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

2023-2024 First Nations Launch Competition Handbook

REVISED: 11/29/2023

Funded through NASA Cooperative Agreement #80NSSC20M0123

Table of Contents

Program Contacts

For additional information about each member of the FNL Administrative Team, please visit: https://spacegrant.carthage.edu/first-nations-launch/about-us/

FNL Program Office
fnl@carthage.edu
(262) 551-6054

Christine Bolz
Program Director
cbolz@carthage.edu
(262) 551-5915

Contact for:
- General program or award/grant questions
- Sponsorship

Rob Cannon
Program Manager
rcannon@carthage.edu
(262) 551-5727

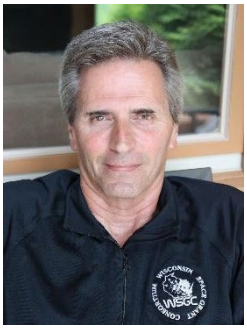
Contact for:
- General program or award/grant questions
- Recruitment and marketing
- Workshops and virtual presentations
- Outreach opportunities

Connie Engberg
Project Support Assistant
cengberg@carthage.edu
(262) 551-6548

Contact for:
- Application support and document submissions
- Travel and lodging
- Shipping and other logistical information

Megan Goller
Grants Assistant
mgoller@carthage.edu
(262) 551-6237

Contact for:
- Reimbursements and payouts



Frank Nobile
Technical Advisor
Wisconsin Tripoli Rocketry Association
maxq3@aol.com

Contact for:

- TRA/NAR Membership
- Design, build, and fly components of competition
- Technical and challenge/payload questions
- Motor selection questions
- General questions about safety

Mark Abotossaway
Aundeck Omni Kaning Ojibwe First Nation
Project Assistant/Advisor Liaison
Structures Engineer – Blue Origin, New Shephard
mark.a.abotossaway@gmail.com

Contact for:

- Assistance locating a NAR/TRA mentor
- Advisor and Mentor support
- Technical and challenge/payload questions
- Handbook questions

Bob Justus
Tripoli Assistant
Illinois Tripoli Rocketry Association
bob@mhbofni.com

Contact for:

- Launch day certifications
- Launch site questions

First Nations Launch 2024 Program Calendar

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

All times listed in Central Time
Central Standard Time (CST): November 05, 2023 - March 09, 2024.
Central Daylight Savings Time (CDT): March 10, 2024 – November 3, 2024

September 2023

1 Announcement of Opportunity
12 Informational Meeting @ 4:00 pm CDT (Zoom)
25 Launch 2 Learn Registration w/Non-Binding Notice of Intent (NOI) to Compete Due
(Level 1 Rocket Certification Workshop @ Carthage College Nov. 4-5, 2023)

October 2023

17 Informational Meeting @ 4:00 pm CDT (Zoom)
20 Visit FNL Booth #1538 at the AISES Conference
20 Non-binding Notice of Intent to Compete Due* (Moon/Mars)
27 Award Announcement (Moon/Mars/Gateway)
31 Kick-off Meeting @ 4:00 pm CDT (Zoom) (Moon/Mars)

November 2023

02 TRA/NAR Mentor Webinar @ 4:00 pm CDT (Zoom)
04-05 L2L Level I Rocket Certification Workshop @ Carthage College (registration required)
07 Proposal, Budget, and Design Review Development Webinar @ 4:00 pm CST (Zoom) (Moon/Mars)
09 FNL Office Hours @ 1:00 - 3:00 pm CST (Zoom)
13 Award Acceptance Material Due* (Moon/Mars)
14 Payload Webinar @ 4:00 pm CST (Zoom)
21 Project Management Webinar @ 4:00 pm CST (Zoom)
28 Introduction to RockSim Webinar @ 4:00 pm CST (Zoom)
30 FNL Office Hours @ 1:00 - 3:00 pm CST (Zoom)

December 2023

11 Proposal Milestone
Proposal Due* (Moon/Mars)
Preliminary Budget Due* (Moon/Mars)
Flysheet Due* (Moon/Mars)
RockSim Due* (Moon/Mars)
12 Structures Webinar @ 4:00 pm CST (Zoom)
14 FNL Office Hours @ 1:00 - 3:00 pm CST (Zoom)
18 Notice of Intent to Compete Due* (Gateway)
Request for Virtual Rocketry Workshop Due*
22 Award Announcement (Gateway)

January 2024

09 Kick-off Meeting @ 4:00 pm CST (Zoom) (Gateway)
10 Launch 2 Learn Kit Reveal @ 4:00 pm CST (Zoom)
11 FNL Office Hours @ 1:00 - 3:00 pm CST (Zoom)
15 Award Acceptance Material Due* (Gateway)
16 Gateway Project Management Webinar @ 4:00 pm CST (Zoom)
18 FNL Office Hours @ 1:00 - 3:00 pm CST (Zoom)
19-20 Launch 2 Learn Rocket Certification Virtual Workshop (Registration Required)
22 Preliminary Design Review (PDR) Milestone
PDR Report Due* (Moon/Mars)
Budget Due (Gateway)
Flysheet, RockSim Due* (Gateway/Moon/Mars)
Flight Demo Due* - Upload rocket demo flight video on Facebook and/or Twitter
23 Avionics/Altimeters Webinar @ 4:00 pm CST (Zoom)
29-31 PDR Virtual Presentations (Zoom) (Gateway/Moon/Mars)

February 2024

01-02 PDR Virtual Presentations Continued (Zoom) (Gateway/Moon/Mars)
05 Final Requests to Change to Different Competition Challenge Due *
06 Recovery Webinar @ 4:00 pm CST (Zoom)
08 FNL Office Hours @ 1:00 - 3:00 pm CST (Zoom)
13 Build & Assembly Techniques Webinar @ 4:00 pm CST (Zoom)
19 Patch Design Due*
20 Advisor/Mentor Meeting @ 4:00 pm CST (Zoom)
22 FNL Office Hours @ 1:00 - 3:00 pm CST (Zoom)
26 Critical Design Review (CDR) Milestone
CDR Report Due* (Moon/Mars)
Flysheet Due*(Gateway/Moon/Mars)
RockSim Due* (Gateway/Moon/Mars)
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)
29 FNL Office Hours @ 1:00 3:00 pm CST (Zoom)

March 2024

04 Reimbursements Due* (First payout) (Gateway/Moon/Mars)
04-08 CDR Virtual Presentations/Initial Virtual Safety Inspection with WSGC (Zoom) (Gateway/Moon/Mars)
14 FNL Office Hours @ 1:00 - 3:00 pm CDT (Zoom)
26 Launch Operations Webinar @ 4:00 pm CDT (Zoom)
28 FNL Office Hours @ 1:00 - 3:00 pm CDT (Zoom)

April 2024

01	**Flight Readiness Review (FRR) Milestone**
	FRR Report Due* (Moon/Mars)
	Flysheet, RockSim, Educational Outreach Forms Due* (Gateway/Moon/Mars)
08-11	Final Virtual Safety Inspection with Tripoli Rocketry Association (Zoom) (Gateway/Moon/Mars)
11-14	Student Launch Initiative (Next Step Award 2023)
16	Advisor/Mentor Meeting @ 4:00 pm CDT (Zoom)
18	FNL Office Hours @ 1:00 - 3:00 pm CDT (Zoom)
22	Oral Presentations PPT Due* (Gateway/Moon/Mars)
25	Teams Arrive in Kenosha, Wisconsin
26	Welcome Breakfast/Competition Kick-off @ 8:00 am CDT - Carthage College, Kenosha, WI
	Team Workday, Motor Build Workshop, Breakout Sessions, Final Safety Inspections of Drone and Rocket, Oral Presentations
27	Launch Day @ 7:30 am – 3:00 pm CDT – Richard Bong Recreational Park, Kansasville, WI
	Closing Banquet @ 6:30 pm CDT – Carthage College
28	Launch Rain Date

May 2024

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

June 2024

03	Notification of Winners
14-20	RockOn! 2024 @ Wallops Flight Facility (Next Step Award 2024)

Summer 2024

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

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

FPV (First-Person View)
A method used to control a radio-controlled vehicle by allowing the operator to see what is happening from the point of view of the vehicle. This is typically done using either by looking at a screen or by using a wearable viewer.

TRUST
The Recreational UAS Safety Test (TRUST) was developed through a collaboration between the FAA and aerospace industry to meet the requirements of US law that requires all recreational flyers pass an aeronautical knowledge and safety test. Successful completion of the test provides a certificate that is considered proof of passage if asked by law enforcement or FAA personnel.

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.

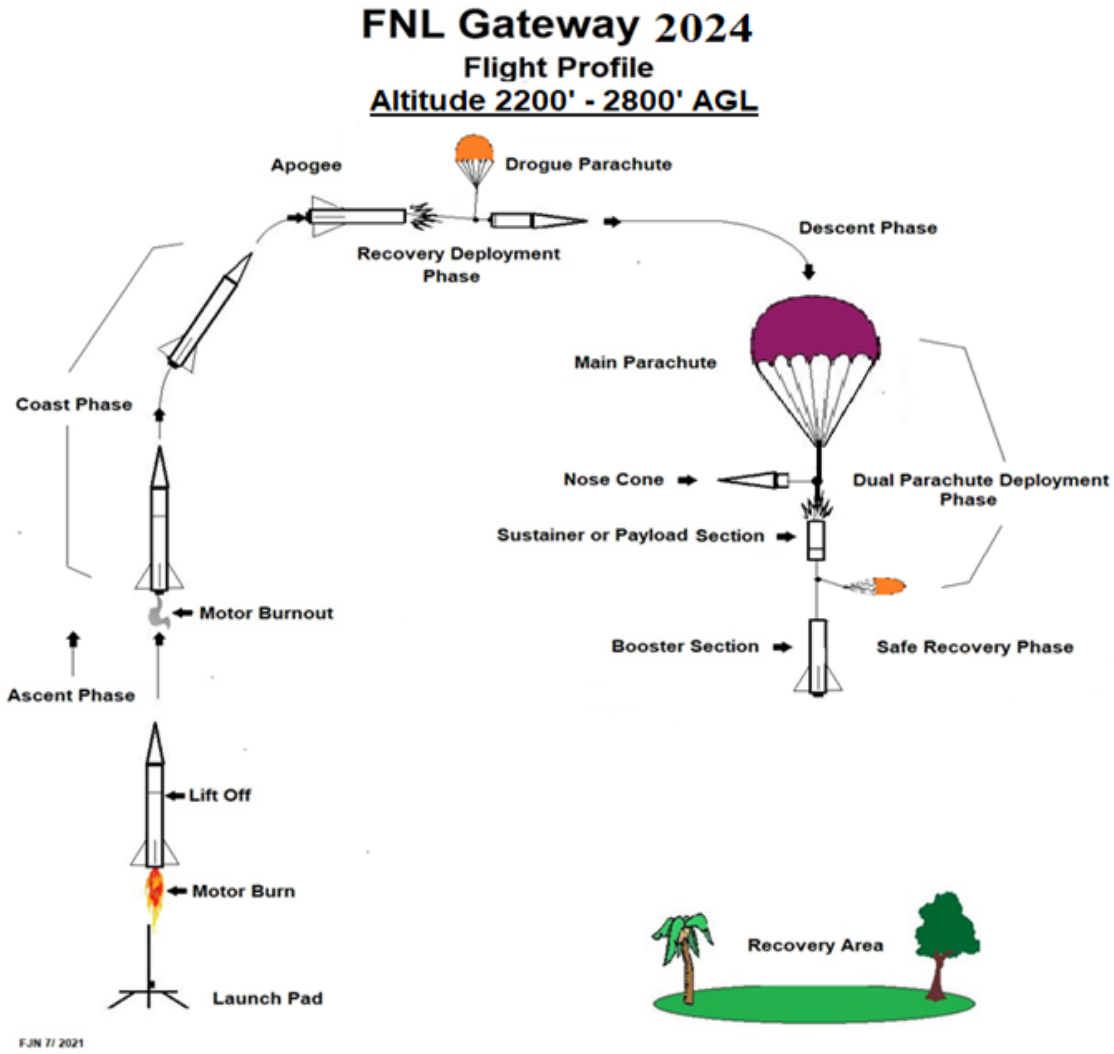
FNL Challenges

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 2023-2024 are as follows: *In the following section any requirements that are denoted with (**) means that requirement is optional for Moon Challenge.*

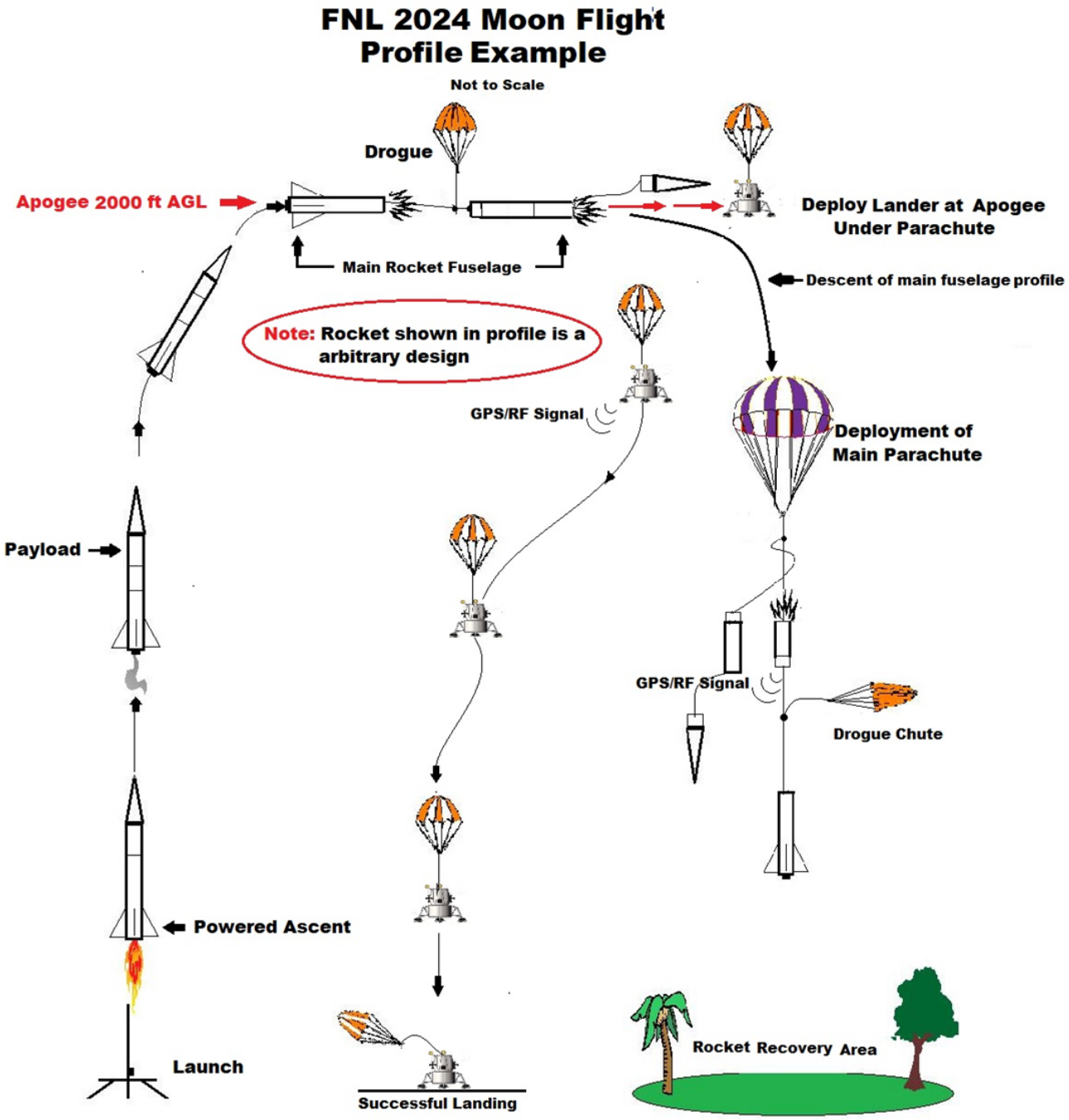
Gateway Challenge:

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.



