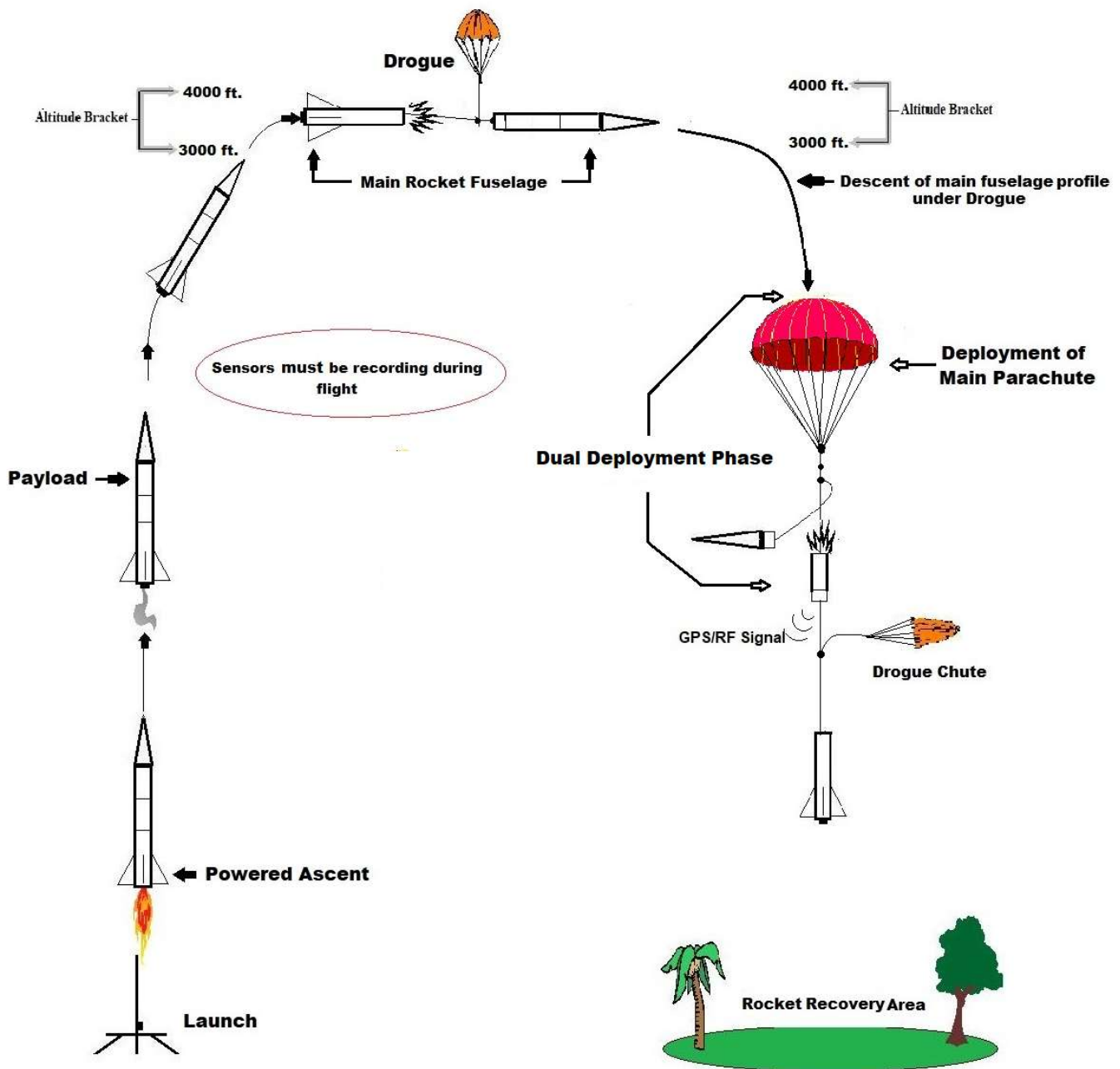
FJN 2025

Mars Engineering Challenge: Mars Engineering Challenge Handbook

Teams shall build a minimum 4" diameter rocket either from components, utilizing one of the competition motors and achieve an altitude of 3,200' – 4,000' AGL. The annual challenge will see the teams incorporate multiple sensors into a cohesive system to analyze the flight. The rocket must satisfy all other technical requirements as outlined in the requirements section of the competition handbook.

FNL 2025 Mars Flight Profile Example
Not to Scale

Drogue

4000 ft.

Altitude Bracket

3200 ft.

Main Rocket Fuselage

4000 ft.

Altitude Bracket

3200 ft.

Descent of main fuselage profile under Drogue

Sensors must be recording during flight

Deployment of Main Parachute

Dual Deployment Phase

Payload

GPS/RF Signal

Drogue Chute

Powered Ascent

Rocket Recovery Area

Launch
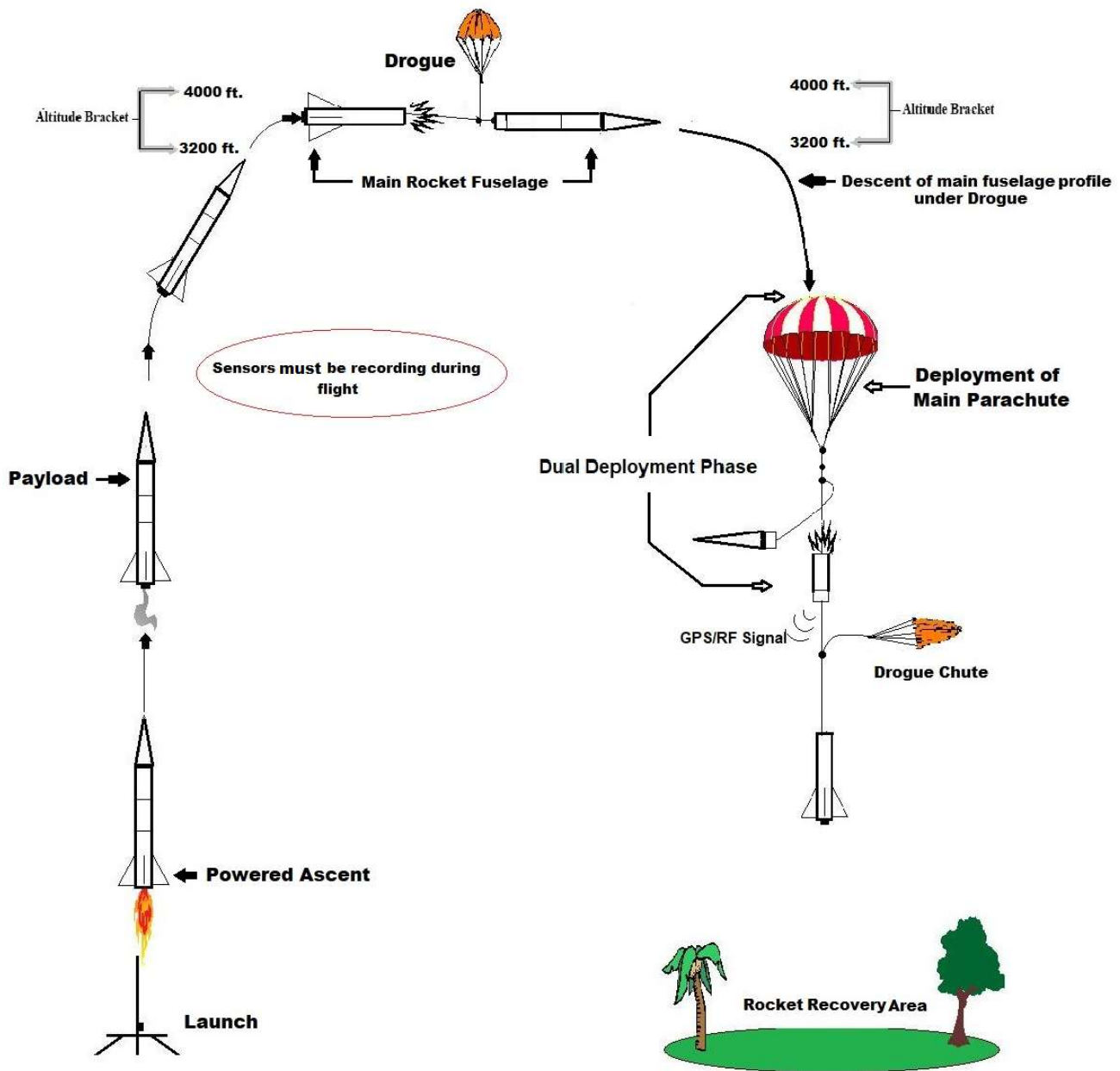
FJN 2025

General Requirements

1. The **team lead, team advisor, and co-advisor** (if applicable) <u>must</u> **create a profile** in the NASA STEM Gateway system. If a profile already exists, it must be updated annually. See '**Appendix B-1**' for instructions on how to create a profile.
2. The **team lead, team advisor, and co-advisor** (if applicable) <u>must</u> then **register** with WSGC before students/team members register. See '**Appendix B-2**' for instructions on how to register.
3. Once the above listed have registered, the **team advisor** will complete and submit the "Rocket Launch Team (Create NOI)" Grant application form.
4. After the NOI application is submitted on the WSGC Grant Application Page, the **team lead** must **apply** to the First Nations Launch program. All steps <u>must</u> be completed in order for the team to be considered eligible to compete.
5. All student **team members** must register a profile on the NASA Gateway application. See '**Appendix B-1**' for instructions on how to create a profile.
6. All student **team members** must **register** on the WSGC website and **then apply** to the First Nations Launch program on the Grant Application page no later than the Critical Design Review (CDR) due date. See '**Appendix B-2**' for instructions on how to register and apply.
7. The **team advisor** and the **team lead** must submit a signed copy of the Award Acceptance letter to their Grant Management page in order for the team to be eligible to receive reimbursements.
8. The team must identify all **team members**, both those students attending and not attending the launch weekend activities, by the due date of the CDR. This is accomplished by ensuring each student is registered and applied (as explained previously), and attendees are listed on the lodging list. Rocketry (TRA/NAR) mentors do not need to register on the WSGC website unless they are attending the Launch Weekend activities. The term 'team member' will include:
   a. Students actively engaged or previously actively engaged in the project.
      i. WSGC recommends 4-6 students, but does not prohibit teams from competing who have fewer or greater number of team members.
      ii. First Nations Launch highly encourages teams to represent the indigenous community, being comprised of Native American, Alaska Native, and Native Hawaiian/Pacific Island team members.
   b. At a minimum, one team mentor (see **General Requirement #9**).
   c. At a minimum, one team advisor (a maximum of two co-advisors allowed).
9. Each team must identify a local/state experienced rocketry **team mentor** (see '**Appendix D-2**' for more information on how to obtain a local mentor and the benefits).
   a. A team mentor is defined as an adult, 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.
   b. The mentor must 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. An industry subject matter expert may serve as a mentor as well.
10. **Team leads** will upload all deliverables to the WSGC Grant Management page (see '**Appendix B-3**' for instructions on how to upload to WSGC website) by the deadline specified in this handbook for each milestone. All report deliverables must be in PDF format.
11. **Teams** will utilize the provided templates (see '**Report Templates and Scoring Rubrics**' on the WSGC website) for each report and virtual presentation.
12. All **teams** will successfully launch and recover an Estes rocket provided by WSGC.
    a. The Estes rocket shall be built and launched by the team, prior to PDR.
    b. The team will record the Estes rocket flight and post the results to Facebook and upload the URL to the Team Lead's Grant Management page.
    c. Teams impacted by adverse weather conditions may request an exemption or extension.
13. **All projects must be completely constructed (at least 95%) ready to fly at least two (2) weeks prior to launch date**. Complete is defined as: all airframe, motor mount, fins, payload/challenge airframe, couplers, bulkheads

should be completely procured/manufactured to spec and permanently attached as designed. A virtual inspection prior to Launch Weekend will be used to determine if satisfied.

14. All projects must have a documented flight stable simulation profile at each design review milestone. Commercial high-power rocketry software is required. **RockSim is the required simulation software, expected to be procured by teams**. OpenRocket may be used to verify/validate RockSim results. See **Appendix D-3** for information on how to obtain RockSim. Teams must submit their simulation files over the course of the project:
    a. At each design milestone (Proposal, PDR, CDR, FRR), upload a RockSim file to WSGC website.
    b. At Launch Weekend, submit a file on flash drive prior to flight day.

General Vehicle Requirements

1. 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), and/or Tripoli Rocketry Association (TRA). Motors are provided by WSGC. Motors are limited to those listed in **Appendix A-1.**
   a. Final motor choices will be declared by the CDR milestone.
   b. Any motor change after CDR must be approved by the Tripoli Wisconsin Range Safety Officer (RSO) and will only be approved if the change is for the sole purpose of increasing the safety margin.
   c. A penalty against the team's overall score will be incurred when a motor change is made after the CDR milestone, regardless of the reason.
2. The vehicle will carry, at a minimum, one commercially available, barometric altimeter for recording the official altitude used in determining the Altitude Award winner (see **Appendix A-4** for awards criteria) and is to be used for electronic deployment of ejection charges.
3. Each altimeter (if redundant) will have a dedicated power supply, on an independent circuit.
4. Each altimeter (if redundant) will be armed by a dedicated mechanical arming switch, on an independent circuit, that is:
   a. Accessible from the exterior of the rocket airframe when the rocket is in the launch configuration on the launch pad.
   b. Capable of being locked in the ON position for launch (i.e., cannot be disarmed due to flight forces).
5. The launch vehicle will have a minimum static stability margin of 1.0 at the point of rail exit (to be determined by simulations). Rail exit is defined at the point where the forward rail button loses contact with the rail.
6. The launch vehicle will accelerate to a minimum velocity of 52 feet per second (fps) at rail exit (to be determined by simulations). This parameter is also known as 'rail exit velocity' or 'velocity at launch guide departure.'
7. The launch vehicle and motor will have a thrust-to-weight ratio greater than 5:1.
8. The Center of Gravity (CG) and Center of Pressure (CP) must be indicated on the exterior of the rocket, from simulation, using the fully loaded configuration prior to flight, prior to competition flight.
9. Vehicle Prohibitions
   a. The launch vehicle will not utilize:
      i. Forward canards. Camera housings will be exempted, provided the team can show that the housing(s) causes minimal aerodynamic effect on the rocket's stability
      ii. Forward firing motors
      iii. Motors that expel titanium sponges (*Sparky, Skidmark, MetalStorm, etc.)
          *Note: Wisconsin Tripoli Rocketry allows a sparky motor at the competition launch site, but they may not be allowed at other launch locations
      iv. Hybrid motors
      v. Multi-stage motors
      vi. A cluster of motors
      vii. Friction fitting for motors
      viii. Blue tube, or sonotube airframes
      ix. Plexiglass/acrylic (or any other non-rigid) fins
      x. Excessive and/or dense metal in the construction of the vehicle
         1. 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
   b. The launch vehicle will not exceed Mach 1 (767+ mph at NTP) at any point during flight.
   c. 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 10 lbs. on the pad may contain a maximum of 1 lbs. of ballast).
   d. The launch vehicle shall consist of an aerodynamic design; no odd rockets (i.e., flying pyramids, saucers, spools, etc.).

Recovery System Requirements

1. The launch vehicle will utilize a standard dual deployment recovery scheme, 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 kinetic energy during drogue-stage descent is reasonable, as deemed by the RSO.
    a. The main parachute shall be deployed no lower than 300 feet.
    b. The apogee event may contain a delay of no more than 2 seconds past apogee.
    c. Single deployment parachute release devices (tender descender, jolly logic parachute release etc.) are not allowed.
2. The recovery system electrical circuits shall be completely independent of any payload/challenge electrical circuits.
3. All recovery electronics will be powered by commercially available batteries.
4. Descent rate after apogee (under drogue parachute) shall range between 45 – 65 feet per second.
5. Descent rate upon touchdown (under main parachute) shall range between 15 – 20 feet per second.
6. Electronics (COTS altimeters) must be used as your primary ejection events, at both apogee and main deployment.
    a. Suggest utilization of two altimeters for ejection event redundancy, but not required.
7. The motor ejection charge is the required backup (redundant) deployment at apogee.
    a. Motor ejection cannot be used as your primary (or only) ejection event.
    b. Note this requires that the drogue parachute sits in the booster section.
    c. The estimated time to apogee should be known (from simulations) to adjust the ejection charge delay fuse during motor prep.
8. An electronic tracking device (i.e., GPS) will be installed in the launch vehicle and will transmit the position of the tethered vehicle or any independent section to a ground receiver.
    a. Any rocket section or payload/challenge component, which lands untethered to the launch vehicle, will contain an active electronic tracking device.
    b. The electronic tracking device(s) will be fully functional during the official flight on launch day.
    c. It is recommended to use an electronic tracking device that does not require licensing.
    d. A list of commonly used rocket tracking devices is available in **Appendix D-6**

Safety Requirements

1. Each team must identify a 'student safety officer' who will be responsible for implementing the requirements in this section. The role and responsibilities of each safety officer will include, but are not limited to:
    a. Monitor team activities with an emphasis on Safety during:
        i. Design of vehicle and payload/challenge
        ii. Construction of vehicle and payload/challenge
        iii. Assembly of vehicle and payload/challenge
        iv. Ground testing of vehicle and payload/challenge
        v. Launch day
        vi. Recovery activities
    b. Implement procedures developed by the team for
        i. Construction
        ii. Assembly
        iii. Launch
        iv. Recovery activities
    c. Document, manage and maintain current revisions of the team's safety procedures, and MSDS/chemical inventory data. (*Mars Challenge ONLY*)**
2. Each team will use a launch and safety checklist. The final checklists will be included in the FRR report and used during any launch day operations (see **Appendix C-4** for checklist support).
3. During test flights (if applicable), teams will abide by the rules and guidance of the local rocketry club's RSO. The allowance of certain vehicle configurations and/or payload/challenges at WSGC FNL does not give explicit or implicit authority for teams to fly those vehicle configurations and/or payload/challenges at other club launches. Teams should communicate their intentions to the local club's President or Prefect and RSO before attending any NAR or TRA launch.
4. For proof of construction and a safe flight, photographs/video must be made during the construction process (especially of sealed or hidden components) to ensure proper technique has been followed. The Flight Readiness Report must contain the photos of the build of sealed/hidden components that can no longer be accessed.
5. All projects must have a virtual inspection with the WSGC Technical Advisor, prior to (to coincide with) Flight Readiness Review.
6. All components and materials must be obtained from a reputable high-power rocketry vendor or must undergo an engineering analysis (or test) demonstrating their suitability and integrity must be included in the design reports.

Notes and Suggestions

1. Project Notes
   a. Students on the team will do 100% of the project, including design, construction, written reports, presentations, and flight preparation with the exception of 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).
   b. The team should ensure they have 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.
   c. **Note from Tripoli**: Without exception, university teams must involve an experienced team mentor, preferably a TAP or L3CC, during the design and construction phases of their rocketry projects if they expect to fly the competition rocket at Tripoli events. The mentor must be certified at or above the level of motor the team wishes to fly AND is experienced in the type of construction, propulsion, and recovery the team uses. Although it is ultimately up to the judgment of the RSO and Launch Director, teams who build a rocket that requires a motor higher than their team member/mentor certification levels may not be allowed to launch the rocket at local club events as recommended by NAR/TRA.
2. Technical Notes
   a. The launch vehicle will have a maximum of four (4) independent sections. An independent section is defined as a section that is either tethered to the main vehicle or is recovered separately from the main vehicle using its own parachute. Coupler shoulders shall be one body diameter length at a minimum.
   b. 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.
   c. To aid in recovery of rockets, 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. This information shall be included in a manner that allows the information to be retrieved without the need to open or separate the vehicle.
   d. Competition ejection charges will be provided by Tripoli Wisconsin at the event. For ground ejection tests or pre-competition flight test (recommended) purposes, it is suggested to use ejection charges of the same size and type as those provided at competition (see **Appendix D-4** for recommendations).
   e. Removable shear pins can be used for both the main parachute compartment and the drogue parachute compartment.
   f. Avoid touching or handling electronic components when not grounded or in a static environment such as walking on carpeted floors, cloth upholstery furniture and in vehicles. Sporadic constant on/off power up connections may cause brownouts, causing altimeter to indicate an error. Always store your electronics in an approved static proof bag that comes with the device. When in doubt, always reset and test.
   g. All teams will be required to use the launch pads provided by Tripoli Wisconsin. No custom pads will be permitted on the launch field. Six-foot (6') 1010 rails and ten-foot (10') 1515 rails will be provided. Please ensure you have the correct rail button for the respective rail. 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, to be determined by Tripoli Wisconsin.

