THE DEVELOPMENT OF THE ELECTRONIC FIELD TRIP
TO STRENGTHEN AND ENRICH EXISTING
K-12 CURRICULUM

By

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Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF EDUCATION
December, 1993

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Thesis Approved:

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ACKNOWLEDGMENTS

I wish to express my sincere gratitude to all the people who assisted me in the culmination of this endeavor. I would like to express my appreciation to Dr. Kenneth Wiggins, whose wisdom and good counsel has inspired and guided me through many challenges from the Teacher in Space Project to the pursuit of the doctorate that has made it possible to change my career path to a direction that has given me a great sense of professional fulfillment. I will never forget the encouragement and support of Mary Chaplin, whose friendship will forever live in my heart. I also thank Dr. Bruce Petty for serving as my thesis advisor, as well as Drs. Kenneth King and Kenneth St. Clair for serving on my dissertation committee. All of the committee members generously gave their time, encouragement, and invaluable advice.

I also wish to thank Faithe Smith for her much needed assistance in proofing and editing. A thank you also goes to Drs. Robert Spillane, Glenn Kessler, and Terence Woolsey of Fairfax County Public Schools, who gave me the opportunity to work on the development of the electronic field trip. I am especially grateful to all the production staff and graphics artists whose talents turned ideas into exciting, high quality programming.

Finally, to my daughter, Kimberley, whose editing skills were as helpful as her moral support, and to my husband, Angel, whose patience and support were always there for me, my deepest appreciation.

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CHAPTER I

INTRODUCTION

The Nature of the Problem

In 1983, the National Commission on Excellence in Education released A Nation at Risk, an alarming report which depicted the failure of far too many schools to give their students a mastery of essential citizenship and economic skills. This report raised the consciousness of the public and government to the critical dilemma the United States would have to face when ill-prepared young people replace their elders in the work force and take on the awesome task of governing a nation that has historically protected freedom throughout the world. The report graphically illustrated the indicators of the risk with some shocking examples of the status of literacy in the United States. In international comparisons of student achievement on 19 academic tests, American students were never first or second and when compared to other industrialized nations, were last seven times; average achievement of high school students on most standardized tests is lower today than when Sputnik was launched more than a quarter of a century ago; and some 23 million American adults are functionally illiterate in simple tests of everyday reading, writing, and comprehension (A Nation at Risk, 1983). The above represent only a few examples of the dimensions of the problem cited by the commission, but perhaps are sufficient to illustrate the urgency to act if the United States were to retain the slim competitive edge still held in the world markets.

Response to the challenge of A Nation at Risk came quickly as state and federal commissions sought solutions to this critical problem. In 1984, for example, a report issued by the Education Commission of the States, showed that all 50 states were affected by resultant mandates designed to improve the quality and resolve the inequities of education in the public schools. In order to implement the reforms, many school districts had to increase graduation requirements, which created more demand on limited public funds (Eiserman, 1987). For example in Texas, the 67th Texas Legislature passed into law Chapter 75, which requires that all school districts provide each student with the opportunity to participate in 30 plus required courses which make up the "well-balanced secondary curriculum" (Barker, 1985).

Similar changes in course requirements were made throughout the fifty states affecting school districts, both large and small. As school districts struggled to implement the reforms, many small, rural high schools found themselves unable to offer courses to meet requirements due to lack of resources and qualified teachers (Barker, 1985). Rural districts often have a small student population and few teachers. Under these circumstances, one teacher at the secondary level often teaches several preparations, sometimes teaching across a number of subject matter disciplines. Even with the most valiant efforts of such teachers, it is usually difficult, if not impossible to offer classroom experiences which enhance a students competitiveness for admission to and success in institutions of higher learning. Chemistry, physics, foreign languages, advanced math classes, and advanced placement classes are all difficult to offer with the existing staff of teachers in many rural districts (Eiserman, 1987).

The problem was recognized in the report of the Carnegie forum in 1986, which emphasized the necessity of providing schools with talented, Board-certified teachers as the key element in improving the quality of instruction in the schools. It is at this critical point that relationships between teacher quality and a school districts wealth become apparent. Not only is it difficult to attract teachers to lower paying positions in a rural setting, all too often high-salary districts raid the best young teachers from low-salary districts once they have gained some classroom experience. The less affluent districts are, in effect, providing a training service for the wealthier districts. The poorer districts then suffer from diminished teacher capacity, and the breadth and depth of their instructional program is often compromised (A Nation Prepared, 1986).

The Phi Delta Kappa Commission on alternative Designs for Funding Education suggested as among basic principles by which government should abide, that education should not be dependent upon the wealth of the parent or the fiscal ability of the school district; and that state school finance plans should not create fiscal imbalances which deny equal educational opportunity (Balancing the Public Schools, 1973). Although they may agree with these principles completely, many districts must face harsh fiscal realities as they strive to meet increasing requirements and search for qualified teachers for their schools. To bridge the gap between their needs and fiscal and geographic circumstances, many school districts turned to satellite or cable delivered instruction (distance education) to provide courses otherwise unavailable to their students.

While equity of course offerings was of primary concern, inequity of access to outside resources such as experts, institutions, and events was not a major focus. Students fortunate enough to live in areas where museums, theaters, universities, major corporations, historic sites, and government and scientific centers are located have a competitive edge over students situated in more remote areas or fiscally disadvantaged districts.

Statement of the Problem

Prior to 1985 only three states had plans for developing distance education for k-12 students. In 1987, fewer than 10 states were involved in distance education; by 1988, two-thirds of the States reported involvement in projects; however today, virtually all States have become involved in or have an interest in distance education (U.S. Congress, 1989: 27). According to the Office of Technology Assessment (OTA), this rapid increase in distance learning projects was initially prompted by its efficiency and cost effectiveness in providing needed courses for rural students. The Federal Government supports the development of these courses, passing Public Law 100-297 which created the Star Schools Program (Withrow, 1990). According to Withrow, this legislation was designed to expand educational opportunities for elementary and secondary students in isolated, small, and disadvantaged schools in the United States. In September of 1988, the U.S. Department of Education awarded a total of $19.1 million to four geographically dispersed distance learning producers (Withrow, 1990, p. 62). Today, distance learning is also meeting the needs of urban schools facing problems of advanced classes with low enrollments, English as a second language, and many other courses particular to specific student populations. But, although distance education has become widespread, actual numbers of students participating in these courses is limited by a school district's or state's membership in a specific consortium. For example, according to OTA, in 1989 the total of students participating in four of the major consortia was 11,224. Minnesota Distance Learning Projects had 3,869 students, ASTS had 2,500, TI-IN Network had 4,000, and Satellite Telecommunications Educational Programming (STEP) had 855. Under the aegis of the Star Schools Program, those students were learning Japanese, Russian, German, French, Spanish, Latin and science and mathematics courses (Withrow, 1990, p. 62).

These figures are impressive in that they indicate that over 11,000 students that year were involved in courses that otherwise would not have been available to them. However, this writer felt challenged to explore how some of the concepts of distance education could be utilized to strengthen and enrich existing curricula for all the 43 million students throughout the United States without regard to memberships, and at no cost to schools or school districts. Because distance learning had been accepted as a viable way to deliver courses otherwise unavailable to students, it seemed logical that it could also address other inequities among school systems, that of accessibility to outside resources such as experts, institutions, historic monuments, or events of historic significance. The objective of this challenge was to design, develop, and deliver a model of distance instruction for k-12 students in a video format that would be of high production quality, would support existing curriculum, would be cost effective and easily accessible to all schools. The potential benefits to students and teachers in applying video technologies to strengthen existing curriculum was very clearly stated by Sheingold.

> Video and videodisc technologies can provide visual examples of real-world phenomena, events, and stories that students can use for problem-finding and problem-solving activities. Computer networking and satellite communications technologies can help promote local and long-distance collaboration and communication among students and teachers and can help them become part of the larger world of scholars and scientists (Sheingold, 1991, p. 20).

Purpose of the Project

As this writer surveyed existing distance education programs, it became apparent that generally, consortia offered a variety of courses that enabled mostly rural areas to fulfill State mandates for graduation requirements. Most often, these were courses in math, science, and foreign languages for which qualified teachers are difficult to find (U.S. Congress, Office of Technology Assessment, 1989). Until 1989, this writer was unable to find any references in the literature to any on-going, video-based special events or enrichment programs for students, designed to strengthen existing curricular offerings in rural or urban schools. In 1989, OTA cites that the Satellite Education Resources Consortium (SERC), one of the Star Schools grant recipients, did offer a series of special science seminars "Science, Technology, and Society," produced by Fairfax County Public Schools in Virginia.

Teachers have always been aware of the value of a field trip to motivate student interest in classroom lessons. Students are often uninterested in things they are learning in school because they have trouble "seeing the point." Gifted students often question teachers about the purpose of lessons. Subjects such as math, science, geography, and government often seem inert to disadvantaged students as they encounter them in textbooks, workbooks, lectures, and discussions. Teachers know the motivational power of well-planned, well-implemented field trips. Often students who had shown no interest in history suddenly become avid learners after they have visited an historic site, or spoken to someone in a prominent position in government who explains historic events, and how they impact upon the present. Regardless of whether the student is gifted, average, or disadvantaged, field trips stimulate thinking and encourage further study. Unfortunately, field trips are usually limited to locally available resources, making opportunities accessible only to those fortunate enough to live in an area where museums, theaters, science centers, and the like, are located, difficult or even impossible for students living in remote locations or fiscally deprived districts. This is an insidious side of inequity in the schools throughout the country, to which only minimal attention has been given.

In August, 1989, this writer was placed by Fairfax County Public Schools (FCPS) in the position of coordinator of program development (CPS) where, among other responsibilities, she was assigned to work with the telecommunications staff on the production of 16 science seminars that would make up the series of "Science, Technology, and Society" that FCPS would provide for SERC in the 1989-90 school year. Apart from the responsibility for the science seminars, the coordinator was permitted to pursue the development of programming that would support and strengthen existing curriculum and address School Board priorities. This writer was given the opportunity to work with highly talented and creative people, who as a team, brought this programming from a concept to reality. This project, to bring the world into the classroom via video teleconferencing, developed into what is now called the electronic field trip.

This paper will describe the evolution of the electronic field trip into a model that other districts may follow, permitting schools within and outside of any given system to share and benefit from resources that otherwise would not be available.

Definition of Terms

The following terms will be used in this paper:

Computer Bulletin Board -- A computer service that permits users at remote locations to access a central "host" to read and post messages.

Downlink -- A dish antenna that receives signals from a satellite. These antenna are also referred to as dishes, Earth stations, TVROs (television receive only), or terminals.

Fixed-Dish -- A satellite receive dish that is stationary, that is, it is pointed at a specific satellite and cannot receive signals from other satellites unless it is reaimed manually.

Footprint -- The area of the Earth's surface which can receive transmissions from a given satellite. Satellites cover different areas of the Earth and therefore, have different footprints.

Interactive Teleconference -- A teleconference designed to permit participants to communicate directly with presenters during the telecast.

Satellite Teleconference -- A teleconference that uses one or more of the Earth orbiting satellites as communication links.

Steerable Dish -- A satellite dish that can be rotated with motors to receive signals from different satellites.

Site -- A remote location from which participants will view the teleconference.

Site Coordinator -- The person at a remote location whose responsibilities include providing participants with accompanying print material for the teleconference, making arrangements for receiving the teleconference signal, setting-up an appropriate location for viewing the teleconference that is equipped with television equipment and a telephone, and gathering and returning evaluation forms.

Teleconference -- A term used for any conferencing using telecommunications links to connect participants at remote sites. There are many types of teleconferencing systems including: videoconferencing, computer conferencing, and audioconferencing.

Transponder -- The electronic equipment on a satellite that receives signals from an uplink, converts the signals to a new frequency, amplifies the signal, and sends it back to earth. Most satellites have 12 to 24 transponders.

Uplink -- A satellite dish that transmits signals up to a satellite.

Summary and Organization of Paper

Chapter I detailed the nature and statement of the problem, the need for the project, and definitions of terms. Chapter II sets the foundation of the project through a review of the literature on distance education projects with applications of various technologies, particularly video based programs. Chapter III relates the initial design and implementation of the electronic field trip. Chapter IV presents the evolution of the electronic field trip and Chapter V presents the summary of the project, findings, conclusions, and recommendations.

CHAPTER II

REVIEW OF THE LITERATURE

History of Distance Education

Distance education has many definitions. According to Batey, distance education is a current "catch-all" phrase for any form of instruction in which the learner is linked to an educational institution and is formally enrolled, but instruction does not necessarily have to be delivered to or from an official school site (Batey, & Cowell, 1986). Another version is that distance education or indirect education is the absence of face-to-face communication in education (Eiserman, & Williams, 1987). The French Government explained it as education which either does not imply the physical presence of the teacher appointed to dispense it in the place where it is received, or in which the teacher is present only on occasion or for selected tasks (Keegan, 1985). Holmberg (1986) defines distance education as study in which the learner is not under the continuous, immediate supervision of teachers in classrooms or on the same premises, and whereby instruction can be one-way, via printed, broadcast and recorded material or two-way, through written correspondence, the telephone, television, or other media. For the purpose of this study, Holmberg's definition will be used.

Because distance education is now receiving much attention as a means to improve the educational offerings of primarily rural schools under new legislation, it is often mistakenly assumed to be a new concept. Distance education began through correspondence centuries ago. According to Holmberg, the Biblical epistles were meant to deliver instruction to early Christian congregations. Education by letter was used, although not in a formalized manner, by Plato (Holmberg, 1986). In more modern times, study by correspondence became the means of developing vocational skills when one was unable to attend formal classes due to geography, economic or other restrictions. The Boston Gazette in 1728, advertised the New Method of Shorthand, stating that "Persons in the country desirous to learn this art, may by having the several lessons sent weekly to them, be as perfectly instructed as those that live in Boston" (Holmberg, 1986). Holmberg also describes a correspondence course that attempted to teach mining and methods of preventing mining accidents that was advertised in the Mining Herald in eastern Pennsylvania. On a more academic level, a weekly published in 1833 in Sweden offered ". . . ladies and gentlemen an opportunity to study composition through the medium of the post . . ." (Holmberg, 1986). Holmberg tells us that the "mother" of American correspondence study was Anna Eliot Ticknor, the daughter of a Harvard University professor. She founded and ran the Society to Encourage Study at Home from 1873 until 1897. Letters between students and teachers centered around guided readings and frequent tests on a classical curriculum. Most of the students were women who were just beginning to seek access to higher education. In 1939, the French faced the dilemma of providing instruction to children who were being evacuated from the towns and cities, while teachers were being called to military duty. The Ministry of Education resolved the problem by setting up a government correspondence college. It was so successful, that it continues today, and is called the Centre National de Tele-Enseignement, but now aims its instruction mainly toward adults (Holmberg, 1986).

The history of distance education in Australia is particularly significant, as that nation has truly pioneered the concept of distance learning. Australia has offered distance education at the university level since 1911, and is the first country to utilize distance education in a systematic way and on a large scale to provide a complete primary and secondary education for children who have never been to school (Keegan, 1985). Australia is approximately the same size as the United States, but presently has a population of 15 million compared to the population of the United States which is approximately 250 million (Smith, 1987). Almost 70% of Australia's population lives in the cities along the coast, leaving large parts of the country sparsely populated. These circumstances forced the Australian government to look at new ways to deliver education to people living far from the cities and their schools. Distance education was the only way in which education could be provided to a significant segment of the population (Smith, 1987).

At the turn of the century, Australia began to deliver instruction to children in remote locations through the mail (Keegan, 1985). It is very interesting to note that distance education for children began in Australia in 1914, at the request on one individual. A father wrote to the Victorian Education Department asking if anything could be done to educate his boys who lived eight miles from the nearest school (Holmberg, 1986). The principal of the Teacher's College arranged for students who volunteered, to send lessons by mail. At the end of the year the boys went to the nearest school and took the final exams. The following year the instruction continued, the youngest boy, five years old, joined the class. Holmberg goes on to state that the success of this experience resulted in the spread of the concept to other states of Australia, then to New Zealand, West Africa, and to Canada. Since those first lessons were sent out in 1914, Australia has pioneered distance education, using various technologies to deliver instruction to students at the primary, secondary, and university levels, making Australians a great source of valuable information and guidance as they share their expertise with those nations just developing distance education programs (Smith, 1984).

Available Technologies and Delivery Systems for Today's Distance Education Programs

Distance education programs today can utilize many different technologies, combinations thereof, and a variety of delivery systems. In this section, these elements will be discussed, and where possible, instructional programs using them will be described.

Print Media

The most common form of media used in distance education are the print media, utilizing textbooks, workbooks, and test packets (Eiserman & Williams, 1987). Before the development of radio and other electronic media, instruction was exclusively conducted through the mail, for adults and children alike. Although today most correspondence courses or self-study packets are usually aimed towards students in higher education (Eiserman & Williams, 1987), they are sometimes used for students at the secondary level, as in Spangle, Washington. Students at Liberty High School may sign up for an elective correspondence course in whatever subject they might be interested in, provided there is a course available in the area of interest (Batey & Cowell, 1986). This type of elective is only available to juniors and seniors and the types of courses they commonly select are wildlife management, creative writing, or sociology for which they receive credit (Batey & Cowell, 1987). The school district pays for the courses and the students must complete them within a semester. If the course is not completed, the student must pay the school district for the cost of the course. There is a teacher assigned to manage the material, guide the students and proctor tests (Batey & Cowell, 1986). Batey notes that a few special education students have successfully completed correspondence courses, but that motivated, independent learners get the most from the expanded options made available through correspondence.

In Australia, up to 1976, a proportion of isolated children were enrolled exclusively in correspondence courses due mainly to the fact, that some were located in areas so remote that they do not have access to radio, and in some instances, do not even have electricity to operate telecommunications equipment even if it were made available to them (Davidson, 1976). In a television interview, Kevin Smith, past president of the International Council on Distance Learning, stated that distance learning in Australia is still based primarily on print media delivered by mail, but telephone and radio communications are now used routinely as extensions of the print media and to connect teachers in a more personal manner to students hundreds of miles away (Elston, 1989). Davidson states that education by correspondence is only acceptable when viewed from the alternative of providing no instruction at all. He points out the major weakness of this method: the time lapse between receipt of an exercise and the eventual return of corrected lessons to the child, which breaks the continuity and relevance of the lessons. However, Kevin Smith states in the previously mentioned television interview, that in Australia today, students who graduate from distance learning programs are not distinguished from students in traditional programs because there has been no significant difference in the achievement levels of the two groups (Elston, 1989).

Although not as extreme in the United States, there is a delay inherent in any system that must rely on the mail for communication between a teacher and a student at a distant location. One of the most attractive aspects of this type of delivery, is that it is very economical.

Audio Technology

The development of the radio brought added means of delivering instruction to students at remote locations, and lessons were further enhanced as phonograph records, tapes and the telephone became more economical and widely available (Eiserman & Williams, 1987).

In Australia, according to Dr. David Lane, the radio is widely used to supplement correspondence courses at the preschool, primary, and secondary levels (Elston, 1989). The School of the Air permits the teacher to talk directly by radio to the student. Unfortunately, radio time is limited because the only broadcast frequencies available to the Schools of the Air are those used by the Royal Flying Doctor Service. Lane states that the quality of the reception is often quite poor and sometimes interference from solar activity is so great that the radio cannot be used at all. Even considering all these negative aspects of using the radio, it is still a very valuable element of the correspondence program. The primary purpose of the radio communication is to foster social and oral development of the student. Many of the children are hundreds of miles away from other children and schools and the radio is their only "live" link to the outside world, so it is a very important element in their correspondence studies which otherwise depend solely on written material sent though a very slow postal delivery system (Elston, 1989).

The Alaska State Department of Education reports widespread use of two-way radio communication for distance education in conjunction with written correspondence (Eiserman & Williams, 1987). That report further states that written correspondence is more effective when used with two-way communication than without use of the radio. In addition, the report of the Alaska State Department of Education described radio instruction as "effective" because it reaches a large audience.

The telephone has been used by this writer on several occasions during her 21 years as a classroom teacher, to provide two-way audio communication between students who are homebound or hospitalized for a long period of time. The telephone is connected to a speaker in the student's room and another in the classroom. The homebound student can hear the teacher and other students as the normal classroom activities are conducted. The homebound student can be heard by the teacher and his or her classmates. This system is very economical and efficient. Lessons and material are sent to the homebound student with classmates living nearby, or parents pick-up and deliver the materials so that the student at home keeps pace with the students at school. Another important aspect of this type of communication is that the homebound student maintains contact with his or her classmates, and therefore does not feel left out or isolated. Also, when the student is able to return to classes, the transition to a regular school routine goes much more smoothly because he or she knows what has been going on routinely during his/her absence.

Computers

Computer-aided instruction, electronic mail, computer conferencing, and other audiographic technologies are being routinely employed in instructional activities. The computer is becoming a central source of instruction both in distance education and traditional programs (Batey & Cowell, 1986). There are many variations of computer applications open to students and teachers today that have created new ways of learning and new sources of information never before available to schools. The following are only a couple of examples of how schools today are using the computer.

In Willamette Valley in Oregon, four rural high schools now are able to offer a course called "Introduction to Writing Fiction: (Batey & Cowell, 1986). A cross-district consortium was formed when they received a grant from Apple Corporation from which they received six computers, two printers, and a modem for each school. A master teacher from one school delivers instruction to students at all four schools using electronic mail to send lessons and assignments to the students. The students write their assignments offline (when the computer is not actively communicating with other schools), and then send their work back to the master teacher. The teacher comments on and corrects the work before returning it to the students. Each school is responsible for any monthly phone charges and for training the students to use the word processing and telecommunications software. The teacher receives a stipend and teaches the course during the prep period and after school. Batey states that the electronic mail system lends itself to the writing process by allowing students to "post" their work for others to read. The students receive a high school elective credit and have the option to also receive college credit.

A program in rural New York offers a course in calculus designed to meet the needs of students in six different schools (Benson & Hirschen, 1987). The schools answered the crisis of a teacher shortage by utilizing audiographic teleconferencing. Audiographic teleconferencing is a microcomputer-based system, which uses graphics tablets, or an electronic blackboard, by which chalk marks, or any writing or drawings made on a pressure sensitive board, called the graphics tablet, are sent through phone lines to computer screens or television sets at distant sites (Levinson, 1984). The formal name of the electronic blackboard is the Optel Telewriter 11-PC. The tablet is a desk-top device that can easily be moved from student to student.

As each participant writes on the tablet or types on the computer keyboard, the results are displayed on all of the screens in the network simultaneously and instantaneously (Benson & Hirschen, 1987). The teacher can also display other materials, just as one would using an overhead projector. Writing or corrections can be superimposed on existing graphs, diagrams, drawings on the tablet, or on frozen video images. Frozen video images, sometimes called slow scan or freeze frame are still pictures that are sent about one per every 30 seconds over phone lines to a distant television set or computer monitor (Levinson, 1984). The telewriter also has another useful feature. Using the microcomputer's information storage capability, pages of information can be prepared by the teacher and stored on floppy disks. Disks can easily be duplicated and distributed to the different schools so that the pages can be "called up" on the monitor screen by the teacher (Benson & Hirschen, 1987).

The advanced calculus course was offered after school, meeting 16 times for 45 minutes over a period of eight weeks. The teacher, Thomas Tucker, a math professor from nearby Colgate University in Hamilton, New York, taught the course from his home (Benson & Hirschen, 1987). Thirteen students from the six schools worked together as a whole class once a week when the professor gave a presentation. During the week the professor met for 25 minutes with each school, during which time he was able to give the students some individual attention (Batey & Cowell, 1986). During the remainder of the week, students worked on assigned problems from the text and used in instructional software program on Calculus. Assignments and exams were mailed to the professor who would return them after they were corrected and graded. It is interesting to note that according to Batey, on the midterm and final exams, the scores of the high school students were only slightly below those of the freshman class at the college where the professor taught.

Benson and Hirschen further state that this New York project is being used to help eliminate some of the isolation experienced by rural schools. Using the above described technology, students can teleconference with other classes throughout the United States and in other countries. These experiences have for example, enabled elementary students studying Mexico to speak with teachers and students in Monterrey, Mexico. Another group of students studying Alaska was able to talk about their studies with youngsters in Naotak, Alaska. The advantages to all students enjoying and learning through such unique experiences may have far reaching, positive results that go beyond the initial aims of the lessons themselves. Understanding of other people, other nations, and a realization on the part of the students, that information obtained in the classroom is real and has valuable applications, can motivate even the most reluctant student to actively participate in class activities and lessons.

Databases

Computers allow students to download information from many central locations, called databases. The information now available to schools staggers the imagination as to possible applications. For example, NASA has a database, called Spacelink, for students and educators, which provides technical information, both historical and on the latest research findings and technological advances. Through routine use of databases, students and teachers can keep abreast of the latest technical innovations and research, rather than waiting for a new textbook, the contents of which, by the time it is written and published, are obsolete. Considering the information explosion we face in today's society, the computer seems to be the only realistic means of handling the mass of information acquired daily.

