Lunar Surface Innovation
CONSORTIUM

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# LSIC Newsletter

The Lunar Surface Innovation Consortium is administered by the Johns Hopkins Applied Physics Laboratory and operates in collaboration with the NASA Space Technology Mission Directorate under the Lunar Surface Innovation Initiative. Its purpose is to harness the creativity, energy, and resources of the nation to help NASA keep the United States at the forefront of lunar exploration. To find out more, sign up to participate or access past additions of this newsletter, please visit lsic.jhuapl.edu.

DIRECTOR'S CORNER

# Director's Corner

Hello LSIC Family!

There is so much going on that I don't even know where to begin! Let's start with the Indian Space Research Organization's (ISRO) landing of the Chandrayaan-3! Congratulations! This marks the first landing in the vicinity of the lunar South Pole. Following this successful soft landing on the Moon (making India just the fourth nation ever to accomplish this!), we await the data from multiple payloads for in situ science investigations.

Also, yet another successful LSIC workshop! The Autonomy Workshop gave us community insight ranging from concern over lack of infrastructure for supporting autonomous systems to the need for a shared open-source sandbox for autonomous system development. Keep an eye out for the out-brief!

And now, as of a few days ago, we are combing through all the abstracts submitted for the LSIC Fall Meeting. Thank you to everyone who took the time to submit. You will be hearing from us very soon. This meeting is filled with tours, LunA-10 announcements, engaging breakout sessions, etc. The agenda will be finalized and posted in the upcoming weeks. Registration is open, so please sign up early because there is a cap for in-person attendance.

Two more exciting workshops are planned for 2023. Registration is open for both of these events:

- The *Transition to Commercial Lunar Operations Workshop* immediately follows the LSIC Fall Meeting on Thursday, October 12. If you are already in town (Pittsburgh) for the Fall Meeting, consider staying the extra day to take a plunge into the discussions on logistics support needed to prepare commercial industry to take the wheel. Please note that the workshop registration is combined with the Fall Meeting, so if there are questions, please let us know.
- The *Path to Sustainable Technologies in the Lunar Surface Environment Workshop* is scheduled for Tuesday, November 7. The Dust Mitigation and Extreme Environments Focus Groups are teaming up to discuss both what exists and gaps related to the combined lunar and dust environment.

Until next month, "Teamwork makes the dream work!"
Let's keep pushing … to the Moon!

## Focus Areas

Monthly Telecon Schedule

### Dust Mitigation
Third Thursdays at 12 PM Eastern

### Excavation & Construction
Last Wednesdays at 2 PM Eastern

### Extreme Access
Second Thursdays at 3 PM Eastern

### Extreme Environments
Second Tuesdays at 3 PM Eastern

### In Situ Resource Utilization
Third Wednesdays at 11 AM Eastern

### Interoperability
First Wednesdays at 1 PM Eastern

### Lunar Simulants
Second Thursdays at 1 PM Eastern

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### Surface Power
Fourth Thursdays at 11 AM Eastern

# LSIC General Updates

### Save the Date: 2023 LSIC Fall Meeting, October 10–11

LSIC will hold its Fall Meeting at the Community College of Allegheny County (CCAC) in Pittsburgh, PA, on October 10–11. The meeting will be held in a hybrid format, both in person and online.

This meeting is immediately followed by the Transition to Commercial Lunar Operations Workshop on October 12, also hosted by CCAC, and also provided in hybrid format.

Register on the LSIC website by September 24. We hope to see you at both events!