First Nations Launch 2025 Project Deliverables

1. Deliverables required for successful participation are listed below. More details are provided in the Project Milestones: Criteria and Expectations section.
    a. Team/students must participate in the virtual Kick-Off Meeting.
    b. Team/students must provide a reusable rocket with required payload/challenge system ready for competition launch.
    c. Team/students must provide a RockSim rocket simulation file:
        i. Of the designed rocket, uploaded to WSGC website at each design phase (Proposal, PDR, CDR, FRR)
        ii. Of the 'as-built' competition rocket, due the day before competition launch
    d. Team/students must fly a lower power Estes (or similar) rocket before PDR and upload a video of the flight prior to PDR. The rocket will be provided by WSGC for all teams. A launchpad will be provided by WSGC for new teams.
    e. Mars/Moons team/students must complete and submit all required Written Reports (PDF) and Virtual Presentations (PowerPoint), to the WSGC FNL Grant Management site by the Team Lead on applicable due dates.
    f. All teams must complete and submit all required Flysheets to the WSGC FNL Grant Management site by the Team Lead on applicable due dates.
    g. Team/students must participate in PDR and CDR Virtual Reviews (Zoom teleconference).
    h. Team/students must participate in one (1) Safety Review after CDR and one (1) Virtual Technical Inspection after FRR with Tripoli Wisconsin (Zoom teleconference).
    i. Team/students must submit flight (avionics) data on competition launch day via flash drive.
    j. Team/students must provide 2 – 3 photos <u>featuring the team</u> designing, building, and flying the competition rocket to be submitted to the WSGC Grant Management page by the team lead by PLAR deadline.
2. WSGC FNL is responsible for providing to the teams:
    a. Project/Travel Award of $4000.
        i. Teams traveling from Mountain, Pacific, Hawaiian, or Alaskan time zones may request additional travel funds in their award acceptance documentation.
    b. Hotel accommodations @ FNL selected location (maximum three (3) rooms for three (3) nights per team at competition hotel) during Launch Weekend.
    c. Select meals (Friday breakfast, lunch, and light dinner, Saturday breakfast, lunch, and dinner) during Launch Weekend.
    d. Low-power rocket (Estes) for flight demo (and launch pad if applicable), shipped to school prior to PDR.
    e. Two (2) Rocketry Reference Books (for schools that are new to the competition).
    f. Ejection charges for competition flight, provided on Launch Day.
    g. One (1) motor maximum for competition flight, prepped on Launch Weekend, provided on Launch Day.
    h. One (1) motor casing for competition flight, provided on Launch Day. Motor casings shall be returned to FNL on Launch Day after final competition flight.
    i. Feedback on reports submitted, a minimum of one (1) week prior to submission of next report.

Program Milestones: Criteria and Expectations

Milestones vary between challenge divisions. Explore each division handbook for specific milestone guidelines.

Gateway Handbook:
The Gateway Division operates on a shortened timeline due to being focused on learning the basics of safe high power rocketry. Teams in this division do not submit reports at Milestones but submit Flysheets and Presentations.

Moon Handbook:
The Moon Division operates on the standard timeline with reports, flysheets and presentations due at each milestone. A proposal is due at NOI Submission.

Mars Handbook:
The Mars Division operates on the standard timeline with reports, flysheets, and presentations due at each milestone. A proposal is due at NOI Submission.

	Gateway	Moon	Mars
NOI	Due Dec 9, 2024	Due Oct 24, 2024 Proposal Due	Due Oct 24, 2024 Proposal Due
PDR	X	Due Dec 2, 2024 Report Due Flysheet Due RockSim Due	Due Dec 2, 2024 Report Due Flysheet Due RockSim Due
CDR	Due Jan 27, 2025 Flysheet Due RockSim Due Flight Demo Due	Due Jan 27, 2025 Report Due Flysheet Due RockSim Due Flight Demo Due	Due Jan 27, 2025 Report Due Flysheet Due RockSim Due Flight Demo Due
FRR	Due Mar 17, 2025 Report Due Flysheet Due RockSim Due Education Outreach Forms Due	Due Mar 17, 2025 Report Due Flysheet Due RockSim Due Education Outreach Forms Due	Due Mar 17, 2025 Report Due Flysheet Due RockSim Due Education Outreach Forms Due
PLAR	Due May 12, 2025 2-3 Team Project Photos Final Reimbursements Due	Due May 12, 2025 Report Due 2-3 Team Project Photos Final Reimbursements Due	Due May 12, 2025 Report Due 2-3 Team Project Photos Final Reimbursements Due

Preliminary Design Review (PDR)

The PDR demonstrates that the overall preliminary design meets at a minimum all requirements with acceptable risk, within the cost and schedule constraints, and establishes the basis for proceeding with detailed design. It shows that the correct design options have been selected, interfaces have been identified, and verification methods have been described. Full baseline cost and schedules, as well as all risk assessment, management systems, and metrics are presented.

Critical Design Review (CDR)

The CDR demonstrates that the maturity of the design is appropriate to support proceeding to full-scale fabrication, assembly, and integration; showing at a minimum that the technical effort is on track to complete the flight and ground system development and mission operations in order to meet overall performance requirements within the identified cost schedule constraints. Progress against management plans, budget, and schedule, as well as risk assessment, are presented. The CDR is a review of the final design of the launch vehicle and payload/challenge system.

The CDR Report and Presentation should be independent of the PDR Report and Presentation. However, the CDR Report and Presentation may have the same basic content and structure as the PDR documents, but with final design information that may or may not have changed since PDR.

Flight Readiness Review (FRR)

The FRR examines tests, demonstrations, analyses, and audits that determine the overall system (all projects working together) readiness for a safe and successful flight/launch and for subsequent flight operations of the as-built rocket and payload/challenge system at a minimum. It also ensures that all flight hardware, software, personnel, and procedures are operationally ready.

Post-Launch Assessment Review (PLAR)

The PLAR is an assessment of system in-flight performance. The panel will be expecting a professional and polished report that follows the order of sections as they appear below.

HPR Safety Overview

The Federal Aviation Administration (FAA) (www.faa.gov) has specific laws governing the use of airspace. A demonstration of the understanding and intent to abide by the applicable federal laws (especially as related to the use of airspace at the launch sites and the use of combustible/flammable material), safety codes, guidelines, and procedures for building, testing, and flying large model rockets is crucial. The procedures and safety regulations of the TRA (http://www.tripoli.org/SafetyCode /) shall be used for flight design and operations. The NAR/TRA mentor and Safety Officer shall oversee launch operations and motor handling.

Virtual Tech Inspection – Tripoli Wisconsin

All teams are required to participate in a Virtual Tech Inspection approximately two weeks before Launch Weekend. The teams must be prepared to discuss the design of their rocket and its systems. In addition, the teams must display:

1. The team's rocket should be 95% + constructed.
2. A diagram of the rocket indicating the configuration of its main components.
3. Flight simulation showing max altitude and launch guide velocity.
4. Knowledge of their altimeter operation.
5. Type of hardware used (eye bolts, recovery harnesses, adhesives, etc.).
6. Discuss construction techniques.
7. Payload/challenge or mechanical operations.

The team will be given a go/no – go by the WSGC Technical Advisor. The Technical Advisor must be satisfied with the state of build to proceed to competition weekend. The schedule will be posted at a later date.

Overview of Safety Regulations

High-power rocketry is federally regulated by the National Fire Protection Association (NFPA). National rocketry organizations, Tripoli Rocketry Association – TRA (http://www.tripoli.org) and the National Association of Rocketry – NAR (http://www.nar.org) also have safety guidelines and regulations to follow. The purpose of NFPA 1127, the Tripoli Safety Code and the NAR Safety Code are to:

1. Provide safe and reliable motors, establish flight operations guidelines and prevent injury.
2. Promote experimentation with rocket designs and payload/challenge systems.
3. Prevent beginning high-power hobbyists from making mistakes.

Detailed NFPA, TRA and NAR Safety Regulations may be found at the following links:

National Fire Protection Association
NFPA 1127 Code for High-power Rocketry
http://www.nfpa.org/1127

Tripoli Rocketry Association
Tripoli Code for High-power Rocketry
Safety Information - Tripoli Rocketry Association

National Association of Rocketry
NAR High-power Rocket Safety Code
http://www.nar.org/safety-information/high-power-rocket-safety-code

HPR Launch Sites

Contact a local NAR or Tripoli Club who have an FAA Waiver, a designated launch site and club launch dates in place where you can safely fly your rocket for test flights, etc.

The Federal Aviation Administration (FAA) regulates and classifies model rockets according to FAR 101 Subpart C, which is summarized in Table 1. See the FARs for more details.

Table 1: FAA Rocket Classification

Limitation	Class 1	Class 2
Rocket Weight	No more than 1500 grams	No limit
Motor Size Limit	No more than 125 grams	No more than 40960 N-sec total thrust
Altitude Limit	None – may be set by local agreement	FAA limited
Other	Clear of clouds	Must have 5 miles horizontal visibility, clouds less than 5/10ths coverage, FAA Waiver and NOTAM filed between sunrise and sunset

NAR and Tripoli certification requirements and limitations can be seen in Table 2.

Table 2: Certification Requirements

Motor Parameter	None	Certification Required		
		Level 1 HPR	Level 2 HPR	Level 3 HPR
Total Combined Impulse	320 N-sec (2xG Class)	640 N-sec (H, I Class)	5120 N-sec (J, K, L Class)	40960 N-sec (M,N,O Class)
Combined Propellant Mass	125 grams	No Limit		
Single Motor Impulse	160 N-sec	No Limit		
Single Motor Propellant Mass	62.5 grams	No Limit		
Single Motor Avg Thrust	80 N	No Limit		
Sparky Motors	Not Allowed	Allowed		
Total Rocket Mass	1500 grams	No Limit		
Field Distance Reqmts	Per Model Rocket Safety Code	Per HPR Safety Code		

High-power Rocketry Safety Code

1. **Certification.** I will only fly high-power rockets or possess high-power rocket motors that are within the scope of my user certification and required licensing.
2. **Materials.** I will use only lightweight materials such as paper, wood, rubber, plastic, fiberglass, or when necessary ductile metal, for the construction of my rocket.
3. **Motors.** I will use only certified, commercially made rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer. I will not allow smoking, open flames, nor heat sources within 25 feet of these motors.
4. **Ignition System.** I will launch my rockets with an electrical launch system, and with electrical motor igniters that are installed in the motor only after my rocket is at the launch pad or in a designated prepping area. My launch system will have a safety interlock that is in series with the launch switch that is not installed until my rocket is ready for launch, and will use a launch switch that returns to the "off" position when released. The function of onboard energetics and firing circuits will be inhibited except when my rocket is in the launching position.
5. **Misfires.** If my rocket does not launch when I press the button of my electrical launch system, I will remove the launcher's safety interlock or disconnect its battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.
6. **Launch Safety.** I will use a 5-second countdown before launch. I will ensure that a means is available to warn participants and spectators in the event of a problem. I will ensure that no person is closer to the launch pad than allowed by the accompanying Minimum Distance Table. When arming onboard energetics and firing circuits I will ensure that no person is at the pad except safety personnel and those required for arming and disarming operations. I will check the stability of my rocket before flight and will not fly it if it cannot be determined to be stable. When conducting a simultaneous launch of more than one high-power rocket I will observe the additional requirements of NFPA 1127.
7. **Launcher.** I will launch my rocket from a stable device that provides rigid guidance until the rocket has attained a speed that ensures a stable flight, and that is pointed to within 20 degrees of vertical. If the wind speed exceeds 5 miles per hour, I will use a launcher length that permits the rocket to attain a safe velocity before separation from the launcher. I will use a blast deflector to prevent the motor's exhaust from hitting the ground. I will ensure that dry grass is cleared around each launch pad in accordance with the accompanying Minimum Distance table, and will increase this distance by a factor of 1.5 and clear that area of all combustible material if the rocket motor being launched uses titanium sponge in the propellant.
8. **Size.** My rocket will not contain any combination of motors that total more than 40,960 N-sec (9208 pound-seconds) of total impulse. My rocket will not weigh more at liftoff than one-third of the certified average thrust of the high-power rocket motor(s) intended to be ignited at launch.
9. **Flight Safety.** I will not launch my rocket at targets, into clouds, near airplanes, nor on trajectories that take it directly over the heads of spectators or beyond the boundaries of the launch site, and will not put any flammable or explosive payload/challenge in my rocket. I will not launch my rockets if wind speeds exceed 20 miles per hour. I will comply with Federal Aviation Administration airspace regulations when flying, and will ensure that my rocket will not exceed any applicable altitude limit in effect at that launch site.
10. **Launch Site.** I will launch my rocket outdoors, in an open area where trees, power lines, occupied buildings, and persons not involved in the launch do not present a hazard, and that is at least as large on its smallest dimension as one-half of the maximum altitude to which rockets are allowed to be flown at that site or 1500 feet, whichever is greater, or 1000 feet for rockets with a combined total impulse of less than 160 N-sec, a total liftoff weight of less than 1500 grams, and a maximum expected altitude of less than 610 meters (2000 feet).
11. **Launcher Location.** My launcher will be 1500 feet from any occupied building or from any public highway on which traffic flow exceeds 10 vehicles per hour, not including traffic flow related to the launch. It will also be no closer than the appropriate Minimum Personnel Distance from the accompanying table from any boundary of the launch site.
12. **Recovery System.** I will use a recovery system such as a parachute in my rocket so that all parts of my rocket return safely and undamaged and can be flown again, and I will use only flame-resistant or fireproof recovery system wadding in my rocket.

13. **Recovery Safety.** I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places, fly it under conditions where it is likely to recover in spectator areas or outside the launch site, nor attempt to catch it as it approaches the ground.

Safe Launch Practices

I. **All Launches:**

    A. Must comply with United States Code 1348, "Airspace Control and Facilities," Federal Aviation Act of 1958 and other applicable federal, state, and local laws, rules, regulations, statutes, and ordinances.

    B. A person shall fly a rocket only if it has been inspected and approved for flight by the RSO. The flier shall provide documentation of the location of the center of pressure (CP) and the center of gravity (CG) of the high-power rocket to the RSO if the RSO requests the same.

    C. The member shall provide proof of membership and certification status by presenting their membership card to the Launch Director or RSO upon request.

    D. A rocket with a predicted altitude in excess of 50,000 feet AGL requires review and approval by the TRA Class 3 Committee.

    E. Recovery

        1. Fly a rocket only if it contains a recovery system that will return all parts of it safely to the ground so that it may be flown again.

        2. Ensure that adequate protection is in place to prevent hot ejection gasses from causing burn damage to retaining cords, parachutes, and other vital components.

        3. Do not attempt to catch a high-power rocket as it approaches the ground.

        4. Do not attempt to retrieve a rocket from a power line or other place that would be hazardous to people attempting to recover it.

    F. Payload/challenges

        1. Do not install or incorporate in a high-power rocket a payload/challenge that is intended to be flammable, explosive or debris that can cause harm.

        2. Do not fly a vertebrate animal in a high-power rocket.

    G. Weight Limits

        1. The maximum lift-off weight of a rocket shall not exceed one-third (1/3) of the average thrust on the motor(s) intended to be ignited at launch.

    H. Launching Devices

        1. Launch from a stable device that provides rigid guidance until the rocket has reached a speed adequate to ensure a safe flight path.

        2. Incorporate a jet/blast deflector device if necessary to prevent the rocket motor exhaust from impinging directly on flammable materials.

    I. Ignition Systems

        1. Use an ignition system that is remotely controlled, electrically operated, and contains a launching switch that will return to "off" when released.

        2. The ignition system shall contain a removable safety interlock device in series with the launch switch.

        3. The launch system and igniter combination shall be designed, installed, and operated so the liftoff of the rocket shall occur as quickly as possible after actuation of the launch system. If the rocket is propelled by a cluster of rocket motors designed to be ignited simultaneously, install an ignition scheme that has either been previously tested or has a demonstrated capability of igniting all rocket motors intended for launch ignition within one second following ignition system activation.

        4. A rocket motor shall not be ignited by a mercury switch or roller switch.

            a) Install an ignition device in a high-power rocket motor only at the launch pad.

    J. Launch Operations

        1. Do not launch with surface winds greater than 20 mph (32 km/h) or launch a rocket at an angle more than 20 degrees from vertical.

2. Do not ignite and launch a high-power rocket horizontally, at a target, in a manner that is hazardous to aircraft, or so the rocket's flight path goes into clouds or beyond the boundaries of the flying field (launch site).
3. A rocket shall be pointed away from the spectator area and other groups of people during and after installation of the ignition device(s).
4. Firing circuits and onboard energetics shall be inhibited until the rocket is in the launching position.
5. Firing circuits and onboard energetics shall be inhibited prior to removing the rocket from the launching position.
6. When firing circuits for pyrotechnic components are armed, no person shall be allowed at the pad area except those required for safely arming/disarming.
7. Do not approach a high-power rocket that has misfired until the RSO/LCO has given permission.
8. Conduct a five second countdown prior to launch that is audible throughout the launching, spectator, and parking areas.
9. All launches shall be within the Flyer's certification level, except those for certification attempts.
10. The RSO/LCO may refuse to allow the launch or static testing of any rocket motor or rocket that he/she deems to be unsafe.

II. Commercial Launches
   A. Use only certified rocket motors.
   B. Do not dismantle, reload, or alter a disposable or expendable rocket motor, nor alter the components of a reloadable rocket motor or use the contents of a reloadable rocket motor reloading kit for a purpose other than that specified by the manufacture in the rocket motor or reloading kit instructions.
   C. Do not install a rocket motor or combination of rocket motors that will produce more than 40,960 N-s of total impulse.
   D. Rockets with more than 2560 N-s of total impulse must use electronically actuated recovery mechanisms.
   E. When more than 10 model rockets are being launched simultaneously, the minimum spectator distance shall be set to 1.5 times the highest altitude expected to be reached by any of the rockets.
   F. When three or more rockets (at least one high-power) are launched simultaneously, the minimum distance for all involved rockets shall be the lesser of:
      1. Twice the complex distance for the total installed impulse. (Refer to V. Distance Tables)
      2. 2000 ft. (610 m)
      3. 1.5 times the highest altitude expected to be achieved by any of the rockets.
         (1) When more than one high-power rocket is being launched simultaneously, a minimum of 10 ft. (3m) shall exist between each rocket involved.

