STUDENTS AND TEACHERS HELP SCIENTISTS ON MARS. C. D. Bowman[1], B. Aubin[2], M. Bebak[3], C. Smith[4], K. Stocco[5], [1]Raytheon ITSS, NASA Ames Research Center, M/S T28-B, Moffett Field, CA 94035, cbowman@mail.arc.nasa.gov, [2]University of Illinois, Urbana, IL, [3]Nardin Academy, Buffalo, NY, [4]Ramsay High School, Birmingham, AL, [4]Sam Rayburn High School, Pasadena, TX.

Program Description: As the Mars Rovers' initial 90 sols drew to an end in April/May 2004, so did the student-scientist research program, the Athena Student Interns Program (ASIP). The program was designed to allow high school students to get personally involved in the Mars Exploration Rover mission. It consisted of 13 teams, each composed of one high school teacher and two students, as well as a scientist-mentor who engaged the team in Mars research. To prepare for their participation, students and teachers attended teleconferences on various subjects relating to the mission, worked with their scientist mentors, and shared what they were learning through outreach activities targeting both schools and communities. Each team visited the Jet Propulsion Laboratory twice, once to participate in an operational test as a whole team and as part of landed operations. For this second visit each team made the week-long trip as an individual unit and played a small but important role alongside their mentors as scientific investigations were carried out on the surface of Mars.

Onsite Activities: While at the Jet Propulsion Laboratory, all of the student teams were assigned different jobs by their scientist mentors, including organizing data from the Alpha Particle X-Ray Spectrometer (APXS), measuring rock distributions, and creating panoramas from rover images, such one of the Columbia Hills. This panorama was later used to help the scientists determine where they wanted to go in the region once the rover arrived at that location. One team spent its time writing a software program designed to sort Mini-TES data and another worked to catalogue rock names and characteristics. In addition to this, all teams wrote journal entries describing their activities while at the laboratory. As an example, **"**Today we got to do some real scientific work! Our mentor, Dr. Crumpler, told us to take a look at some images that had just come back from Mars. We looked at the images on the Science Activity Planner (SAP), and picked a specific area were we could do some work determining the distribution of rocks. Then we used a measuring tool that SAP has and measured the area. The area was 61.6 square centimeters. That might not seem very big, but it really is when you're counting and measuring pebbles and small rocks! We classified the rocks by their size and then we measured them with the ruler tool on SAP. We measured them in meters than converted that to centimeters. After that we put all the data into a spreadsheet computer program to make it more organized and to get a graph" [1].

Figure 1. Team views Mars in 3-D.

Student Products: Students who participated in ASIP had the unique opportunity to serve on several different teams within the MER Science Team. ASIP teams were assigned to specific MER payload instruments, including Mini-TES, APXS, the Mössbauer, the microscopic imager, the Rock Abrasion Tool, and various cameras (hazcam, navcam, and pancam). During the week that each team spent at JPL, the teams worked on projects related to their instrument. For example, the team from Lafayette, CO used downlink data from the Pancam to create and spectrally analyze several mosaic images. The Birmingham, AL team used data from the Mössbauer Spectrometer and microscopic imager to establish ratios of structures and anomalies, which were used to help determine the mineralogy and makeup of surface materials. The Durham, NC team used Mini-TES data to complete specular isolation and analysis of martian compounds. These data products, images, and analyses were used by the teams' mentors and the science team as a whole to aid scientific investigations and have been archived along with other mission data. Additionally, the teams all contributed to the production of a public website designed to share the information, images, and insights of their experience [2].

Working with Mentors: The most important aspect of the program was working with the science mentors. For example, the team from Sam Rayburn High School in Pasadena, TX had the unique opportunity of being paired with a mentor from Brazil, Dr. Paulo Souza. Dr. Souza is an authority on the Mössbauer Spectrometer used on both rovers. Through

the Internet, email and teleconferences, Dr. Souza shared his knowledge of the spectrometer and his enthusiasm for Mars exploration. Despite occasional language barriers and not being able to meet face-to-face until the first trip to JPL, the team was able to participate actively in Mössbauer-related research. The students were tasked with looking for a correlation between the thermometers' temperatures on the rovers. The data they collected and analyzed will be used for a paper in *Nature.* Dr. Souza also had a chance to learn from his team when he and the team teacher, Karen Stocco, developed several curriculum ideas that they plan to publish.

Outreach Activities: Extensive outreach was required of all student and teacher participants in an effort to share information with a wider audience. Teams responded to this requirement with great effort, enthusiasm and creativity. The activities of the Buffalo, NY team provide an example of ASIP outreach. They focused on three major areas, including presentations to community groups, teacher workshops and science museum scout camp-ins. The team either directly contacted groups such as the Buffalo Astronomical Association and the Buffalo Museum of Science or were contacted themselves by organizations such as women's clubs and business associations who had seen local publicity about the team. The students did their own research and writing, resulting in a multimedia presentation about Mars and the rovers' scientific instruments. Added to this was a teacher-developed presentation using digital photographs detailing the team's experience at the Jet Propulsion Laboratory.

Teacher workshops were arranged by contacting Buffalo area teacher resource centers, colleges, and science teacher networks. During the workshops teachers received copies of the multimedia presentations as well as several hands-on activities developed by Arizona State University (ASU). Activities for scout camp-ins included viewing 3-D images of Mars and having the scouts do selected projects from ASU's Mars teacher resource packet.

Evaluation: To formally evaluate ASIP, the program employed the technique of *empowerment evaluation*, which had been used with ASIP precursor programs since 2001 [3]. Empowerment evaluation mirrors the active involvement philosophy of ASIP by engaging all participants in a transparent and dynamic assessment process throughout the program. Together, the team crafted the vision of ASIP, identified and rated the most important aspects of the program, and planned for future improvements including making mid-course corrections. For example, the team identified, "Close contact with professional scientists from around the world," as the most crucial aspect of ASIP. To further strengthen this aspect in the future, they suggested having more time with a greater variety of scientists beyond their team mentors. Feedback from this evaluation will inform the development of future student intern programs.

Student learning was also gauged informally through products and activities created by the participants, weekly updates and working diary installments included on the outreach website, team-created presentation materials (such as slides, handouts, and images), and the projects carried out during the landed mission alongside the scientists.

Ongoing Participation: Having cultivated such a talented, enthusiastic, and creative group of students and teachers for over a year, the Mars Public Engagement Office sought a way to continue participants' involvement and expand the ways they could contribute to Mars education and public outreach. The resulting program is the Mars Student-Teacher Advisory Roundtable (Mars STAR), a voluntary advisory group made up of a subset of the participants of ASIP. Through monthly meetings, Mars STAR members help review and test NASA educational materials, suggest future outreach activities and web resources, and provide a school-based perspective on Mars public engagement.

Future Student Involvement: In 2007, NASA will launch the Phoenix mission to Mars. This mission, which will engage scientists from around the world in investigating Mars' northern pole, will also actively involve high school students and teachers in a follow-on program to ASIP called the Phoenix Student Interns Program (PSIP). PSIP will draw on the lessons learned from ASIP and its precursor programs and again enable students and teachers nationwide to experience the thrill of Mars exploration.

References: [1] http://marsrovers.jpl.nasa.gov/classroom/students/asip_journal_laguna.html. [2] http://marsrovers.jpl.nasa.gov/classroom/students/asip.html. [3] Fetterman, D. and C.D. Bowman. (2002) *J. Experiential Edu, 25, 2*.

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