



BIG IDEA CHALLENGE

2024 Proposal Guidelines

Inflatable Systems for Lunar Operations

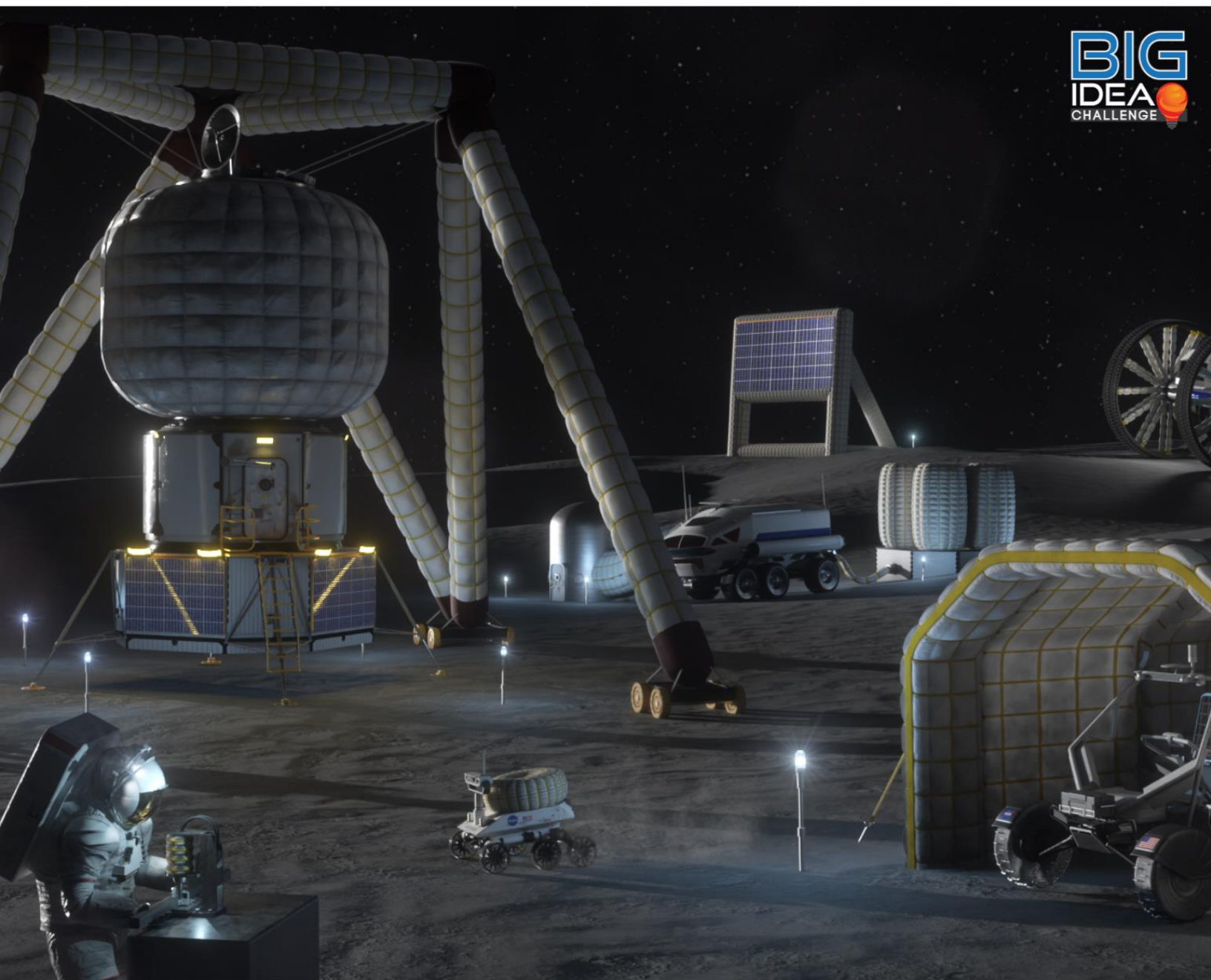


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Change log: NOI deadline changed from Oct. 22, 2023, to Rolling until the proposal deadline of Feb. 1, 2024.

Change log: A new hi-res photo/graphic image requirement was added to the Proposal and Video submission.

Change log (01.23.2024): The permitted proposal page length under Proposal Formatting Instructions was updated to reflect the correct count of 15-21 pages.

Overview

The **B**reakthrough, **I**nnovative, and **G**ame-changing (BIG) Idea Challenge is an initiative supporting NASA's Space Technology Mission Directorate's (STMD's) Game Changing Development Program's (GCD) efforts to rapidly mature innovative and high-impact capabilities and technologies for infusion in a broad array of future NASA missions. The BIG Idea Challenge allows students to incorporate their coursework into real aerospace design concepts and work together in a team environment.

The BIG Idea Challenge also offers real-world experience for university students in the development of the systems needed to support NASA's exploration goals. For this reason, the National Space Grant College and Fellowship Project supports the challenge by leveraging funds to help develop the next line of a STEM-trained workforce with skills and experience aligned directly with STMD technology focus areas and capability needs.

Participation in the BIG Idea Challenge is open to teams of undergraduate and graduate students at **accredited U.S.-based colleges and universities officially affiliated with their state's Space Grant Consortium**. However, non-Space Grant affiliated colleges and universities may partner with a Space Grant-affiliated academic institution. NASA recognizes the benefits of having diverse and inclusive scientific, engineering, and technology communities and expects the reflection of such values in the BIG Idea Challenge. As such, multi-university and interdisciplinary teams are encouraged. **Minority Serving Institutions are also highly encouraged to apply or participate by partnering with a Space Grant affiliated university.**

The 2024 BIG Idea Challenge provides collegiate teams the opportunity to **design, develop, and demonstrate novel uses of low Size, Weight, and Power (SWaP) inflatable technologies, structures, and systems* for lunar operations**. Teams are invited to submit proposals that support NASA's long-term goal of conducting sustained crew and science missions on the surface of the Moon with Artemis through the use of their technology.

****Exclusions apply. Please see below.***

This competition is intended to be an open innovation challenge with minimal constraints so that proposing teams can genuinely create and develop out-of-the-box solutions.

Based on the review of detailed proposals, it is anticipated that 4-7 university teams (the primary institution for each team must be a Space Grant-affiliated school) will be selected to build and demonstrate their proposed inflatable system concept.

Each team will submit a detailed and realistic budget in their proposals, not to exceed \$150K. A wide range of award sizes is expected (in the range of \$50K to \$150K), depending on the scope of the work proposed. We anticipate funding several larger-scope awards (\$100 - \$150K) and several smaller-scope awards (\$50K - \$99K). **Proposers are encouraged to request what is actually needed to conduct the proposed work. To maximize NASA's Return on Investment (ROI), judges will carefully consider cost as an important factor in determining the overall value of the proposal.**

Context for the 2024 BIG Idea Challenge Theme

NASA is looking for novel and cost-effective technologies and applications that utilize inflatable systems to support [Artemis](#) missions. Artemis is the first step in the next era of human space exploration. Together with commercial and international partners, NASA will establish a sustainable presence on the Moon to prepare for missions to Mars.

