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**CALIFORNIA STUDENT
GET AWAY SPECIAL PAYLOAD GAS-450**

presented at

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Space Information Laboratories
P.O. Box 5090
Vandenberg AFB, CA 93437

A non-profit company dedicated to student "hands-on" education. Consists of professional engineers, scientists and technicians at Vandenberg AFB and the California Central Coast Community.

Authors

Glen Ray, GAS-450 Payload Manager
Edmund Burke, GAS-450 Technical Director & SIL Founder
Marty Waldman, GAS-450 Program Manager

1.0 ABSTRACT

The California Student Get Away Special Payload GAS-450, recently went into orbit on the STS-57 Mission, Space Shuttle Endeavour, 21 June 1993, 6:14 AM and landed on the 29 June 1993 at Kennedy Space Center (KSC). Fifty students (Figure 1, Ages 7 to 18) from 13 California Central Coast Schools and one in San Francisco designed and built 13 active experiments (6 modules) for this mission. Preliminary analysis of our **completely reusable payload bus system** indicated that the structure, power system, microprocessor and sensor systems in each experiment module worked flawlessly. The experiments themselves performed exceptionally well with a 60 % success ratio. The students are thoroughly documenting their own experiments and results via a standard research paper guideline generated by the GAS-450 technical staff. If you would like to review any one or all of these papers (13) please write to the SIL address above. Lessons learned (program management and technical) are documented at the end of the paper. If any other organization needs payload/experiment development or NASA documentation assistance, then please contact us. We can help make your idea a space tested reality.

Three years of intense effort culminated on 3 February 1993, the GSFC field operations team at Kennedy Space Center performed the final pressure decay and electrical tests upon the fully integrated GAS-450 flight canister. Subsequently, the payload was integrated with its parent GAS Bridge Assembly in mid-February and the bridge was transferred to the KSC orbiter team in late February 1993. The STS-57 mission originally scheduled to launch on the 29 April 1993 slipped until 21 June 1993. Our Payload shared the cargo bay with ten other GAS Canisters, the EUREKA experiment, the SHOOT experiment, and the SPACEHAB-1 module. The SIL technical staff retrieved the GAS-450 payload after flight from the NASA Spin Test Facility at KSC and shipped it back to California on the 22 July 1993 for student analysis at Allan Hancock College this summer.

2.0 INTRODUCTION

This payload was conceived to encourage young people's growth through practical problem

solving. The challenge is to enclose several thousand pounds of space science into a two hundred pound canister. Sixty percent of the GAS-450 payload is dedicated to the necessary hardware, structures, and electrical systems required to support fifteen science packages. Six science modules with their enclosed microgravity experiments represent the remaining forty percent of the payload mass. Thirteen science teams were recruited three years ago via a short video and application form circulated through K-12 schools in Santa Barbara and San Luis Obispo County. Forty proposals were chosen from the hundreds of applications submitted. Each of the forty team leaders gave an oral presentation to an assemblage of parents, peers, and payload technical staff - who then selected the thirteen flight science packages. Thirteen experiment teams accomplished the design, development, and test schedules required to meet NASA's hardware and paperwork requirements. The following miniaturized masterpieces of basic space science are now flight tested.

<u>Exp. No.</u>	<u>Experiment Title</u>	<u>Responsible School</u>
01	Benzoic Acid Crystals	Cabrillo High School
02	On Orbit Fluid Transfer	Cathedral School for Boys
03	Bacteria Growth	Lompoc High School
04	Magnets in Space	Arroyo Grande High School
05	Bacteria, Radiation affects	Fesler Elementary School
06	Zero Point Energy	Lompoc High School
07	Electrolysis in Space	San Luis Obispo High School
08	Adhesives in Space	San Luis Obispo High School
09	Osmosis	Pine Grove Elementary School
10	Seeds in Space	Paulding Middle School
11	Rock Crystals	Orcutt Junior Middle School
12	Fluid Behavior in space	Vandenberg Middle School
13	Silver Crystals	May Grisham Elementary School
14	Radiation Detector	SIL Staff
15	Accelerometer	SIL Staff

Four of the science modules contain two experiments each, the other two modules contain three and four experiments, respectively. Each module contains a locally designed and fabricated microprocessor to activate and sequence experiment functions, while simultaneously collecting and storing sensor data. The microprocessors and experimental apparatus in each of the six modules are connected to the GAS-450 power distribution system via umbilical cables.