### Upcoming Meetings

- 2023 LSIC Fall Meeting, October 10–11 (hybrid)
  Hosted by CCAC, Pittsburgh, PA
- Transition to Commercial Lunar Operations Workshop, October 12 (hybrid)
  Hosted by CCAC, Pittsburgh, PA
- Path to Sustainable Technologies in the Lunar Surface Environment Workshop, November 7 (virtual)
  Hosted by the Dust Mitigation and Extreme Environments Focus Groups
- 2024 LSIC Spring Meeting, Week of April 22, 2024 (hybrid)
  Johns Hopkins Applied Physics Laboratory, Kossiakoff Center, Laurel, MD

*LSIC harnesses the creativity, energy, and resources of the nation to help NASA keep the United States at the forefront of lunar exploration. LSIC operates in collaboration with the NASA Space Technology Mission Directorate under the Lunar Surface Innovation Initiative, fostering communications and collaboration among academia, industry, nonprofits, and government. Visit http://lsic.jhuapl.edu for more information.*

## Focus and Working Group Updates

### Dust Mitigation

The Dust Mitigation (DM) Focus Group held its monthly focus group meeting on August 17. The meeting featured two technology presentations on the topic of passive and active dust mitigation: "Large-Area Nanotextured Surfaces for Passive Dust Mitigation: SBIR Phase II Project Updates and Key Questions," by Dr. Stephen Furst (Founder and CEO, Smart Material Solutions, Inc.), and "Chemically modified reduced graphene oxide (CMrGO)-based Electrodynamic Dust Shield (EDS) devices for Lunar dust mitigation," by Dr. Micah Schaible (Georgia Institute of Technology). In addition to Q&A and discussion on passive and active technologies, we had a brief overview of monthly LSIC updates and upcoming opportunities and meetings as well as a preview of the LSIC Dust Mitigation and Extreme Environments Workshop: "Path to Sustainable Technologies in the Lunar Surface Environment."

The DM and Extreme Environments Focus Groups' Path to Sustainable Technologies in the Lunar Surface Environmen Workshop will be held Tuesday, November 7. The objective for this virtual workshop is to focus on the qualification path to fielding long-lived technologies on the lunar surface. Stakeholders across industry, academia, and NASA will come together in a collaborative format to discuss the current state of the art, as well as essential knowledge and technology gaps related to the combined lunar and dust environment. Registration is now open!

You can view the recording, slides, and notes from August's DM Focus Group meeting and previous meetings on the Dust Mitigation Focus Group page.

Our next focus group meeting is Thursday, September 21, at 12:00 p.m. EDT. The meeting will include a panel discussion on testing with dust and simulants along with a discussion session. We look forward to seeing you then!

### Excavation & Construction

The Excavation & Construction (E&C) Focus Group did not hold a monthly meeting in August, to enable our community to engage in the two-day virtual LSIC Autonomy Workshop hosted collaboratively by E&C and the Extreme Access Focus Group on August 21–22. Our next monthly meeting will take place on Wednesday, September 27, at 2:00 p.m. EDT.

### Extreme Access

It has been a very busy month for the Extreme Access (EA) Focus Group, with a lot of informative speakers and a fantastic technical workshop! Our main telecon meeting featured George Lordos, Cesar Meza, and Jacob Rodriguez (Space Resources Workshop at the Massachusetts Institute of Technology). They gave a talk regarding "WORMS: Field-Reconfigurable Robots for Extreme Lunar Terrain." Our Mobility Technology subgroup hosted Peter Dillon (NASA JPL) discussing "Bulk metallic glass gear motors and the actuators for the Cold Operable Lunar Deployable Arm (COLDArm)."

On August 21 and 22, the EA Focus Group and the E&C Focus Group hosted our very first Autonomy Workshop. We entered the workshop with the goal of gathering the lunar community to exchange ideas on autonomy in support of a presence on the Moon. With that in mind, LSIC hosted a dozen technical presentations and four different panel discussions and hosted a myriad of networking opportunities. Topics for these sessions included autonomous systems, situational and self-awareness and reasoning and acting; collaborative systems; applications in autonomy on the lunar surface; and challenges in autonomy. The two days were filled with productive, in-depth conversations. We are hopeful that we can take the input from these breakout sessions and synthesize it in a way to help focus our line of thinking in the LSIC community.