Another type of database consists of computer networks which enable students and instructors to interact at their convenience with each other or with other schools, throughout the United States and even in other countries. Leasing time with these networks allows the user to store and retrieve information. An example of how this type of network can be used is found in rural Wyoming. Vocational agriculture teachers were having great difficulty finding current information, textbooks and resource people to aid in instruction in managing livestock health, developing marketing strategies, and selecting irrigation systems (Batey & Cowell, 1986). They found the answer to the problem in an online information service called AgriData Network. Besides providing daily reports on market prices, news, and trends, over 500 lesson plans developed by teachers are available, and can be downloaded and saved on diskettes. Teachers can modify the lessons to their students needs, and then students go online to gather information to complete the lessons. Batey & Cowell state that besides increased student interest and enthusiasm for Voc-Ag classes, the community has developed great interest in the system. Farmers and ranchers who are parents of the students come to the school to get current market prices, and several teachers are preparing evening courses for adults. What began in the classroom has extended into the community to the benefit of everyone.

Tele Text

Tele text or video text is another means of accessing information sources. Through these systems, pages of material can be transmitted to distant television screens. Information is sent over cable or phone channels via a distribution center which can receive user requests for particular information (Levinson, 1984). The traditional library may find that the use of such technology is the only way to provide adequate service to its users in view of the explosion of data the information age is creating.

Telecommunications

In today's society, businessmen, industrialists, government officials, and other professionals rely on telecommunications technologies to send and receive the most current data from distances that vary from across town to across continents. An information-based society must have access to updated data in order to successfully function in the fiercely competitive environment of today's workplaces. It seems only fitting that this same technology should be applied to education, to help resolve some of the critical problems facing educators in their attempt to bring the finest instruction possible to their students. The following section of this paper will describe telecommunications technologies, and where possible, provide examples of how they are being applied to schools.

Cable Transmission

Some school systems have benefitted from cable television opportunities in areas wired for cable television service. For example, in New York's Westchester County, eight schools joined together to form the Interactive Telecommunications Cable Project (Benson & Hirschen, 1987). American Cablesystems of Ossining, New York, provided a cable connection between two schools and equipped each school with monitors, cameras and microphones. Using two public access channels that were made available to the schools, lessons could be taught with two-way audio and two-way video capability. Benson and Hirschen emphatically point out the fact that this project was planned and built on existing resources through a partnership between the schools and the cable company, so no large grants were necessary. The results of the first program, 45 minute daily lessons in Latin, were so satisfactory that the schools are looking into expanding the network and increasing the course offerings. The cable company has proposed that all of the high schools be wired in a "closed loop" (Benson & Hirschen, 1987).

In Oklahoma, four rural school systems met in 1984 to find a way to share faculty members from the four systems in Beaver County, in an effort to increase the curriculum offerings at the high school level (Danley, 1989). The administrators investigated the potential of two-way talk-back television by touring schools in LaCrosse, Wisconsin. After talking to teachers and administrators involved with the interactive television system, they decided that this type of delivery system would enable the schools of Beaver County to effectively share their faculty. Upon their return to Beaver County, an engineer was employed to work jointly with GTE to develop a proposal to link the schools with coaxial cable and microwave towers. Danley states that one of the lowest points for the school administrators was when they saw the $1.5 million price tag on the proposal.

After many frustrating months of an unsuccessful search for funds for the installation of the coaxial cable and microwave towers, the group nearly admitted defeat. In the final attempt to find a solution, the Board of Directors of Panhandle Telephone Cooperative Inc. authorized the management of the cooperative to meet with the school administrators. The company offered to install 55 miles of fiber optic cable, and worked out a five year pay-out plan with the school districts. Danley points out that the total cost over a five year period was $322,000 compared to the $1.5 million price tag on the first proposal. Installation of the fiber optics began in June, 1988. On the second day of school, classes were offered over their two-way television system. Danley proudly states that after five years of patience and hard work, Beaver County, Oklahoma, had the first fully operational digital fiber optics system in a school district in the United States. Presently instruction is given in Spanish, art, and accounting, with plans to increase course offerings in the 1989-90 school year.

A moral to this school district's story might be, not to accept the first proposal as a final one. Before making commitments or scrapping an idea, various technologies and resources for help should be thoroughly investigated.

Cable Systems

Perhaps a brief description of the types of cable systems mentioned above will clarify the differences between them. Coaxial cable, sometimes called "hard cable," is a metal cable consisting of a conductor surrounded by another conductor in the form of a tube which can carry broadband television signals by guiding high-frequency electromagnetic radiation (Kitchen & Kitchen, 1988). The coverage pattern of coaxial cable is point-to-point or point-to-multi-point, with an average range of 30 miles. Kitchen & Kitchen further state that coaxial cable is fully interactive, but is limited by the number of channels on the cable, and once the system is in place there is a limited ability to expand. They describe fiber optics as one of the newest and potentially the most expensive of the two-way interactive technologies. They explain that is a cable made of glass that transmits light signals instead of electrical signals. Each glass fiber is as small as a human hair, can carry up to 24 television channels, as well as audio and data transmission. This means the system can carry far greater loads than coaxial cable and permits expansion at a later date. Kitchen & Kitchen indicate that fiber optics has a point-to-point or point-to-multi-point coverage pattern and can reach more than 20 miles.

Instructional Television Fixed Services

Instructional Television Fixed Services (ITFS) is a closed-circuit telecommunications broadcast system authorized by the Federal Communications Commission (Benson & Hirschen, 1987). ITFS permit the transmission of video and audio signals over low-powered transmission equipment. Several schools over an area of ten miles or more can be served, or distant and isolated schools can be linked into the system through a point-to-point relay system. Benson & Hirschen state that due to the system's limited range, optical line of sight is required between transmitter and receivers. They describe a program in rural New York State that has adopted this system enabling three schools to share classroom instructional services. They also report that the schools are satisfied with student achievement using this system as compared to a more traditional setting. Thus far, test scores and other data indicate no significant difference in the scores of students participating or not participating in the project (Benson & Hirschen, 1988).

Satellite Delivery

In the period of little more than three decades since the launching of Sputnik, communications satellites have become the foremost instrumentality of long distance communication on a global scale, and since the 1970s, they have become an increasingly important element in domestic communications (Codding, 1990, p. 1). Satellites provide telecommunications service in areas where terrestrial alternatives are not available due to geographical barriers, such as mountains, thus providing communication between isolated or remote areas and the rest of the world (Codding, 1990, p. 24 & p. 38). For many years now, businesses and post-secondary institutions have used satellite technology to conduct teleconferences, seminars, and classes (Kitchen & Kitchen, 1988). Communication satellites are now becoming an increasingly popular means of delivery of distance education. The greatest advantage of this delivery system is that it is not limited in range as other systems are. A satellite transmission can reach any area in the continental United States (Kitchen & Kitchen, 1988). They state further that the satellite can provide "simultaneous, reliable, and high quality, full motion viewing and clear audio listening." Talk-back capability can be provided over regular telephone lines. Kitchen & Kitchen further explain that the satellite receives microwave signals from Earth from a federally licensed uplink dish. The signals are transmitted back to Earth at a different frequency to downlink dishes which require no license, and can be owned by the general public. A few examples of interactive instructional television satellite systems that are providing instruction to high school students throughout the United States will be described in this section.

<u>Interactive Satellite Instruction</u>

TI-IN Network is privately owned, and provides a variety of educational and staff development programs via satellite to more than 200 schools in Texas and 17 other states (Barker, 1988). From the studio in San Antonio, certified teachers beam lessons into subscribing schools. The Region 20 Educational Service Center selects the teachers and develops the lesson plans. The lessons are submitted to the Texas Education Agency for approval and accreditation (Batey & Cowell, 1986). The fees paid to the TI-IN Network by subscribing schools cover the costs of installing and maintaining equipment. TI-IN supplies the school with a dish to receive the satellite signal, a television monitor for the students to see the teacher and view graphics, and a telephone connection for instantaneous feedback to the teacher. They have videotaping capability, so if a student misses a class, he or she will not miss the lesson. TI-IN offers courses for students across the K-12 curriculum. On the high school level, subjects include French, Spanish, German, Latin, computer science, business management, business law, algebra, trigonometry, honors English, honors calculus, and psychology (Barker, 1984). A variety of professional and support staff development programs are offered to meet inservice training requirements, and during the 1986 fall semester, the Texas College and University Coordinating Board approved the first college credit courses to be offered by TI-IN (Barker, 1984). TI-IN's programs are received by over 200 schools in Texas and 17 other states (Barker, 1988). This writer has noted that in none of Barker's papers or articles used in the preparation of this paper, does he mention that the satellite dishes TI-IN provides and maintains for subscribing schools are fixed, not steerable dishes. Consequently, it is not possible for subscribing schools to receive signals from sources other than those transmitted by TI-IN.

Oklahoma State University's (OSU) Arts and Sciences Teleconferencing Service (ASTS) began delivering a high school German course for credit in 1985 (Batey & Cowell, 1986). Each week students participate in two or three live, interactive, one-way video and two-way audio programs, which are broadcast from OSU's studios. During the remaining days of the week, students work with instructional software capable of speech generation and recognition, which allows students to hear correct German pronunciation, practice pronouncing themselves, and be checked for accuracy in pronunciation. Materials available to the students include a textbook and a lab manual. The program was highly successful, growing from ten subscribing schools to over 100 by the second year (Batey & Cowell, 1986). Physics was offered during this same year, and was considered to be equally successful. In the 1989-1990 school year, OSU offered German I & II, Russian, advanced placement (AP) physics, AP chemistry, AP calculus, trigonometry, analytic geometry, applied economics, AP American Government, and basic English and reading (ASTS, 1989).

In the fall of 1986, Eastern Washington University and Education Service District #101 in Spokane, Washington established the Satellite Telecommunications Educational Programming Networking (STEP) (Barker, 1988). This network began by broadcasting four high school courses to 15 schools in Washington. At the end of the 1987-88 school year, the network had schools in Idaho and Oregon subscribing to their courses. Barker points out that the course offerings have increased to include Spanish, Japanese, advanced senior English, pre-calculus, introductory sociology, and introductory psychology. Inservice for teachers and administrators is also offered.

From Connecticut, programming chiefly in the sciences, is broadcast on what is called the SciStar Satellite (Barker, 1988).

The broadcasts originate from the Talcott Mountain Science Center and are received by nearly 100 sites in 25 states. Student programming includes science news, reading proficiency, high school computer science, amateur radio, and physical science. Teacher inservice has covered topics such as brain hemisphericity, chronobilogy, gifted education, and creative teaching strategies (Barker, 1988). Barker points out that the most popular SciStar program has been the "Shoulders of Giants" series, which features a different world leader in science during each of ten, one-half hour sessions. Through the interactive capabilities of the system students are able to ask questions and make comments to the featured speakers during the broadcast.

Statewide Distance Education Networks

Several states are developing and operating their own educational networks, often utilizing cable or microwave. Cable, both coaxial and fiber optics, was described in a previous section. It may help the reader if at this point, microwave is explained.

Microwave involves high-frequency radio waves used for transmitting audio, video, or data though the air (Kitchen & Kitchen, 1988). A microwave system is directional, going from point-to-point for up to 30 miles, depending on topography. An advantage of microwave technology is that there is control over who receives the signal. Classes taught over a cable system can be viewed by any subscriber on the system. Kitchen & Kitchen point out that a big disadvantage of microwave is that it is limited in channel availability. Adding a single channel can nearly double the cost of the system.

Minnesota has organized a statewide education network that provides two-way interactive television instruction to rural classrooms in 50 school districts (Batey & Cowell, 1986). Each district has a TV classroom equipped with video cameras and monitors so that it can send and receive video images between the other participating districts (Batey & Cowell, 1986). Also, any TV classroom can be the source or a remote classroom.

Alaska with its great distances and remote settlements, established in 1981, the Learn Alaska Instructional Network. Through satellite transmission courses and instructional support are provided to K-12 and postsecondary students. The network also provides administrative teleconferencing, and staff development for educators (Batey & Cowell, 1987).

In Kentucky, plans were approved in 1986 for a multi-million dollar statewide network that includes 1650 downlink dishes. Since then, dishes have been installed at each elementary and secondary school, as well as at vocational schools, libraries, community colleges, and universities (Barker, 1988). The primary daytime thrust is to levels K-12. Staff development, college credit courses, and adult education are offered during the evening hours (Barker, 1988).

Effectiveness of Video Delivered Distance Education

The major rationale for distance education is to address the issue of equity (Williams, 1987). The increased use of technology provides class offerings to students that previously would not have been available. While this issue of equity has been amply addressed in the literature, there is a paucity of information on the effectiveness of distance learning at the K-12 level. However, the available information is generally favorable. The Office of Technology Assessment (OTA) found, on one survey of both K-12 and adult distance education literature, that students seem to learn as well in distance education programs as they do in regular programs. OTA also cites findings from Iowa's two-way interactive television (TWIT) project that no significant differences between televised classes and other sections of the same class taught face-to-face by the same teachers could be found. In another survey, OTA reports that between the years 1983 to 1986 the wide range of elective programming in rural Minnesota showed no statistically significant differences in achievement by distant learning students compared with students in a traditional class.

In summary, according to conclusions on a report from the Office of Technological Assessment on distance education for the U.S. Congress, distance learning, of which video based delivery is the primary medium, is as effective as face-to-face classroom instruction providing that teachers adjust their teaching styles and that interactivity is a basic element of the design.

In most instances, distance learning appears to be as effective as face-to-face instruction in the classroom. Since distance learning has been used primarily with adult learners in industry and military training, higher and continuing education most research has evaluated effectiveness in these settings. It is high. While the evidence is incomplete in K-12 education, preliminary results are encouraging. To be effective on these systems, teachers report that they must change their style and create new opportunities for interaction. Students report that they must work harder in courses offered at a distance, but they welcome the increased course options, responsibility for their own learning, and the opportunity to expand their community. Whether distance learning works well with with all students is yet to be determined (U.S. Congress, 1989, p. 1).

Summary

Distance education has become established as a means of addressing issues of inequities in rural schools or economically disadvantaged school districts. The variety of technologies available enable educators to implement wide offerings of courses and enrichment programs designed to meet the needs of specific groups of students. Research has indicated that distance education may be as effective in accomplishing academic objectives as instruction in a traditional classroom. It is always far better than no learning opportunities at all. Technologies also provide students access to information, people, places, and events that otherwise are unavailable in the traditional formats such as the textbook.

CHAPTER III

DESIGN AND IMPLEMENTATION OF THE ELECTRONIC FIELD TRIP

Introduction

The primary purpose of this project was to create distance learning programming that would strengthen and enhance existing curriculum by bringing people, places, and events, otherwise not available, into K-12 classrooms throughout the nation, at no cost to the schools. The decision to create video based programming is best explained through the observations of Margaret Taylor who characterized the value of video programming.

> Video has immediacy and relevance. It is timely, up-to-date and can be designed for a group or individual instruction. Video can take to students what you cannot take them to see. It enables everyone to see properly, magnifying small items so details may be observed. It focuses attention when there is a mass of information to be discriminated. It permits the sharing of experiences and lessons not limited to those who were there at the time (Taylor, 1988, p. 14).

Fairfax County Public Schools

In order to understand how the electronic field trip (EFT) evolved, it is necessary to have some background information on Fairfax County Public Schools (FCPS), the organization that provided this writer the opportunity to work on this project.

Fairfax County Public Schools, the tenth largest school system in the nation (over 136,000 students), is located in the Washington, D. C. metropolitan area in northern Virginia. The County has a population of over 850,000 persons and covers a 400-square-mile area. Forty-nine percent of all county residents over 25 years of age have completed four years of college (Fairfax County Public Schools, 1992). There is strong community interest in and support of the school program. The school system also has access to the many resources available in the Washington metropolitan area, which include government agencies, major military installations, embassies, museums, theaters, universities, science centers, and offices of major national and multinational corporations, as well as an international community, all of which provide rich learning experiences that support classroom lessons.

Prior to 1975, FCPS had film production capability, but in 1975 switched to video. In 1985, FCPS was made the beneficiary of fierce competition among cable companies vying to get the contract for Fairfax County's first cable franchise. The Director of Media Services in FCPS at the time, Ted Gates and a media specialist, Howard Simms, demonstrated wisdom and vision as they worked with representatives of the cable companies to obtain cable access for the school system (Woolsey, 1993). According to Woolsey, Gates and Simms stipulated that six cable channels be made available to the schools, that a full production studio be created, and that annual support for engineering and maintenance be a part of the bid for the franchise. Media General accepted FCPS's terms, came in with the lowest bid, and therefore was awarded the franchise.

Of FCPS's six channels, four are closed and offer daily programming to the district's 209 schools and centers, while the two remaining channels are open and provide information and instructional programming to the community. The staff at Chapel Square Media Center (CS), working with state-of-the-art production facilities, provides programs to support training, communication, and instruction. In addition to the cable channels, Chapel Square has access to statewide microwave and national and international satellite uplinks (Woolsey, 1993).

In 1985, Dr. Robert R. Spillane was appointed superintendent of Fairfax County Public Schools. A dedicated educator and visionary, he proceeded to chart a new course for FCPS that would professionalize teaching. He initiated a controversial merit pay program for teachers, also called Pay for Performance, designed to award excellent teachers and dismiss ineffective ones. If this program were to succeed, Dr. Spillane realized that he had to dispel the widespread misinformation and fear of the plan. Communicating with the teaching staff through the print media or the press did not prove to be effective in spreading his message. On the other hand, his face to face meetings with teachers were very effective, but to conduct such meetings with 9,000 teachers was impossible. At the suggestion of a staff member, Dr. Spillane turned to FCPS's cable system and studio, and held interactive teleconferences that proved to be highly effective in defusing the tension in the district. Dr. Spillane experienced personally how powerful video communications can be, and became an ardent supporter of the work of the telecommunications staff in the studios at Chapel Square Media Center (Woolsey, 1993). Telecommunications in FCPS was now in an enviable position. The district had a professional production studio, six cable channels, and the support of the superintendent, who was willing to create positions for additional personnel to produce and deliver high quality educational programming.

In August 1989, this writer joined the Chapel Square staff in the position of coordinator of program development (CPD) and began to work on the production of the Satellite Education Resources Consortium (SERC) sixteen "Science, Technology, and Society" seminars. In addition to organizing the production of the science seminars for SERC, plans for the first electronic field trip began to take shape almost immediately.

"Physics: From the Classroom to Outerspace"

The decision to produce the first electronic field trip brought many challenges to this writer and the production staff at Chapel Square. There were no models to follow. Some guidelines could be take from publications authored by people who were experienced in business teleconferencing or delivery of courses or training at the university level. At the K-12 level, the limited literature on distance learning was centered on the production of courses involving daily instruction. New territory had to be charted in the development of the electronic field trip.

During the first three months at Chapel Square, this writer made presentations at a number of meetings with teachers and administrators, at which time she questioned them about their views on what was needed to support instruction at their schools. Topping the list was a need for programming that would motivate students to study science and math beyond the minimal requirements for graduation. This was especially critical for girls and minorities, who are greatly under-represented in these areas at the upper levels. At the elementary level, science programs are in the hands of teachers who often feel uncomfortable and ill-prepared to teach science. They wanted activities that they could handle that would also be interesting for the students. They all wanted material that would show relationships between disciplines. They also felt that information on careers and how school studies relate to them would be highly motivational for the students.

After a number of these meetings, the CPD felt she had identified the general area on which to focus the first electronic fieldtrip. Based on her own experiences with students while working on a two-year project with the National Aeronautics and Space Administration (NASA), she decided to use space exploration as the vehicle to deliver to students some of the messages the teachers and administrators had given her. During her tenure with NASA, she had observed that all students are fascinated by manned space flight, which is a topic that although obviously based on science and technology, crosses all disciplines. The staff at Chapel Square was enthusiastic about the topic and worked to develop the concept and format that began in November 1989.

The CPD decided to pursue the possibility of featuring NASA Langley Research Center (LaRC), where she had been assigned to work for varying periods of time during her two years with NASA. Ongoing projects at LaRC cover aeronautics and space exploration. The center has many unique facilities, including over 40 wind tunnels. The research and development projects at LaRC include creating designs for Space Station Freedom, engines for the new aerospace plane, satellites, and much more. In addition to the fascinating projects at LaRC, the location of the center in Hampton, Virginia, a short three-hour drive from Fairfax, was very convenient.

The CPD proceeded to submit an outline of a proposal for the project to Mr. Gary Price, Director of External Affairs at LaRC. Dr. Robert Brown, Director of Educational Affairs at NASA Headquarters in Washington, D.C., also received a copy. In subsequent meetings, approval was given to the proposal to focus the EFT on the work being conducted on Space Station Freedom at LaRC, and also feature selected aerospace engineers.

Mr. Price assigned Ms. Shelley Canright, education specialist at LaRC, to work with the CPD. Mr. Price reserved the right to approve the script before taping began.

Identifying the Components of the Electronic Field Trip

Having obtained the cooperation of LaRC, the CPD began collaboration with Shelley Canright on the selection of engineers to be featured in the project. As the process advanced, the CPD was so impressed with the aerospace engineers and their work that she felt that much information would be lost if the EFT were limited to a thirty-minute or even a one-hour pretaped program. Also, the objectives set forth by the teachers and administrators in the preliminary meetings were too broad to be covered in a single event, yet each objective was significant in the impact it would have on students. Another concern to the CPD, was the commitment to avoid allowing students to become passive observers of just another educational television program, which would promptly be forgotten as soon as it went off the air. The format of the EFT had to be designed to assure maximum student involvement and be very "teacher friendly."

Basic Components of the Electronic Field Trip

The format of the EFT then began to take shape and, rather than a single videotaped event, it evolved into a combination of four components. The first component was the print support materials. As Zigerell (1991, p. 65) points out, ". . . video is the highlight of the process (distance learning), but printed materials comprise an essential element that lead students to read, contemplate, and follow directions." The materials would contain suggested student activities, subjects for student research projects, and lists of available resources. It would also provide teachers with technical information as to how to access the televised programs and give them advance notice of the content of the program. To reduce the cost of producing the print materials, and to facilitate the duplication and sharing of the materials at the schools, the support material would be designed in a simple black and white format. Graphic artists at CS would create artwork and overall designs that would enhance the appeal of the material.

The second component would take advantage of video's power to convey even complex information quickly through the combination of visual images, graphics, and sound. A pretaped, thirty-minute video would provide students with an overview, or background information on the subject of the EFT. This pretaped program was called the orientation program. When viewed in combination with the activities in the print material, students would become knowledgeable about the topic on which the EFT would focus. Their interest in the subject area would be strengthened and their self-confidence would increase, allowing them to feel comfortable as active participants in the third component of the EFT.

The third component of the EFT would be a live interactive teleconference. This type of program is referred to by Kelleher and Cross as *ad hoc* teleconferencing, which they define as ". . . a special, one-time event that an organization chooses to broadcast"

(Kelleher and Cross, 1985, p. 216). Although it would be one of the four components of the EFT, the teleconference could stand alone, independent of the other components. However, the intended impact of the EFT would be based on the interrelationship of all four components. The teleconference would feature experts who would make presentations, do experiments or demonstrations, and interact with students and teachers who could call in questions and comments via an 800 number.

The fourth component would be the computer bulletin board, which students and teachers could access via an 800 number for two weeks after the live event. The staff at CS would forward questions to the presenters, and then post the answers on the computer bulletin as soon as the presenters responded. This element of the EFT was considered essential to the ultimate success of the interactive teleconference, which would be offered nationally, because it would often be difficult, if not impossible to get through to the presenter during the program due to the volume of incoming calls. Also, as students processed the information and concepts from the program, they might think of questions or want advice from the presenters after the program went off the air. The electronic bulletin board also would enable students who watch the teleconference on a delayed basis (taped), due to scheduling problems, or the time differences across the country, to still have the opportunity to communicate with the presenters.

Development of the Components

Because the components were closely interrelated, the project had to be developed first as a whole, then as individual parts of the whole. The first task was to define what was to be accomplished in each component of the EFT and then identify projects and personnel at LaRC who would be featured in the programs.

Looking over the notes of initial meetings with teachers and administrators regarding what they wanted in supplemental programming, the following points emerged indicating that the programming should:

1. Excite and motivate students to pursue their science and math studies beyond minimal requirements;
2. Dispel the "nerd" image of individuals interested in the academics, especially those in math and science related professions;
3. Have minority and women role models;
4. Relate classroom activities to real world situations;
5. Be interdisciplinary;
6. Inform students about career opportunities.

It was decided to create a program that would have something for students in upper elementary grades through high school. Since this was the first EFT, it was felt that it should be made as inclusive as possible.

The CPD made a visit to LaRC to meet some of the staff assigned to Space Station Freedom, to look over facilities, and to get a briefing on other projects underway at that center. This visit helped the CPD to identify the content for each of the components of the EFT. Upon her return to CS, she outlined scripts for the orientation program and the teleconference, which were submitted to Gary Price at LaRC and subsequently approved.

The Orientation Program

The pretaped orientation program would provide a tour of LaRC's unique facilities and give a broad stroke overview of the variety of projects in progress at the center. After the tour, Space Station Freedom would become the primary focus of the program with an emphasis placed on the aerospace engineers assigned to develop this ambitious endeavor. The engineers would discuss their work, how they prepared for a career in the aerospace industry, and how they as individuals, view the value of their efforts. The engineers chosen to be interviewed would represent various areas of the Space Station project, but also would be selected with an eye to providing minorities and women as role models. Fortunately, there was no scarcity of young dynamic individuals who fulfilled most of the criteria that had been identified. They all were well-spoken, thoughtful, and personable.

