BOLD & BLUE

South Dakota State University
Jerome J. Lohr College of Engineering

JEROME J. LOHR COLLEGE OF ENGINEERING

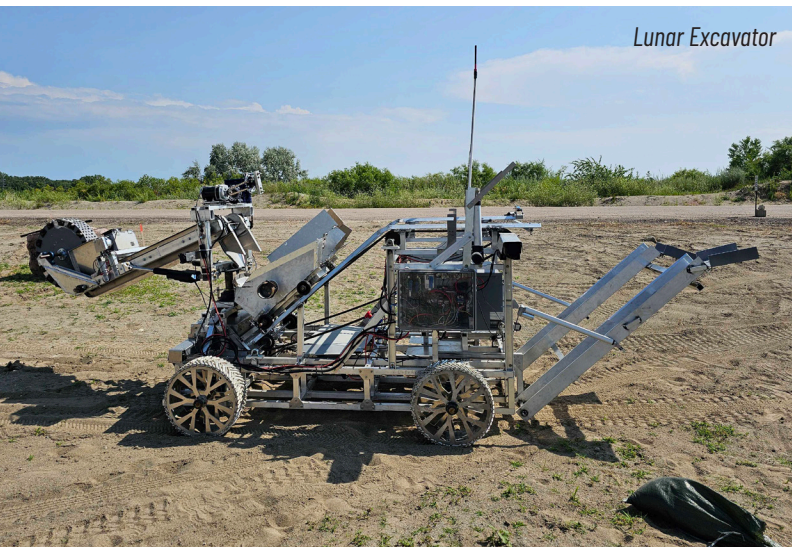
GOING TO THE MOON

LUNAR EXPLORATION REQUIRES VITAL RESOURCES — INCLUDING WATER

The stage is set for the finale of NASA's Break the Ice Lunar Challenge.

Conceived in 2020, Break the Ice tasked innovators with creating robotic systems that can traverse the volatile terrain of the Lunar South Pole. These robots must be able to dig into the Moon's regolith – the dusty, icy "dirt" that makes up the lunar surface – and transport it to a secondary location for processing. If successful, NASA can excavate the regolith from this area and use the resources derived from the materials, like frozen water, to aid astronauts living on the Moon. "Our goal is to provide solutions to make living on the Moon a reality, and Break the Ice directly contributes to that mission," said Denise Morris, program manager for NASA's Centennial Challenges. See video for more on the challenge.

In Phase 2: Level 2, the finalist pool comprised of garage inventors, academics, industry professionals, and hobbyists from 11 U.S. states, the Netherlands, and India. Nine of these teams attempted a 15-day demonstration trial at their own testing sites to prove the capabilities of their prototypes. The teams live-streamed the tests and took turns hosting representatives from Centennial Challenges for in-person observations.



Lunar Excavator

Phase 2: Level 2 winning teams are:
1st Place ($300,000): Starpath Robotics (San Francisco, CA)
2nd Place ($200,000): Terra Engineering (Gardena, CA)
3rd Place ($125,000): The Ice Diggers (Golden, CO)
Runners Up ($75,000 each):

- Cislune Excavators (Los Angeles, CA)
- **Space Trajectory (Brookings, SD)** **(video story)**
- MTU Planetary Surface Technology Development Lab (Houghton, MI)

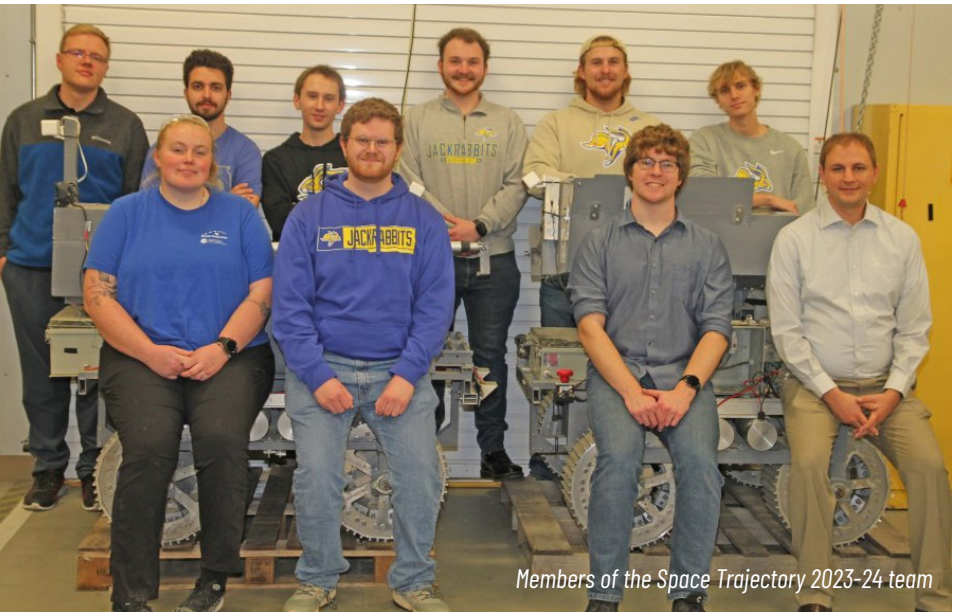
In the last round of competitions, scheduled for June 10-12, 2024, the above winners will bring their prototypes to a NASA-designated test facility in Huntsville, AL for a series of head-to-head matchups. Expected testing includes excavation under reduced gravity – using gravity off-loading – and transportation over complex terrain, including rocks, craters, slopes, turns, and loose granular soil.