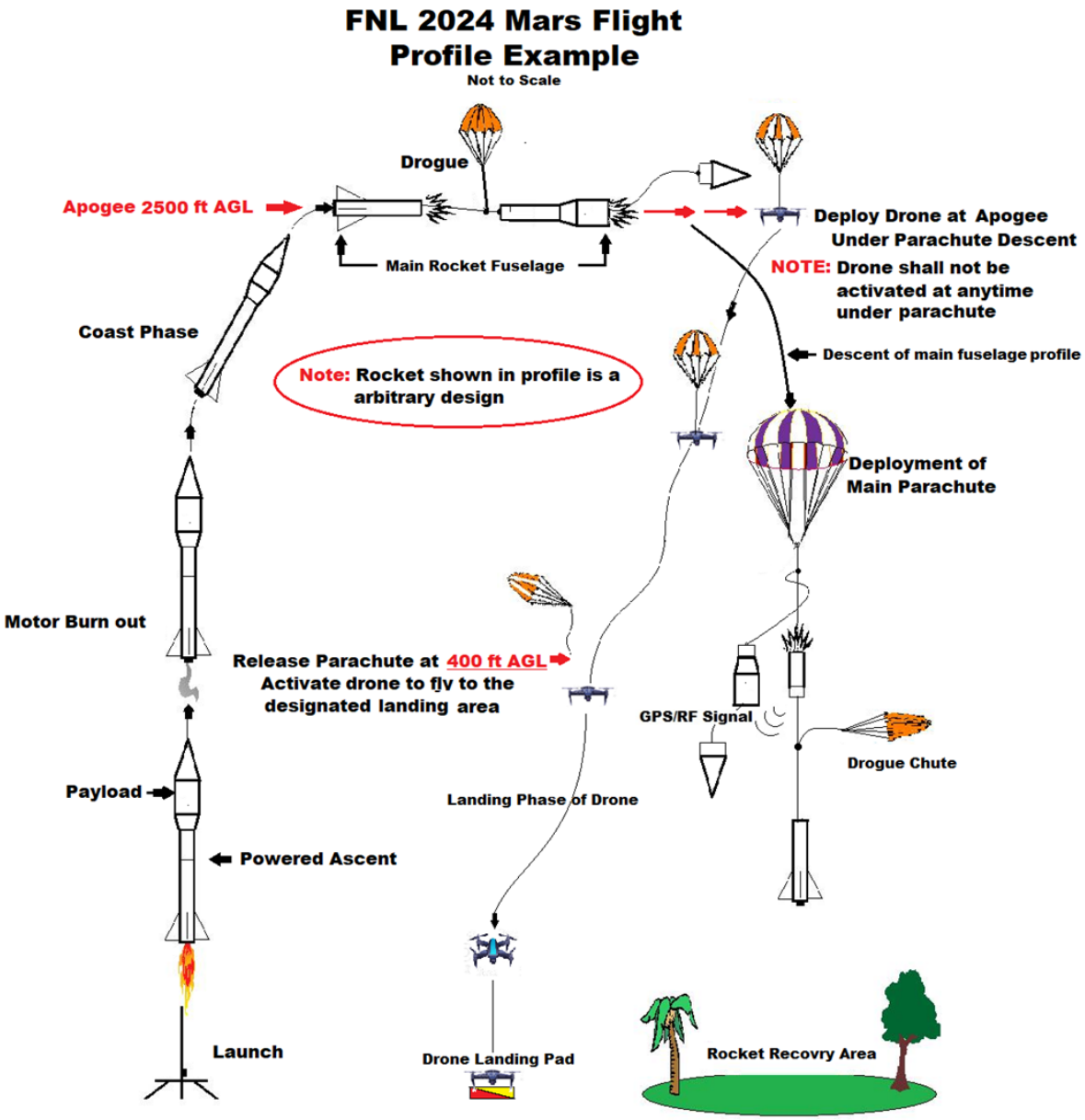
Moon Challenge:

Teams shall design, test, and fabricate a rocket that will air deploy a lander with a fabricated retractable payload chassis at apogee. The payload chassis must be equipped with a recovery device (streamer, parachute), camera, and GPS System/tracking device (RF, audible). The rocket flight shall be stable and reach an apogee of 2000' AGL. The rocket must satisfy all other technical requirements as outlined in the requirements section of the competition handbook.



Mars Engineering Challenge:

Teams are required to design, test, and fabricate a rocket that will air deploy a drone with a fabricated retractable air frame payload with size and weight limitations designed to deploy at apogee and return safely to the ground under control. The rocket flight shall be stable and reach an apogee of 2500’ AGL. The drone payload must descend under drone parachute until it reaches 400’ AGL, wherein the drone parachute will release, and a TRUST certified drone pilot will pilot the drone to a predetermined landing zone. The rocket must satisfy all other technical requirements as outlined in the requirements section of the competition handbook.



Challenge Requirements

Gateway Challenge – The following specific challenge requirements must be satisfied:

1. Detailed Parameters
    a. The team shall select one of the rockets listed in **Appendix A-5**
    b. Motor selection for the team is based on the rocket selected
    c. The rocket shall reach an altitude of 2200' – 2800' AGL
    d. The team / rocket should satisfy all other requirements as outlined in this Handbook
    e. The team shall submit a Flysheet at PDR, CDR and FRR (written reports are not required for this challenge)
    f. The team shall submit a RockSim flight simulation at PDR, CDR, and FRR
2. Competition Performance – Shall be judged on the following criteria
    a. Quality and timely completion of program milestones (see **Program Milestones** section)
    b. Success of competition flight
    c. Recorded altitude of competition flight

Moon Challenge – The following specific challenge requirements must be satisfied:

Moon Team challenge will involve the assembly, integration, testing and air deployment of an uncontrolled payload lander during rocket flight.

(* denotes a flag to the requirement, not a requirement in itself)

1. Payload Requirements
    a. Teams must design and fabricate a payload chassis that will integrate into the rocket sustainer, which will be air deployed.
    b. Detailed requirements must also be met:
        i. Teams must use (at a minimum) the following COTS components (from a reputable supplier):
            1. GPS System – Teams must purchase and use a suitable COTS GPS system.
            2. Camera System – Teams must purchase and use a suitable camera system on the payload (does not need to transmit live feed).
            3. *NOTE – additional electronics (COTS or custom) are allowed if they don't interfere with or replace the above functions or violate weight requirements.
        ii. Teams must fabricate the following payload components:
            1. Payload chassis must:
                a. Have lander legs for stable landing.
                    i. Legs must be retractable to fit inside of a rocket airframe (cannot simply be designed small enough to fit without retracting)
                b. Have the ability to attach / release a drogue parachute in flight (hardware)
        iii. The size of the assembled payload must meet the following constraints:
            1. The payload must fit in a 7.5- to 8-inch diameter rocket tube (payload arms should be retractable).
        iv. The deployed payload should be larger than 16" by 16" square as viewed from above, for safety reasons, to allow immediate visual contact once deployed.

v. The assembled payload should range from 1 - 3 lbs.
    1. Teams may use ballast to reach the required weight range.
vi. Teams must design and fabricate a system to integrate (and deploy) the payload into and out of the rocket.
    1. The payload must:
        a. Sit in the sustainer rocket airframe below the nosecone for ease of integration and deployment.
        b. Use an independent mechanical system to deploy it from the rocket (cannot be deployed using the same system as parachute for example)
        c. Have a dedicated electronics controller (situated either in the rocket or on the drone) to enable proper deployment within the proper window.
    2. The payload legs must open and lock into flight configuration once deployed from the rocket.
vii. Teams must deploy their payload at apogee, under parachute or streamer.
viii. Teams must allocate and maintain their budgets (see Project Management section – from Proposal), as follows:
    1. No more than $1500 can be spent on the drone payload.
    2. No more than $1500 can be spent on the rocket and components.
    3. Budgets must list components, manufacturer, and supplier/vendor once selections are made (updated at each Milestone).

2. Rocket Vehicle
    a. Teams must use a 7.5- to 8-inch diameter airframe for the payload section of their rocket (it will be difficult to find an existing kit at this diameter, teams will need to buy and integrate components instead).
    b. *Teams may use a transition to step the rocket down to a smaller diameter for non-payload sections to save weight.
    c. Teams must select a motor from **Appendix A-1** such that the rocket and payload will reach an apogee of 2000 ft and satisfy all other performance requirements.
3. Teams must ensure all other technical requirements from the remainder of the Requirements section are followed.

Mars Challenge – The following specific challenge requirements must be satisfied:

Mars Team challenge will involve the assembly, integration, testing and air deployment of a drone during rocket flight, where the drone will be piloted to a predetermined location following deployment.
(* denotes a flag to the requirement, not a requirement in itself)

1. Payload Requirements
    a. Teams must design and fabricate a drone chassis (cannot use a COTS chassis) that will integrate into the rocket sustainer, which will be air deployed.
    b. Teams must research, select, and integrate the necessary COTS drone electronics components.
    c. Detailed requirements must also be met:
        i. Teams must use (at a minimum) the following COTS components (from a reputable supplier):
            1. Radio Transmitter – teams must purchase a suitable COTS radio transmitter.

2. Radio Receiver – teams must purchase a suitable COTS radio receiver (compatible with transmitter).
3. Electric Motors – teams must purchase the proper size motors for the final overall size / weight (motors should provide enough lift and control over the range).
    a. The payload should use 4 motors (quad configuration) at a minimum.
4. Propellers – teams must purchase the proper size propellers for the final overall size / weight.
5. GPS System – Teams must purchase a suitable COTS drone GPS system.
6. Camera System – Teams must purchase a suitable First Person View (FPV) system, which includes:
    a. The camera on the drone
    b. The transmitter on the drone
    c. The receiver (goggles) on the pilot
7. *NOTE – additional electronics (COTS or custom) are allowed if they don't interfere with or replace the above functions or violate weight requirements.

ii. Teams must fabricate a drone chassis that meets the following parameters:
1. May design / build from scratch or purchase / modify a COTS airframe (reverse engineer)
2. Drone chassis must be retractable to fit inside of a rocket airframe (cannot simply be designed small enough to fit without retracting)
3. Drone chassis must have the ability to attach / release a drogue parachute in flight (hardware)

iii. The size of the assembled drone payload must meet the following constraints:
1. The payload must fit in a 7.5- or 8-inch diameter rocket tube (drone arms should be retractable).
    a. The deployed payload should be larger than 16" by 16" square as viewed from above, (for safety reasons), to allow immediate visual contact once deployed.
2. The assembled drone payload should range from 1 – 3 lbs.
    a. Teams may use ballast to reach the required weight range.

iv. Teams must design and fabricate a system to integrate (and deploy) the drone payload into and out of the rocket.
1. The drone payload must:
    a. Sit in the sustainer rocket airframe below the nosecone for ease of integration and deployment.
    b. Use an independent mechanical system to deploy it from the rocket (cannot be deployed using the same system as parachute for example)
    c. Have a dedicated electronics controller (situated either in the rocket or on the drone) to enable proper deployment within proper window.
    d. Open and lock into flight configuration once deployed from the rocket.

v. Teams must deploy their drone payload at apogee, under parachute (not piloted).
1. The drone payload must:
    a. Descend under parachute from apogee until 400 ft AGL.
        i. *NOTE – there must be no piloting of drone while on descent from apogee

ii. *NOTE – this requirement ensures that the drone will be in a safe, stable orientation prior to pilot beginning powered flight

b. Eject or release the parachute at 400 ft AGL.
c. Begin controlled powered flight at or below 400 ft AGL.
d. Be piloted remotely to the pre-determined landing zone.

vi. Teams must allocate and maintain their budgets (in Project Management section – from Proposal), as follows:
1. No more than $1500 can be spent on the drone payload.
2. No more than $1500 can be spent on the rocket and components.
3. Budgets must list components, manufacturer, and supplier/vendor once selections are made (updated at each Milestone).

vii. Teams must select one (1) certified drone pilot by FRR but encourage having multiple certified pilots.
1. All team members must complete TRUST certification.
a. *Ensure any certification, local club / flight fees, are accounted for in the budget.

2. Rocket vehicle
a. Teams must use a 7.5- to 8-inch diameter airframe for the payload section of their rocket (it will be difficult to find an existing kit at this diameter, teams will need to buy and integrate components instead).
i. *Teams may use a transition to step the rocket down to a smaller diameter for non-payload sections to save weight.
b. Teams must select a motor from **Appendix A-1** such that the rocket and payload will reach an apogee of 2500 ft and satisfy all other performance requirements.
3. Teams must ensure all other technical requirements from the remainder of the Requirements section are followed.

General Requirements

1. The **team lead, team advisor, and co-advisor** (if applicable) must **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) must 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 must 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 #5**).
    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 2024 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 featuring the team 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.
    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

Proposal Requirements

The proposing team shall identify the following in a written proposal due to WSGC as outlined in the FNL Calendar (please use the Proposal Template found at *include link*)

1. General Information
    a. The cover page should include the name of the college/university or secondary education institution.
    b. Name, title for advisor and co-advisor (if applicable).
    c. Name, title for the student Team Leader.
    d. Name, title for the student Safety Officer.
    e. Name, title of the experienced rocketry mentor (certified member of NAR or TRA). If none, list 'in work.'
    f. Name of the NAR/TRA section(s) the team is planning to work with for purposes of mentoring, review of designs and documentation, and local launch assistance. If none, list 'in progress.'
    g. Brief listing/bio of student participants who will be committed to the project and their proposed duties. Include an outline of the project organization that identifies the key managers and technical personnel.
2. Facilities/Equipment
    a. Description of facilities and hours of accessibility, necessary personnel, equipment, and supplies that are required to design and build the rocket and payload/challenge(s). Include images as necessary.
        i. Describe what shops (makerspace, student shops etc.) are available to students.
        ii. Describe the general tools / equipment available (woodworking, metal working etc.).
        iii. Describe the specific tools / equipment available for 3D printing (type of machines, number of machines).
        iv. Describe what training is needed to access the shops.
        v. Discuss plans to train team members (may include in Project Management section).
        vi. Describe the dedicated workspace to store rocketry components and complete the build.
        vii. Describe the dedicated space for meeting on campus.
        viii. Describe the dedicated space for virtual presentations (camera and audio set).
        ix. Discuss if your school has a drone team already – will you have done support, equipment, etc.
    b. Description of computing equipment available, for communication, design, development, simulation, and document development to support design reviews. The necessary equipment identified should include:
        i. Computer hardware (labs)
        ii. Computer software (for file sharing, report writing etc.), computer-aided drafting (CAD) and solid model software, internet access and email capability
    c. State the number of simulation software licenses (RockSim mandatory) available. See '**Appendix D-3**' for assistance with how to acquire and learn RockSim.
        i. If none, provide a plan to procure the software. (Note: free trial versions may be used until full license is procured).
3. Safety

Provide a written safety plan addressing the safety of the materials used, facilities involved, and student responsible, i.e., Safety Officer, for ensuring that the plan is followed.

a. A risk assessment is suggested but not required.
b. Provide a description of the procedures for NAR/TRA personnel (mentor) to perform. Ensure the following:
    i. Compliance with TRA High-Power Safety Code requirements (http://www.tripoli.org/SafetyCode).
    ii. Performance of all hazardous materials handling and hazardous operations.
c. Describe the plan for briefing students on hazard recognition and accident avoidance as well as for pre-launch briefings.
d. Describe methods to include necessary caution statements in plans, procedures, and other working documents including the use of proper Personal Protective Equipment (PPE).
e. Each team shall provide a plan for complying with federal, state, and local laws regarding unmanned rocket launches and motor handling. Specifically, regarding the use of airspace, Federal Aviation Regulations 14 CFR, Subchapter F, Part 101, Subpart C; Amateur Rockets, Code of Federal Regulation 27 Part 55: Commerce in Explosives; and fire prevention, NFPA 1127 "Code for High-power Rocket Motors."
f. Provide a plan for NRA/TRA personnel (mentor) purchase, storage, transportation, and use of rocket motors and energetic devices.
g. Include a written statement that all team members understand and will abide by the following safety regulations:
    i. Range safety inspections will be conducted on each rocket before it is flown. Each team shall comply with the determination of the safety inspection or may be removed from the program.
    ii. The Range Safety Officer has the final say on all rocket safety issues. Therefore, the Range Safety Officer has the right to deny the launch of any rocket for safety reasons.
    iii. The team mentor is ultimately responsible for the safe flight and recovery of the team's rocket. Therefore, a team will not fly a rocket until the mentor has reviewed the design, examined the build, and is satisfied the rocket meets established amateur rocketry design and safety guidelines.
    iv. Any team that does not comply with the safety requirements will not be allowed to launch their rocket.

4. Technical Design

Discuss your proposed and general approach to rocket and payload/challenge design. Include alternatives (trade studies) to show you have examined various options as the WSGC Tech Team may prohibit your choice. In your report (use the Proposal Template found at *Insert Link*) please include:

a. a. General vehicle dimensions.
    i. Material selection and justification.
    ii. Construction methods.
    iii. Research the various rocketry kit options and present your leading choice. Design drivers will include:
        1. Satisfying technical requirements (obtained via simulations).
        2. Dimensions of the rocket (diameter and length).
        3. Weight of kit / payload and motor combination to achieve expected altitude.
        4. Robustness of material to handle the expected loading.
        5. Capability of team / school to work with the material.

6. Cost of rocket kit and raw materials (will a spare airframe be purchased / fabricated etc.).

b. Projected recovery system design.
   i. Research various rocketry recovery methods / components and present leading choices. This includes:
      1. Parachutes and hardware.
      2. Vehicle avionics for deployment.
      3. Electronic tracking systems.
c. Projected motor brand and designation.
   i. Research various motor performance parameters and use simulations to determine leading choices (for each of the proposed kits from item a above).
   ii. Motor should be selected to satisfy technical requirements.
d. Initial RockSim simulations are expected at the Proposal phase including simulation data.
e. General description of the team's projected challenge.
   i. Describe the general design of the drone / payload chassis (trade study)
      1. Include material, size, configuration etc.
   ii. Describe initial selections for relevant electronic components (trade study)
      1. Include pictures of components
      2. Ensure manufacturer, vendor, costs are included in your budgets
   iii. Describe initial concepts of how you plan to deploy your payload (trade study)
      1. Include proposed hardware / integration
      2. Include electronics selections
f. General, Vehicle, Recovery, Payload/Challenge, and Safety Requirements of this handbook.
   i. Create a checklist (spreadsheet) of all the requirements and ensure that each one is addressed (not violated) during the design.
   ii. Ensure performance parameters are met via simulations.
g. Major technical challenges and solutions.
   i. Share any major technical concerns and identify the critical path.