The Live Interactive Teleconference

The orientation program would show the exciting work being done at LaRC, and reveal that aerospace engineers are real people, who enjoy their work and their lives outside the workplace. The teleconference would be a complete change of pace. Lance Bush, an energetic and creative aerospace engineer with experience at mentoring at-risk boys, agreed to be featured on the program. Shelley Canright, the education specialist assigned to assist the CPD, volunteered to work with Bush to organize his demonstrations for a video format and to assist him on-camera. Bush wanted to create fun activities around the principles of physics that are basic to the design and construction of spacecraft, such as the second generation shuttle, which he was working on at the time.

Print Materials

As soon as the outline for the script was approved, the CPD contacted science, math, and social studies curriculum supervisors for guidance in the development of the print materials. The math and science teachers recommended several NASA-produced materials that they felt were appropriate to the overall theme of the EFT. A social studies teacher and a science teacher developed the student activities. The Teacher Resource Center at LaRC provided the CPD with materials that were interdisciplinary and rated by grade level from elementary through high school. The final product was a packet of material that used the topic of space to teach lessons in social studies, math, science, art, poetry, and physical education.

Funding

Initially, the EFT was anticipated to be a single videotaped program, with print material to support it. It had now evolved to two video programs, one pretaped and the other live and interactive. Both required satellite time and uplink service. An 800 number was needed for the interactivity during the live teleconference and for the computer bulletin board. The teachers who worked on the print material were to be paid the usual curriculum development stipend. A brochure was to be designed, printed, and mailed to school systems known to have satellite dishes. Postage and other mailing costs of the print material and the brochure were not insignificant. There was some money available in the CS funds, but not enough to cover the entire cost. The CPD contacted the Virginia Department of Education (DOE) in Richmond and presented the project to Ida Hill, Director of the Virginia Satellite Education Network (VSEN). Through VSEN, additional funding was made available, as well as satellite time and use of DOE's 800 number for both the teleconference and the computer bulletin board. There was still a shortfall of $4,500. In February, the CPD approached Dr. Robert Brown, Director of Educational Affairs at NASA headquarters, but was told there were no funds available. Before leaving, the CPD met with Ann Bradley, Director of Personnel at NASA headquarters. Ms. Bradley had been one of the principal NASA administrators assigned to the Teacher in Space Project, and was acquainted with the CPD through that project. When she learned that part I of the EFT was a video that covered careers in NASA, she became very enthusiastic, stating that NASA was very short on good video that presents careers with that agency in a positive light. The lure of more money in the private sector for young engineers and scientists makes it difficult for NASA to be competitive with private industry in recruiting young professionals. Ms. Bradley made $4,500 available to the project from funds from personnel recruitment.

Brochures and Publicity

A brochures was designed and mailed in April to school systems known to have satellite dishes (See Appendix A). To reach districts that were not in CS's database, professional organizations such as the National Association of Secondary School Principals (NASSP), the National Association of Elementary School Principals (NAESP), and the National School Boards Association (NSBA) were provided with information on the upcoming EFT. These organizations put announcements in newsletters that were sent on a regular basis to their memberships. In addition, the FCPS Department of Communications issued a press release that was picked-up by the local press. In order to receive the satellite information, schools or individuals would have to register. The print materials, which would be sent out upon receipt of the registration, contained the technical information. This would facilitate keeping accurate records on viewership.

Print Material

The print material was mailed out to schools in mid-April (See Appendix B). To save on costs, only one copy was sent to each school district.

The recipients were urged to make as many copies as they needed for their school or district.

Registrations

Registrations began coming in immediately by mail, by phone, and by fax. The staff sent out print material as they received the requests. Unfortunately, due to the small staff, accuracy of records varied, depending upon who handled the request. This became apparent to the CPD when she made a call get an accurate address for a site that had phoned-in to register. This had been counted as one receiving site, when in reality it was a television service that served 21 school districts in Michigan. The State of Kentucky, which had equipped every school in the state with satellite dishes, was recorded as one receive site. Our best estimate was that 804 registrations were received, representing nearly 2,000 school districts throughout the United States.

Part I - "A Vision of the Future"

The pretaped orientation first took the students on a tour of LaRC. They saw wind tunnels, the Landing Dynamics Facility, where landing gear for aircraft and spacecraft are tested, and the Crash Test Facility, where planes are hoisted high into the air and allowed to crash. This research helped make aircraft safer for passengers on commercial airliners.

The CPD, the on-camera host, then introduced Leonard DeRyder, Jr., Chief Engineer of the Space Station Freedom Project. DeRyder gave a brief overview of the project and promptly turned the program over to two young aerospace engineers, Pat Troutman and Washito Sasamoto, who is of Japanese descent. They gave students a quick peek at their roles in this fascinating project, then the cameras moved on to meet Judith Watson, another aerospace engineer whose work focuses on large space structures. She explained to students that her challenge is to design the outer structure (the keel) of the space station. The products of her efforts had already flown in space, where astronauts practiced constructing a fifty-foot tower outside the bay of the space shuttle. Students then met Melvin Ferrebee, Jr., a young aerospace engineer of African-American descent. Ferrebee's assignment was to help design the second generation space station that will probably not fly until the year 2050. The program ended with a philosophical discussion with Lance Bush, and two of the other engineers. They gave students a lot to consider as they discussed their work and their outlooks on life.

Part II - "Spaced-Out Physics"

Students knew this would be a different kind of physics class when Lance Bush arrived in the studio on a skateboard, propelled by a fire extinguisher. During this program, Bush introduced Newton's three laws of motion, and Bernoulli Principles. He involved students in the studio audience in demonstrations of each law and used spray paint on a wall for diagrams and formulas. He connected these laws of physics to the launch, flight, and reentry of the space shuttle.

Before the program aired, the students in the studio were asked to think of questions to ask in case we did not get any from the viewing audience. However, when Bush asked for phone calls, the boards were flooded. Even the younger students had interesting questions, such as, "How can you determine how much gravity is on another planet?"

Computer Bulletin Board Response

The aerospace engineers at LaRC accessed the bulletin board daily and answered students' questions directly from the center. On an average they answered 15 to 20 questions a day.

Evaluation

A simple evaluation form was included in the print material (See Appendix B, page 105). At the end of the teleconference, teachers were asked to send them in, with an explanation of the importance of receiving them in terms of how future programs would be designed and supported. Much to the dismay of the staff at CS, only 15 evaluations were received. Some came with lengthy notes and letters, others were incomplete. A follow-up request was made later, to which only 18 responses were received. The following is a basic summary of the 33 evaluations received:

Part I - Vision of the Future

1. What was your opinion of the overall quality of the program?

   Excellent: 21 Good: 7 Average: 1 Fair: 0 Poor: 1

   No response: 3

2. What is your opinion of the content?

Very interesting: 16 Interesting: 14 Uninteresting:

No response: 3

Part II - Spaced-Out Physics

1. What is your opinion of the overall quality of the program?

Excellent: 19 Good: 7 Average: 3 Fair: 2 Poor: 1

No response: 1

2. What is you opinion of the content?

Very interesting: 15 Interesting: 12 Uninteresting: 4

No response: 2

3. The support material was:

Excellent: 25 Good: 5 Average: 1 Fair: 0 Poor: 1

No response: 1

Although developers were disappointed with the number of evaluations received, the teacher's comments on them were generally favorable (See Appendix C). Additional useful information came back through contacts with the professional organizations and interviews conducted by phone with some of the registered sites that confirmed the project was a successful undertaking. LaRC officials were very pleased with it, and requested that copies of the EFT be sent to the Teacher Resource Centers at each of the NASA Centers. The 25 telephone interviews produced some insight as to why some site coordinators did not return the evaluations. Many of the sites had to tape both video programs for viewing at a later date due to difficulties with schedules. Those the CPD spoke to indicated that they did not return the form because they had not participated live.

There were other reasons given for not sending in the forms, but that was the most frequently stated one. Unfortunately, in June when these calls were made, many of the teachers who had participated had already left for summer vacation, so this limited access to accurate information.

Among lessons learned on this first EFT, was that the target audience had to be narrowed and clearly identified. The print material had to streamlined to eliminate overruns on printing and postage. The system for answering and holding calls during teleconferences had to be improved so that viewers could not talk over each other. And last, but certainly not least, a system had to be designed that would promote the return of evaluations.

With almost no time to consider the previous experience, CS was involved in the development and production of an EFT with an elementary school in Swansea, Wales.

"Hands and Hearts Across the Waters"

In November, 1989, Dr. Terry Woolsey, Coordinator of Communications (COC) at CS, received a phone call from police officer, Bill Silva, from Suffolk County, Long Island, New York. Silva had just returned from Swansea, Wales, where he had traveled on an police exchange trip to Britain. While in Swansea, Silva, accompanied by Sergeant Peter Hall, visited Gendros Primary School. The Welsh police and headteacher of Gendros, Randall Killa had initiated a plan to establish a unique exchange between Gendros and an American School involving telecommunications. Silva had heard that FCPS had production facilities, and from the phone number from directory service, he managed to contact Woolsey. After a brief meeting with the CPD and production staff, the decision to "take on" the project was made.

The fifth grade class at Timberlane Elementary School in Fairfax County was selected to begin a cultural exchange program with the students from Gendros in January 1990, which would culminate with an international teleconference June 8, 1990.

Funding of the Project

The CS staff felt that this unique cultural exchange should be shared throughout the district, and perhaps, even the country, and began making plans to mold the project into the EFT model that CS had piloted with "Physics: From the Classroom to Outerspace." This proposal was approved by both the Welsh and FCPS administrators and the funding agreement was quickly worked-out. The print material and the studio production services for American students would be the responsibility of CS. Chapel Square would also provide conversion of videotapes from PAL to NTSC. Fairfax Public Schools would provide national satellite time. HTV Production Services, Cardiff, Wales, would provide studio production for the Welsh students. British Telecom International would provide uplinking and downloading services in both countries, as well as provide standards conversion for the Welsh students.

Description of the Project

Beginning January 1990, fifth grade students from Timberlane Elementary School and students from Gendros Primary School began a cultural exchange program. The students studied their own culture and regularly exchanged this information with their international counterparts. The information would be recorded in written reports, drawings, map work, photographs, and audio and video tapes. The students gathered this information by interviewing local officials and representatives from state and national government. They also studied the history of their respective areas and gathered information on local points of interest and recreational activities. Students also exchanged photographs and written correspondence to gather information from a more personal perspective. The purpose of the project was to:

1. To provide students an opportunity to analyze and exchange primary source materials with students from another culture;
2. To develop a variety of primary source materials for use in the elementary social studies program;
3. To provide an opportunity for upper elementary students to develop friendships with children from another culture;
4. To provide an opportunity for upper elementary students to study their own county, state, and national governments and compare and contrast their organization and operation with those of another democracy.

The COD and COC worked closely with the staff at Timberlane School as they began working with their students to record information that would be sent to Wales. None of them had experience with a camcorder and they were very nervous about learning. During the weeks that followed, the teachers gained confidence as their expertise with the camera increased as they videotaped the students as they visited government offices in Richmond and in Washington, D.C. They recorded their recreation, family life, school activities, historic sites, shopping centers, and more.

The Welsh did the same on their side. The Gendros children were even received by Margaret Thatcher who spoke to them at length, and even stated her admiration for the American "can do" attitude towards life.

As the activities went on, students became engrossed in their school work. Connections were being made between classwork and what they were observing on their field trips to gather information. Another positive spin-off, was the increase of self-esteem of the very multinational group of Timberlane students. Among the 55 fifth graders, 16 different languages were spoken in the home. There were children in the class from virtually every corner of the Earth. Some had come to this country as refugees, fleeing for their lives. As the project progressed, these children began to learn more about each other, and according to the teachers and the principal, a deeper respect and appreciation for one another towards classmates who were "different" brought down the barriers between students and their classmates who were perceived as "different."

Print Material

Selected teachers from Timberlane School developed print material (see Appendix D), that would enable teachers in other schools to involve their students in activities that would parallel the activities in the cultural exchange. The activities would also maximize student appreciation and understanding of the content of the orientation program and the international teleconference.

Orientation Program

The orientation was developed on the material received from the Welsh students. This afforded an opportunity for students from other schools in FCPS, and other locations in the United States and Wales, to benefit from the information gathered during the exchange. The COC and COD developed a script for a one-hour, pretaped program that was organized in three parts: family and daily life, cultural differences and commonalities, and government. The video footage shot by Gendros Primary School and Timberlane Elementary School was to be incorporated into the program. The COC and the COD co-hosted the program and interacted with Timberlane students on the set. The orientation program was broadcast nationally at 1 p.m. on May 25, 1990.

The Live International Teleconference

The one-hour teleconference took place at 11:30 a.m., June 8,

1990. Moderators in each studio controlled the pace of the program and "handed" the program, as necessary, to his or her counterpart on the other side of the Atlantic. The COC and COD co-hosted from the Fairfax studio and a professional moderator was present in the Welsh studio. The bulk of the program consisted of question and answer sessions between the two groups of students. The program was divided into the three topics that were covered in the orientation program. Interspersed in the question and answer sessions were prerecorded presentations by the students. The Welsh students performed a brief play that focused on the development and evolution of the Welsh language. The student choir also performed. The American students did two brief presentations. Video excerpts of the Welsh students' visit to Downing Street was also incorporated into the program. Prime Minister Thatcher discussed the cultural ties between the United States and Great Britain and responded to questions from the students. Mrs. Thatcher also made specific reference to Gendros Primary School and Timberlane Elementary School.

Registrations

There were two factors that would affect the participation of schools throughout the country in this project. First, very few elementary schools were equipped with satellite dishes and second, the school year ended by the end of May for many districts. Registrations came in from nine television services and media centers in different states. They intended to tape the program for teachers to use in the following year. A request was made that teachers send in evaluations regardless of when the programs were used in the classroom. Although an evaluation was included in the print materials (See Appendix D) none were returned.

However, from within FCPS, it seemed as though teachers from all 130 elementary schools in the county were calling CS to find out how they could do a similar project. The EFT was very successful locally and the teachers asked that CS provide more programming for elementary students.

Summary

When the CPD began to organize the first EFT, it was envisioned as a single videotaped program with accompanying print material. This concept of the format was changed first, to accommodate the observations of teachers and administrators in regard to what they felt was needed in supplementary programming that would enrich and strengthen existing curriculum. The second reason was that a single video event could not adequately communicate the scope of the projects at LaRC and at the same time, properly present the different aerospace engineers to the students as well-rounded people, who do not fit into the "nerd" image. A pretaped program could provide information, but would not permit students to become actively involved with dynamic and creative people working on fascinating projects. After some consideration and discussion with the staff, the EFT evolved to four components: print material, a pretaped orientation program, a live interactive teleconference, and post teleconference mentoring via computer bulletin board. During the live program, students could call in on an 800 number to ask questions or make comments. They could also use an 800 number to post questions on the computer bulletin board. Funding that CS was unable to provide for the project was obtained through VSEN and Office of Personnel, NASA at Headquarters.

The number of returned evaluations, 33 in total, was very disappointing, but the response was generally very positive. Most of the criticism was that older students did not respond as favorably to the live program as they did to the orientation program. This made the CPD realize that future programs had to identify and target a narrower audience in terms of grade levels.

The second EFT came about due to an unexpected opportunity that resulted in a cultural exchange between elementary students in Wales and students from an elementary school in FCPS. The exchange culminated in an international EFT. British Telecom provided the international satellite time, HTV Studios provided production service to the Welsh, and CS provided production service and national satellite time on the American side.

Because of the dates for satellite time provided by British Telecom, many schools throughout the United States were already closed for the summer. In addition, elementary schools generally do not have satellite dishes. Due to these two facts, a limited live viewership was anticipated. In FCPS, teachers were very pleased with the project and requested more elementary programming. A number of television services took taped the programs for use in schools throughout the country during the following school year.

Professional associations such as NSBA, NAESP and NASSP supported the concept of both of the EFTs and publicized them to their membership.

CHAPTER IV

THE EVOLUTION OF THE ELECTRONIC FIELD TRIP

In May of 1990, the staff at CS successfully inaugurated the first EFTs. The experience gained from "Physics: From the Classroom to Outerspace" and the international EFT, "Hands and Hearts Across the Water," gave the production team and the CPD valuable insight as to how improve procedures and techniques in the preparation and production of future EFTs. But, as these lessons were being considered, the financial situation in the state and the county were drastically changing, and this was to present even greater challenges to the CPD and the staff.

Funding of the Electronic Field Trips

Fairfax County Public Schools is located in one of the wealthiest areas in the United States. The school system had always had generous support from the community, but 1990 was the beginning of a new fiscal era. In the spring of 1990, Virginia Governor Douglas Wilder announced that the state would experience a 1.5 billion dollar deficit requiring reductions in spending throughout the Commonwealth. This translated into very significant reductions in state aid to education. Fairfax County Public Schools faced cuts in the amount of 60 million dollars for the 1990-91 school year. Word soon came from the County Board of Supervisors and then through the School Board that additional cuts in spending had to take place due to the lack of anticipated revenues from a declining local and national economy. These additional reductions were to take place through a divisionwide 10% adjustment in the approved FY 1991 budget. It was projected that reduced spending would continue over a period of several years in view of an unfavorable outlook and available revenues. By the end of FY 1990, the state publicized a more dismal deficit projected at nearly 2 billion dollars.

In response, the School Board called for a 10% reduction in spending and the Division Superintendent directed all departments and schools to determine where they could cut back on spending in order to come up with the necessary savings to accommodate the anticipated shortfall (Appendix F).

The Office of Media Services at Chapel Square was no exception to the cuts. Telecommunications lost personnel and funding. The staff was determined not to lose the momentum gained in the spring with the first two EFTs, and immediately began to seek means to fund the four EFTs planned for the 1990-91 school year. To facilitate fund raising, each EFT was treated as an individual project rather than part of a package. Funding was then sought from different sources for the individual EFTs.

Virginia Satellite Educational Network (VSEN) of the Virginia Department of Education, over the past three years, has provided the strongest support for the EFTs and other programs produced at CS. But, without funding from other sources, it would have been impossible to create the 16 EFTs which CS has produced in the three and one-half years since the first one was broadcast in the spring of 1990. Most often, all funding does not come from one source, but rather from several. For example, "Berlin: Yesterday, Today, Tomorrow" was one of the most ambitious and expensive EFTs undertaken. It involved producing a live, two-way video, two-way audio interactive teleconference, which required transponders on five satellites, four international, to simultaneously carry signals to and from the studio in Virginia, and the other in Berlin, and one domestic for the national broadcast. It was also necessary to find a full production studio in Germany that could work with the engineers at CS to make technical arrangements for the broadcast and produce the German side of the teleconference. In order to organize the project, meet and select German guests for the live teleconference, tape areas around the dismantled Berlin Wall, and select archival footage for both the orientation and the live interactive teleconference, it was necessary for the CPD and staff to travel twice to Berlin.

The first step taken by the CPD and other staff members, was to hold a meeting with representatives of RIAS-TV, a Berlin based television station that has an office in Washington, D. C. Although somewhat doubtful, Rudiger Lentz, the chief editor of RIAS-TV, promised support for the project. The next step required going to Berlin to obtain the cooperation of organizations and individuals who would take part in the teleconference on the Berlin side. Lufthansa Airlines provided airline tickets for CS personnel to go to Berlin on two different occasions to make the necessary arrangements.

Other costs of the production were covered by contributions from the Goethe Institute, the National Textbook Company, and VSEN. **CNN Newsroom** offered the use of one of **CNN**'s transponders, (provided that no important news story broke-out) and they also offered one of their news anchors, Cassandra Henderson, to co-host the teleconference. Without the help of these organizations and many other individuals who generously volunteered their time, this EFT would never have become a reality.

This writer is frequently asked why organizations are willing to support these EFTs. Organizations, private corporations, and government agencies are constantly flooded by requests from school districts, individual teachers, and other education agencies, for support for many excellent projects. Unfortunately, today's troubled economy has impacted on the amount of available funding. Most organizations have had to cut some of the funding they traditionally have made available for educational projects, and others have had to eliminate it entirely. Resources are diminishing, and demand for them is increasing. If the CPD approached a business asking support for a project that would serve only Fairfax County students, it is highly doubtful that the project would be supported, even though it might be a very worthwhile endeavor. But, by providing this same high quality educational programming to schools throughout the United States at no cost to the schools, the project is looked upon more favorably. The supporting organization will get high national visibility and the dollars spent for an EFT will serve thousands of students and teachers rather than be limited to those within the borders of a single school district. It is a win-win situation. Fairfax County Public School's students and teachers gain, because if the EFT were limited to FCPS, outside support would not likely be obtained and therefore, the EFT would not be available for FCPS. By offering the EFT at no cost to schools throughout the country, students and teachers, regardless of geographic location or fiscal wealth of the district, have access to resources that otherwise would not be available to them. No one loses, and everyone wins, especially the students.

It is important to point out that support other than direct funding is essential to the production of EFTs. Inkind support, such as contributions of satellite time, production service from another studio or production truck, uplink service, services of professional and non-professional on-camera talent, access to archival footage and facilities, and the like, have been vital to CS's productions. An excellent example of this inkind support, is the production work RIAS-TV did for "Berlin: Yesterday, Today, Tomorrow." A modest estimate of the dollars and cents value of the service they donated was over $15,000.

Obtaining funding for the EFTs is time consuming, frequently frustrating, and, too often, very disappointing. Sometimes success is a matter of having the right project presented to the right person at the right time. At other times, a most worthwhile proposal may get no support at all. Then there are rare and wonderful occasions when an outstanding opportunity comes from nowhere, as with the phone call from police officer Bill Silva, that initiated the international EFT with Wales. To successfully cope with the uncertainties and stress of the EFTs and other projects at CS, the CPD and other staff members have had to cultivate patience, tenacity, versatility, flexibility, and above all, maintain a sense of humor at all times.

Designing the Electronic Field Trips

Each EFT has provided the CPD and the staff with greater insight as to how to make the next one better. The first EFT, "Physics: From the Classroom to Outerspace," provided the first critical lesson: do not try to target too broad an audience. The first EFT tried to provide activities and information in both the print material and the televised segments for middle and high school students. Although there were high points for each group, messages and information were sometimes diluted or lost on one group or the other throughout the project. Electronic field trips are now targeted at specific grade levels, i.e. middle school or high school. This is clearly stated in the publicity and print material. However, if a teacher chooses to participate in an EFT targeted at an age group other than that of his or her students, he or she may do so, and it can be successful. An example of this occurred during the live interactive teleconference for "Mission to Planet Earth," which was advertised for high school students. As the CPD worked with the scientists on the project, she became concerned that it should have been aimed more precisely towards students in grades 11 and 12. Nevertheless, during the teleconference, phone calls came in from a sixth grade class in Mesquite, Texas. The students did not hesitate to ask their questions, which were very appropriate to what was being discussed. The teacher, demonstrating her understanding of her students' interests and ability levels, had modified activities in the print material, and added to them some of her own. The result was, her students were perfectly capable of active participation in an EFT that was assumed to be over their heads. The off-site teacher is critical to the success of the EFT, not only for the organization of the setting so the students can see, hear, and call-in, but also for the attitude they express to the students regarding the experience. An enthusiastic teacher will have enthusiastic students. The importance of the classroom teacher in any instructional setting can never be overstated. O'Bryan supports the use of television in instruction, while recognizing the importance of the teacher role in the process.

> The odds from the research on ITV instructional television in the elementary school are overwhelmingly supportive for a belief that the medium cannot replace the teacher; is dependent for ultimate success on intelligent interaction and mediation by a skilled, live professional; and perhaps most strongly of all, can do an exceptional job of motivating and instructing children in almost any area of education from basic skills to fine arts (O'Bryan 1980, p. 22).

Because an EFT can focus on any discipline or multiple disciplines, the CPD must work closely with several curriculum specialists, upon whom she depends for input as to the worthiness of a particular topic. They inform her as to how and whether a topic will fit into the curriculum. If there is ample and suitable material already available on a subject, they advise her of it, thus allowing her to drop the project so that the limited time and funding available can be directed to areas in need of support and enrichment. Once a decision is made to go forward with a particular project, the curriculum specialists provide the CPD with the names of outstanding, creative teachers, who are especially knowledgeable about the topic. As the CPD begins to work with the outside experts, these teachers are consulted to help in development of the projects concepts and format. They provide valuable information and guidance, which is used in the final design of the project.

Print Material

The print material is a vital component of the EFT. It provides the teacher with technical information, phone numbers to call in case of difficulties in receiving the signal, the 800 number to use to call in questions during the live interactive teleconference, and information students need to access the computer bulletin board after the broadcast of the live event. The material also gives the teachers an idea of what will be covered on both of the televised segments. In some cases, lists of items that should be on hand in the classroom are provided to enable students in the off-sites to actively participate in activities they are watching on the screen. Such activities are designed so that no matter where the students are located, the materials which they need in order to participate can be easily obtained and should be free or require a minimal expenditure of funds.

The teachers recommended by the curriculum specialist play a critical part in the design of the print material. They are paid for their efforts on these projects from funding included in every budget for teacher support of the EFT. At first, a committee of teachers was formed to handle create support material, however, it was discovered that one or two selected teachers do a better job and do it more efficiently than a committee does. The CPD now asks one teacher to take on the task, then allows that teacher to choose a partner to work with, if he or she wishes to collaborate with a colleague. The first teacher is held responsible for meeting dead lines, and for assuring the accuracy and appropriateness of content. During the process of developing the material, the teachers take information provided by the outside experts from which they create student activities and projects, list available resources, and more. The key is that it all must be very teacher friendly. Evaluations from teachers indicate that they want concise material. Lengthy volumes of material often remain unopened. Teachers just feel too busy to go through it all. They want activities that do not take hours of preparation to set-up; they should no require the purchase of equipment or expensive material.