One of the biggest constraints to establishing a sustainable human presence on the Moon is the immense mass and volume of assets needed to support this effort. Given the size of current space launch vehicles, it is difficult to deliver large structures in fully assembled configurations, and typically require multiple launches and assembly after they are placed on the surface. A large inflatable system can be tightly packaged to fit into the limited volume constraints of a rocket or lunar lander. After it is placed on the lunar surface, it can be inflated into a robust, rigid structure many times its stowed volume. Inflatable deployable structures can take advantage of using fabric materials and internal pressure to become rigid multi-dimensional pressure vessels when filled with air.

Properly designed inflatable systems, such as tires on our cars, can operate in harsh conditions under high dynamic loads, require very little maintenance, and are very mass efficient. These same qualities are critical for the systems that will operate on the Moon. With the potential for significant mass reductions and the ability to deploy a large structure from a small package, NASA is interested in investigating concepts based on inflatable components.

There have been many studies related to the use of inflatables for lunar habitats. The 2024 BIG Idea Challenge is asking student teams to go beyond habitats and explore innovative concepts incorporating inflatable components such as deployable towers, gantries, antennas, and more. Applications may also include soft robotics, actuators, connectors, deployment mechanisms, airlocks, as well as temporary shields or shelters – among many others.

NASA's [Lunar Surface Innovation Initiative](#) is working to develop and demonstrate technologies to navigate and explore the Moon's surface, mitigate lunar dust, as well as capabilities to excavate and construct structures on the Moon. Use of inflatable systems have the promising potential for lower mass and packaged volume than rigid systems, operating as deployable structures that expand from their packaged launch configurations to their operational expanded states. Utilizing inflatable structures to develop capabilities to reduce the weight and volume of sending the required assets to the Moon will pave the way for a feasible and affordable path to substantially lower the costs, improve safety, and increase the performance of deep space exploration. Through the 2024 BIG Idea Challenge, NASA hopes to garner information on potential new materials, designs, and solutions for applications of inflatable structures on the Moon.

Challenge Guidelines, Design Requirements, & Assumptions

BASIC CHALLENGE GUIDELINES

NASA is engaging the collegiate community for ideas to support the Agency's [Moon to Mars Objectives](#) and [Lunar Surface Innovation Initiative](#) through the 2024 BIG Idea Challenge, which invites university teams to submit proposals to **design, develop, and demonstrate novel uses of low (Size, Weight, and Power) SWaP inflatable technologies, structures, and systems*** for a wide variety of lunar applications, including but not limited to:

- deployable towers
- soft robotics
- inflatable actuators and deployment mechanisms
- large antennas and solar reflectors
- emergency shelters for extended EVAs
- internal or external secondary structures on habitats (i.e., floors, walls, support structure for radiators, etc.)
- deployable living volume for long-term rover exploration
- pressurized tunnels and airlocks
- low mass cranes and gantries for offloading and transporting equipment
- deployable debris shields and dust protection systems
- inflatable mandrels for construction
- gas or liquid storage tanks
- "drive-in" volumes/garage for rover repairs

These applications are just a few of the possible uses for inflatable structures.

***Exclusion:** *The challenge is NOT looking for concepts that focus on the use of inflatables for lunar habitats. Proposals that focus solely on inflatable habitats will NOT be considered for selection in the 2024 BIG Idea Challenge.*

Proposed solutions can be new/unique methods or the adaptation of Earth-based and existing space-based methods for use in the lunar environment where mass, power, reliability, and automation are key attributes.

Proposals must describe the inflatable components being proposed and potential scenarios and uses for lunar missions and activities. The proposal should provide a description of the compelling need, what makes this concept novel and innovative, and potential business cases based on the proposed inflatable concept. The proposal should identify resources and support systems needed to test and demonstrate the inflatable structure in a relevant environment.

Teams will be responsible for developing key performance parameters based on the capabilities required to meet their specific use case for their proposed inflatable concept. Furthermore, proposed concepts must be feasible for operation in the targeted lunar environment (mechanisms resistant to lunar dust, incorporating thermal management for extreme cold, realistic power considerations, etc.).

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Proposals should also provide adequate descriptions of the supporting systems, fabrication processes and deployment methods along with basic loads analysis that attest to the proposed inflatable structure's feasibility. Since inflatable structures require internal pressure to maintain structural rigidity, proposals should include details on gas/pressure control systems for the initial deployment and expected duration of the systems' lifetime.

Teams are also responsible for describing how they would prepare test environments and perform verification testing to show their concepts are credible. Teams are encouraged to be creative and design one or more verification scenarios to demonstrate the functionality and performance of the proposed inflatable concept. This is key, because if any proposed concepts are deemed viable, NASA may be interested in including all or part of one of these concepts in a future NASA technology demonstration.

If selected as finalists, teams will be expected to describe a complete system but can focus their prototype demonstrations on how they overcome the key technology challenges for implementing their concept. Examples include demonstrating innovative fabrication processes, generating test data that confirms innovative loads analysis methods, demonstrating innovative system deployment methods, or demonstrating innovative test environments.

REQUIRED CAPABILITIES

- Maximizes deployed-to-stowed volume and minimizes mass.
- Able to operate for long periods in the harsh lunar environment (e.g., pervasive and abrasive lunar dust, vacuum, wide temperature ranges, etc.). See [DSNE](#) for more information on lunar applications.
 - Materials and components should be selected that can survive the lunar environment and the stress levels determined for the chosen application. Typical softgoods materials used for space inflatables are high-strength Vectran and Kevlar for the structural membranes, other synthetic polymers for air barriers, and thermal insulative materials for temperature control. Note: flight-like materials aren't expected for the prototype, but teams should try and use as close a corollary as is feasible under the constraints of the competition.
- Minimal barriers to NASA adoption/commercial infusion (e.g., cost-effective, low mass, small size, low power, simplicity, high reliability, etc.)
- Technologies should reach a minimum system-level [Technology Readiness Level](#) (TRL) of 4** at the end of the challenge. For the purposes of this challenge, TRL 4 refers to:
 - Operation on Earth with analog materials and in relevant environments (including a delta-pressure environment that stresses the structural softgoods)
 - Analysis showing the design can operate in targeted environments (environmental testing on critical subsystems is highly encouraged)
- Must demonstrate a working system/sub-system

DESIRED CAPABILITIES

- Demonstrate testing in a relevant environment (TRL 5) **See [NASA Technology Readiness Level Definitions](#)