### Extreme Environments

September has arrived, and we have more to look forward to than just pumpkin spice lattes! Our Extreme Environments (EE) Focus Group's September monthly meeting (Tuesday, September 12, at 3:00 p.m. EDT) will host a talk by Emily Law (NASA Jet Propulsion Laboratory) on Moon Trek. This open-source tool is a NASA interactive online portal for planetary data visualization and analysis. Our speaker will provide an overview of the visualization and analysis tools that Moon Trek can enable to facilitate lunar mission planning and exploration by NASA, commercial entities, international partners, and researchers. Hope to see you there as we all learn about this fantastic resource!

A heads up that for October, we will be canceling our monthly meeting due to the LSIC Fall Meeting—don't forget to register before September 24! Our subgroups are also planning to hold their September monthly meetings and will be updating the information via email. Stay informed by accessing the Extreme Environments Focus Group page—we look forward to your attendance and participation! Finally, we are excited to host the DM and EE Focus Groups' *Path to Sustainable Technologies in the Lunar Surface Environment Workshop* on November 7 at 10:00 a.m. EST. This virtual workshop will bring together industry, academia, and NASA stakeholders to discuss qualification paths for long-lived technologies on the lunar surface. Join us by registering here. We look forward to your ideas, suggestions, and comments!

### In Situ Resource Utilization

The In Situ Resource Utilization (ISRU) Focus Group hosted an extended telecon (approximately 2 hours) this month to highlight all seven winners of the 2023 BIG Idea Challenge. Each university team is pursuing technologies that will support a future metal production pipeline on the Moon. Each team had about 10 minutes to share their technology and progress with the community, followed by 5 minutes of Q&A for each team. The talk titles and corresponding teams are as follows:

- *Lunar Alloy Metal Production Plant (LAMPP)*
  (Colorado School of Mines)
- *Artemis Steelworks: Advancing Reactor Technologies for Electrolytic Manufacturing of In-Situ Steel*
  (Massachusetts Institute of Technology with Honeybee Robotics)
- *Lunar In-Situ Aluminum Production Through Molten Salt Electrolysis (LISAP-MSE)*
  (Missouri University of Science and Technology)
- *ACRE: Autonomous Casting RovEr*
  (Northwestern University with Wearifi, Inc.)
- *Development of the Smelting with Microwave Energy for Lunar Technologies (SMELT) System for In-Situ Resource Processing*
  (Pennsylvania State University with RFHIC and Jacobs Space Exploration Group)
- *Solid-state Integrated Manufacturing Process for Lunar Environment (SIMPLE)*
  (University of North Texas [UNT] with Advanced Materials and Manufacturing Processes Institute, Enabled Engineering)
- *Production of Steel from Lunar Regolith through Carbonyl Iron Refining (CIR)* (University of Utah with Powder Metallurgy Research Laboratory)

In September, the ISRU Focus Group monthly meeting will be pushed back a week (to September 27), to avoid conflicting with the Lunar Exploration Analysis Group (LEAG) annual meeting. As a reminder, all ISRU Focus Group meetings going forward will occur at a new time, 11:00 a.m. EDT! We'll look forward to two talks next month: Danielle Mortensen (APL, EA Focus Group) will present an overview of the NASA TechPort website and how beneficial this tool can be, and Andy Krebs (Argo Space) will discuss Argo Space's technology to develop propellant from water.

### Surface Power

The August Surface Power telecon featured a presentation by Alex Miller (ThermAvant Technologies) about recent work completed under a NASA Phase II SBIR to mature high-capacity Oscillating Heat Pipe (OHP) radiator technologies that can enable lighter, higher power density Fission Surface Power (FSP) systems. In particular, the radiator systems will be required to operate through the temperature range of lunar night and day and also be able to start up from lunar night conditions. Alex began by discussing the basic design principles underlying ThermAvant's OHP solution that is capable of rejecting fluxes as high as 100 W/cm$^2$. This was followed by an overview of recent tests utilizing a range of tube materials (copper, aluminum, stainless steel) and different alcohol mixtures that are specifically formulated to be operated for long periods of time. The talk prompted a number of questions and an interesting discussion of the importance of dust mitigation.