Once the print material is written, it is proofed and edited by the staff at CS. The CPD also reviews it to assure that it is appropriate to the goals of the EFT. After it has been approved by the editors, it is sent to the graphics department, where the artists format the material, adding interesting artwork or other graphics to enhance the appearance and clarity of the content. The material is printed in a simple black and white format so that it can be easily duplicated at the participating schools. One copy is sent out per registration to keep down the costs of printing and postage. The staff makes every effort to get the material to the schools three to four weeks prior to the orientation program. This allows time for local duplication, distribution, and for implementation of the student activities contained in it.

Publicity

As soon as an EFT is confirmed and the general design and content has been established, a brochure is created that describes the EFT concept, then introduces the topic and content of the particular EFT. A brief description of the content of the orientation program and the live interactive teleconference is provided. A registration form is included with 800 phone and fax numbers for further information. The brochures are sent to school districts, cable companies, television services, and some individual teachers. The mailing list includes nearly 6000 school districts and over 50 cable companies that have participated in the EFTs. Satellite coordinates are not provided in the brochures. In order to obtain them, a registration form must be sent in by mail, faxed, or phoned in. Print material is then promptly sent out that contains this information. If the coordinates were published, CS would have no way of keeping track of the registrations. This information is very important to organizations considering supporting an EFT.

Information on the EFT is also sent to appropriate professional organizations such as the National Association of Secondary School Principals (NASSP), the National School Board Association (NSBA), the National Association of Elementary School Principals (NAESP), and professional organizations of particular disciplines that are covered in the EFT. They often publicize the EFTs in the news letters or announce them at meetings or conferences if the timing is appropriate. They have also published articles on the EFTs in their journals, an example of which can be found in Appendix E. Program information and satellite coordinates are sent to PBS stations. Announcements of upcoming programming are also provided to distance learning magazines such as Satellite Scholar and Education SATLINK that publish schedules of K-12 programming.

The Orientation Program

The objective of the pretaped orientation program is to provide an overview or background information on the subject of the EFT. The information contained in the print material and the orientation should provide the students with a basis of knowledge about the subject that will encourage active participation in the live interactive teleconference. Some orientation programs have taken students on a tour of a space center, gone into a courthouse and a jail, and even stepped back into history at Colonial Williamsburg.

The length of the first EFT's varied from 30 minutes to nearly an hour. It soon became evident that a shorter orientation program was preferable to a longer one. Teachers often wanted to use the program as part of a lesson, and a lengthy program did not allow them to incorporate other information and class activities into a single class period. The orientation programs are now 28 minutes in length. The 28 minute limit also makes it possible for the PBS affiliates to air them, allowing two minutes for station identification and for commercials, which are not associated in any way with the EFT.

Through teacher comments, the CPD has learned that the teachers would further prefer that the program be divided into "teachable segments" that can be taught separately or during different class periods. The EFTs are now designed with "seams" in them. That is, a topic is introduced and presented in modules that permit the teacher the flexibility of showing the tape in its entirety or in segments which support or form the basis of the lesson.

The Live Interactive Teleconference

The live interactive teleconference is the culminating point of the EFT. The potential impact of video teleconferencing on learning and its importance to the EFT was well-stated by Brown.

> The live interactive video teleconference may be the 'next best thing to being there' since it serves as an alternative to face-to-face learning. Its potential as a learning/communication tool continues to unfold, and it is anticipated that its use will increase as more people gain an understanding of it. It does

> minimize the role of location in educational access; it has potential for bringing economic efficiency to highly specialized educational offerings; it enriches the distance learning experience through visual stimulation and human interaction. Its biggest point is that learning opportunities may be brought to thousands of individuals who previously could not participate in organized learning experiences (Brown, 1988, p. 10).

The live interactive teleconference brings experts from a variety of fields, such as scientists, judges, lawyers, astronauts, journalists, and many more, to meet with students in the classroom. The students are prepared to actively participate in the live event, through completion of the activities in the print material and information obtained from the orientation program. As the experts do demonstrations, experiments, or explain a topic or phenomenon, students are invited to call in on an 800 number to ask questions, make comments, or tell of results they have had on a particular activity. The effectiveness of the preparation of students for the live event has been clearly demonstrated on a number of programs. In one instance, Leonard Nimoy, of "Star Trek" fame, was a featured guest in the studio. "Never Forget," a movie he had co-produced for Turner Network Television (TNT) and starred in, was used as the basis of this EFT. The movie centered on the true life story of Mel Mermelstien, a Holocaust survivor, who was also present on the set. The objective of turning this movie into an EFT was to use the Holocaust as an example of genocide, a crime against humanity that can occur anytime, anywhere to anyone if individuals do not stand their ground in fighting injustice, even when that injustice is not perceived as threatening to themselves. There was concern among CS staff that students calling in might be more interested in Leonard Nimoy in his role as Dr. Spock than in his portrayal of Mel Mermelstien. The calls were not screened, but there was not a single reference made to "Star Trek" or to Hollywood glitz of any kind. The students' questions were carefully considered and sensitive to troubled areas in the world where genocide was actually being attempted.

The judge and the lawyer who were guests on the EFT "Justice: What Is It?," expressed amazement that the questions that came in demonstrated a depth of knowledge of the judicial system and the Constitution that they had not encountered in talking to numerous groups of students. Judge Fitzpatrick stated that in her meetings with students, she usually was asked if a principal has the right to search for drugs in a locker without a warrant. The answer is "yes", after which there are few if any questions, followed by an uncomfortable silence. The print material and the orientation make a remarkable difference in the level of student preparedness and participation.

<u>On-Camera Talent</u>

The selection of guests and other on-camera talent is critical to the success of the program. The common theme in selecting talent for K-12 programming is to find someone the students can relate to, meaning young and energetic. Generally, this is true. But, if the guest is enthusiastic and personable, age does not appear to be the only criteria to be considered. Brown, Brown, and Danielson note that presenters do affect the reactions of adult viewers in a similar manner the CPD has noted that K-12 students are affected.

> Results suggest that . . . presenters in televised instructional segments were not only responded to differently in terms of attitudinal reactions of the learner but also that achievement in one instance at least was significantly related to characteristics of the talent . . . that learners are responsive to an enthusiastic portrayal. The presenters must appear to be intrinsically interested in the subject matter themselves and eager to share the knowledge with the viewer. A bland presentation or one marked by apparent confusion yields negative attitudinal responses and can effect achievement (Brown, Brown, and Danielson, 1975, p. 401).

Another important criteria in selected guests and talent is the consideration of providing positive minority and women role models. But, regardless or who they are, old, young, or in between, television can be a frightening experience for them. Sometimes a guest who is dynamic and outgoing in person will freeze in front of the camera. Other guests have expertise in an area critical to the program, but have no personality in person or on camera. In either case, an on-camera host can save the day, diverting attention from awkward moments and transitioning from one area to another if the guest becomes too long-winded. The host is a key person, who must have charisma, but be able to control any situation that arises. He or she must be willing to do some homework on the topic of the program, so that if it is necessary to diverge from the script, it will be done smoothly, without embarrassment. Knowledge of the subject will also enable the host to lead the guests through the program more smoothly.

Guests should be given an opportunity to rehearse and get a feel of the studio of on-location set, but over-rehearsing can be counterproductive. Responses and reactions that look rehearsed lose their impact. There are instances where a guest will arrive only minutes before air time, and here again, the host will be critical to guiding the guest comfortably through the program. One of the major difficulties with live television is that it is always unpredictable. A snow storm may have a guest held captive in a distant airport, or caught in a traffic jam across the city. The executive producer must anticipate events such as these and have an alternative plan ready in advance. An interview by telephone from the snowbound airport can be turned into shared adventure rather than a disaster. The key is to think ahead, have several alternatives in mind, and be flexible.

The host has one other very important task during the live interactive. He or she must handle incoming calls from throughout the United States. There is no way to really guarantee that a caller is legitimate, even though they are questioned before putting them on the air as to where they are calling from and a few other details. The host must hand-off questions to the guest most able to answer, and also draw out a conversation about a question when suitable. If a call is not appropriate, the host must remain unruffled, make a comment fitting to the situation, and move on to the next call.

Computer Bulletin Board

The computer bulletin board was initially thought of as a way for students who did not get a question called-in during the live event, to be able to communicate with the guests after the program aired. It has served that purpose, but also, it has been an answer to another problem confronting distance education producers. There is no possible way to schedule an EFT to fit the complexities of time zones across the country. In fact, even within FCPS, there is absolutely no time slot that would enable all students targeted for a particular program to participate live. Therefore, schools are permitted to tape the programs for use at a later time. However, even if a student watches the program on a delayed basis, her or she can still actively participate and talk to the experts via the computer bulletin board.

After the live event, the CS staff monitors the computer board. Usually several questions on the board boil down to five or six basic questions. Students tend to ask the same questions. These questions are forwarded to the presenters, who return their responses to CS. The CS staff posts the answers on the bulletin board, and the process repeats itself for a two-week period after the live event.

Evaluations

The most frustrating part of the EFT has been to get evaluations returned from participating teachers. The evaluation form has been designed for easy response. Self-addressed, stamped envelopes have not had a noticeable effect on the number of evaluations returned. Enticements such as free posters from NASA, tee-shirts, and books have been offered, but have not elicited the response needed to make accurate assessments. In an interview, Frank Withrow, currently the Director of Education Technology at the Council of Chief State School Officers, and previously with the U. S. Department of Education, in charge of Star Schools grants stated that ". . . the trouble with trying to evaluate programs such as the EFT is that we are trying to use workbook and pencil measurements to judge the effectiveness of new methodologies in instruction" (Withrow, 1993, p. 10). He went on to state that most evaluations of such programming are based on the number of viewers. Large numbers indicate success, but do not tell the whole story. Withrow emphasized the need for developing an appropriate instrument to measure the effectiveness of this type of programming, because now there are a number of organizations producing special events. When this writer asked if there had been any such programming prior to 1990, he answered "not to his knowledge" (Withrow, 1993). He added, "FCPS's EFT set the model."

The evaluation is very important to the CS staff for input as to how to improve the programming and to determine which areas of the curriculum are in the greatest need of support. Evaluations are also critical to obtaining funding for future EFTs.

The evaluations returned have generally been favorable, but the CPD agrees with Parker and Monson who state that ". . . a distinction should be made between user satisfaction and the overall effectiveness of the system" (Parker and Monson, 1980, p. 48). It is a goal of the CPD to devise a more appropriate and accurate instrument to measure actual effectiveness of the EFT. She is currently working on a grant with the Smithsonian Institute at the National Zoo to implement an ambitious evaluation system to be put into effect in the 1994-95 school year to evaluate EFTs developed in collaboration with the NOAHS (New Opportunities for Animal Health Services) Center at the Zoo.

Registration

If increasing numbers are an indication of success, then the EFT is truly successful. The last EFT of the 1992-93 school year had 4971 school districts and 41 cable companies and television services registered. This is in contrast to the first EFT that had 804 registrations that represented nearly 2000 school districts. The EFTs go to schools in all 50 states and six countries including Canada, Mexico, and other Caribbean countries.

Copyright

Fairfax County Public Schools holds the copyright for the television programs produced by the staff at CS. As the EFTs and material are developed, care is taken to include only copyright material for which the staff can obtain written permission to use, and for which permission is granted to participating teachers or educational services to record and duplicate as necessary in their schools or school districts.

Summary

After the successful implementation of the first two EFTs in the spring of 1990, the CPD and staff looked forward to an ambitious schedule for the 1990-91 school year, only to be confronted by serious fiscal difficulties caused by a deteriorating financial situation in both the state and county. Funding for the EFTs had to be obtained from outside resources if they were to survive newly imposed budget cuts. Although the CPD and the CS staff were not able to fulfill all the programming goals planned, 14 EFTs were produced between the period of the fall of 1990 to the spring of 1993, all of which were funded from outside resources (See Appendix G).

Lessons from the first EFTs were applied to the following productions, each of which brought more new learning experiences to the CPD and staff. Audiences were more precisely defined, so that maximum benefits could be gained by targeted students. Print material development was assigned to one or two teachers rather than a committee. The teachers would work closely with experts in the field and the CPD and staff as the material was produced to assure that the activities and information in the print material would integrate well with the televised components of the EFT. This process proved to be efficient and a better product was created. The orientation programs were designed to provide students an overview of the topic of the EFT. It was soon discovered that teachers prefer a short format to a long one, so that the program can be used within a class period with other activities. Teachers also wanted the program to be produced in segments which could be used separately for specific class activities. The live interactive teleconference allowed students to talk to the experts in the field via an 800 number during the program. The computer bulletin board provided ongoing mentoring for a period of two weeks after the live event, as students posted their questions using an 800 number. On-camera talent is critical to the success of the EFT. The on-camera host is vital in keeping the program moving smoothly. He or she must make the guests as comfortable as possible and not allow time to run out before all identified topics for the program have been covered. The importance of the classroom teacher in the ultimate success of the EFT cannot be overstated. How the teacher uses the print material, arranges the room where students will participate in the EFT, and especially his or her attitude towards the experience, all greatly influence the value of the EFT for the students.

The number of returned evaluations was disappointing. It is evident that a more appropriate instrument for assessing the value of the EFTs will have to be developed, otherwise, numbers of participants per program remain the only measure of success for an EFT.

CHAPTER V

FINDINGS, RECOMMENDATIONS, AND CONCLUSIONS

Summary of the Study

Since the publication of A Nation at Risk, educators have been seeking answers to very serious and complex problems regarding the quality of instruction in K-12 classrooms throughout the United States, as well as equity in regard to access to quality education. Isolated, rural, and less affluent urban areas often have difficulty finding qualified teachers, particularly in, but not limited to, the areas of science, math, and foreign languages. Educators have turned to technology to provide students with high quality instruction regardless of where they live, or the fiscal limitations of their school districts. Distance learning has taken many different forms depending on the technology or combination of technologies involved. Although there is considerable information as to the effectiveness of distance learning with adults, there is a paucity of studies on K-12 students. However, available data indicate that the achievement level of K-12 students in distance learning programs is comparable to and often higher than the achievement level of students in traditional settings. The bottom line is, distance learning works.

Until 1989, distance learning centered on courses involving daily instruction. There were no programs or special events for K-12 students that addressed inequities of access to enrichment experiences enjoyed by students who live near museums, universities, theaters, government agencies, science centers, and the like. Students living in rural or fiscally limited school districts could not benefit from field trips as could their more urban and affluent counterparts. Thus, disparity of opportunity broadened, providing another competitive advantage to the privileged students.

This writer became intrigued with the notion that outside resources could be brought into classrooms anywhere in the country, by utilizing the same technologies in schools that were delivering daily coursework in distance learning programs. The challenge was to develop a model that would effectively enrich and strengthen existing curriculum for K-12 students, would be offered to schools throughout the nation at no cost, and would provide a framework that other school districts could emulate in the production of their own programming. In 1989, this writer was made the coordinator of program development at the Chapel Square Media Center (CS) in FCPS, where she began working with the highly talented and creative telecommunications staff; together they developed the EFT. In the process of designing the EFT, she tried to find models that would provide guidance for the project, but to no avail. The EFT format evolved as the project progressed.

Findings

The EFT was based on a video format with computer bulletin boards to enhance interactivity between students and presenters. Richardson states, "Today's challenge is to communicate knowledge as the world becomes increasingly dependent on information" (Richardson, 1992, p. 3). The EFTs brought cutting edge information on science, the Constitution, current events of historic importance, and much more into the classrooms. While aimed at students, the programs also provided instructional models for teachers.

Since the spring of 1990, the CPD with the CS staff has produced 16 EFTs (see appendix G for titles and a brief description). Even through the worst economic times Fairfax County has ever faced, these programs were made available to schools at absolutely no cost. Funding and inkind support were obtained from outside resources. Schools were encouraged to tape the programs to be used in future classes.

Evaluation of the impact of the programs has been difficult to measure. Even the offering of posters, tee-shirts, books, and other enticements to teachers who send in evaluations does not elicit the response needed to make accurate assessments. Due to the lack of other data, numbers of registrations are used to measure an EFT's success. Numbers may indicate success, but the CPD is concerned that they do not tell the whole story. However, if numbers are an indication of success, then the EFT has succeeded. Registrations vary from one EFT to another, depending on the topic and the target audience, but in total, over 5000 school districts have registered, and 47 cable companies and television services download the programs. PBS posts the programs on its communications system, allowing their affiliates to pick-up the EFTs if they choose to do so. Numbers of viewers are difficult to assess when the cable companies take down the programs, because entire communities, as well as the schools, then have access to the programming.

Registrations have come from all 50 states, Canada, Mexico, Santo Domingo, Venezuela, Colombia, Costa Rica, Puerto Rico, and even one site in Hong Kong, on a delayed basis, of course. The 800 number reports indicate how many attempted calls are made during the one-hour teleconferences. During "Women in Aerospace," just fewer than 1000 calls were attempted.

Since the 1990 shortfall of funds in Fairfax County, no money has been available to support the EFTs. Fourteen EFTs have been produced and offered free to all schools without using any tax dollars. The CPD has been privileged to work with the Smithsonian, CNN Newsroom, Turner Network Television, the Williamsburg Foundation, NASA, and other organizations that have supported the programming with inkind contributions or funding.

Organizations, such as the Federal Reserve Board, the U.S. Geological Survey, the American Chemical Society, the Smithsonian Institute, the Goethe Institute, and others have come to the CPD to explore how FCPS can collaborate with them to create programs for K-12 students. These partnerships make it possible to create EFTs that the individual organizations, operating alone, would not be able to accomplish. However, care must be taken by the school system to maintain control over the content and the development of the print material and the televised segments. The outside experts should assure that information is accurate, and there should be an agreement as to how each organization will be represented. But, the last word on content and the quality and format of each component must remain with the school system to assure the educational integrity of the project.

Although FCPS lacks clear-cut statistical data to evaluate the effectiveness of the EFT, the popularity of the programming demonstrated by the continually increasing number of registrations, and the support from many highly respected organizations, indicate that the development of the EFT has indeed been a successful endeavor.

The staff at CS is proud of their accomplishments, but continually tries to improve their productions. As a result of teacher input, the instructional design of the EFTs has been changed to facilitate using segments of them in the classroom as primary source material. There is an ongoing effort to find new and creative ways to deliver information and concepts to students of different age groups, learning styles, and ability levels. Much of what we learn comes from evaluations received or calls from teachers, students, or administrators. The CPD and staff incorporate appropriate observations into the productions. The EFT will continue to evolve with the objective of making it a useful and versatile instrument in the teacher's hands.

Recommendations

There are a number of recommendations this writer proposes that apply to the production of EFTs, evaluation, access and use of EFTs, and acquisition of hardware and services to enable schools to participate in EFTS and other types of distance learning programming.

Evaluation

This writer recommends that FCPS, or another qualified agency, conduct an evaluation that would provide a reasonably accurate measurement of the effectiveness of the EFT.

Accessing EFTs

In order to receive EFTs and other available distance learning programs, a school must be able to capture the signal with a satellite dish, or have the programs downloaded by a cable company. Apart from this, all that is needed is a television set and a telephone for interactivity with guests on the teleconference. A computer and a modem are needed for participation on the computer bulletin board. The following recommendations are offered to help those who may not have all this equipment in place in their schools:

- Contact a company that sells and installs satellite dishes to investigate the possibility of receiving a donated dish for the school system;

- Inform the local cable company of the school's interest in the programming and ask that they download it for the school district;
- Hotels, museums, universities, private companies, and private residences often have satellite dishes and requests should be made to have them download programs for schools;
- Take students to a local facility that has a satellite dish, be it another school, hotel, or university to participate in the EFT;
- Contact the producer for tapes of the programming, and use it on a delayed basis;
- Contact computer companies for donations of hardware needed to participate with experts on the computer bulletin board;
- If no computer equipment is available, call in questions on the 800 number used for registration for the program;
- Publicize the contributions of any organization that has facilitated student participation in these activities.

Utilization of the EFTs

- Try to have a telephone close to the television set, so that students, who are waiting for a response, will not miss parts of the program;
- Turn down the volume of the set when the student goes on the air to prevent feedback;

- Help the student formulate his or her question prior to getting on the phone. This gives the student more confidence to speak up and state the question clearly, thus eliminating a delay of activity on the set;
- Utilize the print material, and have students view the orientation program. All four components are related. Viewing only the live teleconference will diminish the effectiveness of the program;
- Make a copy of the program and retain it as part of your professional library;
- When scheduling makes it impossible to participate in the live event, tape it and show it to the students at a more convenient time. Utilize the computer bulletin board for student interactivity with the presenters;
- Utilize appropriate segments of the programs as support for other or future lessons.
- Send in evaluations to the producer, even if the program is viewed on a delayed basis. Evaluations are critical in planning and designing future programming, as well as in acquiring funding.

Wiring the School District

This writer would encourage superintendents and administrators to contact their local cable company, telephone company, and other major organizations to explore wiring their schools with cable, creating a production facility, and providing the school district with one or more cable channels. The value of such a system is that it can facilitate access to quality programming from the outside, while providing opportunities to produce instructional programming within the school system. It can also be used to serve the community with adult education and public service programs.

Local Production of EFTs

A last recommendation is that no matter where a school or school district is located, teachers should consider creating EFTs of their own. There are fascinating sites, people, and events in any geographic location or school. If a school is equipped with a camcorder, television monitor, and a VCR, it has the basic tools needed to create EFTs. The following should be considered in producing an EFT:

- Choose a topic that will fit into the existing curriculum, the general school program, or support community spirit;
- Limit the content of the topic to what can be effectively communicated in a single program;
- Limit the information on a single graphic. If the audience cannot read it, it will confuse rather than clarify an issue;
- Involve students, colleagues, and parents in productions. They will have great ideas, provide needed support and develop a team spirit about school activities that will carry beyond a single project;

- Do not be afraid to make mistakes. An imperfect video can still be powerful in its message, and the lessons learned from one production will make the next one better;
- Seek positive role models for students as presenters. Be particularly sensitive to the need for women and minority representation. Although it is assumed that students relate best to young presenters, do not overlook the fact that a dynamic, interesting presenter, regardless of age, will hold their attention;
- Communicate with other schools and school districts to learn what they are doing;
- Share your production and your expertise with your colleagues and other schools and school districts;
- Invite other organizations to provide support through funding or inkind services, but assure that the school has control over content and format of the production.

Conclusions

Technology today has become "user friendly," and it is also more affordable to schools that are now routinely using a variety of technologies to provide learning experiences for students that otherwise would not be available to many of them. Thanks to government grants and funding and inkind contributions from private industry, many school systems are being wired with cable and/or provided with equipment to receive and produce distance learning courses and special events. Telecommunications technologies benefit teachers, students, and the school community. For students some of the benefits are:

- Access to courses, people, places, and events that otherwise would not be available;
- Access to the rapidly increasing sources of information that textbooks and other traditional resources cannot provide;
- A means of connecting classroom activities to skills needed to succeed in the "real world."

For teachers, the technology provides the following benefits that ultimately serve the students:

- Facilitates the sharing of innovative techniques and ideas with colleagues, thus eliminating the isolation that characterizes classroom teaching;
- Enables administrators to conduct interactive televised inservice meetings, thus eliminating lost time and money due to travel or substitute pay;
- Allows master teachers to provide models for others as they are observed teaching by cable or satellite.

Fairfax County Public Schools pioneered the development of a project that utilized the telecommunications technologies used in schools to provide distance learning courses to students, to deliver enrichment opportunities to students throughout the country. This project, now called the EFT, has become a viable means of providing students access to enrichment experiences that can motivate them by connecting their classroom experiences to the real world. Fairfax County Public Schools is in an enviable position from the standpoint of its location in the Washington, D.C. metropolitan area, and its good fortune in obtaining six cable channels and a professional production studio. However, without funding, a production studio cannot produce. The EFT has created a win-win situation for everyone involved in one of these projects. The organizations with whom FCPS collaborates, have funding or resources that they intend to use for educational programs. Unfortunately, today's economic situation has shrunk available funding, and there are many schools and educational organizations competing for the limited resources for many worthwhile causes. When an organization funds an EFT, the project benefits students throughout the country, which provides that organization with high visibility, and they have made a widespread impact funding a single project. On the other hand, because of lack of sufficient funds within FCPS, CS cannot produce the EFTs without outside funding. Therefore, students in FCPS would not be receiving this programming if CS produced exclusively for the district, because funders would be less likely to support a project limited to local students. By serving students and teachers throughout the country, CS is providing programming to FCPS students that otherwise would not be available.

schools in America. Technology can never replace face to face teaching, and should not try to do so. But, the many technologies available to schools today, can serve as valuable tools in the hands of skilled teachers that will enhance and strengthen their effectiveness in the classroom. Technology brings information, people, places, and events from anywhere in the world into the schools, creating a living curriculum that provides new and exciting learning opportunities. Students are living in the information age, and as part of a quality education, they must learn to utilize the available technologies to access and process information in order to be productive and successful citizens in the next century. The staff at CS hopes that their efforts in the production of EFTs will enrich and strengthen students' classroom experiences and encourage them to become life-long learners. FCPS also looks forward to receiving EFTs that other school districts produce.