3.0 EXPERIMENT DESCRIPTIONS

The GAS-450 payload is composed of thirteen experiments packaged into six self-contained modules (Fig. 2). The experiments are designed and developed by California Central Coast elementary, middle, and high schools. A technical staff of SIL engineers, scientists and technicians at Vandenberg AFB and the local community invented the GAS-450 payload bus system and are supporting the student experimenters.

Our principle objective of flying this payload is to educate young students about space science and engineering through hands-on experience. These young people are excited and have expended an enormous amount of energy developing their scientific and engineering skills.

The experiments are contained within a standard sealed GAS Canister purged with one atmosphere dry nitrogen. This payload has been classified Class B (Benign) in accordance with policy set forth in JSC TA-91-029.

3.1 EXPERIMENT OBJECTIVES

The scientific objectives of each experiment follows.

**MODULE 1 - Cabrillo High School & Cathedral School for Boys
"BENZOIC ACID CRYSTAL GROWTH" & "ON-ORBIT
FLUID TRANSFER EXPERIMENT"**

**EXPERIMENT 1
"BENZOIC ACID CRYSTAL GROWTH"**

The objective of this experiment is to investigate the solidification/crystallization process of a Benzoic Acid Crystal. An earth grown Benzoic Acid crystal was heated to its melting point once in microgravity, then allowed to reform and cool. The resulting "SPACE CRYSTAL" will be compared to earth grown crystals after recovery. Because convection and buoyancy effects are essentially eliminated in space, it should be possible to produce more perfect crystals.

**EXPERIMENT 2
"ON-ORBIT FLUID TRANSFER EXPERIMENT"**

The experiment plans to demonstrate the feasibility of on-orbit transfer of cryogens using an ullage exchange technique. Ullage exchange is the process of transferring gases from a receiver tank to a supply tank while the receiver tank is being filled with liquid (Freon 113) from the supply tank. The ullage exchange technique allows vent filling of a tank which results in lower energy requirements for on-orbit fluid transfer. Heating of the fluid will take place on orbit. Ullage exchange is achieved by connecting the receiver tank and supply tank in a closed fluid circuit. Liquid is pumped from the supply tank to the receiver tank, while either liquid or gas can return to the supply tank. As the process continues, liquid tends to accumulate in the receiver tank and the ullage gas collects in the supply tank. Benefits of this experiment include providing effective technology for cryogenic and other fluid transfers between spacecraft, and reducing power consumption, fluid losses, and contamination risks over competing techniques. The applications to future space missions are many.

**MODULE 2 Lompoc High School & Arroyo Grande High School
"THE EFFECTS OF A SPACE ENVIRONMENT ON BACTERIAL CHEMICAL
RESISTANCE" & "MAGNETS IN SPACE"**

**EXPERIMENT 3
"THE EFFECTS OF A SPACE ENVIRONMENT ON BACTERIAL CHEMICAL RESISTANCE"**

In the near future we could be exposed to higher levels of cosmic radiation if depletion of the Ozone layer continues. The purpose of this experiment is to determine effects of unfiltered radiation upon growth, propagation and mutation of common Earthside bacteria. Space grown bacteria was subjected to selected household chemicals and antibiotics. The increased radiation experienced outside the atmosphere provide an environment similar to earth's should we allow our Ozone layer's continued degradation.

**EXPERIMENT 4
"MAGNETS IN SPACE"**

The purpose of this experiment is to study the effects of zero gravity on magnets and friction properties as magnet travels along a horizontal shaft. The interaction of magnetic forces between permanent magnets was investigated.

**MODULE 3 - Fesler Elementary School, Lompoc High School
"BACTERIA IN SPACE" & "ZERO POINT ENERGY"**

EXPERIMENT 5

"BACTERIA IN SPACE"

The purpose of this experiment is to investigate the survival rates and mutation rates of bacteria sent into orbit and exposed to higher radiation levels than found on Earth. The hypothesis is that the bacteria exposed to higher energy short-wave radiation (gamma and x-rays) when sent up into space, will suffer significantly higher morbidity and higher mutation rates than bacteria grown under identical conditions beneath the protection of the ionosphere of Earth.