5. Project Plan
   a. Provide an initial test plan for each of your fabricated components (this will be refined / updated at each milestone). See '**Appendix C-2**' for support.
      i. Payload / Challenge tests should include:
         1. PDR – component tests to ensure each component works individually.
         2. CDR – assembly tests to ensure all the components work as an assembly (the drone operates smoothly)
         3. FRR – deployment tests to ensure the drone integrates and deploys properly (this may or may not include a full-scale flight test, or drop tests)
      ii. Rocket Vehicle tests should include:
         1. CDR – avionics (altimeters / GPS) component tests to ensure each component works individually
         2. FRR – ejection tests to ensure parachute deployments are acceptable, and the safe use of black powder is understood

         *a full-scale flight test is optional, but scale flight tests may prove beneficial to understanding or testing components (deployments) in flight

b. Provide an initial schedule/timeline covering all aspects necessary to successfully complete the project (this will be refined/updated at each milestone). Use Gantt chart format. See '**Appendix C-1**' for support.
    i. Use the milestone dates (Proposal, PDR, CDR, FRR, Flight, PLAR) as guidance and create a general schedule for the successful completion of the project.
    ii. Include items such as (start and end of):
        1. Team training and recruitment timeline.
        2. Challenge design and selection (material / methods research and simulations).
        3. Procurement (equipment, raw materials) timeline.
        4. Component build / fabrication timeline.
        5. Component testing timeline.
        6. Flight test timeline (if applicable).
        7. Launch Weekend travel timeline.
        8. Outreach events timeline.
c. Provide an initial budget to cover all aspects necessary to complete the project successfully (this will be refined/updated at each milestone). Use spreadsheet format. See '**Appendix C-1**' for support.
    i. Initially, breakdown your budget into groups such as:
        1. Software costs
            a. You are required to procure RockSim simulation software licenses (see '**Appendix D-3**' for support).
        2. Fabrication or testing equipment / supplies costs.
        3. Rocket parts / payload materials costs.
        4. Payload / challenge costs
        5. Team travel on Launch Weekend costs.
    ii. Provide a detailed funding plan.
    iii. You may need to seek additional funds beyond the WSGC funding, for long term sustainability.
d. Develop a clear plan for sustainability of the rocket project in the local area. This plan should include:
    i. How to provide and maintain established partnerships and regularly engage successive classes of students in rocketry.
    ii. Partners (industry/community/local state Space Grant consortium), recruitment of team members, funding sustainability, and STEM engagement/outreach activities.

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.

The panel will be expecting a professional and polished report that follows the order of sections as they appear below.

Preliminary Design Review Report

All information contained in the general information section of the Project Proposal shall also be included in the PDR Report. Page Limit: PDRs will only be scored using the first 40 pages of the report (not including title page or Appendixes). Note that (**) items are optional for Moon Challenge teams.

1. Team Summary
    a. Team name
    b. School name
    c. Name of team advisor and co-advisor (if applicable)
    d. Name of student team lead and student safety lead
    e. Name of mentor, NAR/TRA number and certification level
    f. Names and roles of team members
2. Summary of PDR report (2 pages maximum)
    a. Highlight any major changes since previous report
        i. Launch Vehicle Summary
            1. Preliminary size and mass
            2. Preliminary motor choice(s)
            3. Preliminary recovery system
        ii. Challenge Summary
            1. Summarize your approach to satisfying the Challenge Requirements
            2. Provide preliminary payload chassis design and dimensions
            3. Provide preliminary payload electronics list
3. Vehicle Criteria
    a. Selection and Design of Launch Vehicle.
        i. Provide an overview of all key components/systems, including alternatives.
            1. Present the pros and cons of each alternative.
        ii. After evaluating alternatives, present a vehicle design with the current leading alternatives, and explain why they are the leading choices.
            1. Describe each subsystem and the components within those subsystems.
        iii. Include images where applicable (manufacturer, simulation, CAD models etc.)
        iv. Provide estimated masses for each component (Mars Challenge ONLY). **
    b. Recovery Subsystem
        i. Using the estimated mass of the launch vehicle, perform a preliminary analysis on parachute sizing and determine what size is required for a safe descent.

ii. Choose leading components amongst the alternatives, present them, and explain why they are the current leaders.

c. Avionics Subsystem
   i. Demonstrate that preliminary design has begun on the structure, sizing, and placement of the avionics bay, including the location and sizing of the vent holes.
   ii. Include overall position of the avionics bay within the vehicle, number of altimeters, layout of avionics sled, and type/location of switch(es) to be used to power on from outside of the vehicle, power/wiring of electronics.
   iii. Present the leading altimeter choices (the altimeters used for parachute deployments – the electronics used for payload should be described in Payload Criteria section below)
   iv. Include any diagrams, drawings, schematics, sketches, images

d. Motor Selection
   i. Review different motor alternatives and present data on each alternative
      1. What drives motor change as the design progresses? How can this be controlled?
   ii. Present the motor retention device (which retains the motor after insertion)

e. Mission Performance Predictions
   i. Show flight profile simulations (that simulations have been run), present altitude predictions with simulated vehicle data (from simulations).
   ii. Show stability margin and simulated Center of Pressure (CP)/Center of Gravity (CG) relationship and locations (using simulations).
   iii. Calculate the expected descent time (normally using simulations – can be hand calculation) for the rocket and any section that descends untethered.
   iv. (Mars Challenge ONLY). ** Calculate the drift (normally using simulations – can be hand calculation) for each independent section of the launch vehicle from the launch pad for three different cases:
      1. No wind
      2. 10-mph wind
      3. 20-mph wind.

4. Payload / Challenge Criteria
   a. Selection and Design of Payload / Challenge Solution
      i. Present the preliminary commercial-off-the-shelf (COTS) electronics components required for the payload operation
         1. Include alternatives examined, and justification for selection (cost, performance, size, integration, etc.)
      ii. Present the preliminary payload chassis you plan on fabricating.
         1. Include CAD, dimensions, materials, extended and folded configurations
         2. Discuss the folding and locking mechanisms of arms
         3. Show that electronic component integration has begun on the chassis
      iii. Discuss the preliminary integration and deployment approach of the payload assembly from the rocket
         1. Discuss what hardware is needed for deployment (purchased or fabricated)
         2. Discuss what electronics will be used to deploy the payload
      iv. You should include 3D CAD renderings for your payload, which will aid in integration and fabrication

5. Safety
    a. Demonstrate an understanding of all components needed to complete the project, and how risks/delays impact the project
    b. Include data indicating that the hazards have been researched, especially personnel (if extensive, may be contained as an Appendix (e.g., NAR regulations, operator's manuals, MSDS, etc.)
    c. (MARS Only**) Discuss the pilot training plan, who will pilot, how will pilot practice before challenge payload is complete, where will practice take place etc.
6. Project Plan
    a. Test Plan
        i. Refine and update your fabrication component test plan (see '**Appendix C-2**' for guidance)
        ii. Include functional tests required to prove the integrity of design to your plan (if applicable at this stage):
            1. Vehicle component tests
                a. Altimeter ground tests
                b. GPS tracking ground tests
                c. Ground ejection tests
                d. Any flight tests, etc.
            2. Payload / Challenge component tests
                a. Electronics component tests
                b. Preliminary payload deployment tests
                c. Preliminary chassis unfolding / locking mechanism tests
        iii. Update your schedule to incorporate these tests
    b. Requirements Verification (Mars Challenge only) **
        i. Create a verification plan (see '**Appendix C-3**' for guidance) for every requirement from sections 1 – 5 of the project requirements listed in the Competition Handbook.
            1. Identify what is required to verify the requirement:
                a. i.e., test, analysis, demonstration, or inspection
            2. Include an associated plan / step needed for verification
            3. If the plan is extensive, may be contained as an Appendix to your report
    c. Project Budget
        i. Refine and update your initial budget. Provide a line-item budget with market values for individual components, material vendors, and applicable taxes or shipping/handling fees
        ii. Include travel estimates for Launch Weekend
        iii. Include TRA/NAR Membership
        iv. Provide a funding plan describing sources of funding, allocation of funds, and material acquisition plan

d. Project Timeline
    i. Refine and update your initial schedule. Provide a timeline including all team activities and expected activity durations. The schedule should be complete and encompass the full term of the project.
    ii. Deliverables should be defined with reasonable activity duration. GANTT charts are encouraged (see '**Appendix C-1**' for Gantt chart example).
    iii. Include parts procurement timeline, component test timeline, build timeline and flight test timeline.
    iv. Recall that the vehicle must be ready (95% complete) to fly two weeks prior to the competition launch date, so the build timeline should reflect this deliverable.

Preliminary Design Review Presentation

This presentation is a concise summary of the PDR report. It must include the following items (please use PDR Virtual Presentation template from the WSGC website https://spacegrant.carthage.edu/first-nations-launch/rubric/):

1. Present preliminary vehicle dimensions and materials
    a. Include preliminary motor selection
    b. Include drawings, diagrams, images
2. Present preliminary vehicle performance
    a. Include static stability margin, CP/CG locations
    b. Include thrust-to-weight ratio, Rail exit velocity
    c. Include predicted altitude
    d. Include drawings, diagrams, images
3. Present preliminary avionics (vehicle only) subsystem
    a. Include location in vehicle
    b. Include type and number of altimeters
    c. Include power sources
    d. Include drawings, diagrams, images
4. Present preliminary recovery subsystem
    a. Include preliminary sizes, locations and descent rates
    b. Include preliminary recovery devices (GPS)
5. Present preliminary test plan
    a. Include any tests completed to date
6. Present preliminary payload / challenge approach
    a. Include chassis design and status
    b. Include electronics component selections
    c. Include deployment scheme
7. Present major technical challenges (the critical path)
8. Present brief budget (over / under) status and brief schedule (ahead / behind) status

The PDR will be presented to a panel of engineers and TRA personnel. The purpose of this review is to convince the WSGC FNL Review Panel that the preliminary design will:

1. Meet all requirements.
2. Have a high probability of meeting the mission objectives.
3. Can be safely:
    a. Constructed
    b. Tested
    c. Launched
    d. Recovered

Upon successful completion of the PDR, the team is given the authority to proceed into the final design phase of the life cycle that will culminate in the CDR.

It is expected that the team participants deliver the report and answer all questions. The mentor or advisor shall not participate in the presentation.

The presentation of the PDR shall be well prepared with a professional overall appearance. This includes, but is not limited to, the following:

1. Easy-to-read slides.
    a. Use the template from the website (note it changes from year to year – do not use your old slides)
    b. Do not add slides, or rearrange order
    c. You may change or add formatting to slides to personalize
2. Appropriate placement of pictures.
3. Graphs and plots.
4. Professional appearance of the presenters.
5. Speaking clearly and loudly.
6. Looking into the camera.
7. Referring to the slides rather than reading them.
8. Communicating to the panel in an appropriate and professional manner.

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.

Page Limit: CDRs will only be scored using the first 40 pages of the report (not including title page or Appendixes). Any additional content will not be considered while scoring. Note that (**) items are optional for Moon Challenge teams.

Critical Design Review Report

1. Team Summary
    a. Team name
    b. School name
    c. Name of team advisor and co-advisor (if applicable)
    d. Name of student team lead and student safety lead
    e. Name of mentor, NAR/TRA number and certification level
    f. Names and roles of team members
2. Summary of CDR report (2 pages maximum)
    a. Highlight any major changes since the previous report
        i. Launch Vehicle Summary
            1. Final size and mass
            2. Final motor choice
            3. Final recovery system
            4. Rail button size
        ii. Payload / Challenge Summary
            1. Provide final payload chassis design and dimensions
            2. Provide final payload electronics list
            3. Provide deployment overview
3. Vehicle Criteria
    a. Design of Launch Vehicle
        i. Present which of the alternatives from PDR were chosen as the final components for the launch vehicle
            1. Provide justification for best choices (cost, weight, performance etc.)
            2. Present all major vehicle structural components
        ii. Demonstrate that the designs are complete and ready to manufacture / procure by:
            1. Listing ALL necessary components

2. Showing that simulations include all components and weights (vehicle weight should not change after CDR, so ensure all weights are accurate in simulation, and all components are accounted for).

iii. Include images where applicable (manufacturer, simulations, CAD models etc.)

iv. If airframe build/manufacture has begun, include:

1. Pictures of assembled components
2. Manufacturing and joining steps (especially sealed components such as inner fin fillets, that can no longer be examined once joined)

v. Update estimated masses for each component (Mars Challenge ONLY) **

b. Recovery Subsystem

i. Present which of the alternatives from PDR were chosen as the final components for the recovery subsystem.

1. Provide justification for best choices (cost, weight, performance etc.)
2. Present ALL components and attachment hardware

ii. Include any diagrams, drawings, schematics, sketches, images

c. Avionics Subsystem

i. Present the final avionics bay structure overview (where is it located in the vehicle, what are the major structural components)

ii. Present the final altimeter selections and the number of altimeters

iii. Present the final avionics sled, material, sled layout

iv. Present the final size/location and number of vent holes

v. Present the final switch(es) selected for powering on the altimeters from the outside of the vehicle

vi. Present the final recovery tracking electronics (GPS) selection and location

vii. Include any diagrams, drawings, schematics, sketches, images

d. Motor Selection

i. Present the final motor selection (cannot be changed after CDR – design should be completely mature at this point)

ii. Present the motor retention device (which retains the motor after insertion)

e. Mission Performance Predictions

i. Show flight profile simulations, present altitude predictions with simulated vehicle data (from simulations)

ii. Show stability margin and simulated Center of Pressure (CP)/Center of Gravity (CG) relationship and locations (using simulations)

iii. Calculate the expected descent time (normally using simulations – hand calculations accepted) for the rocket and any section that descends untethered

iv. (MARS Challenge ONLY) ** Calculate the drift (normally using simulations – hand calculations accepted) for each independent section of the launch vehicle from the launch pad for three different cases:

1. No wind
2. 10-mph wind
3. 20-mph wind

4. Payload / Challenge Criteria

a. Design of Payload / Challenge Approach

i. Present the final commercial-off-the-shelf (COTS) electronics components required for the payload operation

1. Include justification for selection (cost, weight, performance etc.)

ii. Present the final payload chassis for fabrication and include status.
1. Include CAD, dimensions, materials, in extended and folded configurations.
2. Present the folded and locking mechanisms of arms
3. Present the status of component integration with chassis

iii. Discuss the final integration and deployment approach of the payload assembly from the rocket
1. Present what hardware is needed for deployment (purchased or fabricated)
2. Present what electronics are needed to deploy the payload

iv. You should include 3D CAD renderings for your payload, which will aid in integration and fabrication

5. Safety
   a. Launch Concerns and Operation Procedures.
      i. Submit a draft of final assembly and launch procedures including (see '**Appendix C-4**' for guidance):
         1. Avionics preparation checklist.
         2. Recovery preparation checklist.
         3. Final assembly checklist.
         4. Setup on launch pad checklist.
         5. Troubleshooting checklist.
         6. Post-flight inspection checklist.
      ii. These procedures/checklists should include specially demarcated steps related to safety. Examples include:
         1. Warnings of hazards that can result from missing a step.
         2. PPE required for a step in the procedure (identified BEFORE the step).
         3. Required personnel to complete a step or to witness and sign off verification of a step.
6. Project Plan
   a. Test Plan
      i. Refine and update your component test plan (see '**Appendix C-2**' for guidance).
      ii. Refine and update your functional tests required to prove the integrity of design.
      iii. Discuss the results of any tests and discuss any remaining critical tests.
   b. Requirements Compliance (Mars Challenge ONLY) **
      i. Update the verification plan for every requirement from Sections 1 - 5 of the Project Requirements listed in the Competition Handbook.
         1. Identify what is required to verify the requirement:
            a. I.e., test, analysis, demonstration, or inspection.
         2. Include an associated plan / step needed for verification.
         3. If the plan is extensive, may be contained as an Appendix to your report.
   c. Project Budget
      i. Refine and update your budget. Provide an updated line-item budget with market values for individual components. Please include:
         1. List all components, sorted by Vehicle or Payload or Supplies or Travel.
         2. Include columns for manufacturer and vendor, for all components.
         3. Include columns for procurement status (ordered, shipped, received etc.)
         4. Consider shipping / handling fees in your budget.

ii. Provide an updated funding plan describing any additional sources of funding.

d. Project Timeline
   i. Refine and update your schedule. The schedule should be complete and encompass the full term of the project.
   ii. Deliverables should be defined with reasonable activity duration. GANTT charts are encouraged.
   iii. Include parts procurement timeline, component test timeline, build timeline and flight test timeline.
   iv. Recall that the vehicle must be ready (95% complete) upon arrival for Launch Weekend.

Critical Design Review Presentation

Your presentation is a concise summary of your CDR report. It must include the following items (please use CDR Virtual Template from the WSGC website: (https://spacegrant.carthage.edu/first-nations-launch/rubric/)

1. Present final Vehicle
    a. Include vehicle dimensions, materials
    b. Include final motor selection
    c. Include drawings, diagrams, images
2. Present final vehicle performance
    a. Include static stability margin, CP / CG location
    b. Include thrust-to-weight ratio, rail exit velocity
    c. Include predicted altitude
3. Present final Avionics Subsystem
    a. Include avionics bay
    b. Include type / number of altimeters, switches, vent holes.
4. Present final Recovery Subsystem
    a. Include parachute sizes, shock cords, descent rates.
    b. Include tracking devices and locations.
5. Present final test plans
    a. Include results and tests remaining
6. Present final Payload / Challenge
    a. Include chassis design and status.
    b. Include electronics component selections and status
    c. Include deployment scheme
7. Present remaining technical challenges (critical path).
8. Present budget status and schedule status.

*NOTE: Please have any built / acquired components and subassemblies on hand to show the judges during presentation or during question period.

The CDR will be presented to a panel of engineers and TRA personnel. The team is expected to present and defend the final design of the launch vehicle (including the payload/challenge) that proves the design meets the mission objectives and requirements and can be safely constructed, tested, launched, and recovered.

Upon successful completion of the CDR, the team is given the authority to proceed into the construction and verification phase of the life cycle that will culminate in a Flight Readiness Review.

It is expected that the team participants deliver the report and answer all questions. The mentor shall not participate in the presentation.

The presentation of the CDR shall be well prepared with a professional overall appearance. This includes, but is not limited to, the following:

1. Easy-to-read slides made with dark text on a light background.
2. Appropriate placement of pictures.
3. Graphs and videos.

4. Professional appearance of the presenters.
5. Speaking clearly and loudly.
6. Looking into the camera.
7. Referring to the slides rather than reading them.
8. Communicating to the panel in an appropriate and professional manner.

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.

The panel will be expecting a professional and polished report that follows the order of sections as they appear below.

Page Limit: FRRs will only be scored using the first 40 pages of the report (not including title page or Appendixes). Any additional content will not be considered while scoring. Note that (**) items are optional for Moon Challenge teams.

