Ants in Space

FRED REISS

The Camden City high schools entered the space age quite by accident on November 29, 1977. On that evening, Riletta Cream, Principal of Camden High, and Irving K. Kessler, Executive Vice–President of RCA, were introduced to each other at a dinner meeting that included NASA officials. Among the topics discussed was Camden High's award–winning chess team. Kessler felt that a school with a superior chess team could do great things in science. He subsequently offered to have RCA cover the cost of placing an experiment aboard one of the early Space Shuttle flights, provided that the experiment was conceived and designed by the students.

Kessler's offer was possible because, early in 1977, NASA announced a program called the "Get–Away Special." This program permitted companies, schools, corporations—indeed, any American—to purchase up to five cubic feet of space on the Space Shuttle. Because of Kessler's offer, both of Camden's high schools, Camden High and Woodrow Wilson High, became part of a project called Orbit '81.

At Camden High, we began our program by developing a time–line. Our schedule called for a space science summer enrichment course, identification of students and teachers who could handle the tasks, and the development of several years' worth of curricula that would be arranged to help students select and develop the final project. About 15 students thus became the core of the Orbit '81 program.

With the understanding that the Orbit '81 students would select an experiment by the end of their freshman year, we developed the first year's curriculum with two things in mind. First, what general knowledge would the students need to make a decision about a viable experiment to place on the Shuttle? Second, what materials and texts existed within the school system that could be adopted outright or modified for this program?

We selected the modules "What's Up," "In Orbit," and "Winds and Weather," which are part of the ISCS series published by Silver–Burdett Co. This allowed the students to get a broad understanding of the rudiments of rocketry, orbital mechanics, and Earth's ambient environment. An electronics module was developed with the help of RCA engineers.

One of the primary objectives was to involve as many people at Camden High as possible. To this end, we created an Orbit '81 club. One group within the club became responsible for organizing assemblies, another group became our hosts and hostesses for guests, and still another group publishes a newsletter about Orbit '81 activities. A fourth group showed interest in catalog-

Students in the Ant Group observe a store-bought ant farm. Later, the group designed and constructed their own.

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An experiment in space by Camden, New Jersey, high school students was a small failure for science, but a triumph for science education.

ing space science books and magazines for our space science library. Artistically talented students began to paint the walls of the science department with space murals. Finally, students interested in photography became our "historians."

Votes for Ants

During a luncheon at the end of the first year, which was held at RCA's Moorestown, New Jersey, plant, the Orbit '81 students from both schools debated the merits of several experiments. Among the choices were experiments involving a seed, a fly–wheel, crystal growing, and a plant. The experiment that captured the imagination of the students, however, was an idea proposed by Kenny Henry of Woodrow Wilson. He wanted to fly an ant colony into space to see how the loss of gravity would affect the colony's social activities. Sending ants into space was unique because ants are social animals; no social animal in its entire colony has ever been sent into space. By the time the meeting was over, the Orbit '81 students voted to change ants into "antstronauts."

As the second year began, the class learned about the Space Shuttle program and how it fits into America's broad space goals. Next they were instructed in the "Get–Away Special" program and the constraints placed on the user. For example, the canister containing the ants had to be self–contained, the astronauts could not be expected to interact with it, and no telemetry could be used.

After this portion of the curriculum was completed, the students were divided into groups, as would occur in industry, to work on different aspects of the experiment. One group experimented with ants; and a second group, with the help of an RCA engineer who came weekly, learned how to flow–chart and to program an RCA 1802 microprocessor.

Discussions were held during the school year to determine how to best evaluate changes in the social development of the colony, how to record the ants' progress or lack of progress, how to control the experiment from lift–off to landing, and how to get the power to operate the electrical components. We also borrowed a video camera, which was used to determine the focal length needed to clearly see the ants.

During their junior year, the students were divided into specialized groups. The ant group maintained the colonies, and attempted to tag the ants for later identification. Unfortunately, none of the tagging experiments worked. The computer group refined their flow–charts as we crystalized our ideas of what should be recorded. Also, this group constructed a simulation of the actual experiment on a TRS–80 computer. The camera group first learned how to use our RCA video camera/recorder and our super 8mm movie camera; they then spent the remainder of the year filming ants in order to interpret the actions of the colony under normal conditions. With this knowledge, the students would be able to spot any anomalies in the pictures of the ants taken in space.

The students, as a class, determined the components needed in the experiment. Once a component was identified, the energy group made a rough calculation of the power required to operate it in space and the amount of heat it would give off. As the school year ended, this group was able to graph the heat emitted into the canister per unit time. This was very important to us because, as an example, we determined that the heat from an incandescent light would cause the temperature of the canister to rise above the point where the ants could survive. At the same time, the engineering group was building a full–scale model of the canister from wood, plastic, metal, and cardboard. This group provided an invaluable service because the model kept the project visible and real, rather than a dream that was months or years away.

We continued the schoolwide programs that grew out of the Orbit '81 project. Moreover, we held an annual overnight trip to Goddard Space Flight Center. Though only two years old, the trip was already seen as an important part of the science department's career development plan. The art department aided us during the year, too. With their help, we launched a fund–raising drive by selling student–manufactured desk and pen sets. (Someone had to pay for the ants!)

Will it Work?