EXPERIMENT 6 "ZERO-POINT ENERGY"

The purpose of this experiment is to study the Zero Point Energy (ZPE) process while in a high velocity microgravity environment. The ZPE hypothesis suggests a basic state of electromagnetic flux exists throughout all space. This experiment tests for this basic flux. The ZPE test cell is designed to concentrate deuteron nuclei about the central palladium electrode. A caduceus coil about the test cell is pulsed simultaneously to bias the nuclei. The biased nuclei are theorized to couple with the ZPE flux to yield a measurable amount of heat within the reaction cell.

MODULE 4 - San Luis Obispo High School "BUBBLES IN SPACE" & "SPACE ADHESIVES"

EXPERIMENT 7 "ELECTROLYSIS IN SPACE"

The objective of this experiment is to investigate the electrode occlusion and bubble formation in electrolysis cells. In an electrolysis reaction, gas molecules accumulate at the electrodes. Small bubbles of these molecules form on the surface of the electrode until their attraction for the surface is overcome by the buoyancy of the gas. In microgravity, however, the factor of buoyancy is negated. Our hypothesis is that the bubble will envelop the electrode in microgravity and end the reaction. Data was recorded with respect to voltage and time for the electrolysis cells.

EXPERIMENT 8 "SPACE ADHESIVES"

The goal of this experiment is to investigate the strength of aluminum material bonded with various adhesives. Samples bonded in microgravity will be compared with gravity bound control. Adhesive grain structure and bond strength are principle objectives of the study. The study of this experiment was proposed for space structure and space flight repair applications.

MODULE 5 - Pine Grove Elementary and Paulding Middle School "OSMOSIS IN SPACE" & SEEDS EXPOSURE TO RADIATION"

EXPERIMENT 9 "OSMOSIS "

The purpose of the osmosis experiment is to examine the effects of microgravity on diffusion of fluids through a membrane. The basic hypothesis is to determine if there is a difference in the rate of diffusion and/or osmotic pressure in space versus the Earth. This will be determined by a pressure transducer and logged in microcontroller memory. Knowledge will be gained in osmosis and membrane technology and it's uses in the medical field and the advancement of desalination in space.

EXPERIMENT 10 "SEEDS EXPOSURE TO RADIATION"

Radish seeds will be exposed to the exoatmospheric cosmic radiation environment. Upon return, the seeds will be germinated and grown to maturity. Comparison will be made to Earthside grown controls. These seeds will be shared with students in grades K-12 in both the Santa Barbara and San Luis Obispo counties who were not able to participate in developing active experiments.

MODULE 6 - Orcutt Junior Middle School, Vandenberg Middle School, May Grisham Elementary

"ROCK CRYSTALS IN SPACE", "FLUID SEPARATION AND SURFACE TENSION EXPERIMENT", & "SILVER CRYSTALS IN SPACE"

**EXPERIMENT 11
ROCK CRYSTALS IN SPACE**

The purpose of this experiment is to determine the effects of microgravity on the growth of rock crystals. The crystals were grown by placing a seed crystal in a supersaturated solution of Sodium Oxide, Silicon Dioxide and water. The crystal growing process occurs at ambient temperature.

**EXPERIMENT 12
"FLUID SEPARATION AND SURFACE TENSION"**

The purpose of this experiment is to study separation of fluids of varying specific gravities in a microgravity environment. The surface tension is studied by observing the interaction of a benign sphere suspended within the fluids.

**EXPERIMENT 13
"SILVER CRYSTALS IN SPACE"**

The purpose of this experiment is to grow silver crystals in microgravity. Normally, gravity dominates the behavior of fluids, with undesirable effects on the quality of crystals. The silver crystals grown without convection should be less compact and cohesive (more powdered) than those produced on Earth.