Table 3: Minimum Distance Table

Installed Total Impulse (Newton-Seconds)	Equivalent High Power Motor Type	Minimum Diameter of Cleared Area (ft.)	Minimum Personnel Distance (ft.)	Minimum Personnel Distance (Complex Rocket) (ft.)
0 – 320.00	H or smaller	50	100	200
320.01 – 640.00	I	50	100	200
640.01 – 1,280.00	J	50	100	200
1,280.01 – 2,560.00	K	75	200	300
2,560.01 – 5,120.00	L	100	300	500
5,120.01 – 10,240.00	M	125	500	1000
10,240.01 – 20,480.00	N	125	1000	1500
20,480.01 – 40,960.00	O	125	1500	2000

APPENDIXES

APPENDIX A-1 – First Nations Launch 2025 Motor Choices

For the 2025 First Nations Launch Challenge, the motor selections are constrained to:

Gateway Challenge Motors

Kit: FANTOM 438

Manufacturer	Size	Type	Motor
Aerotech	38mm	DMS	I175WS
Aerotech	38mm	RMS	I285R

Kits: Patriot and LOC IV -X2

Manufacturer	Size	Type	Motor
Aerotech	38mm	RMS	I366R
Aerotech	38mm	RMS	I284W

Moon and Mars Challenge Motors

Manufacturer	Size	Type	Motor
Aerotech	54mm	DMS	K400C
Aerotech	54mm	DMS	K535W

Motor Types
DMS = "Disposable Motor System"
RMS = "Reloadable Motor System"

Important Notes about Motors:

1. Final motor selection is due by February 17, 2025. No changes can be made without approval from Frank Nobile, TRA.
2. Motors (and hardware) will be purchased by WSGC after the CDR report.
3. Motors (and hardware) will be provided to teams at Launch Weekend.
4. Motor prep will be taught during Launch Weekend (motor workshop), prior to Launch Day.

APPENDIX A-2 – First Nations Launch 2025 Outreach Form

May be found on the First Nations Launch Tools and Tips webpage: https://spacegrant.carthage.edu/live/files/4953-outreach-form

First Nations Launch
High-Power Rocket Competition
Artemis Student Challenge
Hosted by Wisconsin Space Grant Consortium

Education/Public Outreach
Documentation Form

The Wisconsin Space Grant Consortium (WSGC) and NASA would like to thank you for giving our high-power rocket competition participants a chance to assist your organization. Please take a moment to fill in some information below to verify the students' participation. A portion of your team's competition score is based on their outreach activities. **Fill out one form for each outreach event you conduct**.

The goal of this activity is to "raise awareness of, or interest in, NASA, its goals, missions and/or programs, and to develop an appreciation for and exposure to science, technology, research and exploration." One of the goals of First Nations Launch is to promote science, technology, engineering, and math (STEM) fields through educational opportunities throughout the United States. We are grateful for your involvement in this mission and we encourage you to be a part of additional projects that are taking place through NASA funding. If you have any questions about the competition or our organization, please visit our website at https://spacegrant.carthage.edu/

Your Team Information		
Team Lead's Name	**Advisor's Name**	**Academic Institution**
Team Lead Signature	**Advisor's Signature**	**Today's Date**

Event Information		
Date of Event	**Approximate # of Attendees**	**List Each City, State, & Zip Code Where the Event Took Place**
Brief Description of Attendees (Click all that apply)		**List All Organizations Involved With the Event**
PreK: ☐ Students ☐ Teachers K-5 Grade: ☐ Students ☐ Teachers 6-8th Grade: ☐ Students ☐ Teachers High School: ☐ Students ☐ Teachers University/Campus: ☐ Undergrads ☐ Graduate ☐ Administrator ☐ Faculty ☐ Public at Large ☐ Informal Education Setting (Museum, etc.)		

Event Information Continued
Brief Description of Activity

Is this a new or existing event? (Select one)	**What was the duration of the event?** (Select one)
◯ New ◯ Existing	◯ < 2 days ◯ = 2 days ◯ > 2 days

How many exhibits were supported/developed by this event?	**How many student hands-on activities were supported/developed by this event?**

How many public at large activities were supported by this event?	**If other activities were supported by this event, please explain:**

Please provide links to any media coverage (via your institution, local, or regional news outlets) received for this event:

Please provide the title, presenter, and venue for any presentations directly attributed to this activity.

Describe how your team plans to build upon this outreach event:

Please use this space to provide WSGC with any additional information about this outreach event:

APPENDIX A-3 – First Nations Launch 2025 Overall Scoring

The competition components will be judged according to the following rubric. Report and presentation templates can be found on the First Nation Launch Competition Rubric webpage: (https://spacegrant.carthage.edu/first-nations-launch/rubric/).

Note that reports make up most of the overall score – this is in part, because a large amount of time is spent on the reports. Completing the reports, forces your team to address every component of the design. Do not skip the reports. It is crucial that you follow the design sequence properly, in order to have a successful flight. Also note that bonus points can be earned by completing outreach events. This 10% may put your team considerably ahead of the competition for overall grand prize.

1. Design Reports   75% of Total
    a. Competition Proposal/Flysheet   (5%)
    b. Preliminary Design Review (PDR) Report/Flysheet   (15%)
    c. Preliminary Design Review (PDR) Presentation   (5%)
    d. Critical Design Review (CDR) Report/Flysheet   (15%)
    e. Critical Design Review (CDR) Presentation   (5%)
    f. Flight Readiness Review (FRR) Report/Flysheet   (15%)
    g. Flight Readiness Review - Virtual Inspection   (5%)
    h. Post Launch Assessment Review (PLAR) Report   (10%)
2. Launch Weekend Presentation   5% of Total
    a. Flight Readiness Presentation   (5%)
3. Flight Performance   20% of Total
    a. Mission Performance (including Apogee)   (10%)
    b. Challenge Performance   (10%)
4. Bonus Points   (Up to 10%)
    a. Plan and conduct an Education Outreach Project
    b. Submit Education/Public Outreach Form (**Appendix A-2**)

Reports submitted after 11:59 pm Central time on the due date will receive a reduction of the overall score.
Central Daylight Savings Time (March 10, 2024 - November 3, 2024, March 9, 2025 - November 2, 2025)
Central Standard Time (November 3, 2024 - March 8, 2025)

1 Day Late	20% Deduction
2 Days Late	40% Deduction
3 Days Late	60% Deduction
4 Days Late	80% Deduction
5 Days Late	Zero

APPENDIX A-4 – First Nations Launch 2025 Awards List

(Based upon availability of funds)

Title	Description	Award
Grand Prize Award*	Team with most overall points.	$3000 with invitation to a NASA Center.
2nd Place Award*	Team with 2nd most overall points.	$2000
3rd Place Award*	Team with 3rd most overall points.	$1000
Golden Gateway Team**	Top performing Gold status Gateway Team	$500
Aesthetic Award	Team whose rocket has the most innovative and professional appearance as determined by peers.	Industry sponsored gift
Team Spirit Award	Team that shows interactive spirit, helpfulness, and cooperation as determined by peers.	Industry sponsored gift
Rookie Team Award	New team that completes all phases of the rocket competition with determination and perseverance.	Industry sponsored gift
Advisor Award	Advisor or co-advisor that equips, encourages, and empowers their team to compete with confidence and capabilities that lead to next step opportunities.	Industry sponsored gift
Team Lead Award	Awarded to a team lead that fulfills their role with excellence.	Industry sponsored gift
Altitude Award	Team whose actual apogee is closest to required/predicted apogee in the Flight Readiness report.	Industry sponsored gift
Judges Award	Team who best met the goals of the program and exemplified hard work and determination as determined by the judges.	Industry sponsored gift
Next Step Award	Team best deemed to compete at the next level of competition as determined by the WSGC team.	Up to $15000 team sponsorship with invitation to Student Launch at Marshall Space Flight Center and/or RockOn! at Wallops Flight Facility
Outreach Award	Team who completes one or more outreach events that can be continued or scaled.	$500
Patch Contest Award	Individual that submits the winning patch submission.	$100
Team Advisor Stipend	Stipend if team meets the conditions of participation.	Up to $1000

*Moon/Mars Division Award **Gateway Division Award

APPENDIX A-5 – First Nations Launch Gateway Competition Kits

The Gateway category must select a kit from the following list:

1. Loc Precision - 4" diameter "FANTOM 438" EXL variant
    a. https://locprecision.com/products/fantom-438?variant=39778638528703
    b. When ordering, remember to include the following additional components from the order page:
        i. "E-bay and Alti-package (EXL)"
    c. RockSim file is available from the manufacturer
        i. https://cdn.shopify.com/s/files/1/0568/7489/3503/files/loc_pk_51_fantom438_exl.rkt?v=1673214533
    d. Motor Options
        i. Aerotech – DMS I175WS
        ii. Aerotech – RMS I285W
2. Loc Precision - 4" diameter "Patriot"
    a. https://locprecision.com/products/4-patriot?_pos=1&_sid=e919eabe1&_ss=r
    b. When ordering, remember to include the following additional components:
        i. "Loc Style Ebay"
    c. RockSim file is available from the manufacturer:
        i. https://cdn.shopify.com/s/files/1/0568/7489/3503/files/YPAT438.zip?v=1623859293
    d. Item to note, the kit is offered in two different "trims"
        i. LOC Cardboard Airframe with birch ply fins
            1. Standard building materials for a rocket and is suggested for most teams
        ii. PML Quantum Airframe with G10 fiberglass fins
            1. Advanced airframe and fin materials. While the finished rocket may look great, the airframe is prone to cracking when handling or dropping and is known for temperature related expansion/shrinkage issues.
    e. Motor Options
        i. Aerotech – RMS I366R
        ii. Aerotech – RMS I284W
3. Loc Precision - 4" diameter "LOC IV X2"
    a. https://locprecision.com/products/loc-iv-x2?_pos=1&_sid=2c3bbffa6&_ss=r
    b. RockSim file is available from the manufacturer
        i. https://cdn.shopify.com/s/files/1/0568/7489/3503/files/LOC-IV-X2.rkt?v=1717091317
    c. Motor Options
        i. Aerotech – RMS I366R
        ii. Aerotech – RMS I284W

Some hardware/component variance may be present between kit/hardware vendors and may include/exclude features including avionics bays, sleds, shock cord, and parachutes. There are some general hardware items that teams may need to also consider that could include items such as: quick links, swivel eyes, motor retaining clips, e-bay switches, and other items.

APPENDIX B-1 - NASA Gateway

All participants (advisors, co-advisors, and students) are required to create profiles within the NASA STEM Gateway system. Applicants will be asked to submit the email address used to register on the NASA STEM Gateway site when registering on the WSGC registration site.
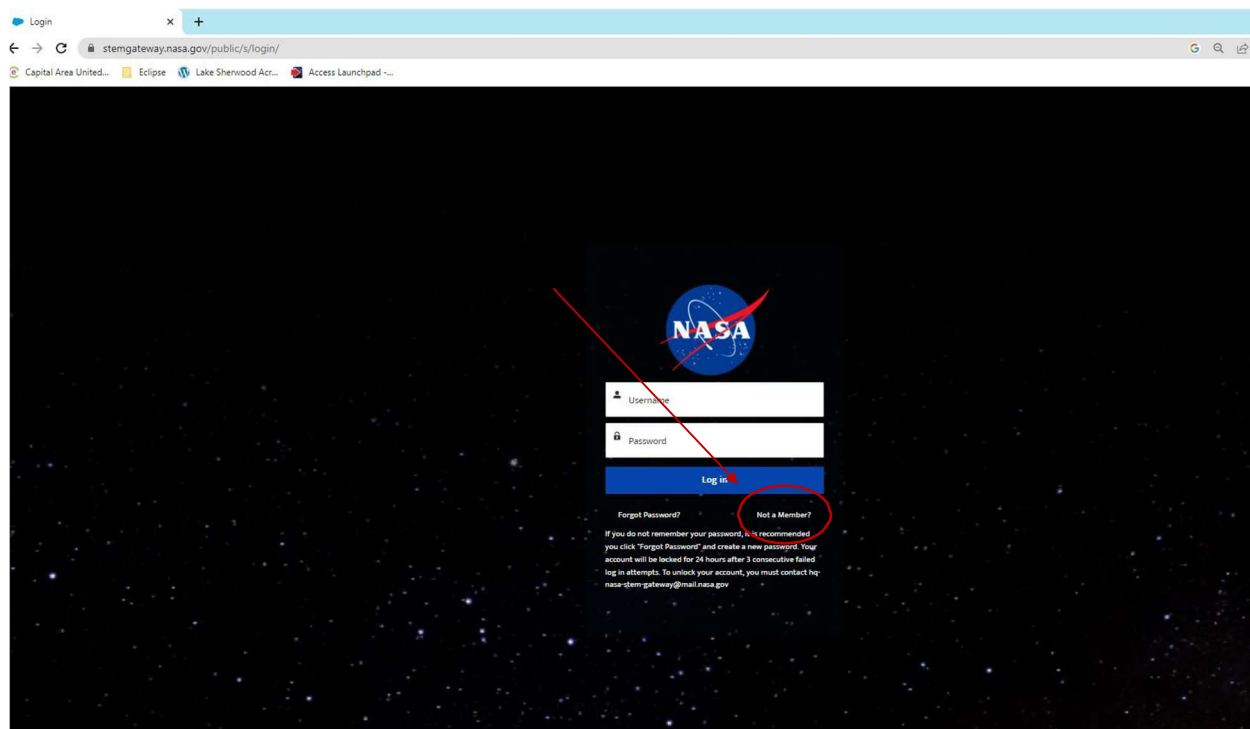
Step 1
Navigate to: https://stemgateway.nasa.gov/public/s

Step 2
Select "Sign Up/Log In"
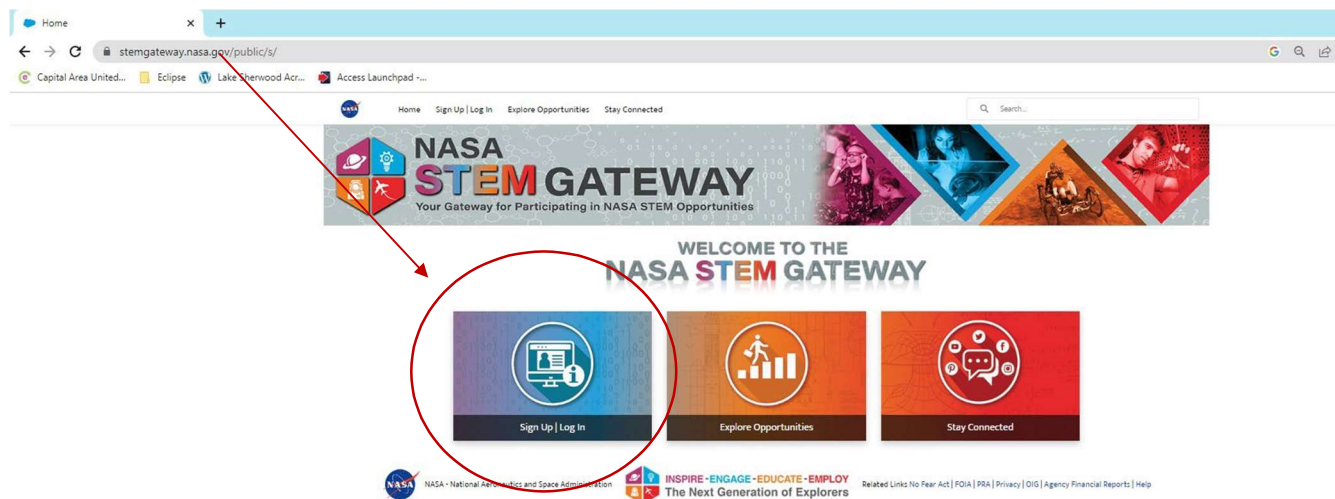
Step 3
Sign In or if this is your first time creating a profile, click on "Not a Member"

Step 4

Click on "Click Here to Register" in the box appropriate for your role in the team (i.e., Active Student for Team Members and Educator for Advisors/Co-Advisors)

Step 5

Use a "permanent" email address (like Gmail), not a school address. Once you have filled in all 4 fields, the submit button becomes dark blue and you can click "Submit"

Step 6

Log into the email account you used to start your registration process to retrieve the link from HQ-NASA-STEM-Gateway to complete your profile.

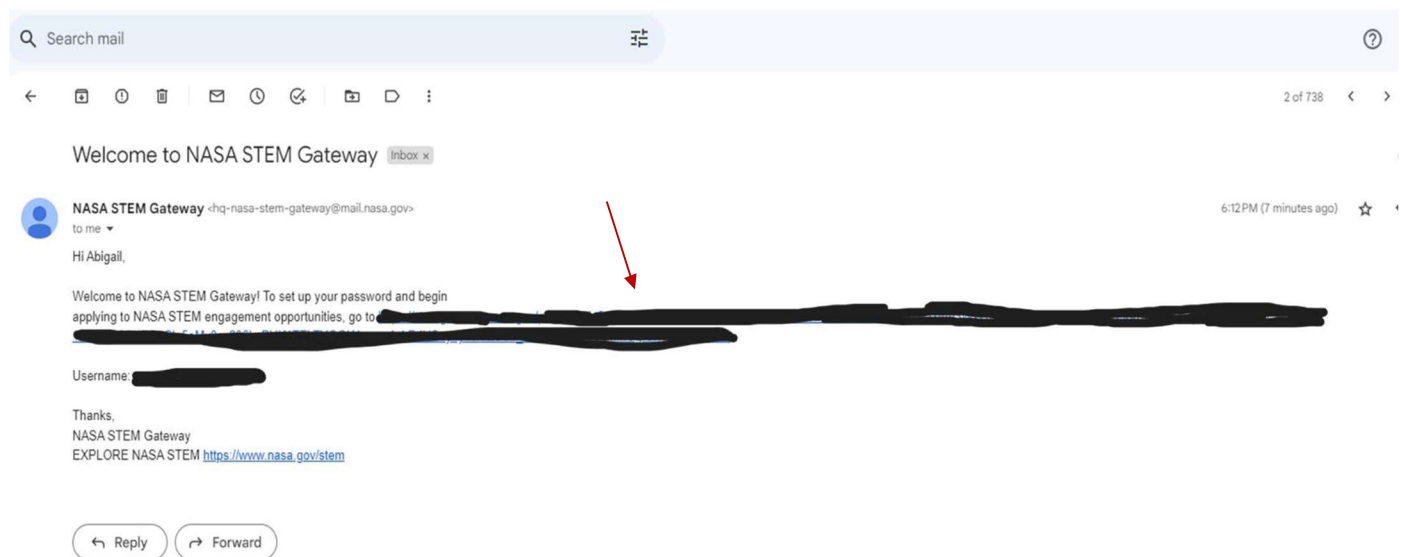**Step 7**

Log into the email account you used to start your registration process to retrieve the link from HQ-NASA-STEM-Gateway to complete your profile. Clink the link. Redacted in Black Below.

Step 8

Log into the email account you used to start your registration process and click the link from HQ-NASA-STEM-Gateway to complete your profile. The first page will be an acknowledgement that you are authorized to access this system. Click "Next."

Step 9

Set up your password using the guidelines provided. Store your password in a safe, secure, and accessible place! You will only be able to click "Change Password" if you meet all the requirements and your passwords match in the "new" and "confirm" lines below.

Step 10

Fill out your personal information and click "Next"

Step 11

Fill out your demographic information and click "Next"

Step 12

Fill out your Citizenship information and click "Next"

Step 13

Fill out your Education or Affiliate Organization. Select "Undergraduate" or "Graduate" Student depending on your classification. Select your grade level and enrollment status. Search for and select the college you are currently enrolled in. Then click "Next"

Step 14

Click the buttons next to "Yes" for the media release and reporting data collection acknowledgement. Then click "Next"

Step 15

You now have a NASA STEM Gateway Profile!!! Click Next to get to the STEM Gateway Home page and start exploring!

Explore!