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ASSUMPTIONS

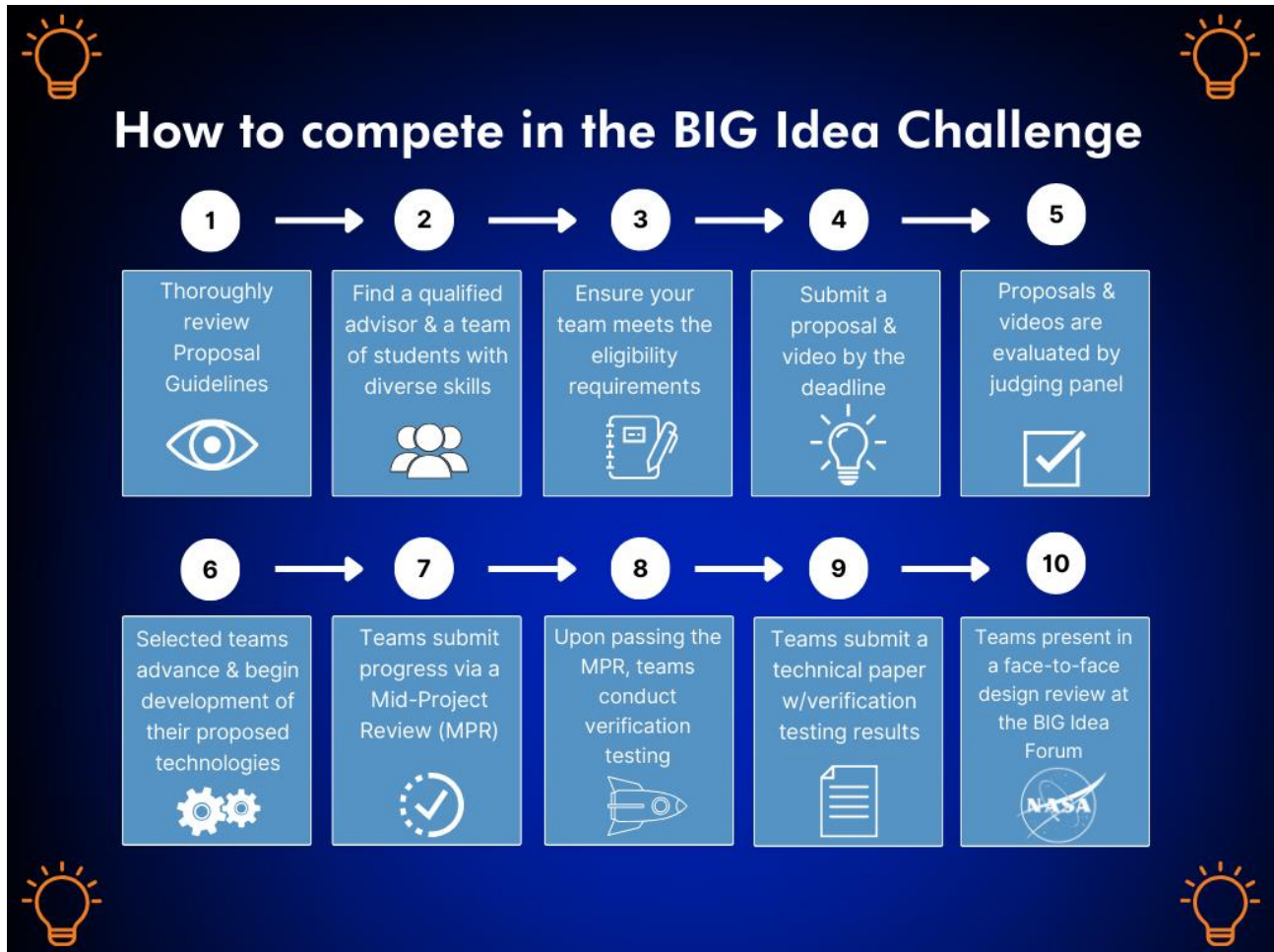
Proposing teams should clearly identify their assumptions and provide the justifying rationale to support them. Below are some recommended assumptions for missions, but teams can adjust them if a good rationale to do so is provided.

- The technology readiness should allow for a technology demonstration on the Moon by 2029.
 - This drives the technology readiness level (TRL) of the components used in your concept. A technology development/qualification plan should be discussed for any required component with a TRL less than 4.
- Operational use and simplicity (minimize required crew time for use and maintenance)
 - Teams are encouraged to avoid concepts that are extremely complex as this adversely impacts long term reliability, and any system maintenance on the lunar surface will be expensive and challenging.
- Verification that the required key performance parameters are met. Examples of performance parameters might be: Deployed volume-to-mass ratio, deployed to stowed volume ratio, force capability vs. reach or system mass (i.e., for actuators or robots), operating temperature range (for low-temp gas or liquid storage), or fundamental frequency for towers, large antennas, or arrays.
- Design for the analog environment
 - Temperature/vacuum/limited power/limited/restricted communications/abrasive regolith, etc.
 - Refer to the [SLS-SPEC-159 NASA Cross-Program Design Specification for Natural Environments \(DSNE\) Revision H](#).
- Energy Efficiency
 - Power and energy supplies will likely be limited in early Artemis operations.
- Credible fabrication and material selection

PROPOSED SOLUTIONS SHOULD CONSIDER

- Through the BIG Idea Challenge, NASA is looking for proposed systems and technologies that are innovative, cost-effective, realistic, and consider the needs of potential stakeholders/funders (i.e., Exploration, Science, Commercial).
- The design package must include a theoretical concept of operations (ConOps) that clearly describes the use of the inflatable concept in Lunar missions and activities, the supporting systems required, all design assumptions, material being used, key performance parameters (KPP) and deployment operation.
 - In the ConOps, consider using NASA Commercial Lunar Payload Services (CLPS) for placing your proposed system on the lunar surface.

How to Compete in the BIG Idea Challenge



Participation and Eligibility

DIVERSITY, EQUITY, AND INCLUSION

Diversity and inclusion are integral to mission success at NASA (see the [NASA Equity Action Plan](#)). The agency recognizes the benefits of having diverse and inclusive scientific, engineering, and technology communities and expects the reflection of such values in the implementation of the BIG Idea proposed solutions. **Participation from organizations and institutions that support and serve under-represented groups including Historically Black Colleges and Universities (HBCUs), Hispanic-Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs), and other Minority Serving Institutions (MSIs) is strongly encouraged.** NASA has created a resource to facilitate partnering with MSIs through the [Minority Serving Institutions Exchange](#). The inclusion of women, members of underrepresented minority groups, veterans, persons with disabilities, and personnel from MSIs in leadership roles is also strongly encouraged. Multi-university and interdisciplinary teams are encouraged.

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ELIGIBLE INSTITUTIONS

The BIG Idea Challenge is open to teams comprised of undergraduate and/or graduate students at **accredited U.S.-based colleges and universities officially affiliated with their state's Space Grant Consortium**. Non-Space Grant affiliated colleges/universities may partner with a Space Grant affiliated academic institution who takes a primary role on the project (i.e., the Space-Grant affiliated university must submit the proposal on behalf of the joint team).

TEAM COMPOSITION AND SIZE LIMIT

Team sizes vary widely, but must contain, at a minimum, one faculty advisor from a U.S.-based, Space Grant Affiliated university, and 2 students from that university who work on the project and present at the BIG Idea Forum, each of whom must be U.S. citizens or Lawful Permanent Residents. Teams may include senior capstone students, clubs, multi-university teams, or multi-disciplinary teams.