Flight Readiness Review Report

1. Team Summary
    a. Team name.
    b. School name.
    c. Name of team advisor and co-advisor (as applicable).
    d. Name of student team lead and student safety lead.
    e. Name of mentor, NAR/TRA number and certification level.
    f. Names and roles of team members.
2. Summary of FRR report (1 page maximum).
    a. Highlight any major changes since the previous report.
        i. Launch Vehicle Summary
            1. Flight ready vehicle size and mass.
            2. Flight ready motor choice.
            3. Flight ready recovery details.
            4. Flight ready rail button size.
        ii. Challenge Summary
            1. Present flight ready payload chassis design and dimensions.
            2. Present flight ready payload electronics overview.
            3. Present flight ready payload deployment.
3. Vehicle Criteria
    a. Design and Construction of Vehicle
        i. Present a launch vehicle overview that ensures the vehicle can be launched and recovered safely. Include overview of as-built components:
            1. Structural elements (i.e., airframe, fins, bulkheads, attachment hardware, etc.).
            2. Electrical elements (i.e., wiring, switches, battery retention, retention of avionics boards, etc.).
            3. Include pictures of critical hardware where relevant showing details (i.e., bulkhead joins/fillets, airframe tube fit/alignments, fin alignments, centering ring fillets, fin fillets, motor retention, eyebolt/shock cord attachment, avionics sled/switches/vent holes, rail button attachment/alignment).
        ii. Prove that the vehicle is fully constructed (component images) and fully document the construction process (assembly images).
            1. Identify any outstanding vehicle assembly or testing that is needed, if applicable.

iii. Include summary of the AS-BUILT rocket dimensions (There is a good chance dimensions have changed slightly due to the construction process).
    1. Do the as-built dimensions match CAD or simulation vehicle?
    2. If not, how will this variation affect performance?
    3. Discuss how / why the constructed rocket differs from design, if applicable.
iv. (MARS Challenge ONLY) ** Update and provide the final masses of all components, and ensure your simulations match the number and mass of components

b. Recovery and Avionics Subsystem
    i. Present the as-built and as-tested recovery system – hardware and electronics. Include:
        1. Structural elements (such as bulkheads, harnesses, attachment hardware, etc.).
        2. Electrical elements (such as altimeters/computers, switches, connectors).
            a. Any redundancy features.
        3. Parachute sizes and descent rates.
        4. Rocket locating devices.
        5. Include relevant diagrams, schematics of the as-built electrical and structural assemblies.
    ii. Discuss any test results related to recovery (such as ejection charges and electronics).
    iii. Identify any outstanding recovery tests / selections that are needed, if applicable.

c. Motor Selection
    i. Present the final motor selection.
    ii. Present the motor retention device (which retains the motor after insertion).

d. Mission Performance Predictions
    i. Show flight profile simulations, present altitude predictions with simulated vehicle data (from simulations).
    ii. Show stability margin and simulated Center of Pressure (CP) / Center of Gravity (CG) relationship and locations (using simulations).
    iii. Calculate the expected descent time (normally using simulations – hand calculations accepted) for the rocket and any section that descends untethered.
    iv. (MARS Challenge ONLY) ** Calculate the drift (normally using simulations – hand calculations accepted) for each independent section of the launch vehicle from the launch pad for three different cases:
        1. No wind.
        2. 10-mph wind.
        3. 20-mph wind.

4. Payload / Challenge Criteria
    a. Design and Testing of Challenge Components.
        i. Present the flight ready commercial-of-the-shelf (COTS) electronics components as selected and integrated for payload operation.
            1. Present each component individually, and as part of the payload assembly.
            2. Identify any outstanding component testing or integration, if applicable.
        ii. Present the flight ready payload chassis as fabricated.
            1. Present the retractable arms and mechanisms.
            2. Present the component integration and unique features.
        iii. Present the flight ready payload deployment approach from the rocket.
            1. Present the unique hardware for deployment.
            2. Present the dedicated electronics system for deployment.
            3. Identify any outstanding component testing or integration, if applicable.
    b. You should include 3D CAD renderings if possible and discuss how the as-built differs from the as-designed.

5. Safety and Procedures
    a. Launch Operations Procedures
        i. Provide detailed procedures and checklists for the following (at a minimum):
            1. Avionics preparation checklist.
            2. Recovery preparation checklist.
            3. Final assembly checklist.
            4. Setup on launch pad checklist.
            5. Troubleshooting checklist.
            6. Post-flight inspection checklist.
        ii. These procedures and checklists should include specially demarcated steps related to safety. Examples include:
            1. Warnings of hazards that can result from missing a step.
            2. PPE required for a step in the procedure (identified BEFORE the step).
            3. Required personnel to complete a step or to witness and sign off verification of a step.
6. Project Plan
    a. Test Plan
        i. Show that all testing (component and functional) is complete and provide test methodology and discussion of results not covered in CDR.
            1. Discuss whether each test was successful or not.
            2. Discuss lessons learned from the tests conducted.
            3. Discuss differences between predicted and actual results of tests.
    b. Requirements Compliance (Mars Challenge ONLY) **
        i. Review and update the verification plan.
            1. Present how each Competition Handbook requirement was verified using testing, analysis, demonstration, or inspection.
    c. Project Budget
        i. Update final budget. Provide an updated line-item budget with market values for individual components, material vendors, and applicable taxes or shipping/handling fees.
        ii. Provide an updated funding plan describing any additional sources of funding.
    d. Project Timeline
        i. Update final schedule. Although the build should be near complete at this stage, include a timeline of any remaining or critical activities between now and Launch Weekend, if applicable.

Launch Weekend Oral Presentation

The Launch Weekend Oral Presentations will be your chance to practice your presentation skills and present the culmination of your work to the panel of judges, the WSGC team and your fellow competitors. Provide the most up-to-date details of your rocket vehicle, payload / challenge, and mission performance predictions.

Your presentation is a summary of your FRR. Your presentation must include the following items at a minimum (please use the Launch Weekend Presentation template from the WSGC website https://spacegrant.carthage.edu/first-nations-launch/rubric/):

1. Present vehicle design, dimensions, materials, motor selection (include any drawings, diagrams, images).
2. Present static stability margin, CP/CG locations, thrust-to-weight ratio, rail exit velocity, time to apogee, and predicted altitude.
3. Present vehicle altimeters, switch / power (include any drawings, diagrams, images).
4. Present vehicle parachute sizes, descent rates, vehicle tracking devices / locations (include any drawings, diagrams, images).
5. Present the final payload / challenge approach (include any drawings, diagrams, images).
    a. Payload electronics summary
    b. Chassis fabrication and integration
    c. Deployment scheme (includes parachute attach and release, if applicable).
6. Present major challenges/lessons learned (can be technical, programmatic etc.).

Note:

1. Your rocket will be on display during the presentation. Please feel free to disassemble or refer to the physical components as they are being discussed.
2. Use the oral presentation template, which consists of 8 slides.
3. You will have 8 minutes to give your presentation to the Judges.
4. Judges will follow with 2-3 minutes of questions prior to finalizing the presentation score.
5. Please practice your presentation, to not exceed allotted time.

Please practice your presentations accordingly. The team is expected to present and defend the as-built launch vehicle (including the payload/challenge), showing that the launch vehicle meets all requirements and mission objectives and that the design can be safely launched and recovered.

The Oral Presentation shall be well prepared. This includes, but is not limited to:

1. Professional overall appearance.
2. Easy to see slides with dark text on a light background (use the templates).
    a. Do not add slides, do not change order of slides.
3. Appropriate placement of pictures, graphs, and videos.
4. Professional appearance of the presenters.
5. Speaking clearly and loudly.
6. Looking into the camera.
7. Referring to the slides, not reading them.
8. Communicating to the panel in an appropriate and professional manner.

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.

Post Launch Assessment Report

Page Limit: PLARs will only be scored using the first 25 pages of the report (not including title page or Appendixes). Any additional content will not be considered while scoring.

1. Team Summary
    a. Team name.
    b. School name.
    c. Name of team advisor and co-advisor (as applicable).
    d. Name of student team lead and student safety lead.
    e. Name of mentor, NAR/TRA number and certification level.
    f. Names and roles of team members.
2. Summary of PLAR report (1 page maximum)
    a. Launch Vehicle Summary
        i. Launch day vehicle size and mass, and launch day motor.
    b. Payload / Challenge Summary
        i. Summarize your payload.
3. Vehicle Criteria
    a. Vehicle Summary
        i. Discuss the overall vehicle performance.
        ii. Did all components (structure, recovery, altimeters, tracking etc.) perform as expected?
        iii. Were there any anomalies or unexpected behavior? If so, can they be explained?
    b. Data Analysis and Mission Performance
        i. Discuss the flight performance data.
            1. Compare predicted versus actual performance (speed, altitude, acceleration, stability, drift, etc.).
            2. Show and discuss plots of the flight data; compare them to simulation data.
4. Payload / Challenge Criteria
    a. Payload / Challenge Summary
        i. Discuss the overall payload performance.
        ii. Did all components (structure, recovery, altimeters, tracking etc.) perform as expected?
        iii. Were there any anomalies or unexpected behavior? If so, can they be explained?
5. Project Outcomes
    a. Lessons Learned
        i. Summarize lessons learned over the program (technical and/or project management).
    b. STEM Engagement
        i. Summarize any STEM Engagement that occurred in the community and outcomes.
    c. Overall Budget Summary
        i. Summarize the project budget summary – contrast predicted versus actual.

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

	Certification Required			
Motor Parameter	None	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 2024 Motor Choices

For the 2024 First Nations Launch Challenge, the motor selections are constrained to:

Gateway Challenge Motors

Kit	Manufacturer	Size	Type	Motor
YANK Iris	Aerotech	38mm	DMS	I280, I500T
EZI 65	Aerotech	38mm	DMS	I140W, I175WS
Mystic Buzz	Aerotech	38mm	RMS	I366R, I435T

Moon Challenge Motors

Manufacturer	Size	Type	Motor
Aerotech	54mm	DMS	K535W
Aerotech	54mm	RMS	K1100T, K1103X
Aerotech	38mm	DMS	J425R,
Aerotech	38mm	RMS	J500G

Mars Challenge Motors

Manufacturer	Size	Type	Motor (Thrust)
Aerotech	54mm	RMS	K695R (156 LBS), K1100BT (247 LBS), K1103X (247LBS)
Aerotech	54mm	DMS	J425R (93 LBS), I500T (112 LBS), K535W (120 LBS)

Important Notes about Motors:

1. Final motor selection is due at CDR submission. 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.

11/20/23 Motor Additions: K1100T and K1103X in Moon and K1103X in Mars
Motor Update: J500G as RMS type (Moon)

APPENDIX A-2 – First Nations Launch 2024 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 2024 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 12, 2023 - November 11, 2023, March 10, 2024 - November 3, 2024)
Central Standard Time (November 12, 2023 - March 09, 2024)

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 2024 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 Challenge Levels

***New in FNL24:

Gateway teams will receive status updates based on their success of meeting competition milestones. These updates will be denoted as Gold, Silver, or Bronze levels.

Full criteria for meeting each performance level is being refined and will be released at the time of Gateway Kick-off.

APPENDIX A-5 – First Nations Launch Competition Kits

Gateway Challenge

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

1. Loc Precision YANK Iris – 4” diameter.
    a. https://locprecision.com/collections/rockets-4-00-diameter/products/yiris4
        i. SKU: YIRIS4
    b. When ordering, remember to include the following additional components:
        i. E-bay module
        ii. 38mm motor adapter
    c. RockSim file is available on their website
    d. Motor options:
        i. Aerotech 38mm I280 DMS
        ii. Aerotech 38mm I500T DMS

2. Loc Precision - 4” diameter “EZI 65”
    a. https://locprecision.com/collections/rockets-4-00-diameter/products/ezi-65
        i. SKU: PK-64
    b. When ordering, remember to include the following additional components:
        i. E-bay module
        ii. 38mm motor adapter
    c. RockSim file is available from the manufacturer
    d. Motor options:
        i. Aerotech 38mm I40W DMS
        ii. Aerotech 38mm I175WS DMS

3. Loc Precision - 4” diameter “Mystic Buzz”
    a. https://locprecision.com/collections/rockets-4-00-diameter/products/ybuzz4
        i. SKU: YBUZZ4
    b. When ordering, remember to include the following additional components:
        i. E-bay module
        ii. 38mm motor adapter
    c. RockSim file is available from the manufacturer
    d. Motor options:
        i. Aerotech 38mm I435T RMS
        ii. Aerotech 38mm I366R RMS

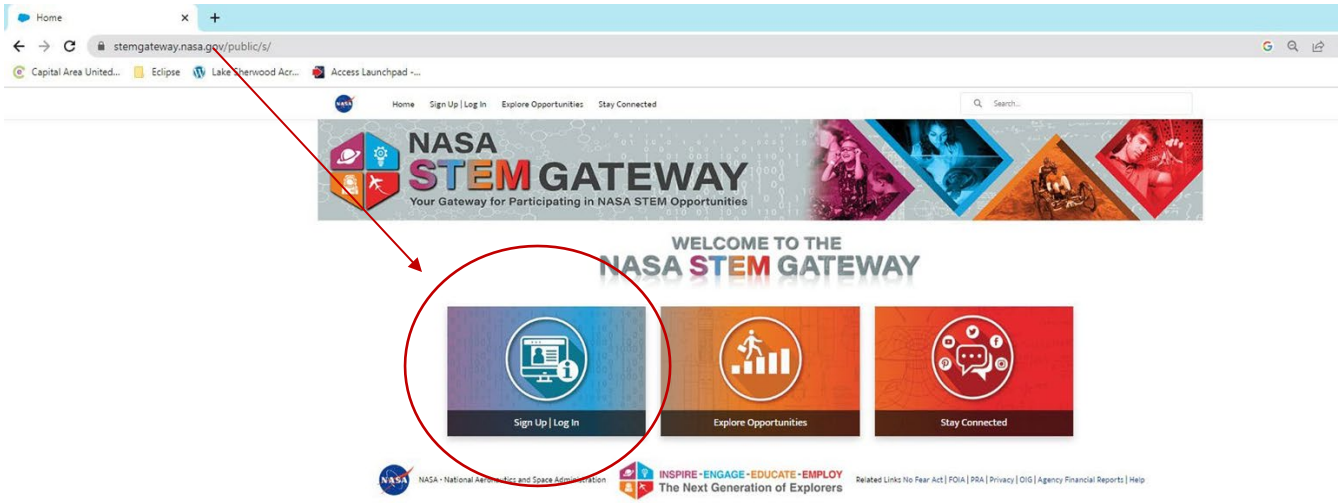
Some hardware/component variance may be present between kit/hardware vendors and may include/exclude features including avionics bays, sleds, shock cord, and parachutes. There are some general hardware items that teams may need to also consider that could include items such as: quick links, swivel eyes,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

APPENDIX B-1 - NASA Gateway

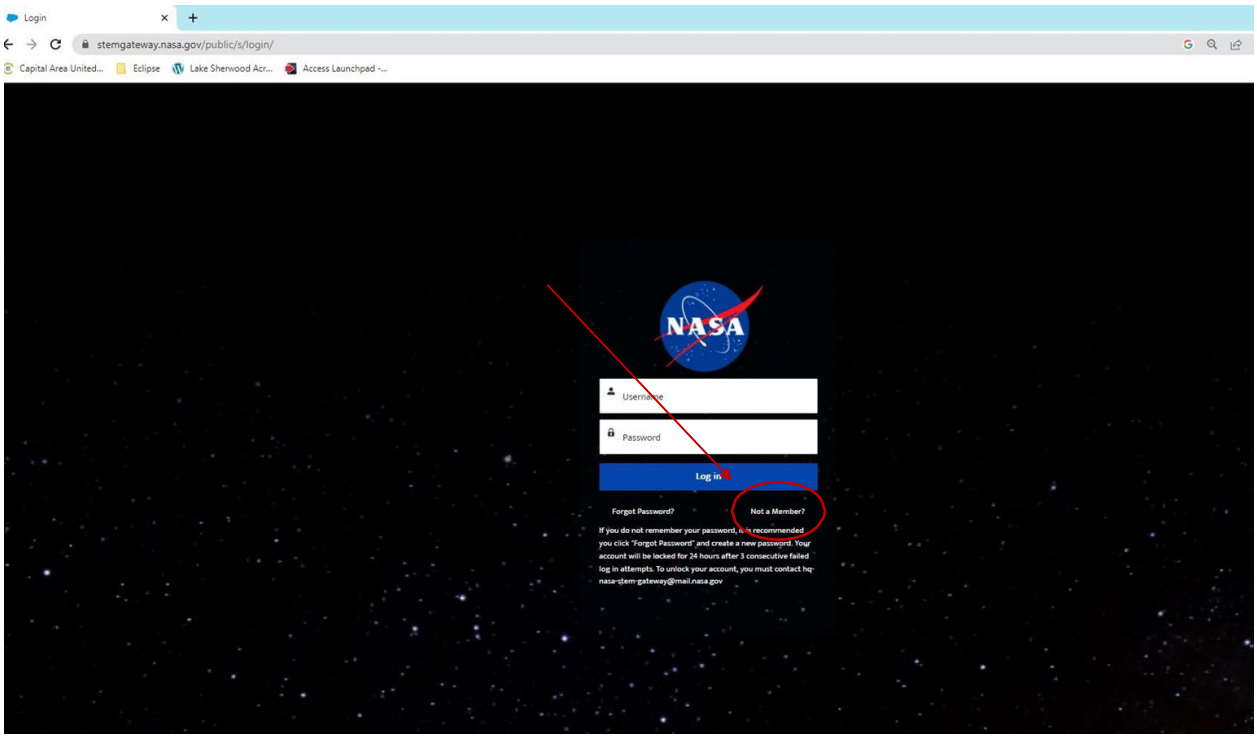
All participants (advisors, co-advisors, and students) are required to create profiles within the NASA STEM Gateway system. Applicants will be asked to submit the email address used to register on the NASA STEM Gateway site when registering on the WSGC registration site.