APPENDIX B-2 – How to Register with WSGC and Apply to FNL Competition
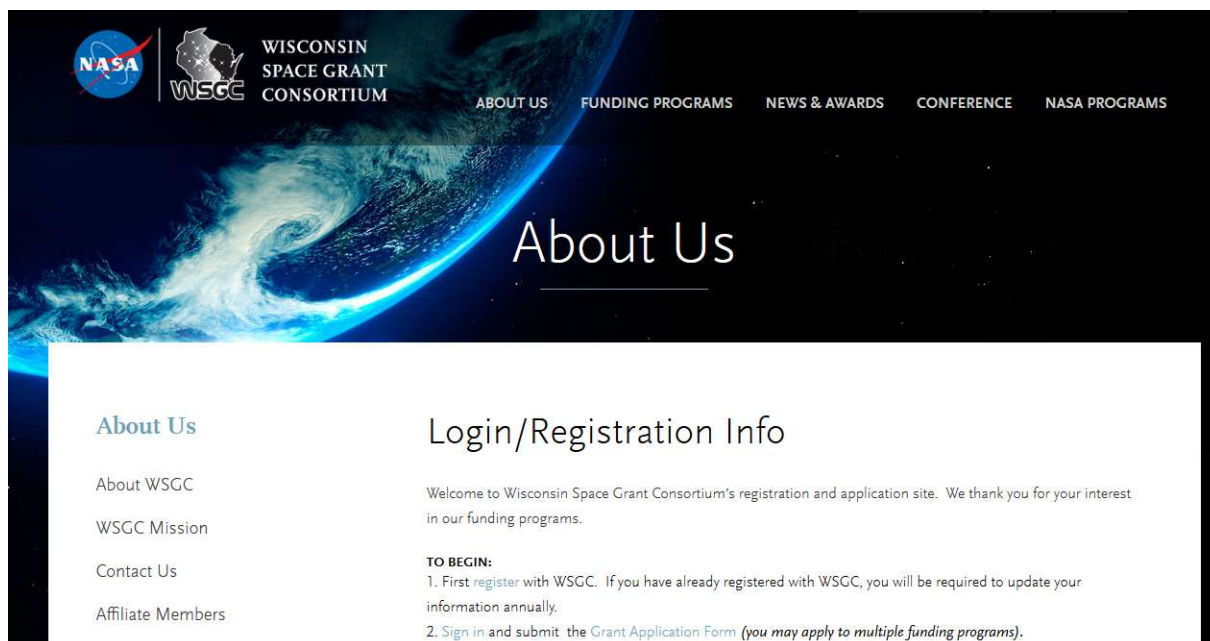
*The **team advisor, team lead, and team co-advisor** (if applicable) must first register with WSGC *before* applying to the program through the "Rocket Launch Team (Create an NOI)" application.

Advisor Application Process

STEP 1: First-time users must register as faculty on the WSGC website. The registration and sign-in tab can be found on the upper right-hand corner of the website.

STEP 2: Sign in to your WSGC account. Applicants will be prompted to update personal information annually (if previously registered).

STEP 3: Select Manage Applications. **(Advisors only - not applicable to co-advisors)**

STEP 4: Under Grant Application Forms, select Rocket Launch Team (Create an NOI).

STEP 5: Complete and submit the Rocket Launch Team (Create NOI) Grant Application Form. The following information/documents will be submitted during this step:
- Other WSGC funding received
- Team Name
- Co-Advisor (if applicable)
- Student Team Lead
- Grants Officer (if applicable)
- Industry, Tripoli, National Rocketry Association Mentor Name and Email
- Competition
- Team Members List

Co-Advisor Application Process

STEP 1: First-time users must register as faculty on the WSGC website. The [registration](#) and [sign-in](#) tab can be found on the upper right-hand corner of the website.

STEP 2: Sign in to your WSGC account. Applicants will be prompted to update personal information annually (if previously registered).

STEP 3: If unable to directly upload a completed W-9 into the WSGC website, complete one and send it to fnl@carthage.edu

Team Application Process

AFTER the team advisor completes the Notice of Intent (NOI), each team member will need to:

STEP 1: Register as an undergraduate student on the WSGC website. The [registration](#) and [sign-in](#) tab can be found on the upper right-hand corner of the website.

STEP 2: Sign in to your WSGC account. Applicants will be prompted to update personal information annually (if previously registered).

STEP 3: Select Manage Applications.

STEP 4: Under Grant Application Forms, select the appropriate program (Collegiate Rocket Launch Competition *or* First Nations Rocket Launch Competition). The following information/documents will be submitted during this step:
- Other WSGC funding received.
- Team Name submitted by the Team Advisor.
- Resume *(Collegiate Rocket Launch Only).*
- Prior Rocket Experience.
- Individual W9 (*First Nations Launch Advisors/Co-advisors and Collegiate Rocket Launch Competition Team Members Only).*

APPENDIX B-3 – How to Upload Documents to WSGC

All of your reports, documentation, etc. will be submitted to WSGC via the website. Depending on what documents are being submitted, either the **team advisor** or the **team lead** will be required to login to the team profile, and upload the respective document before the due date.

Click the 'Select File' below the document that needs to be uploaded, and then search for the file in the folder dialog box on your computer. Please ensure it is in the proper format and labeled appropriately. Do not forget to include the document submission deadlines in your master schedule, so as not to miss a deadline (or document).

APPENDIX B-4 – Reimbursement Guide

Project Expense Form Reimbursement Instructions

1. Make purchases.
    a. Teams should select one team member to oversee the budget, ensuring collective purchases/expenses do not exceed award amount.
2. Save all original digital and hard copy receipts.
    a. We recommend saving receipts in a folder until time of reimbursement submission.
    b. Number each receipt.
    c. Circle date and total on receipt(s).
    d. All purchase receipts must be itemized, detailing each item purchased.
3. Complete a Project Expense Form (see Tools and Tips on the WSGC website). If your expenses exceed the allotted space on the form(s), print off a second form to add the remaining expenses. Do not list both supply and travel expenses on one form.
    a. Carefully read and follow instructions before completing form(s).
    b. List receipt(s) in numerical order.
    c. Identify date from each receipt.
    d. List name of Vendor/Store from each receipt.
    e. Describe the purchase from each receipt.
    f. Provide the total expended amount from each receipt.
    g. The "Total" box will automatically sum all receipts together - this is your total reimbursement being requested.
    h. Initial and date each receipt with date of reimbursement submission.
    i. Sign, date, and enter your phone number.
    j. Have your team lead and advisor complete their required signatures.
4. Submit the completed form(s) and receipts in one email by the due date(s) to:
    WSGC Accounts
    wsgc.accounts@carthage.edu
    (262) 551-6054

   In emails, please include in the subject line: *FNL25_{{School Name}}_Reimbursement**

<u>**Do Not Submit:**</u>
1. Partially completed forms.
2. Forms without all required signatures.
3. Forms past due date(s).
4. "Flat" per diem rate requests.

**An example of a filled-out Project Expense form and accompanying receipts can be found on the following pages.*

Project Expense Form Example

PROJECT EXPENSE FORM

To receive reimbursement, this form must be submitted by each team member who made a purchase.

NOTE: The team leader cannot be reimbursed for purchases made by team members and then distribute the money.

Email Form and Receipts To:	Please Make Check Payable To:
WSGC Accounts wsgc.accounts@carthage.edu (262) 551-6054	Name: Address line 1: Address line 2: City, State, Zip:
	Team Institution:

Rcpt #:	Date	Vendor/Store	Description	Amount
			TOTAL	$ 0.00

REQUISITIONER STATEMENT: I declare (under penalties of perjury) that this account of expenses is accurate and conforms to all applicable WSGC regulations. The expenses are actual, reasonable and were personally incurred in accordance to my award letter criteria.

Team Member Signature	Phone #	Date
Team Leader Signature	Phone #	Date
Team Advisor Signature	Phone #	Date

A fillable project expense form can be found on the WSGC website at:
https://spacegrant.carthage.edu/live/files/4563-project-expense-form

The following is an example of a filled-out project expense form and accompanying receipts.

PROJECT EXPENSE FORM

To receive reimbursement, this form must be submitted by each team member who made a purchase.

NOTE: The team leader cannot be reimbursed for purchases made by team members and then distribute the money.

Email Form and Receipts To:	Please Make Check Payable To:
WSGC Accounts wsgc.accounts@carthage.edu (262) 551-6054	Name: Jane Doe Address line 1: 1234 Instruction Way Address line 2: Apt 401 City, State, Zip: Kenosha, WI 53140
	Team Institution: Test Team

Rcpt #:	Date	Vendor/Store	Description	Amount
1	04/21/22	Lowe's	Batteries, lighter, tape, glue, screws	$ 42.58
2	03/31/22	L&M Fleet Supply	Washers, glue, quick links	$ 34.60
3	03/04/22	Adafruit	Servo motor, charger, gyroscope	$ 109.25
			TOTAL	$ 186.43

REQUISITIONER STATEMENT: I declare (under penalties of perjury) that this account of expenses is accurate and conforms to all applicable WSGC regulations. The expenses are actual, reasonable and were personally incurred in accordance to my award letter criteria.

Jane Doe
Team Member Signature

Susan Smith
Team Leader Signature

John Doe
Team Advisor Signature

(123) 456-7890	04/22/22
Phone #	Date
(234) 567-8901	04/22/22
Phone #	Date
(345) 678-9012	04/22/22
Phone #	Date

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Revised 01/2023

(1.)

LOWE'S

LOWE'S HOME CENTERS, LLC
6500 GREEN BAY ROAD
KENOSHA, WI 53142 (262) 653-8770

- SALE -
SALESM: FSTLANE1 13 TRANSM: 7586534 04-21-22

```
93857 DURACELL 9V 2-PACK          10.28
3734208 BIC LIGHTER 2 PACK         2.48
87237 SCOTCH BLUE 1.88 SHARP LI    9.98
1314367 I/O 1.75 FL OZ GOR CLEAR   6.98
39340 700 TAPE 1-UNIT 3M           2.38
556898 CLEARWELD EPOXY SYRINGE     6.98
58492 PPH SELF DRIL 6X1/2 12-CT    1.28

              SUBTOTAL:           40.36
                   TAX:            2.22
    INVOICE 07233 TOTAL:          42.58
                  VISA:          [42.58]
```

VISA: XXXXXXXXXXX!   AMOUNT:42.58 AUTHCD: 04788D
CHIP REFID:256007047249 04/21/22 19:14:56
APL: VISA CREDIT   IVR: 8080008000
AID: A0000000031010 TSI: 6800
STORE: 2560   TERMINAL: 07 04/21/22 19:15:34
OF ITEMS PURCHASED: 7
EXCLUDES FEES, SERVICES AND SPECIAL ORDER ITEMS

THANK YOU FOR SHOPPING LOWE'S.
FOR DETAILS ON OUR RETURN POLICY, VISIT
LOWES.COM/RETURNS
A WRITTEN COPY OF THE RETURN POLICY IS AVAILABLE
AT OUR CUSTOMER SERVICE DESK

STORE MANAGER: MARK PEPLINSKI

LOWE'S PRICE PROMISE
FOR MORE DETAILS, VISIT LOWES.COM/PRICEPROMISE

```
  SHARE YOUR FEEDBACK!
  ENTER FOR A CHANCE TO BE
  ONE OF FIVE $500 WINNERS DRAWN MONTHLY!
  ¡ENTRE EN EL SORTEO MENSUAL
  PARA SER UNO DE LOS CINCO GANADORES DE $500!

  ENTER BY COMPLETING A SHORT SURVEY
  WITHIN ONE WEEK AT: www.lowes.com/survey
  Y O U R   I D #072336 256001 114299

  NO PURCHASE NECESSARY TO ENTER OR WIN.
  VOID WHERE PROHIBITED. MUST BE 18 OR OLDER TO ENTER.
  OFFICIAL RULES & WINNERS AT: www.lowes.com/survey
```

STORE: 2560   TERMINAL: 07 (04/21/22 19:15:34)

ꭓ𝒪
4/22/22

(2.)

L&M FLEET SUPPLY

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10680 State Hwy 27/77
Hayward, WI 54843
715-934-2300

Online Bill Pay And eStatements Now
Available! Check out details at
www.lmsupply.com

PROD ID	QTY UM	PRICE	TOTAL
WASHER FENDER 3/8X1-1/2			
25663053	3 EA	1.89	5.67 e
GORILLA GLUE EPOXY 5MINSET .85OZ			
31120166	4 EA	5.99	23.96 e
QUICK LINK ZNC BCODE 1/4"			
3461170	2 EA	1.49	2.98 e
QUICK LINK ZNC BCODE 5/16"			
3461183	1 EA	1.99	1.99 e
SUBTOTAL			34.60
Tax			.00
TOTAL			34.60
L&M Charge Account			[34.60]

# of Items Sold   = 4
Qty of Items Sold = 10

(03/31/22) 15:22:22 008   70300459008
8000012300
ATB:
PO NUMBER: ꭓ𝒪 4/22/22
INVOICE #:
DCBD8992-BE6B-4671-8E87-BE0699311148
9756KA 2.93.6199 TILL ID: 02

Shop online at lmsupply.com

Sign up to receive our Weekly Ad in
your email at signup.lmsupply.com

Thank you for shopping at
L&M Fleet Supply!

Online Bill Pay And eStatements Now
Available! Check out details at
www.lmsupply.com

3.

INVOICE NO. 2797183

DATE ORDERED: Friday 04 March, 2022

PAYMENT METHOD: Credit Card

SHIP TO

SOLD TO

PRODUCTS		INFO	PRICE	TOTAL
(4) Analog Feedback Servo		PID: 1404 SID:	$14.95	$59.80
(1) PowerBoost 1000 Charger – Rechargeable 5V Lipo USB Boost @ 1A		1000C PID: 2465 SID:	$19.95	$19.95
(1) Adafruit ICM–20649 Wide Range ±30g ±4000dps 6–DoF IMU		STEMMA QT / Qwiic PID: 4464 SID:	$14.95	$14.95

	Sub-Total:	$94.70
United Parcel Service (1 pkg x 0.65 lbs total) (UPS GROUND):	Shipping:	$14.55
	Tax:	$0.00
	Total:	$109.25

1Z71EY050393838304

4/22/22

Travel Expense Form Reimbursement Instructions

1. Make purchases(s). **Please note: Reimbursements are funded under a federal grant; therefore WSGC and FNL awardees must comply with the [Carthage College Travel Policy](#).**
   a. Teams should select one team member to oversee the budget, ensuring collective purchases/expenses do not exceed award amount.
   b. Save all original digital and hard copy receipts.
      i. We recommend saving receipts in a folder until time of reimbursement submission.
      ii. Circle date and total on receipt(s).
      iii. If food or lodging receipts cover more than one person, list participant's name on receipt(s).
      iv. Itemized restaurant receipts are required. If purchases are made on a credit card, a signature copy must be included. There is a **$45 per diem** per person for food.
      v. Alcohol and tips over 20% will not be reimbursed.
   c. All purchase receipts must be itemized, detailing each item purchased. Complete a Travel Expense Form (see Tools and Tips on the WSGC website). Use a separate Travel Expense Form for each event. If your expenses exceed the allotted space on form(s), print off a second form to add the remaining expenses. Do not list both supply and travel expenses on one form.
      i. Carefully read and follow instructions before completing forms.
      ii. Print out a Google map for verification of **personal vehicle mileage** ($.655 per mi). Circle the total miles. **The mileage rate includes fuel costs. Gas receipts will only be reimbursed for rental vehicle travel.**
      iii. Organize your receipts to align with the Travel Expense Form (by receipt category and day of the week). Label each receipt with the coinciding row and column information (i.e. Receipt 1-Fri, 3-Mon, 11-Mon, etc.).
      iv. Provide the total expended amount from each receipt in the coinciding box on the expense form.
      v. **IMPORTANT**: You must manually add all mileage together for your "Mileage Line Total". If the decimal number is below .5, it should be rounded down. And if the decimal is above .5, it is rounded up (i.e. 52.1 miles would become 52 miles).
      vi. For all other categories, the "Line Total" box will automatically sum receipts together – your total reimbursement being requested will automatically add up in the "Total" box.
      vii. Initial and date each receipt with date of reimbursement submission.
      viii. Sign, date, and enter your phone number.
      ix. Have your team lead and advisor complete their required signatures.
   d. Submit the completed form(s) and receipts in one email by the due date(s) to:
      i. **WSGC Accounts**
         wsgc.accounts@carthage.edu
         (262) 551-6054
      ii. In emails, please include in the subject line: *FNL25_{{School Name}}_Reimbursement*.

Do Not Submit:
1. Partially completed forms.
2. Forms without all required signatures.
3. Forms past due date(s).
4. "Flat" per diem requests.

**An example of a filled-out Travel Expense form and accompanying receipts can be found on the following pages.*

TRAVEL EXPENSE FORM

To receive reimbursement, this form must be submitted by each team member who made a purchase.

NOTE: The team leader cannot be reimbursed for purchases made by team members and then distribute the money.

Email Form and Receipts To:		Please Make Check Payable To:							
WSGC Accounts wsgc.accounts@carthage.edu (262) 551-6054		*Name:* *Address line 1:* *Address line 2:* *City, State, Zip:*							

Travel Start Date:	Travel End Date:	Team Institution:							

Travel Purpose:

Receipt Category	Description	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Line Total
1	Mileage Total								
	miles x 0.655								$ 0.00
2	Air/Rail Fare								$ 0.00
3	Baggage Fee(s)								$ 0.00
4	Rental Car								$ 0.00
5	Uber/Lyft/Taxi/Metro								$ 0.00
6	Parking/Tolls								$ 0.00
7	Misc. Ground Transport								$ 0.00
8	Lodging								$ 0.00
	Meals ($45 per diem)								
9	-Breakfast								$ 0.00
10	-Lunch								$ 0.00
11	-Dinner								$ 0.00
12	-Other								$ 0.00
13	Tips								$ 0.00
14	Miscellaneous 1								$ 0.00
15	Miscellaneous 2								$ 0.00
	TOTAL ---------->								$ 0.00

REQUISITIONER STATEMENT: I declare (under penalties of perjury) that this account of expenses is accurate and conforms to all applicable WSGC regulations. The expenses are actual, reasonable and were personally incurred in accordance to my award letter criteria.

Team Member Signature	*Phone #*	*Date*	
Team Leader Signature	*Phone #*	*Date*	
Team Advisor Signature	*Phone #*	*Date*	

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Travel Expense Form Example

A fillable travel expense form can be found on the WSGC website at:
https://spacegrant.carthage.edu/live/files/5405-travel-expense-form

The following pages include an example of a filled-out travel expense form and accompanying receipts.

Travel Expense Form Example Continued

TRAVEL EXPENSE FORM

To receive reimbursement, this form must be submitted by each team member who made a purchase.

NOTE: The team leader cannot be reimbursed for purchases made by team members and then distribute the money.

Email Form and Receipts To:	Please Make Check Payable To:
WSGC Accounts	**Name:** Jane Doe
wsgc.accounts@carthage.edu	*Address line 1:* 1234 Instruction Way
(262) 551-6054	*Address line 2:* Apt 401
	City, State, Zip: Kenosha, WI 53140

Travel Start Date:	Travel End Date:	Team Institution:
03/16/22	03/20/22	Test College

Travel Purpose:

Instruction Workshop

Receipt Category	Description	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Line Total
1	Mileage Total	57.6			57.6				115.0
	miles x 0.655								$ 75.33
2	Air/Rail Fare								$ 0.00
3	Baggage Fee(s)								$ 0.00
4	Rental Car								$ 0.00
5	Uber/Lyft/Taxi/Metro								$ 0.00
6	Parking/Tolls						$ 36.05		$ 36.05
7	Misc. Ground Transport								$ 0.00
8	Lodging				$ 275.12	$ 275.12	$ 286.65	$ 286.65	$ 1,123.54
	Meals ($45 per diem)								
9	-Breakfast	$ 6.75							$ 6.75
10	-Lunch								$ 0.00
11	-Dinner				$ 50.30				$ 50.30
12	-Other								$ 0.00
13	Tips								$ 0.00
14	Miscellaneous 1								$ 0.00
15	Miscellaneous 2								$ 0.00
	TOTAL ---------->								$ 1,291.97

REQUISITIONER STATEMENT: I declare (under penalties of perjury) that this account of expenses is accurate and conforms to all applicable WSGC regulations. The expenses are actual, reasonable and were personally incurred in accordance to my award letter criteria.