- Team size is limited to a maximum of 25 student team members.
- Teams will be comprised of a minimum number of 2 U.S. citizen students or Lawful Permanent Residents who can present the teams' work at the culminating BIG Idea Forum if it is held on-site at a NASA Center.
- A faculty advisor is **encouraged** to attend the Forum with each team.
- An individual (either students or faculty advisors) may join more than one team.
- A university may submit more than one proposal (multiple proposals may be funded from the same institution).
- While faculty and/or post docs can contribute to the team's BIG Idea challenge efforts, it is expected that the bulk of the work is completed by the undergraduate and/or graduate students.

SPECIAL NOTES REGARDING FOREIGN NATIONALS

Foreign Nationals (FNs) attending the proposing U.S.-based university can participate on a BIG Idea Challenge team, with one notable exclusion. Due to prohibitive restrictions and ever-changing NASA security regulations, **foreign nationals will not be able to attend culminating BIG Idea Forum events that take place on-site at a NASA Center (including tours)**. There will be no exceptions to this policy. FN's can, however, participate in any portions of the culminating BIG Idea Forum that take place off-Center.

FOREIGN UNIVERSITIES - INELIGIBLE

Eligibility is limited to universities in the United States. **Foreign universities are not eligible to participate in the BIG Idea Challenge.**

INDUSTRY PARTNERSHIPS ENCOURAGED

Teams are encouraged to collaborate and work in concert with other government or industry partners. An "industry partner" is defined as a non-government business or organization that can provide support to the team in terms of mentorship, access to labs or other facilities, in-kind donations, and/or even financial sponsorship.

- Partner vs. Vendor: if a team is paying for a service (e.g., to use a vacuum chamber for testing) provided by a specific company, the company is considered a vendor, NOT a partner.

Award Funding for Finalist Teams

A wide range of award sizes is expected (in the range of \$50K to \$150K), depending on the scope of the work proposed. We anticipate funding several larger-scope awards (\$100K - \$150K) and several smaller-scope awards (\$50K - \$99K). **Proposers are encouraged to request what is actually needed to conduct the proposed work. To maximize NASA's Return on Investment (ROI), judges will carefully consider cost as an important factor in determining the overall value of the proposal.**

Special notes concerning budget:

- The expected number of new awards is somewhat uncertain, as it may depend on the distribution of submissions that have received sufficiently high ratings on the proposals.
- NASA may support an award as outlined in the proposal budget or may offer to fund only selected tasks.
- NASA has the authority to suspend or terminate an award in whole or in part, and funding is contingent upon availability.
- BIG Idea Challenge funding **may not be used** to directly support travel or stipends for federal employees acting within the scope of employment (including co-op students with civil servant status).

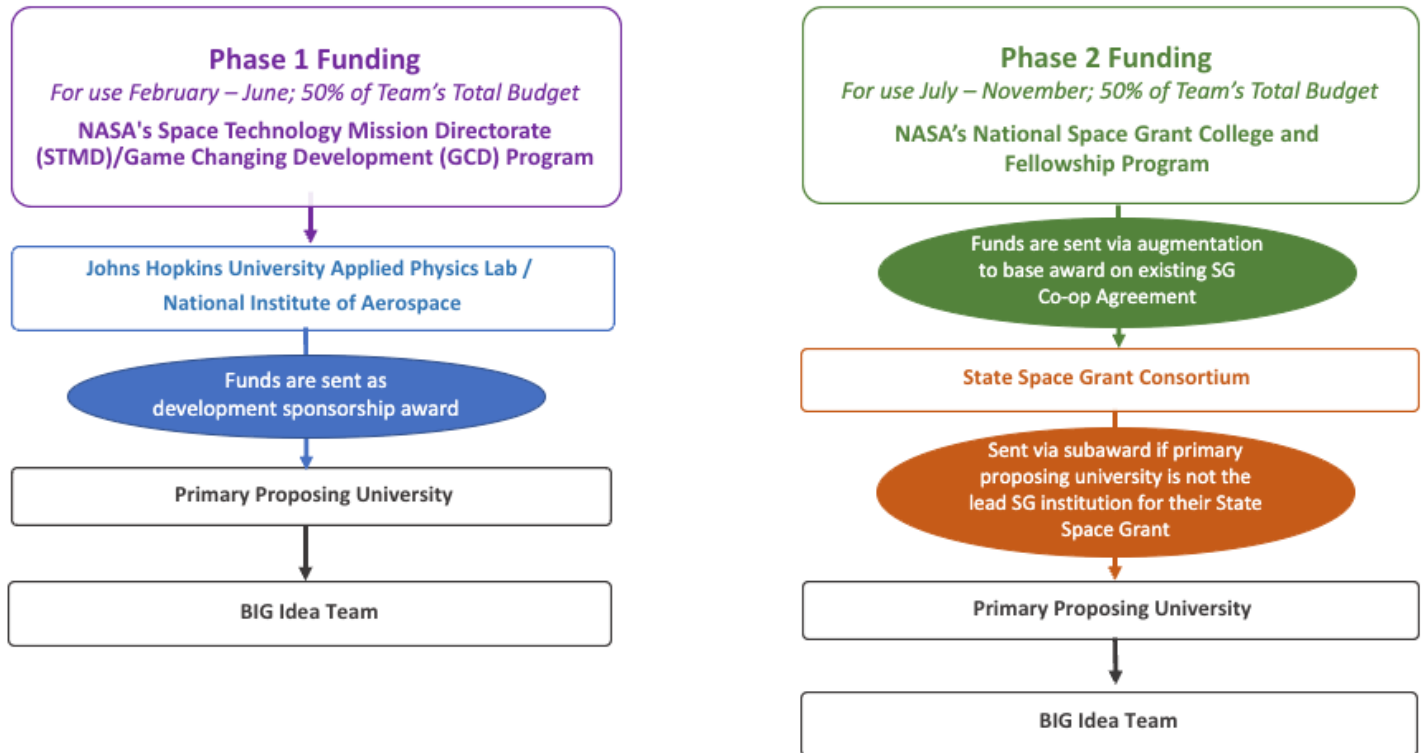
TWO-PHASED FUNDING STRUCTURE FOR FINALIST TEAMS: INSTALLMENTS FROM TWO SOURCES

- **STMD Funds for Phase 1:** The 1st funding installment will be sent immediately upon selection so that finalist teams may begin development of their proposed concept and will amount to **50% of the total budget requested**.
 - These funds will be provided directly to the primary proposing university, from either the Johns Hopkins University Applied Physics Laboratory or National Institute of Aerospace (on behalf of NASA STMD's GCD Program).
- **Space Grant Funds for Phase 2:** The 2nd funding installment (i.e., the remaining half of the total requested funds) will be provided after teams successfully complete their mid-project review in June.
 - These funds will be provided directly to the state Space Grant Consortium affiliated with the primary proposing institution from NASA's Office of STEM Engagement (National Space Grant Program), via an augmentation to the state Space Grant's base award. The state Space Grant Consortium's lead institution will then direct the funds to the primary proposing university for the BIG Idea Challenge via a subaward.