Step 1
Navigate to: https://stemgateway.nasa.gov/public/s

Step 2
Select "Sign Up/Log In"

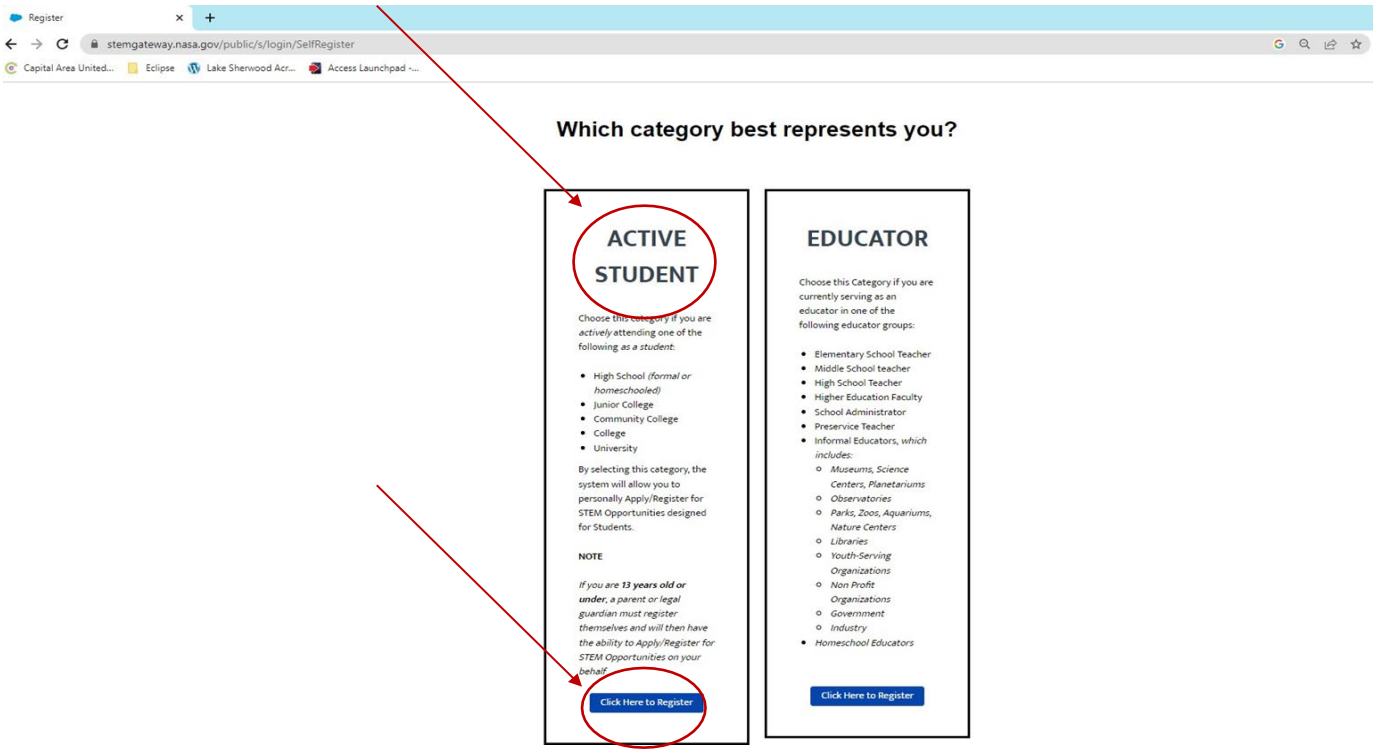


Step 3
Sign In or if this is your first time creating a profile, click on "Not a Member"



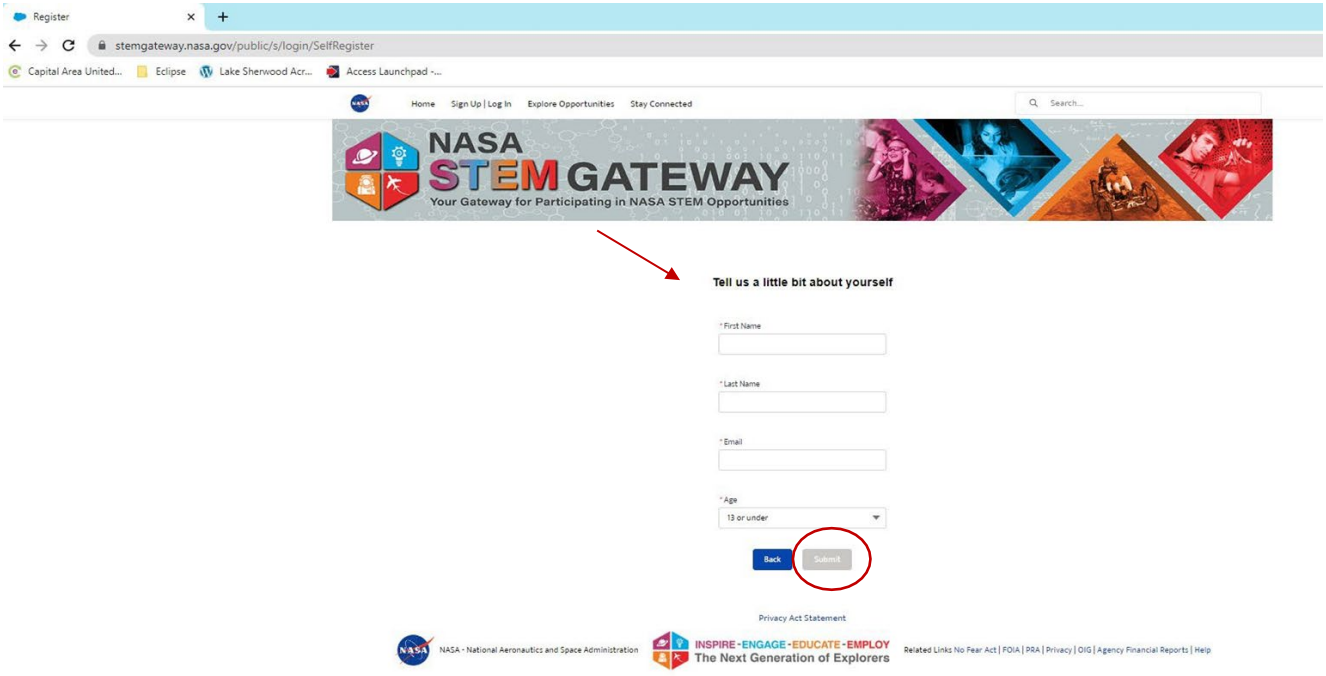
Step 4

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)



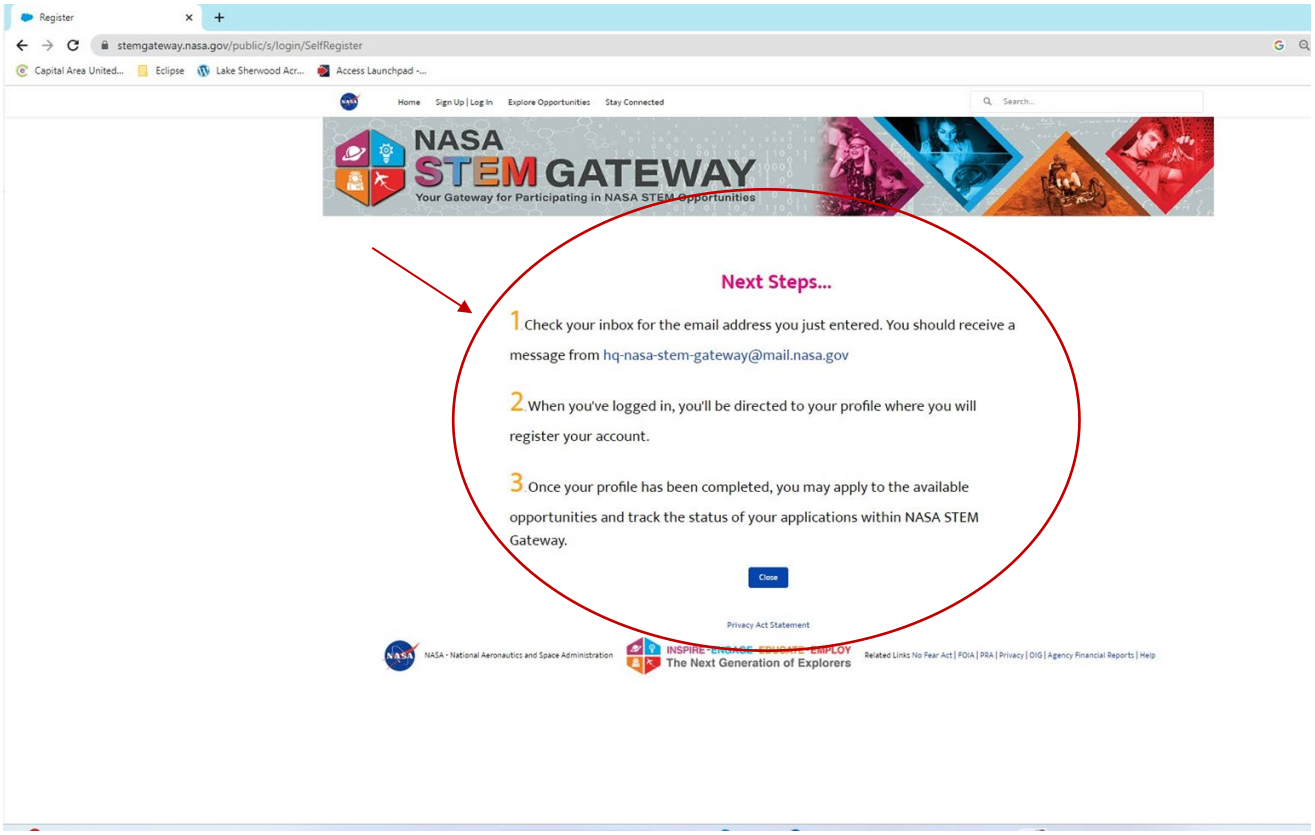
Step 5

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.

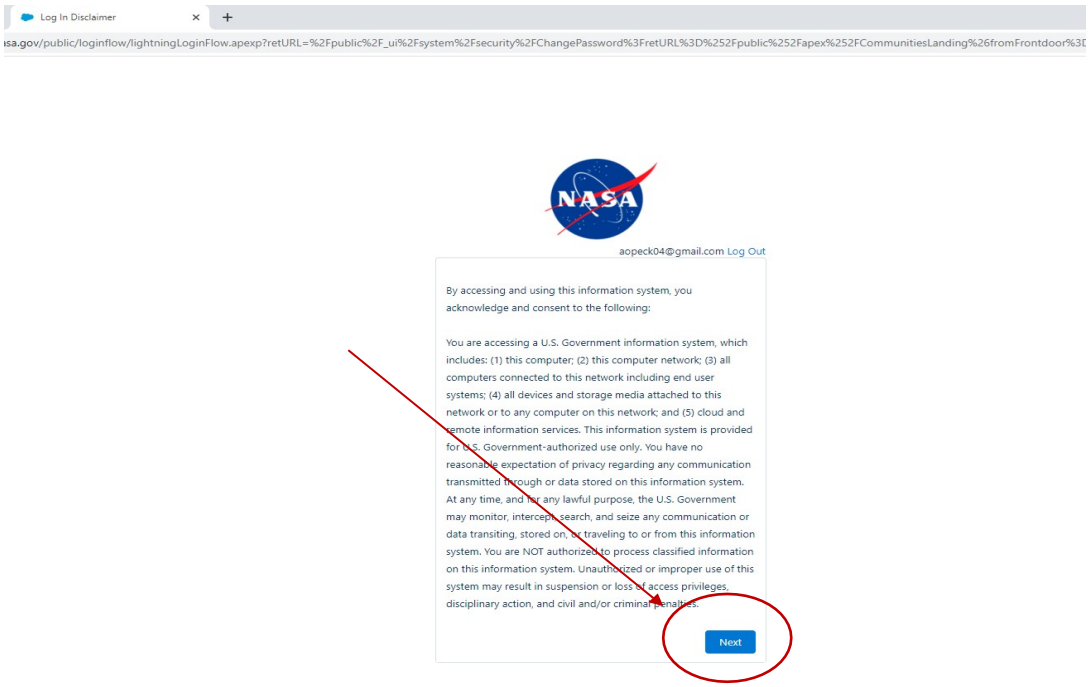


Step 7

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.

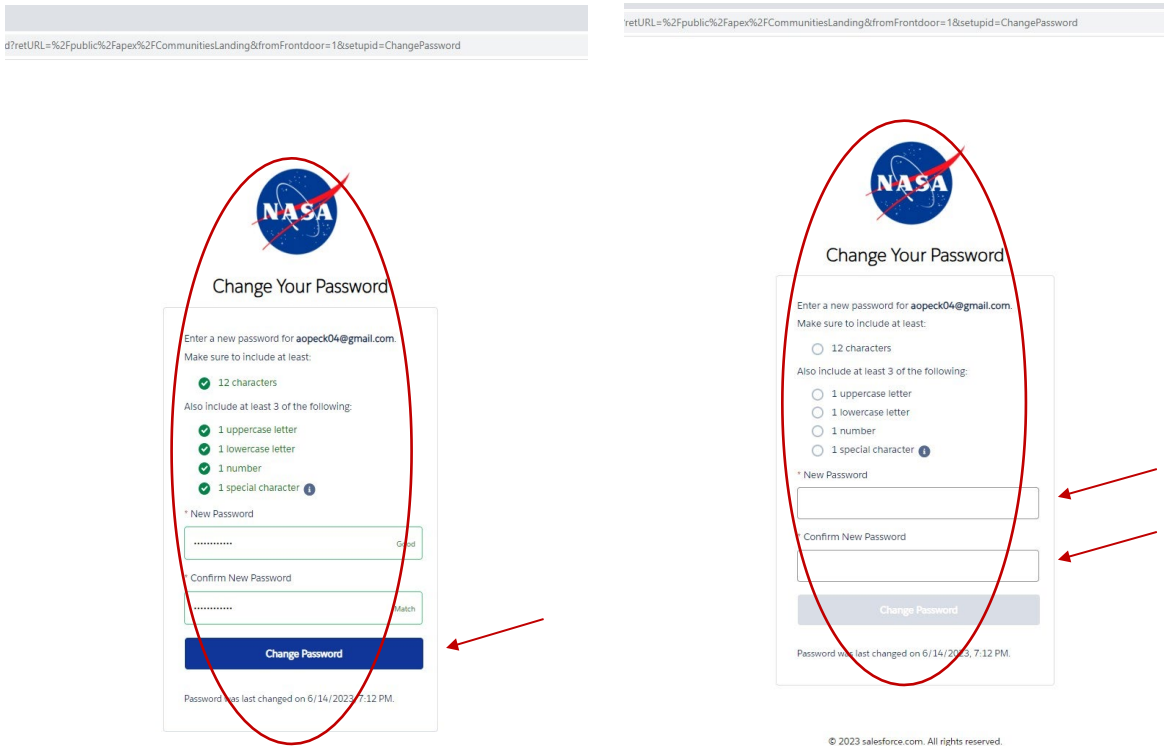
Step 8

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.”



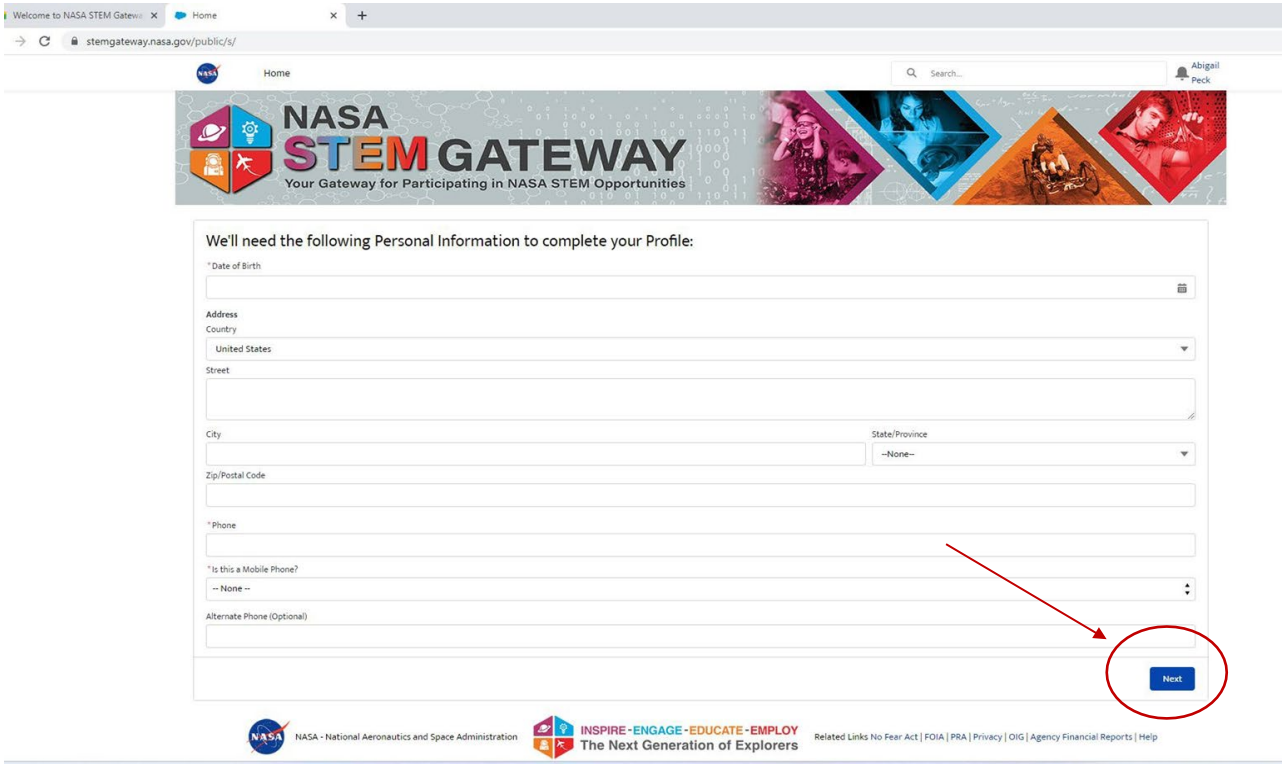
Step 9

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.



