

Educating the Next Generation of Lunar Scientists. A. J. Shaner^{1, 2}, S. Shipp^{1, 2}, J. Allen^{1, 3}, D. A. Kring^{1, 2},
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Introduction: The Center for Lunar Science and Exploration (CLSE), a collaboration between the Lunar and Planetary Institute (LPI) and NASA's Johnson Space Center (JSC), is one of seven member teams of the NASA Lunar Science Institute (NLSI). In addition to research and exploration activities, the CLSE team is deeply invested in education and public outreach. In support of NASA's and NLSI's objective to train the next generation of scientists, CLSE's High School Lunar Research Project is a conduit through which high school students can actively participate in lunar science and learn about pathways into scientific careers.

The High School Lunar Research Project provides a national science standards-based, authentic research experience for secondary students. With the aid of a scientist mentor, student teams undertake research projects that envelop them in the process of science while supporting the science goals of CLSE. The objectives of the program are to enhance 1) student understanding of the nature of science; 2) changes in student attitudes toward science and science careers; and 3) student knowledge of lunar science. The 2009-2010 program was used as a pilot to develop and evaluate the program's logistics. Four schools from Binghamton, NY, San Antonio, TX, Springfield, MO, and Waco, TX participated in the pilot.

The 2010-2011 academic year marks the second year of the program. 10 teams from nine schools across the country are participating in the 2010-2011 program. Three of these schools participated in the pilot. Participating schools are located in Belfry, KY; Bellaire, TX; Binghamton, NY; Chattanooga, TN; Houston, TX; McClellan, CA; Pelham, AL; San Antonio, TX; and Springfield, MO (Figure 1).



Figure 1. Nine high schools from across the U.S. are participating in the 2010-2011 program.

“Moon 101”: Most high school students' exposure to lunar science is limited to lunar phases and tides. Before beginning their research, students undertake “Moon 101,” a guided inquiry activity designed to familiarize students with lunar geology and exploration. Students read articles covering various lunar geology topics including impact cratering, volcanism, and tectonics. Students also analyze images from past and current lunar missions to familiarize themselves with available lunar data sets. At the end of “Moon 101”, students present their findings about the geology and chronology of features in the region surrounding the Apollo 11 landing site. Students give their presentation using the Adobe Connect videoconferencing software provided by NLSI (Figure 2).

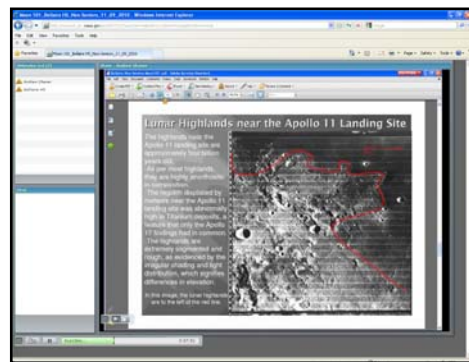


Figure 2. Students give their Moon 101 presentations over the Adobe Connect software provided by NLSI.

Student Research: Most high school students' lack of scientific research experience leaves them without an understanding of how to conduct research. Because of this, each team is paired with a lunar scientist mentor responsible for guiding students through the process of conducting a scientific investigation.

To begin their research, teams choose a research subject from a pool of topics compiled by the CLSE staff that fall within the scope of CLSE research and are appropriate at the high school level. After choosing a research topic, and with the assistance of their mentors, student teams ask their own research questions (within the context of the larger question), and design their own research approach to direct their investigation. At the conclusion of their research, teams present their results to CLSE staff, mentors, and other student teams. These presentations are also given over Adobe Connect (Figure 3). After receiving feedback, each

team creates, and presents, a conference style poster to CLSE staff, mentors, other student teams, and a panel

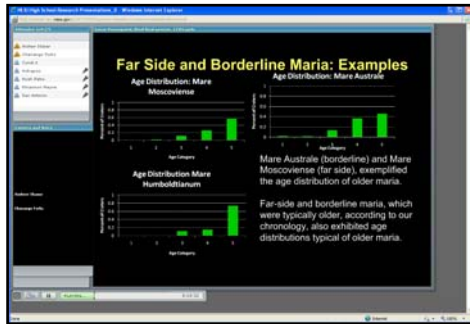


Figure 3. Students present their research findings over the Adobe Connect videoconferencing software.

of lunar scientists. This panel judges the presentations and selects four teams' posters, those with the highest scores, to be displayed at the annual NLSI Forum held at NASA Ames in July. The team with the highest score is invited to attend the forum and present their work in person.

In addition to research, teams interact with lunar scientists during monthly webcasts in which scientists present information on lunar science and careers. Working with school guidance counselors, the CLSE staff assists interested students in making connections with lunar science faculty across the country.

Evaluation: Three instruments have been developed/modified to evaluate the extent to which the High School Lunar Research Project meets its stated objectives. These three instruments measure changes in student understanding of the nature of science, attitudes towards science and science careers, and knowledge of lunar science. Exit surveys for teachers, students, and mentors were also developed to illicit general feedback about the program.

The nature of science instrument is an open-ended, modified version of Lederman's [1] Views of Nature of Science questionnaire. The science attitudes Likert-scale instrument is a modified version of Gogolin and Swartz's [2] Attitudes Toward Science Inventory developed by Slater, Slater, and Shaner [3]. The lunar science content instrument was developed by CLSE education staff. All three of these instruments are given to students pre and post to measure the program's impact on students' understanding of the nature of science, attitudes toward science, and understanding of lunar science.

Feedback from exit surveys revealed two prominent lessons learned from the High School Lunar Research Project pilot program. First, students need more time to complete their research. Second, both teachers and mentors believe more direction and a more con-

crete explanation of expectations should be given at the beginning of the program. Despite feeling the need for more direction, both teachers and mentors recognized the necessity of the projects' ambiguity and praised the program for its ability to expose students to the process of science. Feedback from student exit surveys also revealed that the program influenced some students to consider a career in science or helped to strengthen their current desire to pursue a career in science.

Looking Ahead: In light of these evaluation results, a few questions arise when looking ahead. How do we meet the needs of our participants without compromising the program's open inquiry philosophy? What level of understanding of the nature/process of science do we hope students achieve? How do we continue to support/groom interested students after their experience with the program? Should the lunar community be working to develop "exchange" opportunities for students in other science experiences?

References: [1] Lederman, N. G., Abd-El-Khalick, F., Bell, R. L. and Schwartz, R. S. (2002), Views of nature of science questionnaire: Toward valid and meaningful assessment of learners' conceptions of nature of science. *Journal of Research in Science Teaching*, 39, 497-521. [2] Gogolin, L., & Swartz, F. (1992), A quantitative and qualitative inquiry into the attitudes toward science of nonscience college students. *Journal of Research in Science Teaching*, 29(5), 487-504. [3] Slater, S. J., Slater, T. F., Shaner, A. J. (2008). Impact of backwards faded scaffolding in an astronomy course for pre-service elementary teachers based on inquiry. *Journal of Geoscience Education*, 56(5), 408.