

Appendix A

Center for Lunar Science and Exploration

The **Lunar and Planetary Institute (LPI)** and the **Johnson Space Center (JSC)** have a long and successful history of collaborative research and exploration activities that began with the Apollo program. The LPI and JSC harnessed that heritage to build the **Center for Lunar Science and Exploration** to better support our nation's new lunar science and exploration activities.

The Center is a founding member of both NASA's Lunar Science Institute and the NASA Solar System Exploration Research Virtual Institute and is designed to:

1. Develop a core, multi-institutional lunar science program that addresses the highest science priorities identified by the National Research Council (NRC) for NASA;
2. Provide scientific and technical expertise to NASA that will infuse its lunar research programs, including developing investigations that influence current and future space missions;
3. Support the development of a lunar science community that both captures the surviving Apollo experience and trains the next generation of lunar science researchers;
4. Complement those activities with studies of near-Earth asteroids that have modified the evolution of the Earth-Moon system and may be targets for future human exploration.
5. Use that core lunar and near-Earth asteroid science to develop education and public outreach programs that will energize and capture the imagination of K-14 audiences and the general public.

To meet those objectives, CLSE designed and integrated a series of science, exploration, training, and education programs.

Science. The LPI-JSC team is augmented by faculty, students, and analytical facilities at several partner institutions, which evolve in response to agency needs. University research partners within the United States have included the University of Arizona, University of Hawaii, University of Houston, University of Maryland, University of Notre Dame, University of Western Carolina, and Rutgers University. The program has been enriched by international partners at Imperial College London (United Kingdom), University of Manchester (United Kingdom), Birkbeck College London (United Kingdom), Australian National University (Australia), Curtin University of Technology (Australia), Swedish Museum of Natural History (Sweden), Université de Sherbrooke (Canada), Westfälische Wilhelms-Universität Münster (Germany). The team was also been augmented with research scientists at the American Museum of Natural History, Arecibo Observatory, the United States Geological Survey, the

NASA Goddard Space Flight Center, the NASA Marshall Space Flight Center, and the Planetary Science Institute.

This collaborative program is built around the Apollo sample collection, which provides the highest-fidelity view of the lunar surface for a new generation of lunar scientists, and the Antarctic meteorite collection, which provides an immense number of near-Earth asteroid samples. The team's initial science theme was driven by the highest-priority science concept (the bombardment history of the inner solar system is uniquely revealed on the Moon) and highest-priority goal (to test the lunar cataclysm hypothesis) that were identified by the National Research Council (2007) for NASA's Science Mission Directorate. This investigative theme will carry us from the earliest moments of the Moon's origin through the immensely important basin-forming epoch to new analyses of impact contributions to the lunar regolith. The team's work will explore the role of near-Earth asteroids in those processes and how their collisional history may be driven by other Solar System processes, both in the past and in the context of future impact hazards. More recently, the scope of the team's research has grown to support the full scope of the Artemis program.

Exploration. The Center's activities were designed to integrate the objectives of NASA's Science Mission Directorate (SMD) with the exploration objectives of NASA's Human and Exploration Operations Mission Directorate (HEOMD), including its successors, and have evolved in response to the agency's Artemis initiative. The team's experience with lunar surface samples, asteroid samples, impact cratered terrains, and volcanic terrains will help integrate science and exploration activities and develop operational procedures for future lunar surface activities.

Training. Future space exploration depends critically on our ability to train young people. The Center for Lunar Science and Exploration developed a pipeline of capability that feeds into research and development programs associated with SMD and the new directorates that evolved from HEOMD in response to Artemis. The Center's programs support undergraduate and graduate student interns and post-doctoral fellows at LPI and JSC. It also provides field-based training and research programs in planetary surface terrains like Meteor Crater and the Sudbury impact structure.

Education and Public Outreach. In addition to enhancing existing lunar and near-Earth asteroid data at LPI and JSC, the results of our science investigations are mined to generate a dynamic education and public outreach (E/PO) program. Activities are designed to assist teachers with their classroom activities and provide materials for those activities. Other activities are designed to reach students at all levels directly, including resources for university students. The Center for Lunar Science and Exploration will build on a long heritage of E/PO products generated by the LPI and JSC staff.