

PLANETS ARE PLACES TOO: PROFESSIONAL DEVELOPMENT WORKSHOPS FOR K-8 TEACHERS. L. F. Bleamaster III^{1,2}, D. A. Crown¹, T. L. Canizo^{1,3}, and L. A. Lebofsky¹, ¹Planetary Science Institute, 1700 E. Fort Lowell Rd., Suite 106, Tucson, AZ 85719 (lbleamas@psi.edu), ²Trinity University Geosciences Department, One Trinity Place, San Antonio, TX 78212, ³Tucson Regional Science Center, 2025 E. Winsett Street, Tucson, AZ 85719.

Introduction: Using NASA data sets, results of currently funded NASA research investigations, and a team of Earth and space scientists and educators, the Planetary Science Institute (PSI), in partnership with the Tucson Regional Science Center (RSC), is offering a series of professional development workshops targeting elementary and middle school teachers within the Tucson, Arizona region. Capitalizing on the curiosity, enthusiasm, and inspiration created by NASA missions, images, and data, we are encouraging interest in planetary science and space exploration to enhance Science, Technology, Engineering, and Math (STEM) learning and teaching. Workshop participants are given the opportunity to improve their content knowledge and conceptual understanding of fundamental concepts in astronomy, geology, and planetary science, which in turn leads to their greater scientific confidence and more positive attitudes towards science. Teacher interaction with scientists during and after our workshops helps them to better model science practices and to identify potential career paths for their students. The current work includes offering two workshops: *The Moon-Earth System* and *Exploring the Terrestrial Planets*, with a plan to develop additional workshops (e.g., *Volcanoes of the Solar System*) and to increase distribution to locations other than southern Arizona.

Our workshops are focused around a simple theme – “Planets are Places Too.” To many, our planetary neighbors are simple points of light in the night sky or mysterious and puzzling places that seem far different than our Earth. Many teachers desire to introduce their students to these other worlds, but lack the content background. Achieving this knowledge can seem an overwhelming challenge, given the time available and monetary constraints. Our aim is 1) to provide teachers with a mechanism for exploring these other worlds by providing content and directing them to resources, 2) to give them the chance to experience these worlds as places by using their own senses, such as touch and sight, and 3) to relate these worlds back to our own Earth. Teachers are provided with the tools and background they need to pass this experience on to their students so they too can learn about these other worlds in the same fashion they learn about their own planet.

Relevance to NASA: Our professional development workshops fit into the Elementary and Secondary

Education Portfolio of NASA’s SMD Education Portfolio by providing: professional development and training opportunities to educators; curriculum resources that use NASA SMD content; and opportunities for students to have first-hand contact with SMD missions, scientists, and research. These activities are designed to engage student interest in STEM disciplines and careers, and motivate them to move up to the education, and ultimately the employment levels of the Education Strategic Framework. A partnership between PSI and RSC allows structured access to school districts in Tucson. By working with RSC, we ensure that our E/PO materials and workshops meet the needs of local teachers and their students and are aligned with their curriculum as well as with state and national science standards.

Contributions to the Education Pipeline. Our project directly promotes development of STEM skills by actively engaging teachers in use of NASA data through hands-on, inquiry-based, and standards-driven content. Teachers improve their content knowledge in STEM areas and have the opportunity for authentic interaction with active NASA researchers. Direct interaction and continued communication via the Internet allow teachers to better educate and model science-related career skills, facilitating their ability to inspire their students.

Contributions to Diversity. Engaging a more diverse population in a greater interest in science and engineering is both a National and a NASA imperative. Our project targets school districts in metropolitan Tucson (population ~1,000,000). The largest public school district in Tucson is the Tucson Unified School District (TUSD). With its large Hispanic (55%), African American (7.1%), Native American (4.3%), and Asian (2.7%) segments, TUSD serves over 40,000 K-8 students while employing ~1750 K-8 teachers. Minority populations are even higher in some of the smaller districts: the adjacent Sunnyside School district’s Hispanic population approaches 88%. Given the natural diversity and varied economic status of Tucson students (65% of TUSD students eligible for reduced or free lunch) and teachers, Tucson is an excellent location for reaching these populations with our targeted professional development opportunity.