3.2 EXPERIMENT FLIGHT RESULTS

Since the Goddard Symposium payload paper due date is 2 August 1993, and the GAS-450 payload arrived back in California on 22 July 1993, we did not have time to adequately analyze experiment flight results for inclusion in this paper. Preliminary results show that all forty-three payload experiment sensors (thermistors (24), pressure (11), photo (2), voltage (5), radiation (1)) worked and were successfully stored in the microprocessor system (EPROM) for post flight analysis and graphing. The only sensor that did not work was the Instrument Sensor Technology 3-axis accelerometer, the 2 month launch delay drained the internal batteries. Preliminary analyze indicates that most of the experiment failures are mechanical in nature. For example, a syringe plunger did not pull in or a linear actuator did not pull a membrane card. Each of the student groups (13) will be documenting their own experiment development and flight results via a research paper (10-15 pages). These will be available at the October 1993 Symposium. During the 1993 Symposium presentation, we will share some of the experiment flight results. Student experiment papers can be obtained by contacting Space Information Laboratories.

3.3 OPERATIONAL SCENARIO

As the Space Shuttle ascends through 70,000 ft., the orbiter baroswitch activates Relay A, initiating the 12 Vdc Power System which distributes power to each module. The microcontrollers in

each module activated the experiments shortly after the Space Shuttle orbital circularization and attitude maneuvers were complete. At launch plus one hour, the module microcontrollers started the experiment sequences. All experiments which require power and control initiated simultaneously. The microcontroller initiated a power down of all experiment support systems and components within each module upon experiment completion. Each module microcontroller system has preloaded software commands to sequence, control and store data from each experiment. The 12 Vdc Power Bus System is deactivated by an astronaut prior to descent.

4.0 GAS-450 Payload Bus System

The GAS-450 Payload is composed of three principle systems (SIL, patents pending): 1). Structural Support System 2). The Power Distribution System 3). Science Module System. (Fig. 3).

The **Structural Support System (SSS)** provides the hardware interface to the NASA experiment mounting plate, reacts battery inertial loads, locates the lateral support bumpers, restrains the six science modules, and establishes a sealed payload containment cylinder within the GAS canister. A layer of Soundfoam HT is bonded to the inner surface of the aluminum SSS stressed skin to increase experiment module energy containment capability and vibration isolation. The payload upper and lower bulkheads complete the containment on each end of the SSS cylinder. Reference paragraph 2.1 for further detail.

The **Power Distribution System (PDS)** provides payload electrical access to the NASA interface equipment plate and supplies 12 VDC to the science modules.

The **Science Module System (SMS)** consists of six sealed modules which enclose all payload experimental apparatus. All power and control leads are routed thru an "O"-ring style bulkhead connector. Each module contains a dedicated microcontroller to sequence the experiments and store data. Ambient air at atmospheric pressure was present inside the module. Experimental apparatus volume utilization is designed so that void space does not exceed thirty percent of total volume. Per requirements of NSTS 22648 the SMS is defined as a sealed container which will not propagate a fire from the interior.

Each of the six aluminum modules have an identical microcontroller system. The locally invented microcontroller system is made so that it can be reused in the future. The system is capable of sequentially controlling up to 20 electrical devices (Sink, 0 to 15 Amps) and storing 11 sensor channels. Each module utilizes the first four channels for temperature sensors (thermistor circuitry, -40 C to + 100 C). The microcontroller system is made up of two boards connected together using a 96 pin din plug and socket connector. The first board can download all data (EPROM) collected from experiments into a PC via an RS232 cable. Sensor information is placed into engineering units and plotted via ground PCs. The second board is a breadboard for special circuitry needed to run experiments. All chips are CMOS and perform over harsh environmental performance specifications.

The GAS-450 Payload Bus System is unique. No other GAS canister in the history of the program has ever flown 15 active experiments in one canister. The payload bus system is also completely reusable. The GAS-450 payload is something our technical staff is very proud of!

5.0 PEOPLE CONSIDERATIONS

The California Student "GAS #450" Space Shuttle Program has something for everyone in the local community. The heart of the project consists of the student experimenters. They are all young, talented and very excited about working on their experiments. These people are full of the stuff of youth and eager for directions in which to channel their energy. The GAS opportunity has provided hundreds of people of all sorts, an avenue to apply their creative energy into space research. Directly supporting the forty students are the teachers and advisors at the schools they attend and the technical staff of engineers, scientists and technicians from the local community.

