TO CATCH A CHILD'S IMAGINATION

Educational Overview of CAN DO G-324

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Can Do
C.E. WILLIAMS
MIDDLE SCHOOL

EDUCATION
STUDENTS
SCHOOLS
CREATIVITY
LEARNING
SPACE SHUTTLES
HALLEYS COMET
EXPERIENCE
TRAINING DEVICES
EXPERIMENT DESIGN

INTRODUCTION

When a public school district is involved in the flight of a GAS package, they have a serious responsibility, along with an unprecedented opportunity. The desire to produce an experiment with real scientific validity must be tempered by the schools' primary mission to make the adventure educationally meaningful to the greatest possible number of students. Such a project can easily become the personal plaything of the select few that are highly scientifically motivated, and technologically gifted. A public school system must, in addition, insure that the resources invested in such a project also reach out to the average student, and those whose interests lie in other directions. Such a broad reach is only possible if the GAS canister is but one part of a comprehensive and ongoing educational effort that involves as many disciplines and levels of student interest as possible.

The total program should include:

1) A background of previous programs which have trained teachers and prepared students to fully utilize special activities as part of the educational process.

2) Direct student involvement in the design of experimental packages to be flown, and in the evaluation of data derived.

3) Supplementary related activities that use a Get Away Special as a motivational catalyst to generate efforts in other disciplines, other schools and other student groups.

4) Future plans to fully exploit and maintain the momentum developed by this one dramatic event.

The one overriding goal of all these activities as articulated by one of our leading classroom teachers:

> "TO CHOOSE AND DEVELOP HIGHLY MOTIVATIONAL ACTIVITIES WHICH WILL CAPTURE THE IMAGINATION AND INTEREST OF STUDENTS, AND TO TAKE ADVANTAGE OF THE "TEACHABLE MOMENT" WHICH IS SO ELUSIVE."

BACKGROUND

CAN DO is a Charleston County S.C. public school project with C.E. Williams Middle School serving as host. Students directly involved in experimental design are drawn from the 14 middle schools (grades 6-8) in the county. Other area schools, primarily in neighboring Berkeley and Dorchester Counties, have also developed independent enrichment activities surrounding the overall CAN DO effort. Organizations such as The Young Astronauts and The Trident Amateur Radio Society also have programs that complement the actual space flight.

For a project to achieve a broad base of support, the efforts of many talented and dedicated people are required. But no matter how large the team, it is always a few key "spark plugs" that make it happen. A proud record of special scientific activities has been achieved by this area. The greatest part of this record is the history of two individuals, a classroom teacher and a college professor who have tirelessly worked to enrich the educational process. The complete list of their efforts on behalf of area science students would take far too much room, but in the last seven years would include:

- Development of airplane field trips to study coastal ecology.
- Development of a student ham radio net of licensed operators.
- Participation in the development of NASA's telelecture program.
- Establishment of a regular program of astronomical sky parties.
- Student construction of a six-inch telescope including grinding the mirror.
- Construction and licensing of a student-run FM radio station.
- Construction of a portable planetarium.
- Tours of NASA moon rocks and space vans with educational training.
- Establishment of a Community Involvement Program with NASA
- Development and certification of the first (below college graduate level) program for saving stranded whales.
- Design and construction of a unique outdoor classroom surrounding two local ponds.
- Construction of a Get Away Special to photograph Comet Halley.

PRIMARY STUDENT INVOLVEMENT

Primary student involvement for the purposes of this paper, can be defined as student activities which are totally dependent on the GAS canister itself. These include design, student experiments, and evaluation of the data and photographs returned.

Junior Design Team

The original intent was for the experimental package to be largely student designed with the help and advice of expert adults. In practice, as the technical complexity needed to achieve mission goals became apparent, the actual student involvement changed. A junior design team was maintained to apprentice and observe the activities of the senior team, but their input never reached the levels hoped for. A few individual members made substantial contribution in the areas of computer programming and film test evaluation, but the bulk of the engineering was done by the senior team. In retrospect, it was probably unrealistic to expect sixth graders to have the ability or desire to tackle the technical minutia of approved alloys and low power Mil spec computer chips. It is highly questionable if such specialized knowledge would be particularly relevant to appropriate educational goals for this age group. Rather than compromise the ambitious goals of the mission, we decided to provide a powerful package designed on their behalf, and place emphasis on other areas such as data evaluation.

