



UNITED STATES
SPACE FOUNDATION

FINAL REPORT TO NASA

K-12 AEROSPACE EDUCATION PROGRAMS

FOR COMPLETED 1998/99 PROGRAMS

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K-12 Aerospace Education Programs

EXECUTIVE SUMMARY

NASA, the United States Air Force Academy, the Air Force Space Command, the University of Colorado at Colorado Springs (UCCS), and the United States Space Foundation teamed to produce a dynamic and successful graduate course and in-service program for K-12 educators that has a positive impact on education trends across the nation. Since 1986, more than 10,000 educators from across the United States have participated in *Space Discovery* and *Teaching with Space* affecting nearly a million students in grades K-12. The programs are designed to prepare educators to use the excitement of space to motivate students in all curriculum subjects.

NASA's participation helped an increased number of teachers, superintendents and administrators to attend the 1998/99 courses. With the grant period continuing for 2.5 additional months, it is expected that NASA funding will help support the development and delivery of 51 in-services, 6 conferences, and 7 graduate courses reaching approximately 2,535 educators and 76,000 students. As a direct result of the programs, we will have conducted 31 speaking engagements at schools and conferences (ITEA, CTEA, NSTA, NCASE, Illinois Science Convention, and HASTI) nationwide, reaching an additional 4,175 educators and 125,000 students.

Development in 1998/99 continued work to produce teacher lesson plans, develop electronic delivery methods for the standard graduate courses and in-services, provide Internet exposure via an educational web site, improve program content, adapt standard in-service content and resources into the Spanish language and culture, and update evaluation tools and methods to NASA EDCATS system.

Evaluations of the programs indicate an overwhelmingly positive response by the attendees. This program and evaluation provided valuable research data including the effect of the program for gender differences, portability of the program to different venues, and the relative effect of the five-day program versus the two-day program. The 1998/99 preliminary report is included under separate cover.

The U. S. Space Foundation received matching funding from private companies and foundations to leverage NASA's grants over the past nine years -- an excellent example of public/private partnership. Sponsorship made directly to the Foundation in 1998/99 is estimated to be \$275,000. Combining the NASA grant of \$375,000 with these contributions, the Foundation education programs in 1998/99 total dollar value was \$650,000.

The performance period for the grant was January 1, 1998 through March 31, 1999.

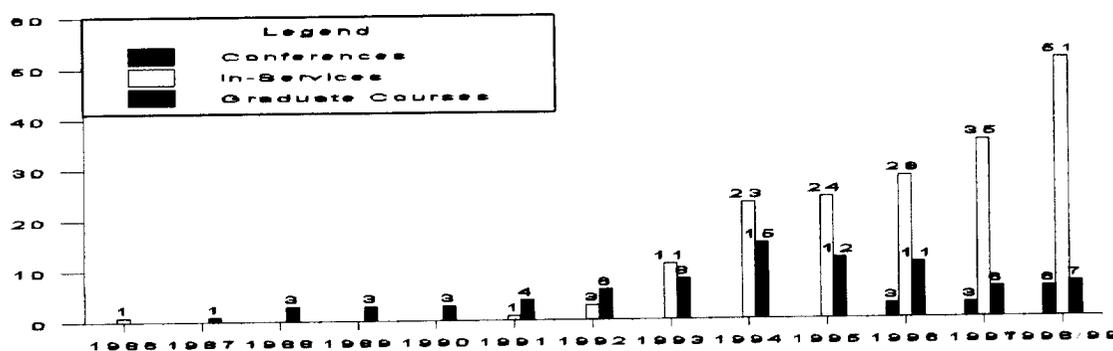
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I. INTRODUCTION

Since its inception in 1986, more than 10,000 educators have completed *Space Discovery* graduate courses and *Teaching With Space* in-services and conferences. The graduate courses have been conducted with contributions of excellent faculty and facilities at the United States Air Force Academy for thirteen consecutive summers. Recent programs have been developed with and delivered at the University of Colorado at Colorado Springs and Space Command. *Space Discovery* contributes directly to national education goals. The programs specifically supports the goals of increasing the graduation rate, improving competency, increasing math and science achievement, and preparing students for responsible citizenship and further learning.

