Hands-On Educational Outreach: Purdue Fall Space Day

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Abstract

Purdue Fall Space Day (PFSD) is both a successful educational outreach program for third through eighth grade students and a professional development program for university student volunteers. PFSD is in its 11th year of program execution, with over 3,000 grade school students and over 900 university student volunteers participating in the program since its inception. PFSD inspires the grade school students to learn about science, technology, engineering and math (STEM) by using a space theme. They participate in three hands-on age-appropriate STEM activities during the day. All activities are accompanied by lesson plans to facilitate the children's understanding.

PFSD encourages the children to think about future careers in engineering and also lets the children become more familiar with a university campus as a place for them to ultimately come. The university student volunteers gain valuable experience as teachers, role models and mentors, and through service learning they learn the inestimable value of reaching the wider community. Additionally, the professional development tasks required to plan and implement a successful PFSD each year with taking a leadership position in managing a large project with interdisciplinary co-operation.

A mix of freshmen, sophomores, juniors, seniors, and grad students from many majors is also a factor in the success of the program. A rolling program with experienced student volunteers taking the lead ensures continuity of program management and student participation.

PSFD has been supported by the Indiana Space Grant Consortium (INSGC), which is a NASA-funded education, outreach, and workforce development program. PFSD allows university students an opportunity to develop an experiential understanding of project management and integrating engineering systems at multiple levels of aggregation. Thus, PFSD provides substantial workforce development contributions to university science and engineering majors, in addition to its ability to provide K-12 students with an informal STEM education experience.

I. Acronyms

INSGC = Indiana Space Grant Consortium
NASA = National Aeronautics and Space Administration
PFSD = Purdue Fall Space Day
STEM = Science; Technology; Engineering and Math

II. Introduction and Background

Purdue Fall Space Day (PFSD) is a free all day program designed to give students in 3rd to 8th grades the opportunity to learn about astronautical engineering and space exploration through listening to a presentation by a Purdue alumnus astronaut and by participating in three unique hands-on experiences with the intention of sparking their interest in science, technology, engineering and math (STEM). PFSD aims to engage those school students who have an interest in science and engineering and to expand their interest in a fun, hands-on environment.

PFSD was inaugurated on Saturday November 9, 1996 by the Purdue University chapter of the Students for the Exploration and Development of Space (SEDS) and has grown to accommodate over 400 third through eighth grade students with volunteer support from 160 university students from over 28 majors. Since 1996, over 3000 grade school students have participated in PFSD and over 900 student volunteers have helped run the program.

In addition to PFSD being a successful educational outreach program, it is also a successful professional development program for university student volunteers. These student volunteers are *vertically integrated* maintaining a mix of freshman through graduate students each year. The student volunteers are *multidisciplinary* as the event draws students from across engineering and from other disciplines. Student participation is *long term* in order to maintain leadership and continuity from one year to the next.

III. Purdue Fall Space Day Description

Each year PFSD is held on the West Lafayette campus of Purdue University on a Saturday in late October or early November. Organized by university students, PFSD is a free educational outreach program, which provides grade school students the opportunity to learn about science technology engineering and mathematics by participating in three age-appropriate activity sessions throughout the day.

Over 400 pre-registered school students in grades three through eight arrive early in the morning and are organized into twenty-one pre-determined groups. Each year the Student Director chooses a Mission Patch and theme by which to name the groups. Past examples have included astronaut names, space vehicle names, and landing crafts. Each group is led by at least two student volunteer Group Leaders. The groups are split into the following grade ranges:

Grade 3-4; Grades 5-6; Grades 7-8;

Within the grades, each group is divided into groups of no more than twenty students. This ensures that overcrowding is avoided in the classrooms where the activities are performed and that the students receive individual attention from student volunteers.

The Group Leaders' are responsible for ensuring the safety of the school students as they move from one activity to the next and ensuring that the groups get to the correct location at the correct time. The safety of the students is the responsibility of the group leader until the school students are returned to their parents or teachers.

The school students participate in three hands-on age-appropriate STEM activities during the day. All activities are accompanied by lesson plans to facilitate the children's understanding of basic engineering concepts. These lesson plans are published in the student's handbook and on the web page www.fallspaceday.com.

IV. Astronaut VIP

Purdue University has played a leading role in providing the nation with engineers who have designed, built, tested and flown the many vehicles that have changed the face of space exploration during the 20th Century and at the beginning of this second century of flight. Purdue University is justifiably proud to be known as the "Cradle of Astronauts", and has now produced 22 graduates to be selected as NASA astronauts.