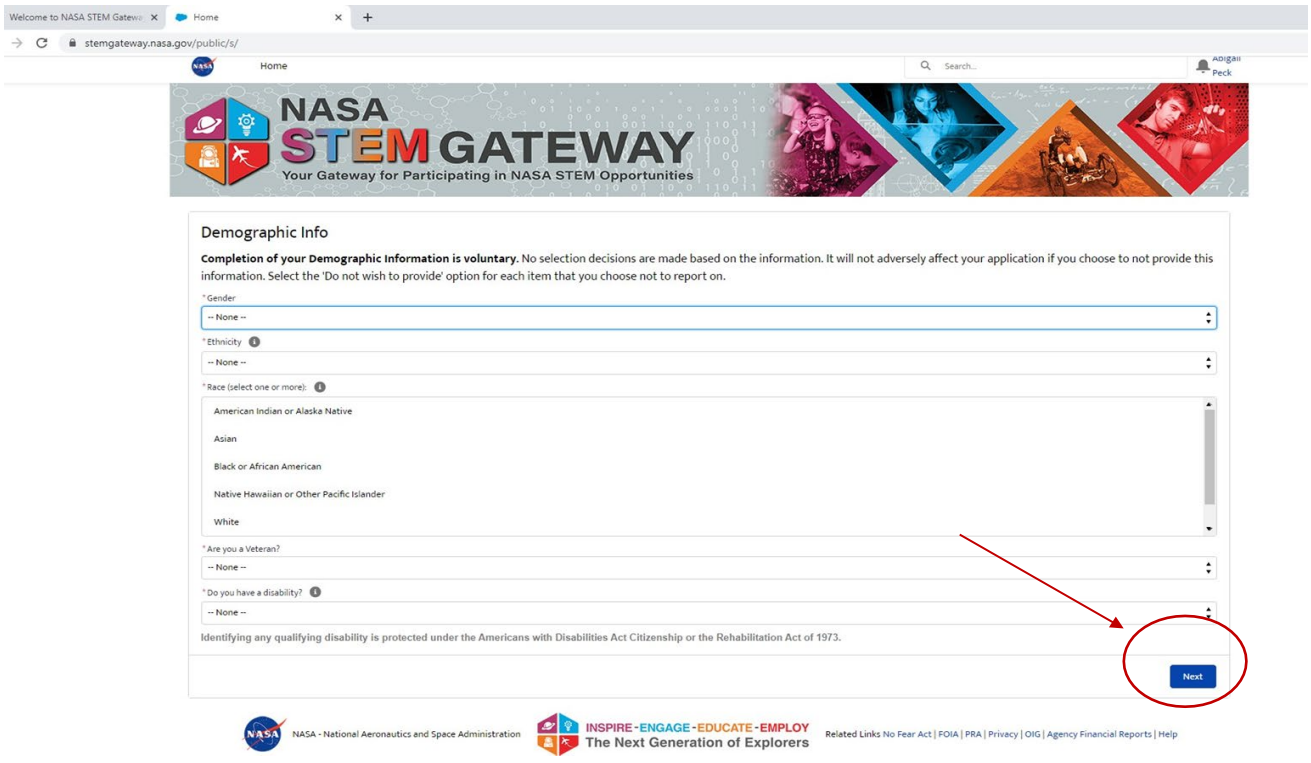
Step 10

Fill out your personal information and click “Next”



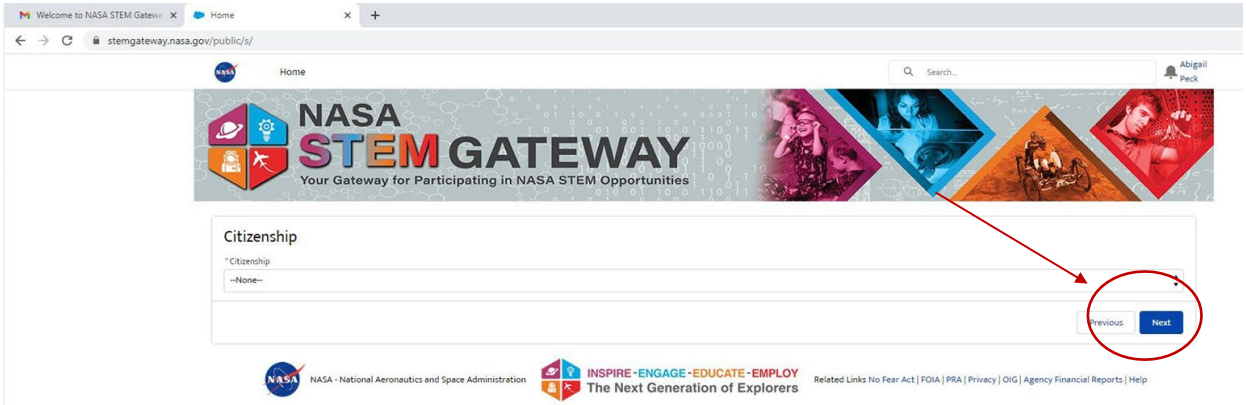
Step 11

Fill out your demographic information and click “Next”



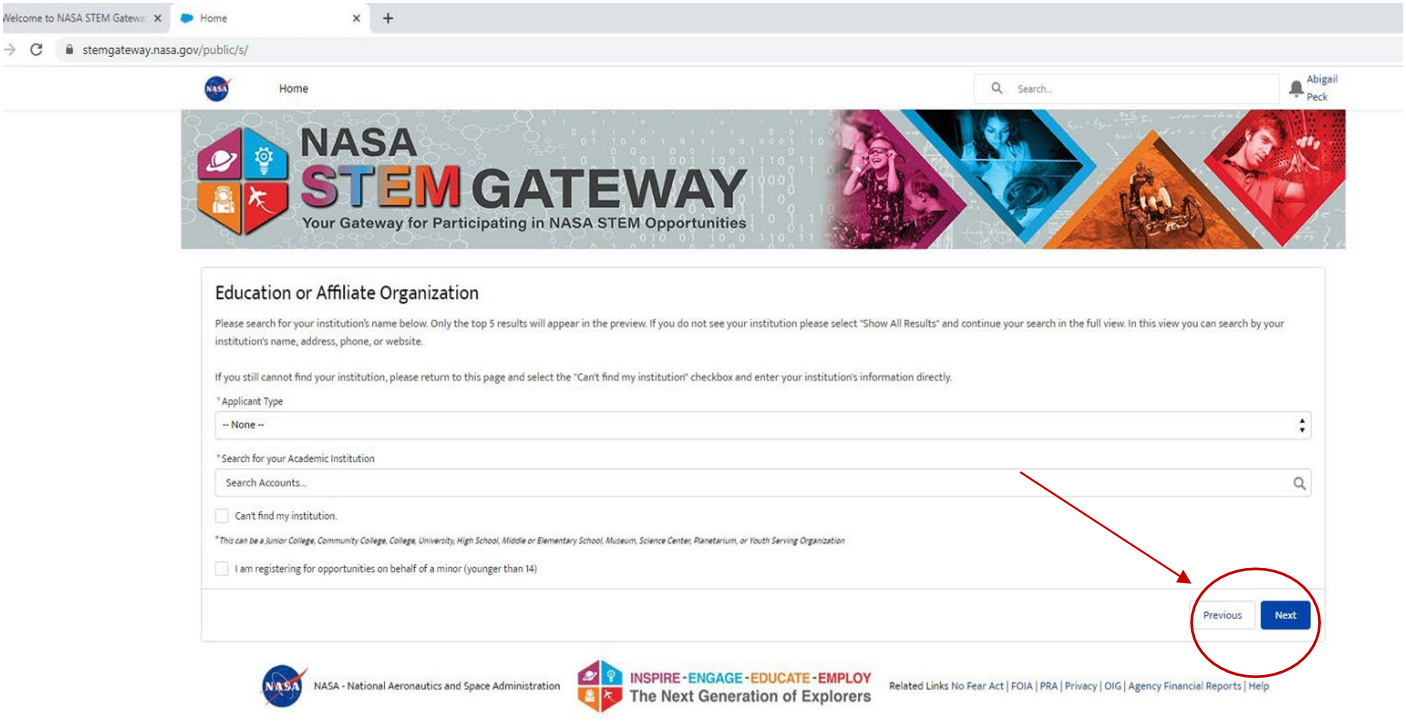
Step 12

Fill out your Citizenship information and click “Next”



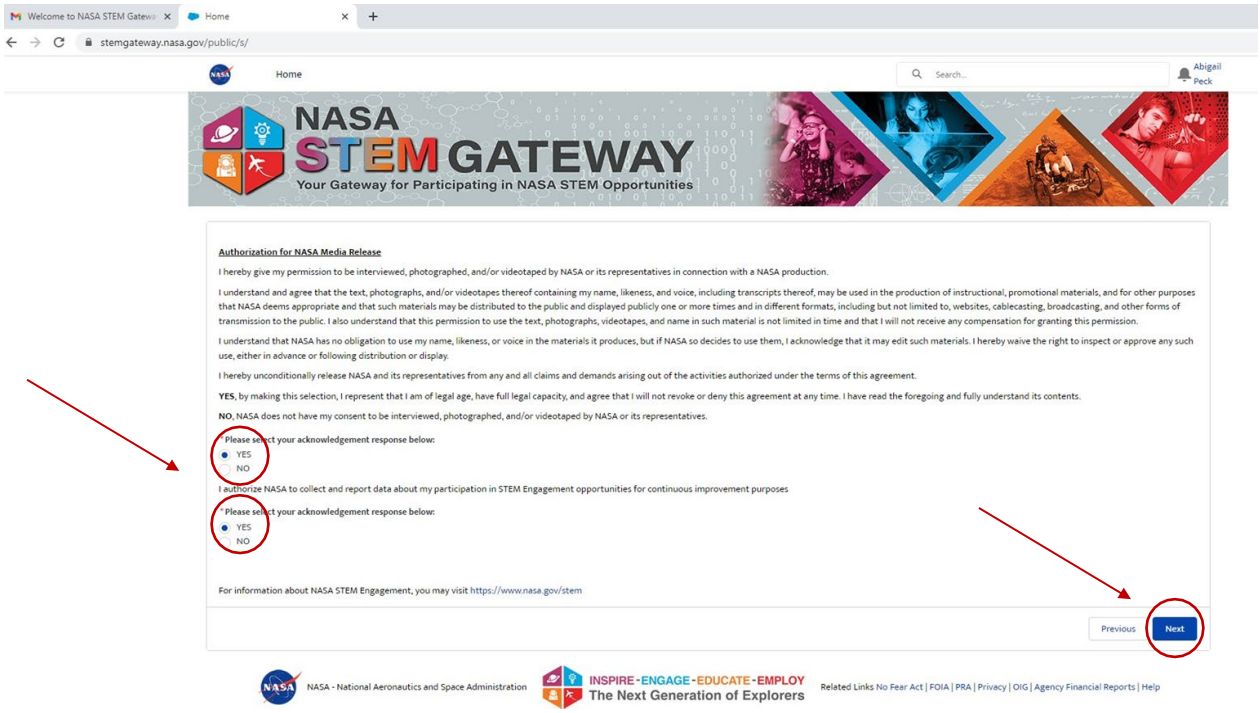
Step 13

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”



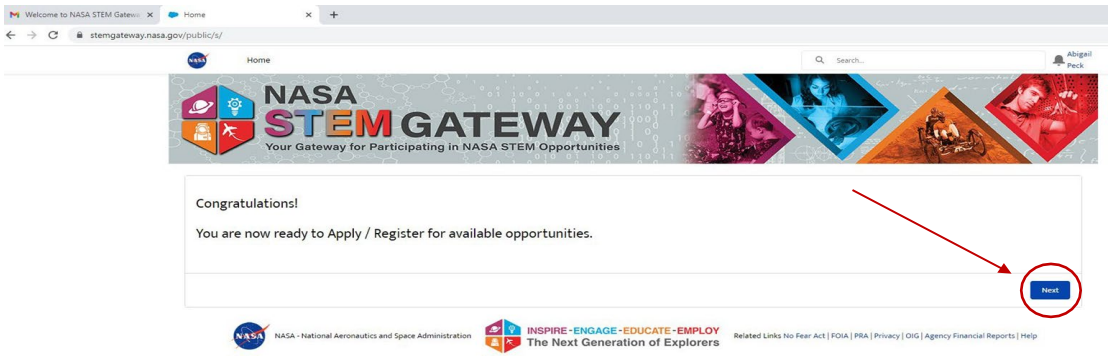
Step 14

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



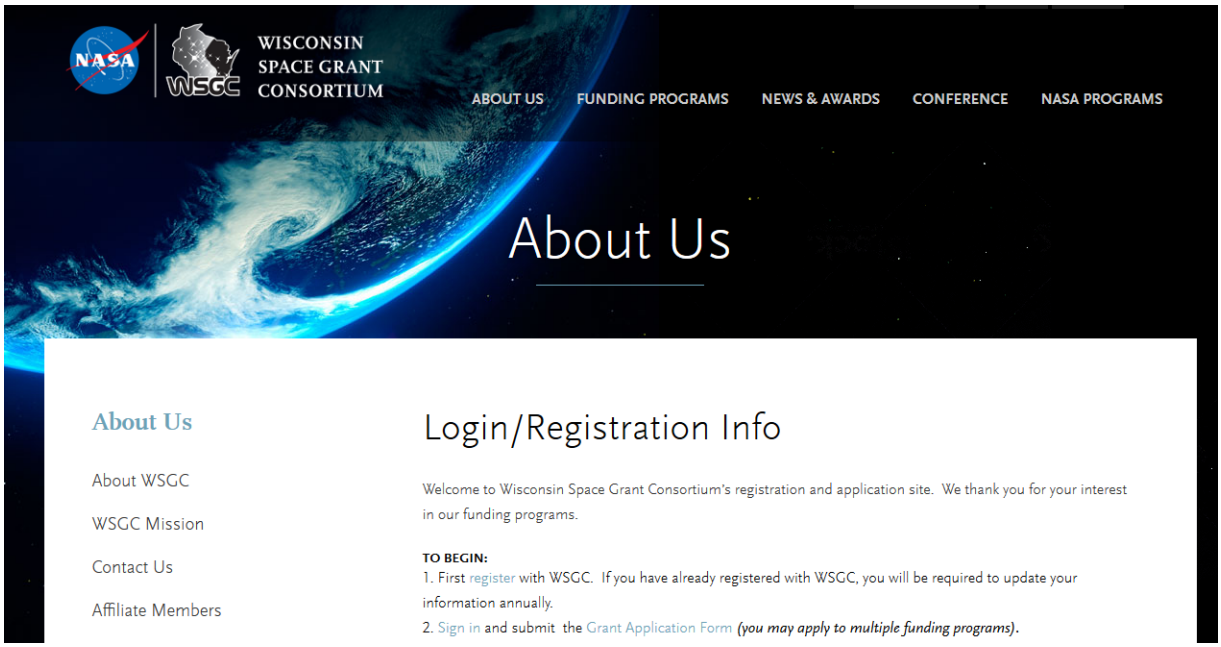
Step 15

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.

