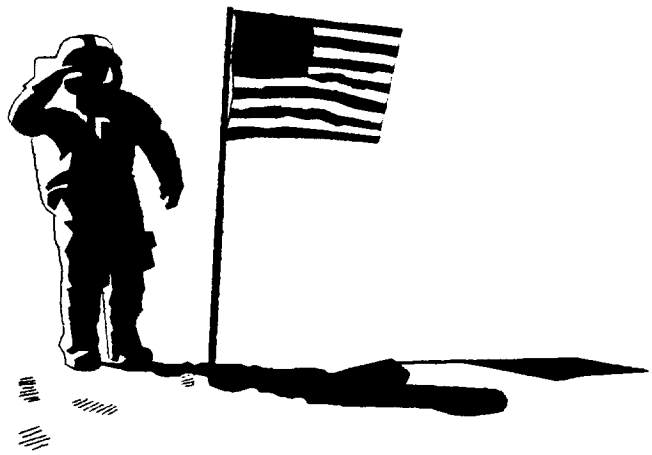
United States Space Foundation

The Effects Of Using Space To Teach Standard Elementary School Curriculum

Final Report, February 1996



Research sponsored by the National Aeronautics and Space Administration
and the
United States Space Foundation
in cooperation with
Fairfax County Public Schools, Fairfax County, Virginia

Robert N. Ewell, Ed.D.
Colorado Springs, CO

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Introduction

This brief report and recommendation for further research brings to a formal close this effort, the original purpose of which is described in detail in **The effects of using space to teach standard elementary school curriculum, Volume 1,** included here as the Appendix. Volume 1 describes the project as a **3-year research program to determine the effectiveness of using space to teach.** The following excerpt is from page 1:

> The research design is quasi-experimental using standardized test data on students from Aldrin Elementary School and a District-identified "control" school, which shall be referred to as "School B." Students now in fourth through sixth grades will be compared now (after one year at Aldrin) and tracked at least until the present sixth graders are through the eighth grade. Appropriate statistical tests will be applied to standardized test scores to see if Aldrin students are "better" than School B students in areas such as:
>
> - Overall academic performance
> - Performance in math/science
> - Enrollments in math/science in middle school

Although designed as a 3-year study, the project was funded for only one year from the beginning, and Volume 1, intended only as a baseline for two more years of data, gave the impression that the study concept was flawed from two perspectives. First, the "control school" appeared not to have enough in common with Aldrin Elementary School to make meaningful comparisons possible (see Volume 1, pages 19-21). Second, it appeared that the "intervention" being tested was primarily the teaching with space courses conducted by the US Space Foundation. The following is from Volume 1, page 3:

> **The United States Space Foundation** conducted its five-day graduate program **Getting Comfortable Teaching with Space** in October 1994 as well as a 2-day in-service in January 1995, sponsored by NASA and private funding.

Volume 1 documented Aldrin as a special place with respect to space and technology.

> **Aldrin Elementary School uses a core space theme to focus on science and technology.** In addition to the standard body of knowledge, Aldrin students are taught "how" to learn in order to function successfully in a rapidly changing technology age. Technology serves as the medium through which the special and diverse populations will learn. State-of-the-art hardware and specialized software are the launching pads for the instructional program. The faculty was selected after extensive screening and personal interviews with the innovative principal, Gina Ross. She emphasized creativity and use of technology in teaching methods. **This is a school using technology to teach about technology within an elementary curriculum.** (Pages 2, 3)

Volume 1 also documented in some detail other features of Aldrin as "confounding variables" on pages 24 - 26. These variables included:

- The "hero" effect
- Faculty and administration quality
- Computers in the lab and classroom
- Corporate sponsorship and involvement
- Parental involvement with the excitement of a "new" venture

Naturally, with all these things going on, it appeared unlikely that any positive effects on the children could be traced back solely to the US Space Foundation's space courses.

Quality research into the effectiveness of any intervention has two objectives:

- Measurable outcomes that can be compared with some national standard or national statistics
- A clear connection between the outcome and the intervention

Since a single intervention with teachers or even students is unlikely to produce measurable, lasting benefits on *students* that can be directly attributed to the intervention, it is imperative that Aldrin be studied as outlined in the remainder of this report.

Recommendation for further research

The first aspect of the follow-on research is to **document Aldrin as the intervention**. The **Aldrin Intervention** is not the US Space Foundation's one-week course or two-day in-service even though Aldrin teachers have taken two one-week courses and an in-service since October 1994, and they all agree that the repetition is critical to their learning the space concepts. The **Aldrin Intervention** is not a Challenger Center classroom in the school house even though Aldrin has such a classroom. The **Aldrin Intervention** is not even a visit by Buzz Aldrin even though he did shake the hand of every kid there last year. The **Aldrin Intervention** is all these things and more:

- It is Gina Ross, the principal, forging partnerships with not just one corporation and nonprofit, but many.

- It is a pioneering effort in the area of science rubrics tied to national education standards at the elementary level.

- It is quality teachers integrating space and technology at every level of the school all year long. Kids don't write stories about bunnies in the forest, as the reading teacher told me; they write about space aliens or the challenges of colonizing Mars.

- It is space-specific teacher training from the U.S. Space Foundation, Challenger Center, and others.

These activities are able to be replicated.

- Any school can (and most are expected to) form partnerships with people and businesses in their community.

- Any school can set up appraisal systems tied to national education standards. Recent studies have shown that teachers from all kinds of backgrounds--from wealthy McClean to the inner city--can apply rubrics to student work accurately and uniformly. And appraisal systems tied to national standards in the areas of science and math will encourage specific kinds of instruction in science and math: problem solving, inquiry-based education.

- Any school can integrate space and technology into their instruction.

- Any school can send at least one teacher to the many U.S. Space Foundation's Space Discovery seminars or Teaching with Space in-service or to programs such as Space Camp and Space Academy at Huntsville, AL.

Documenting the activities at Aldrin would provide valuable insights to any educator wanting to improve a school or school system. Furthermore, documenting those activities as the **Aldrin Intervention** would meet the second research objective. It would not be hard to make a connection between a student's performance or attitude coming out of the sixth grade and the entire tenor of his elementary experience over the past several years. The objective then would be to find a measure that would allow integration and comparison of national data.

Future research would look for some simple meaningful measures that have a broad base of existing data that could be used to **compare Aldrin graduates to themselves** from year to year and to broad population bases. Consider the following examples:

- Virginia Literacy Test

This test was used in the preliminary report we published June 1995. The test is given to sixth graders in three areas: reading, writing, math. Given in February, we did not expect significant results for the June 1995 research report since tested students had been at Aldrin less than six months. We would expect to see the Aldrin Intervention take effect for students who have spent at least three years at Aldrin. Therefore, we would propose to track for research purposes the amount of time an Aldrin student has been at Aldrin along with the other demographic factors gender and ethnicity. Then data could be compared among Aldrin students as they mature through the program (this year's students would be into their second year; next year's, into their third....); data also could be compared against all students in Aldrin's subarea of Fairfax County, all of Fairfax County, and all of Virginia. Of special interest would be how girls do on the math

portion. Can the Aldrin Intervention prevent the stereotypical downward spiral of girls' interest and ability in mathematics?

- Math Anxiety Rating Scale

This is a test published by the Rocky Mountain Behavioral Science Institute. It is offered here as just an example of what might be out there for use in this research. There is an elementary school version of the test which is purported to be able to measure students' self-perception of their apprehensiveness in performing mathematics in every day situations. Again, gender comparisons would seem particularly apt here as well as national comparisons if they exist.

A very small amount of research funding will return significant dividends to NASA's education programs. Research needs to be conducted, as the US Space Foundation proposed initially, over at least a 3-year period. For a modest funding level, Foundation researchers can:

- Identify the best two or three attitude and achievement measures to use on sixth grade Aldrin students. Criteria would include:
  - Existing broad data base (state or national)
  - Measuring something meaningful to this study (math and science)
- Collect and analyze data including significant interactions involving:
  - Gender
  - Ethnicity
  - Length of time at Aldrin
- Document Aldrin activities as the **Aldrin Intervention** in a way that would make what's going on at Aldrin accessible to schools nation-wide.

Aldrin Elementary remains an important opportunity for NASA to get meaningful student-based data. The June 1995 report (Appendix) was written to be very preliminary, and the potential of the research may have been clouded by the poor selection of a single "control" school. The research recommendations described in this report do not require a control school to generate meaningful comparisons. In addition, this recommendation makes clear that the "intervention" is not a single program with a lot of confounding variables documented on page 25 and 26 of the June 1995 report. Future research should understand that the intervention **includes** all those variables which the new research will document as factors to be replicated elsewhere.

Research based on data collected from and activities observed at Aldrin Elementary School is a project worth pursuing in order to document how any school can use space and technology in the classroom and what the effects of such an intervention might be.

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Volume 1, June 1995

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Fairfax County Public Schools, Fairfax County, Virginia

Robert N. Ewell, Ed.D.
Colorado Springs, CO

Research Purpose

Since 1986, the **United States Space Foundation**, a nonprofit organization based in Colorado Springs, CO, has conducted a five-day graduate program for K-12 teachers in cooperation with the **National Aeronautics and Space Administration** (NASA). The program, **Getting Comfortable Teaching with Space**, equips the teachers to use space and technology concepts in the classroom.

Since 1992, NASA-sponsored research into the effectiveness of **Getting Comfortable Teaching with Space** has focused on course structure and quality and teachers' abilities, attitudes, and application of space-related activities. The existence of Aldrin Elementary School with a school-wide emphasis on space and technology offers an unprecedented opportunity to broaden the research base from teachers' activities to the effects of space and technology on students.

Sponsored by NASA and private funding, the **United States Space Foundation** conducted **Getting Comfortable Teaching with Space** for Aldrin teachers in October 1994. Since then, Aldrin teachers have been using course concepts to integrate space into their teaching activities while presenting standard curriculum.

The purpose of this 3-year research program is to determine the effectiveness of using space to teach. The research design is quasi-experimental using standardized test data on students from Aldrin Elementary School and a District-identified "control" school, which shall be referred to as "School B." Students now in fourth through sixth grades will be compared now (after one year at Aldrin) and tracked at least until the present sixth graders are through the eighth grade. Appropriate statistical tests will be applied to standardized test scores to see if Aldrin students are "better" than School B students in areas such as:

- Overall academic performance
- Performance in math/science
- Enrollments in math/science in middle school

This report analyzes data collected the first year, representing only preliminary findings.

Background and Introduction

Since 1986, the **United States Space Foundation**, a nonprofit organization based in Colorado Springs, CO, has conducted a program for K-12 teachers in cooperation with the **National Aeronautics and Space Administration** (NASA). The program, **Getting Comfortable Teaching with Space**, equips the teachers to use space and technology concepts in the classroom. The idea is that kids seem to be motivated by "dinosaurs, ghosts, and space" (in no particular order). If standard curriculum could be "spiced up" with aerospace examples, more students would stay in school, be interested in math and science, and become the next generation of scientists and engineers.

Since 1992, NASA has sponsored extensive research into the effectiveness of **Getting Comfortable Teaching with Space**. Through computer-administered questions, pre and post surveys and follow-on surveys 6-9 months after training, research has focused on course structure and quality and teachers' abilities, attitudes, and application of space-related activities. Extracts of a recent study giving more detail on the program and showing some of the results are in Appendix A.

The key element missing from previous research is data from students. **Getting Comfortable** graduates number over 5,000 representing hundreds of schools throughout the US and Canada; therefore, obtaining data related to students would be a formidable task.

The existence of Aldrin Elementary School with a school-wide emphasis on space and technology offers an unprecedented opportunity to study the effects of space and technology on students. The following summarizes the significance of Aldrin Elementary School to the concept of using space in the classroom.

> Aldrin Elementary School, located in Reston, Fairfax County, Virginia, opened September 8, 1994, as the largest elementary school in Fairfax County, encompassing approximately 100,000 square feet of inside space and 13.7 acres of outside grounds. The school is named after Dr. Buzz Aldrin, the second astronaut to walk on the moon.
>
> Aldrin Elementary is housed in a two-story, 30-classroom building which also contains a technology center, a science center, a health and nutrition center, a weather station, and television broadcast facilities. The school also has a computer lab with at least four computer stations with telephone and modem.
>
> Aldrin Elementary educates a diverse population of students. That diversity includes pre-school handicapped, non-categorical, physically disabled, English as a second language, and general education programs. The school had about 550 students enrolled the first year with a capacity of 950 students.
>
> **Aldrin Elementary School uses a core space theme to focus on science and technology.** In addition to the standard body of knowledge, Aldrin students are taught "how" to learn in order to function successfully in a rapidly changing technology age. Technology serves as the medium through which the special and diverse populations will learn. State-of-the-art hardware and specialized software are the launching pads for the instructional program. The faculty was selected after extensive screening and personal interviews with the innovative principal, Gina Ross. She emphasized creativity and use

of technology in teaching methods. **This is a school using technology to teach about technology within an elementary curriculum.**

The theme for Aldrin's first year was "Reaching for the Moon With Its Stars." The **United States Space Foundation** conducted its five-day graduate program **Getting Comfortable Teaching with Space** in October 1994 as well as a 2-day in-service in January 1995, sponsored by NASA and private funding.

The purpose of this research is to determine the effectiveness of using space to teach standard curriculum.

Research Design and Methodology

Data Collection

The research design is quasi-experimental using data from students from Aldrin Elementary School and a District-identified "control" school, referred to in this report as School B.

> Note: quasi-experimental research is distinguished from a "true experiment" in that in a true experiment, the researcher's control extends to the ability to assign subjects at random to the levels of the independent variable (the two schools). This research is quasi-experimental because we obviously cannot control random assignment of subjects to the two schools.

Since the subject of the study is Aldrin Elementary and since the District identified School B as the control school for the study, specific internal data comparing Aldrin with School B were not obtained this first year. As test data were analyzed, it became apparent that comparisons between Aldrin and School B might be useful, and some observations have been incorporated into the first year's discussion on pages 21-22. More detailed Aldrin/School B comparison data will be obtained in this study's second increment: 1995-1996.

Subjects of the study are all 4th through 6th grade students of School B and Aldrin Elementary Schools identified as such in the Spring 1995.

In September 1994, a simple instrument designed to measure student attitudes toward space and science was administered to students from both Aldrin and School B.

In October 1994, **Getting Comfortable Teaching with Space** was conducted for all the teachers of Aldrin and the standard pre and post surveys used for that course were administered.

In January 1995, Teaching with Space, a two-day inservice, was conducted for Aldrin teachers, along with some space-related programs for students.

In April 1995, the kids' survey was readministered to grades 4-6 at both School B and Aldrin. Also in April 1995, the follow-on **Getting Comfortable Teaching with Space** survey was administered to Aldrin teachers. In addition, samples of Aldrin 4th through 6th grade students were interviewed in small groups during April 1995. Similar interviews are planned for Spring 1996 and 1997. These interviews are conducted on school premises on a non-interference basis such as over lunch.

Copies of these surveys are in Appendix B.

In addition to the surveys, data have been and will be collected from appropriate standardized tests, using only those test scores already existing or that will come into existence during the ordinary course of events. These tests include:

Cognitive Abilities Test (CAT): measures verbal, nonverbal, and mathematics proficiency

Iowa Tests of Basic Skills (ITBS): measures skills in mathematics, reading, and language arts

Program of Studies Mathematics Tests (POS): given to all students through algebra

Degrees of Reading Power (DRP): measures reading skill

A rough time line for collecting standardized test data is shown below.

Using the 1994-1995 test schedule as a guide, the following data will be collected over the remaining two years of the study. Numbers in the table represent the grades given the test. Numbers in parenthesis represent the present grade of those students. For example, in the Spring of 1997, we will be able to collect the ITBS scores of 8th graders who are in the 6th grade now (shown on the table as 8 (6)).

	Fall 94	**Spring 95**	**Fall 95**	**Spring 96**	**Fall 96**	**Spring 97**
CAT	4		5-6 (4-5)	5-6 (4-5)	6 (4)	6(4)
ITBS		4				8 (6)
POS		4-6		5-7 (4-6)		6-8 (4-6)
DRP	5		5(4)			

In June 1995, both schools made available the standardized test scores for their students. A database for processing with Microsoft® Access was established for the 150 Aldrin fourth through sixth graders and 307 School B fourth through sixth graders consisting of the following:

- Student ID number for later tracking through elementary and middle school
- School attending
- Grade during 1994-1995
- Raw scores of available tests
  (Note: it is recognized that some tests are "normed" and that the normed scores (percentiles) may be more suitable for long-term tracking. However, since this year we would be making straight comparisons of students who took the same test at the same time, it seemed ill-advised to add one artificial construct (the normed score) on top of another (the raw score estimate of ability in some dimension). Therefore, this year's comparisons are made with raw scores. For subsequent years, and particularly to compare performance across time, normed scores will be incorporated into the database.)
- Date and place each test was taken
- Gender and ethnic group where available
  (Note: as of this writing, these data are incomplete. During the next research year, ethnic and gender data will be acquired and entered for all students ID'd during 1994-1995.)