The Planetary Science Institute (PSI) is a private, nonprofit corporation founded in 1972 dedicated to solar system exploration and research. Part of PSI's mission is education and public outreach. While for many years PSI scientists have been involved in individual-driven outreach activities, recently PSI scientists have collaborated on a series of focused, intensive E/PO projects, including three NASA institutional supplement awards: *The Explorer's Guide to Impact Craters* (2003-2007) [1, 2] and its successor *Motivating Learning about STEM Careers, Research, and Content through the Study of Impact Craters* (Explorer's Guide II; 2006-2009), and *Planets are Places Too! Inquiry-based Professional Development Workshops for K-8 Teachers* (2007-2009).

Tucson Regional Science Center: In 2007, the second largest school district in Arizona, TUSD (Tucson Unified School District), established the RSC, which expanded the reach of the former TUSD Science Resource Center to additional school districts. The RSC supports member districts with nationally recognized instructional kits that were developed through NSF funding. These kits provide carefully guided science investigations that develop conceptual understanding of big ideas in science, process skills, and specific content knowledge as outlined by the National Science Education Standards and the Arizona Science Standard.

Currently, RSC provides all necessary material resources for approximately 2,200 teachers who work with 61,000 students in three member districts. Approximately 4,800 science modules are delivered and refurbished each school year. It is anticipated that additional public school districts, charter schools, and private schools will join the RSC. In addition to instructional materials, the RSC coordinates a mature and vigorous professional development program. The program consists of classes for curriculum modules, study groups, and workshops. An important point of emphasis is the unique nature of hands-on scientific inquiry as a vehicle for improving literacy skills for all students including English Language Learners.

Workshop Report: Evaluation of our professional development workshops includes formative and summative evaluations to assess and refine workshop implementation. This includes qualitative analyses of teacher program satisfaction through questionnaires at each session. The questionnaires request self-reports on learning as well as teachers' suggestions for improvement of the program. We are also using pre- and post-tests to evaluate our project's effectiveness. Before the first session, teachers complete a questionnaire

on science content knowledge specific to the proposed program, pedagogical knowledge of inquiry as a teaching process, use of inquiry as a teaching strategy, and attitude toward inquiry methods and science. Teachers receive their pre-test questionnaires at the end of the workshop, with the opportunity to retain or change their original answers.

Our pilot offering of the *Moon-Earth System* workshop in the fall of 2008 involved 15 hours of interaction between scientists and educators from the PSI, a science specialist from RSC, and a group of elementary and middle school science teachers. Teachers learned current information on the Moon-Earth system, with an emphasis on earth-based and spacecraft observations, geology and lunar evolution, past exploration, and future plans to explore the Moon. They also participated in activities to illustrate the processes scientists follow when analyzing data collected through observation and lunar missions. Results from pre- and post-testing showed a 16% growth in content knowledge. Teachers self-reported an average of 84% growth in understanding and judged the workshop value at 85%. The successful results of the initial workshop provide a valuable model for future offerings.

References: [1] Pierazzo E., G. Osinski, F. Chuang, 2004, AGU Fall Meeting, Abst. #4451. [2] Chuang F., Pierazzo E., G. Osinski, 2005, 36th LPSC, Abst. #2390.



Teachers spend two consecutive Saturdays performing simple experiments (like the impact cratering sandbox model pictured above), making observations of the natural world, and discussing fundamental questions regarding planetary science. These experiences are tied directly to mission data and results, and how scientists approach resolving these questions. Teachers are also given additional resource materials for later reference. Both during the workshop and afterward, teachers are provided guidance as to how to incorporate and communicate their new found experience and knowledge in their classroom curriculum.