BIG Idea Challenge funding is to be used for full participation in the competition, including the purchase of hardware/software, creation of analog testing environment, stipends for student research that directly supports the proposed activity, travel to the culminating design review (aka, 2024 BIG Idea Forum), etc. ***Please refer to the [Budget Instructions](#) below for specific guidelines related to the intended use of funds for each installment/phase.***

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BIG Idea Challenge 2-Phase Funding Structure



Dates and Deadlines

All deadlines must be met by 11:59 p.m. ET on the dates specified below, unless otherwise noted.

Late deliverables will not be accepted.

| DATE | Description |
|--|--|
| Rolling until Feb. 1, 2024 (Previously: October 22, 2023) | Notice of Intent Deadline |
| October 29, 2023 | Deadline to Submit Questions for Q&A Session |
| November 7, 2023 | Q&A Session for interested teams |
| February 1, 2024 | Proposal and Video Deadline |
| February 29, 2024 | Teams are notified of their selection status |
| Mid-March, 2024 | 1st installment of development stipends sent, as appropriate |
| June 4, 2024 | Deadline for Mid-Project Review (MPR) submission |
| June 18, 2024 | Teams are notified of Pass/Fail status |
| Late June, 2024 | 2nd installment stipends are sent as appropriate from SG directly to schools |
| June - August, 2024 | Summer work |
| September – October 2024 | Fall work (technology verification demonstrations) |
| September 10, 2023 | Fall Status Report Deadline |

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Dates Below are tentative, pending FY25 funding.

*At the time of the solicitation, NASA's FY25 budget (beginning October 2, 2024) is unknown, and as such, the challenge is tentatively planned to end on September 30, 2024. However, the desire is to continue the challenge as outlined below, including having a Forum in November 2024. **Team proposals should include budget and schedules through November or December 2024, taking the tentative schedule below into account.***

Tentative Dates, Pending FY25 funding.

October 2, 2024 Deadline for Forum Registration and Payment

October 16, 2024 Deadline to submit Technical Paper and Technology Verification Demo

November 2, 2024 Deadline to submit Presentation Chart Deck and Digital Poster

4:00 PM Eastern Time

November 5-7, 2024 2024 BIG Idea Forum (NASA's Langley Research Center, Hampton, VA)**

*** Although an in-person culminating Forum is currently planned for November 2024 (Quarter 1 of Fiscal Year 2025), it is contingent on continued availability of NASA funding in FY25. In the unexpected event that funding for the BIG Idea Challenge is not available in FY25, finalist teams will be notified on or before July 15th, 2024 with further instructions.*

Notice of Intent

Notice of Intent deadline: 11:59 p.m. ET February 1, 2024 (Previously: October 22, 2023)

Interested teams are highly encouraged to submit a Notice of Intent (NOI) to compete by the deadline to ensure an adequate number of reviewers, to receive pertinent challenge updates, and to be invited to participate in helpful events prior to the proposal deadline, including a Questions and Answers session with the judges. NOIs are non-binding.

Please visit the [2024 Challenge Details](#) page on the BIG Idea website to complete the brief online NOI submission form.

The following information will be requested on the NOI Submission Form:

- Primary proposing college/university
- Additional university and/or industry partners (if any)
- Project title, if known
- Name and contact information of the primary faculty advisor and student team leader
- Space Grant Affiliation
- Synopsis of the concept, limited to 3,000 characters (including spaces) providing a high-level overview of the proposed project
 - **Note:** We understand that NOI's are due early in the development process, and teams will still be in the process of fleshing out many of the details of their concepts. We expect that teams' concepts will change and evolve between the NOI and Proposal submissions. **Teams have the flexibility to change ideas as they work over the course of the semester, and the idea submitted in the NOI does not need to match the proposal submission.**

Proposal and 2-3 Minute Video Submission

Proposal submission deadline: 11:59 p.m. ET on February 1, 2024

PROPOSALS MUST INCLUDE

Proposing teams will develop a 15–21-page proposal that describes their concept. The proposal must include the following sections **in order**:

- **Cover Page (Excluded from page limitation)**
 - University name
 - Project title
 - Full names of all team members, with academic level (grad or undergrad) and major
 - Identify any foreign nationals
 - Space Grant Affiliation and Space Grant Director contact information
 - Full name(s) and affiliation(s) of all faculty advisor(s)
 - Faculty advisor signature, attesting to review and approval of the proposal submission on the Cover Page
 - **Note: Submissions without a valid faculty signature will be deemed non-compliant and will not be reviewed.**
- **Quad Chart (Excluded from page limitation)**
 - **Proposers must use the [BIG Idea Proposal Quad Chart Template](#).**
 - A Quad Chart is a way for teams to display some standardized information that helps evaluators quickly compare many projects (see example [NASA Quad Chart](#)). Teams must insert the provided [BIG Idea Proposal Quad Chart Template](#) as an image into their proposal. Quad charts must address:
 - A description of the inflatable system being proposed, and the team’s measurable technical objectives for their BIG Idea project.
 - An image/graphic of part or all of the concept
 - A description of the team and management approach of the project
 - A summary of the major project milestones and cost for the project, broken out by Phase 1 and 2
 - No rounding, please. Use the exact total proposed budget.
- **Summary Statement (Not to exceed one page)**
 - An overall summary of the proposed lunar inflatable system concept, including a title of the project, a one-paragraph synopsis of the operational scenario the proposed technology is addressing, an overview of the proposed technology solution, a one-paragraph statement on the proposed testing and verification, and a statement of the impact the innovative technology concept will have on lunar exploration and mission goals.
- **Problem Statement and Background (Not to exceed two pages)**
 - Mission Scenario/use case where the proposed inflatable system would be applicable and advantageous.
 - Include commercial use cases, if applicable.
 - Challenge being addressed and overall approach.

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- **Project Description** (Not to exceed 10 pages)
 - What inflatable technology are you going to develop, and why is it important?
 - How does your proposed technology support the Artemis mission to establish a permanent presence on the lunar surface?
 - Adherence to the Challenge Guidelines, Design Requirements, and Assumptions
 - Provide adequate descriptions of the supporting systems, fabrication processes and deployment methods along with basic loads analysis that attest to the proposed technology's feasibility. Since inflatable structures require internal pressure to maintain structural rigidity, proposals should include details on gas/pressure control systems for the initial deployment and expected duration of the systems' lifetime.
 - Verification Through Testing and Demonstration
 - Proposers must describe HOW their technology could be demonstrated on Earth to provide confidence it can work in the chosen lunar environment. **Selected teams will need to demonstrate a working technology.**
 - As a part of the challenge final deliverables, teams selected as finalists will be required to submit a video demonstrating a subscale prototype demonstration of their system or sub-system deploying and inflating here on Earth, from a stowed configuration.
 - It is up to each team to determine the best way to accomplish this and provide details on how verification testing will be conducted. Physics-based modeling may support verification but is not a sufficient replacement for hardware testing.
 - Teams are encouraged to be creative in designing tests and demonstrations to be as realistic as possible (e.g., operation and environments).
 - What are the key performance parameters based on the mission scenario being addressed?
 - For the testing, will you accomplish a realistic simulated environment? If so, how? What have you considered from the [DSNE](#)?
 - Teams planning to work with hazardous materials or systems should include some information on safety plans. (i.e., ruptures due to excessive pressurization within the inflatables).
 - Path-to-flight
 - A brief discussion on the concept's anticipated path-to-flight for a mission to the Moon. Based on significant differences between on-Earth and off-Earth operations, the path-to-flight description must address the critical modifications that would be made to the design for use on the Moon.
 - Scalability
 - Can the proposed inflatable solution be scaled for larger mission scenarios?
- **Capabilities Statement** (Not to exceed two pages)
 - The relevant experience, expertise, and capabilities of the team members, faculty advisors, and industry mentors (if applicable)