II. 1998/99 PROGRAMS

The following graph shows the growth of our programs since inception. The figures for 1998/99 are projected.



Note the trend to increase the number of in-services while reducing the amount of NASA funding provided to each location. The Foundation matching funding continues to increase. From January 1, 1998 through March 31, 1999 we estimate \$275,000 will be raised to match NASA funding. Since many more teachers can be reached through in-services and conferences the number of graduate courses are stabilizing (we expect to complete 7-10 annually), being offered in those areas that provide the best aerospace facilities and render the greatest outcome in teacher attendance. Moving the in-service and conference attendees into the graduate course programs, and back again, allows for lengthier/more in-depth instruction as a follow-up and increases the probability that systemic change will occur. Integral to the success of these programs is the follow-up support provided by the Foundation. Educators are also being held accountable to the Foundation and to their school districts to implement the training and resources they receive through these programs.

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A. *Space Discovery* 5-Day Graduate Courses

In 1998/99, we completed one Aviation and Space Basics course (Introductory), five Living in Space and Basic Rocketry courses (Standard), and one Advanced Space Technology (Advanced) course. The number of educators served by these program was 337. The number of students reached via these educators is expected to exceed 10,000.

B. *Teaching With Space* In-services

We completed 14 one-day, nine two-day, and one three-day in-services through December 31, 1999. The number of educators served was 720. The number of students reached via these educators is expected to exceed 21,000.

We expect to complete an additional 21 one-day, five two-day, and one three-day in-services before the end date of this grant period of March 31, 1999. These programs will include an expected 840 educators who will in turn reach more than 25,000 students.

C. *Teaching With Space* Conferences

To date, we completed five one-day conferences with one more pending. The expected number of educators served is approximately 800. The expected number of students reached via their teachers is 24,000.

D. Extensions in 1998/99 (not funded by the grant, but a direct result of contacts made possible by the grant) - We will complete 31 speaking engagements reaching an estimated 4,175 educators. The number of students reached via these educators is estimated to be more than 125,000.

E. Pre- and Post-Test Scores

Pre- and post-tests administered at the U.S. Air Force Academy courses demonstrated, on average, a 25% improvement (there is a slight margin of error due to tests that were not returned). These tests are valuable indicators of teacher progress.

F. Formal Evaluations

Each year an independent evaluation firm evaluates the quality of the programs. Raw data is collected and tabulated during the summer graduate courses and in-services throughout the year. The preliminary 1998/99 results show the programs prepare and motivate educators to integrate

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space and technology in the classroom. Improvements in attitudes, abilities, and interest were seen across the board. Adapting graduate programs that span the K-12 grade levels is a difficult challenge. Elementary teachers want less advanced concepts and secondary teachers want more. The majority of the attendees expressed their appreciation for the opportunity to share the experience with a diverse audience since one of their goals is to prepare students for (or to receive them from) other grade levels making the continuity in concepts very important. It is obvious in all evaluations we do that educators want MORE. More lessons, resources, career information specific subject applications, and time to discuss implementation. The only problem with "more" is that we cannot get them to tell us what we could cut so we can provide "more". Again, increasing the number of in-services will ensure that we can provide more customization and coverage of relevant information.

The overall ratings for 1998/99 is approximately 3.6 on a 4.0 scale for graduate courses and in-service programs. The population served by the graduate course programs was 70% female and 30% male. Ethnic diversity was at 11%, however, many of the EDCAT submissions were not complete as educators left this section blank. We feel that the 11% listed in this report is not a true representation of our course attendees. Many in-service programs in 1998 were held in areas where most of the teachers are of ethnic minority. Also, our largest block fellowship was awarded to African American teachers who came to the graduate courses from St. Louis, MO. We recently completed an in-service (these numbers are not included in the evaluation report) in Houston, TX for bi-lingual educators, most of whom were of Hispanic origin. Further development and implementation of Spanish curricula will help us increase our goal to reach a larger minority population.