Student Experiments

A competition was held in all 14 county middle schools for student designed independent experiments. The criteria for selection were that the experiment must be passive in nature, light in weight and moderate in size. The experiments were then selected on the basis of scientific value and were to be flown in order of the least weight first. Eleven projects were chosen, representing 28 students at four schools. Most projects involved the effects of microgravity and the space environment on material including human blood cells, local seeds, mold spores, penicillin, a magnet, and even a Timex watch. Other experiments included passive dosimeter measurements, and a device to measure maximum acceleration experienced in flight.

Where appropriate, identical packets of control material will be prepared. These will be stored until flight time, and then exposed to a combination of cold, low radiation, and high radiation depending on the particular experiment. The students will then evaluate the flight and control material and tabulate the results, before knowing which packet actually flew. All of the student experiments will be housed in a single styrofoam block which will be cut to securely hold each experiment. This block will then be sealed and mounted to the upper battery plate in the canister.

These experiments are more appropriate to the age group and can be completely designed and evaluated by the students themselves with minimal supervision. The details and results will hopefully serve as the subject of a paper at next year's symposium.

Student Evaluation of Results

The most intensive involvement for the greatest number of students will begin after the actual flight. If all four cameras perform as planned, some 7000 photos will be taken of which up to 1400 may include Halley's Comet. The time of each comet picture must be identified and changes in the structure of the comet will be noted. Brightness values will be estimated by comparison to background stars and the size of the visible tail will be plotted as a function of photographic exposure time. This work will be performed in cooperation with and under the supervision of astronomers who will prepare packets of photos with appropriate background information.

Classes and clubs who participated in ground based photography will be suppled with matching space photos to compare. If proper calibration can be achieved, this information, for both space and ground-based efforts, will be supplied to the International Halley Watch.

The 5500 "misses" may well include other astronomical objects of considerable interest. Our experiments indicate that the cameras and lenses are capable of capturing stars down to magnitude 10-11 and diffuse nebulae such as the Rosette. A large project will be the identification and evaluation of these other photos.

We assume that some percentage of the time exposures will be spoiled by excess drift rates in the Orbiter. These photos will provide an accurate measure of these rates by the length and axis of the streaked star images. The constant 30 sec. firing of the Feather-cam will allow the reconstruction of a drift rate history for the mission. This profile will be of value to future astrophotography missions.

SECONDARY STUDENT ACTIVITIES

Secondary activities are independent and self sufficient, but inspired or enhanced by CAN DO. They have the great advantage in that they are unaffected by contractural obligation or administrative boundary line. Any number can play, as long as they have interest and enthusiasm enough. These activities will be divided into the areas of historical perspective, technology, astronomy, and communications.

Historical Perspective

An active program of historical research has developed which includes library research on past apparitions. In addition, students have solicited letters and personal interviews from the elderly who remember Halley's 1910 visit. The interviews are on a standard form which asks questions about the impact of the Comet as reflected in what was said in their church and schools. This interaction between generations teaches far more than astronomy. It can teach a sense of history and a perspective on the changes in society.

This new perspective can then be exploited in turn to impress the students with the value of records that they leave for those that come after them. Several projects are under way to compile and archive the views and impressions that this generation receives.

Not to be left out, several English teachers are preparing to take advantage of the interest generated. Besides the library science entailed in the historical research, they plan to introduce books about space and science fiction into their reading programs.

Technology

Many local science teachers are integrating CAN DO into their teaching plans. This will be detailed in a sample curriculum given below. In addition, several extracurricular science activities are also involved. The NASA-supported Young Astronauts also have their own active programs of scientific activities, many of which complement the overall program. The Young Astronauts played an especially active role in the recent Spoleto Children's Festival which had space as a theme. This highly successful activity included scientific and education exhibits, space art competition and was capped by a live rocket firing.

Astronomy

Area schools have a well established astronomy program going back several years. Activities have included numerous sky parties and the actual construction of a telescope. It is a natural progression to continue these activities with Halley's comet and its related meteor showers as a subject. During the apparition period, regular visual and photographic observations will be made and compiled. During the flight period, the emphasis will be on concurrent photography with closely matched cameras and film. Active recruitment is underway to establish observation groups at as many locations as possible. Contacts have been made with groups in South American, who will have a much better viewing angle. Results will be compared with the space photos to evaluate the gains made. It is hoped that the results will be suitable for inclusion in the data being gathered by the International Halley Watch.