The Surface Power Focus Group's next monthly telecon will be hosted jointly with the Interoperability Working Group. The event will occur on September 28 and will feature presentations and discussion about the DoD/US Army Tactical Microgrid Communications and Control Standard. Jeff Csank (NASA Glenn Resarch Center) and Tom Bozada (US Army Engineer Research and

Development Center) will be the featured speakers for the event. The standard itself is a set of protocols that allows a mobile grid to optimally distribute power from a variety of sources (e.g., batteries, vehicles, diesel generators). Terrestrially, the capability is designed to better enable multi-domain operations. However, the principles of interoperability in the system are extremely applicable to lunar operations as well. If you are interested in presenting at a future LSIC Surface Power telecon, please contact Matt Clement or Samantha Andrade. We hope to see you all at the upcoming Fall Meeting in Pittsburgh!

### Interoperability Working Group

The Interoperability Working Group hopes that you have enjoyed your summer. On September 28 at 11:00 a.m. EDT, please join us and the Interoperability Working Group for a joint telecon on the DoD/US Army Tactical Microgrid Communications and Control Standard. We are in the process of confirming our fall telecon schedule; if you have an interest in presenting, please reach out to Kristin Jaburek. Also, you may wish to review the DARPA announcement of opportunity for the 10-Year Lunar Architecture (LunA-10) Capability Study.

### Lunar Simulants Working Group

The Lunar Simulants (LS) Working Group has remained quiet through August due to the plethora of amazing meetings and workshops, but we do plan to hold a talk in September! We will host the Lunar Simulants Working Group team, who will speak about their Lunar Simulants Assessment. Stay tuned for that meeting invite! Remember, the speaker series will be held on the second Thursday of the month at 1:00 p.m. EDT! If you are interested in being informed about future talks in our speaker series, please email our LS Working Group team (LSIC-Simulants@jhuapl.edu) so you can be added to our list. We are also interested in hearing about your simulant-related research and are accepting topic suggestions that you'd like to hear more about. If you would like to volunteer to be a speaker or have an idea for a topic that you'd like covered or for a speaker you'd like to hear, please email us!

# Feature Article

## Surface Power Reliability Workshop

**By: Matt Clement**

On July 26, the Surface Power Focus Group kicked off a two-day-long virtual workshop on the topic of power grid reliability on the lunar surface that drew over 150 attendees, featured a plethora of thought-provoking talks and panel discussions, and sparked a myriad of insightful discussions. Prior to this workshop, multiple speakers at other surface power events had highlighted the challenges related to quantifying and characterizing reliability when designing components and systems that might one day become part of an integrated microgrid on the Moon. Given the inherent decentralized nature of the hypothetical Moon grid, coupled with the fact that a diverse set of organizations are expected to contribute to its development, reliably providing power to both crewed and uncrewed systems on the Moon presents an inherently different challenge when compared to previous monolithic systems such as the International Space Station (ISS). While a full summary of all of the workshop's content is beyond the scope of this article, we highlight three sessions (one presentation and two panel discussions) that were particularly informative and pertinent. For anyone who missed the workshop and is interested in the topic, we highly encourage you to check out the recordings and speaker slides that are currently available on the workshop website.

***Reliably providing power to crewed and uncrewed systems on the Moon presents an inherently different challenge when compared to monolithic systems such as the ISS.***

To start the workshop, Dr. Clay Smith (APL) outlined the basics of reliability and defined several key metrics (namely reliability and availability) to ensure all participants started off on even footing:

- Reliability refers to the probability that a system will perform as intended under specified environmental conditions.
- Availability is the percentage of time that a system performs its specified function.

