TEACHING, MODELING AND MENTORING GRADUATE AND UNDERGRADUATE NASA SPACE GRANT STUDENTS ON HOW TO BE EFFECTIVE IN STEM OUTREACH USING IMMERSIVE EXPERIENCES, PERSONAL STORYTELLING, AND FOCUSED EDUCATIONAL OPPORTUNITIES. S. L. Klug, T. Sharp, C. Jackson, Arizona State University, Mars Space Flight Facility, Moeur Bldg. Rm. 131, Box 876305, Tempe, AZ 85287-6305, sklug@asu.edu.

Introduction: Students in NASA’s Space Grant Program represent a good cross-section of the science, technology, engineering, and mathematics (STEM) disciplines that are highly regarded and desired by employers. Today, high quality STEM-majoring students showing up at colleges and universities are fewer in number. The NASA Space Grant students represent a self-selected, high profile, high achieving group of students that have made the choice to pursue these STEM areas of study.

Trends in International Mathematics and Science Study (TIMSS) scores over the past several years have showed a steady decline in U.S. math and science scores in comparison to the rising scores of other countries in the world. According to a survey presented at the 2005 AAS meeting:

- 15\%-20\% of Americans are “science literate,” which means 80\%-85\% are not.
- In one survey, 75\% of middle school science teachers did not know that the speed of radio waves is the same as the speed of light.
- In another, 47\% of U.S. teens could not convert “nine tenths” to a percentage.
- 20\% of U.S. adults could not answer “does Earth go around Sun or Sun around Earth?”
- 63\% of U.S. adults think that lasers work by focusing sound waves.
- 78\% of U.S. adults cannot define “molecule.”

Because of these illuminating (and disturbing) trends, national surveys, interviews with K-12 classroom teachers, industry partners, and other educational partner programs (e.g., NASA), we decided to utilize the valuable assets of the STEM students within our program in a creative way to reach out to the next generation of students and to make these K-12 students more aware of the college and career choices that could be available to them. Research shows that career interests and choices that lead to these college and career pathways begin many years before entering college. The ASU/NASA Space Grant Program decided (with the Fall 2005 semester) to create, as a parallel program to the research these students usually perform within the Space Grant program, a long-term teaching, modeling, and mentoring outreach training program for its graduate fellows and undergraduate interns to capitalize on their enthusiasm, commitment, and interesting personal academic journeys to inspire younger students.

Procedure: Outreach has very often been part of the NASA Space Grant Program. The ASU/NASA Space Grant Program Steering Committee wanted to accomplish several goals through this outreach training component of its program. These goals are:

1. Make STEM students (and their faculty mentors) more aware of the value of outreach,
2. Demonstrate the types of efforts constitute “good” outreach,
3. Determine the kind of outreach opportunities that best suit the student (i.e., not everyone is meant to talk with 4th graders),
4. Determine the best methodologies that would match outreach opportunities and ASU/NASA Space Grant students, and
5. Glean lessons-learned to make this prototype program into a model that could be exported to other Space Grant Programs.

The applications for the ASU/Space Grant Program in the Fall of 2005 asked the students what their interests were in outreach and had them delineate an outreach plan in addition to their desired research plan in addition to their criteria for their selection. This year’s students included:

Undergraduates:
- 19 engineers (aerospace, electrical, chemical, mechanical, and computing systems),
- 1 computer science,
- 1 kinesiology,
- 1 intermedia (3-D),
- 4 geological science,
- 3 physics,
- 1 physics and astronomy,
- 1 mathematics,
- 1 CAED (School of Design),
- 1 journalism/mass communication,
- 1 undeclared

Graduates:
- 1 astrophysics,
- 2 geoscience,
- 1 geography,

1 microbiology,
2 physics,
1 law

Other demographics on these students included 12 females (out of 38 students), 3 African Americans, 3 Hispanics, 1 Native American, 1 Pacific Islander, and 2 Asians.

At the beginning of the Fall 2005 semester, each of the student’s outreach plans were discussed and critiqued by the Steering Committee for value and approach. Comments were emailed back to the student. The students were required to attend an ASU/NASA Outreach Introduction seminar that was held on campus at the beginning of the semester. At this time, the ASU/NASA vision for outreach, outreach methodologies, and approaches were explained and discussed. Some examples of formal and informal activities that could be easily utilized for outreach were demonstrated. A large K-16 educator conference was held in September and was another requirement for the students to attend. This was done to allow them to: 1) see what an educator conference was like as a full participant; 2) see STEM presenters and their presentation styles that met the teacher’s needs; and 3) participate in the conference’s hands-on activities.

The students were then tasked with putting in 20 hours of outreach time in addition to their regular research commitment. As questions or needs arose, the students contacted the ASU/NASA Space Grant Office or the ASU Mars Education Office to discuss their needs or pick up materials to be used for their outreach. The ASU Mars Education Program has a lending library of hands-on activity materials that were accessible to the students. Some of the outreach examples that these students have participated in or will be participating in are:

- ASU Earth Science Day (1000s of families visit for hands-on activities, displays, and talks);
- ASU Astronomy Open House (held monthly);
- SEE ASU (1000s of students visit campus for hands-on activities and displays);
- ASU Mars Education Teacher Conference;
- Sally Ride Science Festival (elementary and middle school girls);
- ASU Astronomy Day (1000s with hands-on activities);
- School classroom visits;
- Salvation Army After School Club (hands-on activities);
- Space Grant Balloon Launches;
- School science camps;

- STEM career pathways activity for students; and
- STEM career research.

As their outreach efforts were completed, the ASU/NASA Space Grant Office set up a reporting system to record their efforts.

**Outcomes:** The students (through their comments and reports) are highly enthusiastic and encouraged at their ability and interest in participating in STEM outreach. They seem eager to have an outlet to, in a sense “give back” to the community and inspire other students. The ASU/NASA Space Grant Steering Committee recognizes some of the communications and reporting structures that it had put into place incurred a burden on certain staff. The open-ended outreach choices made it more difficult for students who had no experience in outreach endeavors to discern meaningful projects. A more structured approach with a “best practices” for outreach opportunities choice list will be incorporated into future semesters. This will not preclude creative ideas that might come forth, but it will lead to more students not feeling that they don’t know what they can contribute towards outreach efforts. All in all, the students have responded very favorably to this new addition to the program at ASU.

**Future Prospects:** The ASU/NASA Space Grant Program will continue the outreach component for undergraduates and graduate students in the future. Plans are to revamp reporting to become more streamlined and ways to engage students in outreach opportunities will continue to be explored. A meeting at the beginning of each semester to educate the new Space Grant students about outreach and highlight some of the past semester’s projects will become standard. An electronic newsletter or portion of the ASU/NASA Space Grant website might also be used in this manner. It is hoped, as Space Grant students tend to apply for multiple semesters, that these students will become more proficient and productive over their course of being Space Grant students at ASU, needing less supervision and being able to in turn, train and mentor other Space Grant students. As a further hope, a new category of Space Grant Fellow Emeritus will be instituted for Space Grant students who have graduated but are still continuing to be active in outreach roles in their careers and communities. Finally, as this program matures, a model for other Space Grant Programs will be produced and disseminated for replication around the U.S.