THE MOON – A GUIDING LIGHT FOR SPACE EXPLORATION. David A. Kring[1,2], [1]USRA-Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058 (kring@lpi.usra.edu), [2]Center for Lunar Science and Exploration, NASA Lunar Science Institute.

Introduction: The National Research Council (2007) defined the science objectives for future lunar exploration and outlined how they can affect models for the evolution of the entire solar system. The Lunar Exploration Analysis Group (Draft Roadmap 2009) has integrated those science objectives with additional objectives related to the sustainability of space exploration and its expansion beyond the Moon. In part to meet those science objectives and integrate them with a successful robotic-human exploration program, NASA's Science Mission Directorate (SMD) and Exploration Systems Mission Directorate (ESMD) created the NASA Lunar Science Institute and selected seven teams to provide a catalyst for that development. To illustrate the impact of that program, I have been asked to provide a status report of first year activities for one of those teams, the LPI-JSC Center for Lunar Science and Exploration (http://www.lpi.usra.edu/nlsi/).

Science: Our team is testing the giant impact hypothesis for the origin of the Moon, testing the lunar cataclysm hypothesis for the early bombardment of the Earth-Moon system (and all other inner solar system planets), and assessing the post-basin-forming impact flux. The work involves a large program of analysis that is impossible within the limits of traditional research and analysis programs. Initial results are providing baseline isotopic compositions for the bulk Moon, an integrated analysis of complementary radiometric systems affected by impact cratering processes, and a similar study to trace the evolution of the lunar regolith: http://www.lpi.usra.edu/nlsi/publications/.

Exploration: Science team members have been working closely with exploration architects, hardware development engineers, mission operations staff, and the astronaut office to develop realistic mission concepts for specific locations on the lunar surface and to test operational concepts in full-scale simulations of lunar missions. The former are conducted at LPI and JSC, while the latter often involve field exercises at lunar analogue sites with the NASA JSC Desert Research and Technology Studies (DRATS) group. Portions of the team have also been tasked to help train a new class of astronauts about impact cratered surfaces, the lithologies associated with them, and sampling concepts that can be used to accomplish science and exploration objectives.

Training: We are providing undergraduate and graduate students with research opportunities at their universities and in Houston. In addition, we have developed a Lunar Exploration Summer Intern Program (http://www.lpi.usra.edu/lunar_intern/) that has, thus far, involved five teams of graduate and advanced undergraduate students in studies of lunar landing sites. These teams have evaluated areas on the Moon where four of the eight concepts identified by the NRC (2007) can be addressed. Furthermore, they produced a strong recommendation for a mission to the Schrödinger Basin (http://www.lpi.usra.edu/nlsi/publications/), where we can determine the duration of the entire basin-forming epoch and provide calibration bench marks for more recent epochs in planetary evolution. Those training activities have been augmented by college-level classroom activities that are being fostered by the Lunar Consortium for Higher Education. A high school-level program has also been organized. Finally, we have developed a Field Training and Research Program at Meteor Crater to train graduate and advanced undergraduate students to work in impact cratered terrains (http://www.lpi.usra.edu/nlsi/mcFieldCamp/).

Conclusions: These lunar activities demonstrate that:

- The Moon is the best and most accessible place in the solar system to address fundamental questions about our origins. Lunar science is answering questions about the formation and early evolution of the Earth-Moon system, providing the data needed to evaluate impact cratering's effect on the origin and early evolution of life, determining the magnitude of impact bombardment of all terrestrial planets (including Mars), providing a calibrated timeline for the geologic history of those same planets, and revealing unexpected details about accretion and orbital evolution of the outer solar system planets.
- An integration of science into exploration planning, the development of mission concepts, and the testing of surface operations in analogue terrains is reducing the risk, while enhancing the productivity, of future mission activities. We are developing the tools needed to explore the Moon and beyond, including Mars.
- Robotic-human exploration of the Moon is inspiring students and producing a level of excitement that currently overwhelms our capacity to satisfy it, even with the current level of NLSI support. The program needs to grow to have the maximum impact on the technical and intellectual capabilities of the next generation.