

STUDENT PLANETARY INVESTIGATORS: STUDENTS EXPLORING THE MOON THROUGH MINI-RF.

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Introduction: The Student Planetary Investigator (PI) Program was created by the Johns Hopkins University Applied Physics Laboratory (APL) Space Department Education and Public Outreach office with support from NASA mission and instrument science and engineering teams.

The program is free and open to teams of students across the country, high school through college. The program provides students with authentic research experiences in the classroom. The program is conducted via distance learning technologies and is designed to provide maximum flexibility for student teams. Live classroom sessions are mostly conducted during after school hours; the sessions are archived for teams that wish to watch at alternate times. Students communicate regularly with peers and science team members through an online bulletin board that is moderated by the Student PI Program manager.

Exploring the Moon: The inaugural Student PI Program focuses on the Mini-RF instrument. Mini-RF, which stands for Miniature Radio Frequency, is a radar instrument orbiting the Moon on NASA's Lunar Reconnaissance Orbiter. It is mapping the lunar poles, searching for water ice and demonstrating new communications technologies. What it finds will support future missions to the Moon. Student PI participants make authentic contributions to this effort. Students directly observe scientists present their methods for research and have the opportunity to model their research similar to the scientists.

For the Mini-RF Student PI program, students (under mentor guidance) join the science team in analyzing real Mini-RF data, using the same software and techniques the mission scientists use. Students develop hypothesis and projects based on data analysis, later presenting their work for peer and science team review. The Student PI program uses Blackboard's Elluminate system to connect scientists, mentors and students from around the country.

During the first year of beta-testing (Sept 2010-May 2011), students were presented with information about Moon exploration from the history to current research, and how scientists are using current data through the Mini-RF instrument to make detailed observations for future exploration of the lunar surface. During this period, approximately 50 students participated in the live presentations and subsequent research activities in the spring of 2011.

Students were presented with two distinct research possibilities utilizing previously selected "Regions of Interest" proposed for the Constellation program. Students could (1) pick a site on the lunar surface that was of interest to their team and provide a compelling case for why scientists should study that area for human exploration, or (2) using a list of 50 available research sites from the "Regions of Interest", rank those sites based upon student interpretation of science value and engineering feasibility.

Integration: The Student PI curriculum materials were designed based on the National Science Education Standards, to allow schools to integrate the curriculum into their existing science programs. Because of the format of the program, rural schools were able to participate and provide their students with opportunities for authentic research. This can be observed from the following teacher submissions:

- We are a very small very rural low income school in which the students have very little ability to travel or participate in other learning opportunities. This type of activity would be a great way to bring authentic science to our school and to expose young women to careers in science and engineering.
- It is important that students feel that they are involved in a project that is useful rather than something that is just busy work. Students are excited about space and technology these two together with a meaningful project will encourage students to consider science more strongly than they might have otherwise.



Students presenting their research using MiniRF data

Educational Impact: The Student PI program is a student driven program that allows students to connect directly with scientists working in the field, as well as with a working NASA instrument. This combination of factors raises the bar for students in a way that develops a sense of ownership of the data they collect, thereby increasing their understanding of the science concepts being presented.

For the 2011-2012 year, there are 10 teams participating in the program, including traditional school systems, after school programs and informal science facilities. This diversity of student participation shows the range with which the Student PI program can operate, and the importance of involving students in authentic research.

student participation in STEM (Science, Technology, Engineering and Mathematics) related fields (careers, post-secondary education, etc.).



Students conducting research using geologic samples

Modifications: After evaluating the initial beta-test for the Student PI program, it was determined that modifications would include both scheduling changes as well as additional meeting times to help refine research presentations.

- **Scheduling modifications:** Most of the presentations (Moon basics, data analysis, Mini-RF, research assignments) will take place during the fall semester to reduce the conflict of spring semester commitments for most schools.
- **Research presentations:** Students need more time and guidance when developing their research ideas. More time will be given to teams to allow for more scientist/student interaction when developing research plans.

Future Outcomes: Data about the Student PI program will continue to be collected and evaluated. Modifications for the current school year (2011-12) are being implemented with positive results, showing that teams are continuing to be engaged with the scientific process. With continued monitoring and evaluation of the Student PI program, we hope to see increased