REFERENCES

Barker, B. & Logan, S. (1985). Small High Schools Curricula: Alternative Delivery Systems for Meeting Essential Elements. Austin, TX: Annual Conference of the Texas Association of Secondary School Principals. (ERIC Document Reproduction Service No. ED 252 371).

Batey, A. & Cowell, R. (1986). Distance Education: An Overview. Portland, OR: Office of Educational Research and Improvement. (ERIC Document Reproduction Service No. ED 278519).

Benson, G. M., Jr. & Hirschen, W. (1987). "Long-distance Learning: New Windows for Technology." Principal, 37(2), 18-20.

Brown, C. E. (1988). "The Live Video Teleconference in Distance Learning." Lifelong Learning, 11(5), 8-10, 24.

Brown, R. D., Brown, L. A. & Danielson, J. E. (1975). "Instructional Treatments, Presenter Types, and Learner Characteristics as Significant Variants in Instructional Television for Adults." Journal of Educational Psychology, 67(3), 391-404.

Carnegie Corporation of New York. (1986). A Nation Prepared: Teachers for the 21st Century. (Carnegie Forum on Education and the Economy). New York, NY: Author.

Codding, George A., Jr. (1990). The Future of Satellite Communication. Boulder, CO: Westview Press, Inc.

Danley, G. (1989). Distant Learning Via the Use of Television and Fiber Optic Cable. Turpin, OK: Turpin Public Schools.

Davidson, G. S. (1976). Education of Isolated School Children. (Report of the Australian Senate Standing Committee on Education and the Arts). Canter Reproduction Service No. ED 153 748.

Eiserman, W. D. & Williams, D. D. (1987). Statewide Evaluation Report on Productivity Project Studies Related to Improved Use Of Technology to Extend Educational Programs. Sub-report Two: Distance Education in Elementary and Secondary Schools. Salt Lake City, UT: Utah State Office of Education. (ERIC Document Reproduction Service No. ED 291 350).

Elston, Robert E. (Producer/Director). (1989). Distance Learning Is the Sky the Limit? Part I (Video teleconference). Stillwater, OK: Oklahoma State University/Educational Television Service for Midlands Consortium, Star Schools Project.

Fairfax County Public Schools. (1992). Profile 1992-93. (Department of Communications). Fairfax, VA: Author.

Holmberg, Borje. (1986). Growth and Structure of Distance Education. Sydney, Australia: Croom Helm.

Keegan, Desmond. (1985). The Foundations of Distance Education. Sydney, Australia: Croom Helm.

Kelleher, K., & Cross, T. B. (1985). Teleconferencing: Linking People Together Electronically. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Kitchen, K. & Kitchen, W. (1988). Two-Way Interactive Television for Distance Learning: A Primer. Alexandria, VA. Institute for the Transfer of Technology to Education Technology Leadership Network.

Levinson, C. (1984). The School Problem-Solvers Guide to Distance Education. Washington, DC: Department of Education. (ERIC Document Reproduction Service No. ED 253380).

National Commission on Excellence in Education. (1984). A Nation at Risk. Westford, MA: Murray Printing Company.

Oklahoma State University. (1989). Setting Up ASTS Courses 1989-90. Stillwater, OK: Author.

O'Bryan, K. (1980). "Yes, Television Does Teach." NASSP Bulletin, 64(437), pp. 21-27.

Parker, L. A. & Monson, M. K. (1980). More Than Meets the Eye: The Effectiveness of Broadcast Audio and Two-Way Audio Instruction for Distance Learning. (ERIC Document Reproduction Service No. ED 1972719).

Phi Delta Kappa. (1983). Financing the Public Schools: A Search for Equality. (The Phi Delta Kappa Commission on Alternative Designs for Funding Education). Bloomington, IN: Author.

Richardson, Alan R. (1992). Corporate and Organizational Video. New York, NY: McGraw-Hill.

Sheingold, K. (1991, September). "Restructuring for Learning with Technology: The Potential for Synergy." Phi Delta Kappan, pp. 17-27.

Smith, Kevin. (1987, June). Distance Education: Touching With Technology. Paper presented at the CIDA/AMIC Seminar on Training Needs in the Use of Media for Distance Education in Asia, Singapore.

Smith, Kevin. (1984). Diversity Down Under in Distance Education. Toowoomba, Q, Australia: Darling Downs Institute Press.

Taylor, Margaret H. (1988). Planning for Video. New York, NY: Nichols Publications.

U. S. Congress, Office of Technology Assessment. Linking for Learning: A New Course for Education. (1989). (OTA-SET-430) Washington, DC: U. S. Government Printing Office.

Williams, D. D. (1987. Statewide Evaluation Report on Productivity Project Studies Related to Improved Use of Technology to Extend Educational Programs: Summary and Recommendations. Logan: Wasatch Institute for Research and Evaluation.

Withrow, Frank (1990, May). "Star Schools Distance Learning: The Promise." T.H.E. Journal, pp. 62-64.

Withrow, Frank, (1993). Unpublished telephone interview on August 26, 1993.

Woolsey, Terrence, (1993). Unpublished interview on July 29, 1993.

Zigerell, James. (1991). The Uses of Television in American Higher Education. New York, NY: Praeger Publishers.

APPENDIXES

APPENDIX A

PHYSICS: FROM CLASSROOM TO OUTERSPACE

BROCHURE

FAIRFAX
COUNTY
PUBLIC
SCHOOLS

ELECTRONIC FIELD TRIPS

Please send me more information about FREE interactive teleconferences.

Name ______________________

School District ______________________

School ______________________

Address ______________________

City/State/Zip ______________________

☐ I wish to be included on your mailing list for future programs.

☐ I have a phone line and modem available for telecommunications connections.

Please list other persons/addresses that should be included on our mailing list:

POSTAGE

Judy Garcia
Program Development Coordinator
FAIRFAX COUNTY PUBLIC SCHOOLS
Chapel Square Center
4414 Holborn Avenue
Annandale, Virginia 22003

PHYSICS:
From the Classroom to Outerspace

FAIRFAX
COUNTY
PUBLIC
SCHOOLS

Electronic Field Trip

Are you interested in receiving an interactive videoconference for your students on how physics is applied to the exploration of space - at NO COST?

PHYSICS: *From the Classroom to Outer Space*

This program will feature **Lance Bush**, an aerospace engineer who is currently working on the Mixed Fleet Project at NASA Langley Research Center. His work is centered on the development of an escape craft for the space station and vehicles that will carry space travelers to the moon and Mars. Lance is a dynamic presenter, who has developed imaginative ways to demonstrate theories of physics to students and show them how their classroom lessons are applied to the creation of the spacecraft that will lead to the development of space colonies and expanded exploration of the universe.

The one-hour, interactive teleconference, **scheduled for May 9, 1990 at 12 noon EDT**, will be aimed at a target audience of upper elementary and secondary students.

The objectives of the program are to:

- stimulate student interest in science and mathematics
- enrich current science programs
- create science literacy in non-science oriented students
- help students gain a perspective of how science and technology fit into the total human picture via cross-curricular activities
- provide information about career opportunities with NASA

A program offering background information of the historic development of spacecraft and the space station will be broadcast May 2, 1990 at 12 noon EDT.

Also available to teachers via computer network or mail are pre-teleconference activities, a materials list for hands-on classroom participation, and lesson plans to use after the teleconference.

POST-TELECONFERENCE MENTORING

Lance Bush has agreed to respond to students' and teachers' questions after the teleconference via computer network, thus enabling participants to benefit from his experience and expertise as they work on ongoing projects and activities.

This program is a first in a series of interactive electronic field trips that will be produced by the Fairfax County Public Schools with the help and cooperation of NASA Langley Research Center and the Virginia State Department of Education.

If you would like more information about this FREE interactive teleconference, please complete the form provided and return by April 20, 1990 to:

JUDY GARCIA
Program Development Coordinator
Chapel Square Center
4414 Holborn Avenue
Annandale, VA 22003

or call (703) 978-0075.

APPENDIX B

PHYSICS: FROM CLASSROOM TO OUTERSPACE

PRINT MATERIALS AND EVALUATIONS

PHYSICS: From the Classroom to Outerspace

PART I: An Electronic Fieldtrip to NASA Langley Research Center

This taped, pre-teleconference program will give students a brief tour of NASA Langley Research Center and provide background information about the design and implemetation of **Space Station Freedom**. Aerospace engineers will discuss their exciting work on this project and advise about careers in the aerospace program. This program is appropriate for students grades 7 through 12, and gifted and talented students grades 5 and 6.

Taped pre-teleconference program
Wednesday, May 2, 1990
12:00 p.m. EDT
Satellite: Westar IV, Channel 14

**Part II:
Spaced-Out Physics!**

This live, interactive teleconference will feature Lance Bush, an aerospace engineer who is working on the Mixed Fleet Project at NASA Langley Research Center. He has developed entertaining methods of demonstrating the principles of physics to students. These principles apply to the creation of the spacecraft that will lead to the development of space colonies and expanded exploration of the Universe. This program is appropriate for upper elementary and secondary students.

Live, interactive teleconference
Wednesday, May 9, 1990
12:00 p.m. EDT
Satellite: Westar IV, Channel 14
Toll free number to phone in questions during the program:
1-800-677-8363

For questions after the May 9 program call the computer bulletin board at:

Number	User ID	Password
(703) 321-2839	PHYSICS A	PHYSICS A
(703) 239-2957	PHYSICS B	PHYSICS B
(703) 978-0212	PHYSICS C	PHYSICS C

SIG name: PHYSICS

If one line is busy, try one of the other numbers
and use the appropriate ID and Password.
You will be charged the toll for the call.

An Electronic Fieldtrip:
"PHYSICS: From the Classroom to Outerspace"

I. Electronic Fieldtrip to NASA Langley Research Center
May 2, 1990
12:00 noon EDT

II. Live, interactive teleconference
"SPACED-OUT PHYSICS!"
May 9, 1990
12:00 noon EDT

A Fairfax County Public School production made possible by the funding and cooperation of NASA Langley Research Center and the Virginia Department of Education

S

SOCIAL STUDIES OVERVIEW - FROM CLASSROOM TO OUTER SPACE

Kurt Waters, Social Studies Curriculum Specialist, Fairfax County Public Schools

Space exploration presents humankind with many practical, political, and ethical questions which are as important for the students of social studies to consider as the technological advances of rocketry are for the students of science and mathematics.

The future will bring out large numbers of people living in close quarters (either on space stations or space colonies) for extended periods, putting strains on limited resources. Some explorers may say goodbye to the earth forever, searching, unknown worlds to inhabit and settle. What will motivate their search? What type of new world order should they create? No doubt many nations will explore the heavens, creating new challenges in international relations and international law.

Not one of these issues is a new one. All have historical parallels that tie into the ages of exploration, immigration and global interdependence.

This seminar can help the social studies student to better understand the past by comparing it to hypotheses about the concerns of the future.

Classroom Activities for Students

United States History - Settling the Frontier

- Research settlers of the American west and research the space Station Freedom of lunar Outpost.
- Make large charts that compare and contrast tools, structures, clothing, the role of women, work, and leisure of the people in these two groups.
- In small groups make general statements about the similarities and differences between these two groups.
- Evaluate which way of life would be harder, more dangerous, more important, etc.
- Do extension activities (such as writing diaries for the two groups of settlers, sketching frontier communities and building models that would portray life on the frontier and life in space).

United States History - Immigration

- Brainstorm historical reasons why different people left their homelands and came to the USA.
- Evaluate each reason determining if any would apply to future space immigration.
- Interview individuals who have immigrated to the USA.
- Create poems that capture the spirit of leaving a homeland behind forever.

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World History - Age of Exploration/ Colonization

- Research "sailing vessels" of the Age of Exploration and the Space Age.
- Discuss how these vessels are similar and different.

- Find examples of conflict that occurred during the Age of Exploration. Find attempts that were made at the time to solve these conflicts.
- Analyze whether these types of conflicts and solutions will re-occur during Space Age exploration.
- Brainstorm different solutions to problems stemming from international competition in space.
- Create newspapers of the future that will tell the story of an international conflict and solution in space.

Government - Types of Authority

- Propose what the way of life on a lunar colony would be.
- Evaluate which form of government would be most successful.
- Conduct a debate, with each side defending their chosen form of government.
- Produce videos that portray successful government structures in action on a lunar colony.

Government - International Organizations

- Research the League of Nations and the United Nations.
- List the strengths and weaknesses of each organization.
- Brainstorm characteristics of international competition and cooperation in space.
- Role play international delegations and draft a constitution for outer space.

E

SOMETHING TO THINK ABOUT

August Fratteli, Science Teacher, Franklin Intermediate, FCPS

NASA is currently working on plans to start a space colony on the moon. More than likely to accomplish this task, we will seek international cooperation. Some nations that might be included will be European Space Agency, Japan, the Soviet Union, and Canada. People who go to live in these colonies will have to spend long periods away from home as well as living in close quarters to each other. This creates a unique set of problems that can be discussed in a social studies or language class.

Some concerns that need to be addressed:

1. Who should these activities in space be controlled by? (United Nations? A new governing body?)
2. Who will set and what might be some of the laws and rules in the colony?
3. Discuss some of the problems of planning a space colony with different cultures.
4. What will be the predominant language spoken?
5. How would you design living conditions?
6. What would you do when you had leisure time? Describe some recreational activities.
7. How would you provide for people's physical needs? (food, water, atmosphere, and health)
8. How would you compensate for people not seeing family and friends for over a year?
9. How do you design a colony that takes into account psychological needs, social and individual?
10. How should the jobs for the maintenance of the colony be assigned? (trash, cooking, cleaning, etc.)
11. How would you provide for privacy in such close quarters?
12. Since it is an international colony, how do you provide a sense of community and shared goals?
13. What are the working hours?

These and other questions can be given to a group of students or a class to discuss or do research on. Some students may actually wish to design and construct a space colony from art materials.

E, S

ROCKET PINWHEEL

Contributed by John Hartsfield

Students in the classroom can join students on the set in the construction of Rocket Pinwheel.

SUBJECT:

Rocketry

TOPIC:

Action-Reaction Principle

DESCRIPTION:

Construct a balloon powered pinwheel.

MATERIALS:

Wooden pencil with an eraser on one end
Sewing pin
Round party balloon
Flexible soda straw
Plastic tape

METHOD:

1. Inflate the balloon to stretch it out a bit.
2. Slip the nozzle end of the balloon over the end of the straw farthest away from the bend. Use a short piece of plastic tape to seal the balloon to the straw. The balloon should inflate when you blow through the straw.
3. Bend the opposite end of the straw at the right angle.
4. Lay the straw and balloon on an outstretched finger so that it balances. Push the pin through the straw at the balance point and then continue pushing the pin into the eraser of the pencil and finally into the wood itself.
5. Spin the straw a few times to loosen up the hole the pin has made.
6. Inflate the balloon and let go of the straw.

DISCUSSION:

The balloon-powered pinwheel spins because of the action-reaction principle described in Newton's Third Law of Motion. Stated simply, the law says every action is accompanied by an opposite and equal reaction. In this case, the balloon produces an action by squeezing on the air inside causing it to rush out the straw. The air, traveling around the bend in the straw, imparts a reaction force at a right angle to the straw. The results in that the balloon and the straw spins around the pin.

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SPACE STATION TECHNOLOGY APPLICATIONS

Shelley Canright, Education Programs Specialist, NASA Langley Research Center

SPACE STRUCTURES

LESSON ONE

The study of space and research projects such as Space Station and Space Structures can be motivating topics of study for students. Through such study topics, the range of academic subjects can be covered and objectives satisfied. To illustrate, the following SPACE STRUCTURES Activity is outlined. The activity is based on the Space Engineering Competition sponsored by the Shreveport Regional Arts Council and NASA.

Identified are a few objectives which this activity addresses. Educators are encouraged to adjust and expand the activity to satisfy the needs of their classes.

Objectives

- Provide opportunity for student to work independently and as a member of a small group in order to encourage sharing, accepting responsibility, and decision-making.
- Provide an opportunity for the student to select, plan, prepare for, implement, and evaluate a science problem/experiment.
- Emphasize process skills beginning with basic process and continuing with the integrated skills.
- Provide opportunity for students to observe and study science and technology.
- Provide classroom experience which incorporate skills and concepts from other disciplines.
- Apply computational and measurement skills and concepts in solving a problem.
- Solve problems in physics through the use of mathematics.
- Collect, analyze, and interpret physical data.
- Demonstrate the appropriate utilization of instruments to measure physical quantities.
- Predict and verify the interrelationships among mass, distance, force and time, using both experimental and mathematical processes.
- Indicate major events in man's space exploration and explain the important role the events have played in advancing technology.
- Given a time constraint, students will be able to prepare for and work within a deadline.

To Begin

- Focus the students' thoughts onto the future. The future as it will likely exist in the next ten years. A future which will include Americans, and perhaps even themselves, living in space aboard the Space Station.
- Discuss the importance of pioneering the space frontier and constructing a Space Station (see SPACE STATION Lithograph).
- Scientists think that low-Earth orbit may be an excellent place for producing better materials, such as crystals, pharmaceuticals, and metals, or for launching voyages to distant planets. It is also an ideal location for well-equipped observatories to study Earth and the Universe.
- Give attention to the construction of a Space Station. Before we can benefit from the studies and work which will occur on the Station, it must be constructed. This will be no easy feat.
- The EASE/ACCESS mission (November 1985) was an important step toward gaining the knowledge needed to build a permanent space habitat. Essential engineering and human factors data gleaned from this mission will play significantly on the planning of other construction projects in space.
- Show students the NASA video (SS/54: 61-B Post Flight News Conference) which demonstrates the construction process of the EASE/ACCESS experiment by Astronauts Ross and Springs. The video is available to educators by simply sending a blank cassette tape requesting a copy of the tape from the Teacher Resource Center.
- Discuss with the students the physics, mathematics, architectural design, and technology which had to be considered in the development of this experiment.
- Discuss with students methods for calculating the forces that pull down on objects on earth. Compare to the space environment.
- Taking all that has been discussed into consideration, challenge the students to design and construct their own space structure. Challenge them to become the framework builders for the future.

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Activity

Using plastic drinking straws and straight pins, construct a freestanding tower than can support a tennis ball at its pinnacle.

Activity Rules

1. Construct a tower of standard plastic drinking straws and straight pins.
2. Scissors are the only tools permitted.
3. The tower must be able to support a tennis ball at its pinnacle for a minimum of 60 seconds.
4. Time limit is 30 minutes to construct the tower.
5. The tallest structure that is able to hold the ball for sixty seconds wins.
6. A team challenge, with teams consisting of five students.

Materials

1,000 straws

2,000 straight pins
scissors
stopwatch
one tennis ball for each team

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Alternate or Follow-On Activity

Build a space platform model from commercially available building sticks or blocks, from toothpicks connected to styrofoam, etc. Take into account its instrument load, need for electrical power, and the stowing of component parts.

Suggested Materials

The following resources are available through the Teacher Resource Center (TRC) located at each NASA Field Center. To secure the following, write to the TRC that serves your region. Request the material which is of interest and/or identify your interest area and suggest that a mailing with this material be sent.

Teacher Resource Center Brochure
Video Tape Catalog and Supplement
Slide Programs Catalog
Lithographs: Space Station and EASE (Shuttle Mission 61-B)
Lesson Plan - Activity Booklet
Space Station Publications (numerous varieties)
A Teacher's Companion to the Space Station: A Multi-Disciplinary Resource (K-12)

EASE/ACCESS: Framework for the Future
EASE/ACCESS: Post mission Management Report

Requests for publications should be directed to the Public Affairs Office at the NASA installation which serves your state. Check the Appendix for the NASA center that serves your state.

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SPACE STATION
SPACE CONSTRUCTION CHALLENGE 1

Shelley Canright, Education and Information Specialist, NASA Langley Research Center

Instructions for the Teacher

Disciplines:

Social Studies	Science
Mathematics	Problem-Solving

Vocabulary:

structure	diagonal
square	rectangle
triangle	right triangle
frame	model

Materials:

small bag of marshmallows
small back of toothpicks
sandwich baggies
weight scale
small paper cup
drawing paper
pencils (1 per student)
notebook paper (to record)
coins (roll of pennies or quarters
two banners: STRUCTURES and FRAMEWORK FOR THE FUTURE
travel posters of historic structures (Egyptian pyramid, castle, cathedral)

Objectives:

1. Compare two objects by length, width, size, and wt. (SOL K - Sci)
2. Rank order by size or weight (SOL 1 - Sci)
3. Select instruments to measure length, wt., volume, and temp. (SOL 2 - Sci)
4. Record observations or measurements (data tables or graphs) (SOL 2 - Sci)
5. Use metric units (SOL 3 - Sci)
6. Record information gathered (SOL 3 - Sci)
7. Infer cause and effect (SOL 3 - Sci)
8. Infer causes of observed event (SOL 4 - Sci)
9. Use data to make inferences (SOL 4 - Sci)
10. Process skills for problem-solving (SOL 6 - Sci)
11. Use appropriate tools and units of measurement to observe (SOL 6 - Sci)
12. Scales and balances (SOL 1 - Math)
13. Weigh and compare weights (SOL 2 - Math)
14. Bar graphs (SOL 2 - Math)
15. Interpret pictures and graphs (SOL 2 - Soc Stud)
16. Landmarks (historic) (SOL 2 - Soc Stud)
17. Periods of history (U.S. and World) (SOL 5. 6. - Soc Stud)
18. Applications of problem-solving skills (brainstorming, fluency, and generating alternatives)

Introduction:

Place the STRUCTURE banner on the chalkboard. Ask the students to name all the different types of structures that they can. Record the list on the board beneath the banner.

(Examples: sentence structure; political structure; building structure)

Define the term structure as it will be used in this lesson.

Select from the above objectives those which the students will satisfy. Write those objectives on the board. tell the students what they will be doing (building two structures) and how the activities will enable the students to satisfy the stated objectives.

Inform the students that as builders it is necessary to hold (possess) certain skills and knowledge. Thus, before beginning the structure challenges, the students must be checked to verify that they have the needed tools.

The teacher should introduce the weight scale and the geometric vocabulary. Demonstrate how to use the scale and how each geometric shape looks. Use different colored chalk for each figure and label each figure. Also, draw the figures in different positions. For instance, draw a right triangle that is reversed. See that the students can use the weight scale properly and accurately. See that they correctly identify the geometric figures.

Discussion on Structures

Display travel posters or magazine pictures on the board. Refer to the display during the discussion.

The following points should be emphasized during the discussion:

- (shapes) come in various sizes, shapes, and materials
- structures stand as tributes to human accomplishments in design and engineering
- (architecture remains as testimony to the culture and values of the builders long after they die)
- historic structures such as the Egyptian pyramids, castles and cathedrals were built by physical strength
- advancement of technology - with this advancement the craft of building has become a science (i.e. Hampton Roads Bridge Tunnel, VA or the Golden Gate Bridge, CA)
- builders adapt materials and techniques to design structures for new, and sometimes difficult, environments.

Discussion on Building Frame

Display the FRAMEWORK FOR THE FUTURE banner.

Make the following points before introducing the first construction activity:

- a building begins with a skeletal frame (define frame)
- structures are built around the frame

ACTIVITY 1:

Students will build a simple frame with toothpicks and marshmallows.

Pair each student with another student.

Give each 2-member team a sandwich baggie which contains 20 toothpicks and 20 marshmallows.

Give each team two sheets of drawing paper and two pencils.

Designate one team member as the "builder," and designate the other member as the "architect," or drawer.

Instruct each team "builder" to take 9 marshmallows and 15 toothpicks from the baggie. Each builder is to use all of them to construct a free-standing frame.

Ask the architects to draw his/her team's finished model.

Next, have each team count the number of squares, triangles, diagonals, and rectangles in their model. Record the numbers beneath the sketch. Label the sketch, A.

Disassemble the frame and put the toothpicks and marshmallows back into the baggie.

Discussion on Building Frame (continued)

- an important element to a frame is that it be strong
- the frame must be able to support the components which make up the structure (i.e. Home - roof, chimney, windows, doors, steps)

ACTIVITY 2:

Same materials as those in ACTIVITY 1.

Have team members switch roles. The builder becomes the architect and the architect becomes the builder.

Have the new "builder" remove 15 marshmallows and 9 toothpicks from the sandwich baggie.

Instruct the teams to build a frame which is structurally strong. The finished frame is to use exactly 15 marshmallows and 9 toothpicks. It is to be able to hold a small paper cup containing at least two coins (teacher's choice of coin).

While the builder is constructing, have the architect weigh the cup and record the weight. Next, have this student weigh one coin, two coins, up to ________ coins. Record the amount.

Instruct the architect to make a sketch of the model after the construction is finished. Label the sketch, B.

Instruct each team, again, to count the number of geometric shapes and record the numbers beneath the drawing.

Next, place the cup on top of the structure (you may need to place a thin cardboard section across the frame to serve as a foundation to which the cup can sit). Add one coin. Continue adding a coin to the cup until the structure buckles or falls over. Calculate how much weight the structure was able to hold.