Jane Doe	(123) 456-7890	03/20/22
Team Member Signature	**Phone #**	**Date**
Susan Smith	(234) 567-8901	03/20/22
Team Leader Signature	**Phone #**	**Date**
John Doe	(345) 678-9012	03/20/22
Team Advisor Signature	**Phone #**	**Date**

Carthage College • 2001 Alford Park Drive • Kenosha, Wisconsin 53140-1994
262-551-6054 • spacegrant@carthage.edu • spacegrant.carthage.edu

Revised 01/2023

Google Maps   2001 Alford Park Dr, Kenosha, WI 53140 to International Parking (Lot D)   Drive 57.6 miles, 59 min

Map data ©2016 Google   5 mi

We don't have the most recent timetables for this area.

via I-94 E   57.6 x 2 = 115.2   59 min

57 min without traffic   Rounded= 115 x **$0.655**   = **$75.33**   57.6 miles

⚠ This route has tolls.

1:58 PM – 5:41 PM										3 h 43 min
🚶	🚌 4	🚈 UP-N	🚌 X9	🚈 Blue Line	🚌 Van Galder	🚶				

1:58 PM – 5:41 PM										3 h 43 min
🚶	🚌 4	🚈 UP-N	🚌 81	🚈 Blue Line	🚌 Van Galder	🚶				

Receipt 1- Wed and Sun

3/20/22

```
Gaylord Opryland
Nashville, TN
DATE :03/18/22
TIME :08:03 PM

Receipt No.   189/1750/89
        * Original *
  Ticket:   426755
  Entry :    03/18/22 08:29 AM
  LPR   :VF3Y1G
             33.01
Net:
             3.04
Tax 9.250%
             36.05
Fee:

Credit          36.05
Trans ID : 700948952
Card No. : xxxxxxxxxxxx8592
Card Type: VISA


      THANK YOU
```

Receipt 6- Fri

3/20/22

HYATT PLACE™

Receipt 8- Wed, Thur, Fri, Sat

INVOICE

2001 Alford Park Dr
Wisconsin Space Grant Consorti
Kenosha WI 531401929
United States

3/20/22

Room No.	0423
Arrival	03-16-22
Departure	03-20-22
Folio Window	1

Confirmation No.   3445305101

Group Name

Folio No.   151068

Date	Description		Charges	Credits
03-16-22	Guest Room		236.55	
03-16-22	State Tax		21.88	*275.12*
03-16-22	Occupancy Tax		14.19	
03-16-22	City Arena Fee		2.50	
03-17-22	Guest Room		236.55	
03-17-22	State Tax		21.88	*275.12*
03-17-22	Occupancy Tax		14.19	
03-17-22	City Arena Fee		2.50	
03-18-22	Guest Room		246.55	
03-18-22	State Tax		22.81	*286.65*
03-18-22	Occupancy Tax		14.79	
03-18-22	City Arena Fee		2.50	
03-19-22	Guest Room		246.55	
03-19-22	State Tax		22.81	*286.65*
03-19-22	Occupancy Tax		14.79	
03-19-22	City Arena Fee		2.50	
03-20-22	Visa	XXXXXXXXXXXX6927 XX/XX		1,123.54
03-28-22	State Tax Exempt		-45.62	
03-28-22	State Tax Exempt		-43.76	
03-28-22	Occupancy Tax Exempt		-29.58	
03-28-22	Occupancy Tax Exempt		-28.38	
03-28-22	Visa	CREDIT TAXES		-147.34
		XXXXXXXXXXXX6927 XX/XX		

Jane Doe
Guest Signature

I agree that my liability for this bill is not waived and I agree
to be held personally liable in the event that the indicated
person, company or association fails to pay for any part or
the full amount of these charges.

Total	976.20	976.20
Balance	0.00	

WE HOPE YOU ENJOYED YOUR STAY WITH US!

Thank you for choosing Hyatt Place Nashville/Opryland. Our goal is to provide every
guest with an exceptional stay and we are interested in any comments regarding your
visit.

World of Hyatt Summary

Membership:	XXXXXX863D
Bonus Codes:	
Qualifying Nights:	4

Please remit payment to:
Hyatt Place Nashville/Opryland
220 Rudy's Circle
Nashville, TN 37214

```
***FREE OFFER ON BACK ***
Wendy's Restaurant #00013257
    Interstate 57/Rout
      Marion IL 6295
      (618) 969-8280


Host: Kimberly              03/20/2022
CCHRISTINE                   10:00 AM
                               10033

Order Type:  DINE IN

RK COMBO                         5.59
SauEggSws Crsnt
    American Cheese
 NO  Breakfast Cheese Sauce
SM Seasoned Potatoes
Orange Juice                     0.70

         Total Items 3          6.29
Tax                             0.4

DINE IN Total            6.75

Visa #XXXXXXXXXXXX8592            $6.75
  Auth:020140
Site #: 13257               Term #: 1
App Label:                 VISA CREDIT
EMV AID:           A0000000031010
Entry Method:                   Chip
Auth Mode:                     Issuer
CVM:                   NoCvmRequired



             *********
             Sandwich?
           ur Survey!
        www.TalkToWendys.com
        (See Back for De
```

Receipt 9- Sun

3/20/22

2400 Music Valley Drive
Nashville, TN 37214
615-724-1200

Server: Theresia   DOB: 03/16/2022
09:39 PM   03/16/2022
Table 16/1   2/20039

SALE

VISA   4194337
Card #XXXXXXXXXXXX8592
Magnetic card present:
Card Entry Method: S

Approval: 016718

          Amount: $41.90

          + Tip: _____ 8%

          = Total: _____ 50.30

I agree to pay the above
total amount according to the
card issuer agreement.

X_ Jane Doe _____

Caney Fork
Where Friends and Family Eat!
Mon-Thurs 4pm-10pm
Fri-Sat 11am-11pm
Sun. 4pm - 9pm

Customer Copy

2400 Music Valley Drive
Nashville, TN 37214
615-724-1200

Server: Theresia   03/16/2022
TBL 16/1   9:30 PM
Guests: 4   20039
Reprint #: 1

Cajun Gator Sliders   13.95
Elk Sliders   13.95
Pulled Pork BBQ Sandwich   10.45

Subtotal   38.35
Tax   3.55

Total   41.90

Balance Due   41.90

Caney Fork
Where Friends and Family Eat!
Mon-Thurs 4pm-10pm
Fri-Sat 11am-11pm
Sun. 4pm - 9pm

Dinner for group:

Jane Doe
John Doe
Jim Doe

JD 3/20/22

Receipt 11- Wed

APPENDIX B-5 – Rocket Shipping Procedure

Please follow the FNL **Rocket Shipping Procedure** when shipping rocket(s) to Wisconsin for the competition. It is the team's responsibility to ensure your rocket makes it to Wisconsin in time for the Launch Weekend.

1. Call a carrier of your choice (FedEx, UPS, etc.), to schedule a package shipment. The delivery date to the hotel should coincide with your arrival. ***NOTE: All rockets should be delivered to the hotel prior to the team's arrival at the hotel.*** We recommend scheduling a return package pickup from the hotel at the same time. ***NOTE: All rockets should be scheduled for pickup prior to your hotel checkout.***
   a. Have package(s) shipped to (request your team's hotel from cengberg@carthage.edu):

      ATTN: (Guest Name)
      Wyndham Garden Kenosha Harborside
      5125 6ᵗʰ Avenue
      Kenosha, WI 53140

      OR

      ATTN: (Guest Name)
      The Stella Hotel
      5706 8th Ave
      Kenosha, WI 53140

   b. The hotel will put an alert on your reservation once the shipment arrives.
   c. Upon check-in, notify the front desk that you shipped a package to the hotel.   The hotel will verify the package's arrival and give you the package(s). ***NOTE: Packages should include the name of the person picking up the package in the return address.***
   d. Rockets will be shipped from the hotel in the original packing material. It's important that you keep boxes, etc. in your rooms to properly package your rocket. ***NOTE: WSGC and the hotel do not have packing materials available for return shipping.***
   e. If you did not pre-set up a return shipment with the carrier of your choice when making arrangements to ship your rocket to Wisconsin, do so upon your arrival.
   f. Take prepared package(s) to the hotel front desk and inform them of the scheduled pick-up date and time. The hotel will hold the package(s) until carrier pick-up.
2. Rocket Shipping Airline Procedure
   a. Baggage policies vary between carriers, double check when selecting your flights.
   b. Checked back weight limit is typically 50 pounds.
   c. Checked bag maximum size allowance is typically 62 linear (total) inches.
      i. Note: 38" x 12" x 12" (62" total) box would be allowed, such as a U-Haul Lamp Box (12" x 12" x 40") with two inches trimmed off the length.
      ii. **Black residue and motors are not allowed**.
      iii. Batteries are only allowed in carry-on bags.

APPENDIX B-6 – Team Roster and Lodging List Form

First Nations Launch

Team Roster and Lodging List Form

Complete and submit the **Team Roster and Lodging List** form to the advisor's grant
management page in the Lodging List field by the due date listed on the FNL Calendar.
**Note: All team members listed on the form should have <u>registered</u> on the WSGC
website and <u>applied</u> for the FNL Competition.**

Submit any <u>changes</u> to the *Team Roster and Lodging List Form* to
cengberg@carthage.edu.

Name of Academic Institution:

FINAL TEAM ROSTER		LODGING LIST	Arrival Date	Depart Date	Note/Food Restrictions
Faculty Advisor	**Shirt Size**	**Room 1** – WSGC Sponsored	eg 4/27	eg 4/30	
Name:	S	1.	4/28	4/30	
Co-Advisor	**Shirt Size**	2.	4/28	4/30	
Name:	S	3.	4/28	4/30	
Team Lead	**Shirt Size**	4.	4/28	4/30	
Name:	S	**Room 2** – WSGC Sponsored			
Team Mentor	**Shirt Size**	1.	4/28	4/30	
Name:	S	2.	4/28	4/30	
List ALL other participants on your team, including those unable to attend the launch	**Shirt Size**	3.	4/28	4/30	
		4.	4/28	4/30	
1.	S	**Room 3** – WSGC Sponsored			
2.	S	1.	4/28	4/30	
3.	S	2.	4/28	4/30	
4.	S	3.	4/28	4/30	
5.	S	4.	4/28	4/30	
6.	S	**Room 4** – Team Budget Funded			
7.	S	1.	4/28	4/30	
8.	S	2.	4/28	4/30	
9.	S	3.	4/28	4/30	
10.	S	4.	4/28	4/30	
11.	S	**Room 5** – Team Budget Funded			
12.	S	1.	4/28	4/30	
13.	S	2.	4/28	4/30	
14.	S	3.	4/28	4/30	
15.	S	4.	4/28	4/30	
16.	S	**Room 6** – Team Budget Funded			
For office use only Submission Date: Notes:		1.	4/28	4/30	
		2.	4/28	4/30	
		3.	4/28	4/30	
		4.	4/28	4/30	

_____   _____
Advisor Signature   Date

A fillable form can be found in Tools and Tips on the WSGC website at:
https://spacegrant.carthage.edu/first-nations-launch/tools-and-tips/

First Nations Launch
Team Bio Template

Please fill out the information below and submit it as your "Team Bio" by the required date.
For dates and deadlines, visit: https://spacegrant.carthage.edu/first-nations-launch/calendar/

1. Please enter the name of your Academic Institution.	
2. Please enter the first and last name of your Team Lead.	
3. Please enter the first and last name of your Team Advisor.	
4. Please enter the first and last name of your Team Mentor.	
5. Please list academic major(s) being pursued by each member of your team.	
6. Has your team or any team members participated in any other rocket competitions? If yes, provide the name and year of each competition.	
7. Has your team or any team members participated in any other design team challenges (CubeSat, RockSat, etc)? If so, provide the name and year of each challenge.	

8. Has your team or any team members been accepted into any NASA internships or Artemis student challenges? If so, provide the name and year of each project.	
9. On a scale of 1-10, how comfortable do you feel right now about participating in First Nations Launch? (Circle one)	1 2 3 4 5 6 7 8 9 10 Least Comfortable --→ Most Comfortable
10. Based on the scheduled informational meetings, handbook, and other resources provided, do you think your team needs more or less time and/or resources from WSGC? (Feel free to elaborate)	Less Resources Appropriate Amount of Resources More Resources Explain:
11. What does your team hope to accomplish by participating in the First Nations Launch program?	
12. Is there any other information you would like to share with WSGC about your team?	

APPENDIX C-1 – Project Planning Guidance

Team Structure
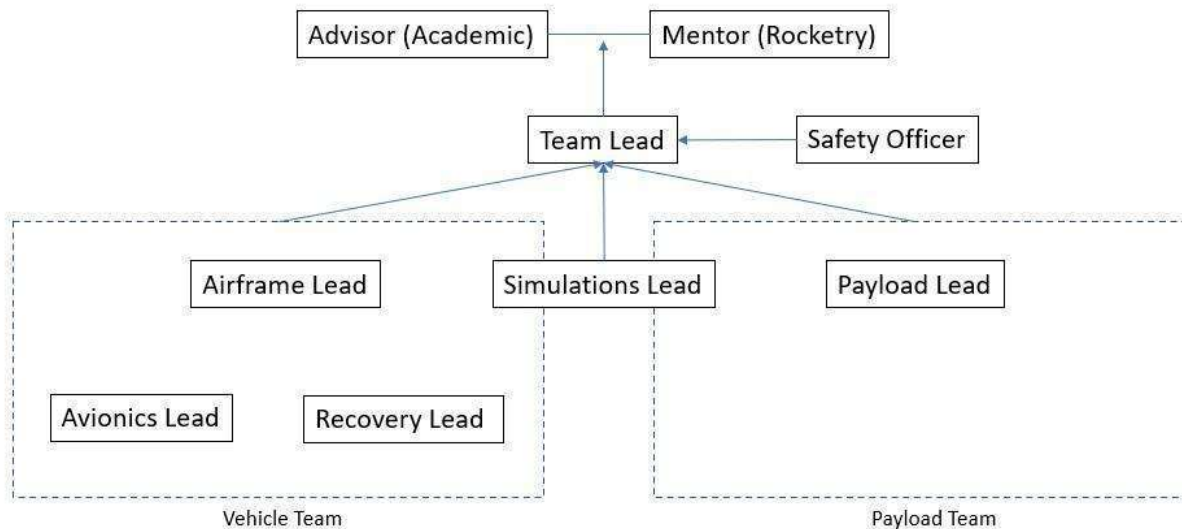
Figure C.1 GANTT Chart- Recommended team structure.

Role Descriptions

Figure C.1 shows the recommended breakdown for a typical Rocket Competition team. This breakdown works best for 5-6 team members. If you do not have 5-6 team members, ensure that you are dividing the work evenly.

a. Team Lead
   i. Organizes meetings, delegate tasks, keeps the team on track and integrated.
   ii. Support other team member's roles as needed.
   iii. Bring issues to advisor and/or TRA mentor.
   iv. Bring issues/questions to the WSGC team.
   v. Assists and organizes parts/supplies procurement.
   vi. Compiles and proofs reports and presentations.
b. Team Safety Officer
   i. Organizes the safety procedures of the team.
   ii. Responsible for the Safety section of the reports.
   iii. Creates and maintains all hazard analysis and risk assessment.
c. *S*imulations Lead (can be combined with Airframe)
   i. Responsible for running/updating simulations and motor selection.
   ii. Responsible for the Mission Performance section of reports.
d. Avionics Lead
   i. Responsible for design/layout/fabrication of avionics bay.
   ii. Responsible for altimeter selection/operation.
   iii. Responsible for the Avionics section of reports.
e. Recovery Lead
   i. Responsible for all recovery hardware and its integration
   ii. Responsible for proper parachute selection/sizing (simulation).
   iii. Responsible for the Recovery section of report.

  f. Sub-Teams

It is important that all members of the overall team are communicating and working together where necessary. This is where your Team Schedule or Gantt Chart will help with workflow. The sub-teams shown in *Figure C.1* are recommended for efficient breakdown of responsibility.

   i. Airframe Team
    1. Responsible for vehicle modification and assembly/construction.
    2. Responsible for subsystem integration.
    3. Responsible for the Vehicle Criteria section of reports.
   ii. Payload/challenge Team (the Challenge)
    1. Responsible for payload/challenge design (hardware and software).
    2. Responsible for integration.
    3. Responsible for the Payload/challenge Criteria section of reports.

  g. Additional Team Resources

Additional team resources can be found under "Tools & Tips" on the First Nations Launch website at https://spacegrant.carthage.edu/first-nations-launch/tools-and-tips/ Resources include:

   i. Team Role Test
   ii. Stages of Team Formation
   iii. Positive Team Building: Bruce Tuckman's Proven Formation
   iv. The Unique Characteristics of an Effective Team
   v. Understanding the Stages of Team Formation
   vi. Team Charters
   vii. Sample Team Charter
   viii. So, You're Going to be a Member of a Team

Budgets

It is important to create and maintain a budget over the course of your project. Many projects struggle or fail due to mismanagement of funds or not anticipating the unexpected. The Team Lead should be responsible for creating and maintaining the budget, with assistance from the Advisor.

There are many Project Management tools available for use. We do not limit which one you prefer. The simplest approach is to use an Excel Spreadsheet. Your initial budget at the Proposal phase will not contain many details. Instead, it will contain a breakdown to the primary functions of your Project.

 1. Proposal Budget
  a. Teams receive a $4000 funded project. You will need to decide how much you will allocate to:
   i. Simulation Software
   ii. Vehicle Parts
   iii. Payload Parts
   iv. Testing or Mockup of Components and Ideas
   v. Rocketry Building Supplies
   vi. Tooling or Special Tools
   vii. Personal Protective Equipment
   viii. Travel and Accommodations

The budget should not be an afterthought – monitor and update the budget weekly or as needed. You may find that your generous allowance slowly fades, as the budget creeps. You may also need to reallocate funds from one source to another, or even seek out additional funds from your school or community.

If you create and maintain your budget in Excel spreadsheet, it is a simple matter to copy the table over to your report when necessary (if it is large, you may add it as an Appendix – do not shrink the table so small that the reader struggles to read it).

Milestone Phases

At each milestone, you will need to update the budget spreadsheet with new details as the team makes design choices. All the remaining reports (PDR, CDR, FRR) require you to submit the updated budget. The WSGC team can also verify you are on track if certain items are in your budget at certain milestones – or conversely, if you are missing key items, we will ask if you have considered them, and help get you back on track.

Bonus: You can also use the budget spreadsheet to track items (create a column for 'status' – purchased, shipped, on-hand etc.). You can also use the budget spreadsheet to verify and maintain the parts mass balance (create a column for 'weight' – weigh each item as it arrives and update the simulations accordingly).

Example Budget

There is an example budget (slightly detailed, perhaps at PDR phase) found on the WSGC website resource page.