As of this writing in late June 1995, not many test scores are available. The POS which is given in late June was not available for processing at this time. Tests scores generated last Fall will not reflect Aldrin's effect on students. Therefore, comparisons in this volume are limited to the only tests offered this Spring: the Iowa tests and Virginia Literacy.

In addition to the standardized tests, students' enrollments in math/science courses also will be added to the database and tracked as they move through middle school. This information relates directly to one of the hypotheses of space-related education: namely, that students will become more interested in math and science.

Data Analysis

The intent of this study is to use standardized tests to compare two like groups of students differing primarily in the level of space activity in the classroom. Appropriate statistical tests are employed to see if Aldrin students are "better" than School B students in areas such as:

- Overall academic performance (CAT, ITBS, DRP)

- Performance in math/science (CAT, ITBS, POS)

- Enrollments in math/science in middle school

To measure the statistical significance of score differences between Aldrin and School B students, the t-test is used with the standard Type I error probability set at 0.05. Again, to compute the t statistic, the researcher needs only the list of scores from each school for a particular test.

Frequency information such as the number enrolling in math/science courses in middle school will be tested for significance using the Chi-square test of independence with α again set at 0.05.

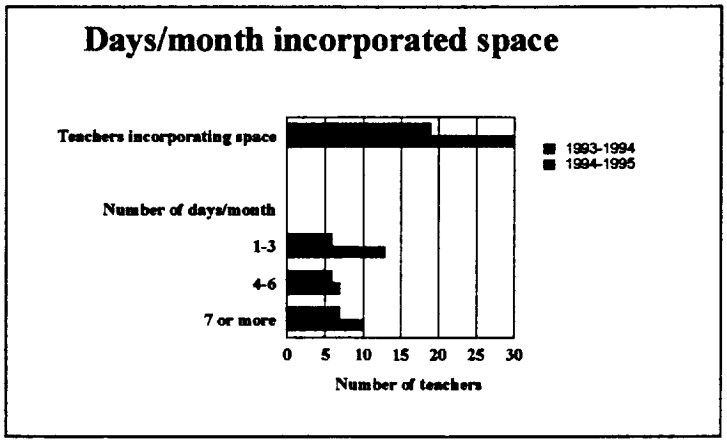
Summary of 1994-1995 results

Preliminary results suggest that the space-related approach to elementary education is working. Following is a brief summary of data highlights.

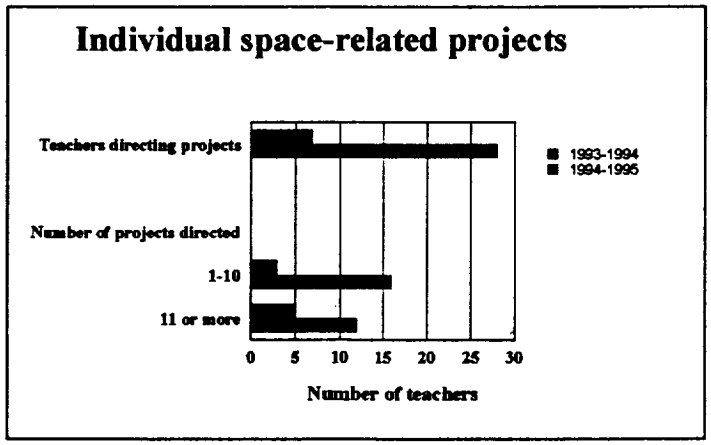
Teacher activities

The heart of this research is the effect of teachers' space-related activities on students. To ensure that teachers had a set of tools to work with, the U.S. Space Foundation conducted a special session of its five-day graduate course **Getting Comfortable Teaching with Space** for Aldrin teachers in October 1994 and a two-day in-service in January 1995. To assess the effect on teacher behavior of the course, teachers were administered surveys before the course and again after the course and in April 1995. The pre-course survey and the Spring survey asked about their teaching activities. The following two charts are samples of the teachers' extraordinary response to the Getting Comfortable concepts coupled with the exciting Aldrin environment.

Note in the first chart the increase in the number of teachers who used space in the classroom in 1994-1995 compared to the previous school year, 1993-1994. Not only did the number of teachers (from a total of 37) using space in the classroom increase from 18 to 30, the frequency of use increased across-the-board.



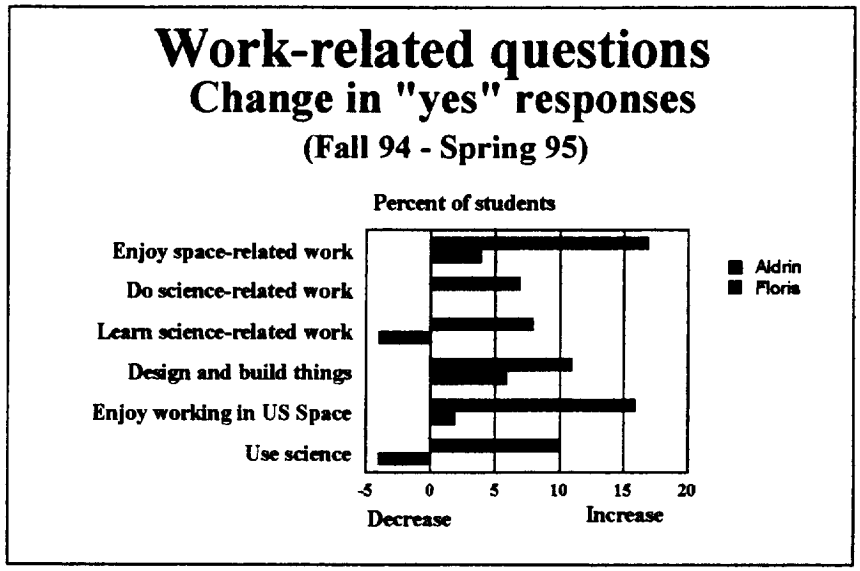
Note also the huge increase in the number of teachers using the technique of individual space-related projects.



There will be more detail on teachers' activities in the detailed analysis section of this report.

Student attitudes

Students at both Aldrin and School B were administered questionnaires designed to determine their attitudes toward math and science. The Aldrin surveys were administered within the first week of school (School B a little later) and again in late April. The following chart shows that from an initial position of near equality, a higher percentage of Aldrin students showed positive movement in questions relating to their future as scientists and engineers.



There will be more detail on the student attitude surveys later in the report.

Anecdotal evidence suggests that the space approach is working. When asked in April 1995 what they liked most about Aldrin school, fourth through sixth grade students responded with comments such as:

- Space and projects
- Technology
- Math
- "Educational"; high tech, computers
- The interest in space technology. "This school is into space."
- Math and science
- Hands-on

When asked what kinds of activities helped them learn, among the items listed were:

- Laser disk programs; specifically, "Nancy and Bob", aliens who travel from planet to planet. "A better way to learn about the planets than just reading descriptions in a book or having the teacher lecture."
- Constellations projects: light boxes

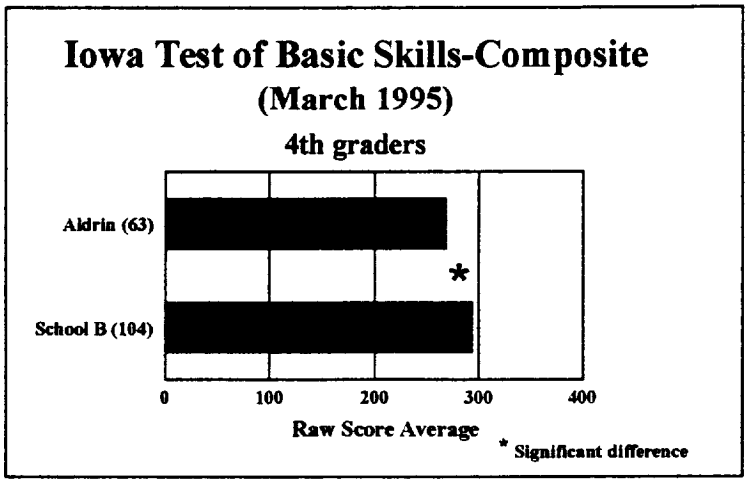
- Our solar system to scale on the field. (mathematics and science)

- Poetry and spelling lessons are using space concepts. (This really seemed to turn the kids on, just as advertised.)

More detail with analysis on three focus groups held with fourth through sixth grade students appears later in this report.

Standardized test comparisons

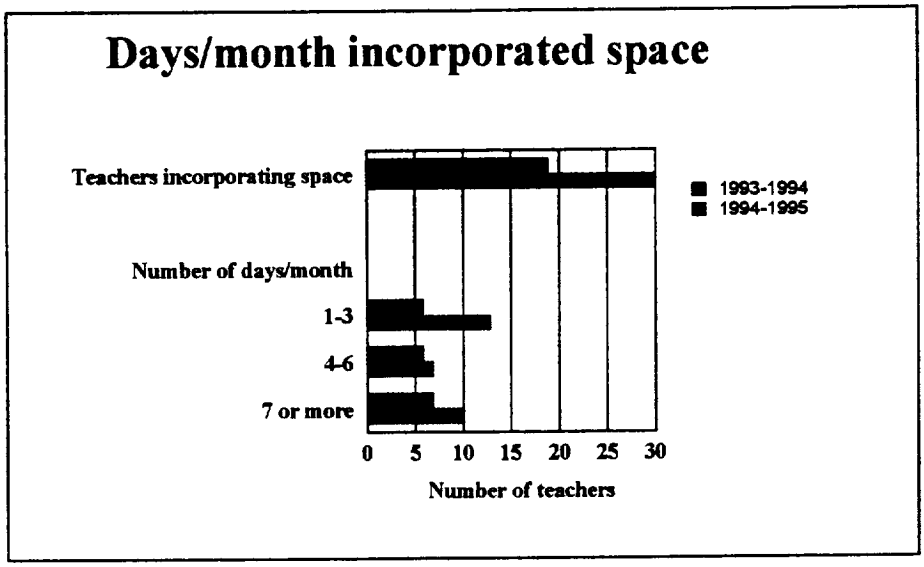
The standardized tests do not yet show that Aldrin is producing superior results to School B. For example, the following chart shows the Spring scores on the Composite ITBS where School B's average was significantly higher than Aldrin's. In depth analysis and interpretation of all the test scores collected so far appear in the Detailed Analysis section of this report.



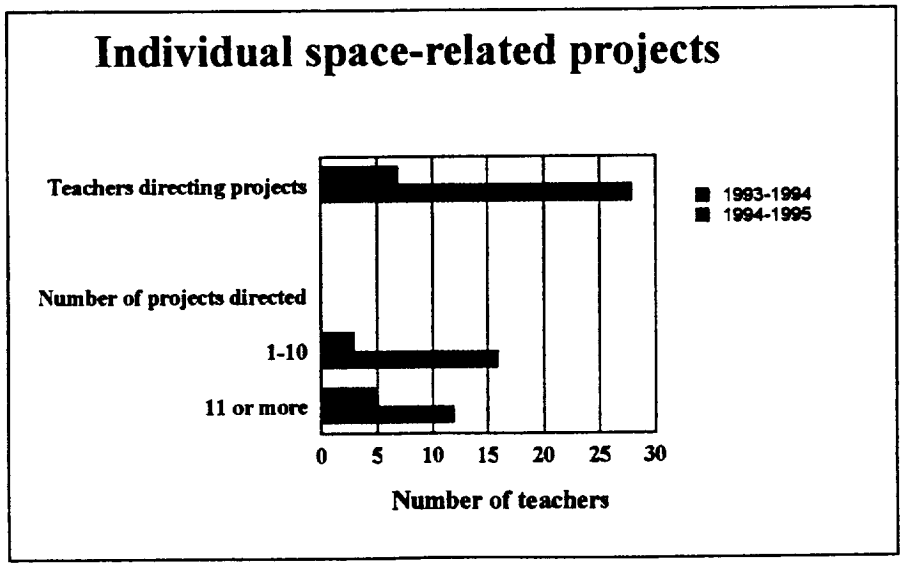
Detailed Analysis

Teacher activities

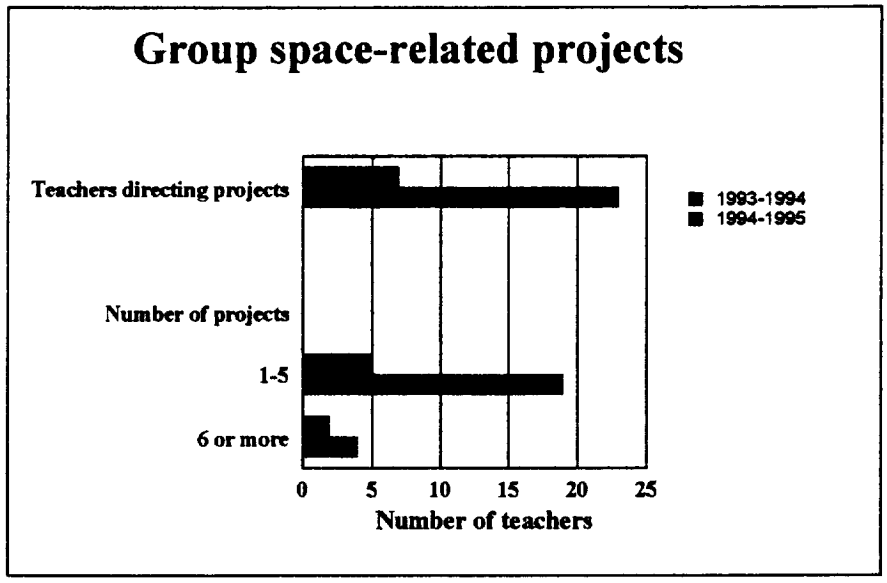
As a result of the five-day graduate course **Getting Comfortable Teaching with Space** presented to Aldrin teachers in October 1994 and the two-day in-service conducted in January 1995, the space-related activities of Aldrin teachers soared throughout the year. We have already noted the increase in the number of teachers who used space in the classroom in 1994-1995 compared to the previous school year, 1993-1994. Not only did the number of teachers (from a total of 37) using space in the classroom increase from 18 to 30, the frequency of use increased across-the-board.



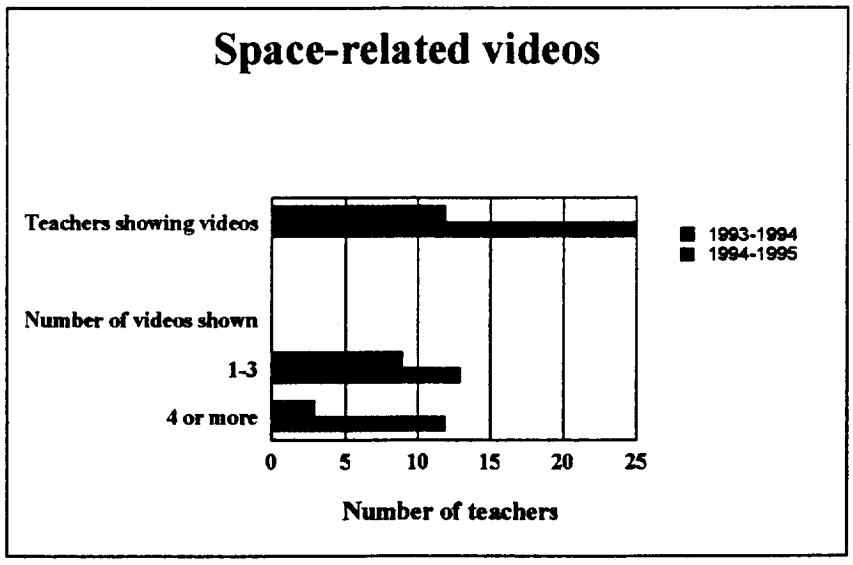
We also reported in the summary section a huge increase in the number of teachers using the technique of individual space-related projects.