During the summer of 1981, we set up a

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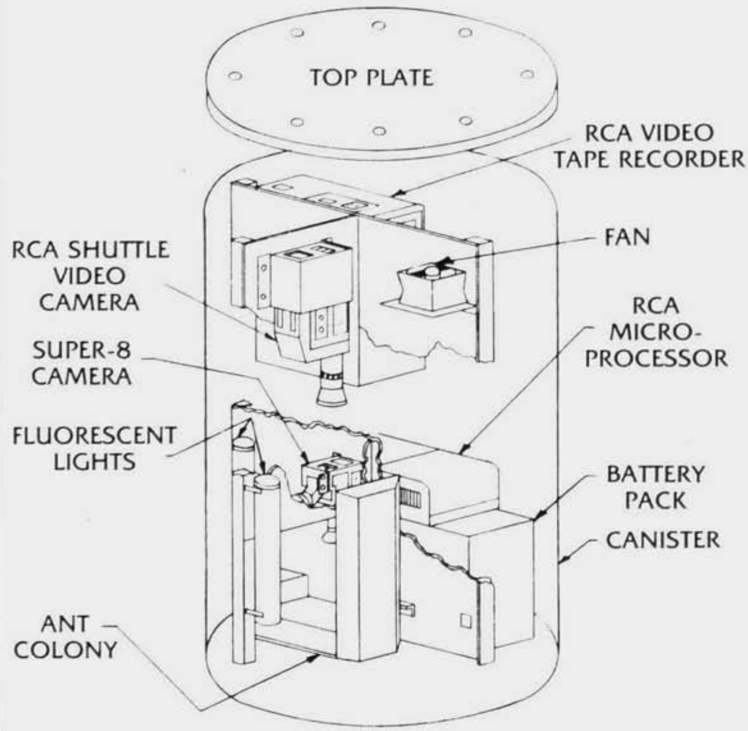


DRAWN BY J. PINKSTON, M. JOY, INSTRUCTOR,
CAMDEN HIGH SCHOOL

tentative time-line for integration and testing of the experiment in its canister. Thus, early in the school year, we met with a group of engineers to review both our design and our integration and testing schedule.

At this meeting, we learned that a design review was like the defense of a doctoral dissertation. The engineers presented us with problems about our design that we had not considered. They offered solutions, of which we had never heard, that had been standard practice in the space field for two decades. Students and teachers argued with engineers. Engineers argued with each other. At the break, one student wanted to know if we had done anything right. We were assured that this was a typical design review, and by the end of the meeting most of the engineers concurred that our design was reasonable.

Once the final presentation was made and the design approved, the tedious detail work began. We had just entered the production phase. In retrospect, this work was the most rewarding because we were now building the real thing—no more simulations. A mechanical engineer, Charles Laible, and an electrical engineer, Mark Tse, were assigned to help us in our work.

After the specific components were identified, we asked the drafting department of Camden High to make mechanical drawings of the canister, lid, and the experiment's components to full scale. We also designed a cylindrical canister with a flange. Then the wood shop cut the bottom and top lid for our canister and made all the wooden mock-ups of the components as we needed them. Next, the metal shop students installed the metal sheets that made up our superstructure and installed the actual components in their proper place. Finally, the electrical shop students connected all the items electrically.

NASA Steps In

The canister and all the components were ready for their first simulated launch the Friday before the students graduated. Four days later the canister was tested at RCA's Astro-Electronics facility. Students, teachers, and engineers watched as the canister went through three test launchings. In each case, the canister, ants, and commercial-grade electronics passed with flying colors.

The experiment, however, did not pass the tough NASA safety requirements for two reasons: First, we drew current before lift-off, and, second, our batteries leaked a small amount of hydrogen. We were also informed that the ants and the experiment would have to

A metal shop student helps fabricate the interior of the Orbit '81 canister.

Students re-assemble the Orbit '81 canister after a launch simulation at RCA's Astro-Electronics facility.

be in Florida 60 to 90 days before the launch. This caused us great concern because we did not think that our present ant farm would live that long.

While each solution took much of the fifth year to develop, build, and test, the students were most directly involved with the redesign and construction of the ant farm. With the aid of Dr. Tarka of Temple University and a box of tinker toys, over the summer of 1982, the students refashioned the ant colony to bend around the superstructure and electronics. Their final product looked like a three–dimensional boot.

In September 1982, it was necessary to train a new group of students because the original group had graduated. Fortunately, we had been using the space science curriculum with selected students in each successive year. The new students mastered the work of the old students in just six weeks, and were ready to continue the work of the previous groups.

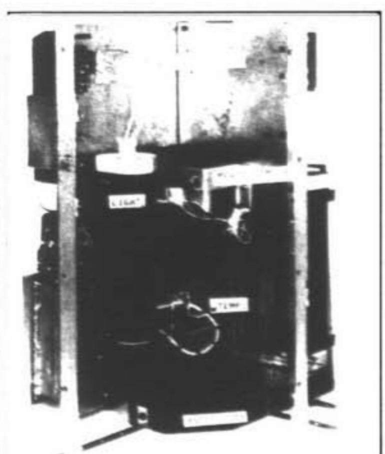
These students built the redesigned ant colony, polished up the computer program, and reshaped the display model. They also changed the ant farm, using the model shown to them by Temple University. This model made use of a nongravity–flow watering system, slow–release oxygen tablets, sugar cubes for food, and sphagnum moss for building material.

Bittersweet Results

Although history recorded that the ants died, it is our belief that history also recorded that Orbit '81 was a success, indeed, a triumph for space science education. The real experiment was not the life or death of an ant colony, but that a group of minority students could be motivated to pursue careers in science, engineering, and computer science. History has shown that this experiment succeeded. Our students are now working on the post–flight analysis of the causes.

Moreover, the science enrollment in our school has increased; nearly one out of every two students will be taking a science course. Intangibles, such as pride and the excitment of being part of something worthwhile, have been observed not only among the students, but among the faculty and the citizens of Camden.

What history has yet to record is this: Will the success of our schoolwide science project act as an impetus for industry to continue supporting our science efforts with greater commitment? Will the success of Orbit '81 stir others within the science education community to attempt similar long–range high school projects?□



Interior of the Orbit '81 canister that was built by vocational education students and teachers.