WSGC (Collegiate, First Nations, Great Midwest) Rocket Competition 20xx
Team ABC
School Name

Proposed Budget

Component Description	Quantity	Cost Per Unit	Total
BODY FRAME CONSTRUCTION			
Body Tube 3.9" ID 4.0" OD 34 inch length	2	$10.45	$20.90
Centering Rings 3.9" OD 38 mm ID 0.5" thickness will be made in house	2	$8.10	$16.20
Nose Cone 3.9" outer diameter	1	$21.95	$21.95
Construction Supplies Epoxy/Paint/Battery/Hardware/Etc. -	-	$100.00	$100.00
PAYLOAD DESIGN			
GoPro Camera	1	$199.99	$199.99
AVIONICS			
Altimeters For systematic parachute deployment (Already have 2)	-	-	-
Altimeter Bay Payload bay to hold altimeters	1	$28.56	$28.56
Pitot tube Used to calculate velocity of rocket	1	$350.00	$350.00
Key switches Used to turn on altimeters at the launch pad	2	$6.00	$12.00
GPS Garmin GTU 10 have	-	-	-
MOTOR/PROPULSION			
Motor Mount Tube 38 mm fits I, and J motors; to mount motor in rocket	1	$7.35	$7.35
Motor Retainer 38 mm retainer; secures motor in motor mount tube	1	$31.03	$31.03
Terminal Block 12 Position terminal strip for wiring ejection charges	1	$3.49	$3.49
Rail Buttons For launch; to connect rocket to launch rail	2	$1.54	$3.08
RECOVERY			
Parachute 60" SkyAngle (10.2-22.1 lbf) (Already have 1)	-	-	-
Parachute Protector Reusable fire resistant cloth to protect parachute (Already have 4)	-	-	-
Rip Cord 1500lb Kevlar Shock Cord (Cost per foot)	60	$0.92	$55.32
GENERAL MATERIALS & SUPPLIES			
Toolbox Storage of tools and components (Already have)	-		-
Dremel Rotary tool kit General purpose tool (used for cutting fin slots, sanding, etc.) have Drogue Parachute To eject before main parachute; have one, but will buy spare have Fins Approximate price for G-10; size and shape to be determined	4	$15.95	$63.80
TRAVEL EXPENSES			
Air fare	5	$200.00	$1,000.00
Baggage fees	2	$50.00	$100.00
Shipping fees	-	$100.00	$100.00
Rental car	-	$500.00	$500.00
Mileage (based on Google map, reimbursement rate of $0.575 per mile)	90	$0.58	$51.75
Tolls & parking	-	$25.00	$25.00
Food ($30/day/person)	5	$30.00	$150.00
TOTAL			**$2,840.42**

Timelines (Schedules)

It is important to create and maintain schedules over the course of your project. Many projects struggle or fail due to poor scheduling or no scheduling at all.

The Team Lead should be responsible for creating and maintaining the schedule, with assistance from the Advisor. There are many Project Management tools available for use. We do not limit which one you prefer. One of the more dedicated tools to assist with scheduling is Microsoft Project. (https://www.microsoft.com/en-us/microsoft-365/project/project-management-software). If you have access to this software via your school computers or licenses you may use it (it is simple to learn the basics on your own). However, creating and tracking a schedule can be accomplished using Excel. We suggest you use the Gantt chart template (this is a simplified version of MS Project).

Proposal Schedule

At the Proposal phase, you will need to start by understanding the Project Lifecycle. We use a gated process where your design progresses through 'gates' or milestones (Proposal -> Preliminary Design -> Critical Design -> Flight Readiness -> Launch -> Post Launch Assessment).

Each milestone you have a certain amount of time (and accomplishments) to complete. So, your team schedule should highlight these milestone dates. The time in-between these dates is where you will need to create daily or weekly tasks to get you to the milestone.

Tasks can be broken down into recruitment, training, design (brainstorming/researching/3D modeling), simulations, procurement, fabrication, component testing, flight testing, assembly, report writing, travel etc.

If you are new to rocketry, your initial schedule may not contain many details which is fine. Keep in mind, the schedule is for YOUR BENEFIT, not simply to satisfy an objective in the reports.

If you create and maintain your schedule in Excel spreadsheet (Gantt chart), it is a simple matter to copy the Gantt chart over to your report when necessary (if it is large, you may add it as an **Appendix** – do not shrink the Gantt chart so small that the reader struggles to read it).

Milestone Schedule

At each milestone, you will update your schedule as needed. You may find or eventually see a 'critical path' – an item or task that is critical to complete on time, so as not to jeopardize the success of your build and flight.

Procurement is an essential item to monitor in your schedule. You do not want to procure the large items too early in the design and constrain your choices (do not procure major items until the entire design is near completion at end of PDR phase or beginning of CDR phase). You also do not want to procure too late (some items have long 'lead times' or are custom order). Depending on where you are located relative to the vendor, shipping times may also be important.

Example Schedule

There is an example schedule section (Gantt chart format – the initial few months of the competition) found on the WSGC website resource page (Tools and Tips).

There is also a Gantt chart template for your convenience, to start with, if you choose to use it.

FIRST NATIONS LAUNCH

Team WSGC Office

| | | Project Start: | Thu, 8/27/2020 |
| | | Display Week: | 1 |

TASK	ASSIGNED TO	PROGRESS	START	END
Application				
Register Team	Each Individual	50%	8/27/20	9/1/20
Apply for NOI	Advisor Name	60%	8/26/20	9/15/20
Apply for FNL Moon	Each Student	50%	9/15/20	9/30/20
Submit Supp. Docs	Each Individual	25%	9/30/20	10/26/20
Attend AISES Conf	Team Lead		10/15/20	10/20/20
Project Proposal				
Draft Proposal	Team Lead	50%	11/1/20	11/10/20
Draft Budget	Team Treasurer	50%	11/1/20	11/10/20

Timeline columns: Aug 24, 2020 | Aug 31, 2020 | Sep 7, 2020 | Sep 14, 2020 | Sep 21, 2020 | Sep 28, 2020 | Oct 5, 2020 | Oct 12, 2020

APPENDIX C-2 – Testing Plan Overview

At each phase of this project (Mars -required | Moon & Gateway -optional), you will be expected to create and update a test plan. It is suggested that you use an Excel spreadsheet to maintain the information of your test plan, and copy necessary information at each design phase into your Report (perhaps as an Appendix).

Testing is a major part of any successful engineering program. Testing is used to validate concepts, and test unknown components and subassemblies, etc. Ensuring that each component will function as expected (on its own) will ensure that the entire collection of components (the vehicle or the payload/challenge) also function together successfully, and reduce the chance of failure.

In the proposal and concept phase, plans should be made to test various items such as:

1. **Structural Components**
   a. Airframe tests
   b. Fin tests
   c. Bulkhead tests
2. **Electrical Components**
   a. Altimeter testing
   b. Tracking testing
3. **Recovery System Tests**
   a. Parachute ejections tests
   b. Parachute deployment tests
4. **Scale Tests**
   a. Small scale rocket tests can be used to test any new components in flight
   b. Wind tunnel tests can determine drag

This is not an exhaustive list; you may test whatever you think is crucial for your design to work. In the critical and flight ready phase, the tests should be executed.

These plans can be shown in the form of a spreadsheet (or table in Word) listing the tests to be completed, what the results are (any anomalies or unexpected behavior) and when the test will be completed. The scale and number of tests that your team chooses to complete depends entirely on the size of your team and your school's resources.

Structural Testing

Early on, your team must decide what material is suitable for your competition rocket (there are a few common rocket materials – phenolic, fiberglass wrapped phenolic, G10 fiberglass, G12 fiberglass or carbon fiber). If you are uncertain what these materials are, and the pros and cons of each, you may purchase a small sample or section of airframe of each, to conduct testing on.

Advanced teams may perhaps build their airframe from scratch – if this is the case, then testing is a must on this material. It helps to understand what tools are needed to work the material (is your school/shop capable of working with this material) – this may help with airframe selection.

Altimeter Testing

Understanding the full capability of your altimeters and how to program them and what the output (and data) means is crucial to the success of your flight. You can test them in various ways; in a vacuum chamber to test the pressure sensors, in a moving vehicle or elevator to test the accelerometers, or in a small-scale rocket flight or drone flight. Opposed to using the

altimeters to ignite black powder charges in a test, use a small diode that lights up when the circuit is completed. Make sure you understand how to wire them properly and how to use the interface.

Some advanced altimeters can be controlled wirelessly or via Bluetooth. Make sure to test these connections, and the range of these connections in the field. Make sure to understand the conditions of the field in Wisconsin, it may not be the same as where you test. Ensure multiple people (or even all team members) are proficient in programming and retrieving information from the altimeters.

Tracking devices should also be tested and understood in the field (perhaps not a literal field, but somewhere outside opposed to bench testing in the lab). Understand your battery life, how long you will have power for. Ensure multiple people (or even all team members) are proficient in using the tracking devices.

Recovery Testing

It is encouraged that teams (with the help of a rocketry mentor) procure energetics and perform parachute ejection tests (on the ground) prior to flight, to understand how much energy is required to successfully separate sections of the rocket and experience the event in order to understand the forces involved.

Ejection tests will also help to understand the need for parachute protection (such as Nomex cloth wrap or cellulose wadding aka 'dog barf') to protect the parachutes from damage from the energetic event.

Ejection tests can also reveal any structural weaknesses (perhaps don't use your competition rocket the first time around, if you are new to recovery testing) or if the sections jam and don't release. You can also test your remote electronics to test (if capable) to ignite the energy for the test. If not, you can run a long set of lead wires to a safe distance away.

Ensure to follow all safe procedures and use the proper personal protection equipment (PPE). Do not attempt recovery testing without an experienced mentor/advisor on hand.

Scale Testing

Some advanced/experienced teams may be able to quickly scale up designs or concepts to a flight ready vehicle during the design phase of the project. This is not expected, but simulating the real conditions is the best test of the component undergoing the test. Please share the results of these tests in reports/presentations.

Challenge Solution Tests

In the proposal phase, there may exist various solutions to the challenge proposed that year. One way to reduce the number of solutions (conversely, to solidify the best solution) is to mock-up or create a test that will show the solution is viable. Usually, if the solution is not viable, or too complex or difficult to construct, this will become evident during the test. The best solution is usually the simplest solution – complexity doesn't gain you extra points, if the solution does not work in the end.

PDR - Develop a test plan by identifying all tests required to prove the integrity of design (you may have already completed some tests at this point, so include those and the results in the 'plan').

CDR - Update the test plan, with results for completed tests or any additional tests required (as the design evolves, the need for certain tests changes, so update as needed).

FRR - Show that all testing is complete and provide test methodology and discussion of results (perhaps all of the tests aren't complete at this point, so will need to decide if tests continue or are eliminated).

Design and testing are an iterative process – the results (or negative results) of a test may change the design, which in turn, will change the future tests etc.

Your Reports (Section 7.1) starting with PDR, through CDR and FRR, should include a table listing your tests (example shown here):

System	Test	Objective	Timeframe	Outcome
Structure	Hoop test	To verify the hoop strength of the structure	Nov	-
	Shear test	To verify the shear strength of the structure	Nov	-
Altimeter	Pressure test	To verify the pressure sensor operates correctly.	Dec	-
	Accelerometer test	To verify the accelerometer operates correctly.	Dec	-
Recovery	Ejection test	To verify the amount of energetic needed for satisfactory ejection.	Jan	-
	Tracking test	To verify the GPS tracking system functions properly, and determine limitations.	Jan	-

At each design cycle, update the list of tests, adding any new ones that may arise or removing unnecessary ones. You may also need to update the time frame and add the outcomes as tests are completed.

APPENDIX C-3 – Requirements Verification Overview

In any engineering project, a major component of project management is requirements management (also known as Verification and Validation - https://en.wikipedia.org/wiki/Verification_and_validation). NASA has many in-depth resources pertaining to Systems Engineering and Project Management.

For a successful project design, it is imperative to understand what the product is supposed to do (its requirements) versus what is nice to have, but not required. The same principles are applied to the project; what is required to complete the project and what is not required.

A simple way to manage this is to create a spreadsheet of all of the requirements, list who is responsible for satisfying the requirement, and list how the requirement will be satisfied. For large scale projects (space shuttle, commercial airplane, aircraft carrier etc.) the requirements are daunting, and it's absolutely essential to manage the requirements.

If not, the end product may not meet some of its expectations or goals, and may gain a few characteristics that were not initially requested. This is known as 'scope creep."

For the FNL, we require the Mars Challenge teams to manage the requirements and show us this is being accomplished in the reports. The steps involved are:
1. List Requirements. The requirements for FNL are explicitly listed in the Competition Handbook.
2. Assign Requirement to Individual/Team (example, structures requirement, avionics requirement etc.)
3. Identify how the requirement will be satisfied. Requirements can be satisfied by:
   a. Test, analysis
   b. Demonstration
   c. Simulation
   d. Inspection
4. List outcomes/ensure requirements are satisfied, or explain why not.

The initial requirements plan needs to be completed by PDR, but work can begin in the Proposal phase, in order to create design goals and help to distribute responsibilities to sub-teams and individuals. Steps 2 and 3 will need to be updated as the team and plan evolves. The Requirements Verification should be reviewed again at CDR, and even at FRR to show that the design matches what is built and it achieves all it is supposed to achieve.

A basic example Requirement Verification spreadsheet would look like the example below. The Requirements Spreadsheet is found in the 'Tools and Tips' page of the WSGC website:
https://spacegrant.carthage.edu/first-nations-launch/tools-and-tips/

		Requirement	Assigned to	Method to Satisfy	Outcome
13	Vehicle Rqmt	The launch vehicle will accelerate to a minimum velocty of 52 fps at rail exit.	Airframe - Simulations	Simulation	Simulation shows 89 fps rail exit.
14	Vehicle Rqmt	The center of gravity and center of pressure must be indicated on the exterior of the rocket, from simulation, using the fully loaded	Airframe	Inspection	-
15	Vehicle Rqmt	All teams must successfully launch and recover an Estes rocket provided by WSGC.	Team	Demonstration	-

Remember to complete and list ALL requirements. Monitoring these requirements will help to ensure a successful build and flight, and ensure nothing is missed during the design.

APPENDIX C-4 – Safety Checklists

Over the course of your project, it is suggested (and a part of the required report content) that your team develop checklists. Checklists can be very useful if designed properly, adhered to and enforced.

Checklists can be used for **inventory**. Examples include:
1. Weekly shop checks to ensure that there are always adequate supplies on hand
2. Parts checks, to ensure all of the required parts/tools are brought when transporting the rocket

Checklists can be used for a complicated **build procedure that** requires consistency and accuracy (that requires many different people to repeat multiple times). Examples include:
1. Building/laying up a carbon fiber cloth tube or part
2. The order and timing of steps to epoxy fins to the motor mount tube and body

Checklists can be used for rocket **launch preparation** (again, where repeatability by various members is required). Examples include:
1. Avionics programming steps
2. Avionics bay assembly
3. Payload/challenge assembly and installation/integration with vehicle

This list is not exhaustive. Brainstorm with your team to determine when best to develop checklists. Checklists will likely change over time as the process changes. Ensure they are up to date, and ensure everyone is using them (they are accessible). Editable example safety checklists can be found on the Tools & Tips page or at: https://spacegrant.carthage.edu/live/files/6461-fnl-example-checklistsxlsx. Screenshots of the examples are available below.

Avionics Preparation Checklist Example

Example Avionics Preparation Checklist
Altimeter Prep can be completed night before Launch

Altimeters

Ensure altimeter(s) are programmed correctly

	Plug altimeter into interface (computer or display)
	Power up altimeter (using switch if possible)
	Ensure altimeter is reading local conditions (if equipped)
	Ensure drogue parachute deployment is set properly
	Ensure main parachute deployment is set properly
	Power down altimeter and then power up
	Ensure audible sequence is indicating correctly
	Ensure sufficient storage bank is available
	Power down altimeter (using switch if possible)

If redundant system, repeat steps with second altimeter

Avionics Bay

Ensure all hardware is attached correctly and firmly
Ensure fresh power sources are installed and attached correctly and firmly
Ensure ejection lead wires are attached to respective bulkplates
Ensure switch wires are attached correctly and firmly
Close avionics bay by securing bulkplates
Ensure nothing is loose inside of avionics bay after closing
Ensure switch still operates correctly
Altimeters power on
Altimeters produce correct sequence

If redundant, repeat steps with second altimeter

Ejection Charges (Energetics)

Ensure altimeters are powered off
Attach all ejection charges to leads on outside of bulkplates
Ensure correct charge size goes to correct bulkplate

Do not power on altimeters after ejection charges are installed

Other

Ensure any other electronics are powered up and functioning properly
Install and seal all other electronics accordingly
Cameras
Tracking devices

Recovery Preparation Checklist Example

Example Recovery Preparation Checklist

       Avionics Prep should be completed prior to start of Recovery Prep

Drogue Parachute / Lower Airframe

- [ ] Attach shock cord to eyebolt on motor centering ring
  - Use quicklink - ensure tightened
- [ ] Attach parachute shroud lines to shock cord at 1/3rd point
  - Use quicklink - ensure tightened
- [ ] Attach shock cord to eyebolt on avionics aft bulkplate
  - Use quicklink - ensure tightened
- [ ] Roll/fold parachute in parachute protector (if used)
- [ ] Daisy chain or coil shock cord
- [ ] Insert cellulose wadding (if used) into tube
- [ ] Insert shock cord and parachute into lower airframe tube
  - Ensure parachute protection is pointed sideways
    - (As charges will come from both sides)
  - Ensure shock cord / parachutes are as far into tube as possible
- [ ] Close section by securing avionics bay with lower airframe
  - Ensure energetics are still attached properly when closing
  - Insert shear pins if used
- [ ] Ensure proper snug fit - lift entire lower assembly by avionics bay only
  - Sections should not slide apart

Main Parachute / Upper Airframe

- [ ] Attach shock cord to eyebolt on nosecone or forward bulkplate
  - Use quicklink - ensure tightened
- [ ] Attach parachute shroud lines to shock cord at 2/3rd point
  - Use quicklink - ensure tightened
- [ ] Attach shock cord to eyebolt on avionics forward bulkplate
  - Use quicklink - ensure tightened
- [ ] Roll / fold parachute in parachute protector (if used)
- [ ] Daisy chain or coil shock cord
- [ ] Insert cellulose wadding (if used) into tube
- [ ] Insert shock cord and parachute into upper airframe tube
  - Ensure parachute protection is pointed towards charges
  - Ensure shock cord / parachutes are as far into tube as possible
- [ ] Close section by securing avionics bay with upper airframe
  - Ensure energetics are still attached properly when closing
  - Insert shear pins if used
- [ ] Ensure proper snug fit - lift entire vehicle by nosecone only
  - Sections should not slide apart

*ensure avionics bay is aligned in proper direction (not reversed)
**ensure shock cords / parachutes are not 'jammed' into airframe tubes / free to release
***can use talcum powder to provide lubrication inside of tube as needed

Flight Assembly Checklist Example

Example Final Assembly Checklist

Avionics

	Ensure **avionics prep checklist** is complete
	Ensure avionics bay is fully assembled
	Ensure ejection charges are connected

Recovery

	Ensure **recovery prep checklist** is complete
	Ensure all sections are joined after checklists are complete

Payload / Challenge

	Ensure payload / challenge components / system are installed properly
	Ensure payload / challenge components are functioning properly

Motor

	Install motor into rocket
	Ensure motor retainer is tight after installation
	Ensure motor ignitor wire remains with rocket
	Can tape to lower airframe until needed on Launch Pad

Rocket should now be flight ready, and ready for RSO inspection

	Physically verify the CG of the flight ready rocket by balancing about CG
	Mark the CG with marker
	Mark the simulated CP with marker

RSO Inspection

	Fill out flight card with proper details
	Proceed to RSO table / tent for final checkout
	After RSO inspection, turn in flight card to Launch Director for next salvo

Launch Pad Setup Checklist

Example Launch Pad Setup
   *following RSO approval

	Wait for Range Open call from Launch Director
	Proceed to assigned lauch rail (if assigned one)

   *Tripoli members will assist / monitor launch prep

	Unlock and tilt rail horizontal
	Slide lower rail button into rail (rocket on top side of rail)
	Slide down until upper rail button is into rail

   Ensure to hold rocket entire time, do not put full weight onto rail

	Slide rocket entire way down the rail (holding rocket)
	Tilt rail (while holding rocket) back to vertical and lock into place

	Power up altimeters

   Ensure altimeters are beeping correct sequence

	Power up any other electronics (Tracking, cameras, etc.)