Please see the enclosed evaluation report for detailed information.

III. DEVELOPMENT

Although more than 10,000 educators have derived direct benefit by attending our programs, the K-12 educator population in America is more than three million. Much more needs to be done; continued outreach, particularly to those in disadvantaged circumstances, is vitally important.

Program Content

Development in 1998/99 included multiple projects to ensure the programs maintain the highest quality.

Development of content for both the graduate course and in-service programs was revised to align with NASA's Four Enterprise areas. The overall goals and methodology of the Enterprises allows for inquiry-based, interdisciplinary lessons that provide for logical and sequential

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instructional strands. The programs' content is also being developed to include more career information for educators to share with their students. Through our work with the local School-to-Career program we are addressing the need to provide students with information about the many options available to them in the aerospace industry. All materials have been and will continue to be evaluated by our Master teacher Advisory Group (MTAG) and modifications will be made based on their suggestions.

Program revision included development of new teacher lesson plans, electronic delivery methods, and Internet exposure via an educational web site; continued improvement of program content to ensure education standards are addressed; and adaptation of the standard in-service content and resources into the Spanish language and culture. We are working with school districts and other program delivery sites to provide computer labs for sessions on Web Site development, Internet resource availability (especially linked to NASA's Enterprises), and satellite properties.

The continued development of the program is critical to its success. In 1999/2000, we will further develop our program content by updating current and adding new content. In-service topics for four different curricula (including instructional content, lesson plans, and extended resource materials) will be further developed and implemented. The number of grade specific lesson plans will be doubled. Pedagogical approaches for overall program instruction will be re-evaluated and modified so we can more effectively provide an increased number of hands-on, inquiry-based lessons; include interdisciplinary lessons for all grade levels; and incorporate relevant technological applications. All program content will align with NASA's Enterprises.

Technology

We successfully integrated technological presentation components into our *Space Discovery* Standard graduate course curricula and are currently working to complete electronic conversion of the Introductory graduate course, Advanced graduate course, and *Teaching with Space* in-service/conference content. Web page construction is well underway with strata that provide in-depth teacher resources. Our 1998/99 summer programs were announced on our education web page that was hyper-linked to multiple educational sites. As new technologies are made available it is essential that we stay at the leading edge in our ability to present the information and do so in a medium that stays abreast of the times.

The use of technology in our programs ensures teachers of the ease in which computer and technology can be incorporated into the classroom. Four laptop computers were made available to program attendees in all graduate courses in 1998/99. The computers were loaded with

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aerospace education software programs for teachers to review. All evaluations for summer graduate courses were input directly into the EDCATS program.

Computer usage and integration into instructional content, lesson plans, and extended resources will be further developed for in-service/conference programs in 1999/2000.

Spanish Translation Development Project

The 21st century will soon be upon us and it is important to realize that several significant changes are happening within the field of education that make it a priority for the space educators to present materials in Spanish. By the year 2000, it is estimated that the largest minority group in the United States will be that of Hispanic origin. If current trends continue, in that same year only 50% of all Hispanic students will graduate from high school.

A significant area in which changes are currently being made through our programs is the development of a two-day Standard Spanish in-service. The translation of content and incorporation of culturally relevant information was completed for the standard program content this year and has been presented at two programs. The first was a graduate course (held in Los Angeles, CA in August) that briefly incorporated ideas for change and requested feedback on the direction in which we are heading. The second program was an in-service (completed in January in Houston, TX) that was delivered to 70 bilingual education teachers. This program included instructional content, teacher lesson plans, and extended classroom resources. We also conducted a needs analysis to determine the needs of the teachers so the approach for these programs can be built based on these results. Results from the programs will be submitted to NASA under separate cover in February 1999. The content of the Spanish program will continue to evolve with an emphasis on converting content, lesson plans, and extended classroom resources from English to Spanish while incorporating information that ensures the materials are culturally relevant.