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- Relevant facilities available to the team (either at the university or another source the team has access to)
- **NEW! Diversity, Equity, Inclusion, and Accessibility (DEIA) Approach** (Not to exceed one page)
 - Describe how the team will promote and implement the values of a diverse and inclusive scientific, engineering, and technology community to enhance the overall development of the proposed solution.
 - Discuss planned interactions and partnerships with industry, other government agencies, non-profit laboratories, and even other universities.
 - Discuss how diversity and inclusion is integrated into the BIG Idea Challenge team:
 - Enabling opportunities for a variety of technical disciplines, cultural backgrounds, creativity, and diversity of thought.
 - Involvement of underrepresented groups (e.g., women, underrepresented minorities, veterans, persons with disabilities).
 - Inclusion and/or partnerships with Historically Black Colleges and Universities, Hispanic-Serving Institutions, Tribal Colleges, and other Minority Serving Institutions (MSIs).
- **Detailed timeline** (Not to exceed one page)
 - The timeline should incorporate the full scope of the proposed project through the conclusion of the 2024 BIG Idea Challenge in November, including development and verification testing.
- **Detailed budget and cost notes** (Not to exceed four pages)
 - Proposals must include a single budget spreadsheet that breaks the costs out by Phase 1, Phase 2, and Total Costs. [Cost notes](#) must accompany the spreadsheet.
 - **Proposers must use the provided [BIG Idea Challenge Budget Template](#).**
 - Budget should include all relevant costs, not to exceed \$150,000. *Proposers are encouraged to request what is actually needed to conduct the proposed work.*
 - See [Budget Instructions](#) below for specific guidelines on preparing the budget and [sample cost notes](#).
- Signed “**University Letter of Budget Review and Compliance**” from the primary proposing university’s office of sponsored programs (or appropriate alternative authority). The faculty advisor **cannot** sign this letter.
 - **Proposers must use the provided [University Letter of Budget Review and Compliance Form](#).**
- Signed “**University Support Letter**” from the primary proposing university’s Dean of Engineering (or appropriate alternative authority)
 - **Proposers must use the provided [University Support Letter Template](#).**
- Signed “**Space Grant Letter of Budget Review and Support**” from the state Space Grant Director affiliated with the primary proposing university.
 - **Proposers must use the provided [Space Grant Letter of Budget Review and Support Form](#).**

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- Letters of Support from any other key partners on the proposal, **clearly indicating what specific type of support they will be providing** (i.e., monetary sponsorship, in-kind services, materials, mentoring, etc.).
 - Proposers may submit a maximum of 10 additional letters of support.
 - If a team is paying for a service (e.g., to use a vacuum chamber for testing) provided by a specific company, the company is considered a vendor, NOT a partner.

BUDGET INSTRUCTIONS

Important: Budgets are required to be displayed as two phases (corresponding to each of the two anticipated funding installments), complete with [cost notes](#).

- **Phase 1 Budget = 50% of total funding requested** (February 2024 – June 2024)

The intent of the 1st award installment is to facilitate participation in the 1st phase of the 2024 BIG Idea Challenge program, including, but not limited to labor costs, materials, consultants, machine rentals, etc. needed to begin building the proposed technology.

 - The proposing team **must collaborate with the primary proposing university's Office of Sponsored Programs (or other appropriate authority)** in the creation of the Phase 1 budget.
 - The Phase 1 budget and cost notes should include any **relevant Indirect Costs (IDCs) charged by the university**.
 - All waived fees or indirect costs must be specifically mentioned in the **Letter of Budget Review and Compliance**.
- **Phase 2 Budget = 50% of total funding requested** (July 2024 – December 2024)

The intent of the 2nd award installment is to facilitate full-participation in the 2nd half of the competition, which can include but is not limited to: stipends for summer/fall research work on the project, costs associated with verification testing (creating simulated analog testing environments or fees for using industry testing facilities such as vacuum chambers or cryo chambers), travel and registration fees for the 3.5 day BIG Idea Forum at NASA's Langley Research Center in Hampton, VA.

 - The proposing institution must collaborate with both the **university's Office of Sponsored Programs (or other appropriate authority)** **AND the Space Grant Consortium** in the creation of the Phase 2 budget.
 - The Phase 2 budget and cost notes should include any **relevant Indirect Costs (IDCs) charged by the university, as well as any IDCs charged by the Space Grant Consortium associated with the lead institution's creation of the subaward** to fund Phase 2 of the selected BIG Idea proposing team(s).
 - **The budget submission will be considered final, and no additional costs will be funded for failure to include IDC costs for the Space Grant's lead institution.** Proposers are encouraged to carefully specify the IDC amounts required (for the university in Phase 1; and for the university AND the Space Grant in Phase 2) if the proposing team is awarded.
- Travel Costs
 1. Although an in-person culminating Forum is currently planned for November 2024 (Quarter 1 of Fiscal Year 2025), it is contingent on continued availability of NASA funding in FY25.

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- **Proposals must include travel to the November Forum in the Phase 2 budget**, tentatively scheduled to take place in Hampton, VA at NASA's Langley Research Center (Assume a **four-night hotel** stay and a **registration fee of \$500** per attendee).
 - Cost notes should also include a brief description of how the travel funds will be utilized if there is no in-person Forum.
 - If a Forum is not held, finalist teams will be notified no later than July 15th that they can re-align the budgeted travel funds as alternatively proposed.
- Overhead/Indirect/G&A Costs (Please see section above titled "Awards for Finalist Teams" for details on how the funding will be distributed)
 - Note: Teams should work with their universities to minimize indirect and overhead costs to make their proposals as competitive as possible. ***It is imperative that the primary proposing university and the affiliated state Space Grant Director approve any reduced or waived indirect fees in writing.***

Examples of relevant and allowable costs include:

- Materials and supplies
- Facilities rental (if any)
- Stipends for undergraduate and/or graduate student work/research
- Testing costs
- Minimal faculty salary (note that the bulk of the BIG Idea Challenge work should be conducted by students)
- Travel to attend the Forum and/or conduct testing

Examples of **unallowable costs** include:

- Scholarships and fellowship support
- Salary, stipend and travel support for federal employees (including civil servant Co-Op students)
- Tuition and books
- Room and board
- Food/beverage (except for per diem meal costs associated with travel)
- Purchase of communication equipment from China

PROPOSAL EVALUATION CRITERIA

The judges' panel is comprised of NASA and industry experts who will evaluate and score all the competition deliverables, including the proposal submissions. Submissions will be evaluated and judged based on adherence to the guidelines and constraints and the published evaluation criteria. Please find a printable copy of the [Proposal Scoring Matrix](#).