Clay stressed that quantifying risk requires consideration of how the system performs as a whole when its components are integrated together, and that relying on documented failure rates fails to capture the complex interactions between components and the environment. These failure rates are often only estimates under a very specific set of assumptions (e.g., manufacturing processes and material sources, which can change over time). Further, these failure rates apply only to components that have been flown before.

Determining failure rates for new, low-TRL elements requires extensive physics modeling and ground testing to determine a probability distribution for the unknown failure rate. Quantifying uncertainty in the inputs to risk quantification is truly the only way to properly address risk. This results in risk measures with large or small uncertainty bounds that can ultimately facilitate better decisions. Mission designers and systems engineers usually value predictability over lower probability of failure.

Clay also addressed several insidious failure modes that are difficult to predict and quantify, including:

- Common cause failures—events or actions that occur on orbit or during system manufacturing or assembly which eliminate system redundancies
- Cascading failures—events in which the failure of one component directly causes the failure of multiple related components

Finally, it is crucial that all intermediate states are considered when determining system reliability. Too often only the final configuration is analyzed , resulting in potentially risky intermediate configurations.

The first panel discussion of Day 1 might have been the highlight of the workshop. The discussion included four ISS power system subject matter experts with a diverse set of experiences ranging from involvement in the early conceptual studies of the 1980s, to the station construction in the 1990s and 2000s, to current operations. Jim Soeder (NASA ret.) began the panel discussion by describing the power system's development. The ISS is the largest power system that NASA has flown to date, reaching 240 kW at beginning of life. Eight power channels (75 kW per channel) at a highly regulated 120 V provide system redundancy. Because the operating voltages were much higher than those previously flown (28 V), entirely new components needed to be developed and qualified. High-voltage solar panels were a challenge as well (due to the interaction with the ambient plasma) and created electrical risks for spacewalking astronauts. Because of the complexity of the system, engineers wanted to conduct end-to-end testing of the full system but were unable to do so.

***High-voltage [ISS] solar panels were a challenge due to the interaction with the ambient plasma, and created electrical risks for spacewalking astronauts.***

Tim Lawrence (NASA ret, Lockheed Martin) was an especially engaging speaker and relayed several anecdotes about his time in the human spaceflight program. One lesson that Tim brought to the discussion was that operators should never assume that parts used at the beginning of programs will be identical to those used at the end. Manufacturing processes change and so will material properties. These can potentially cause Loss of Crew (LoC)/Loss of Mission (LoM) if not properly addressed. Another story involved a utility panel on the ISS that continuously tripped shock hazard circuits, because of current loops between power and data lines. This spoke to the need to test as you fly, using both ports simultaneously on the ground. Tim concluded with an emotional story about the Space Shuttle Columbia disaster that highlighted the human element of the space industry that was referenced again and again throughout the workshop.

The second panel on Day 1 focused on analogous approaches taken by terrestrial organizations with exemplary track records for reliability. Commander David McGlone (SUBSAFE) described the culture surrounding the US Navy Submarine Safety program. It was formed after the loss of the USS Thresher with all hands on April 10, 1963. The subsequent investigation showed that deficient requirements, manufacturing and maintenance practices, and operating paradigms all could have contributed to the disaster. The fundamentals of the program were designed to mitigate these deficiencies before they arise. SUBSAFE advised NASA after the Challenger accident, imparting some of its culture of proactive correction, a healthy obsession with the consequences of failure, and a mentality to prove that a system is safe rather than unsafe.

Bill Anderson (Naval Facilities [NAVFAC] Command) described the process his team applies to recommend acquisitions of power-generation elements to congress that result in microgrids that are resilient in the face of climate change and cyberattacks. Using Monte Carlo techniques, his team's analysis typically focuses on high-impact, low-probability events, and they develop architectures that minimize downtime and recovery time while still keeping costs low.