To many, the highlight of the day is the attendance of a Purdue Alumnus Astronaut who starts PFSD with a presentation providing the students first hand information about his/her space flight experience. Several of Purdue's astronaut alumni have returned to help ignite the next generation of engineers and space explorers. Past PFSD astronauts include John Blaha, Mark Brown, John Casper, Guy Gardner, Greg Harbaugh, Gary Payton, Loren Shriver, Janice Voss, and Don Williams. Charles Walker has graciously agreed to attend on November 3, 2007.

The evening prior to PFSD, the astronaut gives a free public presentation. This presentation has become increasingly well attended by the local community and media. Every year the standing-room only attendance at this presentation demonstrates the great public interest in the nation's space program and astronauts.

During PFSD, the astronaut stays involved with the grade school students during their activity sessions, and finishes the day with a session that provides interaction solely with the student volunteers. Purdue benefits greatly by having former students return as astronauts and give so willingly of themselves for this program and help ignite the next generation of engineers and space explorers.

V. Brief History

Purdue Fall Space Day held its first event on November 9, 1996. Three university organizations worked together to put on the event; Purdue Students for the Exploration and Development of Space SEDS); the Purdue Engineering Student Council (PESC); and the Purdue student chapter of the American Institute of Aeronautics and Astronautics (AIAA). It was designed to meet the needs of educational outreach to the community and was an opportunity for school students to come to the Purdue campus and learn about astronautical engineering and space exploration and to meet and interact with an astronaut. In its first year, 120 school students attended with 40 Purdue student volunteers running the event. Now in its 12th year, PFSD has grown to accommodate over 500 3rd – 8th grade students with volunteer support from over 160 student volunteers, who represented 28 majors.

Since 1996, over 3,000 grade school students and over 900 student volunteers have participated in PFSD. The event has grown steadily and has gained recognition both in the Greater Lafayette community and across both Indiana and its neighboring states as an exceptional space-related educational outreach program. Originally the event was under the auspices of the student organization Purdue SEDS, it is now a Student Organization in its own right and known as Purdue Space Day.

VI. Funding

An important aspect in the planning of FSD is obtaining external funding. Due to sponsorship, PFSD is able to provide an entire day's worth of space, science, and engineering centered activities for third through eighth graders at no cost to the participants. Local and national business sponsorship creates closer ties between the university, industry and business. The logos of the companies are put on the back of the t-shirts and in the booklets. This high-profile event reflects well on Purdue University and the event's sponsors and receives significant media coverage. The Indiana Space Grant Consortium (INSGC) provides a major and ongoing source of PFSD funding, as a model of both informal education and higher education workforce development activities of value to NASA.

VII. T-Shirts

All student volunteers wear a brightly colored PFSD T-shirt with that years' PFSD mission patch. These T-shirts clearly identifies the student volunteers to the grade school students and serves as a safety feature. The grade school students are encouraged to ask the student volunteers questions about engineering, space exploration, and college life throughout the day and can easily look for them in their PFSD T-shirt. The student volunteers are thus visible (literally, and not simply figuratively) as role models by the younger students. These T-shirts also promote a sense of unity amongst the student volunteers and the back of the T-shirt also allows space for sponsorship logos to be added.

VIII. Impact on Grade School Students

PFSD encourages the grade school children to think about future careers in engineering and also lets the children become more familiar with a university campus as a place for them to ultimately come.

By attending PFSD, grade school students have the opportunity to learn about aeronautical and astronautical engineering and space exploration on the Purdue campus and get the chance to meet the VIP astronaut during the day. In addition, the school students interact throughout the day with student volunteers who serve as enthusiastic and knowledgeable mentors as well as role models. This interaction is a first introduction for most of the grade school students to considering STEM majors at the university level.

The school students also interact with their peers from different race or backgrounds both in a large group and in smaller groups. In order to achieve their objective in the "hands-on" activity, they have to following directions from both peers and the student volunteers and work together in teams to achieve their objective.

IX. Impact on University Students & Campus

PFSD allows student volunteers an opportunity to develop an experiential understanding of project management and integrating engineering systems at multiple levels of aggregation. Thus, PFSD provides substantial workforce development contributions to university science and engineering majors, in addition to its ability to provide 3rd – 8th grade students with an informal STEM education experience. Under the guidance of a staff coordinator (the only major non-student role associated with PFSD), the PFSD committee works closely over an entire year with their student volunteers to define, design, test, and support the systems that the day needs. The coordinator provides important continuity to the program, while still nurturing each new set of students taking on leadership roles. PFSD thus has a major and long-term impact on:

- The student volunteers who run the event
- The grade school students who attend the event
- The greater community who benefit from the event

University students participating in PFSD obtain real-world experience in managing and leading a large, multifaceted project (and people with a variety of skills and talents) in a cooperative fashion. Both citizenship and role model considerations are highly important and immediately tangible to any student volunteer working with the students and parents. Some majors in the university allow students to obtain Service Learning curriculum credit for their PFSD participation.