Compare Structure A with Structure B. Consider these questions:

a. What do you notice about the geometric design of the two sketches? How are they similar? Different?
b. What geometric shapes do you find?
c. Which structure had more rectangular shapes? More triangles? More diagonals?
d. Which structure do you think would be able to handle more weight and stress? Why?

Conclusion:

Restate the objectives and ask the students to indicate who they were able to satisfy the objectives.

Restate this Structures Discussion Point: Builders adapt materials and techniques to design structures for new, and sometimes difficult, environments.

Point to the FRAMEWORK banner. Tell students that in the next lesson they will look to the Space environment and will be given a final construction challenge. Prior to the challenge, they will view a videotape and witness the construction of a structure in Space. Following this the students will be challenged to use today's lesson and what they observe on the videotape to tackle their own Space truss structure.

Extensions:

1. Have the students measure the height of Structure A and Structure B. Which structure is taller? Find the class average for both structures.
2. Using 14 marshmallows and 20 toothpicks, make a structure that is strong enough to hold a hardcover book.
3. Using an unlimited number of marshmallows and toothpicks build a bridge between two chairs 30 cm (1 ft.) apart. The bridge must be capable of holding a paper cup containing five quarters.
4. DESIGN BRIEF

Using plastic driking straws, construct a freestanding tower that can support a tennis ball at its pinnacle.

Design Specifics:

- Standard plastic drinking straws and straight pins
- Support tennis ball for at least 60 seconds
- Tallest structure that is able to hold the ball for 60 sconds win
- Team effort

Design Constraints

- Time limit of 30 minutes to construct
- Scissors are the only tools permitted

5. APPLICATION FOR MARS FLIGHT

Congratulations! You have been offered a chance to apply for a position of crew member for the first flight to Mars. However, you have to pass a test. You must convince the advisory panel of your qualifications for the flight. You must convince them that your skills are important to this first visit to the red planet. Here is the application form:

Name: Age:

Occupation:

In the space below, briefly tell us why your occupation is important for this flight and why you should be considered.

If you are selected, you will undergo an extensive training session prior to your flight. When the day arrives for your flight, you will be allowed to take along 25 pounds of personal items. Remember to consider what you want to do when you have free time. Also, remember your TV time will be subject to the desires of all the other crew members and will become almost impossible when you near Mars due to the distance from the Earth. List what items you want to take just for yourself... be specific....

6. LARGE SPACE STRUCTURE

NASA has asked Congress for funding to design, construct, and launch into Earth orbit by the 1990's a Large Space Structure (Space Station). Your task is that you have been selected to work on one of the NASA decision making teams. Your instructions are listed below. Congratulations and good luck on your appointment!

☐ 1. Design, construct and place your structure into space.(Your report should include a drawing and description of the structure shape. A listing of materials used in construction must also be included. Also, a step by step report on how the structure will be placed in space and where it should be placed. On this report you should include any other pertinent data to successfully complete your part of the task.)

☐ 2. Staffing of the Large Space Structure.(Your task is the selection of a group of people to man the space structure and an explanation as to why these people were selected. A list of possible candidates will be provided.)

☐ 3. Function of the station. (Your duty is to decide what will be the function of this station in space. Should it be military or a non-military? This and other questions will need to be answered.)

☐ 4. Nationality of Space Structure Inhabitants. (Should this station be operated solely by Americans or should this be an international work station? Your decision must be supported by statements explaining why.)

7. POTENTIAL PERSONNEL FOR SPACE STRUCTURE

OCCUPATIONS

1. doctor
2. nurse
3. lawyer
4. teacher
5. cook
6. military person
7. news media representative
8. librarian
9. policeman
10. computer expert
11. communication expert
12. minister
13. politician
14. astronaut
15. janitor
16. administrator
17. fireman
18. phychiatrist
19. pharmacist
20. aeronautical engineer
21. mechanical engineer
22. astronomer
23. geologist
24. meteorologist
25. rocket expert
26. mathematician
27. director of entertainment
28. historian
29. mechanic
30. others

NOTICE!!!!

Because of a budgetary cut-back, the funds for personnel hiring have drastically been cut. You will only be able to select 10 people to staff the station in the beginning. Please list them and give reasons for their selection. (If funds become available, some of you will be able to select 5 more individuals. Those decisions will depend on the reason you state for the the 5 additional staff you decide to take if possible. Be sure that your statements are convincing!)

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A TEACHER'S COMPANION TO THE SPACE STATION: A MULTI-DISCIPLINARY RESOURCE

The following lessons are excerpts from
A Teacher's Companion to the Space Station:
A Multi-Disciplinary Resource,
a project of Martin Marietta and the
Louisianna Nature and Science Center.
This booklet is available at the NASA Teacher Resource Centers.

PHYSICAL EDUCATION LESSON PLAN

The students will design new rules for the "Olympic Games in Space".

TERMINAL OBJECTIVE
The student will design new rules for one of the Olympic events in space.

PROCEDURE
The teacher will present a discussion of the effects of gravity and friction on movement in the traditional Olympic events.

ASSIMILATION
The students will list the new rules for his Olympic event in space and explain his reasoning for each.

ENRICHMENT
Design exercise machines, training machines, and/or workout machines for weightlessness.

2. HYGIENE

Anti-bacterial sponges and showers will be provided. Shower water will be recycled.

3. SANITATION

a. Ordinary waste will be compacted and returned to Earth.
b. Human waste: (1) Urine will be recycled (through distillation) or evacuated to space. (2) Solid wastes will be freeze dried and returned to Earth in the logistics module.

II. WHAT ARE MAN'S PSYCHOLOGICAL NEEDS AND HOW WILL THEY BE MET IN SPACE?

A. SOCIAL

1. A sense of community, a relational context - (National context; United Nations context). While the Space Station is a miniature Earth nation, it is also an international microcosm. The U.S. will be joined in the Space Station by Japan, the 10 nations of the European Space Agency (ESA), and Canada. Also, astronauts of many other nations may eventually work abroad.

CIVICS LESSON PLAN

OBJECTIVE
The students will research, prepare and conduct a "United Nations" Security Council debate on the rights of nations in space.

SUGGESTED RESEARCH SOURCES
- Congressional Representative.
- The "Outer Space" treaty (below) from the security Council of the United Nations, January 27, 1967
- Aviation Week and Space Technology Magazine, 1986 issues contain a number of articles tracing the negotiations, disagreements, etc., occurring between the U.S. and the nations involved in the Space Station project.

PROCEDURE
The teacher will present a review of research techniques, debate techniques, and United Nations structure. The students will assume the roles of the nations involved and debate the issues raised in the Aviation Week and Space Technology articles and/or "The Outer Space Magna Charta" summarized below.

ASSIMILATION
The students will present a debate proposal to the teacher.

EVALUATION
The students will conduct the debate and vote on the issues.

LESSON CONTEXT
"A Treaty of Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies."

1. International law and the charter of the United Nations shall apply to space activities.

2. Outer space and celestial bodies are the province of mankind and shall be used only for peaceful purposes and for the benefit of all mankind.

3. Nuclear weapons, weapons of mass destruction, military bases, and military maneuvers are banned from space.

4. Outer space shall be free for exploration, use, and scientific investigation.

5. There can be no claims of sovereignty or territory by nations over locations in space, by means of use or occupation or by any other means.

6. Jurisdiction over space objects launched from Earth shall be retained by launching state.

7. Private interests are recognized as having freedom of action in space, so long as a government or group of governments on Earth authorize and exercise continuing supervision over their activities. Signatory nations (78 at last count, including the United States and the Soviet Union) are therefore under a duty to oversee the activities of their citizens and commercial ventures in space.

8. Governments are liable for damage caused on earth by their space objects.

9. Astronauts are "envoys of making" and are entitled to non-interference and all necessary assistance in distress.

10. The natural environments of celestial bodies should not be seriously disrupted, and Earth must not be contaminated by extra-terrestrial organisms".12

12 Summary reprinted from The Teacher in Space Project, by Thomas P. Descair, "A Treaty of Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies." Wash. D.C. Government Printing office, 1985. p15.

2. Shared goals, espirit de corps: A union arising from common interests, team spirit.

B. INDIVIDUAL

1. AVOIDANCE OF CROWDING TENSION

ART/PSYCHOLOGY/ENGLISH LESSON PLAN

THE PSYCHOLOGY OF COLOR AND ITS EFFECT ON MAN'S SENSE OF ROOM SPACE

Astronauts who have experienced extended stays in space have reported that they have missed colors, that the lack of color comprised a discomfort and a deprivation. Color has psychological effects on people who live in confined spaces for extended periods of time.

PREMISE
Colors, shapes, and patterns have psychological effects on emotional comfort/ discomfort, "size" of environment (feeling of space), passive/aggressive behavior, work/ energy levels.

HYPOTHESIS
Enclosed environments can be designed for psychological effect.

APPLICATION
The living model should have a restful effect on astronauts. The laboratory module should foster productivity.

ART OBJECTIVE
Design the color scheme for the habitation module or laboratory module of the Space Station.

PSYCHOLOGY OBJECTIVE
Given library research, presents a report of the effect of color on aggressive/passive behaviors. Example: psychological studies have shown that a certain shade of pink has an enervating and calming effect. Studies have proven that a man can lift less weight after being exposed to a particular shade of pink. This pink has been used in prison containment tanks to calm fighting inmates.

ENGLISH OBJECTIVE
After limiting the topic, the student will utilize his library skills to write a report (or documented essay, or research paper) on some aspect of the psychological values of colors, shapes, and patterns and how they affect emotional comfort/discomfort, work/ energy levels, and/or passive/aggressive behavior.

MATERIALS
- colored posters
- a system of attaching posters to the classroom wall.
- Note: The same objectives can be attained with a scale model.

PROCEDURE
The psychological values of color, shape, and pattern. The students will design a wall of the Space Station habitation module or the laboratory module. Note: See the Space Station parameter sheet for module dimensions and details.

LESSON CONTENT

I. COLOR
1. Color Values
• Cool colors: Do cool colors have a relaxing effect? Can they make one feel cold? Do cool colors expand one's sense of room space?
a. Blue
b. Green

• Warm colors: Do warm colors have a stimulating effect? Can they make one feel warm? Do warm colors "shrink" one's sense of room space?
a. Yellow
b. Orange
c. Brown
d. Mild Pink

• Hot Colors: Do "hot" colors have a more intensified effect than warm colors?
a. Hot Pink
b. Red

2. Primary vs. pastel: Do pastels have a softer feel to them than primary colors?

3. Shades: Light vs. dark: Do light colors "expand" one's sense of room space?

II. LINE

- Curve: Do curves provide a soft, warm, mellow psychological effect to an area?

- Angle: Do angles provide an energetic, tense psychological effect which may quicken mood and add to work output? Is a vertical line static while a horizontal line is a line at rest and a diagonal line is dynamic?

III. PATTERNS

- Stripes: Do stripes make a room seem taller?

- Polka dots: Do polka dots make a room seem "busy"?

- Do mixed sizes of polka dots create the illusions of motion and perspective?
- Super graphics: Do super graphics make a room seem larger?

NOTE: The answer to all the content questions above is "yes".

ASSIMILATION
The students will explain/justify their choice of color, shape, pattern for the habitation module or laboratory module.

EVALUATION
Each student will construct a model of habitation or laboratory module and a report justifying the rationale for his choices.

2. PRIVACY

3. QUIET (AVOIDANCE OF NOISE POLLUTION)
One of the ways that astronauts set up a "privacy space" is through control of sound. Some wear ear plugs for sleeping and for noise control. Many listen to music through earphones.

MUSIC LESSON PLAN

OBJECTIVE
The student will study music which has been written about outer space and space exploration. Examples: "Telstar" the Gustav Holst's "The Planets".

PROCEDURE
The students will research music titles which deal with space and space exploration. The class will choose a piece to learn and perform through voice or instrument.

ASSIMILATION.
The students will ask and answer questions during the lesson.

EVALUATION
The teacher will evaluate the students' recital of the musical selection.

ENRICHMENT
Holst is purported to have written each of the planets' selections based on the resonating frequency of the planet.

Note: "Holst: the Planets' is available in Dolbytm "B" by Leonard Bernstein with the new York Philharmonic, Columbia Records, Inc., 51 W. 52 Street, N.Y., N.Y.

III. WHAT ARE MAN'S CONTEXTUAL NEEDS AND HOW WILL THEY BE MET IN SPACE?

Note: Contextual - relational. How are all things, beings, linked together in a sphere of interdependence and shared meaning? What is the hierarchy of importance of things and beings? What is man's relationship with the universe on the physical level and on the philosophical level of meaning?

A. PHYSICAL KNOWLEDGE OF THE UNIVERSE

1. POINTED "INWARD": REMOTE SENSING OF THE EARTH.

One of the major tasks of the Space Station will be to provide a systematic picture of the Earth on an ongoing basis. It will provide not only geological surveys for prospecting purposes, crop surveys for economic and political purposes, but will also provide a reliable platform for ecological study of the Earth and its ecosystems. Pollution monitoring will be a major part of this ecological study; prevention and recovery from pollution will become a more exact science. Air, water, and land pollution will be studied on an ongoing basis and will provide information which will enable man to administer the environment more responsibly.

a. ECOLOGICAL CONCERNS: FOOD CHAIN

During the 1970's, the "Environmental Decade", Congress passed the laws listed below in a national determination to protect the ecological balance; which so affects the good chain. "The new laws, strong enough to challenge abuses to our environment, gave rise to new business and changed the operating procedures in old business. In many cases, new projects can no longer be undertaken without first seriously considering their effects on the environment of which we are all a part. Looking back on that decade, it is clear that the United States took a new direction in protecting enviromental quality".

ENGLISH LESSON PLAN

The students will read "King of Beasts" by Philip Jose Farmer and analyze its significance in the ecological debate in light of the fact that from the Space Station the Earth is viewed as a whole to be protected by mankind.

PROCEDURE

The students will read the short story and the teacher and students will discuss the food chain, the ecological debate, and the message of this dystopian (anti-utopian) story.

ASSIMILATION

The students will ask and answer questions during the lesson.

EVALUATION

The students will write an analysis of the short story and its message that man is the most dangerous beast in the jungle because of his sometimes callous treatment of the environment.

ENRICHMENT

Research the warnings of scientists as regards the effects of pollution on the food chain.

LESSON CONTENT

THE KING OF BEASTS
by Philip Jose Farmer

The biologist was showing the distinguished visitor through the zoo and laboratory.

"Our budget," he said, "is too limited to re-create all known extinct species. So we bring to life only the higher animals, the beautiful ones that we wantingly exterminated. I'm trying, as it were, to make up for brutality and stupidity. You might say that man struck God in the face every time he wiped out a branch of the animal kingdom."

He paused, and they looked across the moats and the force fields. The quagga[14] wheeled and galloped, delight and sun flashing off his flanks. The sea otter poked his humorous whiskers from the water. The gorilla peered from behind bamboo. Passenger pigeons strutted. A rhinocerous trotted like a dainty battle. With gentle eyes a giraffe looked at them, then resumed eating leaves.

"There's the dodo.[15] Not beautiful but very droll. And very helpless. Come. I'll show you the re-creation itself."

In the great building, they passed between rows of tall and wide tanks. They could see clearly through the windows and the jelly within.

"Those are African elephant embryos", said the biologist. "We plan to grow a large herd and them release them on the new government preserve." "You absolutely radiate," said the distinguished visitor. "you really love the animals, don't you?"

"I love all life."

"Tell me", said the visitor, "where do you get the data for re-creation?"

"Mostly, skeletons and skins from the ancient museums. Excavated books and films that we succeeded in restoring and then translating. Ah, see those large eggs? The chicks of the giant moa[16] are growing within them. These, almost ready to be taken from the tank, are tiger cubs. They'll be dangerous when grown but will be confined to the preserve."

The visitor stopped before the last of the tanks.

"Just one?" he said. "What is it?" "Poor little thing," said the biologist, now sad. "It will be so alone. But I shall give it all the love I have."

"Is it so dangerous?" said the visitor.

"Worse than elephants, tigers, and bears?"

"I had to get special permission to grow this one," said the biologist. His voice quivered.

The visitor stepped sharply back from the tank. He said, "Then it must be...But you wouldn't dare!"

The biologist nodded.

"Yes. It's a man."[17]

[14] quagga: an extinct South African ancestor to the zebra and horse
[15] dodo: an extinct bird
[16] moa: an extinct New Zealand bird
[17] The King of Beasts" by Philip Jose Farmer.

PHYSICAL SCIENCE - OVERVIEW

August Fratteli, Fairfax County Public Schools

Physical Science is an important area for students to study to understand what is happening in their daily lives. We live in a technical world of cars, computers, robots, space shuttles, etc. In most of our students lifetimes we will have a working space station, start a space colony on the moon, and will land on Mars. It is important to motivate students to understand physical science and encourage them to enroll in classes that deal with these concepts in high school and college.

The videoconference and activities are designed to give students an opportunity to explore physical science concepts using everyday materials. It will also show the importance of these Laws to the flight of the Space Shuttle and future space vehicles.

Materials needed for videoconference May 9, 1990.

Balloons (1 per student)
Meter stick or yard stick (if possible, 1 per student)
Sheets of scrap paper for each student

VOCABULARY

Acceleration - The rate at which velocity changes.

Angle of Attack - The angle at which the wing meets an air stream.

Attraction - A force which tries to draw two objects together

Drag - The resistance the air presents to the movement on an object through the air. Drag encountered on an object relates to its shape and speed of the object.

Force - An influence which produces or tends to produce motion or change of motion. Push or a pull.

Lift - Lift is produced by (a) the difference in the speed of air flowing around a wing surface (Bernoulli's Principle). (b) the angle of attack.

Mass - The amount of material a substance contains.

Momentum - Product of the mass and the velocity of an object.

Velocity - Speed in a certain direction.

Weight - Force of gravity on a mass.

Work - Work is done when a force moves an object.

PRINCIPLE: GRAVITY

DEFINITION:
Newton's Universal Law of Gravity - Every body of matter in the universe attracts every other body with a force that is directly proportional to the product of the masses of the two bodies and inversely proportional to the square of the distance between them.

BACKGROUND:
Gravity's pull holds you on earth's surface and pulls back objects you throw into the air. Weight is produced by the attraction of gravity. The initial stage of a rocket must be the most powerful to overcome the pull of Earth's gravity. As a person gets farther from Earth, the weight decreases even though the mass remains the same. The weight of any object in space is equal to the mass times the gravitational attraction at that particular location. w=mg

An object that has gone into orbit around the earth is in an "almost" weightless condition because the earth's gravitational pull is balanced by the objects circular motion.

Newton's Law of Gravity states:

1. All bodies attract each other with what is called gravitational attraction.
2. The strength of a body's gravitational pull upon another is dependent upon its mass.
3. The closer two bodies are to each other the greater their mutual attraction.

E, S

ACTIVITY 1:

Throw a rubber ball vertically. Have students observe what happens. The ball starts slowing down as soon as it leaves the hand. The ball has a certain momentum as it leaves the hand. momentum = Mass x Velocity. The balls' mass does not change as it leaves the hand, yet the ball slows down, stops, and falls back to the ground at increasing speeds. What force is acting upon the ball?

ACTIVITY 2:

Materials:
Coffee can
Nail and hammer
Water
Ladder
Waste basket

1. With nail and hammer, place a hole at the bottom of can.
2. Have students put finger over hole and fill can with water. Student should let finger off of hole to show other classmates that water will pour out of hole.

3. Have student climb ladder making sure it is stable. Have another student at bottom of the ladder prepared to catch can with a waste paper basket.

4. When all is ready, instruct student to remove finger from hole and drop into trash can.

Why didn't the water pour out of the hole during the drop? The acceleration due to gravity is the same for all objects regardless of their mass. The can and water were in a state of "free fall". That's how astronauts float in space. The astronauts and their spacecraft are falling together. A bathroom scale on a shuttle would not record an astronauts weight since it is also in a state of free fall.

S

ACTIVITY 3:

Materials
String
Fishing lead weights
Flat metal cooking sheet pan.

1. Fasten lead sinkers to string at 10, 40, 90, 170, 250, 360, 490, and 640 cm from the floor.

2. Fasten string to ceiling and place metal pin underneath string.

3. Inform students that they are to listen to the lead weights strike the pan.

4. Cut the string. They hit at regular intervals even though the distance is different.

5. Repeat above steps except this time place the sinkers at 50 cm apart. They will strike at increasingly shorter intervals. What does this tell us about the speed of a free falling object?

6. Discuss the acceleration of objects during free fall. How does the shuttle falling through the atmosphere decrease this acceleration without any engines.

S

EXTENSIONS:

Newton states the force of gravity decreases in inverse proportion to the "square" of the distance between the two bodies.

Example: Twice the distance from the center of the earth is equal to one-fourth the weight at the original value. Three times the distance is equal to 1/9th the original value. Ten times the distance is equal to 1/100th the original value.

* Can you calculate the force of gravity on satellites, shuttle, moon, etc., by their distance from the center of the Earth.

E, S

OTHER ACTIVITIES:

1. A way of balancing the downward pull of gravity is hanging a balloon on a ceiling using static electricity.

2. Compare the speed of fall of two objects of identical size and shape but different weights.

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

3. Observe and record the change of speed of an object, or objects with different masses, rolling down an inclined plane as the angle of inclination is increased.

4. Drop steel balls into clay at different heights. The higher up the greater the depth of hole. Acceleration - objects at greater heights fall faster.

5. How do NASA space probes use gravity to aim them to another planet? "Gravity Assist"

6. Calculate a student's weight on another planet by multiplying their earth's weight time the other planet's surface gravity.

Surface Gravity

Mercury	.18
Venus	.91
Earth	1.00
Mars	.38
Jupiter*	2.34
Saturn*	.93
Uranus*	.85
Neptune*	1.14
Pluto	.04

* at cloud tops of gas planets.

PRINCIPLE: FRICTION

DEFINITION:
The resistance to motion between two surfaces moving over each other. Friction only appears when the surfaces try to move. If the moving force is not strong enough, friction prevents motion.

BACKGROUND:
It seems that something called a force friction is present in every slowing down process. In a space vehicle it is called resistance or drag. When a shuttle launches, it has to throttle down its engines to go through the atmosphere to reduce this resistance. Tiles are added to the shuttle so that it can survive the heat of re-entry. Much research into tires and brakes went into the shuttle so that it can land safely on a runway. At the Kennedy Space Center, runway grooves had to be removed because they were causing too much friction and wearing out tires. Friction is a force that must be added into any equation when developing new spacecraft. Something called the head barrier of an aircraft is the temperature at which the heat, caused by drag or friction, weakens the structural parts of a vehicle.

Two factors that affect friction are type of surface and weight. Smooth and even surfaces produce less friction as well as lighter objects compared to heavier objects. When work is done against friction this work changes into another form of energy - heat.

E, S

ACTIVITY 1:

Open up large umbrella in classroom. Have student come up, hold umbrella high, and pull down quickly. Describe the force. Air resists movement.

S

ACTIVITY 2:

Materials:
Meter stick
(2) 500 gram weights (or equivalent)
Spring scale that measures force in Newtons
Different types of surfaces - i.e., highly polished rough cement, glass, oiled surface, rug, etc.

1. Connect 500 gram weight to scale and pull across a surface 1 meter in length.

2. Record Newton's (force) when weight is in a sliding motion.

3. Repeat same procedures for other surfaces.

4. Calculate work done on each surface
   Work = force x distance
   (Newtons) (meters)

   Answer will be in Newton - meters
   1 Newton meter = 1 joule of work

5. Repeat above steps, only this time, use two 500 gram weights.

6. Discuss what two factors produce friction and what are some ways of reducing its effects.

S

ACTIVITY 3:

Materials:
Estes Model Rockets (Alpha III is easy to construct and durable)
Cost: $6.99

A-3 Rocket Engines from Estes - comes in packs of 3.

Igniters from Estes

Launch pad and power source - can be bought in pack wadding.

Different types of nose cones - can be made with the help of shop teachers or you can change shape of existing cone by sanding surfaces.

1. Launch an Estes Rocket with original cone and measure its altitude to find altitude (refer to overview section)

2. Change the nose cone so that it has a different shape. Launch again and measure altitude.

3. Repeat with different shaped nose cones. (flat, pointed, round, rough edges, etc.)

4. Chart results - What type of nose cones produced the least amount of drag?
   *It is important that each cone weighs the same. Clay can be added to accomplish this.

E, S

EXTENSION:

Introduce concepts of wasted energy and efficiency.

Other Activities:

1. Take two balls - one smooth and one rough and spin them in water. Which one stops first.

2. Launch different balloon shapes on a string.

3. Rub two pieces of metal together. Lubricate with oil. Repeat the process and discuss the difference.

PRINCIPLE: PERNOULLI'S PRINCIPLE

DEFINITION:

An increase in the speed of gas produces a decrease in pressure. Therefore, when air moves faster across the upper surface of an object, the amount of downward pressure of the air on the upper surface is less than the amount of upward pressure of the air on the lower surface. This causes lift on an aircrafts wing.

BACKGROUND:

Daniel Bernoulli was a Swiss scientist of the 18th century. He studied the relationship of fluid, speed, and pressure. Bernoulli's principle accounts for the flight of birds and aircraft. Wings are designed so that air moves over the top surface quicker than the lower surface. This causes a reduction in pressure on the top part of the wing. Since there is a greater pressure underneath the wing, the wing will lift upwards. When lift equals weight, flight is possible. Bernoulli's Principle can be experienced by a curve ball in a baseball game to the shower curtain becoming stuck to our leg during a shower.