Joe Miller (National Science Foundation Antarctic Program) described the challenges faced by the three US Antarctic stations of McMurdo, Palmer and Amundsen-Scott. Because the primary power source for each station is a diesel generator set, the supply-chain logistics of keeping the science stations up and running are daunting, especially in the winter. There is, however, an increasing use of

renewables at the South Pole that will increase resilience and available power in case of supply-chain interruptions. He also briefly described a South Pole master planning workshop that may have some interest to the lunar community.

Finally, Brian Lee (CenterPoint Energy) spoke about the power grid that his company operates for the city of Houston, TX. CenterPoint manages over 50,000 miles of distribution cabling capable of carrying 20-GW peak loads at 12–25 kV. Because of the sheer number of components (transforming, switching, etc.), varying and uncertain component ages, and the unpredictability of power customers, commercial power grids are inherently a big data problem and are difficult to model. Maintaining such a grid without interrupting customers is an ongoing challenge. Predictive maintenance, where components are repaired or replaced on a schedule before they are likely to fail, improves the system health and customer experience.

The LSIC Surface Power team would like to express their sincerest gratitude to all the community members who participated in the workshop. The workshop clearly revealed a number of unanswered questions that will be crucial to address in the coming years. Thus, follow-on discussions, studies, and meetings will undoubtedly be required to continue to flesh out these issues and ensure a reliable, flexible, and maintainable lunar grid.

Visit the workshop website for more information.

# NASA and Community News

### Chandrayaan-3: India becomes fourth country to land on the Moon

8/23 \\ Space News \\ Andrew Jones

https://spacenews.com/chandrayaan-3-india-becomes-fourth-country-to-land-on-the-moon/

### NASA clears Crew-7 mission for launch to the space station

8/22 \\ Space News \\ Jeff Foust

https://spacenews.com/nasa-clears-crew-7-mission-for-launch-to-the-space-station/

### Pittsburgh becoming a 'space city' as Astrobotic, ProtoInnovations prepare to send technology to the Moon

8/21 \\ TribLIVE \\ Julia Felton

https://triblive.com/business/pittsburgh-becoming-a-space-city-as-astrobotic-protoinnovations-prepare-to-send-technology-to-the-moon/

### Astrobotic Collaborates with NASA for Techrise Student Challenge

8/17 \\ Astrobiotic

https://www.astrobotic.com/astrobotic-collaborates-with-nasa-for-techrise-student-challenge/

### NASA's Lunar Trailblazer Gets Final Payload for Moon Water Hunt

8/16 \\ NASA \\ Naomi Hartono

https://www.nasa.gov/feature/jpl/nasa-s-lunar-trailblazer-gets-final-payload-for-moon-water-hunt

### NASA Announces Round 1 Winners of 2023 NASA Entrepreneurs Challenge

8/10 \\ NASA \\ Karen Fox

https://www.nasa.gov/feature/nasa-announces-round-1-winners-of-2023-nasa-entrepreneurs-challenge

### NASA's Moon crew enjoys first close encounter with their Orion spaceship

8/8 \\ digitaltrends \\ Trevor Mogg

https://www.digitaltrends.com/space/nasas-moon-crew-meet-their-orion-spacecraft-for-first-time/

### Trio of tiny autonomous NASA rovers will launch to the Moon next year

8/8 \\ Space.com \\ Andrew Jones

https://www.space.com/nasa-cadre-autonomous-mini-moon-rovers-2024-launch

### Nokia's lunar network completes a major field test in Colorado

8/7 \\ Nokia Bell Labs \\ Luis Maestro Ruiz De Termino

https://www.bell-labs.com/institute/blog/nokias-lunar-network-completes-a-major-field-test-in-colorado/

### Blue Origin, Astrobotic Receive NASA Funds to Develop Power Grids for the Moon

7/25 \\ The Messenger \\ Adam Kovac
https://themessenger.com/tech/blue-origin-astrobotic-receive-nasa-funds-to-develop-power-grids-for-the-moon

# Funding Opportunities

## Tech Development Opportunities

- **10-Year Lunar Architecture (LunA-10) Capability Study**

  Abstracts Due: September 6, 2023

  White Paper and Technical Presentation Due; September 25, 2023.