This high profile event reflects well on Purdue University and the event's sponsors and receives significant media coverage. In order to allow other universities across the globe to learn about PFSD and successfully implement their own Space Day, it is important to share lessons learned in sustaining PFSD, including organizational and financial considerations. .

X. Executive Committee and Organization

A Director, assistant director, treasurer, chair of mission control and the PFSD staff coordinator make up the executive committee. In recent years, both the roles of director and assistant director have been split to accommodate the workload associated with increased numbers of 3^{rd} – 8^{th} students attending. In order to maintain leadership and continuity, student volunteers from first year through graduate school participate in the PFSD teams;

The assistant directors will have at least one year's experience as a general volunteer, group leader or activity head, usually in their first or second undergraduate year. They would then take over as assistant director in their junior year with the role of director in their senior year. The Executive committee trains student university student volunteers, collects feedback, and implements changes to improve the program from year to year. This ensures a rolling program with experienced university student volunteers who are able to take the lead and to establish a teaching role in the execution of the program. New students are recruited to replace graduating seniors and grad students. Now that the program is in its second decade of operations, some students who participated in PFSD as students are now attending Purdue and participating as university student volunteers.

XI. Expansion of the Purdue Fall Space Day Program

Under the funding of the Indiana Space Grant Consortium, (INSGC) PFSD will be expanded to serve other educational establishments within the state of Indiana. The existence of PFSD programs at several sites has opened the possibility of addressing community and educational needs that extend beyond those of a university and its local community.

The first multi-site PFSD project at the University of Evansville will be initiated in 2007, and students from the University of Illinois began shadowing Purdue students in 2005 to develop their own interest in launching a Space Day program. The local goal for each event is to enable the university to share knowledge and information on the service learning and STEM education concept and to encourage educational outreach in local communities. Once these programs have been established, then future expansion to other campuses will continue. Through the INSGC, other states have also expressed interest in expanding this program. The extension of this project could then continue from statewide to a national scope.

XII. PFSD Advisory Committee

Under funding from the INSGC, the Purdue Fall Space Day Advisory Committee was formed in September 2006. Past Directors of PFSD were invited to be Founding members and the aim is that this committee will serve an important role in the expansion of PFSD. The success of our program at Purdue depends on strong support from existing students; the success of our program outside of Purdue depends on the support from those who have been through the program and know what is involved in the running of the event and now have knowledge of life "after university". One challenge is that very few universities can replicate the "astronaut alumni" feature of the PFSD program. Thus, additional discussions are underway to expand the general participation model to other disciplines as well as other states.

XIII. Conclusion

Purdue Fall Space Day has added a new and multidisciplinary dimension to the education of Purdue undergraduates. It integrates service learning and a variety of broad education goals in the campus. PFSD helps to foster a relationship between Purdue University and K-12 schools and students, thus expanding those students' awareness of STEM majors and opportunities. The academic benefits of PFSD participation by student volunteers include the opportunity to be involved in all phases of planning, deployment, and continuous improvement. Most importantly, PFSD provides a very public, and well received, model of how Purdue students can use their skills to benefit the community.

ANN BROUGHTON has been the Fall Space Day coordinator at Purdue University since 2000, and is instrumental in expanding the program to other universities. She is a staff member of the School of Aeronautics & Astronautics and the Indiana Space Grant Consortium. She has a BA degree from Bristol University, U.K. in Business Administration.

Dr. BARRETT CALDWELL PhD is an Associate Professor of Industrial Engineering at Purdue, and Director of the NASA Indiana Space Grant Consortium. His research examines human factors engineering aspects of how people get, share, and use information well, with focuses on space flight mission operations and healthcare delivery. He has two BS degrees from MIT (Astronautics, Humanities), and a PhD in social psychology from the Univ. of California-Davis.

CINDY MAHLER is an International Space Station systems integration engineer at the Boeing Company in Houston, Texas. She is the founder of Purdue Fall Space Day and has a vision for creating a National Organization to expand Fall Space Day not only geographically but also to use the model to reach out to students in other subject areas. While working at United Space Alliance in spaceflight training, Cindy was awarded a Silver Snoopy, the highest award given by Astronauts to less than 1% of the workforce, for the successful integration of the U.S. and Russian Guidance, Navigation, and Control Astronaut Training Program. Cindy attended the International Space University Summer Session Program in Adelaide Australia and received a Graduate Certificate in Applied Science & Space Studies from the University of South Australia. She has an MBA from Rice University and a BS in Aeronautical and Astronautical Engineering from Purdue University.