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FLORIDA'S SPACE EDUCATION DEVELOPMENT PROGRAM

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Background

The Space Education Development Program (SEDP) discussed in this paper was strongly influenced by a highly successful Space Education Conference held in Cocoa Beach, Florida in October 1991. This national conference, entitled ***Meeting Space Education Needs of the Future***, was sponsored jointly by the Florida Space Grant Consortium (FSGC) and the Technological Research and Development Authority (TRDA). At the meeting, thirty-three outstanding educators, industry leaders and government representatives from around the nation presented bold, innovative and interdisciplinary approaches to enhancing education at all levels. The focus of the meeting was on successful experiences and recommendations for the future. Several messages came through loud and clear:

- University curricula must be continually re-evaluated and updated to reflect both changing technologies and changing needs in the aerospace work force.
- Universities possess valuable resources that need to be more effectively focused on improving science and mathematics education in K-12 classrooms.
- We need to accelerate the introduction of educational technologies into the classroom and to make better use of advanced communications.

The Space Education Development Program was developed to help address these needs, within the constraints of presently available resources. It is the newest of six programs currently being offered by the Florida Space Grant Consortium. For the 1992-93 academic year, the total budget for the Space Education Development Program is only $40,000, of which $20,000 is from NASA and $20,000 is in matching funds from the universities receiving awards. Despite these low numbers, we think we can achieve some useful goals.

Program Goals

The Space Education Development Program goals are to:

- Develop and improve university curricula by increasing the number and enhancing the quality of space related courses.
- Provide K-12 teachers with the resources necessary to enrich science and mathematics classes through the use of in-service training in space science and applications.
- Develop the space education skills of university faculty, K-12 teachers and

space professionals.

- Identify, develop and use advanced educational technologies and communications for delivering space education and training services.

Program Emphasis

In establishing the program, an attempt has been made to leverage human, financial, and technological resources to enhance space education at all levels. Consequently, emphasis is placed on educating educators, maximizing the number of grant awards, promoting cooperative programs, and encouraging the use of advanced educational technologies and communications. In short, the program emphasizes using the multiplier effect to distribute high impact, high technology space education experiences to the largest possible audiences.

Curriculum Development at the University Level

Curriculum development is a major responsibility of all educators. The need for curriculum development at the university level becomes more important as the rate of change in technology increases, and as the education demands of the entering work force change. Unfortunately, the process of developing and offering new courses often slows when budgets are severely reduced, as they have been in Florida and much of the country for the past several years. To counter this trend and to encourage curriculum development, the SEDP is providing grants of $4,000 to university faculty for either introducing new space related courses, or for significantly enhancing existing courses.

New courses may be proposed in any discipline, at either the graduate or undergraduate level. Proposed enhancements of existing courses must include at least 12 hours of new space related material. To qualify for funding, proposed new courses and enhancements of existing courses must be approved at least at the academic department level prior to submitting the proposals. This is a significant requirement, especially at the state universities, because of the effort that must be expended to develop and obtain approval for course actions. Because of this SEDP requirement for course action approval prior to submitting proposals, it is anticipated that some proposed courses will be introduced into the curriculum even if funding is denied.

It should be noted that substantive curriculum development involves much more than the introduction of a course here and there. Rather, it involves the development of meaningful programs that are carefully thought out and reviewed. However, limited resources prohibit the funding of major program development at the present time. Consequently, it is our intent that the Space Education Development Program at least initiate and stimulate the process of curriculum development in space related areas.

In-Service Training Programs for K-12 Teachers

One of the highest priorities of the Space Education Development Program is to improve science and mathematics education in K-12 classrooms. To help address this need,

the SEDP encourages proposals and is providing grants of $6,000 for the development of in-service training programs for K-12 teachers. The in-service programs must use some aspect of space science and applications as a common theme in the training.