E, S

ACTIVITY 1:

Place two tennis balls on a string and hang them so that there is a 5 cm gap between them. Ask students to predict what would happen if you took a straw and blew in between the two balls. Have student come up and blow a steady air stream between the two tennis balls. Due to Bernoulli's Principle they will come together.

E, S

ACTIVITY 2:

Materials:
Balloon - long rather than round
Tissue Paper
Fishing Line
Straw
Tape

1. Cut two pieces of tissue paper length 3 inches by width 1 inch.

2. Tape straw to side of balloon.

3. Slide straw with balloon through fishing line and tie line in a horizontal direction across the classroom.

4. Blow up balloon and have student hold nozzle closed. Connect the two pieces of tissue paper on the bottom of the balloons (one towards the middle and one back near the nozzle).

5. Have student bring balloon to one end of line and let go. (If balloon starts turning, you may want to tape a quarter to the bottom.)

6. Have students notice the tissue paper hanging down from the balloon in the two locations.

7. The middle tissue paper only moved slightly. The tissue hanging near the nozzle experiences an increase in air movement which reduced the pressure. Due to Bernoulli's principle that tissue paper moved toward the nozzle.

E, S

ACTIVITY 3:

Materials:
Rule
Tape
Index Cards
Straw
Six sided pencil

1. Form index card into a shape of a wing and tape to one end of the ruler.

2. Place the ruler on a six sided pencil with the wing end slightly lower.

3. With a straw, blow across the top of the wing surface.

4. If wing is shaped properly, student should see a lifting action.

5. Change the shape of wing and repeat above procedures.

9-12

EXTENSION:

To help visualize the air flow over different shaped wings, prepare a steam machine. Add hot water to dry ice in a flask that is set up with a cone hole stopper that contains a right angle tube. Direct the steam over the leading edge of the wings.

OTHER ACTIVITIES:

9-12

1. Place a candle so that the flame is in the center of a wide mouth funnel. Blow through the funnel and try to put out the flame. The air hugs the sides of the funnel. Almost none of your breath travels down the center. The flame flickers inward toward the funnel due to Bernoulli's Principle.

E, S

2. Suspend a ping pong ball in the airstream of a hair dryer.

E, S

3. Attempt to blow a ping pong ball out of a funnel. The air flow is exerted on the curbed side of the ball and will decrease the pressure and hold the ball.

PRINCIPLE: NEWTONS LAW OF MOTION

DEFINITION:

First Law: *A body at rest (or motion) will remain at rest (or motion) unless it is acted upon by a greater force.*

Second Law: *The acceleration of a body increases as the amount of force increases.*

Third Law: *For every action there is an equal and opposite reaction.*

BACKGROUND:

In 1665, Isaac Newton developed his famous Laws of Motion. They have dominated the thinking of the best minds for over 2,000 years. Every aspect of a rocket flight, from launch to landing depends on these laws. The three laws help us to understand how a rocket launches, how it accelerates to 17,500 mph as it orbits the earth. In this section I will combine the three laws. Teachers may want to handle each of Newton's Laws of motion separately.

E, S

ACTIVITY 1:

First Law

Pile a stack of checkers, about 5, on top of each other. Take another checker, and with a ruler, flick it hard at the bottom checker in the stack. The bottom checker should fly away but the rest of the stack will remain.

Second Law

Place 5 marbles in a line. (A chalk tray can be used for this experiment.) Roll a single marble into the other marbles. How many moved? Now take two marbles and roll toward the stack. What happens now? Acceleration of a body increases as the amount of force increases.

Third Law

Inflate a balloon which has been taped to a soda straw. Place the straw on a length of tight wire fastened to the floor and ceiling. Bring the balloon to the floor and release. Now inflate balloon only 1/2 full and then release. Action - equal and opposite reaction.

ACTIVITY 2:

E, S

First Law

Materials:
Weak string
Heavy book

1. Hang a book from a string.
2. Tie another piece of string from the book.
3. Grab the lower string and give it a steady, slow, downward pull.
4. Set up again but this time give a quick hard jerk.

The force of the pull plus the weight of the book were exerted on the top string when the pull was gradual. Inertia prevented the complete force of the fast, sudden jerk from traveling all the way to the upper string.

E, S

Second Law

Materials:
Basketball
Tennis ball
Tape

1. On a basketball, tape a tennis ball to its surface.
2. Drop the basketball to the floor. What happens to the tennis ball? (Caution students that the tennis ball will fly in the opposite direction toward them) the tennis ball goes off with the momentum it has plus the momentum of the larger ball.

E, S

Third Law

Materials
Two pails
Scale
Water or Sand

1. Stand on a scale. (Ask for volunteers - some students might be sensitive about their weight.) Fill two pails with water.
2. Slowly raise and lower the pails to side while observing weight. (Ask for volunteers to step on scale). As you raise your arms you raise your weight as your feet press down with an equal amount of weight on the scale to the floor. As you lower your arms the opposite will happen.
   Action reaction.

ACTIVITY 3:

E, S

First Law

Materials
Toy dump truck
Weights 500 gram
Rubber bands - medium width

1. Attach a rubber band to the front of a toy dump truck. Pull on the rubber band to move the truck at a constant speed.
2. Measure the distance the rubber band moved to start the truck moving.
3. What happened to the rubber band as the truck moved at a constant speed.
4. Repeat experiment with more weight.

Observe that more pull is needed at first to overcome inertia than is needed once the truck has started moving.

9-12

Second Law

Materials
3 different rocket engines (A-3, B-4, C-3, etc.)
Estes Rocket and launch equipment.

1. Launch a rocket with an A-3 Engine. Measure its height and record time it took to achieve height.
2. Repeat process with a B-4 engine and then a C-6 engine.
3. Chart the heights and time it took for rockets and compare and discuss. Any time the speed at which an object is moving is changed, the object is accelerated. If at a greater speed positive acceleration. If at a lower speed - negative acceleration.

Older students may want to determine some values for accelerations and velocities for model rockets.

$$V_2 = \left(\frac{F}{Wav} - 1\right) gt$$

Wav = average weight of rocket
F = force (average thrust of rocket engine)
g = acceleration due top gravity 32 ft/sec2
t = Time in seconds

S

Third Law

Materials:
Bottle
Cork
Tissue
Baking soda
Vinegar
10 round pencils

1. Wrap a teaspoon of baking soda in a tissue.
2. Insert in a bottle and add vinegar.
3. Quickly, cork loosely and shake mixture.
4. Lay bottle quickly on its side and the round pencils. Observe the action reaction as the cork pops out.

*For more dramatic results, coat bottle with vaseline.

OTHER ACTIVITIES:

E, S

1. On the bus hold a fish weight hanging down from a string in front of you. What happens when the bus moves forward? When it stops? Will you get the same reactions in your family car?
2. Put a marble in a cup that is on its side. Move cup rapidly toward the bottom of the cup. Move rapidly toward open end of cup. What happened?
3. Set a table in class with heavy plastic dishware and a "smooth" table cloth without borders. Grab the cloth with two hands and see if the plates have inertia. (Teacher's discretion)
4. Place a dollar bill between two glasses (stacked top to top). Can you get the dollar bill out without breaking the glasses? Remember - inertia. (With younger students use heavy plastic glasses.)
5. Connect a tennis ball to a string and twirl it around your head. Let go! In which direction did it travel curved or straight line?

6. Standing on roller skates or sitting on a swing, toss a milk carton full of sand to a friend. Skates must be straight and you need spotters. Measure the action and reaction. Take 1/2 the sand out. Same action and reaction?

E, S

7. Make a list of Newton's Three Laws of motion and give examples of them in every day life situations.

8. Drill a hole in a tennis ball with smallest bit you can find. Fill the balloon with fine sand and reseal the hole so that it is not visible. Have students throw several normal tennis balls then slip in the weighted ball. Why was the weighted ball more difficult to throw?

   F = ma

S

9. (Under teacher supervision) obtain a water rocket and pump. (Outside activity with goggles.) Weigh and record rockets weight. Determine volume of rocket by displacement using water and graduated cylinder. Fill rocket 1/4 full and record volume in cc. Pump rocket 15 times. (May vary depending on rocket size). With a stopwatch have a partner time the rocket from launch until it reaches its highest point. (Make sure rocket is launched vertical.) Repeat experiment two more times - 1/2 full and 3/4 full.

   Set up tables to record.

   1. Trial
   2. Time
   3. Mass/Rocket
   4. Mass of Fuel

S

EXTENSION:

Add weight to the nose cone with clay to increase rockets mass - repeat above trials.

E, S

OTHER SUGGESTED ACTIVITIES: TOYS IN SPACE

An excellent resource for all teachers and ages is the Toys In Space Project. A group of toys were brought aboard a space shuttle flight to see how they react in space compared to each operation. The toys are inexpensive and most students can locate them in their homes. A copy of the lesson plans are available at your local NASA Teacher Resource Center.

Suggested activities include:

1. Give a different toy to a small group of students.

2. Record how each toy functions on Earth.

3. Allow students to predict how toys will behave in space.

4. Show video "Toys In Space" (short version) available from NASA Core 216-774-1051.

These activities introduce many physical laws and are fun for the students.

Another highly motivational activity for students is the launching of model rockets. Students actually design, build, and launch the rockets using solid propellant. It is a safe and easy activity to do with students. In some of the activities listed here there are some that use student made rockets. Some activities require students and teachers to measure the altitude of the rockets in flight. An excellent reference to accomplish this is Technical Reports TR-3 or TN-5 by Estes Industries. They both offer a variety of ways to accomplish this task.

OBJECTIVES:

1. For students to state and apply to examples Newton's Laws of Motion and Gravity, Bernoulli's Principle, and the force of friction.

2. To provide hands-on activities to motivate students using everyday materials.

3. To show the importance of physical sciences to space vehicle design.

4. For students to gain a better understanding of space physics.

5. To give teachers activities to do in the classroom and resources that will enable them to make space science an integral part of the curriculum.

CLASSROOM AND GROUP ACTIVITIES

S

1. Obtain NASA Fact sheet on space launch vehicles, KSC 135-81 and compare size and weight of rockets with total thrust capabilities.

S

2. Develop bulletin boards that illustrate historical flights of rockets, their functions, and their capabilities.

E, S

3. Develop an anthology of songs and poems related to flight.

S

4. Develop time lines on developments in rocket research. (pictorial)

E, S

5. Take a class trip to a NASA visitors center.

E, S

6. Investigate the difference between an orbit and a revolution.

E, S

7. Read about Issac newton in school library. Do a report on his laws of gravity and motion and how they apply to everyday life.

E, S

8. Demonstrate the principles involved in orbiting satellites.

S

9. Purchase an Estes Designer kit for model rockets, and as a class design and construct a working rocket. Test for weights, stability, speed, altitude, distance, recovery system, etc. What laws and principles apply?

SOURCES FOR ADDITIONAL INFORMATION

Elementary School Aerospace Activities
A Resource For Teachers
NASA

A Teacher's Companion to the Space Station:
A Multi-Disciplinary Resource
A Project of Martin Marietta and the Louisiana Nature and Science Center

Wings and Things
Norman D. Poff
NASA

NASA Aerospace Education Services Project
Oklahoma State University
Stillwater, OK

Exploration Station Activities
Kennedy Space Center
NASA

NASA Educational Briefs
Teacher Resource Centers
NASA

The Laws of Motion and Model Rocketry
Robert L. Cahnon
Estes Industries

Aeronautic Adventure
NASA Langley Research Center
Developed by Shelly Canright

NASA Fact Sheet
KSC 130-81
Propulsion Fundamentals
NASA Teacher Resource Center

COMPUTER SOFTWARE

Source: *Software For Aerospace Education - NASA*

Title:	Aeronautics Disk
Type:	Utility
Producer:	Science Software
Grade Level:	7-12
Cost:	$19.95
Systems:	IBM, Commodore, Amiga

Title:	Aerodynamics of Model Rockets
Type:	Tutorial
Producer:	Estes Industries
Grade Level:	7-A
Cost:	$44.95
Systems:	Apple II

Title:	Glidepath
Type:	Simulation
Producer:	HRM Software
Grade Level:	6-9
Cost:	$69.00
Systems:	Apple II

Title:	Principles of Flight
Type:	Tutorial
Producer:	Federal Aviation Administration
Grade Level:	4-6
Cost:	Free
Systems:	Apple II

Title:	Gravity
Type:	Simulation
Producer:	Cross Educational Software
Grade Level:	9-A
Cost:	$40.00
Systems:	IBM

COMPUTER SOFTWARE (Con't)

Title: Newton's Third Law
Type: Tutorial
Producer: Prentice-Hall Courseware
Grade Level: 6-12
Cost: $69.00
Systems: Apple II, IBM, Tandy

Title: Physics
Type: Tutorial
Producer: Sensel
Grade Level: 9-12
Cost: $99.95
Systems: Apple II

Title: The Physics of Model Rocketry
Type: Simulation
Producer: Venier Software
Grade Level: 9-12
Cost: $24.95
Systems: Apple II

Title: Simon
Type: Simulation
Producer: Micro Innovations
Grade Level: NR
Cost: $36.75
Systems: Apple II

Title: Sir Isaac Newton's Games
Type: Game
Producer: Sunburst Communications Inc.
Grade Level: 4-A
Cost: $59.00
Systems: Apple II, IBM, Tandy

Title: ASTROCAD: Performance Analysis for Model Rockets
Type: Utility
Producer: Estes Industries
Grade Level: NR
Cost: $19.95
Systems: Apple II

Title: The Physics of Model Rocketry
Type: Tutorial
Producer: Estes Industries
Grade Level: 9-8
Cost: $24.95
Systems: Apple II

Title: Orbit II
Type: Simulation
Producer: Venier Software
Grade Level: 9-12
Cost: $24.95
Systems: Apple II

Title: Satellite Orbits - Newton
Type: Simulation
Producer: Edward Arnold Ltd.
Grade Level: 9-A
Cost: $45.00
Systems: Apple II

NASA VIDEO PROGRAMS

Source: *Video Catalog - Goddard Space Flight Center Teacher Resource Laboratory and NASA CORE*

Toys In Space (Short Version)
1986/16:38
Film clips from the 51-D shuttle mission are shown after each toy is introduced showing how they really did behave in space. A popular tape.

Zero G & Gyroscopes In Space
1974/15:00
A fascinating introduction to the weightlessness aboard space station Skylab. Experiments are performed in zero gravity. A perfectly free spinning gyro is observed for the first time.

NASA's Get Away Special
1983/30:00
Your opportunity to fly an experiment in space. Includes technical requirements and prohibitions.

Reflections
1978/16:15
Aesthetic and philosophical look at the earth from Astronaut Rusty Schweickart's flight on Apollo 9.

Lunar Sample Education Project
1978/7:00
Brief explanation of the program and security requirements for participants.

Astounded At The Past
1987/30:00
Covers the developments in aviation from the Wright Brothers to the most modern experiments. Contains brief interviews with the engineers involved with the various projects.

Aeronautical Oddities
ND/Black and White/16:00
A comical look at early attempts to fly. The program, composed mainly of excerpts from newsreel footage, shows both failures and successes.

Space For Women
1981/27:30
Traces the work opportunities for women at NASA. It tells how women feel to be working at NASA and how they achieved what they have gained.

What It Takes To Become An Astronaut
ND/20:00
An interview with Astronaut Guy Bluford held at the NASA Lewis Research Center. Major Bluford discusses the requirements needed to become an astronaut and the importance of setting high goals for oneself at an early age.

Preparing Today For Tomorrow
1988/32:00
Four students from a class of 11 and 12 year olds tell of their visit to the NASA Langley Research Center. They interviewed people from the different professions to discover what training and preparation was necessary to work for NASA. This tape was produced as part of the Teacher In Space Project.

Eating And Sleeping In Space
1985/28:45
Astronaut Sally Ride discusses eating and sleeping in space.

NASA VIDEO PROGRAMS (Con't)

Space Station: The Next Logical Step
1984/15:00
The tape discusses the possibilities of living and working in space and why it should be considered the next logical step in space exploration.

Zero G
1974/15:00
A fascinating introduction to weightlessness aboard space station Skylab.

Astrosmiles
1986/23:30
Popular with all ages. Educational and entertaining. Composite footage of post-flight press conferences showing life aboard the shuttle.

Liftoff Footage
1987/8:30
Dramatic liftoff footage for use in assembly and/or musical programs.

It Looks Good On Paper
1986/24:44
Astronauts and Engineers are shown in real-life test and evaluation exercises at the Johnson Space Center. The complexities of the test and evaluation process are highlighted.

Mars: The Next Step
1986/6:00
This video establishes that an expedition to Mars is possible in our lifetime. It covers a scenerio of a mission to Mars involving three vehicles launched from Earth orbit. six months of interplanetary travel. and establishing a base on martian soil.

Earth Views From Shuttle Orbit
1986/No Sound Track/26:00
Earth views from space. Great for social studies or geography classes.

Legacy Of Skylab
1979/9:00
Utilizes onboard photography from Skylab to provide a visual indication of what life on the space station was like. Emphasis is on the zero-g environment.

Shuttle Flow At KSC
1984/22:00
The complicated work involved in processing the Space Shuttle's flight components at the Kennedy Space Center is shown.

The Young Astronaut Program
1987/9:35
A promotional videotape from The Young Astronaut Program.

A Conversation With Barbara Morgan
1986/60:00
Barbara Morgan shares her experiences as a Teacher In Space participant after the Challenger tragedy on "Schoolview".

Rocket Propulsion
ND/20:00
A lecture demonstration on the principles of solid and liquid rockets.

The Sky Is Your Classroom (Teacher Workshop)
1981/30:00
A taped teacher workshop to help acquaint teachers with the new knowledge gained by NASA research so that teachers can pass on this information to their students.

SOURCE LIST

NASA CENTERS	*SERVES STATES*	
NASA Langley Research Center Teacher Resource Center Mail Stop 146 Hampton, VA 23665 (804) 865-4468/3017	Kentucky North Carolina South Carolina Virginia West Virginia	
NASA Goddard Space Flight Center Teacher Resource Laboratory Mail Code 130.3 Greenbelt, MD 20771 (301) 286-8570	Connecticut Delaware District of Columbia Maine Maryland Massachusetts	New Hampshire New Jersey New York Pennsylvania Rhode Island Vermont
Ames Research Center Teacher Resource Center Mail Stop 204-7 Moffett Field, CA 94035 (415) 694-6077	Alaska Arizona California Hawaii Idaho Montana	Nevada Oregon Utah Washington Wyoming
Jet Propulsion Laboratory Teacher Resource Outreach Mail Stop CS-530 Pasadena, CA 91109 (818) 354-6916	Alaska Arizona California Hawaii Idaho Montana	Nevada Oregon Utah Washington Wyoming
John F. Kennedy Space Center Educator Resource Library Mail Stop ERL Kennedy Space Center, FL 32899 (305) 867-4090	Florida Georgia Puerto Rico Virgin Islands	
Lyndon B. Johnson Space Center Teacher Resource Center Mail Stop AP-4 Houston, TX 77058 (713) 483-8696	Colorado Kansas Nebraska New Mexico North Dakota	Texas
John C. Stennis Space Center Teacher Resource Center Building 1200 Stennis Space Center, MS 39529 (601) 688-3338		

Lewis Research Center Teacher Resource Center Mail Stop 8-1 Cleveland, OH 44135 (216) 433-2016/2017	Illinois Indiana Michigan Minnesota Ohio	Wisconsin
Marshall Space Flight Center Alabama Space and Rocket Center NASA Teacher Resource Center Huntsville, AL 35807 (205) 544-5812	Alabama Arkansas Iowa Louisiana Mississippi	Tennessee

SPACE ORGANIZATIONS

Young Astronaut Council
1211 Connecticut Avenue, NW
Suite 800
Washington, D.C. 20036
(202) 682-1985

Education Resource Center
Office of Education P-700
National Air and Space Museum
Smithsonian Institution
Washington, D.C. 20560
(202) 786-2106

Challenger Center for Space
Science Education
1101 King Street
Suite 700
Alexandria, VA 22314
(703) 683-9740

National Science Teachers
Association (NSTA)
1742 Connecticuit Avenue, NW
Washington, D.C. 20009
(202) 328-5800

Aerospace Education Association
1810 Michael Farady Drive
Suite 101
Reston, VA 22090
(703) 620-6747

American Association of
Physics Teachers
5112 Berwyn Road
College Park, MD 20740
(301) 345-4200

U.S. Space Camp
Alabama Space and Rocket Center
One Tranquility Base
Huntsville, AL 35807
1-800-633-7280

American Society for Aerospace Education
821 15th Street, NW
Washington, D.C. 20005

National Aerospace Education Association
Middle Tennessee State
University
Box 59
Murfreesboro, TN 37130

Aviation Education Programs Division
Office of General Aviation
Federal Aviation Administration
Washington D.C. 20402

Students for the Exploration
and Development of Space
Room W20-445
Massachusetts Institute of
Technology
77 Massachusetts Avenue
Cambridge, MA 02139

PUBLICATIONS, PACKETS, AND MAGAZINES

NASA Report to Educators A Periodical of the Educational Affairs Division
Code XE
NASA Headquarters
Washington, D.C. 20546
(202) 453-1000

Center for Aerospace Education Development
Civil Air Patrol
Headquarters, CAED
Maxwell, A.F.B. AL 36112

Air and Space Smithsonian
Air and Space Museum
Smithsonian Institution
Washington, D.C. 20560
(202) 357-1300

Aerospace Facts and Figures
by Aerospace Industries
Association of America
Available through:
McGraw Hill Publications
1221 Avenue of the Americas
New York, NY 10020

AIMS Education Foundation
P.O. Box 7766
Fresno, CA 93747

U.S. Government Printing Office
Main Office
710 North Capital Street
Washington, D.C. 20402

Junior Engineering Technical Society
JETS Report
1420 King Street
Suite 405
Alexandria, VA 22314

Aviation Week and Space Technology
McGraw Hill Publications
1221 Avenue of the Americas
New York, NY 10020
(212) 512-2000

VIDEOS, SLIDES AND FILMSTRIPS

NASA CORE
Lorain County JVS
15181 Route 58 South
Oberlin, OH 44074
(216) 774-1051
Extension 293 or 294

MODEL ROCKETS AND AIRPLANES

Estes Industries
P.O. Box 227
Penrose, CO 81240

Flight Systems, Inc.
9300 East 68th Street
Raytown, MO 64133

Wesco Models, Inc.
1453 J. Virginia Avenue
Baldwin Park, CA 94025

EDUCATIONAL TECHNOLOGY

Satellite Videoconferences
Video Conference Coordinator
NASA Aerospace Education Services Program
Oklahoma State University
300 North Cordell
Stillwater, OK 74078
(405) 744-7015

Spacelink Information Access System
Spacelink Direct Dial via Modem:
(205) 895-0028
or
Spacelink Administrator
Marshall Space Flight Center
Mail Code CA-20
Huntsville, AL 35807
(205) 544-6527

EVALUATION

Name: ______________________________

School: ______________________________

Address: ______________________________

____

Telephone: ______________________________

Your input is very important! Please take the time to fill out this form and return it to:

Judy Garcia
Coordinator, Program Development
Fairfax County Public Schools
4414 Holborn Avenue
Annandale, VA 22003

Program 1 - ELECTRONIC FIELDTRIP TO NASA LANGLEY RESEARCH CENTER

1. What is your opinion of the overall quality of the program?

Excellent Good Average Fair Poor

2. What is your opinion of the content?

Very interesting Interesting Uninteresting

Comments: ______________________________

____

Program II - PHYSICS: FROM THE CLASSROOM TO OUTERSPACE

What is your opinion of the overall quality of he program?

Excellent Good Average Fair Poor

What is your opinion of the content?

Very interesting Interesting Uninteresting

The support material was:

Excellent Good Average Fair Poor Relevant

Appropriate to student level(s)

Motivational

Comments: ______________________________

____

General information:

Number of students who viewed the Program I ____________

Grade level(s)) of students ____________

Number of teachers ____________

Number of students who viewed the Program II ____________

Grade level(s)) of students ____________

Number of teachers ____________

Thank you!

APPENDIX C

TEACHER'S COMMENTS

1. The support materials had the best collection of hands-on activities I've seen in a long time. Very creative.

2. Activities integrate into the FCPS POS for 8th grade APS course. I intend to use some of the experiments with my students.

3. The printed material was outstanding--the best of any teleconferences I've been involved with. Also, I felt the program did well in the presentation. I am so glad that both male and female role models were used.

4. The approach and commentary was too elementary for the junior high school student.

5. One of the best teleconferences I've seen.

6. Students enjoyed the teleconference component of this program.

7. Presentation was a little too elementary, but subject matter was appropriate.

8. Good beginning--caught their interest. First teleconference on kids level. Difficult concepts were presented in an interesting format.

9. This program was outstanding in every way.

10. Made physics fun--Id like the presenter and the activities chosen.

11. We will use the BBS.

12. My physics students were very interested until they saw the level of students the program was aimed at. Could you do a program aimed at 11th & 12th grade physics?