Even with this kind of support, the project could not be successful unless other people pitched in and helped. The parents are supporting the experimenters by providing transportation, helping on experiment designs at home, attending meetings, and altering their own schedule during conflicts to insure the experimenters enough time to work on experiments. The sponsors help provide the equipment it takes to complete the experiment. They are the unsung heroes because many of the experiments use

specialty items that are not available at local stores and are not available as "off the shelf" items anywhere. The sponsors work hard to provide the item needed or to recommend a substitute. The student experimenters and technical advisors are thankful for the support from the 100 local and national sponsors of the California Get Away Special program.

NASA has been very supportive. The GAS-450 technical coordinated every design change through NASA to insure that a dangerous experiment was not inadvertently packaged in the GAS canister. The NASA personnel have responded to the SIL's efforts in a timely manner and a good working relationship has been established between the two organizations.

Last but not least, is the community at large. Community media was important as it told the local community what positive things a few of its citizens were doing and accomplishing. Newspaper, magazine articles, and television time spots were critical to the success of our payload by giving us credibility with potential sponsors. Three press conferences with the local media and newspapers were scheduled, one at the outset of the program, one after Phase II development was complete and one before shipment to Kennedy Space Center for final checkout and installation on the Space Shuttle. One individual in the GAS organization should be totally dedicated to fundraising.

An organization chart which describes the GAS #450 project in a humanistic way is shown in Figure 4. NASA Goddard, Parents, Family, SIL, Contractors (Sponsors), Schools, Friends and Teachers are veins feeding the heart of the project, "the young students". As long as everybody keeps the heart pumping, excited and willing to work hard, the project stays alive and on schedule.

6.0 STUDENT SCHEDULES AND MEETINGS

One of the guided objectives is to provide the students with an experience similar to the aerospace industry at large. Meeting organization, action item discipline, scientific procedures, and schedule milestones processes are utilized to enhance the program. The GAS-450 program used a 3 phase development approach. Under Phase 1, a preliminary experiment design paper, drawing and prototype model is due. Phase 2 development consists of producing a final experiment paper and drawing and a functional prototype model. Documenting experiment evolution and ground testing results with professional laboratory notebooks donated by Scientific Notebook, Co. is also part of Phase II development. The laboratory notebook is a written record of the student experiments. It is broken into the following scientific method categories: Purpose, Procedure, Experiment Apparatus, Observations and Data, Calculations and Conclusions. The experiment notebook is a vital tool in explaining to NASA in a final report how microgravity and space environmental factors effect the experiment. Plenty of ground testing is needed to prove the purpose of the experiment and draw a final conclusion. Phase 3 development consists of producing the final flight ready experiment module and interfacing it into the payload bus system. The students meet with the SIL Technical Staff once a week (3 hrs, June 1990, Program Inception) at Allan Hancock Community College (Santa Maria, California) to develop and test experiments. It has become apparent that regularly scheduled meetings are crucial for any GASCAN program. We have found that these reviews identify problems in designs, can help find flaws in basic system approaches to experiments, allow one to make changes to systems before they become difficult to change, help identify safety related issues and provide a good educational experience for the students. The technical staff monitors all three phases of the project each month with a progress chart.

7.0 LESSONS LEARNED

TECHNICAL

1. Utilize batteries with a very low self discharge rate (2-3% a month). Two battery types serve this purpose very well: Sealed Lead-Acid Gell Cell and Alkaline Batteries. The GAS-450 Payload used five Johnson Control Lead Acid Batteries (JC12150, 12V, 15AH each). We fully charged the batteries at the NASA Spin Test Facility at KSC five months prior to the launch. The GAS-450 payload batteries were 85% fully charged for the STS-57 mission. Count on a three to six month time frame from payload turnover to NASA at KSC and an actual launch date. Read the 1992 Shuttle Small Payload Symposium Papers, "Battery Selection for Space Experiments", by David R. Franciso and "Proper

Battery System Design for GAS Experiments", Stephen A. Calogero for further knowledge on battery selection and power system design. Utilize the electricity payload hazard report format in Mr. Calogero's paper for your Safety Data Package.