IV. ACCOMPLISHMENTS OF AEROSPACE PROGRAMS FOR 1998/99

To date for 1998/99 we completed:

One **Aviation and Space Basics** (Introductory) graduate course at CUCS in Colorado Springs, CO; five **Living in Space and Basic Rocketry** (Standard) graduate courses: one at AlliedSignal in Phoenix, AZ; three at the U.S. Air Force Academy in Colorado Springs, CO; and one at Futures Academy in Redondo Beach, CA.

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One **Advanced Space Technology** (Advanced) graduate course at Space Command, Colorado Springs, CO.

Five **Conferences**: the Lowell Observatory in Flagstaff, AZ (2 days); California State University, Dominguez Hills, Los Angeles, CA (1 day); the Museum of Science and Industry Chicago, IL (2 conferences - 1 day each); and the California ScienCenter, Los Angeles, CA (1 day). The Colorado Space Education Initiative will be held in Colorado Springs, CO in January (1 day - to be held January 22, 1999).

24 **in-services** at various locations nationwide. We are scheduled to complete an additional 27 in-services by the end of this grant period.

The newest program change was converting existing content into Spanish, to meet the needs for bilingual education. The materials were presented at one graduate course (for feedback and direction) and one in-service (that generated information requested as part of a needs assessment and the overall content/approach).

Organizations who contributed directly to the programs included: Aerospace Education Foundation, Air Force Association, AlliedSignal, American Defense Preparedness Association, American Institute of Aeronautics and Aviation, Armed Forces Communications and Electronics Association, Beckley-Cardy, Colorado Commission of Higher Education, Futures Academy, Lockheed Martin, National Security Industrial Association, Woodmen of the World, and numerous school districts. Estes, Industries supplied model rockets at no cost to our programs, advertised the programs in their catalogs, provided booth space for our programs at national and regional education conferences, and sponsored educators to our programs. Estes partnered with us to award the *1998 Space Educator Award* at the NSTA National Convention in Las Vegas, NV and will do so again in 1999. OWI provided robots for the advanced course and two in-services at a 50% discount. Pitsco and the National Science Teachers Association announce our programs through catalogs, conferences and newsletters. We will continue to partner with outstanding organizations such as these listed and will search for other organizations who would like to participate in the fast paced advances we are making in aerospace education.

We continued to distribute aerospace materials to educators at all of our programs. Most of these materials were from NASA, others came from the Federal Aviation Administration, Civil Air Patrol, and a variety of publishing companies. We estimate that 39,800 pieces will be disseminated during this grant period.

As a direct result of NASA's support for these education programs, the Foundation received two Eisenhower Professional Grants from the Colorado Commission of Higher Education (CCHE).

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The purpose of the Eisenhower program is to improve systemic change within Colorado school districts. The first grant provides partial funding for 65 educators from five Colorado Springs' school districts to attend two graduate courses and three in-service programs. The educators are to take the lessons learned back to their districts to share with their colleagues. The educators we are currently serving through this program requested additional help to reach their colleagues and the CCHE responded with a second grant. The second grant is to provide partial funding to additional educators within the original five school districts to attend in-service programs. This will be limited exposure for the additional educators, but will assist the original educators in generating enthusiasm for the overall program as they present the information and help us reach our joint goal of systemic change. These grants were awarded as a direct result of NASA's sponsorship of these programs.

V. CONCLUSION

The benefits of the Foundation's *K-12 Aerospace Education Programs* go well beyond teaching educators how to incorporate space topics into their curricula. Other benefits include making the best and most current national education resources available to teachers, networking opportunities for teachers in all grade levels, brainstorming sessions for developing and integrating new lessons for students, providing information on leading edge technology as a tool and space technology as a subject, applying aerospace concepts to national education standards, and demonstrating motivational teaching methodologies. The primary benefit of these programs is taking the reality of space exploration into today's classroom so educators can better prepare tomorrow's astronauts and "space literate" citizens.