Teachers in Florida need 120 in-service points every five years to remain certified (where one hour of instruction is equivalent to one in-service point). At least 60 points must be in the teacher's content area. Because of the relatively large number of hours required for certification, 12 hours of instruction time has been set as a minimum for proposed in-service training programs. Proposed programs with less than 12 contact hours need strong justification.

Space Symposia and Conferences

The national Space Education Conference mentioned earlier was useful in a number of ways. In addition to identifying roles of industry, government and academe in pursuing national education goals, it presented successful approaches to enhancing science and mathematics instruction, and provided details of innovative curricula and courses. It also presented an assessment of military, government, and industry needs for proper preparation of the entering work force, and outlined examples of successful cooperative programs.

For the 1992-93 academic year, the Consortium solicited proposal abstracts for space symposia and conferences. Multi-institutional involvement and a conference proceedings were requirements. Because only three abstracts were received, the FSGC Executive Board voted to eliminate this category from the competition for the 1992-93 academic year. One consideration in this decision was the opportunity for these programs to be self supporting through the use of registration and other fees.

Seed Grants for the Development and Use of Advanced Educational Technologies and Communications for Space Education

One of the aims of the Space Education Development Program is to encourage faculty to identify, develop and use advanced educational technologies and communications for delivering space education and training services to their students. Some of the technologies, media and materials encouraged are:

- Satellite image and data processing
- Interactive video, computer animation and simulation
- Computer-aided design, engineering, instruction, and manufacturing
- Expert systems and artificial intelligence
- Distance education, distributed learning, and instructional television
- Virtual reality
- Video tapes and innovative applications
- Low cost, user friendly classroom aids for K-12 teachers
- Advanced communications technology.

As with the other program areas, the Consortium solicited proposal abstracts for seed grants in this area in late summer of 1992. Five abstracts were received and, because all of the proposed activities involved either curriculum development or in-service training, the proposers were asked to submit formal proposals under either one of those two categories.

Eligible Institutions and Individuals

All twelve of the universities affiliated with the Florida Space Grant Consortium are eligible to participate in the Space Education Development Program. One or more co-project directors or co-principal investigators are permitted. The FSGC encourages the participation of women, minorities, and the disabled in all of its programs. For the Space Education Development Program, participation of these groups is encouraged as either project directors, principal investigators, or as recipients of the educational services.

Eligible Fields

"Space education" is broadly defined to include aeronautics and astronautics, remote sensing, atmospheric sciences, and other fundamental sciences and technologies relying on, or directly impacting, space technological resources. Included within this definition are space science, earth observing science, space life sciences and medicine, space policy and law, engineering, astronomy and astrophysics, space facilities, and space applications. Projects that enhance interaction with and promote cooperation among industry, government and education professionals are particularly encouraged.

A Two-Step Solicitation Process

The Executive Board of the Florida Space Grant Consortium decided that application for funding under the 1992-93 Space Education Development Program would be a two-step process as follows:

1. Submission of a one-page *Intent to Propose* abstract by September 14, 1992.
2. Submission of a formal proposal by November 2, 1992.

The *Intent to Propose* abstracts were required to be submitted under one of the following four categories:

- Space related courses at the university level
- In-service training programs for K-12 teachers
- Grants for symposia and conferences
- Seed grants for the development and use of advanced educational technologies and communications for space education.

The two-step process was used because the FSGC Executive Board wanted to assess the level of interest in the above categories, as well as evaluate the quality of the abstracts, and examine the funding levels requested.

Response to the Call for Proposal Abstracts

In response to the initial solicitation, a total of 35 proposal abstracts (of which 5 were ineligible) were received. The overwhelming majority were from the University of Central Florida (16) and the University of Florida (11). Of the 30 eligible proposal abstracts, 15 proposed space related courses at the university level, 8 proposed in-service training programs for K-12 teachers, 3 proposed symposia and conferences, and 4 proposed seed grants for the development and use of advanced educational technologies and communications. Funding requests ranged from $5,000 to $40,000, with the average being approximately $11,000.