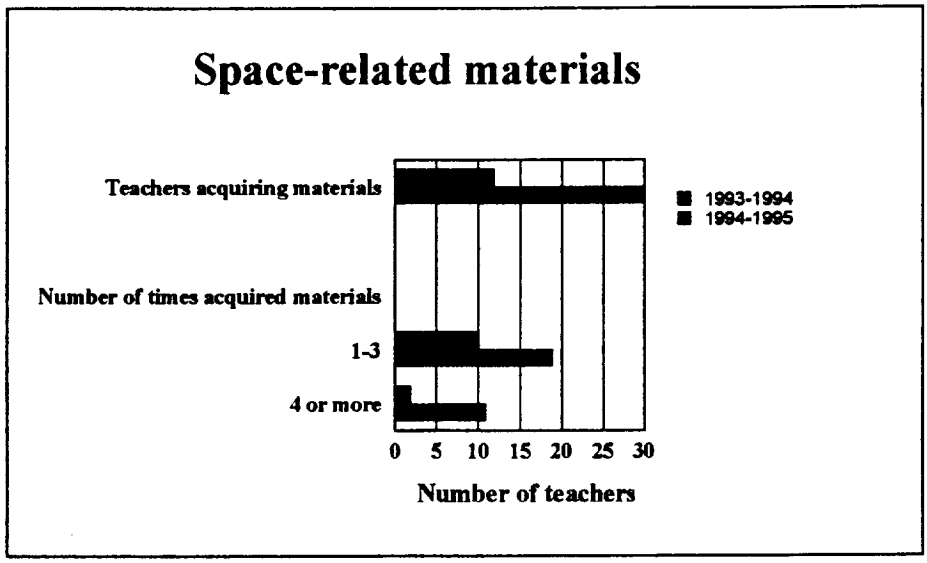
Other space-related teaching techniques flourished under Aldrin teachers' direction. Note the large increase in the number of teachers directing group space projects.



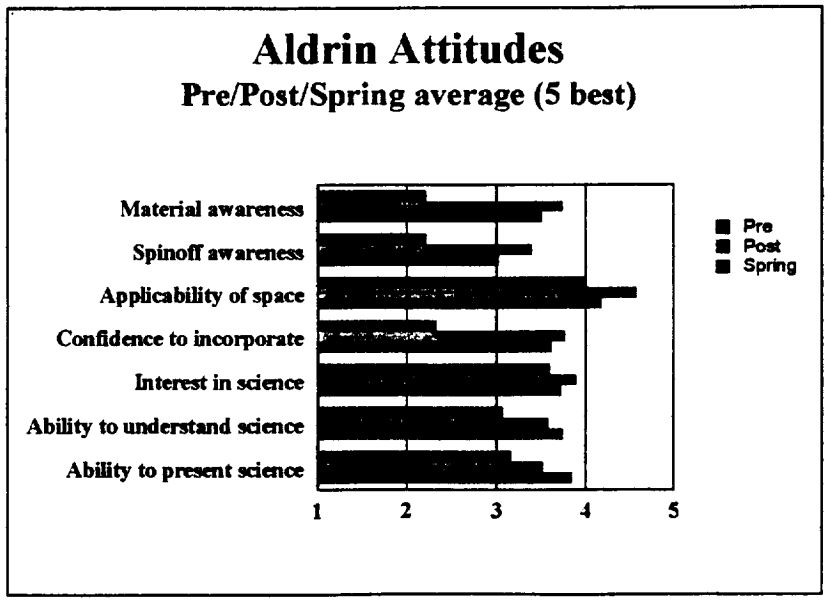
The number of teachers taking advantage of space videos more than doubled. The total number of space-related videos shown by these teachers increased from 32 in the 1993-1994 school year to 84 during the first year of Aldrin.



The number of teachers acquiring space-related materials to use in the classroom nearly tripled.

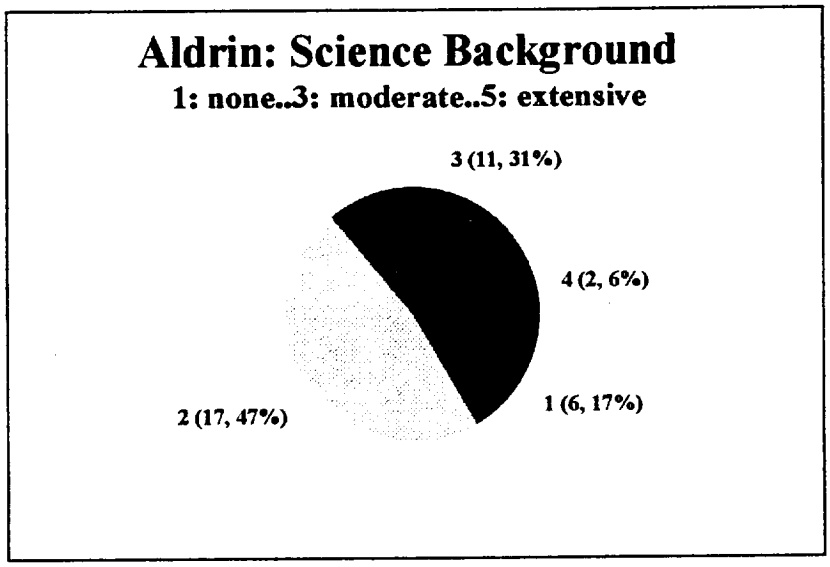


These changes in activities among the teachers was not unexpected given the change in their perceived attitudes and abilities as a result of the **Getting Comfortable Teaching with Space** program. The following chart depicts the average of their responses to the attitude/abilities questions in the pre, post, and Spring surveys and shows gains in all areas.



Of particular importance are the last two areas. Note that the teachers' perceived ability to understand and present science not only improved immediately after the course (post) but continued to improve throughout the year (Spring) as they put into practice what they had learned.

This improvement in understanding and presenting science is especially noteworthy in this group of teachers who do not have particularly high science backgrounds. For the last several years of presenting **Getting Comfortable**, approximately 70-75 percent of thousands of teachers rate their science backgrounds moderate or below: 1-3 on a 5-point scale. In this group, **94 percent** put themselves in the moderate and below categories. (There were none in category 5, extensive.) Yet they frequently and successfully incorporated space into their teaching and gained confidence and ability in the process.



Student attitudes

The teachers' integration of space into the classroom had a positive affect on the students.

Samples of Aldrin 4th through 6th grade students were interviewed in small groups during April 1995.

The group of fifth graders was the most enthusiastic, volunteering specific reaction to the space nature of the school to a question designed just to get them talking: **What do you like best about this school?**

- "Educational"; high tech, computers

- The interest in space technology. "This school is into space."

- They knew about their teachers' space training week in October, and their teachers have told them about the underwater training. They were very impressed with that even though it wasn't "hands-on" for them (the kids).

- Computers including encyclopedias on computers

- New building and books (compared with other schools attended which were old)

- Lots of subjects and projects

- Science center with lots of "neat" stuff

- "Main accomplishment of the school is to get us to understand space."

- "The space training the teachers took gave them confidence which we see when they teach us about space."

A group of eight sixth graders, deliberately selected to be "average", not necessarily bright or affluent, liked Aldrin because:

- "It's big, and we have four computers in each room."

- "The school emphasizes math and science"

- "We take field trips, e.g., the space center"

- "We do lots of hands-on"

When asked, **What kind of activities helped you learn?** A group of fourth graders mentioned a variety of factors, most of which involved some sort of participation and hands-on activities [some of which were presented at the **Getting Comfortable** program]:

- Social studies, science, math projects

- Games

- Student-directed: choice of projects; if game, make up rules

- You can hear, talk, or do--we do

- Solar system books

- Physical activities: e.g., jeopardy

- Field trips

- Fraction bar

- Teachers are patient

- Geography relays (also math relays); a game that motivates the students to learn so they won't miss a question twice. [Most knew where Madagascar was!]

The fifth graders listed the following learning-enhancing activities:

- Laser disk programs; specifically, "Nancy and Bob", aliens who travel from planet to planet. "A better way to learn about the planets than just reading descriptions in a book or having the teacher lecture."

- Constellations projects: light boxes

- Our solar system to scale on the field. (mathematics and science)

- Poetry and spelling lessons are using space concepts. (This really seemed to turn the kids on , just as advertised.)

- Even in music we are learning and singing space-related songs.

The sixth graders appreciated the following activities, none of which was space-related:

- Current events. [Note: Brian Mulholland, General Manager of the Sheraton and the number one corporate sponsor, conducts a weekly current events class for sixth graders. I observed one such class, and both Brian and the students were impressive. Mr. Mulholland provides the newspapers he expects them to read. For further comment on this aspect of Aldrin, please see "Corporate sponsorship" under "Other factors" in the conclusions section of this report.]

- Math: more hands-on. For example, we did a chart with ratios based on a survey of who liked rap music versus other kinds

- Science: more hands-on

- Computers: some take their spelling tests on computers

- More student-directed: for example, we get to choose our own spelling words

During the focus groups, the students were asked, **How do your teachers use space ideas in the classroom?**

The fourth graders listed:

- Movie on planets

- Science and music questions from the morning "news" program

- Video of people living on moon, mars

- "We have to take notes during videos to answer questions later."

- Mars project: [This project was effective with this group. The fifth graders didn't like the Mars project.]

- Groups to research planets and build slide show on the computer

- Colony in space project

- "Teacher uses what we know to take us where we don't know. Sometimes we use space, sometimes not."

The group of fifth graders had already expressed their enthusiasm for the space concepts their teachers were using. The students were aware that the **Getting Comfortable** program strengthened the teachers' understanding so that they could present the material more confidently.

The sixth graders I interviewed were not as aware of their teachers' attending the space training earlier this year. They remembered the underwater part of their teachers' training. They did appreciate writing assignments based on space. For example, they had to write a poem about the planet they were studying. Some acknowledged that using space made the poetry more fun.

To get to the concept of whether or not teachers using space in the classroom could turn kids on to math and science, we asked them, **What is your favorite subject?**

The fourth graders reported that they:

- Like science better now than last year: more hands-on.

- Like math better; math relays helped

- Feel that science more fun, and they enjoy learning more about space.

Of the group of 10 fifth graders from all three classrooms: five said math was their favorite subject; when the question was broadened to include science, all but two raised their hands as saying math or science was their favorite subject.

Many of the sixth graders said they liked math/science although several said it was better last year [different school] because they didn't have to write everything up last year. [Sixth grade is not as much fun...!] They did appreciate the hands-on whether it was at this school or the last school.

Student reaction was not limited to the older kids. One pre-school, special education teacher wrote:

> We never expected that our 3-5 year olds would be that interested in space. We were wrong. They learned about rockets, weightlessness, stars, and planets. We all enjoyed the lessons.

Nothing showed student pride and positive attitudes like the dedication ceremony. The school was dedicated in formal ceremonies held April 25, 1995. Dr. Buzz Aldrin was there along with both Virginia senators and the District representative. [I was there, too.] The day was marked by several assemblies after the dedication and a "Space Night" show and tell that evening.

The dedication ceremony was very moving and was eloquently described by Robert Devaney of **The Washington Times** in a special article entitled "Return of the hero" published April 28, 1995.

> On a day when America was mourning the dead of Oklahoma City and the FBI charged others associated with the bombing suspect, a Virginia school dedicated itself to a real-life American hero: astronaut Edwin E. "Buzz" Aldrin, Jr.
>
> Buzz Aldrin Elementary School in Reston is the first building in the United States to be named after Mr. Aldrin, the second man to walk on the moon after Apollo 11's Eagle landed July 20, 1969....
>
> This brand new school gets to talk to and hug its namesake, who shook hands with every student in the school Tuesday and went to all the class assemblies.
>
> Excited children were heard exclaiming: "He touched me twice" or "I'm never washing this hand again."
>
> With his wife Lois at his side, Mr. Aldrin was welcomed by student Tabby Mahdi and Principal Gina Ross on a sunny spring morning--along with more than 600 students; Robert Spillane, Fairfax County public school superintendent; ... Sens John Warner... and Charles Robb...; Rep. Tom Davis; parents; and other friends.
>
> In the morning, the students raised the flag anew and greeted their honored guest. Mr. Robb as guest speaker applauded the science and technology emphasis of the school, which he saw as a leader for the future.

Mrs. Ross invoked the theme, "When you do things in the name of mankind, you do great things."

"We all take different steps," Mr. Aldrin remarked amid bands, banners, and songs. "But in this school you take some steps by way of wheelchairs, some steps by way of walker and others with great strides. But we are all going in the same direction--the future."

"But my message today," concluded Mr. Aldrin, who stayed all day, "is no dream is too high if you have your eye on the sky. At Buzz Aldrin Elementary School, every day, you take 'one small step for a man, one giant leap for mankind.'"

The Reston school kept celebrating into the evening with "Space Night Expo/Teach-in."

Mr. Aldrin, who holds a doctorate from Massachusetts Institute of Technology in astronautics, got a few lessons from the students, such as the fifth grade's "Constellations Aglow." He and Mrs. Aldrin listened to a young astronomer explain the mythology behind the Big and Little Dippers and Cassiopeia while black lights lit up the Styrofoam ball models.

In the cafeteria, there was astronaut food, put together by the kindergarten: "McAldrin's Fast Space Food," Tang juice, space pudding and dehydrated fruits.

Wonders of our solar system were demonstrated in the gym where fourth-grader Nikki de La Vergne, whose mother Jeanne is a fifth-grade teacher at the school, talked to Mr. Aldrin about aspects of Mars in her class project: "Destination Mars." Mr. Aldrin--who has designed "the Cycler" concept, a spacecraft system that makes perpetual orbits between Earth and Mars--listened intently and then recommended a science-fiction novel, "Red Mars."

...Despite all his education, experience, and travels, Mr. Aldrin said, "I still am bedazzled by computers"--especially at a school that has four computers in each of its 30 classrooms, each of which has a television, video-cassette recorder and printer.

The school is indeed the best equipped elementary school in terms of technology in Fairfax County, the region's largest school district with 140,400 students. (Aldrin is the most "technologically current," school officials like to say.)

It also has a TV studio, weather station and two separate school-wide computer labs. A library of 10,000 books is fully automated. Students search on the computer to find books....

While the school may be extraordinary in its scientific focus and fervor, its student body represents the demographic makeup of the school system, now more than 30 percent minority. The school offers classes in English as a second language. It also has a large special education program, including several classes of handicapped preschoolers.

....By the way, [Buzz Aldrin's] name legally is Buzz Aldrin: Dr. Buzz Aldrin, teacher and astronaut. And yes, he was wearing a tie with moons on it.

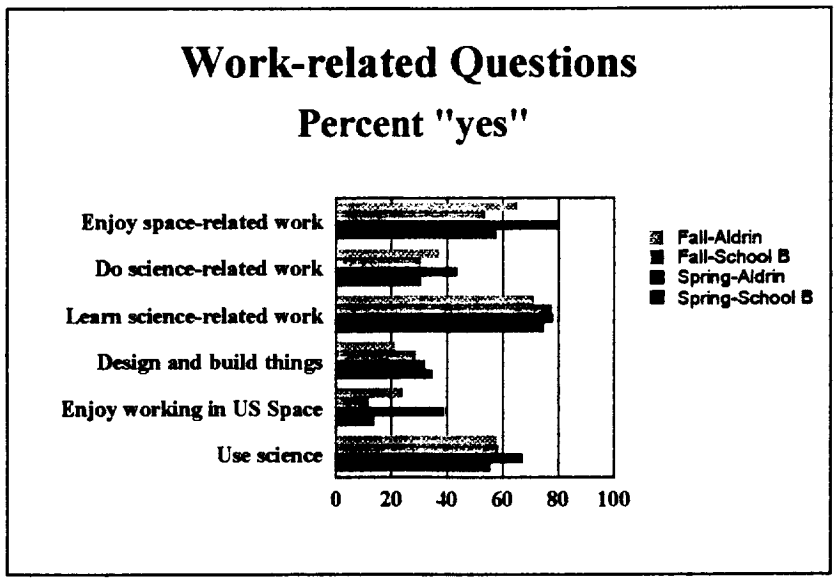
In the midst of all the hoopla, I found it fascinating that some of the children's most prevalent memories of the day were their singing a song at the ceremony and the fact that they all got their picture taken with Dr. Aldrin who did shake hands with every one.

In addition to the Space Night projects mentioned above, there were student-made model space crafts with illustrated descriptions on computers. One class made constellation diagrams by punching holes in Styrofoam trays which could then be displayed using an overhead projector.

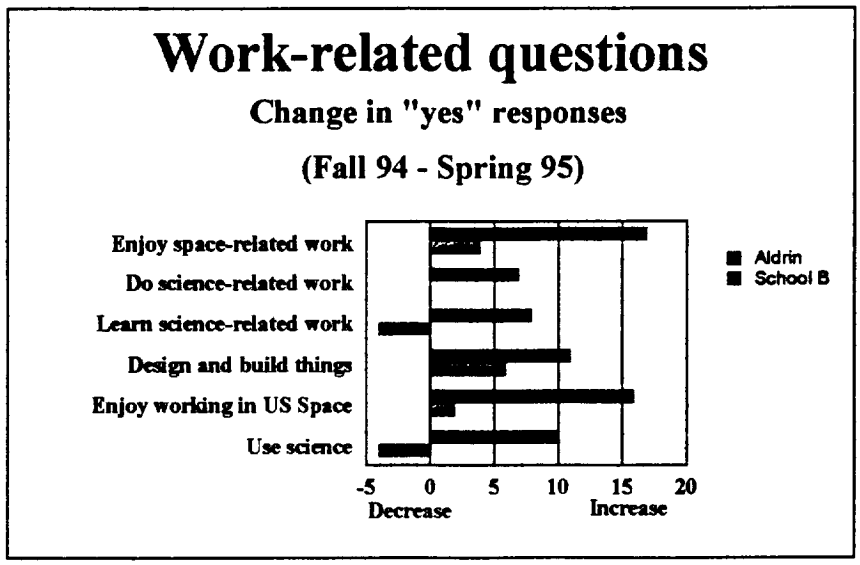
Older students designed vehicles to explore planet surfaces and wrote accompanying explanations.

