

EVALUATING THE HIGH SCHOOL LUNAR RESEARCH PROJECTS PROGRAM. A. J. Shaner^{1,3}, C. Shupla^{1,3}, S. Shipp^{1,3}, J. Allen^{2,3}, D. A. Kring^{1,3}, ¹Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX 77058, ²NASA Johnson Space Center – ARES, ³LPI-JSC Center for Lunar Science and Exploration.

Introduction: The Center for Lunar Science and Exploration (CLSE), a collaboration between the Lunar and Planetary Institute and NASA's Johnson Space Center, 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 outreach. In support of NASA's and NLSI's objective to train the next generation of scientists, CLSE's High School Lunar Research Projects program is a conduit through which high school students can actively participate in lunar science and learn about pathways into scientific careers. The objectives of the program are to enhance 1) student views of the nature of science; 2) student attitudes toward science and science careers; and 3) student knowledge of lunar science. In its first three years, approximately 168 students and 28 teachers from across the United States have participated in the program.

Before beginning their research, students undertake Moon 101, a guided-inquiry activity designed to familiarize them with lunar science and exploration. Following Moon 101, and guided by a lunar scientist mentor, teams choose a research topic, ask their own research question, and design their own research approach to direct their investigation. At the conclusion of their research, teams present their results to a panel of lunar scientists. This panel selects four posters to be presented at the annual Lunar Science Forum held at NASA Ames. The top scoring team travels to the forum to present their research in person.

Evaluation Instruments: Three instruments have been developed or modified to evaluate the extent to which the High School Lunar Research Projects meets its objectives. These three instruments measure changes in student views 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 elicit general feedback about the program and its impact.

The nature of science instrument is an open-ended, modified version of the Views of Nature of Science questionnaire [1]. The science attitudes Likert-scale instrument is a modified version of the Attitudes Toward Science Inventory [2]. The lunar science content instrument was developed by CLSE education staff. All three of these instruments are administered to students before and after their research experience to measure the program's impact on student views of the

nature of science, attitudes toward science, and knowledge of lunar science. All instruments are administered online via Survey Monkey®.

Evaluation Results:

Lunar Science Content Survey This survey evaluates changes in student knowledge of the Moon's formation, lunar geology, the lunar cataclysm, relative dating of surface features, and differences between high-resolution versus low-resolution spacecraft imagery. Data show that the number of students describing the Giant Impact Hypothesis (GIH) as the leading explanation for the Moon's formation increased by 21% (Fig. 1). Another notable result was that students' ability to identify the three main types of feature seen on the Moon with the naked-eye increased from pre to post.

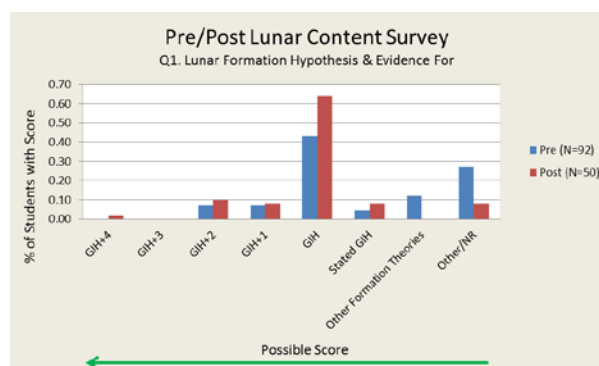


Fig. 1. Students showed improvement in their identification of the GIH as the leading explanation for the Moon's formation.

Attitudes Toward Science Data from the pre and post attitude survey suggest that the research program does little to alter students' attitudes toward science. A strong majority of students enter the program with very positive attitudes toward science. Post survey responses show that these attitudes remain the same following the program. This is not surprising as most students participating in this type of program do so because they already have a strong interest in science.

Views of Nature of Science We use a modified version of the Views of Nature of Science questionnaire to look for changes in students' views of the nature of science. A difficulty with the use of the instrument is the absence of a standardized rubric to assess student responses. To evaluate changes in student views of the nature of science, student responses were coded, or grouped into similar themes that arose from individual

responses. It is difficult to conclude from the pre/post results if students' participation in the research program had an effect on their views of the nature of science. Follow-up interviews with students would shed more light on their responses, however, conducting these interviews to verify our interpretations is impractical given the relatively large sample size (Pre N = 83, Post N = 49).

Student Exit Survey This survey asks students for general information including their grade level, extra-curricular activities, and time they spent on their research project. The survey also asks how the program affected them personally, including their views on a science career. Just under half (41.5%) of the students reported that their experience in the program has contributed to their consideration of a career in science. When asked how the program affected their potential career choice, one student replied, "This taught me what it's like to be a scientist, and it doesn't really seem completely unattainable and alien anymore." Another student said, "It gave me a lot of experience and helped me decide that this is a career I feel I could be successful in." About 77% of students report viewing the Moon differently than they did before the program. Many of them explain that the Moon is "not just a grey rock" but "rather an object that is telling its life story and explaining what has happened in the past."

Teacher Exit Survey The teacher survey asks teachers for general information including number of years taught, courses taught, and what other types of authentic research experiences they have been part of in the past. When asked how this program is different from their past experiences, one teacher replied, "It is truly student inquiry with far broader scope." Another teacher said, "This program provides students the opportunity to perform authentic scientific research on a greater scale than high school science fair. It also provides students the initiative by providing the opportunity to present their research at a professional conference." One hundred percent of teachers rated the Moon 101 activity as "Excellent" or "Good." Eighty three percent rated the research portion as "Excellent" and 83% rated the entire experience as "Excellent." When asked about obstacles teams had to overcome to succeed, teachers described issues with time, student motivation and technology. However, every teacher enthusiastically agreed that the authentic research experience was worthwhile to their students.

Mentor Exit Survey Items on the mentor survey mainly deal with their experience as a program mentor. Eighty percent had never mentored high school students before. Their reasons for being a mentor included having the opportunity to excite students about lunar science and the chance to educate young people. All

mentors reported spending no more than two hours per week working with their teams. Every mentor who completed the survey would recommend others to be mentors.

Discussion: The evaluation of the High School Lunar Research Projects program is only as strong as the instruments used to evaluate the program. Though the lunar science survey has not been validated, the evaluators feel the instrument can be successfully used for this program's purposes with validation. Pre and post data from the attitude inventory showed little to no change in student attitudes toward science and science careers. Analyzing student pre and post responses to the Views of Nature of Science questionnaire indicate that student understanding of the nature of science is affected very little, if at all, by the program. However, a key activity not done by the program is conducting follow-up interviews with students to discuss their responses on the instrument. This is impractical due to the relatively large sample size. We plan to further modify these instruments and the program going forward to better assess the impact on students and to create a more impactful program. Specifically, further modification to the nature of science instrument will take place to focus on particular aspects of science the program can best address.

Despite seeing a ceiling effect in the attitudes data, teacher and student exit survey data show that the experience changes students' attitudes toward science and science careers. Other feedback from the exit surveys show that, currently, minimal changes to the program's logistics should be made. This will continue to be evaluated in outgoing years.

References: [1] Lederman, N., Abd-El-Khalick, F., Bell, R., & Schwartz, R. (2002) *Journal of Research in Science Teaching*, 39(6), 497-521. [2] Gogolin, L., & Swartz, F. (1992) *Journal of Research in Science Teaching*, 29(5), 487-504.

Additional Information: If you have any questions regarding the High School Lunar Research Projects, please contact Andy Shaner at 281-486-2163 or shaner@lpi.usra.edu.