2. Building a battery box with a removable lid (NASA safety inspection of fuses and electrolyte resistant material inside (Conap) in the field) to pass a proof pressure test of 22.5 psi (Safety Paperwork, 24 hour test) is no easy task. Make sure you consult with an engineering company or individual who has experience in building pressure vessels before you develop your own. Leave plenty of excess room in power system area for your battery boxes.

3. Think about how to install fuses inside your battery boxes so that you do not have mechanical damage to them during launch. Plastic batteries with sunk-in terminals and areas to place fuses into are critical.

4. Include an acoustic and vibration dampening system in your payload system design. This will reduce the risk of experiment mechanical failures. If you hard mount components directly to the canister structure, then experiments and payload systems must be able to handle the acoustic and metal vibration during launch and landing.

5. Provide fans in experiments that use heaters to reduce hot spots. Remember, there is no convection in orbit. Make sure you utilize adequate heat sinks (conduction) for items such as regulators, transistors and diodes that dissipate significant power.

6. Develop a structure that is not excessively heavy and overdesigned. You may need this weight for experiments and batteries. Remember, you must be within the 200 lb limit for a 5 cubic ft. canister. Perform a basic classical structural analysis (X,Y,Z load of 10g's with factor of safety of 2.0) on your design idea before building it. Read the 1992 Shuttle Small Payload Symposium paper, "Structural Verification for a GAS Experiment", by Mark Peden for further knowledge on structural and vibration design and analysis. Utilize the structure hazard report format in this paper for your Safety Data Package.

7. Don't underestimate the time it takes to complete NASA's paperwork requirements: Payload Accommodation Requirement (PAR) and Safety Data Package (SDP) documents. We revised the PAR three times and the SDP five times before the documents were approved. This alone took over 2500 man-hours. The good part is that once you qualified your payload system, it's much easier to refly the same canister on future missions. Make sure you develop a payload bus system that can be reused.

PROGRAM MANAGEMENT

1. Provide a straightforward approach to soliciting students and teachers such as a video tape and application forms so that K-12 schools can be involved from the start of the program. Have the students submit experiment proposals for evaluation.

2. Interview the best individual or student group proposals for final acceptance into the program.

3. It is crucial to hold regularly scheduled meetings at least twice a week initially and once a week when the experiments are adequately researched and designed. Keep the pressure on the students to perform with experiment action items and design feedback, part procurement, and constant engineering drawing and prototype improvements. The students learn the most if they design and build their own experiments. Effort and curiosity is the key to significant learning.

4. It's crucial to obtain a tax-write off number (501C (3)) for parts, materials and funding. The only way to obtain this tax exempt status is to form partnerships in your local community so you can use their tax exempt status. Schools, colleges and universities, and non-profit organizations are prime candidates. Parts and materials are much easier to obtain than funding if you contact the company via letter and

describe the goals of your program and specific need. Send newspaper and magazine articles and any video information about your program. It usually takes much longer to obtain money. In our experience, companies or individuals will not donate parts, materials or funding unless you approach them via letters, presentations, grant proposals, etc. This all takes valuable time. Organizations that obtain grants without doing anything are few and far between. Do something and then start asking for parts, materials and funding. Administrative costs such as travel expenses, telephone calls, copies, video tapes, momentos, mailings, etc. add up. Partnerships in the local community can help to reduce this significant cost.

5. If your organization wishes to support an educational payload, please see NASA interim final rule amending 14 CFR Part 1214. NASA offers lower prices for SSCP's sponsored by domestic educational institutions (5.0 cu. ft.-\$10,000, 2.5 cu. ft.-\$5,000). Unfortunately, the current policy definition of a domestic educational institution excludes some educational GAS users. The definition includes only the following institutions: universities, colleges, elementary or secondary schools, or university- affiliated research foundations. If you are truly an educational payload and do not fit this rule, then contact Dr. Malcom V. Phelps (NASA HQ., NASA Educational Division, Code FET, Washington D.C. 20546, 202-358-1540) with a 2-3 page proposal discussing why you are an educational payload. Dr. Phelps will study proposals on a case by case basis and make a ruling. We think that the new policy should include any 501 (C) (3)- public charity or organization such as AIAA, IEEE, NSS, etc. that are developing canisters for students.