- **NASA SBIR Ignite 2023 Program Solicitation**

  Proposal Due: Septmber 21, 2023

- **NSF SBIR and STTR**

  NSF recommends treating the submission window like a deadline, but you can submit anytime within a year of receiving an official invitation from NSF. (NSF uses submission windows to help gather and review proposals, but sometimes proposals are reviewed as they are received.)
  Remaining window: July 6 – November 1, 2023

- **NASA Suborbital/Hosted Orbital Flight and Payload integration Services 4 (FO IDIQ 4)**

  Offers Due: August 28, 2023

- **Technology Advancement Utilizing Suborbital and Orbital Flight Opportunities "TechFlights"**

  Full Proposals Due: October 4, 2023

- **"Fission Surface Power Advanced Closed Brayton Convertor (FSP-ACBC) system" as an Appendix to the "Space Technology Research, Development, Demonstration, and Infusion"**

  Inactive Date: July 1, 2024

## Student Tech Opportunities/Competitions

- **Lunabotics 2024**

  NASA's Lunabotics Challenge is one of the agency's Artemis Student Challenges. It provides college students from around the country an opportunity to learn and apply the NASA systems engineering process by designing and building robotic lunar excavators capable of mining regolith and icy regolith simulants

  Proposal Deadline: September 13, 2023

- **Human Exploration Rover Challenge**

  The primary objective of NASA's Human Exploration Rover Challenge (HERC) is for teams of students to design, develop, build, and test human-powered rovers capable of traversing challenging terrain and a task tool for completion of various mission tasks.

  Proposal Deadline: September 21, 2023

- **NASA Space Technology Graduate Research Opportunities – Fall 2024 (NSTGRO24)**

  NASA Space Technology Graduate Research Fellows will perform research at their respective campuses and also at NASA Centers. Each recipient will be matched with a technically relevant and community-engaged NASA researcher to serve as the research collaborator on the award. Through this collaboration, graduate students will be able to take advantage of broader and/or deeper space technology research opportunities directly related to their academic and career objectives, acquire detailed understanding of the potential end applications of their space

technology efforts, and directly disseminate research results within the NASA community.

Proposal Deadline: November 1, 2023

- **NASA TechRise Student Challenge**

  Schools are invited to join NASA in its mission to advance space exploration and enhance our knowledge of Earth. If you are in sixth to 12th grade at a U.S. public, private, or charter school—including those in U.S. territories—your challenge is to team up with your schoolmates and develop an experiment idea for one of this year's two NASA TechRise flight vehicles: a high-altitude balloon or a rocket-powered lander!

  Close Date: October 20, 2023

- **NASA's 2024 BIG Idea Challenge: Inflatable Systems for Lunar Operations (Theme Preview)**

  The Breakthrough, Innovative & Game-changing (BIG) Idea Challenge is a collegiate-level design competition sponsored by NASA and managed in a partnership with the National Institute of Aerospace (NIA) and APL. To participate, teams of approxiately 5 to 25 students will submit proposals on concepts for a wide range of solutions for inflatable technologies, structures, and systems for lunar operations. Selected teams will receive up to $180,000 to build and test their proposed inflatable solutions, then will present their test results to a panel of NASA and industry experts at the BIG Idea Forum in November 2024

  Notice of Intent Deadline: September 30, 2023

  Proposal Deadline: January 23, 2024

## Future Solicitations and Opportunities

- **NASA Innovative Advanced Concepts (NIAC) 2024 Phase I Call for Proposals**

  The NIAC program supports visionary research ideas through multiple progressive phases of study. Phase I studies are nine-month efforts to explore the overall viability and advance the technology readiness level (TRL). Eligible recipients of Phase I awards can propose for a follow-on Phase II study.