

## **NASA MUREP Space Technology Artemis Research (M-STAR) Implementation Awards**

**Title: MUREP Advancing Regolith-related Technologies & Education (MARTE)**

**Institution: New Mexico State University**

**City/State: Las Cruces, NM**

**PI: Douglas Cortes**

### **Summary:**

Two minority serving institutions (New Mexico State University and San Diego State University), three industrial partners (Russell Sand Gravel, AeroAggregates, and Spaceport America), three STEM outreach and education partners (NMSU STEM Outreach Center, New Mexico Alliance for Minority Participation, New Mexico Space Grant Consortium) and a representative from the Space Technology Mission Directorate funded Lunar Surface Innovation Consortium (John Hopkins University) propose developing the research, academic, and technology capabilities of our MSIs in three key areas of need: i) regolith simulants; ii) testing facilities to simulate relevant environmental conditions; and iii) field testing sites.

The main goal of the “regolith simulants” activities is to establish a reliable, affordable, adaptable, and scalable supply chain of regolith simulants to satisfy the needs of our research and education thrusts. This will be achieved by working in collaboration with our industrial partners Russell Sand Gravel Co., Inc, and AeroAggregates LLC to develop, manufacture and stockpile regolith simulants.

The major goal of the “testing facilities to simulate relevant environmental conditions” activities is to develop a modular Dusty Thermal Vacuum Chamber (DTVC) capable of simulating lunar subsurface conditions while meeting the specific demands of varied testing applications with minimal required investment in modifications. To achieve the proposed research thrust goal, our team will design, instrument, assemble, and validate a modular DTVC capable of producing a medium vacuum (10-4 to 10-7 Torr) and reaching a temperature of -50°C while filled with Lunar regolith simulant.

The key “field-testing sites” activities goal is to create a unique field-testing site to support analog missions, promote collaborations with NASA and industry, advertise the work of our researchers, and deploy STEM outreach activities. This goal will be achieved by working together with our industrial partner Spaceport America to design, build, and instrument field-testing infrastructure to study regolith-based construction materials for Lunar landing/launching pads. In addition, in collaboration with our STEM outreach and education partner New Mexico Space Grant Consortium, we will plan, support, and pursue funding for a Lunar pad student challenge.

Last but not the least, in order to create meaningful STEM engagement opportunities for middle school, high school, undergraduate, and graduate students, our educational thrust will synergistically integrate our research and education activities. This will be accomplished by leveraging our knowledge base and NMSU STEM Outreach Resources to develop and implement culturally relevant middle school and high school curriculum for after-school

programs at institutions with large minority and underserved student populations, and by engaging college students from diverse groups in meaningful research and mentoring experiences.

Regolith-related technologies are at the core of all six target capabilities identified by the Lunar Surface Innovation Initiative as critical to the live on and explore thrusts. Our team of faculty brings together a wealth of knowledge in terrestrial granular media characterization, thermo-chemo-mechanical behavior, tool/robot interaction, performance improvement, and resource extraction. We also share the excitement about extending our work beyond our home planet in support of the exploration of the Moon and ultimately of Mars, and a clear commitment to supporting and promoting STEM education and outreach. If funded, our multidisciplinary team will become well poised to leverage the capabilities generated by the M-STAR Implementation Grant to become an innovation hub around which faculty, students, and local businesses, who would not typically participate in NASA-related research, can come together to significantly contribute to space exploration.