Subjectively, there seems no doubt that the Aldrin experience is affecting students positively. To get a more objective grasp of attitudinal change and compare Aldrin kids with those in School B, the surveys described earlier were administered to the kids at the beginning and end of the year. Again, the survey instrument, along with student responses is in Appendix B-2

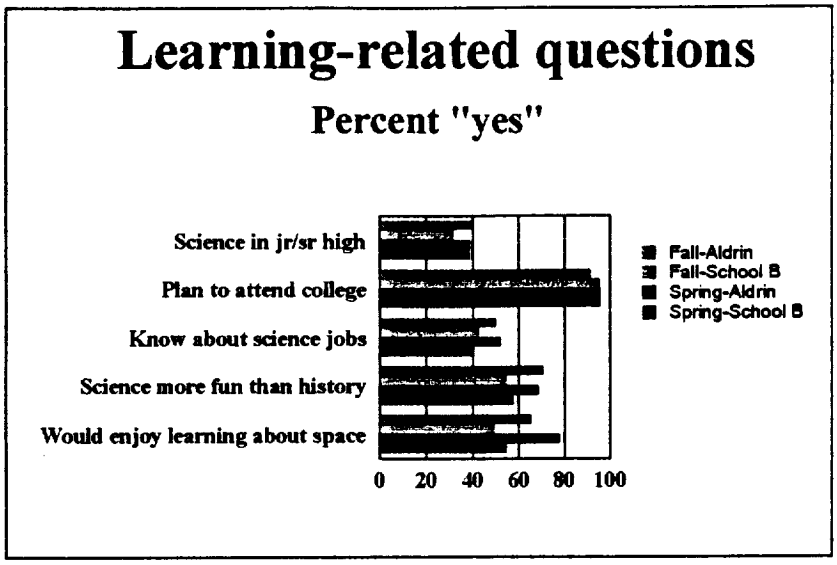
The first chart shows the relative responses on six "work-related" questions. Note that in several areas, Aldrin students showed more gains and a higher percentage of them feel positively about space and science related work. The only exception was the "design and build things" question (how many want to be engineers) where a slightly higher percentage of School B students ended the year answering that question positively.



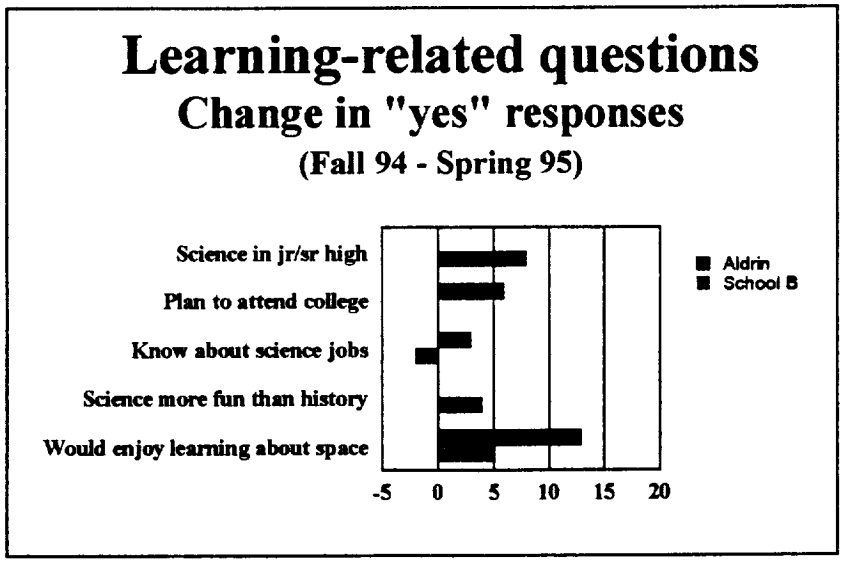
This chart, shown earlier in the summary section shows that generally Aldrin students posted more gains (and no losses) than those in School B.



A higher percentage of Aldrin students also responded positively to five "learning-related" questions including picking up a few Aldrin students who hadn't planned to attend college.



This slide captures the *change* in responses for those questions. Missing bars indicate no change from Fall to Spring. For example, a higher percentage of Aldrin students responded positively to the science in junior high question in the Fall, and the percentage did not change. It will be interesting to get the actual data beginning next fall and see what classes they choose to enroll in.



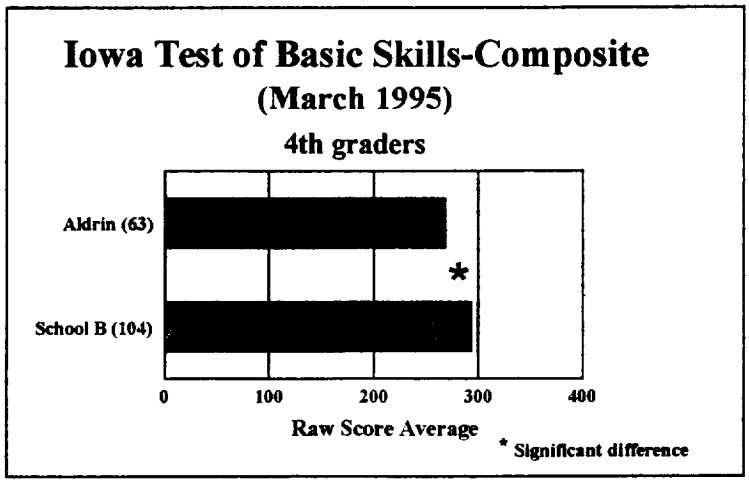
There is no question that Aldrin school is making a difference in the lives of children, and the space emphasis certainly gives it a certain flair. It appears that Aldrin students are at least slightly more inclined to math and science than their School B counterparts. The only item left to check is whether or not a space-motivated educational program can inspire students to better performance.

Standardized test comparisons

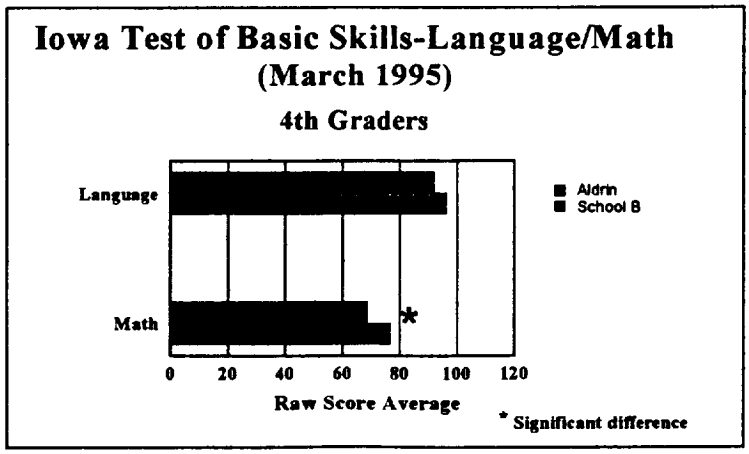
Using standardized tests as a measure of performance between students of different schools is the only objective criterion. However, straight comparison is difficult since one would have to be sure that the schools being compared were "equal"--a nontrivial task.

At this early stage of the research, the standardized tests do not yet show that Aldrin is producing superior results to School B. Further study will be required to determine if the space-related program of Aldrin will make a difference in students' performance. At this point, all that is available for meaningful comparison are the two tests taken by students in the spring of 1995: Iowa Test of Basic Skills (ITBS) administered to fourth graders in late March and the Virginia Literacy Test administered to sixth graders in late February. For a complete table of data on the test results displayed in this section, please see Appendix D.

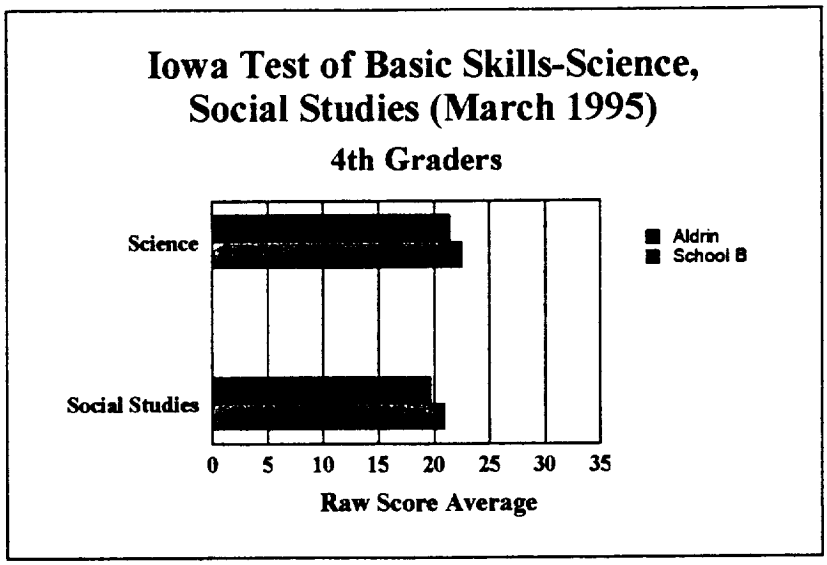
The following chart shows that the raw score average of School B students is 25 points higher than Aldrin's students on the ITBS-Composite--a statistically significant difference. It should be pointed out that both averages are good--Aldrin's average of just under 270 is about the 67th percentile, and School B's of 294 is about the 80th percentile--both schools well above average.



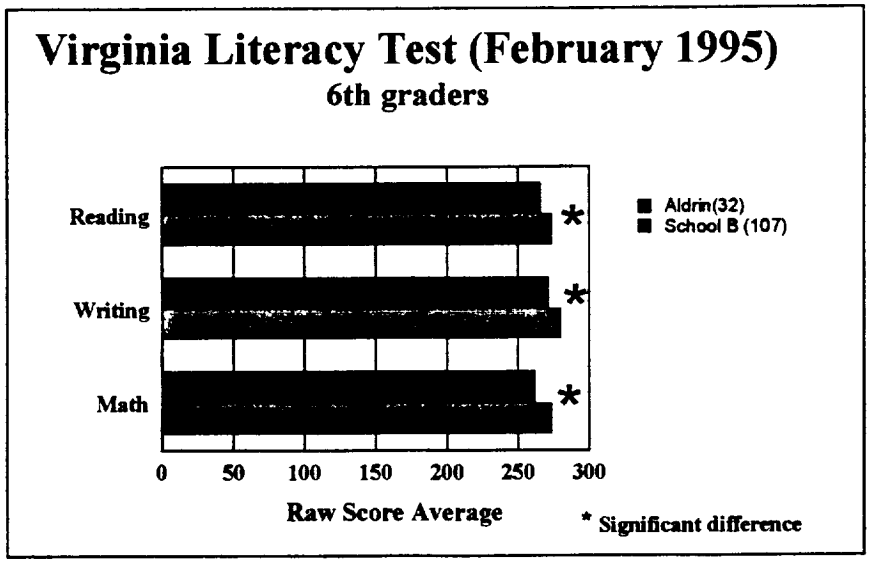
The ITBS-Composite is a combination of student scores on the Lanaguage and Math portions of the test. However, note in the next chart that while School B's averages were higher than Aldrin's in both areas, the language scores were close and School B's difference was not statistically significant (using a t-test with an α of 0.05).



Even more encouraging from the Aldrin perspective were the ITBS Science and Social Studies scores. Again, School B's averages were higher on both, but the differences were not statistically significant.



The Virginia Literacy Test is given to sixth graders in three areas: reading, writing, math. Passing is 250 with a maximum score of 300 in all three tests. School B's averages were statistically significantly greater than Aldrin's averages on all three tests.



At this early point in the research, the standardized test scores do not show that Aldrin with its space-oriented environment produces superior results. However, the choice of School B as a "control" school for the research assumed essential equality of the two school's populations. Initial impressions are that this might not be the case. Even though the schools are close geographically (less than 3 miles apart), there is evidence that School B has a socio-economically more homogeneous mix than Aldrin.

(It is beyond the scope of this research to prove or disprove the theory that higher socio-economic status tends to produce higher academic performance, at least in some measures. For

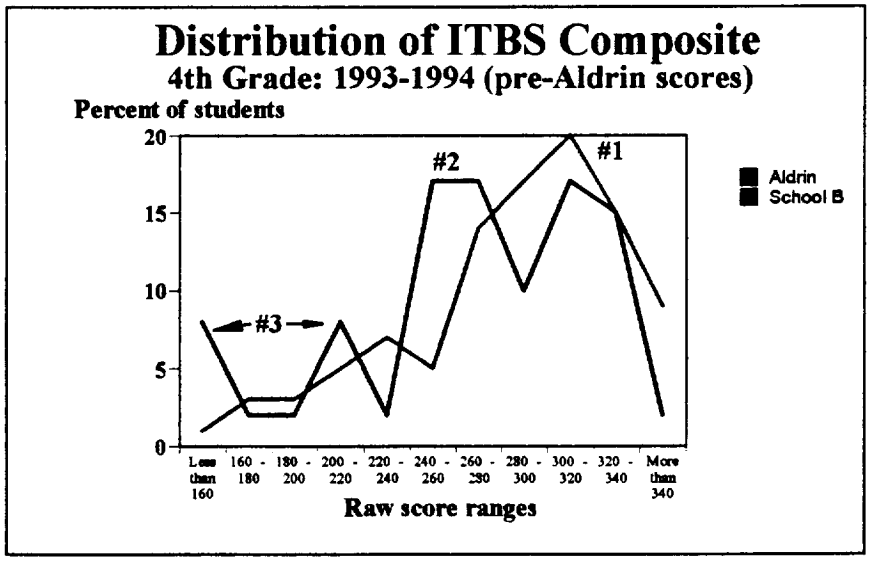
strong statistical support that socio-economic status does make a difference in academic performance, see the extensive report, Growing Up Is Risky Business and Schools Are Not To Blame, by Jack Frymier, Published by Phi Delta Kappa, 1992.)

Aldrin students show a wide spectrum of background. Five special populations are bused in from other areas with the result that 18-20 percent of Aldrin's students are from low income housing who speak English as a second language and who may or may not have attended school before coming to the US. These children were age-placed in classes. In addition, physically disabled students and learning disabled students are all mainstreamed in regular classrooms and take the standardized tests. Entering sixth graders had a choice of schools to attend and many of those who chose Aldrin did so because they were having problems in their present school.

This extremely mixed population makes Aldrin a fantastic school in which to study whether or not space can make a difference since one of the goals of the America 2000 National Educational Goals which NASA and the U.S. Space Foundation support is to increase retention and learning among just such groups.

Comparing Aldrin with School B, the variation of Aldrin scores is higher on every test than School B. **Aldrin minima and maxima are lower while standard deviations (measures of data spread) are higher on every test**. (See the data in Appendix D.) Follow-on research will attempt to identify specific quantifiable comparisons between Aldrin and School B which will facilitate interpretation of these and future results.

This phenomenon of higher School B scores also can be seen on the ITBS scores "pre-Aldrin." The following chart shows the fourth grade composite scores from the ITBS given in the Spring of 1994--**before Aldrin was opened**. These are students who just completed their fifth grade years at Aldrin and School B. Note that a higher percentage of School B's students have the higher scores (area #1) while a higher percentage of Aldrin students have lower scores (areas #2, #3).



Again, these are pre-Aldrin scores of the most recent year's fifth graders, suggesting that at least some of the score differentials could be due to pre-existing conditions which less than one year at Aldrin could not overcome. Further study will show whether or not this initial gap can be overcome by the aggressive and innovative Aldrin program.

Summary, Conclusions, and Recommendations

Summary

Since 1986, the **United States Space Foundation**, a nonprofit organization based in Colorado Springs, CO, has conducted a five-day graduate program (and a two-day in-service program) for K-12 teachers in cooperation with the **National Aeronautics and Space Administration** (NASA). The program, **Getting Comfortable Teaching with Space**, equips the teachers to use space and technology concepts in the classroom.

The existence of Aldrin Elementary School with a school-wide emphasis on space and technology offers an unprecedented opportunity to broaden the research base from teachers' activities to the effects of space and technology on students.