- **Technical Innovation (Max 30 points)**
 - How innovative is the proposed solution?
 - How well does the proposed technology advance the state of the art?
 - How compelling are the proposed concept's goals and objectives?
 - How well does the proposed concept align with [NASA's Moon to Mars Objectives](#)?
- **Technical Credibility (Max 25 points)**
 - Does the technology help solve a real problem?
 - How feasible is the proposed technology?

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- Is credibility of the proposed solution presented?
- Is the TRL advancement plan of the proposed technology viable?
- What level of risk is associated with development and verification of the concept?
- What is the risk mitigation plan?
- Has the team proposed a rigorous systems engineering approach?
- Has the team provided adequate descriptions of the supporting systems, fabrication processes and deployment methods along with basic loads analysis that attest to the proposed technology's feasibility?
- Does the proposal adhere to the required Design Guidelines and Constraints?
- Is the technology operationally resilient? (ability to withstand adverse circumstances and the harsh lunar environment, the capability to degrade gracefully)
- **Technical Management (Max 20 points)**
 - Is the cost plan, including cost feasibility, value, and risk adequate, thorough, and reasonable?
 - Is the proposed implementation plan adequate and thorough?
 - What is the probability of team success? [i.e., team expertise (including faculty and any industry support), access to required facilities, etc.]
 - Has the team complied with all proposal requirements? (i.e., inclusion of all required sections, forms, and letters; and adherence to format and page count requirements).
- **Performance Verification Testing Plan (Max 20 points)**
 - How feasible is the verification and validation testing plan for the proposed technology?
 - Is the team's proposed verification testing thorough?
 - Does the planned testing environment adequately represent the lunar environment?
- **Diversity, Equity, Inclusion and Accessibility (DEIA) Approach (Max 5 points)**
 - Has the team adequately addressed DEIA considerations in implementing the values of a diverse and inclusive community to enhance the overall development of the proposed solution?
 - Has the team demonstrated an effort to include various technical disciplines, cultural backgrounds, and/or underrepresented groups in the team composition?
- **Bonus (Max 2 Points)**
 - Are any optional cost-sharing or partnerships identified with industry, other government agencies, non-profit labs, or other universities (including Minority Serving Institutions) that add value to the submission?

ASSESSMENT

- **Excellent** = Criteria is fully met with exceptional merit, as documented by numerous or significant strengths and with no major weaknesses.
- **Very Good** = Criteria is met with high merit and little errors; strengths fully out-balance any weaknesses and none of those weaknesses constitute fatal flaws.
- **Good** = Criteria is met with a credible response and a few errors; strengths and weaknesses essentially balance each other.
- **Fair** = Criteria is only nominally met and significant errors are apparent; weaknesses outweigh any strengths.

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- **Poor** = Criteria is not met and /or has serious flaws; one or more weaknesses constitute fatal flaws.
- **Missing** = No effort was made to meet criteria.

CHECKLIST FOR A SUCCESSFUL PROPOSAL

Please find a printable copy of the [Proposal Checklist](#). Where noted by an asterisk (*), teams must use the provided template.

- Does the proposal include all required sections in the Main Proposal? Include the following in a single PDF:
 - Cover Page (complete with advisor's signature)
 - [Quad Chart](#)*
 - Summary Statement
 - Problem Statement and Background
 - Project Description
 - Capabilities Statement
 - Detailed Project Timeline
 - Detailed Budget [Cost Notes](#)* and [Budget Spreadsheet](#)*
 - Signed [University Support Letter](#)*
 - Signed [Letter of University Budget Review and Compliance](#)*
 - Signed [Letter of Space Grant Budget Review and Support](#)*
 - Letters of Support from additional Key Supporters
- Does the proposal include the supplementary forms required to be uploaded separately on the Proposal Submission Form?
 - [Excel version of Budget Spreadsheet](#)* (note: this budget table must also be included in the PDF proposal file)
 - [Vendor W9 Form](#)* for the primary proposing university.
- Does the proposal adhere to the format and page count requirements?
- Are appropriate/needed citations included?
- Is a video provided in the correct format (a "public" or "unlisted" YouTube link)?
- Is a high-resolution photo or graphic of all or part of your concept provided, with a minimum dpi of 300?
- Is the budget under the cost cap?
- Does the cost of this effort provide a good ROI based on current NASA technology needs (see NASA taxonomy and the [Moon to Mars Objectives](#))? If not, the proposal will likely not be considered for selection.
- Does the budget address all categories of allowable costs?
 - Materials and supplies
 - Facilities rental (if any)
 - Stipends for undergraduate and/or graduate student work/research
 - Testing costs
 - Minimal faculty salary
 - Travel for Forum participation
- Is the schedule and development approach realistic for the budget and time available?
- Does the proposal include the proposed development plan describing the activities and approach?
- Is the team correctly formed and documented?

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- Does it include a space grant affiliated university, two US citizen students or Legal Permanent Residents and a faculty advisor?
- Are roles and responsibilities for the student team members defined? Roles to consider include engineering, project management, testing and operations.
- ❑ Has DEIA been addressed in the proposal?
- ❑ Does the proposal describe the inflatable concept and its use in lunar activities and missions?
- ❑ Does the proposal describe the innovation and novel aspect of the concept?
- ❑ Is a business case or infusion path provided in the proposal?

PROPOSAL FORMATTING INSTRUCTIONS

Teams are responsible for the formatting and appearance of their proposal. Figures and tables must be placed in the file and therefore must be in digital format.

- 15 pages minimum; 21 pages maximum (including figures and tables)
 - The Cover Page, Quad Chart, Letters of Support, and Appendices **do not count** toward the minimum or maximum page limits.
 - A Table of Contents is not required.
 - **Appendices are to be used for references only.**
 - **Note:** Judges are not obligated to look at the appendices. Include important details in the body of your paper to ensure they are reviewed. There is no preference in citation formatting, but references must be formatted uniformly and correctly. Just listing a link to the source is not acceptable.
- Proposals should be single spaced and formatted as a single column with normal 1" margins on the top, bottom, left, and right.
- Please use fonts common to Macintosh and PC platforms, i.e., Times, Calibri, Helvetica, or Arial for text, Symbol for mathematical symbols and Greek letters.
- Font size can be either 11 or 12 pt., (including text within charts, tables, graphs, and figures).
- File size cannot exceed 90 MB.

VIDEO FORMATTING INSTRUCTIONS

As a part of the proposal submission process, teams will be required to include a 2–3-minute video. The intent is for the video to augment your paper proposal by including animation, graphics, or other creative ways of showcasing unique aspects of your proposed concept. We have included several sample videos from previous teams to serve as examples on the BIG Idea Website - visit the "Resources" section on the [2024 Challenge Details](#) page.

- Videos are limited to a maximum length of 3 minutes.
- Videos must be uploaded to YouTube, and the video's YouTube URL will be required on the online proposal submission form. **Other types of video files will not be eligible for consideration.**
- Videos must be **publicly viewable** via a link. Videos should be "Unlisted" or "Public" on YouTube.
 - Troubleshooting Tip: If your video is stuck in the "processing" stage, check to [make sure your YouTube account is verified](#).
- All team members should appear in the video if possible. In the event a team member is not available for filming, displaying a photo of that team member is fine.
- University name, Space Grant Affiliation, and project title should appear in text at the front of the video.
- Do not use music or images which may violate copyright law. You may use images created by NASA.