13. We taped the program and plan to lend it to other schools.

14. This should have been billed low elementary only.

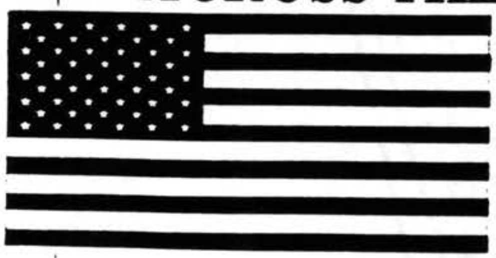
APPENDIX D

HANDS ACROSS THE WATERS PRINT

MATERIALS AND EVALUATION

FAIRFAX COUNTY PUBLIC SCHOOLS

HANDS AND HEARTS ACROSS THE WATER



A Welsh/American Cultural Exchange

Introduction

A cultural exchange program between the students of Gendros Primary School in Swansea, Wales and the students of Timber Lane Elementary School in Fairfax County, Virginia was established in Janurary, 1990. The program culminates in a pre-teleconference broadcast on May 25, 1990 and an international videoconference via satellite on June 8, 1990. A group of 10- and 11-year-old students from each school is participating in the program. The students studied their own culture and regularly exchanged this information with their international counterparts. The information was recorded in written reports, drawings, map work. and audio and videotapes. Students also exchanged photographs and written correspondence to gather information about school and family life.

A study of World Cultures (historic and present) is a vital aspect of any upper elementary social studies program. The Swansea cultural exchange video is a powerful instructional tool because it contains contemporary visual material about young people, produced for young people.

Activities surrounding this program can be used as either an instructional tool to introduce new skills and information or as an end-of-the-year review of objectives that have already been taught. This program contains a wealth of possibilities for studying geography, European history, economics, government and comparitive cultures.

Satellite Information:

Orientation Broadcast: May 25, 1990, 1 p.m. EDT
Weststar IV, 11
The Videoconference: June 8, 1990, 11:30* a.m. EDT,
Weststar IV, 14

***Please note this time change from previous information**

Previewing Activities

Have students begin a KWL process. Individually, or as a large group, have children brainstorm what they **know** (K) and what they **want** (W) to know about Wales and Britain. Save individual responses, or the group responses, on chart paper for a guide for further research and/or a culminating activity. At the end of study, students can add what they have **learned** (L).

Locate Swansea, Wales on a map or globe. Have students find its longitude and latitude. Ask students to explain the relationships between Wales and England and between Wales and the United Kingdom (which includes England, Scotland, Wales and Northern Ireland).

Divide students into six groups. Provide each group with an atlas or almanac and one of the following topics:

Climate	*Vegetation*
Natural resources	*Manufacturing*
Exports/Imports	*Living standard*

Ask each group to make five general statements about Swansea, Wales based on their investigation of the topic.

Have students prepare a chart for viewing the program based on their atlas/almanac research:

TOPIC: ______________________

What types of things should you see?	Check if you found evidence	Discussion

Viewing Activities

Ask students to watch the segment on the sights and sounds of Swansea and fill in the checklist they made as a previewing activity. Discuss the evidence students found, aspects that were not evident, and reasons for discrepancies.

During the government section of the program, ask students to take brief notes on ways in which the British government structure is similar to, and different from, their own (at both the federal and local levels).

During the final segment of the program (Swansea school days), ask students to think about how a school day in Swansea compares to their average school day.

Extension Activities

Make a chart that shows similarities and differences between school days in Swansea and your students own school experiences. Extend the chart to include advantages and disadvantages for the two systems. Students could further evaluate the differences by creating a journal of a hypothetical school day which includes the advantages of both school settings.

Ask students to brainstorm all the ways in which the people in Swansea are tied to their past (language. culture, historic places, etc.) Have students list ways in which they are tied to their own past. Have students plan a local field trip that visitors from Swansea might take that would introduce them to your local history. Create a travel brochure, containing pictures and narrations, that describes this field trip and what it would teach about the past.

Ask students to discuss the roles of kinship, community and tradition in the lives of the people who live in Swansea. Compare these roles to the roles of kinship, community and tradition in the lives of the students in your class. Have students write and perform skits (about a meeting of students from Swansea and students from America) that portray the similarities and differences.

Ask students to report on the structure of the British government. Which aspects did the United States borrow? Discuss the impact of females in key political positions in Britain. Ask students to hypothesize why there has never been a female president. Research women who do hold powerful positions in the USA. Predict when the first female will be elected president in the USA and ask students who they think that person might be.

Investigate castles as a weapon of war. Have students research the who, what, where, when, why and how of castle building. Draw or model castles that include as many defenses as possible.

Research the role of the Angles, Saxons, Jutes, and Normans in the history of Wales. Ask students to research and illustrate examples of these cultures that Americans have borrowed and are a part of our culture today.

Ask students to compare the way of life in Swansea to the way of life in their own community. Have them produce a videotape that represents the sights and sounds of their own daily life.

Collect a variety of newspaper and magazine articles about current events in Wales and Great Britain. "Publish" these in a scrapbook containing student summaries or use these articles as references for students to publish their own newspaper about contemporary issues important to the people in Wales.

Have students paraphrase Prime Minister Thatcher's impression of America and Americans. Ask students to evaluate whether they think it is accurate or not. Discuss the validity of these types of "global" generalizations. Ask students about some of the stereotypes they have about different people and places in the world. Have students research the validity of their own statements.

Have students write down five questions and answers based on the information they learned while watching the program. Use the questions in some form of review game.

5 Have students complete the KWL chart.

EVALUATION

Name: ______________________________

School: ______________________________

Address: ______________________________

____

Telephone: ______________________________

Your input is very important! Please take the time to fill out this form and return it to:

Dr. Terence Woolsey
Coordinator, Communications Services
Fairfax County Public Schools
4414 Holborn Avenue
Annandale, VA 22003

Program I - The Welsh/American Cultural Exchange Program: The Orientation Broadcast

1. What is your opinion of the overall quality of the program?

   Excellent   Good   Average   Fair   Poor

2. What is your opinion of the content?

   Very interesting   Interesting   Uninteresting

Comments: ______________________________

____

Program II - The Welsh/American Cultural Exchange Project: The Teleconference

What is your opinion of the overall quality of the program?

Excellent   Good   Average   Fair   Poor

What is your opinion of the content?

Very interesting   Interesting   Uninteresting

The support material was:

Excellent   Good   Average   Fair   Poor

Appropriate to student level(s): yes ❑ no ❑

Motivational: yes ❑ no ❑

Comments: ______________________________

____

General information:

Number of students who viewed Program I ____________

Grade level(s) of students ____________

Number of teachers ____________

Number of students who viewed Program II ____________

Grade level(s) of students ____________

Number of teachers ____________

Thank you!

APPENDIX E

ARTICLE

School Board News is a publication of the National School Boards Association

The National School Boards Association, headquartered in Alexandria, Va., within the Washington, D.C., metropolitan area, is a not-for-profit federation of the 49 state associations of local school boards and the Hawaii State Board of Education, plus the boards of education of the District of Columbia and the U.S. Virgin Islands. NSBA's primary mission is to promote the advancement of public education through the unique American tradition of local lay citizen control.

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[illegible]

Cable brings the world into the classroom

Cable television brings Berlin, China, Wales, American jails, and astronaut toys to K-12 students in Fairfax County, Va.

The traditional term "school field trip" has been modified by the Fairfax County, Va., School District to "electronic field trip."

And while, yes, that means sitting in front of a television set for the school system's 130,000 students, it means much more.

Over the past two years, those field trips have included:

- a trip to Berlin, providing the Northern Virginia students with an historical, political, and human perspective of the Berlin Wall and its dismantling, including a two-way teleconference with both adults who knew the divided Germany and Germany's students of today;
- a mission to Planet Earth, a journey focusing on the environmental changes that can have a profound impact on life here, with NASA researchers discussing the decisions and policies critical to the future of our planet;
- an exploration of Toys in Space, showing elementary students how astronauts work, eat, and sleep in the zero-gravity environment of the orbiter and then helping the students learn basic physics principles by using toys that were carried on a Discovery shuttle mission;
- teleconferences with students in Wales and China; and
- an exploration of justice, with pretaped visits to a court and a jail, then teleconferences with a judge, a lawyer, a policeman, and inmates.

Each activity has included watching—and participating—in the cable television program as well as extensive classroom work to introduce the students to the topic before the program and help them retain and further explore the issues following the program.

There is little doubt that Fairfax County (Va.) public schools have developed the Cadillac of school cable television systems. And, while the elaborate system is far more extensive than what most other school districts are likely to undertake, its breadth and depth provide a fun picture of the various possibilities cable television offers for improving a community's schools.

The Fairfax County government in 1982 awarded to Media General, one of the nation's largest cable firms, a franchise to wire most of the huge suburban community for a 100-channel cable television system. As part of that contract, the county government was given rights to use two channels, while the school system successfully negotiated for six channels.

Two of the school channels are "open" to all county cable subscribers. Red Apple 21 provides school-related programming, such as the Superintendent's Roundtable, school board meetings, details of student summer activities and a daily show during vacation for young students, an explanation for parents of the ongoing national testing debate, an introduction to the "culture" of Fairfax County for its substantial immigrant population, and a series of programs for parents in English, Vietnamese, Spanish, and Korean.

Channel 25 is the community classroom. It offers instruction for both students and adults on topics ranging from matrix algebra to how to deal with a child's fears and how to get utilities for a new house.

The other four channels are "closed," feeding only into the county's 178 schools and 11 other school facilities. Two are used for classroom instruction, two for teacher training and administrative work.

Fine Tuning, a weekly program guide for the six channels, presently is distributed to a mailing list of 23,000, but the schools are looking for local media assistance in a wider distribution plan.

The heart of the communications system is the Chapel Square Center, a former elementary school now housing four television studios, two control rooms, and a library of 5,000 video tapes. It is equipped for interactive or two-way teleconferences, allowing a speaker or teacher to come to a single location and, via cable and the telephone, work with any number of classes, individual students, or teachers throughout the county.

A production staff of seven produces regular programming for the two community channels, and the staff helps students and teachers develop their own classroom shows.

The same system also makes possible the electronic field trips, such as a history lesson by former British Prime Minister Margaret Thatcher, followed by an hour conversation via satellite between children at Timber Lane Elementary School in Fairfax and their six-month pen-pals at Gendros Primary School in Swansea, Wales. The trip was shared via satellite with schools around the country.

Each school has a video camera and at least one television set for every three classrooms. Each of the 23 high schools has a satellite receiving dish.

The extensive Fairfax program has added interest and frequently excitement in the school day for students, says Elsa Norris, cable programming specialist. "But just as, if not more important, is the way the system has cut down the isolation of our 9,000 teachers" in the 400 square-mile county, be it in providing new class materials, new teacher training, or just opportunities to communicate with their colleagues.

The school cable system "is only as useful as the teachers make it. If you bring them the materials they need," adds Dolores Bohen, Fairfax assistant superintendent for the office of community relations. "You have to have teachers involved in the system's development."

The Fairfax system is producing 400 hours of programming annually, in addition to airing education programs offered by others. All school system-produced programs are available to other school districts, the only charge a $50 to $300 satellite fee.

Most of their extensive programming efforts have been done without cost to the school system, Bohen says, because corporations, networks, and others have been eager to invest in model projects. NSBA's Institute for the Transfer of Technology to Education has cooperated in planning productions and distributing program information.

But, Bohen says, pride evident, "all this primarily has been developed by the Fairfax Schools."

Fairfax County, Va., students—aided by CNN correspondents—talk with their peers in East and West Germany during a teleconference on how life can change without the Berlin Wall.

Sounding Board

Good advice for Alexander

I enjoyed reading the advice to Education Secretary Lamar Alexander offered by Executive Director Thomas A. Shannon in the March 6, 1991, issue of *School Board News*. I particularly appreciated Shannon's comments regarding his skepticism of the "panacea peddlers" who abound in education today.

New and challenging needs have developed because of the confluence of changing demographics, the family structure, and societal values. The quick, easy solutions to these emerging needs can be very dangerous because, unlike industry, we are working with students' lives and futures.

Carol L. Grosse
Superintendent
Alhambra School District No. 68
Phoenix, Ariz.
(Grosse is 1991 National Superintendent of the Year.)

APPENDIX F

BUDGET CUTS

FAIRFAX COUNTY
PUBLIC SCHOOLS

Robert R. Spillane, Superintendent
Burkholder Administrative Center
10700 Page Avenue
Fairfax, Virginia 22030

August 16, 1990

MEMORANDUM

TO: Leadership Team

FROM: Jay D. Jacobs

SUBJECT: FY 1991 Budget Reductions

Due to the current uncertain economic climate, I am asking each Leadership Team member to identify funds equal to 10 percent of your FY 1991 non-personnel accounts to be held in reserve. These potential reductions should be in accounts that have the least impact on the instructional program. No reductions should be taken which would adversely effect students or employees health and safety. Attached is a copy of your FY 1991 baseline budget displaying the value of the 10 percent reduction.

You are to hold these funds until the end of the first semester at which time further guidance will be given. It may be necessary to make further reductions including personnel accounts.

Concerning the issue of allowable budget transfers, the following will be permissible:

Classroom Supplies TO Textbooks
Textbooks TO Classroom Supplies
Supply/Textbooks TO Consumable Equipment
Library Materials TO Library Expenditures
Supply/Textbooks TO Field Trips
Supply/Textbooks TO Printing

No transfers into equipment accounts will be approved. Any other necessary transfers may be requested, but will be subject to review by this office.

Your FY 1991 budget reduction plan is due in my office on August 31, 1990. It should identify, by account, how you will accomplish the 10 percent reduction. It need not be by school or office.

Your cooperation and leadership in this time of fiscal austerity is greatly appreciated.

Thank you.

/mma
Attachment

APPENDIX G

ELECTRONIC FIELD TRIPS: 1990-1993

1. **Physics: From the Classroom to Outer Space**

Orientation Program: **A Vision of the Future** - May 2, 1990

The pretaped program took students on a tour of NASA Langley Research Center (LaRC), and then introduced them to aerospace engineers, who are developing Space Station Freedom.

Live Interactive Teleconference: **Spaced-Out Physics** - May 9, 1990

This program, targeted at middle and high school students, featured Lance Bush, a young aerospace engineer, who is presently working on the Mixed Fleet project at LaRC. His work is centered on the development of an escape craft for the space station and vehicles that will carry space travelers to the moon. Bush is a dynamic presenter, who has developed imaginative ways to demonstrate theories of physics to students and show them how their classroom lessons are applied to the creation of the spacecraft that will lead to the development of space colonies and expanded exploration of the universe.

2. **Hands and Hearts Across the Water**

Orientation Program: May 25, 1990

This program, targeted at upper elementary students, is centered on the tapes received from the Welsh students that covered family an school life, government, and recreation. Margaret Thatcher greeted the students at 13 Downing Street, and commented on America.

Live Interactive Teleconference: June 8, 1990

Through two-way video and two-way audio, students from Wales and Virginia were able to see and talk to each other. The program was divided into three segments family and daily life, cultural differences, and government. Students asked one another questions and commented on what they had learned about each other.

3. **TOYS in Space**

Orientation Program: **A Day In Space** - September 21, 1990

The orientation program was taped in the Challenger Center at Greenbelt, Maryland. That Center has a mock-up of a mission control center and a space station. Children were taken on a "pretend" mission in space, and had to consider what working, eating, and sleeping in space would be like. Taped sequences of astronauts in the shuttle were used throughout the program.

Live Interactive Teleconference: **TOYS in Space** -September 28, 1990

This program, aimed at upper elementary students, featured astronaut Charlie Walker, who had flown on the TOYS mission and Shelley Canright, an award winning elementary teacher, working as an education specialist at LaRC. Canright and Walker worked with students on the set and in the vie wing audience to complete hypotheses and do experiments based on three of the toys flown in space. They also read letters from astronaut Rhea Seddon and Senator Jake Garn who had flown on that mission as well.

4. **Mission to Planet Earth**

This EFT was targeted at upper high school students in response to comments on evaluations received from **Physics: From the Classroom to Outerspace.**

Orientation Program: **The Earth Observing System** - October 19, 1990

This program focused on the work of LaRC on the international project called the Earth Observing System that will place space platforms in positions to study the Earth's system much in the same manner that spacecraft provide information to scientists about other planets. The international concern for the future of the is of great interest to young people and the principles of physics used in the collection is fascinating. **The Earth Observing System** provided students with an overview of the work of the scientists who are assigned to devise methods of studying the Earth's atmosphere. Six scientists and two support people were featured.

Live Interactive Teleconference: **The Challenge of Atmospheric Studies** -October, 26, 1990

Six NASA scientists from LaRC joined the CPD, who hosted **Mission to Planet Earth** in the studio at CS. They did demonstrations of how equipment is designed to gather information from above the Earth's atmosphere, how to analyze the results, and make decisions as to whether a phenomena is natural or man made.

5. **Berlin: Yesterday, Today, Tomorrow**

Orientation Program: November 30, 1990

The purpose of this program was to clarify historic events from the end of WWII to the time of the dismantling of the Wall. This was to be accomplished by discussing the events with a German born professor of humanities at George Mason University. Dr. Egon Verheyen had survived through the difficult historical period, and could gave a very human, personal account of the events and how they affected the lives of ordinary people.

Live Interactive Teleconference: December 7, 1990

Escapees from the East appeared on the teleconference to share their stories, exemplifying the dignity and strength of the human spirit. Students from high schools in both East and West Berlin were guests on the set in the studio. Cassandra Henderson of **CNN Newsroom** co-hosted the program. The mayor of Berlin, Herr Momper, also made an appearance.

Print Material:

Social studies teachers and German language teachers collaborated on the print material.

6. **Justice: What Is It?**

Orientation Program: March 8, 1991

Students were introduced to the officials of the court, including a judge, prosecuting attorney, bailiff, and court recorder. The interviews permitted students to view the jury system, as well as learn the difference between criminal and civil cases. Afterwards, the camera was "arrested" and students were taken inside a jail. They saw how people are processed after arrest, the different types of cells, and caught a glimpse of what prison life is like.

Live Interactive Teleconference: March 15, 1991

Students were able to interact with a judge, lawyer, sheriff's deputy, and two inmates from the local jail.

7. **Never Forget**

Target audience middle and high school students. Turner Network Television (TNT) and **CNN Newsroom** contacted the CPD in late April, asking if CS would be willing to work with them to build an EFT from a movie based on a Holocaust survivor's life. The film was produced by Leonard Nimoy of **Star Trek** fame, and Robert Radnitz, producer of **Sounder** other films nominated for academy awards. The offer, of course, was accepted.

Orientation Program: **An Orientation to the Holocaust** - March 14, 1991

An award winning social studies teacher was selected to teach a lesson on genocide to a class of high school students, after which, a 30-minute condensed version of the movie would be shown.

Live Interactive Teleconference: March 21, 1991

Leonard Nimoy, Robert Radnitz, and Mel Mermelstein, the man on whose life the movie was based, joined Cassandra Henderson, CNN anchorwoman, in the studio at CS. Various ethical points brought out in the movies were discussed.

8. **Eyes on the Past**

Targeted at high school students. This EFT focused on the work of NASA's only archaeologist, Tom Sever. Sever uses satellite technology to find and investigate ruins of ancient civilizations. He hopes that his work will help modern civilizations understand man's impact on the environment, so that human life can continue to prosper without destroying the home planet.

Orientation Program: January 10, 1992

The Production went to Stennis Space Center, located in Mississippi. Sever works out of Stennis when he is not in the field. Students were given a tour of the center, saw the testing of the shuttle's main engines, and met NASA scientists and engineers, who discussed careers and the excitement of working in research. Women and minorities were among the guest researchers interviewed.

Live Interactive Teleconference: January 17, 1992

Tom Sever talked to students about his many adventures as he showed slides of his work in the field. He explained the importance of discovering the secrets of the past to understand how humankind can avoid repeating the mistakes of our ancestors.

9. **Women in Math and Science**

Meeting with guidance counselors, psychologists, and teachers led to this EFT. Up to the age of 12 and 13, girls do better than boys in math and science. After that age, they do less well, and a majority of them do not pursue these subjects to the advanced levels. Women are also very under represented in engineering and science based careers.

Orientation Program: February 7, 1992

An aerospace engineer, a medical doctor, a researcher in biochemistry, and a mechanical engineer were interviewed at their places of work. They talked about their careers and how they prepared themselves for them.

Live Interactive Teleconference: February 14, 1992

Kathleen Matthews, an anchorwoman on the local CBS channel, hosted the program. The women answered girls' and boys' questions on school, their work, their personal lives, and more.

10. **TOYS in Space II**

Due to teacher requests, it was decided to make a second visit to the TOYS mission.

Orientation Program: March 6, 1992

The same orientation that was produced for TOYS I, was aired for TOYS II.

Live Interactive Teleconference: March 13, 1992

Astronaut Charlie Walker joined Shelley Canright to do demonstrations and work with students on experiments centered on two toys flown on Walker's shuttle mission.

11. **Life Under Glass** March 27, 1992

Live Interactive Teleconference:

This program was to be the "orientation program," followed by a second, and a third program in the subsequent two years. Thus, students would be able to trace the progress of the Biospherians and hear their comments when Biosphere II opened in September, 1993.

During this first interactive teleconference, students were given a tour of Biosphere II and called in questions to two Biospherians.

12. **Apollo-Soyuz: A Glimpse of Our Future**

As the communist world crumbled, representatives from NASA and the Soviet Space Agency were already talking about cooperative ventures in space. Taking advantage of this historic geopolitical change, the EFT looked back to 1975, when during a lull in the Cold War, an American and Soviet spacecraft linked-up in space. This historic project provided the world a glimpse of what the two nations could hope to do more of in the future.

Orientation Program: May 1, 1992

Nicholas Daniloff, a prize winning journalist, who was arrested in Moscow in retaliation for the arrest of a Soviet spy in New York, was featured on this program. Professor Daniloff is an expert on soviet affairs and authored a book on the Soviet space program. He talked with students on the set about the political changes that have occurred since WWII, and discussed both the American and Soviet space programs.

Live Interactive Teleconference: May 8, 1992

One of the original seven American astronauts and member of the Apollo crew, Deke Slayton, Soviet cosmonaut, Valery Kubasov, Professor Nicholas Daniloff, Dr. Raoul Sagdeyev, noted Soviet scientist, and Rick Hauck, shuttle astronaut were guests in the studio. They discussed the momentous events that have occurred in both countries space programs and the future of manned space flight and joint ventures.

Students from the Air Space Museum in Oklahoma City joined the program live. This was an opportunity to feature the excellent education programs that museum and others like it are providing for young people.

13. **First Amendment: Who Needs a Free Press?**

Orientation Program: December 11, 1992

The Williamsburg Foundation cooperated with the production staff at CS, allowing the program to be taped in Colonial Williamsburg. The history of the First Amendment was discussed with noted authorities from the University of Virginia and American University. The development of the press was made very captivating when colonial pressmen demonstrated how the old printing presses worked and how journalists of that period were not so different from journalists today.

Live Interactive Teleconference: December 18, 1992

A noted authority on the development of the free press and the First Amendment from American University, joined Nicholas Daniloff, director of the Department of Journalism of Northeastern University in Boston, and a group of high school journalism students discussed the pros and cons of a free press. Daniloff made a strong statement about the value of a free press when he told of his unjust arrest in Moscow and made the point that had there been a free press in the USSR, he would have surely been released, or perhaps, not even have been arrested.

14. **Women in Aerospace**

Orientation Program: January 22, 1993

Women in engineering, research, and marketing were joined by an astronaut, an aviation mechanic, and a Air Force pilot. They were taped at their place of work, where they discussed the duties they perform and their responsibilities in general.

Live Interactive Teleconference: January 29, 1993

The above mentioned guests talked further about their work and how they prepared for their careers. They gave very personal insights to the struggles of women in many of the fields, but encouraged girls to pursue careers in these areas.

15. **Smart Sports** March 31, 1993

Live Interactive Teleconference:

This was a one-part event. David Hyle of PBS's **Newton' Apple**, taught teachers how to use professional athletes' experiences using technical information and "their smarts" to perfect their skills and win at sports. This scientific approach to sports captivates the attention of even reluctant learners.

16. **What's Happening at the Zoo?**

Targeted at middle school students. The NOAHS Center (New Opportunities for Animal Health Services) at the National Zoological Park in Washington, D.C., invited the FCPS to do an EFT on the work of the scientists at NOAHS. The focus would be on the preservation of species in danger of extinction.

Orientation Program: May 23, 1993

Students toured the hospital and research facilities at the National Zoo. They learned about the plight of endangered species, particularly the cheetah.

Live Interactive Teleconference: May 30, 1993

This teleconference was broadcast live and on location from the zoo. The program took place in front of the cheetah exhibit and scientists were able to work with the cheetahs, showing their incredible speed and beauty. Three of the most noted scientists in the field were on the set to answer the questions posed by students from throughout the United States.

VITA

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Candidate for the Degree of

Doctor of Education

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Biographical:

Personal Data: Born in Morgantown, West Virginia, October 27, 1940, the daughter of George F. and Lola A. Faunce.

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Professional Experience: Foreign language/history teacher and Department chair, Fairfax County Public Schools, Fairfax, Virginia, August 1963 to August, 1985; National NASA Teacher in Space Finalist August, 1985 to August 1987; Special Projects Teacher, Fairfax County Public Schools, August 1987 to August 1988; Associate Program Director, Oklahoma State University Midlands Star Schools Consortium, September 1988 to August 1989; Coordinator of Program Development, Fairfax County Public Schools, August 1989 to present.

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