Sponsored by NASA and private funding, the **United States Space Foundation** conducted **Getting Comfortable Teaching with Space** for Aldrin teachers in October 1994. Since then, Aldrin teachers have been using course concepts to integrate space into their teaching activities while presenting standard curriculum.

The purpose of this 3-year research program is to determine the effectiveness of using space to teach. The research design is quasi-experimental using standardized test data on students from Aldrin Elementary School and a District-identified "control" school, which shall be referred to as "School B." Students now in fourth through sixth grades will be compared now (after one year at Aldrin) and tracked at least until the present sixth graders are through the eighth grade. Appropriate statistical tests will be applied to standardized test scores to see if Aldrin students are "better" than School B students in areas such as:

- Overall academic performance

- Performance in math/science

- Enrollments in math/science in middle school

In September 1994, a simple instrument designed to measure student attitudes toward space and science was administered to students from both Aldrin and School B.

In October 1994, **Getting Comfortable Teaching with Space** was conducted for all the teachers of Aldrin and the standard pre and post surveys used for that course were administered.

In April 1995, the kids' survey was re-administered to grades 4-6 at both School B and Aldrin. Also in April 1995, the follow-on **Getting Comfortable Teaching with Space** survey was administered to Aldrin teachers. In addition, there were informal discussions held with samples of students from grades 4-6 at Aldrin.

In addition to the surveys, data have been and will be collected from appropriate standardized tests.

As a result of the **Getting Comfortable Teaching with Space** program, most Aldrin teachers used space in the classroom frequently and effectively during the 1994-1995 school year.

Aldrin students responded to the space emphasis with increased interest in math and science, increased interest in science and space-related jobs, and an enthusiastic approach to participatory learning, all at levels exceeding those from School B.

Aldrin student averages of the Composite and Math scores on the Iowa Test of Basic Skills for fourth graders were above the national average but lower than averages of School B students. Aldrin's average scores on the Language, Science, and Social Studies portions of the ITBS were slightly lower than School B, but the difference was not statistically significant. School B's averages on all three portions of the Virginia Literacy Test were higher than Aldrin's. It appears possible that there is more diversity at Aldrin than School B that it will take longer than part of one school year to close.

Conclusions

Overall

Anecdotal evidence supports the hypothesis that the space emphasis is working to keep kids enthusiastic about school. Further study of all the factors of interest for this research will be needed to confirm this initial conclusion. Specifically, we need to look at future math/science enrollments and future scores of both present and past Aldrin students.

Other factors

There are many factors outside the scope of this research that could confound the results.

- Aldrin versus School B

One of the key components of the research is to be the comparison of standardized scores between two similar schools differing only in their use of space in the classroom. The first year's comparisons were not favorable to Aldrin. Specifically, Aldrin's variation on all tests was noticeably higher than School B's, and Aldrin had more extreme low scores on every test than School B. It will be interesting to see if longer term exposure to the Aldrin program will turn these numbers around.

In the meantime, it appears that School B's population is more nearly homogeneous than Aldrin's with nearly no extremely poorly performing students. Future years' research will identify School B factors for comparison with Aldrin in areas such as student-teacher ratios, technology in the classroom, and corporate sponsorship.

Other factors could include the fact that School B is NOT new. Aldrin with its new mix of administrators, teachers, and students could be considered at a disadvantage compared to a more established program.

- Potential Aldrin positive factors:

There are many factors that could possibly contribute to Aldrin students' positive performance besides just the space emphasis, and all are beyond the scope of this research.

- The "hero" effect

It seems that attending a school named after a real-life person (that you've even met!) would be a powerful motivator for students. During the dedication, one of the students said in a speech to Mr. Aldrin, "We don't want to do anything that would make you ashamed of us." I attended an elementary school named after a street. Many attend a school that is merely numbered (good old PS 147). How much positive performance will be attributable to students "reaching for the stars" like their school's namesake did?

- Faculty and administration quality

The faculty of Aldrin Elementary School was hand-picked by Mrs. Gina Ross. All are very good at what they do, they show personal attention to each student, and they have expended enormous amounts of energy in running the school. I called the school several times, often as late as 7:00pm and never failed to find Mrs. Ross still working. How much of students' performance is attributable to the professional competence, dedication, and personal attention of the staff?

- Computers in the lab and classroom

It was cited in the quoted newspaper report that Aldrin Elementary is technologically advanced. I observed second graders composing a story using computers in one of the computer labs. It appeared that the computers were "integrated", a concept described in Microcomputers and Education (James D. Lockard, Peter D. Abrams, Wesley A. Many, 1990) as "the process of totally integrating the use of computers into the existing curriculum through learning activities that address the subject area objectives." That is, don't teach computers, use computers to teach. Aldrin does that so that the students are exposed to technology not only when the teachers use space-related examples in their teaching, but also in the course of their day-to-day computer activities. (By the way, one student asked his teacher if the teacher had seen one of those machines which when you type something *it comes right out on the paper immediately*--you don't have to wait to print it out.!) At any rate, there is technology at Aldrin--what is its affect on student learning?

- Corporate sponsorship and involvement

Brian Mulholland, General Manager of the nearby Sheraton Premiere hotel, has been a near constant presence at Aldrin since its inception. Before the school opened in September 1994, he became chair of Advocates for Aldrin, a group of Fairfax County business leaders formed to provide business support. His Vice-Chairman was Dr. John D. Sanders, Chairman and CEO of Washington Technology. Advocates for Aldrin generated donations form Fairfax County businesses to round out the school's complement of computers. Mr. Mulholland himself comes in every Friday to conduct a current events class with sixth graders using newspapers that he provided to the students. He provided facilities for the **Getting Comfortable Teaching with Space** program conducted in October 1994. Advocates for Aldrin embodies the philosophy propounded by Louis V. Gerstner, Jr., Chairman and CEO of IBM, who wrote in Reinventing Education (1994) that businesses should "Advise schools what you expect students to learn, help them manage themselves effectively, and contribute people and money to assist them in making changes." What is the contribution to Aldrin students' excellence by Mr. Mulholland and Advocates for Aldrin?

- Parental involvement with the excitement of a "new" venture

Levels of parental involvement in Aldrin programs were high. How much of kids' improvement will be due to the newness of the school, the energy of the teachers, high corporate involvement, all attracting the involvement of parents?

Recommendations

Even with all the positive factors listed above, it seems reasonable that any change or improvement in math/science interest, performance, and enrollment could be at least partially attributable to teachers' using space in the classroom as facilitated by the **Getting Comfortable Teaching with Space**. The other factors might improve the general climate of the school, but not necessarily find fulfillment in improved math/science factors. Therefore, it is imperative that the full research program be continued at least for the planned three years. Data collection for 1995-1996 will include:

- Detailed internal data from the two schools to facilitate data analysis and interpretation. Such data may include but not be limited to: teacher/pupil ratio, technology, corporate and parental involvement, proportion of disabled or impaired students.

- Another round of fourth through sixth grade pre and post year kids' attitude surveys at both schools.

- Fall survey of School B teachers to check for their use of space-related instructional techniques during 1994-1995.

- Aldrin teacher reaction to an advanced space in the classroom course to be conducted in January 1996.

- Spring 1996 survey of both sets of teachers to see if Aldrin teachers are still using space in the classroom and to compare against School B teachers for 1995-1996 activities.

- Further collection and analysis of standardized test scores including breakouts by ethnic group and gender by school.

- Interviews with Aldrin students in the Spring of 1996 to clarify last year's findings and look for more insight into the students' perspective of learning with space.

- Registrations of this year's sixth graders in junior high school science and math courses, especially where there is a choice.

Aldrin remains an extraordinary school providing an extraordinary research opportunity. Space is being used in the classroom with positive effect, and further study will focus on specific outcomes of the teachers' prolific space-related activities.

Appendices

A: Excerpt from previous research on Getting Comfortable Teaching with Space

B: Surveys

1: Teachers' surveys

2: Kids' surveys

C: Summary of student interviews, April 1995

D: Standardized Test Scores, February, March 1995
Virginia Literacy
ITBS

Appendix A

Excerpt from previous research on Getting Comfortable Teaching with Space

Executive Summary

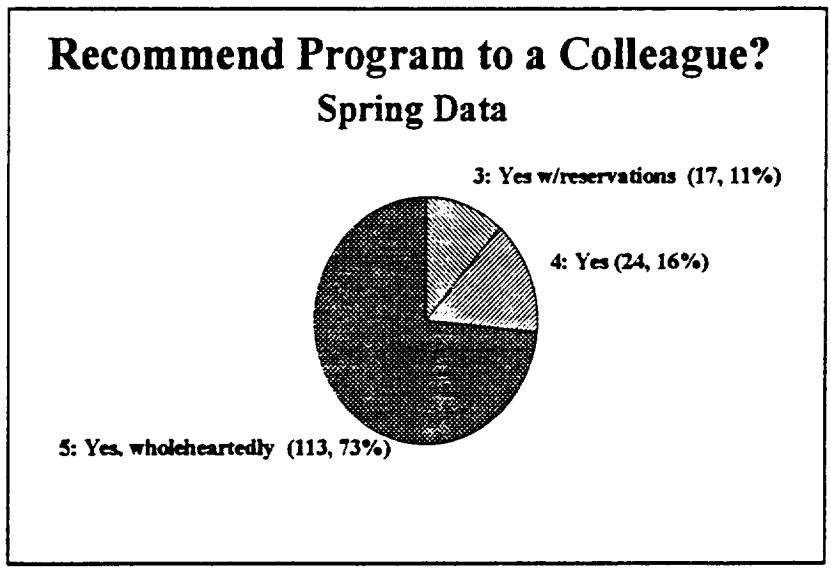
This is the final report of the 1993-1994 NASA-sponsored research into the effectiveness of the **United States Space Foundation's Getting Comfortable Teaching with Space** five-day graduate program and derivative two-day In-Service program. The purpose of the program is to motivate and equip K-12 teachers to use proven student-attracting space and technology concepts to support standard curriculum. The programs support the **America 2000 National Educational Goals** encouraging more students to stay in school, increase in competence, and have a better opportunity to be attracted to math and science.

The 1993-1994 research program continues the comprehensive evaluation begun in 1992, this year studying the five-day offerings in Colorado, Alabama and Los Angeles and two-day presentations to a variety of locations including areas with heavy minority populations.

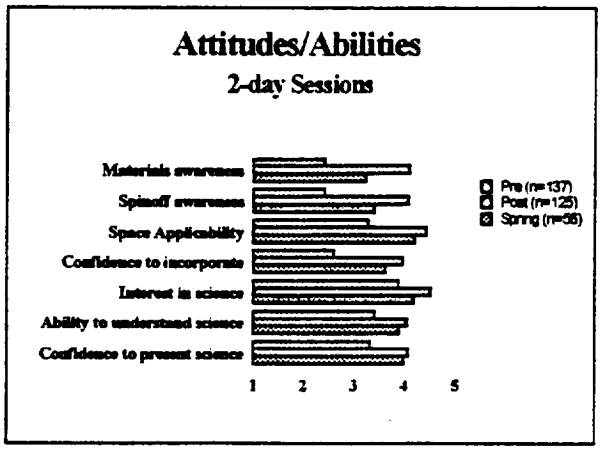
A comprehensive research design by Dr. Robert Ewell of ***Creative Solutions*** and Dr. Darwyn Linder of Arizona State University evaluated the effectiveness of various areas of the program and its applicability on diverse groups. Primary research methodology was a set of survey instruments administered before and immediately after the courses, and again in late March--7-8 months following the five-day summer graduate courses and 3-6 months following the Fall two-day courses.

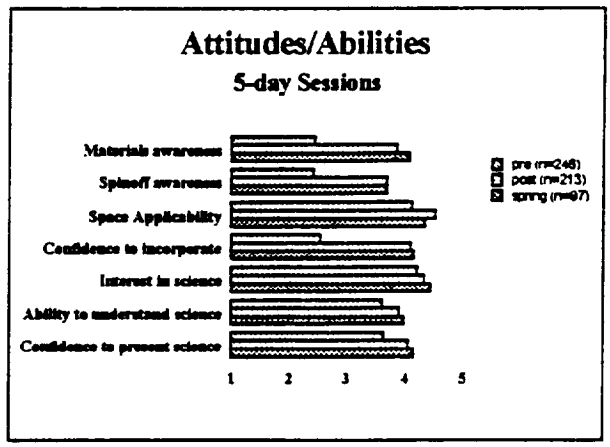
There were 249 pre-course surveys and 215 post course surveys from attendees of the five-day courses from whom we received 97 returns from the Spring survey. Of the approximately 180 attendees to the two-day courses, 140 course surveys were analyzed along with 56 Spring surveys. Data were manually entered into a computer spreadsheet program and processed using the statistical program SPSS/PC+. Some important conclusions are:

- Overall, these programs continue to get rave reviews from participants. The chart below shows that all attendees would recommend the program to their colleagues, most without reservation.

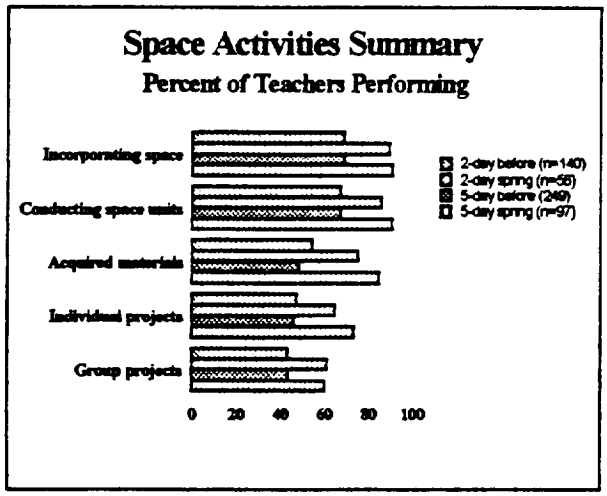


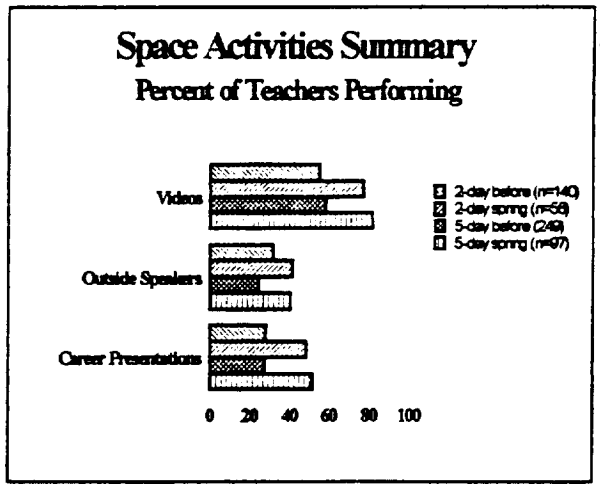
- The programs did an outstanding job improving **students' attitudes** and general space awareness. The two charts below show that impressive gains were recorded across the board in important areas such as awareness of aerospace materials, awareness of aerospace spinoffs, ability to understand science, and confidence in ability to incorporate aerospace into their curriculum.





- The 1993-1994 programs also produced a significant increase in **aerospace-related activities**: number of times aerospace concepts were incorporated, acquisition of aerospace materials, number of space-related videos shown, and number of space-related projects directed. Note on the charts below how the percent of teachers performing each activity increased from before the courses (first and third bars of each group) to after the courses (second and fourth bars of each group).

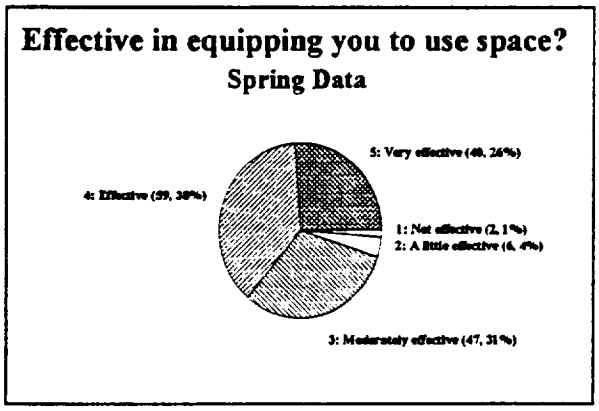


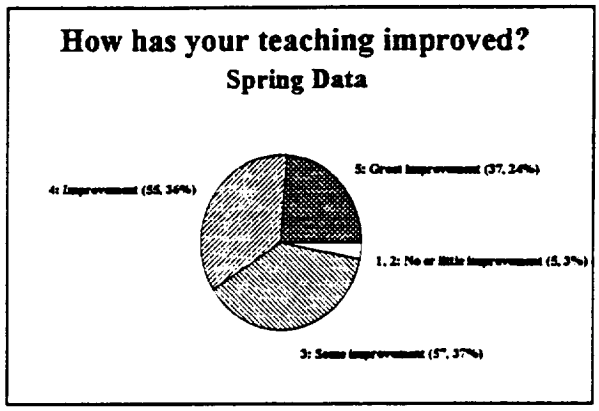


- Teachers appear satisfied with the program structure but recommended on both end-of-course surveys and the Spring returns that they want adjustments toward more hands-on, more instruction on specific applications, and less information on advanced theoretical concepts.