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SUBMITTING THE PROPOSAL AND VIDEO

To upload a proposal and video (.pdf file and link), please visit the [2024 Challenge Details](#) page on the BIG Idea website to complete the online Proposal Submission Form. Teams are encouraged to review the [Proposal Evaluation Criteria](#) above to better understand how the competition will be judged. Teams are also encouraged to use the downloadable [Proposal Checklist](#) to ensure all required proposal items are accounted for prior to submitting.

No revisions can be accepted after the submission deadline, so please proof your proposal file very carefully before submitting it. If there are any technical problems with the content of your proposal (for example, your file was corrupted), we will try to contact you immediately, so it is very important that you provide us with up-to-date contact information on the submission form.

Late proposals will not be accepted, and the submission form will close promptly at midnight (ET).

The following information will be requested on the Proposal Submission Form:

- Name of college/university
- University and/or Industry partners (if any)
- Name and contact information of the primary faculty advisor and two student team leaders
- Names and email addresses for all students listed on the proposal
- Space Grant Affiliation and Space Grant Director contact information
- Name and contact information for any additional faculty or industry advisors
- Survey question: How did you hear about the BIG Idea Competition?
- Project title
- High-resolution photo or graphic of part or all of your project with a minimum resolution of 300 DPI
- URL link for team's public or unlisted YouTube video
- File upload for Main proposal PDF document
- A 500-character description of the proposed concept
- Phase 1 Budget, Phase 2 Budget, and Total Budget (exact costs only, please...no rounding)
- File upload for the [Excel version Budget Spreadsheet](#), using provided template
- Vendor W9 Form for the primary proposing university (to be completed by the accounting department at the university)
 - Please download, complete, and submit this [Template Vendor W9 Form](#).
 - W9 vendor form must be completed/dated in the same year as the proposal submission.
- Mailing address and Point-of-Contact information for award checks (for use only if a team is selected as a finalist in the competition)
- Acceptance of the BIG Idea Challenge [Intellectual Property Statement](#)
- Optional Survey Question: What excites you about this competition? If possible, include input from your teammates.

Resources

Please visit the *Resources* section of the [2024 Challenge Details](#) page on the BIG Idea website for information useful in developing your BIG Idea Challenge concept.

Intellectual Property (IP) and Media Release

Proposers must acknowledge that they have read and agree to abide by the [Full Intellectual Property and Media Release Statements](#).

INTELLECTUAL PROPERTY - SUMMARY

In addition to any rights granted to NIA, JHU/APL and/or the Space Grants Consortium Cooperative Agreement Recipients, as applicable, recipients of monetary awards under the Big Idea Challenge agree to grant to NASA and the Federal Government, as the source of awards funding, the Rights in Data and Patent Rights set forth in detail below. In summary, awardees agree to grant to NASA and the Federal Government (i) a license to use, distribute, reproduce, perform, display, and prepare derivative works, any data first produced by recipient in carrying out recipient's responsibilities under this award in which the recipient asserts copyright, or data for which copyright ownership was acquired under the grant for Federal purposes and to have or permit others to do so for Federal purposes only, and (ii) a license to practice or have practiced for or on behalf of the United States any invention of the recipient conceived or first actually reduced to practice in the performance of work under this award if recipient chooses to retain title to such invention, and NASA may elect to obtain title or patent such invention if recipient chooses not to do so, all as set forth more particularly in the below Rights in Data and Patent Rights provisions.

Please review the full [Intellectual Property Statement](#).

MEDIA RELEASE

The recipients of monetary awards under the Big Idea Challenge (“Teams”) agree to give permission to be recorded, photographed and/or videotaped by or for NIA, JHU/APL, NASA or their representatives or designees for the purpose of announcements and other outreach or informational purposes, including public announcements, concerning the Challenge.

The Teams further give permission to NIA, JHU/APL, NASA or their representatives or designees to use, reproduce, prepare derivative works, publish, distribute to the public, perform publicly, and/or publicly display all challenge deliverables, including excerpts and any ancillary material, which may include each team participants’ names, affiliations (schools), images, voice, and/or likenesses. NIA, JHU/APL, or NASA may distribute the materials, including excerpts therefrom, and any ancillary material through a variety of media in existence now or in the future, including but not limited to print, television, websites, radio, or any other means. NASA may also permit a third party to exercise NASA’s rights, including but not limited to the right to display or distribute the recording, including excerpts therefrom, and any ancillary material, in any manner NASA deems appropriate.

The teams also understand that this permission to use each participant’s name, image, voice and/or likeness in such materials is not limited in time and team participant will not receive compensation for granting this permission.

Teams acknowledge that NASA has no obligation to use any participant’s name, affiliation, image, voice, and/or likeness in any materials produced by NASA, but if NASA so decides to use them, each participant waives the right to inspect or approve any such use. Teams hereby unconditionally release NASA and its representatives from all claims and demands arising out of the activities authorized under this Media Release.

Deliverables for Finalist Teams

Teams selected to receive funding and attend the on-site Forum are responsible for the following Project Deliverables, all of which must be releasable to the public with no copyrights asserted:

- Mid-Project Report
 - A 5-9-page report demonstrating where the team is in the development of their system.
 - Reports must provide confidence the team can complete their system by the challenge delivery dates to receive the 2nd half of their stipend award.
- Verification through Testing and Demonstration
 - Finalist teams will be required to perform verification through testing and/or demonstrations and document the results in their technical reports and discuss in their final presentation. Teams are encouraged to be creative in designing tests and demonstrations to be as realistic as possible (e.g., operation and environments).
 - **Reminder:** Physics-based modeling may support verification but is not a sufficient replacement for hardware testing and demonstration.
 - **Prototype Demonstration Video:** Teams must submit a video demonstrating a small prototype demonstration of their system or sub-system deploying and inflating here on Earth, from a stowed configuration.
- 15–25-page Technical Paper
- 20-25-minute Presentation, with an additional 25 minutes of Q&A at the BIG Idea Forum
- Technical Poster (for Poster Session conducted during on-site Forum)
 - Teams will be required to submit a digital poster file **in addition to** bringing a full-size printed poster for display during the Forum’s poster session.

Additional details on the final deliverables will be provided to teams selected as finalists in the 2024 BIG Idea Challenge. Technical papers, presentations, and posters will be posted and archived on the BIG Idea Website, and technical papers may be submitted to [NASA’s Technical Report Server \(NTRS\)](#).

Contact Information

For BIG Idea inquiries, please contact the BIG Idea Program Team at BigIdea@nianet.org.



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The Breakthrough, Innovative, and Game-Changing (BIG) Idea Challenge is managed by a partnership between the National Institute of Aerospace (NIA) and the Johns Hopkins University Applied Physics Laboratory (JHU/APL) on behalf of the National Aeronautics and Space Administration (NASA).