This final round of competition will offer up to $1.5 million in cash prizes, split between first place ($1 million) and second place ($500,000). NASA will also award opportunities for teams to test their concepts at one of the agency's Thermal Vacuum Chambers, which can simulate the temperature and vacuum conditions at the Lunar South Pole.

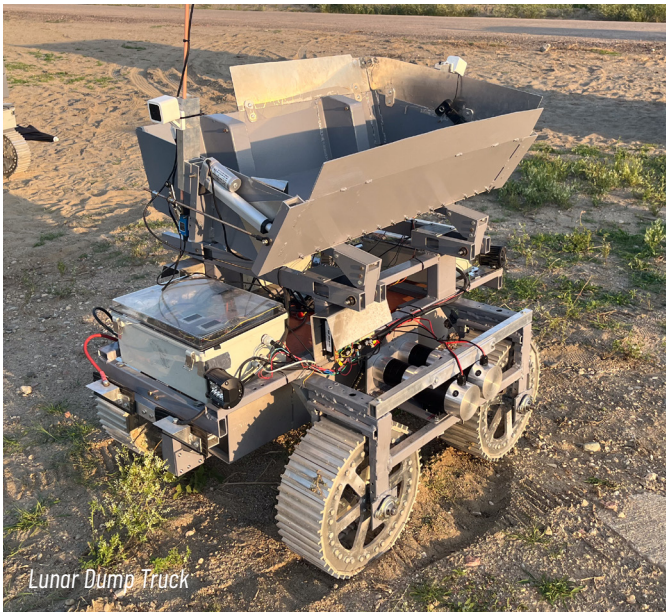
The SDSU - **Space Trajectory** team is already at work redesigning and fabricating their excavator for the next phase of the competition. This team consists of 2 – faculty, 2 – graduate students and 15 - undergraduate students. Completing the design, fabrication, testing and transportation for the final round of the competition will require additional resources.

Estimated Financial Support Needed:	$250,000
Current Available Support:	$100,000

Objective: Finish in the top two of Level 3. That will require some redesign, refabrication and rehearsal and potentially fabricate some additional test fixtures for rehearsals. There will be expenses for renting a space suitable for the rehearsal and for travel to the head-to-head testing event in Huntsville, Alabama.



Members of the Space Trajectory 2023-24 team


Lunar Dump Truck

IMPACT OF TRANSFORMATIVE LEARNING EXPERIENCES - NASA PROJECTS AT SDSU

The NASA "Break the Ice Challenge" project stands at the forefront of interdisciplinary collaboration, innovation, and hands-on learning, offering invaluable experiences for undergraduate students transcending beyond only space exploration.

Through the lens of diverse areas such as Manufacturing, Agriculture, Product Design, and Leadership, this effort highlights the multifaceted skills and competencies honed by the student participants.

- **Technical Proficiency:**
  - Students engage in iterative design optimization, fostering creativity and adaptability.
  - CAD modeling, simulations, and hands-on prototyping cultivate robust engineering expertise.
  - Emphasis on weight and cost reduction encourages innovative problem-solving and collaboration.
- **Communication and Collaboration:**
  - Effective communication across diverse platforms and disciplines strengthens teamwork.
  - Collaborative efforts with stakeholders enhance adaptability and interdisciplinary skills.
  - In-person meetings, virtual collaborations, and clear articulation of ideas foster effective communication strategies.
- **Life Skills Development:**
  - Cultivation of accountability and time management instills professionalism and responsibility.
  - Conflict resolution skills are honed through teamwork and project management.
  - Encouragement of a competitive spirit and pride in workmanship fosters a sense of achievement and ownership.
- **Real-World Application:**
  - Transferable skills acquired in the project find application in diverse industries beyond space exploration.
  - Adaptation to challenging environments and problem-solving in GPS-denied areas offer practical experience.
  - Strategic planning and robustness considerations prepare students for real-world challenges and unforeseen circumstances.
- **NASA - Path to Flight Concept:**
  - Implementation of a strategic development approach ensures scalability and feasibility of solutions.
  - Continuous refinement of ideas and solutions paves the way for groundbreaking advancements.
  - Emphasis on practicality and adaptability ensures readiness for future implementations and innovations.

Team Demographics:
Faculty Advisors – Dr. Todd Letcher (ME); Jason Sternhagen (EE)
Students (13): ME (9) / EE (4); UG (11) / Grad (2)

In summary, this project offers a transformative learning experience, equipping students with technical prowess, effective communication, and invaluable life skills. With real-world applicability and a strategic pathway to innovation, we empower the next generation of leaders and innovators

ADDITIONAL INFORMATION

Inquiries regarding the projects, contact:
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