OUTCOMES OF EMBEDDED SPACE SCIENCE E/PO WORKSHOPS IN LONG-TERM PROFESSIONAL DEVELOPMENT FOR TEACHERS. M.L. Urquhart, Department of Science/Mathematics Education and the Center for Space Sciences, University of Texas at Dallas (FN 33, P.O. Box 830688, Richardson, TX, 75083-0688, urquhart@utdallas.edu)

Introduction: NASA’s Education and Public Outreach (E/PO) programs provide an important vehicle for bringing the excitement and content of cutting-edge science to teachers as well as the general public. For formal education efforts targeted at K-12 classrooms, workshops are often utilized to leverage NASA’s impact by working with teachers, who then pass their newfound knowledge or materials to their own students. How much of an impact do these workshops make on teachers? Is the transfer to classrooms happening as expected? To investigate these questions I have embedded several teacher workshops into semester or full year long professional development programs for in-service teachers (total of 55 participants). Each workshop has also been given at science teacher conferences in single one-to-three hour sessions (250+ total participants). Topics have included space weather in conjunction with the joint NASA/Air Force Coupled Ion Neutral Dynamics Investigation (CINDI), Scale in the Solar System, Lunar Phases, Seasons, and Mars Exploration. Most embedded space science workshops utilize NASA-supported materials.

Why Embedded Workshops?: Most forms of professional development for teachers are short term [1], ranging from one hour to one day. For NASA E/PO personnel, short-term programs have the advantage of reaching relatively large numbers of teachers. In addition, they can be provided as workshops or short courses at teacher conferences, significantly reducing the administrative burden on workshop providers. Longer-term professional development is significantly more expensive, and is often given in intensive summer institutes to accommodate the schedules of classroom teachers. In contrast, teacher education such as that provided by the Science Education program at the UT Dallas provides true long-term professional development in the form of courses for teachers pursuing a Masters of Arts in Teaching (M.A.T.) and programs such as our local Texas Regional Collaborative for Excellence in Science Teaching.

The long-term model of the Science Education M.A.T. Program provides an avenue to determine the impact of workshops on pre-college classrooms and students, which is difficult in shorter-term content or activity-based workshops. Data on teacher learning, evaluation of E/PO activities intended for pre-college classrooms, and the application of workshop content into classrooms is collected via course work, teacher journaling, pre and posttesting, surveys and interviews.

Teacher Learning: Utilizing activities with embedded assessments provides a window into teacher misconceptions even in the context of shorter-term workshops. However, the depth of assessment is limited by time and the informal nature of most workshop settings.

Teachers in a 3-hour short course at the annual Conference for the Advancement of Science Teaching give their estimates for the distance of the Earth and Moon in a scale model. These estimates are typical of most in-service and pre-service teachers tested by the author.

After completing an activity used in the CINDI EPO, the teachers in the previous photo give a revised (and much more accurate) estimate of distance in their scale model of the Earth and Moon system.

Our embedded workshops confirm that in time-limited programs such as that shown in the photos above, there can be sufficient time to correct some simple misconceptions commonly held by teachers and relevant to the topics they, themselves, must teach. An example from the journal of one embedded workshop participant and elementary teacher illustrates this point. “It was remarkably surprising to me to see that the..."
outer planets were so much farther apart than the inner planets. That was a misconception that I had had! In my memories of previous astronomy lessons, I had never been taught that!"

However, workshop ratings of excellent and apparent understanding by teachers do not mean that teachers understand the material as well as the presenter may think. I have embedded this same workshop in my astronomy courses for the UT Dallas M.A.T. program and have asked participants to complete pre and post tests on the subject material specific to the workshop. Questions were designed by my Co-EPO lead for the CINDI project, Dr. Marc Hairston, and myself, and were given in short answer or essay style. Pretest scores were generally low, 33% on average, and posttest scores were significantly higher with a mean of 89%. However, an analysis of which questions participants continued to have difficulty with suggests that facts were easily acquired, but not more in-depth concepts. One participant was able to correctly identify the orbit of the space station and the top of the exosphere, but nevertheless insisted that the space station orbits in a vacuum because it is in space. When asked about the magnetosphere and its effect on space weather, many of the participants recalled details from class, but had trouble applying what they had learned to the question. A quote from one student is perhaps most telling: “Today’s class allowed me to BEGIN to see the big picture as far as the Sun’s activity affecting the Earth.”

Time Is Not Enough: For topics such as phases of the moon and seasons, a single 3-hour session has never been sufficient for most teachers to form a scientific understanding of the phenomenon. This was true even when outside observations such as a full month of lunar observations were required prior to instruction. Indeed, these topics are well known as difficult to understand the material as well as the pr

Transfer to the Classroom: Many E/PO workshops focus on providing new and interesting activities reflecting active and cutting-edge science programs for teachers. Feedback on my inquiries into the transfer of activities into the classroom has been mixed. When equipment is not an issue, time and district curriculum requirements are most frequently sited as reasons why teachers are unable to utilize specific activities in their own teaching. Some activities, such as Marsbound! Mission to the Red Planet from ASU are sufficiently popular that several teachers stated they would find a way to use the materials, even if in the context of an after school science club. When materials are an issue, we have found greater transfer to the classroom if we are willing to provide everything necessary to complete the activity, in some cases as a loan. For other NASA activities, including our own CINDI activities, many participants state that they will not be able to utilize them, despite a strong desire to do so. Teachers often express frustration at the exposure to exciting materials they do not feel they will be able to implement in their classrooms.

Implications for E/PO: Short-term professional development can be useful to teachers but is necessarily limited in scope. Topics selected for these workshops and their assumed impact on K-12 classrooms should be treated with caution. Long-term professional development provides a window into both teacher learning and the transfer of both that learning and E/PO activities into classrooms. Quality long-term professional development experiences provide additional advantages for teachers by allowing them to explore topics and applications in depth. Ideally these experiences should also provide sufficient time for participants to reflect on their own learning and form learning communities, network with peers. Despite their inherent high cost-to-participant ratio, the experiences at UT Dallas strongly suggest that investing and partnering in long-term professional development can benefit the NASA E/PO community as well as our nation’s K-12 teachers and students.