Communications

Another well established local program is the ham radio net. With students already trained and equipment in place, they are ready to render valuable communication service. During the flight of STS-61E, they will attempt to establish around-the-clock radio monitoring of Shuttle activities. In addition, they will serve as a vital communication link with the far flung astronomical observation teams. This is in addition to the service they have already done in the solicitation of long distance interviews with 1910 Halley veterans.

ORIGINAL PAGE IS
OF POOR QUALITY

OPERATION CAN DO
LOW COUNTRY STUDENTS IN SPACE
STUDENT EXPERIMENT RECORD

Student name John Doe School C.E. Williams
Sponsor Mrs. Smith Grade 7
Student Address 01 Oak Drive Phone 000-0000
Charleston
School Address 02 Oak Drive Phone 000-0000
Charleston
Phone where you can be reached during summer 000-0000
Name of experiment The Effect of Space on S.C. Seeds
Nature of material Seeds from South Carolina native plants such as wild flowers.
Weight of 1 sample 1/2 oz
Goal of experiment To see if microgravity or cold or radiation in space effects the germination of seeds.
Any hazards? NO
Special handling required? Controls to be exposed to cold + radiation.
(attach pages if necessary)

Submit this form with two samples of non-biological and four samples of biological material. The extra samples will be used as blind controls. You will be informed on which sample actually flew in space after all experiments are concluded. Use seperate forms for each experiment.

(1)

HALLEY'S COMET QUESTIONNAIRE

BACKGROUND DATA

LAST NAME DOE, FIRST NAME John, MIDDLE NAME M.

DATE OF BIRTH July 23, 1900 PLACE OF BIRTH Charleston RESIDENCE IN 1911 Charleston

FATHER'S OCCUPATION Farmer FATHER'S EDUCATION 6th Grade

IN WHICH OF THE FOLLOWING SETTINGS WERE YOU LIVING WHEN YOU VIEWED THE COMET? URBAN___ RURAL ✓

YOUR PRESENT RELIGION Baptist
YOUR RELIGION AT THE TIME YOU SAW THE COMET Baptist

COMET QUESTIONS

1. DO YOU REMEMBER OBSERVING HALLEY'S COMET? YES ✓ NO___

2. HOW DID YOU VIEW THE COMET? Through the door.

(2)

(A) NAKED EYE
B. TELESCOPE
C. OBSERVATORY
D. OTHER________

3. HOW MANY OBSERVATIONS DID YOU MAKE?

(A) ONE OR TWO
B. SEVERAL
C. MANY
D. NONE

4. HOW VISIBLE WAS THE COMET WHEN YOU OBSERVED IT?

A. BEARLY VISIBLE
B. DIM
(C) BRIGHT
D. VERY BRIGHT

5. WHICH OF THE FOLLOWING PARTS OF THE COMET WERE OBSERVED?

A. HEAD
(B) TAIL
C. [redacted]
D. [redacted]
E. OTHER________

6. CAN YOU REMEMBER ANY MYTHS ABOUT THE COMET MENTIONED AT THE TIME OF YOUR OBSERVATION?

(A) FEAR OF COLLISION WITH EARTH

(3)

(B) FEAR OF POISON GASES IN THE TAIL
C. TALES OF RELIGIOUS EXPERIENCES
D. OTHER________

7. IF YOU WERE IN SCHOOL, HOW WAS THE EVENT TREATED?

A. IGNORED
(B) BRIEFLY DISCUSSED
C. EXTENSIVELY DISCUSSED
D. NOT IN SCHOOL

8. HOW WAS THE EVENT TREATED IN CHURCH?

A. IGNORED
B. BRIEFLY DISCUSSED
(C) USED AS PART OF A SERMON
D. OTHER________

9. BRIEFLY DESCRIBE YOUR OBSERVATION. I remember, it looked like a long stringy cloud. A Friend of mine had a dress that was named after the comet because it had a long tail.

(4)

Fig. 1: Example of "mini-PAR" used by student experimenters.

Fig. 2-4: Example of one of the questionnaires used to interview the elderly. This questionnaire uses mostly short answers and is especially designed for younger grades and ham radio use.

CURRICULUM ACTIVITIES

The success of the overall project in reaching the average classroom student depends on how well it is integrated into the regular curriculum of the courses that these students normally take. Below is an example of the special activities planned by an eighth grade Earth Science teacher for the 1985/86 school year. Many of these are at least partially inspired by the Comet Halley activities while others are totally unrelated. The emphasis will be different for teachers of seventh grade Life Science and sixth grade General Science.