By reading the above lessons learned, you now realize that your organization must be extremely dedicated and do whatever it takes to finish the payload. The individuals organizing your program must realize the commitment and skills necessary to design and build a "GAS" payload for the Space Shuttle. You need professional engineers, scientists and technicians on your team to help.

8.0 CONCLUSION

The Get Away Special GAS-450 Payload successfully flew on the STS-57 mission, Space Shuttle Endeavour, 21 June 1993. The GAS-450 payload bus system (power, structure, microprocessors, sensors) enjoyed a 100% success rate and the student experiments were 60% successful. We are planning to re-fly our unsuccessful experiments and a few new ones on the STS-64 mission (GAS Bridge, Late 1994) and apply lessons learned in order to achieve success. Concurrently, SIL will be starting another program with a new group of K-12 students and experiments for a flight opportunity in mid 1996. This approach will allow us to have a GAS Payload in Space every 1 1/2 years. Special thanks to the Special Payloads Division of Goddard Space Flight Center, Mr. Mark Anderson our GSFC Technical Manager, Mr. Steve Calogero our NASA Safety Officer, and Mr. Russell Griffin our KSC/GSFC GAS Field Operations Manager, for their technical expertise, attention to detail, and assistance. NASA's Get Away Special program offers a unique opportunity for communities to provide "hands-on" experiences for children, as well as their adult helpers, opening their minds to the world of science and space, as well as the joy of learning. Many of the students involved in our program now express a desire to pursue scientific careers and have learned real skills such as electronics, metal fabrication, computer aided design, etc., that will help them reach their goals in life. The founders of Space Information Laboratories hope others will be inspired to start "hands-on" programs similar to the California Space Shuttle Program for our Children.

If you would like to contribute funds to this or future California student "Get Away Special" programs please contact Edmund D. Burke or Marty Waldman, Space Information Laboratories, P.O. Box 5090, Vandenberg AFB, CA 93437. Phone Number: 805-735-1155. Your contribution is tax deductible through the Allan Hancock College Foundation or Space Information Laboratories.