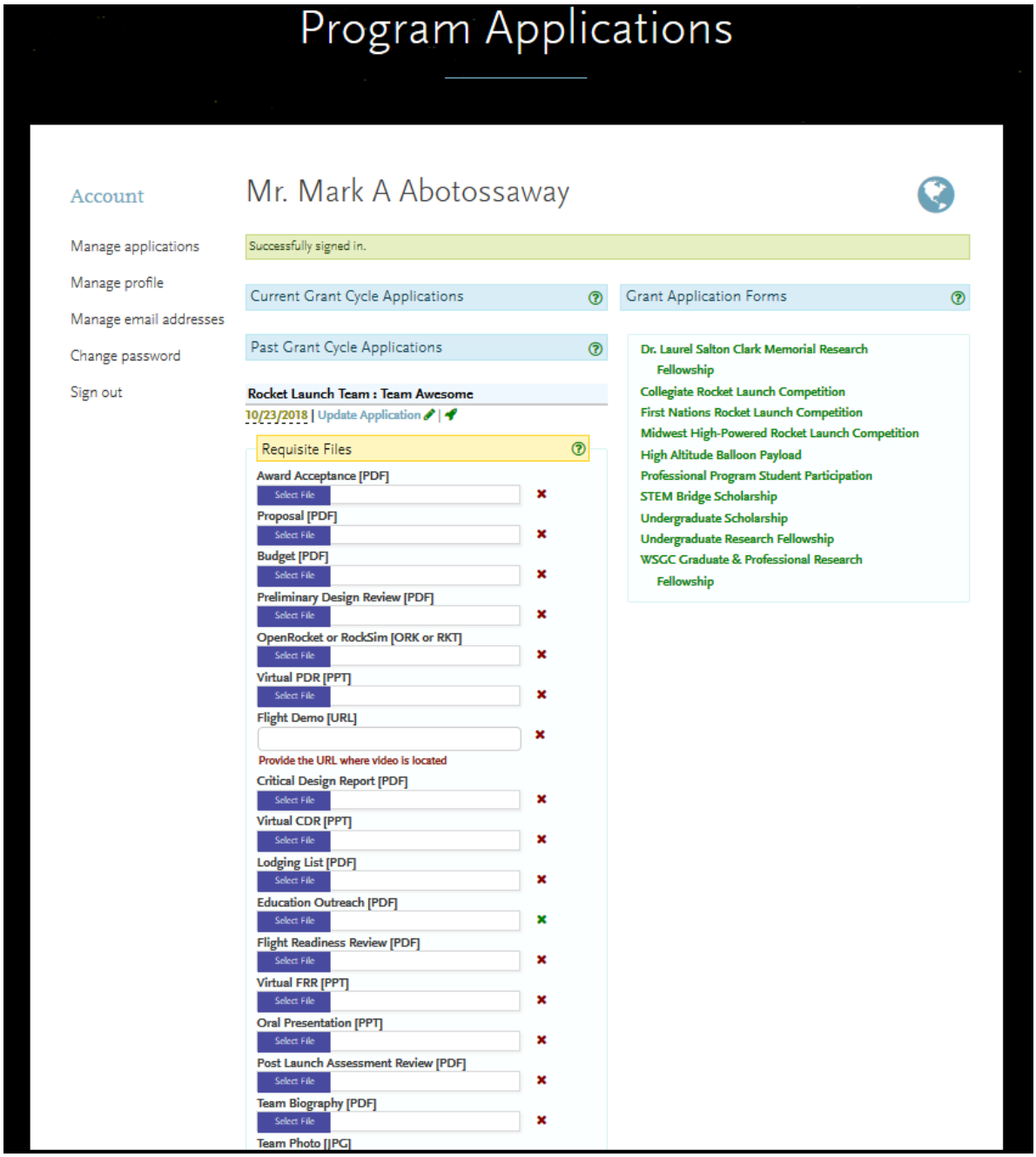
STEP 4: Under Grant Application Forms, select the appropriate program (Collegiate Rocket Launch Competition *or* First Nations Rocket Launch Competition). The following information/documents will be submitted during this step:

- 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

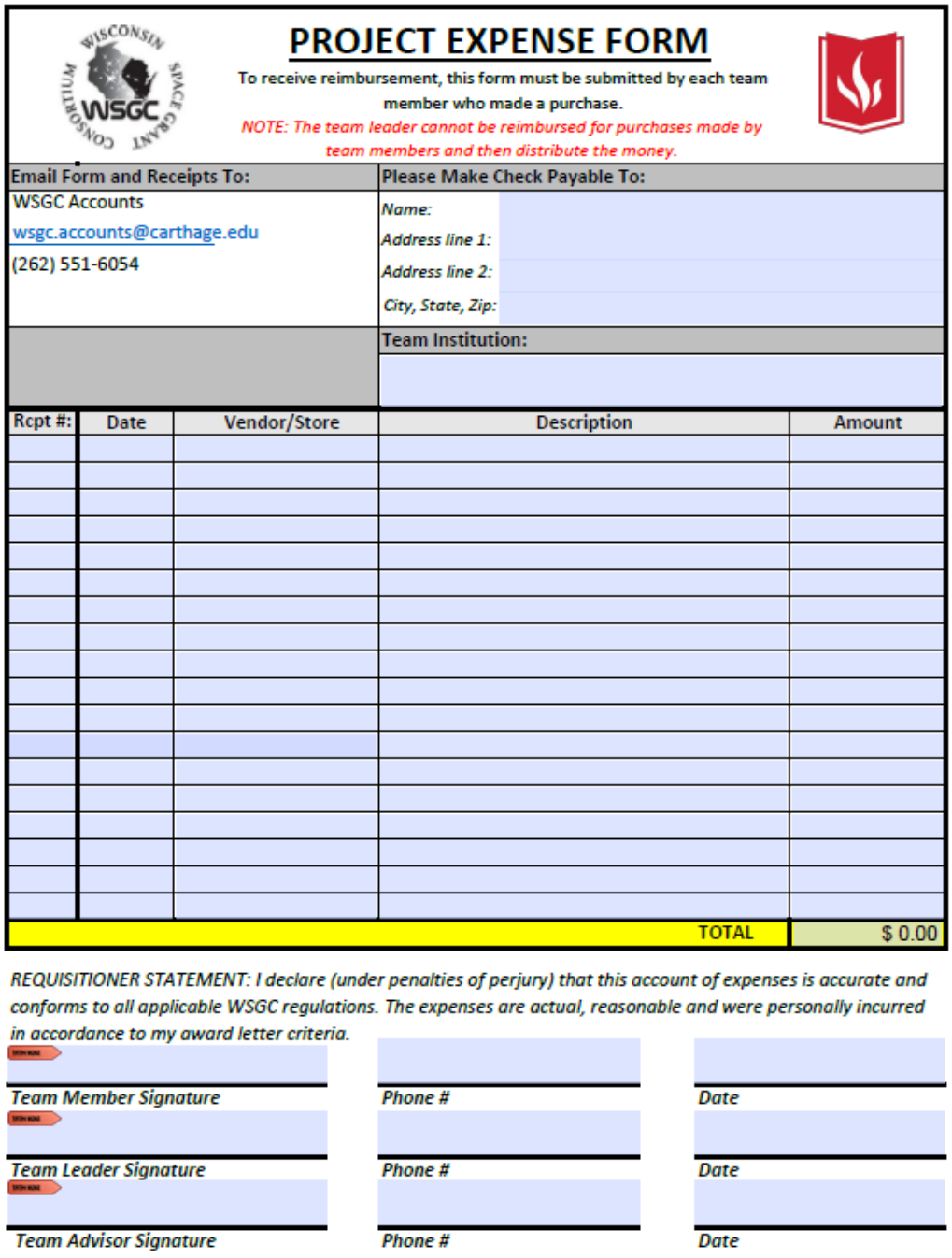
****In emails, please include in the subject line: *FNL24_{{School Name}}_Reimbursement*****

Do Not Submit:

1. Partially completed forms.
2. Forms without all required signatures.
3. Forms past due date(s).
4. "Flat" per diem 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*

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

Revised 01/2023

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***	(123) 456-7890 *Phone #*	04/22/22 *Date*
Susan Smith ***Team Leader Signature***	(234) 567-8901 *Phone #*	04/22/22 *Date*
John Doe ***Team Advisor Signature***	(345) 678-9012 *Phone #*	04/22/22 *Date*

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

Revised 01/2023

1.

LOWE'S

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

- SALE -
SALES#: FSTLANE1 13 TRANS#: 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: XXXXXXXXXXXX' 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

4/22/22

2.

L&M FLEET SUPPLY

"Quality at a Discount"

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:
INVOICE #:
DCBD8992-BE6B-4671-8E87-BE0699311148
9756KA 2.93.6199 TILL ID: 02

4/22/22

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.

adafruit

150 VARICK ST #3, NEW YORK, NY 10013

FOR SUPPORT: http://www.adafruit.com/support

2797183-5785585445

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

https://www.adafruit.com/invoice.php?order_id=2797183 1/1

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: *FNL24_{{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***

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

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 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

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.

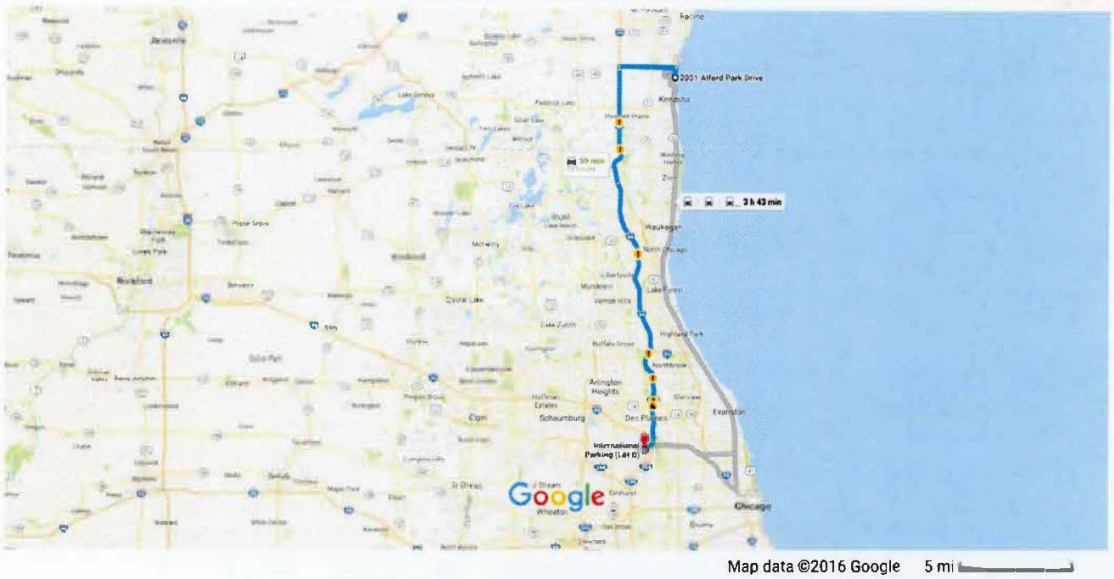
Jane Doe ***Team Member Signature***	(123) 456-7890 ***Phone #***	03/20/22 ***Date***
Susan Smith ***Team Leader Signature***	(234) 567-8901 ***Phone #***	03/20/22 ***Date***
John Doe ***Team Advisor Signature***	(345) 678-9012 ***Phone #***	03/20/22 ***Date***

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

Revised 01/2023

2001 Alford Park Dr, Kenosha, WI 53140 to I ...4ir/2001+Alford+Park+Dr,+Kenosha,...

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



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

via I-94 E
57 min without traffic
This route has tolls.

57.6 x 2 = 115.2
Rounded= 115 x $0.655 = $75.33

59 min
57.6 miles

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

Net: 33.01
Tax 9.250% 3.04
Fee: 36.05

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

THANK YOU

Receipt 6- Fri

3/20/22

HYATT PLACE™

Hyatt Place Nashville Opryland
220 Rudy's Circle
Nashville, TN 37214
Tel: 615-872-0422
Fax: 615-872-9283
nashvilleopryland.place.hyatt.com

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
Folio No. 151068

Confirmation No. 3445305101
Group Name

Date	Description		Charges	Credits
03-16-22	Guest Room		236.55	
03-16-22	State Tax		21.88	
03-16-22	Occupancy Tax		14.19	
03-16-22	City Arena Fee		2.50	275.12
03-17-22	Guest Room		236.55	
03-17-22	State Tax		21.88	
03-17-22	Occupancy Tax		14.19	
03-17-22	City Arena Fee		2.50	275.12
03-18-22	Guest Room		246.55	
03-18-22	State Tax		22.81	
03-18-22	Occupancy Tax		14.79	
03-18-22	City Arena Fee		2.50	286.65
03-19-22	Guest Room		246.55	
03-19-22	State Tax		22.81	
03-19-22	Occupancy Tax		14.79	
03-19-22	City Arena Fee		2.50	286.65
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 XXXXXXXXXXXX6927 XX/XX		-147.34

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.

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

World of Hyatt Summary

Membership: XXXXXX863D
Bonus Codes:
Qualifying Nights: 4

***FREE OFFER ON BAC ***
Wendy's Restaurant #0 13257
Interstate 57/Rou
Marion IL 629
(618) 969-8280

Host: Kimberly
CCHRISTINE

03/20/2022
10:00 AM
10033

Order Type: DINE IN

RK COMBO 5.59
SauEggSws Crsnt
American Cheese
Breakfast Cheese Sauce
SM Seasoned Potatoes
Orange Juice 0.70

Items 3 6.29
Tax 0.46

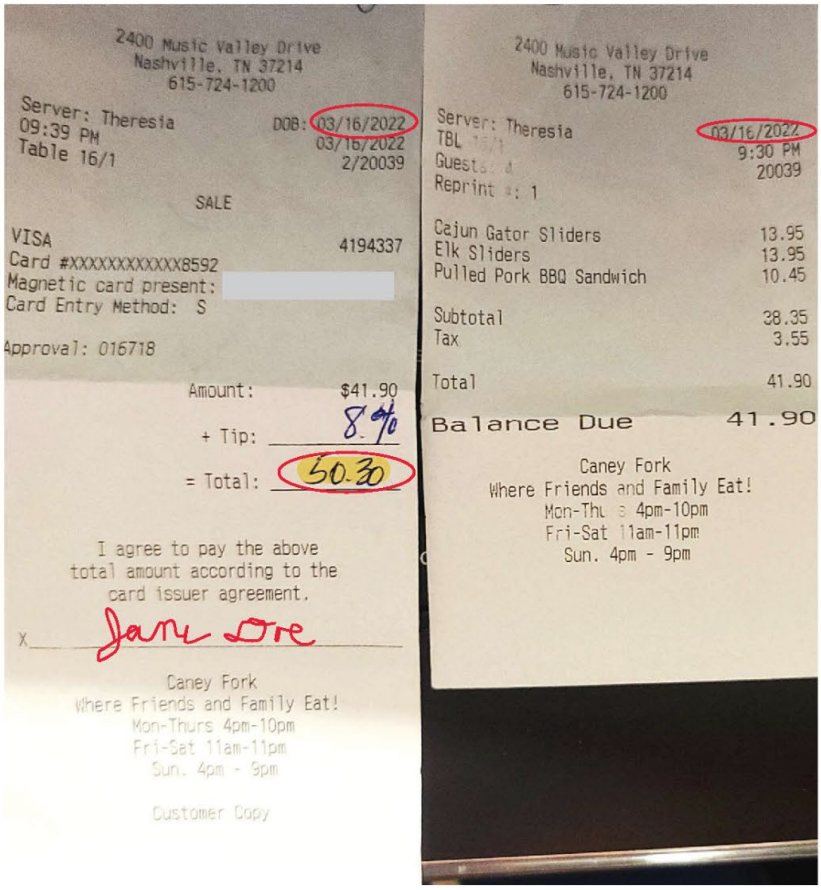
N Total .75

Visa #XXXX XXXX8592 $6.75
Auth:020146
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 Details

Receipt 9- Sun

3/20/22



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

Server: Theresia
09:39 PM
Table 16/1

DOB: 03/16/2022
03/16/2022
2/20039

SALE

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

Approval: 016718

Amount: $41.90
+ Tip: 8.40
= 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
TBL 16/1
Guests: 4
Reprint #: 1

03/16/2022
9:30 PM
20039

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

DO 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 registered on the WSGC website and applied for the FNL Competition.

Submit any changes 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:
Tools and Tips | First Nations Launch | Carthage College Form Needs Update on website

APPENDIX B-7 - Team Bio Form

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?	

For questions about First Nations Launch or this form, contact spacegrant@carthage.edu.

APPENDIX C-1 – Project Planning Guidance

Team Structure

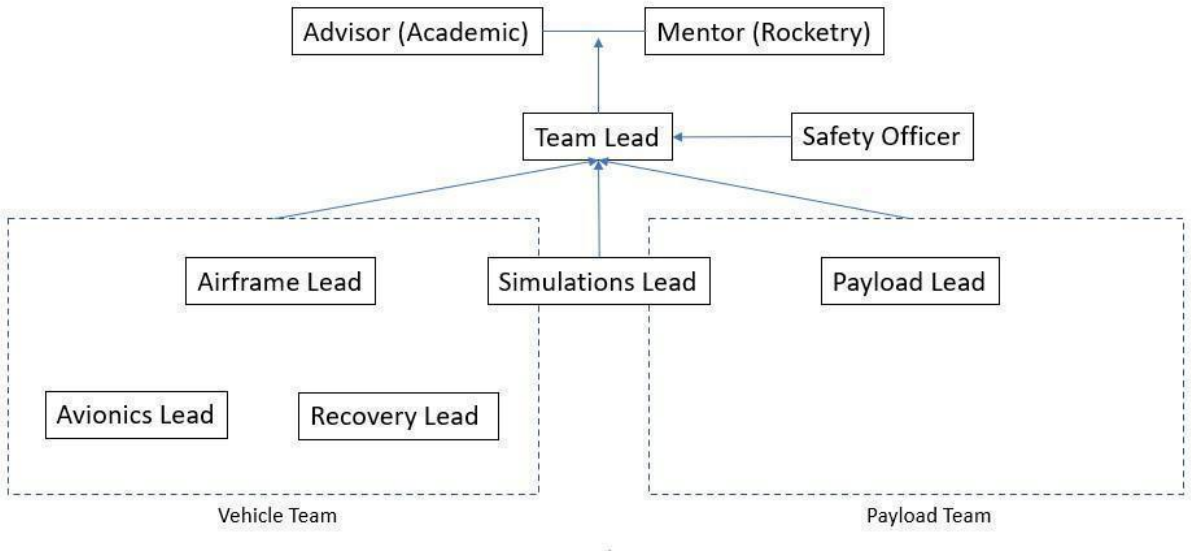


Figure C.1 GANTT Chart- Recommended team structure.

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

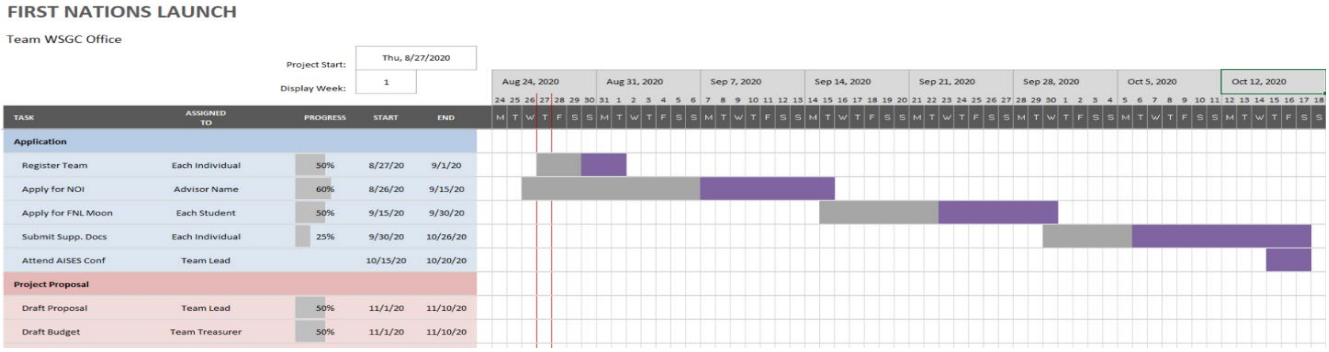
At each milestone, you will update your schedule as needed. You may find or eventually see a 'critical path' – an item or task that is critical to complete on time, so as not to jeopardize the success of your build and flight.