1985-1986 Earth Science Schedule

Planned Date	Activity
9/1	*Teams established and procedures defined for stranded whales rescue.
	*Comet Halley historical research begins with library research and distribution of questionnaires.
9/15	*Ham radio classes begin (2 nights per week) for students who wish to obtain novice license.
10/1	*Develop filing system for Comet Halley material gathered.
10/20	*Sky Party #1 to observe Comet Halley, Orionid Meteor shower and Orion nebulae. Also there will be computer and radio demonstrations.
11/1	*Field Trip to Planetarium.
11/15	*Select weather forecasting team and begin daily in-house forecast.
12/1	*Novice radio class graduates, radios are set up and first contacts are established.
12/15	*Use radio/computer equipment to capture satellite news programs and analyze them for frequency and propagation characteristics. Great circle routes are computed for stations.
12/20	*Sky Party #2 to continue observations of Halley and other astronomical targets. Radio and computer demonstrations included.
1/5	*Explore local area for likely fossil dig sites.
1/15	*Ham radio classes begin for those with novice license who wish to obtain a general license.
1/15	*Begin the regular photography and visual tracking of Halley and establish procedures for the correlation of comet data.
2/1	*Field trip to University library to do research on Comet Halley, prehistoric animals, coastal land formation, electromagnetic wave propagation and whales.
2/15	*First field trip to fossil dig site and the start of operations.
3/6	*CAN DO launch to be observed on television or in person.
3/6-3/13	CAN DO IN ORBIT
	*Monitor STS-61E by radio with assistance of ham radio net.
	*Use triangulation to compute height and speed data for shuttle and comet.
	*Photograph comet and assist in coordination of concurrent comet photography by other schools in Northern and Southern Hemispheres.
	*Conduct various radio exercises to establish educational ham net.
3/13	*CAN DO landing to be observed either on television or in person.
	*Begin analysis of data gathered during flight.
4/15	*Guests speakers to discuss local area geography conservation. Start gathering data on the impact of local industries.
5/1	*Students fly in chartered aircraft to observe local sea islands and to observe areas where industry and population are impacting on the natural order.
5/15	*Final compilation and archiving of Comet Halley historical and observational information.

(This particular schedule represents the plans of an exceptionally active teacher. Other teachers will adapt the activities to fit their own teaching goals.)

FUTURE PLANS

Looking down the road to a time when Halley's Comet is Pluto-bound and its pictures have all been sorted and digested, what next? We hope to keep the design team intact in anticipation of the arrival of the next crop of students. What's left after space flight? We would like to think it's more space flight.

One idea is "CAN DO II," a new flight with a new mission. Building on the lessons learned, we feel we could redesign and reprogram a canister to tackle deep space, solar, lunar or terrestrial targets. If the TV targeting system is successful, it can be easily adapted to a wide variety of mission profiles.

Even more ambitious plans are in the preliminary discussion stage. The NASA Hitchhiker program offers two important assets--power and communications. A project could be developed to fly a powerful battery of cameras and optics, possibly including a telescope. Various cameras would be equipped with appropriate filters and films for terrestrial, solar, and deep space subjects. Digital TV targeting images would be transmitted back to Earth and forwarded to schools anywhere in the world. Each school would be responsible for developing their own research efforts, which could range from hurricane tracking to solar flare studies. They would have to develop communication and computer imaging facilities appropriate to their mission. When their target imaging indicated that they were in range, a fire signal would be relayed to the appropriate camera. Ambitious? Yes! But no insurmountable obstacles seem in the way except for a lot of hard work and some funding support. With hundreds of schools involved, the load would be made bearable. Without ambitious dreams, nothing worthwhile would ever be accomplished.

CONCLUSION

~~Our~~ THE experience has shown that a GAS experiment can be a valuable education tool. It can return results far in excess of the resources invested. ~~Our~~ THE best estimate on the financial investment per student indicates that it is somewhat less than the cost of a school lunch. That's a bargain in a time when educational bargains are hard to come by.

To reach this goal means reaching far beyond the students who could possibly design or fly experiments in a single canister. The greatest value of CAN DO is that it serves as a catalyst and inspiration for other activities. To not reach out would have turned it into an overblown, expensive "science fair project" for a few exceptional students.

To fully exploit the benefit of a GAS canister, you should build on a well established science enrichment program. As part of a comprehensive plan, a Get Away Special can be one of the most motivating educational tools available. It could touch a child's life and give him a special memory to carry with him always. It might just teach him that even the road to the stars is open to those that know how to dream. How much is a lesson like that worth?