PROJECT WISER: EVALUATION STRATEGIES FOR PROFESSIONAL DEVELOPMENT WORKSHOPS AT THE PLANETARY SCIENCE INSTITUTE. L. A. Lebofsky[1], S. R. Buxner[1], D. A. Crown[1], T. L. Cañizo[1], W. Schmitt[2], and S. W. Anderson[3], [1]Planetary Science Institute, 1700 E. Ft. Lowell Road, Suite 106, Tucson, AZ 85710 (lebofsky@psi.edu), [2]Science Center of Inquiry, Fountain Hills, AZ 85268, [3]MAST Institute, University of Northern Colorado, Greeley, CO 80639.

Introduction: The Planetary Science Institute (PSI), in partnership with the Tucson Regional Science Center, is offering a series of professional development workshops targeting elementary and middle school science teachers in southern Arizona. Using NASA data sets, research results, and a team of Earth and space scientists and educators, these workshops provide teachers with in-depth content knowledge of fundamental concepts in astronomy, geology, and planetary science. By participating in hands-on exercises, the teachers model the processes and skills scientists use. With a stronger knowledge of science content and of how science is actually conducted, the workshops instill greater confidence in teachers' ability to teach Earth and space science.

Need for These Workshops: The need for well-designed and well-executed professional development for K-8 science teachers is clear. Most elementary school teachers have had limited coursework in the sciences, little training in how to use an inquiry-based pedagogical approach in their classrooms, and are typically not aware of how new information relates to national and state science standards. At the middle school level, science teachers may or may not have academic backgrounds in Earth and space science, and may also lack the ability to structure their classroom lessons around authentic science practices. For teachers, direct interaction with scientists during professional development programs is rare despite its value. The significance of this interaction is the basic premise guiding the development of PSI workshops.

Current workshops: Since 2008, 90 individual teachers from 52 schools have attended 16 offerings of our currently developed workshops: *Moon-Earth System, Exploring the Terrestrial Planets, Impact Cratering, Asteroid-Meteorite Connection, and Volcanoes of the Solar System.* Two more workshops, *Deserts of the Solar System* and *Astrobiology and the Search for Extrasolar Planetary Systems* are being developed. See Buxner et al. and Croft et al. [this issue] for information on the design and content of our currently offered workshops and training for the rock kits used in them. Each 12-hour workshop is conducted over three sessions, two four-hour Saturday sessions and a mid-week two-hour follow-up combined with a two-hour homework assignment. Days 1 and 2 consist of lecture and directed discussion, inquiry-based activities, and hands-on investigations. In the third session, teachers and instructors identify ways to incorporate these experiences into their grade-level curriculum and to meet the pertinent requirements of the Arizona Science Standard. Teachers who have participated in our workshops teach over 7,000 students in grades K-9 and represent schools with minority student populations ranging from 46% to 95%.

Workshop Goals: The goals of the workshops are: to give teachers a firm understanding of Earth and space science content knowledge; to improve teachers' conceptual understanding of planetary processes; to instill greater confidence in teaching science; to practice authentic science process skills through the use of the most current data available; and to gain a greater understanding of the scientific community by interacting with Institute scientists. The PSI program meets these goals with on-going evaluation. Formative evaluation provides information for improving or revising the workshops; summative evaluation determines to what degree the workshop goals have been achieved.

Formative Assessments:

A. *Observation.* Team members work with teachers during hands-on activities. We participate in group work and observe factors such as the time allotted for each workshop activity, and whether the length of certain activities need to be changed; the clarity of instruction; level of participation by group members; and indications of confusion or off-task behavior. These observations inform changes in design for future sessions.

B. *Journaling.* There are prompts for teachers to respond to in writing at the beginning and end of each workshop session. Examples of these prompts include explaining their initial understanding of various workshop topics and how this has changed after instruction, relating the workshop information to their curriculum, and identifying areas of confusion they still have. The journal entries are collected for the team to gain insight into teachers' thinking and misconceptions.

C. *Teachers' formal questions.* Teachers review their journals and their notes, and submit a list of remaining factual and conceptual questions. During the final workshop session, scientists hand out written responses and review these with the group. This has a benefit for all the teachers since they hear others' questions in addition to their own. The questions often extend and go beyond the content of the workshop. This may be the case because the process is more

formal and both their questions and the scientist's responses are in written form.

D. *Final evaluations from the teachers.* Teachers complete a final evaluation for the workshops with both a numeric scale and open-ended responses. They indicate the value of the workshop and how much they have gained in understanding of the topics. The evaluation form also asks the participants to identify the most helpful parts of the workshop, to give suggestions for topics or activities to add, and any general suggestions or comments they have. Teachers consistently cite hands-on activities, modeling of scientific process, and interaction with scientists as the three top benefits of the workshops. Additionally, they report an increase in the knowledge of science content, increased understanding of how science is actually conducted and a greater confidence in their ability to teach earth and space science after their participation in the workshops. On this evaluation teachers typically first refer to classroom applications and activities, either wanting to use the activities from the workshop directly in their classrooms or asking to do classroom activities for students during the workshop.

E. *Team meetings*. Our team of scientists and educators conducts planning meetings for each workshop. Before the workshops, we discuss the activities and materials and assign tasks. After each workshop, we review difficulties teachers encountered as well as formative feedback for future offerings of the workshop.

Summative Assessments: A survey of 10-15 multiple choice questions and several open-ended questions is given both at the beginning and end of each workshop and provides an indication of how teachers' knowledge may grow during the workshop. Scientists compose questions at different levels of difficulty to reflect the topics he/she will present. The team tracks both the teachers' growth of knowledge as well as their confidence in the answers they provided to the survey questions. After each session, the team meets to debrief.

We may make adjustments for future sessions after we share observations and discuss ways to make improvements.

External Evaluation: The following strategies were used by an external evaluator to assess the workshops:

- Meetings with project staff to review project components
- Grading and review of pre- and post-assessments given at workshops including multiple choice and extended responses
- Workshop observations
- Review of supporting documentation including journals, participant questions, materials, and post-workshop evaluations by participants.
- Anonymous surveys and interviews of randomly selected participating teachers and instructors (scientists)

Major findings include: Workshops are regularly scheduled and have good attendance. The staff has created and organized valuable resources that contribute significantly to the learning process. In interviews of past participants, every teacher believed that the workshops were highly valuable and that the instructors and the teaching resources were very effective. There is evidence to support that teachers' knowledge has been enhanced and there is evidence of some transfer into the teachers' classrooms. The project has been well documented. Teachers actively participate and generate many questions that inform the teaching and are answered in class. Recommendations for improvement include strengthening the alignment of all activities to the workshop Big Ideas using the pre and post content surveys as a formative assessment to understand what teachers understand during the workshop, not only after the workshop is complete, and using information from workshop evaluations to adapt future workshops to better meet teachers' needs (e.g., shorter lectures, focusing more on major ideas to be mastered, and more hands-on activities). An important indication of the success of our program is that 46% of teacher participants have attended two or more of our workshops and 26% have attended three or more workshops.

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