Final Terms of Competition and Request for Formal Proposals

The Executive Board of the Florida Space Grant Consortium, after reviewing the proposal abstracts, established the final terms of competition and issued a request for formal proposals. Proposals were requested in only two categories: space related courses at the university level, and in-service training programs for K-12 teachers. Only faculty who had submitted proposal abstracts were eligible to make formal proposals. Also, the maximum funding levels were set at $5,000 for the space related courses at the university level, and $10,000 for the in-service training programs for K-12 teachers. The Board also asked proposers to submit a minimum acceptable level of funding for their proposed projects. The deadline for the formal proposals was November 2, 1992.

Proposals for Space Related Courses at the University Level

The Consortium received eleven proposals for the development or enhancement of space related courses at the university level: one from Florida Atlantic University, seven from the University of Central Florida, and four from the University of Florida. Eight of the proposals were for new courses; nine were for undergraduate courses; six were for aerospace engineering courses; one was for an anthropology course; one was for a health science course; two were for industrial engineering courses; and one was for a plasma physics course. The quality of the proposals varied considerably and, overall, was not as good as expected based on the proposal abstracts.

Proposals for In-Service Training Programs for K-12 Teachers

The Consortium received ten proposals for the development and implementation of in-service training programs for K-12 teachers: one from Embry-Riddle Aeronautical University, one from Florida State University, one from the Southern Technology Applications Center (including both the University of Florida and University of South Florida offices), three from the University of Central Florida, and four from the University of Florida. The overall quality of the proposals in this category was high.

Proposal Evaluation Criteria and Process

For the 1992-93 Space Education Development Program, the reviewers were asked to

evaluate the proposals using the criteria expressed in the following statements:

- The proposed project will achieve one or more of the objectives of the Space Education Development Program.
- The proposed project will have a significant, positive influence on space education, or on science and mathematics education.
- The proposed approach to implementing the project is appropriate and should help ensure success.
- The proposed principal investigator(s) is (are) qualified to successfully complete the proposed project.
- The proposed project will produce results that can be replicated, or used for larger, follow-on efforts, or used to enhance the recruitment of extramural funding.

All twenty-one proposals were evaluated independently by the same three reviewers. Two of the reviewers were experienced NASA professionals, who also had academic experience. The third reviewer was a university professor and director of a space grant consortium in another state. The evaluation form used by the three reviewers required a four-point, forced choice response to each statement, combined with a "no ties" ranking of the proposals to adequately distinguish quality among them. The reviewers were also given the option of commenting on the proposed budget and suggesting a more appropriate amount.

Once the proposal evaluations were completed by the three reviewers, the results were forwarded to the SEDP office and summarized for the FSGC Executive Board. The FSGC Executive Board made all final decisions on the winning proposals and on the amount of the grant awards.

Deliverables Required

The recipients of SEDP grant awards must produce, package, and deliver significant course and program materials to the Florida Space Grant Consortium. The reason for this requirement is to allow the results of the projects to be shared with other interested faculty in the FSGC affiliated universities. The following materials must be delivered to the Consortium within 30 days after the project end date:

- A syllabus and schedule for the course or program
- Course or program prerequisites
- A list of goals and objectives for the course or program
- A purpose statement or rationale for the course or program
- A list of the recommended text(s) and reference materials
- A list of desirable and/or required hardware, software, and other course ware
- A complete set of lecture notes
- Typical exams (not required for in-service training programs)
- Typical assignments (not required for in-service training programs)
- A description of the evaluation methods
- A summary of recommended teaching methods.

Awards for Space Related Courses at the University Level

On December 4, 1992, the FSGC announced four grant awards for space related courses at the university level, based on the evaluations by the three reviewers. Each of the grant awards was for $4,000. The recipients and their projects are as follows:

Dr. Loren Anderson, Associate Professor of Aerospace Engineering at the University of Central Florida, received a grant award for ***A Course Enhancement in Aerospace Design***. The grant will be used to incorporate advanced computer software into an existing undergraduate aerospace engineering design course. Because it is a required course, the grant will affect the many aerospace engineering students who will graduate from UCF in the future.