FIGURE 1

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH



FIGURE 2

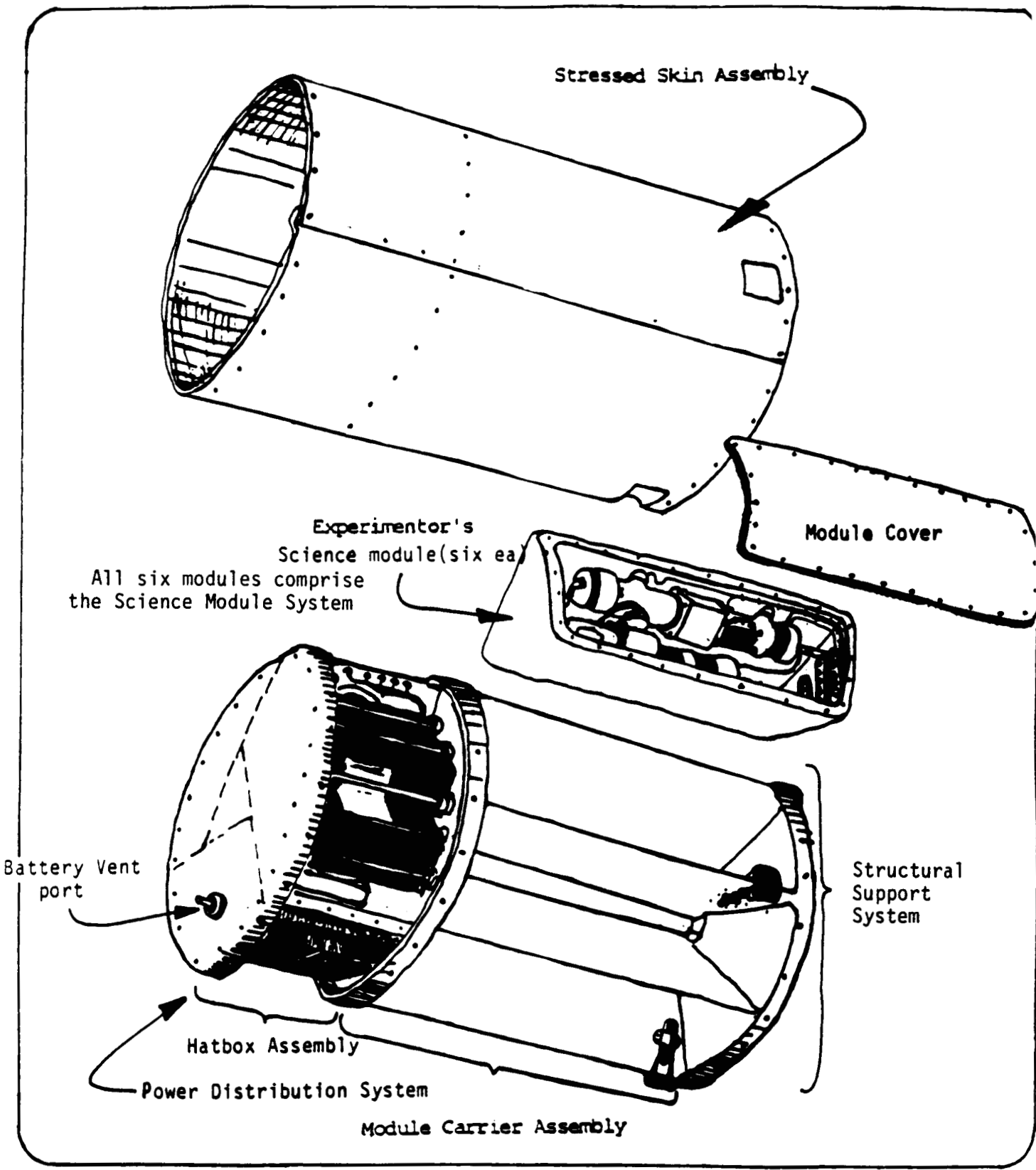


FIGURE 3
Payload Principle Systems

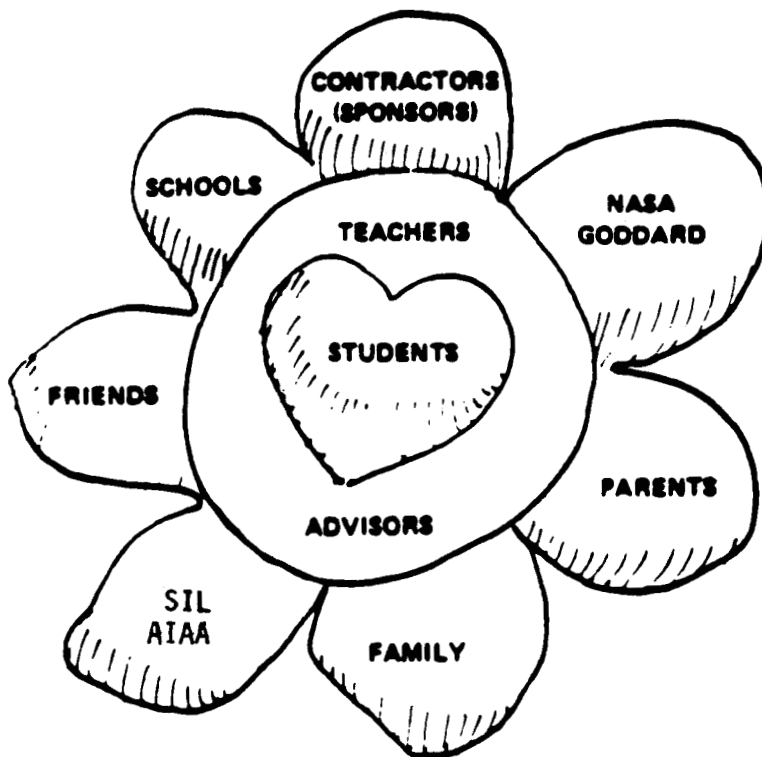


FIG. 4
ORGANIZATION CHART

