

ENCOURAGING INTEREST IN SPACE EXPLORATION AND PLANETARY SCIENCE AMONG NAVAJO PRIMARY STUDENTS; J. H. Allton¹ and C. S. Allton, ¹Lockheed Engineering & Sciences Co.

Two educational projects were initiated and organized by two individuals, implemented by 15-20 Houston, Texas volunteers who contributed time and money, and helped by many more NASA and contractor professionals. Principal goals for both projects were to 1) encourage interest in space exploration and planetary science among students with little exposure to science and engineering, 2) relate space exploration and planetary science to Navajo culture and environment, 3) motivate students with little interest or incentive to study math and science and 4) complete a project within one year with a limited number of volunteers on a small budget. A space/science fair was sponsored at a small Indian boarding school in Arizona, and the winners toured the Johnson Space Center. The following year winners traveled to Houston and trained at "Mars Camp" culminating in a simulated rover traverse geology sampling mission on Mars.

Students at the 60-student boarding school in Arizona were targeted because a former Indian school teacher was available to serve as liaison between the Houston group and the school administration. Sponsorship of a space/science fair with student winners and teacher chaperones being brought to Houston to tour the Johnson Space Center was proposed to school officials. The trip to Houston was intended not only as an educational experience for the winners, but also as an incentive to all students to participate and work earnestly on their science fair projects. A broad range of topics was eligible for projects since one goal was to relate Navajo tradition with math and science. For example, one student did a statistical compilation of patterns and colors in Navajo rugs by inspecting over one hundred specimens.

The Arizona teachers had little background in space exploration and the school had few resources for projects. Houston volunteers furnished reference books, posters, maps, videos and other teaching aids. Once student projects were chosen, materials to build projects were provided. Project initiators wrote each child encouraging them with their project and answered specific questions. Working with unfamiliar teachers via letter and telephone probably lessened the effectiveness of the significant effort expended supporting these projects because of lack of feedback and actual observation about how the materials were used. The school managed the science fair and the judging. Although some criteria for judging the 23 projects were suggested by the initiators, they were not used. Student oral presentations were videotaped and provided to the Houston volunteers, so they could see the results of their efforts.

Seven students toured Johnson Space Center. In addition to the public tour, students met with an astronaut, talked with an Earth Observation specialist, and toured meteorite and closed loop plant growth laboratories. The laboratory tours were selected because they were related to specific student projects. The project initiators desired to expose students to new experiences available during the trip to Houston. Students experienced flying, collecting specimens at Galveston beach (seeing an ocean), and an educational tour of Sea World of Texas. Since the well-behaved students were used to boarding school, they adapted quite well to travel and food available. However, the tour schedule was too rushed and Houston humidity was exhausting to the Arizona natives. The students were very fascinated with trees and examined and photographed many leaves. The initiators observed a reserved response to the astronaut chat and lecture type presentations and decided that more hands-on activities would be an improvement.

The second year, the initiators decided to combine several hands-on activities into a Mars Camp. Students would attend a week-long "astronaut" training session for a geological sampling mission to Mars culminating in a simulated rover traverse mission. The major decision was whether to take Mars Camp to Arizona where it would be available to more students and in a more Mars-like terrain or to again bring students to Houston for Mars Camp. The teachers felt that the students greatly benefited from travel to Houston and recommended the trip be repeated. Thus, plans were made to take advantage of three educational resources in Houston: Challenger Center, Johnson Space Center and the Lunar and Planetary Institute.

Like the first year, a space/science fair was proposed as a way of motivating students and selecting participants in Mars Camp. However, the projects were to be selected from a list of activities

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related to Mars mission skills (living in space, surface exploration topics). Materials and advice were again furnished by Houston volunteers. New teachers and administrators decided to change the science fair projects from in-class science activities to Science Club activities to be worked on after school hours. Fewer students participated and the projects were of lower quality. Nearly all students who completed their project were winners.

Seven students attended Mars Camp, located at a commercial camp with a classroom near the Johnson Space Center. Mornings were spent in the classroom experimenting with space suits and robotic arms, estimating the amount of consumables needed for a trip to Mars, comparing the Martian surface features to familiar features in Arizona and New Mexico, and learning how to navigate using maps and communicate on the radio. Afternoons were spent on field trips: space mission simulation at the Challenger Center, history of space flight at Johnson Space Center, and Mars cratering and volcanic features experiments at the Lunar and Planetary Institute. Outdoor activities at the camp included practice at rover driving, rover TV operation, and soil sample collection with core tubes. Finally, the trained "astronauts" were ready for the simulated mission to Mars. The Mars rover, a modified golf cart equipped with TV and radio transmission and laser range-finder, was operated on a deserted, cold beach at Galveston. Each EVA sample collection crew included a rover driver, communicator using CB radio, and geologist who collected, bagged and labelled samples. The geologist was also supposed to use a laser range finder to plot the rover position on a map, but overnight flooding rendered the primary, mapped site inaccessible, so this mission objective had to be dropped. Students did a good job collecting and documenting samples. The wet conditions provided core samples with layering. The students did find life on "Mars" in the form a dead shark, which they proudly brought back draped across the front of the rover. Student mission controllers communicated constantly with the rover crews via radio, keeping them informed of possible hazards and recording crew observations.

Post-mission sample analyses were conducted in the classroom. Students examined samples under the microscope, performed a size analysis on sand and wrote a report about the findings of their mission to Mars. The intensive 12-hour-a-day training at Mars Camp should have been more beneficial than the previous year's tours, but feedback from students was not obtained.

Mars Camp training for a simulated rover traverse geology sampling mission to Mars neatly tied together many aspects of spaceflight and planetary exploration using hands-on activities. Driving the rover was very appealing to elementary school students. These Navajo students were verbally creative and CB communications worked well. Name tags and astronaut jumpsuits, popular at commercial space camps, were not used because previous year Navajo students were not fond of such identification.

Many volunteers were needed to implement this project. The community around Johnson Space Center is rich with people willing to contribute. This type project is suitable for activities which depend on free help because the electronics, radio and geology volunteer experts had fun. More importantly, this is an example of what a few individuals can do without the burdens of educational bureaucracy.