   Prep motor ignitor lead wire

	Separate 5 - 6 inches of lead wires (so they wont touch)
	Strip 1 - 2 inches of each end of lead wire (for joining to power)
	Insert motor ignitor (coated end) into motor until stops

   Ensure tip of ignitor is all the way to the top of the motor

	Kink the ignitor wire at the edge of motor when inserted

   Secure the ignitor in position by either:

	Tape the ignitor to the motor retainer at the kink
	Use the plastic motor cap to hold the ignitor in place at kink

	Locate power leads on ground (alligator clips)
	Ensure power / continuity is off by touching leads together (sparking)

   If sparking, inform Tripoli member

	Wrap one ignitor lead wire around alligator clip

   Position alligator clip / wire such that it is not pulling on ignitor in motor

	Wrap other ignitor lead wire around alligator clip

   Position alligator clip / wire such that it is not pulling on ignitor in motor

   *Clips may be taped to launch rail base
   *Ensure alligator clip is not touching metal
   *Ensure alligator clips are not close to each other (accidental contact)

	Take rocket pictures / setup any ground cameras
	Proceed back to pit area

Post Flight Checklist Example

Example Post Flight Checklist

Proceed to general area of last sighting of rocket impact
Power up GPS and ensure lock
      Proceed to rocket location
      Listen for PA if other rockets are in the air

Take photos of landing site prior to disturbing rocket components
      *this can be used in post launch assessment
Listen to / record audible sequence from altimeters (prior to disturbing)
      *this can be used to verify apogee altitude
Disable / power off electronics (try not to disturb)
Verify that ejection charges have gone off (canisters are empty)
      If not, cut wires to disable charges

Ensure all components are accounted for (in the area)
Inspect airframe components for any structural damage
      If damage, photograph (for post launch assessment)
Inspect parachutes and recovery hardware for any damage
      If damage, photograph (for post launch assessment)
Inspect payload for any damage
      If damage, photograph (for post launch assessment)

Once inspection is complete, return to pit area with all rocket components
      Listen for PA while walking if other rockets are in the air

Remove motor casing
Dispose of any spent grains.
Clean motor casing with cleaning wipes.

Disassemble avionics subsystem
Power up altimeters and extract flight data.
Turn in flight data
      Transfer flight data to flash drive.

APPENDIX D-1 – How to Join NAR or TRA

All team members must have an active membership by the time of the Lodging List submission. There are benefits to being a member in your local chapter or prefecture. Many students continue to design, build and fly high-power rockets after the competition as a personal hobby – in this case, you must be a member to continue flying. It is not necessary to join both organizations.

Team members who participate in L2L in order to attain their first level 1 HPR certification, FNL will pay for their first year of membership.

You must first be a National member (by joining the National Organization) to join a local club. You are not required to join a local club to be a national member, but a local membership has additional benefits). You can search for local clubs near you on each National website.

Tripoli Rocketry Association

TRA membership includes:

1. Tripoli is the premier high-power rocketry organization! If high-power flying is your primary interest, Tripoli is the organization you want.
2. Tripoli's annual launch, LDRS, is by far the best-attended high-power launch in the world! Many of these special events are posted on social media.
3. Tripoli flyers are taken seriously by the commercial rocket community. TRA members were the first civilians to put a rocket into space (CSXT), and Tripoli members have been invited to assist NASA on rocketry research projects.
4. Tripoli is an international organization, with prefectures worldwide. At TRA launches in the US, you may meet some of our members from Canada, Australia, the U.K., Sweden, Germany, Switzerland, etc. more.
5. Tripoli has its own private, active forums so that members can ask rocket-related questions and get answers (sometimes too many answers!), without the spam and noise that accompanies some other forums.
6. Tripoli-sanctioned launches are insured for up to $3,000,000 with primary insurance coverage. That means that in the highly-unlikely event of an accident, TRA insurance kicks in first.
7. Tripoli is an organization where there is no "little guy". At TRA launches you'll meet both novices and experienced rocketeers, all open and friendly to newcomers, all eager to share knowledge.
8. In Tripoli Rocketry, you can advance into the exciting world of rocketry — designing, constructing and flying your own rocket motors!
9. Tripoli is a group of serious rocketeers that is open to new generations and new members.
10. Last but not least, Tripoli launches are just plain FUN!!

National Rocketry Association

NAR membership includes:

1. Six issues of Sport Rocketry magazine
2. The NAR Member Guidebook—a 64-page how-to book on all aspects of rocketry
3. $5 million rocket flight liability insurance
4. Access to the "Member Resources" website
5. Access to NAR technical reports, high-power certification, and clubs

Membership Links

Tripoli Rocketry Association membership can be found at: http://www.tripoli.org/Membership
National Association of Rocketry membership can be found at: https://www.nar.org/my-membership/

Annual Membership Fees

TRA membership fees are: Student (18-24 yrs.) - $20 Adult (18+) - $70 Annual renewal $60.00
NAR membership fees are: JR/LR/SR (0-25yrs) - $30 Adult (26+) - $70

APPENDIX D-2 – How to Obtain a Local NAR or TRA Mentor

How to Acquire a Local Rocketry Mentor

It is recommended that your team reach out to the local rocketry clubs in your area, to obtain a volunteer rocketry mentor. This is equally beneficial to new teams - who are just learning the sport and rules - as well as to veteran teams, who may want to take their experience to another level. There are two national organizations you can appeal to for mentorship.

The primary national rocketry organization that would be able to support high-power rocketry teams:
1. Tripoli Rocketry Association (TRA)   http://www.tripoli.org/
2. Prefecture (Chapter) Search   http://www.tripoli.org/Prefectures

Note that the host of the FNL competition, Tripoli Wisconsin, is among many Tripoli prefectures around the country. If there is not a Tripoli Prefecture in your area, you can also contact the low powered national rocketry organization:
1. National Association of Rocketry (NAR)   https://www.nar.org/
2. Chapter Search   https://www.nar.org/find-a-local-club/nar-club-locator/

Once you find a local chapter, there are many ways to ask for support, or learn from the experience in your own backyard. Most chapters will have monthly club meetings, of which you can attend. Explaining to the club what your team is trying to do, and asking for a club member (or a set of members, depending on time commitments) to be on call for your questions is fairly straightforward.

Most chapters will also have a launch site nearby, with an FAA waiver and monthly club launches (usually weekends). Club launches are open to spectators, and there is no fee to attend and observe. Some of the larger club launches will have rocketry vendors and food vendors on-site, so you can make local connections for parts and supplies. Attending a club launch with your team as spectators is a great way to recruit new members and get your team excited to design and build a high-power rocket, as well as to network with veteran rocketeers in your area.

Benefits to Acquiring a Local Rocketry Mentor

There are many benefits to obtaining a local rocketry mentor. A local mentor can:
1. Provide technical advice to save your team from making common mistakes during the design and build process.
2. Come to your campus in person, and physically inspect the rocket or address any concerns or provide build advice from the beginning of the project.
3. Help students get high-power rocket certified, by explaining the process and utilizing the local club to observe and approve your certification flight.
4. Allow your team to perform test flights prior to competition.
5. Provide advice on how to obtain and handle energetics properly (black powder or pyrodex, motors etc.).
6. Provide advice on where to obtain rocketry supplies, parts and materials locally.
7. Work with your school, to provide advice and inform the school about regulations, to support the safe handling of hazardous materials and processes that are involved with building and testing high-power rockets.

WSGC FNL expects teams to take advantage of their local NAR or TRA clubs, in order to increase the team skills, experience, resourcefulness and autonomy. It is likely that the local NAR or TRA would also be interested in gaining more young members in their clubs and having a connection to academia is always beneficial for outreach.

Note: Tripoli Wisconsin is still the final authority pertaining to what is acceptable to fly in FNL. If your team finds it difficult to acquire a mentor please contact the WSGC office.

APPENDIX D-3 – How to Acquire RockSim and Simulation Resources

RockSim – What Is It?

There are various tools for the amateur rocketeer to assist with creating and simulating a high-power rocketry flight. A few of these are:

1. RockSim   https://www.apogeerockets.com/RockSim/RockSim_Information
2. OpenRocket https://openrocket.info/
3. RASAero   http://www.rasaero.com/

For First Nations Launch, **RockSim** is the required simulation tool.

RockSim is a computer program (simulation tool) that allows you to design any size rocket then simulate its flight to see how high and fast it will fly! Even before you start buying components and building your design, you'll find out if it will be stable and safe to launch, as well as meet any weight, speed or height criteria you might want. Instead of wasting money on incorrect components and numerous test motors, imagine how much money you'll save by doing all your test flights on the computer!

You can also use it to find the best motor and delay combinations for your existing kits. Because nearly every rocket manufacturer uses this software, nearly all available rocket kits have a RockSim design file that you can open. RockSim is available for both Mac and Windows.
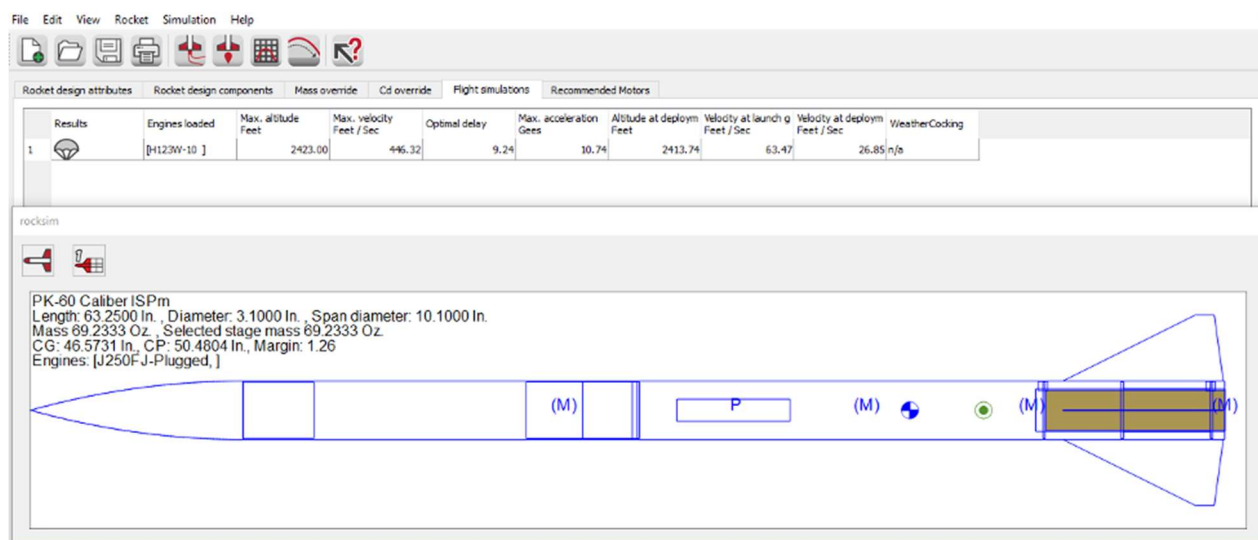

Figure 1 – Image of RockSim user interface.

RockSim - Why Do I Need It?

RockSim is the required primary simulation tool. Many other competitions also require teams to learn and use RockSim as their primary simulation tool:

1. The American Rocketry Challenge (TARC) https://rocketcontest.org/)
2. NASA Student Launch Initiative (SLI)   https://www.nasa.gov/stem/studentlaunch/home/index.html)
3. Spaceport America Cup (SAC)   https://spaceportamericacup.com/)

Like any industry engineering project, the high-power rocketry challenge begins with concepts, which need to be examined using simulations, to aid in design, prior to procurement, manufacture, test and flight. You will use RockSim, beginning at Proposal phase to:

1. Research and examine various dual deployment rocket kits
2. Ensure the rocket kit can accommodate the payload/challenge solution
3. Select a corresponding motor that allows the rocket and payload to achieve all performance requirements

As the design progresses, you will refine your simulation models to:

1. Ensure every component of the model has an accurate mass (matches on hand part).
2. Select proper parachutes to meet recovery requirements.
3. Ensure all component masses are accounted for in the simulation (hardware, electronics etc.).
4. Ensure all internal components are in the correct location, to obtain an accurate center of gravity.
5. Ensure drag components are accounted for:
    a. Surface finish
    b. Rail buttons
    c. Any protuberance
6. Ensure all performance requirements are satisfied

Your team is required to submit a RockSim file at each Milestone, for our inspection, to ensure that your simulations and design are progressing on track, and that your rocket will have a safe, stable flight.

Some flight parameters needed from RockSim at each milestone (in your report or flysheet) include:

1. Fully loaded rocket weight
2. Rocket length and diameter
3. Center of Gravity (CG) and Center of Pressure (CP) location
4. Stability margin
5. Velocity at launch guide departure (rail exit velocity)
6. Descent rate
7. Maximum altitude
8. Time to apogee

PK-60 Caliber ISPm
Length: 63.2500 In. , Diameter: 3.1000 In. , Span diameter: 10.1000 In.
Mass 69.2333 Oz. , Selected stage mass 69.2333 Oz.
CG: 46.5731 In., CP: 50.4804 In., Margin: 1.26
Engines: [J250FJ-Plugged,]
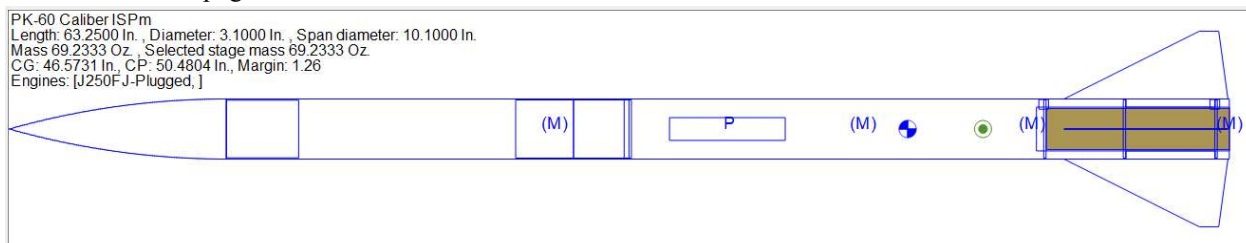
Figure 2 – Image of RockSim user interface, showing rocket inset.

RockSim – How Do I Get It?

RockSim is distributed by Apogee Components. https://www.apogeerockets.com/

Suggested Approach
1. It is suggested that students of interested teams request the trial version of RockSim by filling out the 'RockSim Trial' form (see links below). This trial version is good for 30 days, it is a limited version. Students can begin learning RockSim using online tutorials (see links below).
2. Once the team (Advisor) receives the Acceptance Letter from WSGC, it is suggested that the Advisor procure multiple licenses to distribute to the team (prior to the trial versions expiring).
   a. To get the discounted rate ($20 per license), you must procure the 'Educational License – TARC Temporary License' (see links below).
      i. You must provide the 'Team ID / Team Number' while ordering.
      ii. You will get a 'Team ID / Team Number' from WSGC FNL in your Acceptance Letter.
         1. Note the license is 'temporary' – it will deactivate on August 31 of the following year.
3. The Advisor will distribute the activation keys to the necessary team members.

Note: L2L participants will receive a free temporary RockSim license as part of their L2L participation

Alternative Approach
1. The trial version is not required or necessary to install RockSim – you may install and activate the full version (once you have been given an activation key from your Advisor) by following the instructions on 'Download/Registration' (see links below).
2. This assumes the Advisor has completed the steps above to procure licenses for the team
3. Alternatively, students may procure RockSim on their own as well (full permanent version at full price, or discounted rate, using the 'Team Award #' FNL<YR>_<Award #>)

There are various license versions, so please ensure you procure the correct one (use the links below). Of course, you may also procure any of the various full licenses as you wish – explore the options on Apogee Components website (single user - permanent, school site licenses - multiple).

ROCKSIM V10 – TARC TEMPORARY LICENSE (EXPIRES AUG 31)

Model: 01123
Manufactured by: Apogee

Additional Info:

Team number is required at purchase. A license registration code will be issued only after the TARC number is confirmed.

Non-TARC Rocketry Competitions: The following rocketry competitions are also eligible for the discounted RockSim.

First Nations National Launch
WSGC Collegiate Launch
Student Launch Initiative
Rockets for Schools
Spaceport America Cup

If you have a team participating in the above competitions, you can benefit from this deal as well, but you will need to provide documentation to prove registration in the program. Enter your school name in the Team Number field, which will be verified.
Please email us or call us at (719) 535-9335 for more information on requirements, if you have any questions. If your competition is not listed, please have your competition director contact Apogee for more information.
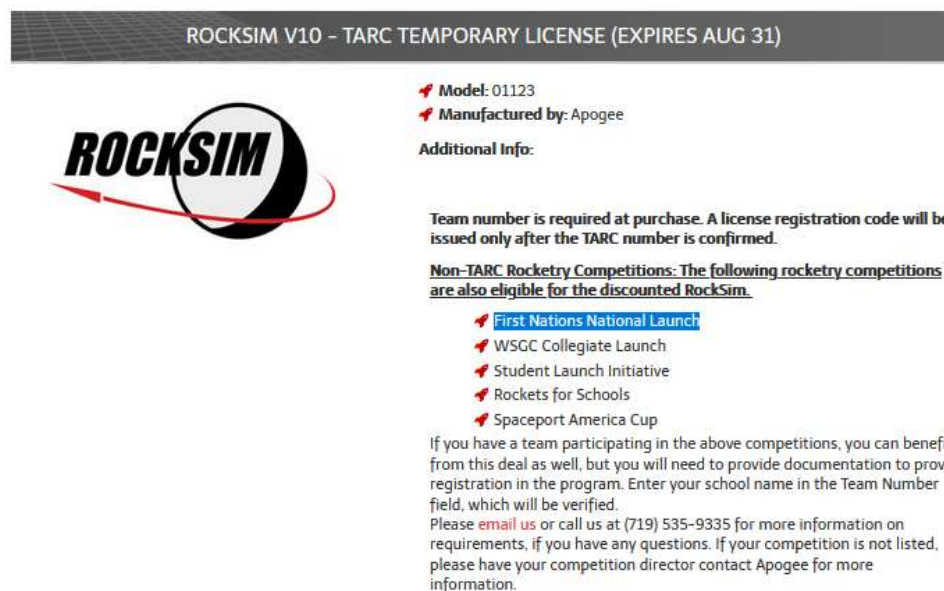
Figure 3 – RockSim TARC Temporary (Discounted) License

RockSim – When Do I Need It?

Students interested in FNL, should request a trial version of RockSim **immediately** (September). RockSim will be needed to begin the Proposal phase, once the NOI is submitted (October). The trial version is valid for 30 days from the installation date. It has reduced capability relative to the licensed version but is still capable of providing all the necessary information to complete the Proposal.

Advisors should procure RockSim licenses as soon as they receive the WSGC FNL Acceptance letter (October), and distribute the activation keys to the necessary team members.

Students should begin to learn RockSim by following the online tutorials provided by Apogee Components (see links below) as soon as possible.

RockSim – How Do I Use It?