- Portability of the program was indicated by substantially no difference among geographic offerings and minorities. We estimate that graduates directly or indirectly influence over 115,000 students of which approximately 10,000 are black and over 50,000 are Hispanic.

- Overall, the programs remain highly successful: 95 percent of the teachers felt the programs were effective in equipping them to use aerospace in the classroom and reported improvements in their teaching as a result of the program. As was noted earlier, all are recommending the programs to their colleagues.





Details on these and other data and results from the research are in the following sections of this report:

Introduction

This is the final 1993-1994 report of the **NASA**-sponsored research into the effectiveness of the **United States Space Foundation's** five-day graduate course **Getting Comfortable Teaching with Space,** along with its derivative two-day inservice course, **Teaching with Space**. This introductory section covers background, program description, previous evaluations, and present evaluation design.

Background

Getting Comfortable Teaching with Space was designed after discussion with a number of K-12 educators who identified the following impediments to their use of space, computer and other high-tech topics in the classroom:

1. Teaching is done primarily from textbooks which have a four- to seven-year period for approval and publication. Therefore, texts are automatically out-of-date regarding space, aviation, computers, and technology when first received in the classroom.

2. Available materials from other sources most often are not in lesson plan format, and teachers seldom have time to prepare lesson plans "from scratch."

3. The vast majority of K-12 teachers have minimal math and science backgrounds. Therefore, computers and other "high-tech" subjects such as lasers, robotics, artificial intelligence, etc. cause most who are not math and science specialists to experience "high-tech anxiety."

4. There are few graduate accredited courses suitable for non-math/science educators to remedy these educational deficiencies.

5. If teachers do become involved with using space and aviation examples to teach traditional subjects, they do not have a resource to turn to in order to get answers for their spontaneous questions, or those of students.

As a result, **Getting Comfortable Teaching with Space** was first designed as a two- and one-half-day training course for one graduate credit, and later was extended to five days for two graduate credits. A major objective of the training course is to help educators overcome the impediments listed above.

This hands-on training course has demonstrated many creative ways to teach effectively all subjects and grades with the use of stimulating space and aviation examples.

Some of the specific objectives of **Getting Comfortable Teaching with Space** are:

- Learn how to use space and aviation concepts to help meet objectives in the standard K-12 curriculum.

- Identify major space and aviation resources and demonstrate how these resources can be used within the classroom.

- Relate the importance of technology spin-offs from space and aviation to people's social, political, and economic lives.

- Support the America 2000 Education Goals.

- Reach out to minorities and teachers of the disadvantaged.

Program Description

The primary vehicle for this research project is the graduate education course **Getting Comfortable Teaching with Space** and its derivative, the two-day In Service teacher education program.

Getting Comfortable Teaching with Space is designed for educators who do not possess a technical background. During the course, teachers are introduced to aerospace and aviation concepts and activities with connections to all standard curriculum areas. Grade-level breakout sessions or other hands-on activities are provided daily. Activities include rocket building and launching and underwater zero-gravity simulation training. These activities allow the educators to simulate various aspects of space first-hand and apply the experience to their curriculum.

Getting Comfortable Teaching with Space has been conducted at the United States Air Force Academy every summer since 1986, at Air University near Montgomery, AL, since 1992, and other venues.. Over 2,500 teachers have completed the course. In addition, 120 teachers took the training in a special offering in Phoenix, Arizona, as part of the **Reaching for the Stars!** program and follow-on sessions sponsored by Allied-Signal since 1991.

Course instructors include Dr. Jerry Brown, director of education at the **United States Space Foundation,** faculty of the **United States Air Force Academy** Astronautics Department, **NASA** contract instructors, and guest instructors.

Teachers are looking for something out of the ordinary to motivate their students to learn, and space is proving to be a very effective motivator. A superior aspect of this course is the fact that teachers leave their **Getting Comfortable Teaching with Space** course motivated and equipped with ideas that they will put into effect immediately.

The ultimate result of motivated teachers effectively equipped with proven student-attracting space and technology concepts is improved education significantly contributing to the **America 2000 Education Goals.** More students will stay in school, increase in competence, and have a better opportunity to be attracted to math and science.

The program has special significance to teachers of minority and disadvantaged students. **Getting Comfortable Teaching with Space** is a proven program which can make schoolwork come alive for those who have found it dull.

Integral to the success of the course is the follow-up support provided by the **United States Space Foundation** throughout the year. The **Foundation** houses the Space and Aviation Education Resource Center which provides teaching materials from **NASA, FAA, NOAA,** and **CAP** to all educators who request them throughout the United States. Included in these materials are activities for students, suggestions for lesson plans and informational educational materials to be used to enhance curriculum. Materials are distributed quarterly to graduates **of Getting Comfortable Teaching with Space** throughout the following year. The graduates contribute to the Resource Center by developing lesson plans in order to receive graduate credit. These are passed on to other teachers in the form of compiled books and teacher kits.

For those teachers who cannot attend one of the five-day resident programs, the **Foundation** also offers one and two-day In Service programs. These programs have the same basic purpose as the longer **Getting Comfortable** program from which the In Service draws its content.

Previous Evaluation

This year's research is a continuation of comprehensive research begun last year by Dr. Bob Ewell, an independent education consultant, and Dr. Darwyn Linder, Department of Psychology, **Arizona State University.** Both have been involved with the program for several years.

Dr. Ewell conducted a formal evaluation of the **Getting Comfortable** course taught at the **Air Force Academy** in 1991. Using questionnaires on the individual periods of instruction, an overall survey, and a group critique session after each course, Dr. Ewell concentrated on those aspects of the instruction that could be measured while the teachers were at the course. Both individual periods and overall course effectiveness were examined. Bottom line was that the teachers were uniformly effusive in their praise for the course.

Dr. Linder conducted an evaluation of the Reaching for the Stars program, conducted in Phoenix in 1991. This research was funded by the **Annenberg School for Communication** at the **University of Southern California** (which provided this pro-bono to the **United States Space Foundation.**) Dr. Linder's design included surveys administered both during the training and again 10 weeks later. Among other things, he found that as a result of the training, more teachers were incorporating aerospace and space technology much more frequently and were more confident with their ability to use the concepts. He also found that the teachers felt they were more effective in using aerospace concepts in presenting all areas of the curriculum (although, as we might expect, space and science-related instruction rated a little higher than non science).

Both conducted the first comprehensive evaluation of the 1992-1993 programs. Their conclusions included that **Getting Comfortable** is a highly successful, proven program. They also concluded that it appeared easier to change attitudes than activities and left open the issue of conducting separate five-day courses for various grade levels. These two areas were, therefore, items of special interest for this year's evaluation.

Getting Comfortable supports the **America 2000 Education Goals.** Using up-to-date and exciting space concepts to teach math and science draws more students to those important areas and will result in measurable improvement in math and science achievement. In addition, the improvement in instruction influences more at-risk students to remain in school thus increasing the graduation rate and improving competency.

Present Evaluation Objectives

This report continues comprehensive evaluation as an integral part of this program. Building on Dr. Linder's work using a post course survey and Dr. Ewell's work to measure perceived effectiveness of various parts and aspects of the courses, we have evaluated the following for both the five-day programs and the two-day programs:

- Effectiveness of various aspects of the programs. Definitive results from this area will aid in further refining each type of course for maximum impact.

- Applicability of the programs on diverse groups such as minorities. Results from this area will ensure that NASA is achieving its long-term goal of recruiting and developing minority engineering students.

Each of these issues has been evaluated for both the five-day program and the two-day program. We would expect that the five-day program is more effective than the two-day program. However, we need to know to what degree the two-day program is effective. The evaluation design has allowed us to assess that issue.

Evaluation Design

Five-day Program

Data were collected during the courses and some months after the courses. Five-day courses were conducted in Los Angeles (June 7 - 11); at Air University, Maxwell Air Force Base, Montgomery, AL (June 14 - 18 and 21 - 25); and the Air Force Academy, near Colorado Springs, CO (July 11 - 16, 18 - 23, and 25 - 30). Sample course schedules are in Appendix 1.

Three separate instruments were used **during** the course.

- **Pre-course survey:** Teachers were surveyed on the first day of the course, answering questions pertaining to their abilities and attitudes to use space and technology in the classroom as well as their space-related activities for the previous teaching year.

- **Subject critiques:** Also during the course teachers completed subject-specific surveys designed to assess the effectiveness of each period of instruction. This year for the first time, computers were used for this portion of the research. The teachers were asked to use computers, specially programmed and placed in the classrooms for this purpose to record their opinions once per day of specific periods. The teachers identified the period on which they wanted to comment, and the computers presented questions and collected the data in files for later processing. The computer-generated subject critiques were used for the Alabama and Colorado course venues.

- **Post-course survey:** Finally, at the end of the course, teachers completed a post-course survey which included both questions on their ability and attitudes having taken the course as well as their perception of the course's effectiveness and balance.

Detailed analysis of data collected during the five-day courses is found in Appendix 3: **Getting Comfortable Teaching with Space, Preliminary Effectiveness Report (Five-Day Program), Fall 1993**. See the last section of that report in Appendix 3 for copies of the instruments used during the course.

In March, teachers were sent a **Spring Survey** designed to assess their attitudes as well as feelings about their abilities to use space in the classroom, having tried it for a school year. The Spring Survey also asked about the space-related activities to see how they had actually implemented the concepts of the program. Finally, we asked the teachers about the course balance again to see if their time "in the field" had changed their opinions.

See Appendix 2 for copies of the Spring Survey.

Two-day Program

NASA sponsored a number of two-day programs in diverse regions of the country, serving widely different populations. Included in this report are data from: several one and two-day programs in Los Angeles, CA; Lockport, IL; Tempe, AZ; Tulsa, OK; and Wausau, WI.

Data collection for the two-day program was similar to that of the five-day program except teachers were not administered a pre and post course survey. They answered questions at the end of the course pertaining to how they felt at the beginning of the course. Also, because of time-constraints, subject critiques were not completed during the two-day program. Detailed analysis of data collected during the two-day courses is found in Appendix 4: **Getting Comfortable Teaching with Space, Preliminary Effectiveness Report (Two-Day Program), January 1994.** See the last section of that report in Appendix 4 for copies of the instruments used during the two-day course.

The two-day graduates received a **Spring Survey** identical to the ones sent to the five-day participants.

Data Processing and Display

Data from the Spring survey were entered into a spreadsheet program and then processed using SPSS/PC+ (Statistical Processes for the Social Sciences), a sophisticated statistical processing software package. Using SPSS made possible not only means and frequencies by category but also facilitated checking for variable interactions. In general, each criterion variable was checked for interactions among all demographic categories. Significant interactions are reported when they occur. For example, it was discovered that K-3 teachers had a much stronger desire for increased time on implementation concepts than all other grades. Graphs were custom designed by Dr. Ewell and prepared using Bravo!, a presentations package.

For detailed analysis of data taken at course time, please see Appendices 3 and 4. This report focuses on additional information gleaned from the Spring data compared to course data where appropriate.

Appendix B-1

Teachers' Surveys

Pre-course
Post course
Spring follow-on

Getting Comfortable Teaching with Space (1994-1995)
Aldrin Elementary School
Pre-course Survey

Please circle the numbers of your responses. Don't worry if numbers seem missing. Thanks.

This course and accompanying research is sponsored by **NASA** and the **United States Space Foundation**. Director of Evaluation is independent consultant Dr. Bob Ewell, 142 Buckeye Drive, Colorado Springs, CO 80919, 719-531-9129.

2. What is your gender?
    1. Female
    2. Male

3. Which best characterizes your position?
    1. Teacher
    2. Teacher with some supervisory responsibility
    3. In-school supervisor
    4. District-level supervisor

If you are an administrator, please skip to Question 7.

4. What grade level do you teach? (circle all that apply)
    1. Pre-school
    2. Kindergarten
    3. Grade 1
    4. Grade 2
    5. Grade 3
    6. Grade 4
    7. Grade 5
    8. Grade 6

5. What is your subject? (circle all that apply)
    1. All
    2. Math and science
    3. Reading, language arts
    4. Social studies
    5. Physical education
    6. Other (specify_____)

6a. What kind of class did you teach? (circle all that apply)
    1. Regular classroom
    2. Special education
    3. Gifted and talented
    4. Other (specify_____)

6b. How many years' teaching experience do you have (all types)? _____

7. What is your science background and training?

None				Extensive
1	2	3	4	5

8. What is your ethnic group?
   1. Black or African American
   2. Hispanic
   3. Oriental
   4. Caucasian
   5. None or other (please specify) _____

Abilities and attitudes

10. How aware are you of aerospace materials available to educators (U.S. Space Foundation, NASA, CAP, FAA, etc.)?

Not at all Aware		Moderately Aware		Very Aware
1	2	3	4	5

11. How aware are you about technology spin-offs from space and aviation?

Not at all Aware		Moderately Aware		Very Aware
1	2	3	4	5

12. How do you feel about the applicability of space and technology-related material to standard curriculum? You think space is...

Not at all Applicable		Applicable to some subjects		Applicable across-the-board
1	2	3	4	5

13. During the past school year, how confident have you been about your ability to incorporate space and technology-related concepts effectively in your teaching?

Not at all Confident		Moderately confident		Very confident
1	2	3	4	5

14. What is your general level of interest in science?

Low		Moderate		High
1	2	3	4	5

15. What is your comfort or apprehension about your own ability to understand scientific information?

Highly Apprehensive				Very Comfortable
1	2	3	4	5

16. How confident are you in your ability to present scientific topics to your students effectively?

Not at all Confident		Moderately Confident		Very Confident
1	2	3	4	5

17. How important a component of the curriculum is science and technology?

Not at all Important		Moderately Important		Extremely Important
1	2	3	4	5

18. Should the proportion of the curriculum devoted to science and technology be increased or decreased?

Greatly Decreased		Stay the same		Greatly Increased
1	2	3	4	5

19. Do you agree or disagree that increased interest and training in science and technology among school children is important if the United states is to remain competitive in the international economy?

Strongly Disagree		Not sure		Strongly Agree
1	2	3	4	5

20. Do you agree or disagree that increased interest and training in science and technology among school children are important for maintaining national security in the areas of armed forces and defense?

Strongly Disagree		Not sure		Strongly Agree
1	2	3	4	5

21. Do you agree or disagree that reducing the school dropout rate is important if the United States is to remain competitive in the international economy?

Strongly Disagree		Not sure		Strongly Agree
1	2	3	4	5

22. Do you agree or disagree that reducing the school dropout rate is important for maintaining national security in the areas of armed forces and defense?

Strongly Disagree		Not sure		Strongly Agree
1	2	3	4	5

Teaching with space (Administrators, please omit questions that do not apply)

23. During this past school year (1993 - 1994), how many days per month, in a typical class, did you incorporate space concepts in your lesson plans? _____

24. During this past school year (1993 - 1994), how many special space-related units or series of lessons did you conduct or participate in? _____

25. What was the total days' duration of those special space-related units? _____

26. During this past school year (1993 - 1994), how many times did you acquire aerospace materials? _____

During this past school year (1993 - 1994), under your direction, how many...

27. Individual students developed projects around a space theme? _____
28. Groups developed projects around a space theme?_____
29. Outside speakers were brought in to talk about aerospace? _____
30. Space-related videos or films were shown? _____
31. Presentations were done for students on careers in aerospace?_____

Interactive computer networks and space organizations

32. This past school year (1993 - 1994), approximately how many times per month did you use an on-line computer network or bulletin board service? _____

33. Please circle all on-line computer services you have used within this past school year.

1. CompuServe
2. Prodigy
3. Genie
4. Space Link
5. Internet
6. Bitnet
7. Local bulletin boards
8. Other (please list)

34. Do you have "easy" access to a computer?
    1. Yes, at home
    2. Yes, at school
    3. Both home and school
    4. Neither home nor school

35. If you circled 34a, 34b, or 34c, please indicate what kind of system you use. (circle all that apply)
    1. IBM or compatible
    2. Apple Macintosh or compatible
    3. Other Apple or compatible

36. Which of the following space-related organizations have you been a member of, been actively involved with, participated in the programs of, or ordered materials from? (circle all that apply)

1. United States Space Foundation
2. Young Astronauts
3. Space Academy/Space Camp
4. Challenger Center
5. Civil Air Patrol
6. NASA
7. Federal Aviation Administration
8. Other _____

Getting Comfortable Teaching with Space (1994-1995)
Aldrin Elementary
Post course Survey

This course is partially underwritten by NASA who also is sponsoring comprehensive evaluation. Please complete this survey and the final survey that we send you next spring. Your cooperation helps ensure this program will make a significant impact on America's education goals. Please circle the number of your response. Thanks! (Don't worry about gaps in the question numbers.)