Dr. Bjorn Lamborn, Professor of Physics at Florida Atlantic University, received a grant award for a course entitled ***Space Plasma Physics***. The grant will be used to develop a new course for both graduate and advanced undergraduate students. Because Florida Atlantic University does not have a formal space science curriculum, it is unlikely that a course such as this would have been developed and offered without the support of the Space Education Development Program.

Dr. Wei Shyy, Professor of Aerospace Engineering at the University of Florida, received a grant award for a course entitled ***Thermofluid Dynamics for Space Applications***. This new graduate-level course will examine combustion, propulsion, and mass transfer under micro-gravity conditions.

Drs. Kay Stanney, Assistant Professor, and William Swart, Professor and Chair of Industrial Engineering at the University of Central Florida, received a grant award for a course entitled ***Work Measurement and System Design in the Space Industry***. This is a new undergraduate course that will help prepare engineering students for space related careers. It will be required of all industrial engineering students, and also will be offered as an elective course in the new UCF Minor in Space Studies.

Awards for In-Service Training Programs for K-12 Teachers

On December 4, 1992, the Florida Space Grant Consortium also announced four grant awards for in-service training programs for K-12 teachers. Each of the grant awards was for $6,000. The recipients and their projects are as follows:

Dr . John Armstrong, Associate Professor and Interim Chair of Instructional Programs at the University of Central Florida, received a grant award for an in-service training program entitled ***Image Processing for Teaching***. This project also involves the University of Arizona's Center for Image Processing in Education, the Orange County School District, and the Florida Department of Education. Teachers will receive 30 contact hours of instruction in exploring some of more than 20,000 images from satellites and interplanetary spacecraft. The teachers will be given the CD-ROMs containing the images and other course materials to share with their students.

Dr. Howard Cohen, Professor of Astronomy at the University of Florida, received a grant award for ***Astronomical Imaging Workshops for Teachers***. The participating teachers will attend one to two-day palette workshops, and also will use NASA CD-ROMs to explore the universe with their students.

Drs. Enrique Ortiz and Robert Everett, Assistant Professors of Instructional Programs at the University of Central Florida, received a grant award to develop a three credit-hour, graduate-level, in-service course entitled ***Small Rocket Applications for Teachers***. The teachers will receive 45 contact hours of instruction in rocketry, space science and applications for the purpose of enhancing science and mathematics instruction in their classrooms. This course is a collaborative effort with the Martin Marietta/UCF Academy and Spaceport Florida Authority.

Drs. Ronald Thornton, Director, and Michelle Young of NASA's Southern Technology Applications Center (STAC), received a grant award to develop an in-service program entitled ***SUCCESS in a Suitcase***. Participating teachers will simulate space exploration experiences at the Museum of Science and Industry in Tampa, and will receive a suitcase filled with slides, take home exercises, and other space education materials they can share with their students. The acronym SUCCESS stands for Students Understanding Colonization in the Cosmos and Exploring Space Spinoffs.

Prospects for the Future

In-service training programs for K-12 teachers will most likely be the focus of attention in the coming year for the Space Education Development Program. The quality of the proposals received this year in that category was high. In addition, the Technological Research and Development Authority has expressed interest in cooperating with the FSGC on K-12 programs. We are hopeful this will occur.

Decisions on the allocation of funds and program offerings for next year will be made by the Executive Board of the Florida Space Grant Consortium. However, it appears likely that proposals for symposia and conferences will not be solicited in the coming year. Also, the prospects for funding projects involving curriculum development and the use of advanced educational technologies and communications are uncertain at this time.

The two-step solicitation process was an interesting experiment, but tended to raise false expectations and cause unnecessary confusion. Every effort will be made to discourage its use next year.

The proposal evaluation forms and procedures used appear to be effective. Overall evaluation of the SEDP, however, will not be possible until a year from now when the first project reports start coming in. In addition to the required deliverables, an informal follow-up evaluation will be conducted. The results will give future direction to the program.