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.



APPENDIX C-2 – Testing Plan Overview

Mars Challenge Teams

At each phase of this project, 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-23	-
	Shear test	To verify the shear strength of the structure	Nov-23	-
Altimeter	Pressure test	To verify the pressure sensor operates correctly.	Dec-23	-
	Accelerometer test	To verify the accelerometer operates correctly.	Dec-23	-
Recovery	Ejection test	To verify the amount of energetic needed for satisfactory ejection.	Jan-24	-
	Tracking test	To verify the GPS tracking system functions properly, and determine limitations.	Jan-24	-

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). Example safety checklists can be found on the Tools & Tips page https://spacegrant.carthage.edu/live/files/5419-fnl21safety-checklistsxlsx.

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.

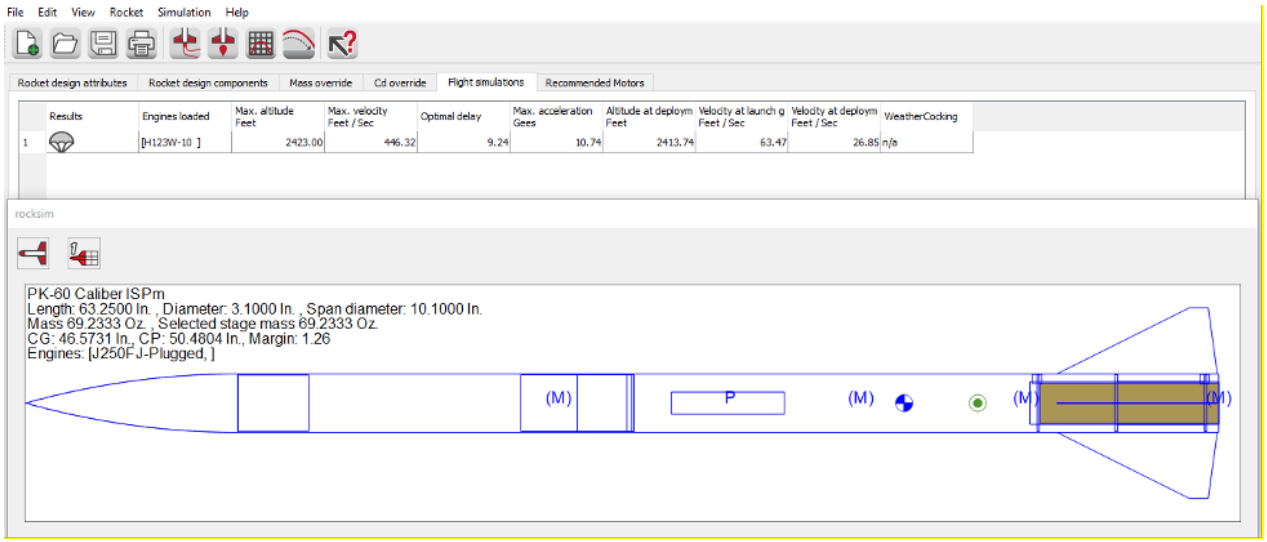


Figure 1 – Image of RockSim user interface.

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

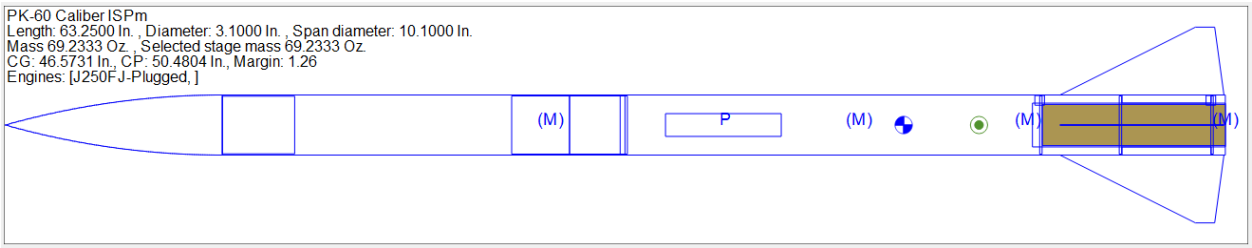


Figure 2 – Image of RockSim user interface, showing rocket inset.

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).

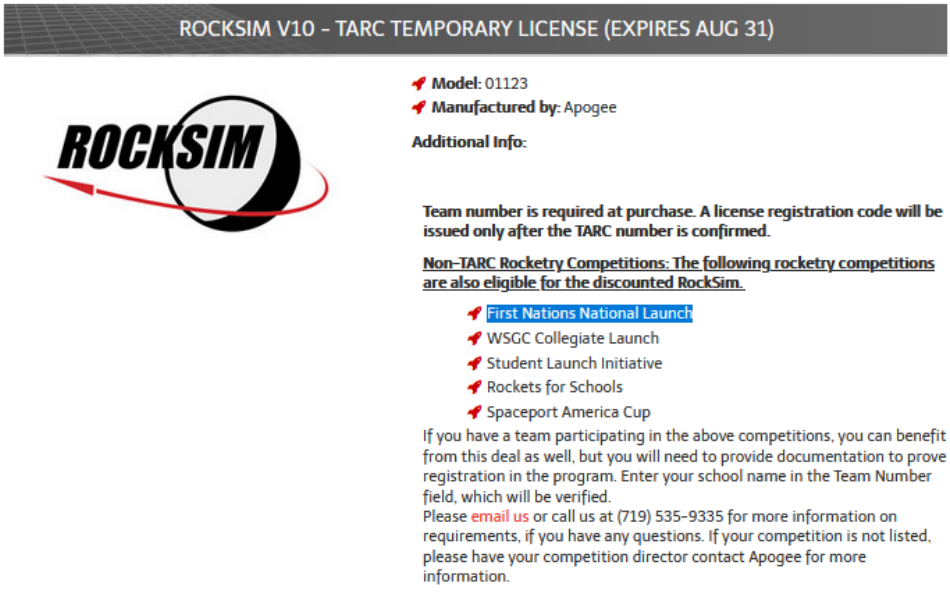


Figure 3 – RockSim TARC Temporary (Discounted) License

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).

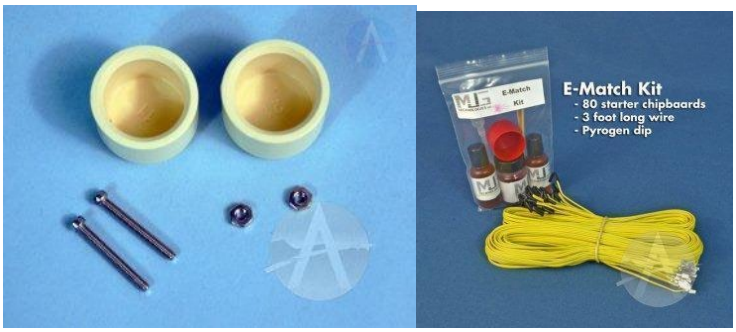


Figure D.4.3 PVC Ejection Canister (left) and E-match kit (right).

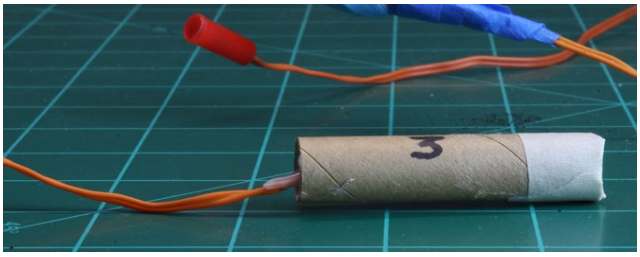


Figure D.4.4 Ejection canister (3 gram load) with e-match installed.

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 (‘**Appendix D-6’)**, 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 - FAA Drone Pilot Certification

As the Mars Challenge is incorporating drones into the challenge parameters this year, an additional requirement is on the advisor or nominated team member to secure FAA Drone Pilot Certification: https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot

The steps outlining a First Time Drone Pilot are below, but the above FAA link will always contain the most up to date information regarding the full process and requirements.

To become a pilot you must:

- Be at least 16 years old
- Be able to read, speak, write, and understand English
- Be in a physical and mental condition to safely fly a drone
- Pass the initial aeronautical knowledge exam: "Unmanned Aircraft General – Small (UAG)"

Requirements for Remote Pilot Certificate:

- Must be easily accessible by the remote pilot during all UAS operations
- Certificate holders must complete an online recurrent training every 24 calendar months to maintain aeronautical knowledge recency

Navigating the Process to Become a Drone Pilot:

Step 1: Obtain an FAA Tracking Number (FTN) by creating an Integrated Airman Certification and Rating Application (IACRA) profile prior to registering for a knowledge test.

Step 2: Schedule an appointment with a FAA-approved Knowledge Testing Center. Be sure to bring a government-issued photo ID to your test.

Step 3: Pass the initial aeronautical knowledge test: "Unmanned Aircraft General – Small (UAG)". Knowledge test topic areas include:

- Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
- Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation
- Aviation weather sources and effects of weather on small unmanned aircraft performance
- Small unmanned aircraft loading and performance
- Emergency procedures
- Crew resource management
- Radio communication procedures
- Determining the performance of small unmanned aircraft
- Physiological effects of drugs and alcohol
- Aeronautical decision-making and judgment
- Airport operations
- Maintenance and preflight inspection procedures
- Operation at night

Step 4: Complete FAA Form 8710-13 for a remote pilot certificate (FAA Airman Certificate and/or Rating Application) using the electronic FAA Integrated Airman Certificate and/or Rating Application system (IACRA)

1. Login with username and password
2. Click on "Start New Application" and 1) Application Type "Pilot", 2) Certifications "Remote Pilot", 3) Other Path Information, 4) Start Application
3. Follow application prompts
4. When prompted, enter the 17-digit Knowledge Test Exam ID (Note: it may take up to 48 hours from the test date for the knowledge test to appear in IACRA)
5. Sign the application electronically and submit for processing.

Step 5: A confirmation email will be sent when an applicant has completed the TSA security background check. This email will provide instructions for printing a copy of the temporary remote pilot certificate from IACRA.

Step 6: A permanent remote pilot certificate will be sent via mail once all other FAA-internal processing is complete.

Step 7: Have your Remote Pilot Certificate available whenever you fly your UAS.

You can read the Remote Pilot –Small Unmanned Aircraft Systems Airman Certification Standards (PDF).

APPENDIX E-2 - The Recreational UAS Safety Test (TRUST)

All Mars team members must attain FAA TRUST Certification. This is a free certification that all FNL participants may attain.

What is TRUST?

The law requires that all recreational flyers pass an aeronautical knowledge and safety test and provide proof of passage if asked by law enforcement or FAA personnel. The Recreational UAS Safety Test (TRUST) was developed to meet this requirement.

TRUST provides education and testing on important safety and regulatory information. If you fly your drone recreationally under the **Exception for Recreational Flyers**, you must pass the test before you fly.

TRUST was developed in collaboration with drone stakeholders to determine content, and how it would be administered. Since June 2021, we have worked with a group of **approved Test Administrators** to provide TRUST as an online test. We in the FAA provide the TRUST content to the approved test administrators who, in turn, provide the online test to you, the recreational flyer.

Before you fly your drone

Note: If your drone weighs more than .55 pounds (lbs.), you must register your drone through the **FAA's Drone Zone**.

To fly your drone as a recreational flyer, it's as easy as 1-2-3

1. Understand recreational flying requirements
    - Visit the Recreational Flyers page to **learn about rules for recreational flyers**.
    - Download the FAA's **B4UFLY mobile app** for more recreational drone flying resources.
2. Take TRUST
    - You may take the free online test through any of the FAA approved test administrators.
    - All FAA-approved TRUST test administrators offer the test free.
    - All test questions are correctable to 100% prior to issuing your completion certificate.
    - After completing TRUST, you'll need to download, save or print your completion certificate.
    - If you lose your certificate, you will need to re-take TRUST.
    - View a list of **TRUST Test Administrators**
3. Receive your certificate
    - After you pass the test, you will receive a certificate from the test administrator you selected.
    - Test administrators will not keep a record of your certificate. You must present a copy of your certificate if asked by law enforcement officers.

WSGC suggests utilizing **uavcoach.com** for TRUST certification as we have experience with other programs utilizing their online training.

APPENDIX E-3 - Drone Registration

How to Register Your Drone

Register your drone at FAADroneZone whether flying under the Exception for Limited Recreational Operations or Part 107. If you are not sure what kind of a drone flyer you are, check out our User Identification Tool or visit our Getting Started webpage to learn more.

- All drones must be registered, except those that weigh 0.55 pounds or less (less than 250 grams) and are flown under the Exception for Limited Recreational Operations.
- Drones registered under the Exception for Limited Recreational Operations cannot be flown under Part 107.

Remote Identification and Your Drone

Beginning September 16, 2023, all drones requiring registration must operate in accordance with the Remote ID rule.

How to Register

Information Needed to Register

- Physical address and mailing address (if different from physical address)
- Email address
- Phone number
- Make and model of your drone
- Specific Remote ID serial number provided by the manufacturer (if applicable)
- Credit or debit card

Note: If you are not sure how to locate your Remote ID serial number, please check with the manufacturer for assistance.

Registration Fees

- Part 107 registration costs $5 per drone and is valid for three (3) years.
- The Exception for Limited Recreational Operations registration costs $5, covers all drones in your inventory, and is valid for three (3) years.
- Once a drone is registered, its registration cannot be transferred between operation types (Part 107 or the Exception for Limited Recreational Operations).

Registration Requirements

- 13 years of age or older (if the owner is less than 13 years of age, a person 13 years of age or older must register the drone)
- A U.S. citizen or legal permanent resident.
- For foreign operators, FAA will consider the certificate issued to be a recognition of ownership rather than a certificate of U.S. aircraft registration.

Where to Register

- Register a drone online at FAA Drone Zone (drone must weigh less than 55 pounds)

Note: If a drone weighs 55 pounds or more, you must register a drone by mail

After You Register

Once you register your drone, you will receive an FAA registration certificate. You must have your registration certificate (either a paper copy or digital copy) in your possession when you fly. If another individual operates your drone, they must have your drone registration certificate (either a paper or digital copy) in their possession. Federal law requires pilots flying drones that require registration, to show their certificate of registration to any Federal, State, or local law enforcement officer if asked. The FAA requires that you label all drones with your registration number before you fly them

Failure to register a drone that requires registration may result in regulatory and criminal penalties.

Registration

When your drone registration expires, you need to renew your registration through the FAADroneZone. If you are having trouble logging into the FAADroneZone, you may need to reset your password (PDF). Be sure to use the email address you used when you originally registered your drone with the FAA.

Got Questions? Contact the UAS Support Center

Resources

- Geographic list of drone registry enrollments and registrants on our website.
- 14 CFR Part 48 — Registration and Marking Requirements for Small Unmanned Aircraft

FAA Last updated: Thursday, June 29, 2023 (Cited for Handbook: July 7, 2023)

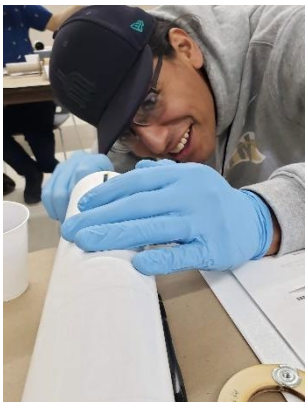
APPENDIX F-1 – Launch 2 Learn Rocket Certification Workshop

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 F-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 F-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 https://spacegrant.carthage.edu/live/files/6238-fnl24proposaltemplatedocx.docx
FNL Preliminary Design Report (PDR) Template https://spacegrant.carthage.edu/live/files/6238-fnl24proposaltemplatedocx.docx
FNL PDR Virtual Review PowerPoint Template https://spacegrant.carthage.edu/live/files/6220-fnl24pdrpresentation-templatepptx.pptx
FNL Critical Design Report (CDR) Template https://spacegrant.carthage.edu/live/files/6240-fnl24cdrtemplatedocx.docx
FNL CDR Virtual Review PowerPoint Template https://spacegrant.carthage.edu/live/files/6221-fnl24cdrpresentation-templatepptx.pptx
FNL Flight Readiness Report (FRR) Template https://spacegrant.carthage.edu/live/files/6241-fnl24frrtemplatedocx.docx
FNL Flight Readiness Review PP Template (Oral Presentation) https://spacegrant.carthage.edu/live/files/6222-fnl24launch-weekendpresentation-templatepptx.pptx
FNL Post Launch Assessment Report Template https://spacegrant.carthage.edu/live/files/6242-fnl24plartemplatedocx.docx

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/6191-fnl24l2l-workshop-flyerpdf.pdf
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 F-4 – Handbook Change Log

Date	Change
11/20/23	Update to Appendix A-1: Motors • Added K1100T and K1103X RMS as Moon options • Added K1103X RMS as Mars option • Updated J500G (Moon) from an DMS to RMS type motor
11/20/23	Corrected formatting in Mars Challenge Parameters (Pages 21-23) to nestle "Detailed Payload Requirements" under Bullet 1, "Payload Requirements" instead of it being a separate bullet. This now follows the formatting of the Moon Requirements Section
11/29/23	Corrected Calendar to appropriately reflect Proposal Due at Proposal Milestone.
12/8/23	• Added SKUs for the Gateway Kits in APPENDIX A-5 – First Nations Launch Competition Kits • Moved Build & Assembly Techniques Webinar from December 12, 2023 to February 13, 2024 • Structures Webinar added back to competition calendar and will be held on December 12, 2023.