2. What is your gender?
   1. Female
   2. Male

3. Which best characterizes your position?
   1. Teacher
   2. Teacher with some supervisory responsibility
   3. In-school supervisor
   4. District-level supervisor

If you are an administrator, please skip to Question 7.

4. What grade level do you teach? (circle all that apply)
   1. Pre-school
   2. Kindergarten
   3. Grade 1
   4. Grade 2
   5. Grade 3
   6. Grade 4
   7. Grade 5
   8. Grade 6

5. What is your subject? (circle all that apply)
   1. All
   2. Math and science
   3. Reading, language arts
   4. Social studies
   5. Physical education
   6. Other (please specify_____)

6a. What kind of class did you teach? (circle all that apply)
   1. Regular classroom
   2. Special education
   3. Gifted and talented
   4. Other (please specify_____)

6b. How many years' teaching experience do you have (all types)? _____

7. What is your science background and training?

None				Extensive
1	2	3	4	5

8. What is your ethnic group?
   1. Black or African American
   2. Hispanic
   3. Oriental
   4. Caucasian
   5. None or other (specify _____)

Abilities and attitudes

10. How aware are you of aerospace materials available to educators (U.S. Space Foundation, NASA, CAP, FAA, etc.)?

Not at all Aware		Moderately Aware		Very Aware
1	2	3	4	5

11. How aware are you about technology spin-offs from space and aviation?

Not at all Aware		Moderately Aware		Very Aware
1	2	3	4	5

12. How do you feel about the applicability of space and technology-related material to standard curriculum? You think space is...

Not at all Applicable		Applicable to some subjects		Applicable across-the-board
1	2	3	4	5

13. How confident are you about your ability to incorporate space and technology-related concepts effectively in your teaching?

Not at all confident		Moderately confident		Very confident
1	2	3	4	5

14. What is your general level of interest in science?

Low		Moderate		High
1	2	3	4	5

15. What is your comfort or apprehension about your own ability to understand scientific information?

Highly Apprehensive				Very Comfortable
1	2	3	4	5

16. How confident are you in your ability to present scientific topics to your students effectively?

Not at all confident		Moderately confident		Very confident
1	2	3	4	5

17. How important a component of the curriculum is science and technology?

Not at all Important		Moderately Important		Extremely Important
1	2	3	4	5

18. Should the proportion of the curriculum devoted to science and technology be increased or decreased?

Greatly Decreased		Stay the same		Greatly Increased
1	2	3	4	5

19. Do you agree or disagree that increased interest and training in science and technology among school children is important if the United states is to remain competitive in the international economy?

Strongly Disagree		Not sure		Strongly Agree
1	2	3	4	5

20. Do you agree or disagree that increased interest and training in science and technology among school children are important for maintaining national security in the areas of armed forces and defense?

Strongly Disagree		Not sure		Strongly Agree
1	2	3	4	5

(Survey continued on reverse)

Course Emphasis

Did the course contain too little, just the right amount, or too much of each of the following? As an educator, you understand that one cannot increase one area without decreasing another. Therefore, would you please try to balance your 1 and 2 responses with an approximately equal number of 4 and 5 responses?

	Too Little		**Just Right**		**Too Much**
37. Hands-on	1	2	3	4	5
38. Breakout sessions	1	2	3	4	5
39. Simple concepts	1	2	3	4	5
40. Advanced concepts	1	2	3	4	5
41. Resources	1	2	3	4	5
42. Lesson plans	1	2	3	4	5
43. Implementation ideas	1	2	3	4	5
44. Career opportunities in aerospace	1	2	3	4	5
45. Scheduled breaks	1	2	3	4	5
<u>Applications to...</u>					
46. Mathematics	1	2	3	4	5
47. Science	1	2	3	4	5
48. Reading	1	2	3	4	5
49. Social studies	1	2	3	4	5
50. Language	1	2	3	4	5
<u>Applications for...</u>					
51. Grades K-3	1	2	3	4	5
52. Grades 4-6	1	2	3	4	5
53. Junior high	1	2	3	4	5
54. High school	1	2	3	4	5

55. Please select exactly three topics from the above list that should receive more time or emphasis in the course. List three numbers from 37-54.

____ ____ ____

56. Please select exactly three topics from the list that should receive less time or emphasis in the course. List three numbers from 37-54. NOTE: We will not read your answers to question 55, areas to expand, unless you also include areas to reduce in this question.

____ ____ ____

57. Please list any topics not on the list that should be added:

Course Evaluation

Please rate the following aspects of the course as excellent, good, fair, poor.

	Excellent	**Good**	**Fair**	**Poor**
58. Course structure	4	3	2	1
59. Selected material's relevance to course objectives	4	3	2	1
60. Staff responsiveness to your needs	4	3	2	1
61. Overall quality of instruction	4	3	2	1
62. Facilities	4	3	2	1
63. Time management (ours)	4	3	2	1
64. Overall course rating	4	3	2	1

Considering the goal of the **Getting Comfortable Teaching with Space program,** to make your teaching more effective by helping you infuse your standard curriculum with space/technology examples...

65. How effective were we in equipping you to do that?

Not Effective		Moderately Effective		Very Effective
1	2	3	4	5

66. How do you think your teaching will improve as a result of **Getting Comfortable Teaching with Space**? I anticipate...

No Improvement		Some Improvement		Great Improvement
1	2	3	4	5

67. Would you recommend **Getting Comfortable Teaching with Space** to a colleague?

No		Yes, with Reservations		Yes, wholeheartedly
1	2	3	4	5

Please add any comments that will help us make **Getting Comfortable Teaching with Space** better.

Getting Comfortable Teaching with Space (1994-1995)
Aldrin Elementary
Spring Survey

This program is partially underwritten by NASA who also is sponsoring comprehensive evaluation. **Please complete this survey and return it to the designated box in the office to ensure your opinions are included.** Your cooperation helps ensure this program will make a significant impact on America's education goals. Please circle the number of your response.

Thanks! (Don't worry about gaps in the question numbers.)

2. What is your gender?
    1. Female
    2. Male

3. Which best characterizes your position?
    1. Teacher
    2. Teacher with some supervisory responsibility
    3. In-school supervisor
    4. District-level supervisor

If you are an administrator, please skip to Question 7.

4. What grade level do you teach? (circle all that apply)
    1. Pre-school
    2. Kindergarten
    3. Grade 1
    4. Grade 2
    5. Grade 3
    6. Grade 4
    7. Grade 5
    8. Grade 6

5. What is your subject? (circle all that apply)
    1. All
    2. Math and science
    3. Reading, language arts
    4. Social studies
    5. Physical education
    6. Other (specify_____)

6a. What kind of class did you teach? (circle all that apply)
    1. Regular classroom
    2. Special education
    3. Gifted and talented
    4. Other (specify_____)

6b. How many years teaching experience do you have (all grades/types)? ____

7. What is your science background and training?

None				Extensive
1	2	3	4	5

8. What is your ethnic group?

1. Black or African American
2. Hispanic
3. Oriental
4. Caucasian
5. None or other (specify _____)

Abilities and attitudes

10. How aware are you of aerospace materials available to educators (U.S. Space Foundation, NASA, CAP, FAA, etc.)?

Not at all Aware		Moderately Aware		Very Aware
1	2	3	4	5

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1	2	3	4	5

12. How do you feel about the applicability of space and technology-related material to standard curriculum? You think space is...

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13. During the past school year, how confident have you been about your ability to incorporate space and technology-related concepts effectively in your teaching?

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1	2	3	4	5

14. What is your general level of interest in science?

Low		Moderate		High
1	2	3	4	5

15. What is your comfort or apprehension about your own ability to understand scientific information?

Highly Apprehensive				Very Comfortable
1	2	3	4	5

16. How confident are you in your ability to present scientific topics to your students effectively?

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1	2	3	4	5

17. How important a component of the curriculum is science and technology?

Not at all Important		Moderately Important		Extremely Important
1	2	3	4	5

18. Should the proportion of the curriculum devoted to science and technology be increased or decreased?

Greatly Decreased		Stay the same		Greatly Increased
1	2	3	4	5

19. Do you agree or disagree that increased interest and training in science and technology among school children is important if the United states is to remain competitive in the international economy?

Strongly Disagree				Strongly Agree
		Not sure		
1	2	3	4	5

20. Do you agree or disagree that increased interest and training in science and technology among school children are important for maintaining national security in the areas of armed forces and defense?

Strongly Disagree				Strongly Agree
		Not sure		
1	2	3	4	5

21. Do you agree or disagree that reducing the school dropout rate is important if the United States is to remain competitive in the international economy?

Strongly Disagree				Strongly Agree
		Not sure		
1	2	3	4	5

22. Do you agree or disagree that reducing the school dropout rate is important for maintaining national security in the areas of armed forces and defense?

Strongly Disagree				Strongly Agree
		Not sure		
1	2	3	4	5

Teaching with space (Administrators, please omit questions that do not apply)

23. During this school year, how many days per month, in a typical class, did you incorporate space concepts in your lesson plans? _____

24. During this school year, how many special space-related units or series of lessons did you conduct or participate in? _____

25. What was the total days' duration of those special space-related units? _____

26. During this school year, how many times did you acquire aerospace materials? _____

During this school year, under your direction, how many...

27. Individual students developed projects around a space theme? _____
28. Groups developed projects around a space theme? _____
29. Outside speakers were brought in to talk about aerospace? _____
30. Space-related videos or films were shown? _____
31. Presentations were done for students on careers in aerospace? _____

Interactive computer networks and space organizations

32. This school year, approximately how many times per month did you use an on-line computer network or bulletin board service? _____

33. Please circle all on-line computer services you have used within this past school year.

1. CompuServe
2. Prodigy
3. Genie
4. Space Network
5. Space Link
6. Internet
7. Bitnet
8. Local bulletin boards
9. Other (please list)

34. Do you have "easy" access to a computer from which you could use an on-line computer service? (circle all that apply)

1. Yes, at home
2. Yes, at school
3. Neither home nor school

35. If you circled either of 34a or 34b, please indicate what kind of system you use. (circle all that apply)

1. IBM or compatible
2. Apple Macintosh or compatible
3. Other Apple or compatible

36. During this school year (not counting the **Getting Comfortable Teaching with Space** program) which of the following space-related organizations have you been a member of, been actively involved with, participated in the programs of, or ordered materials from? (circle all that apply)

1. United States Space Foundation
2. Young Astronauts
3. Space Academy/Space Camp
4. Challenger Center
5. Civil Air Patrol
6. NASA
7. Federal Aviation Administration
8. Other _____

Survey continued on next page.

Course Quality

Now that you have been teaching, we would like your current perspective on the structure of the course.

Did the course contain too little, just the right amount, or too much of each of the following? As an educator, you understand that one cannot increase one area without decreasing another. Therefore, would you please try to balance your 1 and 2 responses with an approximately equal number of 4 and 5 responses?

	Too Little		**Just Right**		**Too Much**
37. Hands-on	1	2	3	4	5
38. Breakout sessions	1	2	3	4	5
39. Simple concepts	1	2	3	4	5
40. Advanced concepts	1	2	3	4	5
41. Resources	1	2	3	4	5
42. Lesson plans	1	2	3	4	5
43. Implementation ideas	1	2	3	4	5
44. Career opportunities in aerospace	1	2	3	4	5
45. Scheduled breaks	1	2	3	4	5
Applications to...					
46. Mathematics	1	2	3	4	5
47. Science	1	2	3	4	5
48. Reading	1	2	3	4	5
49. Social studies	1	2	3	4	5
50. Language	1	2	3	4	5
Applications for...					
51. Grades K-3	1	2	3	4	5
52. Grades 4-6	1	2	3	4	5
53. Junior high	1	2	3	4	5
54. High school	1	2	3	4	5

55. Please select exactly three topics from the above list that should receive more time or emphasis in the course. List three numbers from 37-54.

_____ _____ _____

56. Please select exactly three topics from the list that should receive less time or emphasis in the course. List three numbers from 37-54. NOTE: We will not read your answers to question 55, areas to expand, unless you also include areas to reduce in this question.

_____ _____ _____

57. Please list any topics not on the list that should be added and turn the page to complete the survey.

Considering the goal of the **Getting Comfortable Teaching with Space program,** to make your teaching more effective by helping you infuse your standard curriculum with space/technology examples...

65. How effective were we in equipping you to do that?

Not Effective		Moderately Effective		Very Effective
1	2	3	4	5

66. How do you think your teaching improved as a result of **Getting Comfortable Teaching with Space**? I experienced...

No Improvement		Some Improvement		Great Improvement
1	2	3	4	5

67. Would you recommend **Getting Comfortable Teaching with Space** to a colleague?

No		Yes, with Reservations		Yes, wholeheartedly
1	2	3	4	5

Please add any comments that will help us make **Getting Comfortable Teaching with Space** better. **(Remember, we need you to return this survey to the designated place in the office by March 31. If you're late, you can mail your survey to Dr. Robert Ewell, US Space Foundation, 2860 South Circle Drive, Suite 2301, Colorado Springs, CO 80906-4184.)**

Appendix B-2

Kids' Surveys

Student Survey: Grades 4-6

Note to teacher:

The purpose of this survey is to begin to gather data on the ultimate effectiveness of using space to motivate and enrich standard curriculum. This research is sponsored by NASA in support of the America 2000 Education Goals which include increasing the number of students who are interested in math and science.

Please administer the attached surveys to your students who are in grades 4 - 6. Have them use a pencil (or pen) to indicate their choice of responses. They can circle the number, check it, X it...we don't care as long as it's clear what their response is. Please remind them to leave their names off. Please return completed surveys to the box designated for that purpose. You may have to help them with teacher's name and room number.

This research is sponsored by NASA and the United States Space Foundation. Evaluation director is Dr. Robert Ewell, ***Creative Solutions***, 142 Buckeye Drive, Colorado Springs, CO 80919, 719-531-9129.

Thanks for your help!