Apogee Components provides many online and self-directed learning resources to learn to use RockSim. See the Video Tutorial section of the Apogee Components website (see links below).

WSGC FNL will also conduct a Virtual Webinar – "Introduction to RockSim" after NOIs and prior to Proposal submission which will highlight simulation tips pertaining to FNL.

RockSim – Important Links

Overview / Information: https://www.apogeerockets.com/RockSim/RockSim_Information

1. Trial Version Sign-Up: https://www.apogeerockets.com/RockSim/Rocksim_Trial
2. Educational License: https://www.apogeerockets.com/Rocket_Software/RockSim_Educational_TARC
3. TARC Temporary License:
    https://www.apogeerockets.com/index.php?main_page=product_software_info&cPath=13_207&products_id=204
4. Download / Registration: https://www.apogeerockets.com/RockSim/Rocksim-Registration
5. Video Tutorials: https://www.apogeerockets.com/RockSim/RockSim_Video_Tutorials

Other Related Resources

Another resource to mention is the User Database of RockSim rocket files (**RockSim Library**), found at RocketReview.com (see link below). Although RockSim comes with an extensive library of rocket files to open and examine, it is not a complete set. As you research rocket kit choices online, there is typically a corresponding rocket simulation file in the pre-loaded database – if not, you may find a rocket simulation file in the RockSim Library (or on the vendor's website for you to download).

1. Design Files: https://www.rocketreviews.com/rocksim-library.html

A final resource to mention is the Motor database at **ThrustCurve.org** (see link below). The RockSim library contains most motors from most manufacturers (Aerotech, Cesaroni etc.) However, there may be times when the RockSim database does not contain the motor you wish to simulate – or you simply want more information about a motor to add to your Milestone report. You can search motors at Thrustcurve.org and download/import motor files into the RockSim Library as needed.

1. Motor Files: https://www.thrustcurve.org/

APPENDIX D-4 – How to Acquire and Use Ejection Charges

During the Launch Weekend, with regards to safe and proper handling of energetics, Tripoli Wisconsin will provide and distribute ejection charges for your competition rocket. These will be a scratch-built canister type, with a minimum of 6 inches of lead wire (that you will connect to your altimeters, either directly through a hole in the bulkhead, or indirectly to a terminal block on the bulkhead).

More experienced or advanced teams may wish to complete ejection tests prior to competition, or even a full scale test flight. This section provides guidance on how to acquire and properly handle ejection canisters and energetics.
Energetics used for ejection come in two types; Black Powder and Pyrodex

Black Powder
Black powder is a fine grain chemical explosive. https://en.wikipedia.org/wiki/Gunpowder

Figure D.4.1

Pyrodex
Pyrodex (a trade name) is a black powder substitute.
https://en.wikipedia.org/wiki/Black_powder_substitute

1.   FYI : When used for recovery system ejection charges in high-power rocketry, black powder substitutes such as pyrodex need a greater degree of confinement to ensure a complete burn and generation of sufficient ejection pressure. This can be achieved by wrapping 2–3 layers of electrical tape over the ejection charge canister.
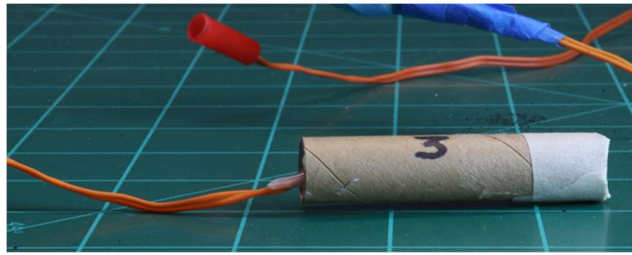

Figure D.4.2

Ejection canisters used for containing the energetics come in various forms; all scratch-built.

Scratch-Built Ejection Canister
A proper ejection canister will need; a canister (or container to hold the energetic) and an igniter (a lead wire containing a filament tip that will ignite the energetic).

Figure D.4.3 PVC Ejection Canister (left) and E-match kit (right).

Figure D.4.4 Ejection canister (3 gram load) with e-match installed.

Ejection canisters with energetics contained (e-match not installed).

Containers may be PVC caps or even small balloons. The igniters (sometimes called e-matches, which are federally regulated) are usually purchased through a reputable manufacturer/source.

Many outdoor sporting stores will sell Black Powder and Pyrodex. It should be stored in a secure and dry place (see the attached MSDS sheet, or search for a proper MSDS sheet for storing and handling information). Canisters (of various types) can be purchased online at various rocketry vendors.

You may want to experiment with various types of canisters and energetics to determine what works best for your team and rocket. Keep in mind however, that the competition charges will be a canister type, with black powder energetics.

Compressed Gas Ejection

An alternative to chemical explosives for energetics, is a CO2 compressed gas ejection system (such as the Peregrine CO2 Ejection Device, shown in *Figure D.4.5* below). Here the canisters are disposable, but the energetic and the canisters are all provided as a kit (little fabrication required).

Figure D.4.5 Peregrine Compressed Gas Ejection System

APPENDIX D-5 – Personal Tripoli HPR Certification

Tripoli Certification Overview (http://www.tripoli.org/Certification). There exists an opportunity for advisors and students to obtain their Tripoli High-power Rocketry Certification, either at a Launch 2 Learn (L2L) rocket certification workshop or at the First Nations Launch competition.

L2L Certifications are subject to the L2L workshop. If the workshop is conducted at Carthage College in Kenosha, WI, attendees will complete the certification process within the workshop. If the workshop is conducted at a different location or virtually, the certification flight may take place at a later date.

Launch weekend certification flights may take place during the competition after the team has flown their competition rocket. Flight time will also be available on Sunday from 10:00 am – 2:00 pm (2:00 pm - 4:00 pm during L2L certification launches in October) so plan your travel accordingly. In order to certify, you must sign up with WSGC (express your intention to certify) by the deadline announced in the FNL Calendar, in order that we may procure and provide motors as needed. If you did not attend the in person L2L Workshop, and plan to certify, you must coordinate your motor choice with Tripoli Wisconsin Technical Advisor.

High-power Level 1 Rocket Certification
The Level 1 certification is open to individuals 18 years and older. The candidate needs to build, launch and successfully recover a rocket using a certified HPR motor in the H to I impulse range.

All L2L workshop attendees may attempt a certification flight, while in Wisconsin. In order to successfully attain the certification, the student must be a registered Tripoli member (fee will be paid by WSGC). All motors will also be purchased and paid for by WSGC at the time of certification.

Those students who did not attend the workshop, and are an official FNL Team Member, may also attempt a certification during the Launch Weekend. However, the costs of the rocket and the motor must be borne by the student. The Tripoli membership fee will be covered by an FNL sponsor. The student must purchase and build their rocket independently, and transport their rocket to and from Wisconsin for the certification flight.

The Tripoli Wisconsin Technical Advisor has a list of motors to choose from, in order to attempt a certification flight.

High-power Level 2 Rocket Certification
The Level 2 certification is open to all individuals who hold a current Level 1 certification. The candidate needs to successfully pass the Level 2 written examination and then build, fly and recover successfully a rocket using a certified HPR motor in the J to L impulse range. Written Test – Only members certified L1 may take the L2 written examination. The written examination for level 2 shall be passed PRIOR to a level 2 certification flight.

Any student who has already obtained their Level 1 certification, may attempt a Level 2 certification during the Launch Weekend in Wisconsin. The written test must be passed prior to the flight attempt. Tripoli Rocketry Association will administer the test during the competition weekend.

The costs of the rocket and the motor must be borne by the student. The Tripoli membership fee will be covered by an FNL donor. The student must purchase and build their rocket independently, and transport their rocket to and from Wisconsin for the certification flight. The L2L workshop does not offer Level 2 certification.

High-power Level 3 Rocket Certification
No Level 3 launch certifications will be conducted through the First Nations Launch program.

APPENDIX D-6 - Common Rocketry Tracking Devices

Here are a list of rocket tracking devices commonly used in High-Power Rocketry. This list is not inclusive of all products available on the market.

Please visit their websites to view the tracker. Some devices may require FCC licensing as indicated.

- BIG RED BEE; ARDF beacons and all-in-one trackers designed for rocketry, both ham and non-licensed
  http://www.bigredbee.com

- EGG TIMER ROCKETRY; non-licensed and ham band GPS tracker and altimeter kits http://eggtimerrocketry.com

- FEATHERWEIGHT: non-licensed GPS tracking system and altimeters.
  https://www.featherweightaltimeters.com/featherweight-gps-tracker.html

- BYONICS: APRS, GPS, and transmitter modules, all-in-one trackers, and direction finding transmitters
  http://www.byonics.com

- ARGENT DATA SYSTEMS; APRS, GPS, and transmitter modules
  http://www.argentdata.com

- RPC ELECTRONICS; APRS modules
  http://www.rpc-electronics.com

- YAESU USA, hand held and mobile Amateur Radio equipment with built in APRS.
  http://yaesu.com/?cmd=DisplayProducts&DivisionID=65&ProdCatID=249

- KENWOOD USA, hand held and mobile Amateur Radio equipment with built in APRS
  https://www.kenwood.com/usa/com/amateur/

- DOPPLER DF INSTRUMENTS; Amateur Radio direction finding equipment
  http://www.silcom.com/~pelican2/PicoDopp/MICROHUNT.htm

- COMMUNICATION SPECIALISTS; Amateur Radio direction finding equipment
  http://www.com-spec.com/rocket/index.html

- MULTRONIX, Very full featured , non-licensed, GPS tracking system for high power rockets
  http://www.multronix.com

- REAL FLIGHT SYSTEMS, Non-licensed GPS Tracking, telemetry and data logging equipment designed for rocketry
  http://www.realflightsystems.com/

APPENDIX E-1 – Launch 2 Learn Rocket Certification Workshop

First Nations Launch offers an exciting opportunity for teams to participate in an Introductory Rocket Certification Workshop referred to as Launch 2 Learn (L2L). Each year, WSGC sponsors a limited number of schools participating in the program to attend the L2L workshop. All attendees receive a Level 1 LOC Precision Caliber-ISP Single Deploy Rocket Kit, Temporary RockSim license, 1 year TRA membership, and Level 1 Tripoli Rocketry Association Certification upon a successful flight recovery.

Salish Kootenai College,
University of Alaska-Anchorage, University at Buffalo
at Carthage College 2020

The workshop will introduce design, build, and fly concepts. Participants will build a high-power single deploy rocket and be presented with the difference between single and dual deploy rockets. They will be introduced to a basic understanding of rocket flight simulation and be given an overview of NAR and TRA certification.

Each year, the L2L workshop may be offered in-person at Carthage College in Kenosha, WI and/or virtually. Team members (advisor/co-advisor, team lead, team member) must submit an application to participate in the program (https://spacegrant.carthage.edu/first-nations-launch/launch-2-learn-rocket-certification-workshop/). A limited number of individuals will be sponsored through the program: 15 individuals at the in-person workshop at Carthage College and 30 individuals during the virtual workshop. Other FNL participants may attend a workshop but will be responsible for all expenses. The basic kit build is $200 plus any travel and FNL per diems associated with the workshop. Technical support available for workshop participants beyond the counts provided above may be limited. Virtual participants training larger groups at their location are advised to find a TRA/NAR Mentor to provide on-site support.

Marshand Vasquez
Salish Kootenai College

This unique opportunity is available for all teams who have submitted a Notice of Intent (NOI) to compete in FNL.

APPENDIX E-2 – Webinar Series Overview

A brief overview of the Webinar Series is provided here. Please see the Calendar for dates. Presenters will be announced prior to each Webinar and may consist of experienced rocketry personnel or professional engineers.

TRA/NAR Mentorship Requirement
One of the first actions your team should take is to search for a local rocketry mentor. This Webinar will discuss the importance of obtaining a local, certified, experienced rocketry mentor (from Tripoli Rocketry Association or National Association of Rocketry). We will hear from previous students, advisors and mentors who will share their experience and tips.

Proposal, Budget, and Design Review Development
Your team will be required to submit a proposal and a budget if accepted into the Moon or Mars Challenge. The WSGC administrative team will review what are the key components of the proposal and the budget, discussing how you will build upon these two documents during the design review process.

Introduction to Structures
Structural failure is one of the primary failure modes in the sport of high-power rocketry. This Webinar will give you an overview of what structural design and analysis should be considered, what primary failure concerns are to watch for, and review the materials involved with commercial off the shelf (COTS) high-power rocket kits.

Introduction to Project Management
The first step when creating a team, is to organize the project effectively and efficiently. This Webinar will provide some tips on how to better prepare yourselves to function as a team, for First Nations Launch. We will discuss budgeting, scheduling, team roles, etc.

Introduction to RockSim
RockSim is your required primary simulation tool, which is essential in designing a rocket vehicle that will contain your payload and satisfy all the performance requirements. It is assumed that you should have already downloaded and installed RockSim at a minimum – this Webinar will give some tips and pointers to help you use the tool effectively.

Introduction to Build and Assembly
Although our Launch 2 Learn Workshop provides hands-on build training, not everyone gets to participate – this may be the first time you have tried to build something as part of a team. This Webinar will review some key build and assembly techniques, going beyond the simple techniques covered in the L2L Workshop. We will also cover key safety elements and review some failure modes when proper build and assembly techniques are ignored.

Introduction to Grant Management
A step-by-step review of grant management and reimbursement submissions for faculty advisors, grants officers, and team leads. This webinar will review how to add team members to the WSGC NOI Submissions, add an authorized user, submit an invoice and/or reimbursement, fill out a WSGC reimbursement template, and properly upload award documentation.

Introduction to Avionics/Altimeters
The avionics subsystem consists of two unique components – the avionics bay structures (coupler, bulkheads, vent/switch band, sled) and the electronics contained within that structure (altimeters, switches, power sources, tracking electronics). This Webinar will provide an overview of the entire subsystem to ensure that you understand and meet the competition requirements for a safe, successful flight.

Introduction to Recovery
The recovery subsystem consists of not only the parachutes (drogue and main, for a dual deployment) but the associated hardware as well (shock cords, quick links, eyebolts, bulkheads, swivels, parachute protectors etc.). This Webinar will

provide an overview of all the necessary components, how to size the components correctly, and some tips and tricks that can be incorporated to a smooth recovery.

Introduction to Launch Operations

Prior to attending the WSGC FNL Launch Weekend in April in Wisconsin, many students may not understand what happens at a typical high-power rocketry club launch. This Webinar will provide an overview of what to expect on Launch Day in Wisconsin, what your responsibilities are, who the key people are directing the launch, the procedure to prep your rocket, the procedure to get your rocket on the launch pad, and some safety elements to be followed.

APPENDIX E-3 – WSGC Resource Page

Wisconsin Space Grant Consortium (WSGC) Resources:
WSGC Website https://spacegrant.carthage.edu/
WSGC Website Registration Page (Login/Registration) https://spacegrant.carthage.edu/about/login/

First Nations Launch (FNL) Resources:
FNL Website https://spacegrant.carthage.edu/first-nations-launch/
FNL Zoom Meetings https://zoom.us/j/99258659434
FNL Calendar https://spacegrant.carthage.edu/first-nations-launch/calendar/
FNL FAQ https://spacegrant.carthage.edu/first-nations-launch/faq/
FNL Patch Contest https://spacegrant.carthage.edu/first-nations-launch/patch-contest/
FNL About Us https://spacegrant.carthage.edu/first-nations-launch/about-us/
FNL History https://spacegrant.carthage.edu/first-nations-launch/history/
FNL Awards https://spacegrant.carthage.edu/first-nations-launch/awards/

FNL Report Templates:
FNL Report Templates and Scoring Rubric https://spacegrant.carthage.edu/first-nations-launch/rubric/
FNL Proposal Template Link Available Soon
FNL Preliminary Design Report (PDR) Template Link Available Soon
FNL PDR Virtual Review PowerPoint Template Link Available Soon
FNL Critical Design Report (CDR) Template Link Available Soon
FNL CDR Virtual Review PowerPoint Template Link Available Soon
FNL Flight Readiness Report (FRR) Template Link Available Soon
FNL Flight Readiness Review PP Template (Oral Presentation) Link Available Soon
FNL Post Launch Assessment Report Template Link Available Soon

FNL Tools & Tips Resources:
The following documents can be found on the FNL Tools and Tips *webpage* or the URL may be copied and pasted into your search field https://spacegrant.carthage.edu/first-nations-launch/tools-and-tips/
FNL Announcement of Opportunity https://spacegrant.carthage.edu/live/files/6214-first-nations-launch-fnl-announcement-of.pdf
FNL Launch 2 Learn Rocketry Workshop https://spacegrant.carthage.edu/live/files/6471-fnl25l2l-workshop-flyerpdf
Adult Media Release https://spacegrant.carthage.edu/live/files/4575-media-release-form-adult.pdf
FNL Outreach Form https://spacegrant.carthage.edu/live/files/4953-outreach-form.pdf
FNL Team Bio Form https://spacegrant.carthage.edu/live/files/4974-team-bio-form.pdf
FNL Team Roster & Lodging Form https://spacegrant.carthage.edu/live/files/5021-team-roster-and-lodging-list-formfillable.pdf
FNL Proposed Budget Example https://spacegrant.carthage.edu/live/files/4955-proposed-budget-example.pdf
FNL Project Expense Form Instructions https://spacegrant.carthage.edu/live/files/4564-project-expense-form-instructions-and-example.pdf
FNL Project Expense Forms https://spacegrant.carthage.edu/live/files/4563-project-expense-form.pdf
FNL Travel Expense Form Instructions https://spacegrant.carthage.edu/live/files/5403-travel-expense-formeditable-instructionsfinal.pdf
FNL Travel Expense Form https://spacegrant.carthage.edu/live/files/5405-travel-expense-form.pdf
FNL Shipping Procedure https://spacegrant.carthage.edu/live/files/4827-fnl-rocket-shipping-procedure.pdf

Additional FNL Resources:
FNL Team Building Resources https://spacegrant.carthage.edu/first-nations-launch/tools-and-tips/
FNL Example Safety Checklists https://spacegrant.carthage.edu/live/files/5296-safety-checklist-examples.pdf
W9 https://www.irs.gov/pub/irs-pdf/fw9.pdf

AISES Resources:
American Indian Science and Engineering Society Website https://www.aises.org/

Apogee Resources:
Apogee Rockets – RockSim Information https://www.apogeerockets.com/RockSim/RockSim_Information
Apogee Rockets – RockSim Quick Start Guide https://www.apogeerockets.com/RockSim_Quick_Start_Guide?pg=quickside
Apogee Rockets – RockSim Discounted Temp License
https://www.apogeerockets.com/Rocket_Software/RockSim_Educational_TARC

NASA Resources:
NASA Space Grant Consortium(s)
https://www.nasa.gov/stem/spacegrant/home/Space_Grant_Consortium_Websites.html

Tripoli (TRA) Resources:
TRA Website http://www.tripoli.org/
TRA Membership http://www.tripoli.org/Membership
TRA Certification Overview http://www.tripoli.org/Certification
TRA Prefectures http://www.tripoli.org/Prefectures

National Association of Rocketry (NAR) Resources:
NAR Website https://www.nar.org/
NAR Membership https://www.nar.org/my-membership/
FAA Waiver on NAR Website
http://www.nar.org/high-power-rocketry-info/filing-for-faa-launch-authorization/filing-for-faa-waiver/

APPENDIX E-4 – Handbook Change Log

Date	Change
10/13/24	Corrected Motor Size listed in Appendix A-1 for Moon and Mars divisions from 38mm to 54mm.
1/7/25	Updated Appendix A-1 for Gateway Motor Options for the three kit options. Updated Appendix A-5 to add Gateway Motor Options
1/27/25	Updated Appendix A-1 to correct Gateway Motor designations.