Student Survey, Grades 4 - 6

Students, please answer all questions according to the following scale and give your completed survey to your teacher. (Circle or check the number of your choice.) **No names, please!**

(1) Definitely yes
(2) Probably yes
(3) Not sure
(4) Probably no
(5) Definitely no

Please write your teacher's name and room number:

Teacher name: _____

Room: _____

	Yes		Not sure		No
	Definitely	Probably		Probably	Definitely
1. Do you think doing space-related work would be fun?	(1)	(2)	(3)	(4)	(5)
2. Do you plan to take as many science courses as you can in junior high and high school?	(1)	(2)	(3)	(4)	(5)
3. Do you plan to go to college after high school?	(1)	(2)	(3)	(4)	(5)
4. When you are an adult, would you like to work at some job that lets you use what you know about science?	(1)	(2)	(3)	(4)	(5)
5. Do you think that there are science-related jobs that you can learn to do when you are an adult?	(1)	(2)	(3)	(4)	(5)
6. Would you like to know more about jobs involving science?	(1)	(2)	(3)	(4)	(5)
7. Would you like a job designing and building things when you are an adult?	(1)	(2)	(3)	(4)	(5)
8. Would you like a job working in the United States space program when you are an adult?	(1)	(2)	(3)	(4)	(5)
9. Do you think learning about science is more fun than learning about history?	(1)	(2)	(3)	(4)	(5)
10. Do you think learning about the space program would be fun?	(1)	(2)	(3)	(4)	(5)
11. Do you think you will use what you learned studying science when you are an adult?	(1)	(2)	(3)	(4)	(5)
12. Do you know that Americans have walked on the moon?	(1)	(2)	(3)	(4)	(5)
13. Do you know who Buzz Aldrin is?	(1)	(2)	(3)	(4)	(5)

14. What grade are you in? (4) (5) (6)

15. Please indicate your gender: (boy) (girl)

Kids' Surveys
Fall/Spring 1994/1995

(1) Definitely yes
(2) Probably yes
(3) Not sure
(4) Probably no
(5) Definitely no

1. Do you think doing space-related work would be fun?

All (Fall)	(| 1 |)	95	(| 2 |)	151	(| 3 |)	89	(| 4 |)	47	(| 5 |)	40	2.5
All (Spring)	(| 1 |)	141	(| 2 |)	161	(| 3 |)	89	(| 4 |)	33	(| 5 |)	29	2.2
Aldrin (Fall)	(| 1 |)	54	(| 2 |)	54	(| 3 |)	35	(| 4 |)	10	(| 5 |)	12	2.2
Aldrin (Spring)	(| 1 |)	75	(| 2 |)	60	(| 3 |)	18	(| 4 |)	6	(| 5 |)	9	1.9
School B (Fall)	(| 1 |)	41	(| 2 |)	97	(| 3 |)	54	(| 4 |)	37	(| 5 |)	28	2.7
School B (Spring)	(| 1 |)	66	(| 2 |)	101	(| 3 |)	71	(| 4 |)	27	(| 5 |)	20	2.4

2. Do you plan to take as many science courses as you can in junior high and high school?

All (Fall)	(| 1 |)	61	(| 2 |)	87	(| 3 |)	152	(| 4 |)	83	(| 5 |)	38	2.9
All (Spring)	(| 1 |)	73	(| 2 |)	104	(| 3 |)	165	(| 4 |)	73	(| 5 |)	39	2.8
Aldrin (Fall)	(| 1 |)	33	(| 2 |)	34	(| 3 |)	59	(| 4 |)	24	(| 5 |)	14	2.7
Aldrin (Spring)	(| 1 |)	30	(| 2 |)	36	(| 3 |)	61	(| 4 |)	20	(| 5 |)	21	2.8
School B (Fall)	(| 1 |)	28	(| 2 |)	53	(| 3 |)	93	(| 4 |)	59	(| 5 |)	24	3.0
School B (Spring)	(| 1 |)	43	(| 2 |)	68	(| 3 |)	104	(| 4 |)	53	(| 5 |)	18	2.8

3. Do you plan to go to college after high school?

All (Fall)	(| 1 |)	369	(| 2 |)	28	(| 3 |)	17	(| 4 |)	1	(| 5 |)	6	1.2
All (Spring)	(| 1 |)	407	(| 2 |)	26	(| 3 |)	13	(| 4 |)	2	(| 5 |)	5	1.2
Aldrin (Fall)	(| 1 |)	138	(| 2 |)	13	(| 3 |)	9	(| 4 |)	0	(| 5 |)	4	1.3
Aldrin (Spring)	(| 1 |)	154	(| 2 |)	7	(| 3 |)	4	(| 4 |)	2	(| 5 |)	1	1.1
School B (Fall)	(| 1 |)	231	(| 2 |)	15	(| 3 |)	8	(| 4 |)	1	(| 5 |)	2	1.2
School B (Spring)	(| 1 |)	253	(| 2 |)	19	(| 3 |)	9	(| 4 |)	0	(| 5 |)	4	1.2

4. When you are an adult, would you like to work at some job that lets you use what you know about science?

All (Fall)	(| 1 |)	57	(| 2 |)	83	(| 3 |)	141	(| 4 |)	82	(| 5 |)	58	3.0
All (Spring)	(| 1 |)	70	(| 2 |)	91	(| 3 |)	168	(| 4 |)	69	(| 5 |)	54	2.9
Aldrin (Fall)	(| 1 |)	31	(| 2 |)	31	(| 3 |)	53	(| 4 |)	29	(| 5 |)	20	2.9
Aldrin (Spring)	(| 1 |)	37	(| 2 |)	36	(| 3 |)	51	(| 4 |)	21	(| 5 |)	22	2.7
School B (Fall)	(| 1 |)	26	(| 2 |)	52	(| 3 |)	88	(| 4 |)	53	(| 5 |)	38	3.1
School B (Spring)	(| 1 |)	33	(| 2 |)	55	(| 3 |)	117	(| 4 |)	48	(| 5 |)	32	3.0

5. Do you think that there are science-related jobs that you can learn to do when you are an adult?

All (Fall)	(| 1 |)	170	(| 2 |)	146	(| 3 |)	72	(| 4 |)	23	(| 5 |)	8	1.9
All (Spring)	(| 1 |)	194	(| 2 |)	149	(| 3 |)	70	(| 4 |)	15	(| 5 |)	22	1.9
Aldrin (Fall)	(| 1 |)	61	(| 2 |)	55	(| 3 |)	27	(| 4 |)	13	(| 5 |)	6	2.1
Aldrin (Spring)	(| 1 |)	74	(| 2 |)	55	(| 3 |)	19	(| 4 |)	6	(| 5 |)	11	1.9
School B (Fall)	(| 1 |)	109	(| 2 |)	91	(| 3 |)	45	(| 4 |)	10	(| 5 |)	2	1.9
School B (Spring)	(| 1 |)	120	(| 2 |)	94	(| 3 |)	51	(| 4 |)	9	(| 5 |)	11	1.9

(1) Definitely yes
(2) Probably yes
(3) Not sure
(4) Probably no
(5) Definitely no

6. Would you like to know more about jobs involving science?

All (Fall)	(1)	114	(2)	81	(3)	73	(4)	81	(5)	72	2.8
All (Spring)	(1)	93	(2)	112	(3)	110	(4)	78	(5)	60	2.8
Aldrin (Fall)	(1)	57	(2)	26	(3)	25	(4)	26	(5)	30	2.7
Aldrin (Spring)	(1)	48	(2)	40	(3)	34	(4)	23	(5)	23	2.6
School B (Fall)	(1)	57	(2)	55	(3)	48	(4)	55	(5)	42	2.9
School B (Spring)	(1)	45	(2)	72	(3)	76	(4)	55	(5)	37	2.9

7. Would you like a job designing and building things when you are an adult?

All (Fall)	(1)	48	(2)	61	(3)	119	(4)	94	(5)	100	3.3
All (Spring)	(1)	51	(2)	101	(3)	121	(4)	83	(5)	91	3.1
Aldrin (Fall)	(1)	16	(2)	20	(3)	39	(4)	37	(5)	53	3.6
Aldrin (Spring)	(1)	19	(2)	34	(3)	38	(4)	27	(5)	46	3.3
School B (Fall)	(1)	32	(2)	41	(3)	80	(4)	57	(5)	47	3.2
School B (Spring)	(1)	32	(2)	67	(3)	83	(4)	56	(5)	45	3.1

8. Would you like a job working in the United States space program when you are an adult?

All (Fall)	(1)	40	(2)	30	(3)	116	(4)	102	(5)	133	3.6
All (Spring)	(1)	49	(2)	57	(3)	145	(4)	105	(5)	96	3.3
Aldrin (Fall)	(1)	22	(2)	18	(3)	43	(4)	35	(5)	46	3.4
Aldrin (Spring)	(1)	38	(2)	27	(3)	47	(4)	30	(5)	24	2.8
School B (Fall)	(1)	18	(2)	12	(3)	73	(4)	67	(5)	87	3.8
School B (Spring)	(1)	11	(2)	30	(3)	98	(4)	75	(5)	72	3.6

9. Do you think learning about science is more fun than learning about history?

All (Fall)	(1)	185	(2)	66	(3)	72	(4)	38	(5)	52	2.3
All (Spring)	(1)	213	(2)	64	(3)	83	(4)	29	(5)	53	2.2
Aldrin (Fall)	(1)	93	(2)	21	(3)	19	(4)	10	(5)	17	2.0
Aldrin (Spring)	(1)	88	(2)	26	(3)	27	(4)	10	(5)	12	2.0
School B (Fall)	(1)	92	(2)	45	(3)	53	(4)	28	(5)	35	2.5
School B (Spring)	(1)	125	(2)	38	(3)	56	(4)	19	(5)	41	2.3

10. Do you think learning about the space program would be fun?

All (Fall)	(1)	113	(2)	123	(3)	98	(4)	45	(5)	41	2.5
All (Spring)	(1)	127	(2)	159	(3)	84	(4)	50	(5)	30	2.3
Aldrin (Fall)	(1)	57	(2)	51	(3)	34	(4)	3	(5)	18	2.2
Aldrin (Spring)	(1)	73	(2)	57	(3)	21	(4)	7	(5)	8	1.9
School B (Fall)	(1)	56	(2)	72	(3)	64	(4)	42	(5)	23	2.6
School B (Spring)	(1)	54	(2)	102	(3)	63	(4)	43	(5)	22	2.6

11. Do you think you will use what you learned studying science when you are an adult?

All (Fall)	(1)	108	(2)	141	(3)	102	(4)	48	(5)	23	2.4
All (Spring)	(1)	115	(2)	156	(3)	108	(4)	50	(5)	22	2.4
Aldrin (Fall)	(1)	50	(2)	46	(3)	42	(4)	17	(5)	9	2.3
Aldrin (Spring)	(1)	53	(2)	59	(3)	32	(4)	13	(5)	9	2.2
School B (Fall)	(1)	58	(2)	95	(3)	60	(4)	31	(5)	14	2.4
School B (Spring)	(1)	62	(2)	97	(3)	76	(4)	37	(5)	13	2.4

(1) Definitely yes
(2) Probably yes
(3) Not sure
(4) Probably no
(5) Definitely no

12. Do you know that Americans have walked on the moon?

All (Fall)	(1)	394	(2)	9	(3)	10	(4)	2	(5)	7	1.1
All (Spring)	(1)	407	(2)	14	(3)	15	(4)	5	(5)	10	1.2
Aldrin (Fall)	(1)	151	(2)	3	(3)	2	(4)	2	(5)	6	1.2
Aldrin (Spring)	(1)	148	(2)	6	(3)	3	(4)	3	(5)	5	1.2
School B (Fall)	(1)	243	(2)	6	(3)	8	(4)	0	(5)	1	1.1
School B (Spring)	(1)	259	(2)	8	(3)	12	(4)	2	(5)	5	1.2

13. Do you know who Buzz Aldrin is?

All (Fall)	(1)	198	(2)	28	(3)	50	(4)	15	(5)	127	2.6
All (Spring)	(1)	282	(2)	25	(3)	41	(4)	21	(5)	80	2.1
Aldrin (Fall)	(1)	136	(2)	9	(3)	4	(4)	4	(5)	9	1.4
Aldrin (Spring)	(1)	162	(2)	1	(3)	1	(4)	0	(5)	2	1.1
School B (Fall)	(1)	62	(2)	19	(3)	46	(4)	11	(5)	118	3.4
School B (Spring)	(1)	120	(2)	24	(3)	40	(4)	21	(5)	78	2.7

Appendix C

Student Interview Responses
April 1995

Interviews/Focus groups with kids
Raw data–few comments, no summary, or analysis

What do you like most about this school?

Designed to be a contextual question just to get them into it. Responses were:

- Group of 12 fourth graders from all three classes

  - space and projects

  - spelling and English

  - new, modern, big

  - technology

  - architecture: computer labs

  - fields are big enough to have multiple activities

  - facilities: library, TVs in every room

  - math

- Group of 10 fifth graders from all three classes:

  - "educational"; high tech, computers

  - the interest in space technology. "This school is into space."

  - They knew about their teachers' space training week, and their teachers have told them about the underwater training. They were very impressed with that even though it wasn't "hands-on" for them (the kids). Their understanding of what the training meant was a little fuzzy in that they knew it simulated how it is to move around in space but they didn't know why one moves in space that way. "No gravity" rather than the constant falling that causes the floating sensation.

  - Computers including encyclopedias on computers

  - New building and books (compared with other schools attended which were old)

  - Lots of subjects and projects

  - Science center with lots of "neat" stuff

  - Main accomplishment of the school is to get us to understand space

  - The space training the teachers took gave them confidence which we see when they teach us about space.

- Group of eight sixth graders, deliberately selected to be "average", not necessarily bright or affluent. Their responses were not as effusive as the 5th graders.

- Big, 4 computers in each room

- Math and science

- Field trips, e.g., the space center

- Spelling

- "Hands-on"

What kinds of activities here help you learn?

This question was designed to see if they were recognizing the many hands-on projects and other techniques communicated during the Getting Comfortable Teaching with Space course, as well as other learning activities.

- Fourth graders

- social studies, science, math projects

- games

- student-directed: choice of projects; if game, make up rules

- you can hear, talk, or do--we do

- solar system books

- physical activities: e.g., jeopardy

- field trips

- fraction bar

- teachers are patient

- geography relays (also math relays); a game that motivates the students to learn so they won't miss a question twice. [Most knew where Madagascar was!]

- Fifth graders

- Laser disk programs; specifically, "Nancy and Bob", aliens who travel from planet to planet. "A better way to learn about the planets than just reading descriptions in a book or having the teacher lecture."

- Constellations projects: light boxes

- Our solar system to scale on the field. (mathematics and science)

- Poetry and spelling lessons are using space concepts. (This really seemed to turn the kids on , just as advertised.)

- Even in music they are learning and singing space-related songs.

- Sixth graders

- Current events (Note: Brian Mulholland, General Manager of the Sheraton and the number one corporate sponsor) conducts a weekly current events class for sixth graders. I observed one such class, and both Brian and the students were impressive. I learned this morning that Brian provides the newspapers he expects them to read)

- Math: more hands-on. For example, we did a chart with ratios based on a survey of who liked rap music versus other kinds

- Science: more hands-on

- Computers: some take their spelling tests on computers

- More student-directed: for example, they get to choose their own spelling words

How do your teachers use space ideas in the classroom?

Question designed as a follow-on to previous one.

- Fourth graders

- Movie on planets

- Science and music questions from the morning "news" program

- video of people living on moon, mars

- have to take notes during videos to answer questions later

- Mars project: worked with this class. The 5th graders didn't like the Mars project

- Groups to research planets and build slide show on the computer

- Colony in space project

- Teacher uses what we know to take us where we don't know. Sometimes we use space, sometimes not.

- In the group of fifth graders, students were aware that the Getting Comfortable program strengthened the teachers' understanding so that they could present the material more confidently. Otherwise, the fifth grade students already covered this earlier.

- Sixth graders

They were not as aware of their teachers' attending the space training earlier this year. They did remember the underwater part, although the concept of "floating" or "falling" in space is not getting across to the students. Question: is it getting across to the teachers? They did appreciate writing assignments based on space. For example, they had to write a poem about the planet they were studying. Some acknowledged that using space made the poetry more fun.

What is your favorite subject?

This question is designed to get at whether or not what we're doing actually turns the kids on to math and science. Results were as follows:

- Fourth graders
    - Like science better now than last year: more hands-on.
    - Like math better; math relays helped
    - Science more fun: learning more about space.

- Group of 10 5th graders from all three classrooms: 5 said math was their favorite subject; when the question was broadened to include science/math, all but 2 raised their hands as saying math or science was their favorite subject.

- Many of the sixth graders said they liked math/science although several said it was better last year (different school) because they didn't have to write everything up last year. (Sixth grade is not as much fun...!) They did appreciate the hands-on whether it was at this school or the last school.

Further inputs from teacher Bonnie White who observed the discussion of the fifth graders:

- The Aldrin people who go back for the advanced course want more theory--not just hands-on. They feel creative enough to develop their own "fuzzies." They want the meat.

- Mrs. White is using less fiction and more history to try to get students into history through reading. For example, a historical novel such as Aurora 7 by Thomas Malen which is about Scott Carpenter.

Other instructors' comments

- Another instructor liked Getting Comfortable because of Jerry Brown's personal involvement with space. Mrs. White expanded that to say that Jerry's personal perspective gave the teachers a personal perspective through their experience. Then it comes personal to the teachers--a quality passed on to the students and their families.

- The male first grade teacher had never been enthusiastic about the space program. He enjoyed Jerry's class and has used some of the material although lack of planning time has prohibited using a lot.

Appendix D

Standardized Test Scores
February, March 1995
Iowa Test of Basic Skills (ITBS)
Virginia Literacy Test (VLT)

Test Score Summary

	School	Number	Average	Standard Deviation	Minimum	Maximum	Significant At .05	t-statistic (Critical value = +/-1.96)
ITBS-Composite								
	Aldrin	63	269.63	59.82	107	364	YES	-3.138
	School B	104	294.94	43.96	153	366		
ITBS-Language								
	Aldrin	63	92.25	20.35	38	123	NO	-1.562
	School B	104	96.76	16.54	37	125		
ITBS-Math								
	Aldrin	63	68.94	16.60	21	94	YES	-3.529
	School B	104	76.94	12.55	35	95		
ITBS-Science								
	Aldrin	63	21.56	5.55	7	32	NO	-1.261
	School B	104	22.62	5.08	8	36		
ITBS-Social Studies								
	Aldrin	63	19.78	5.65	4	33	NO	-1.475
	School B	104	21.06	5.30	9	35		
VLT-Math								
	Aldrin	34	262.50	13.68	236	292	YES	-4.795
	School B	107	272.76	9.83	253	300		
VLT-Reading								
	Aldrin	32	266.94	23.39	218	299	YES	-2.361
	School B	107	274.78	13.81	241	300		
VLT_Writing								
	Aldrin	32	272.06	21.97	226	300	YES	-2.562
	School B	105	280.70	14.75	248	300		