EDUCATION FLIGHT PROJECTS (EFP)

Administered by Oklahoma State University (OSU)
Type of Agreement: Teaching From Space Cooperative Agreement

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PROJECT DESCRIPTION

Education Flight Projects (EFP) is a NASA Office of Education K-12 project, managed by the Teaching From Space office at the NASA Johnson Space Center. The project's strength is its capability to highlight the Agency's missions and connect education audiences to NASA content, people, and facilities. EFP activities involve K-12 students and educators in hands-on experiences and research applications, on the ground, above the ground, and in space. Activities are "as only NASA can" and utilize a variety of NASA flight platforms, including the International Space Station (ISS) and NASA ground-based research and test facilities. EFP provides opportunities for students and educators to interact with NASA researchers, scientists, and engineers.

These experiential activities are designed to inspire, engage, and educate K-12 students and educators through NASA specific science, technology, engineering and mathematics (STEM) content, resources and experiences. EFP activities are national in scope, scheduled throughout the year, and open to K-12 students and educators throughout the country. Some EFP activities are open to international K-12 students and educators.

EFP student activities are diverse and allow students to engage in NASA missions through hands-on authentic experiences. In FY2012, students took Earth photographs from the ISS, interacted real-time with astronauts on the ISS, developed experiments for astronauts to perform on orbit, created sports games that were played in microgravity, and launched rockets to approximately one mile above the ground.

The project provides short and long duration educator professional development, both face-to-face and electronically. The project gives educators rich opportunities to interact and work with personnel at NASA Centers, participate in research activities, and use the Agency's exceptional resources and facilities. In FY2012, EFP professional development activities utilized multiple NASA facilities and flight platforms including the reduced gravity aircraft, a NASA research aircraft, and a NASA microgravity drop tower.

To improve access to NASA content and education resources, EFP develops "one stop shopping" topic-specific websites for educators and students. In FY2012, the project added new content to its suite of comprehensive websites and developed two new websites – *Teach the International Space Station* and *Microgravity*. The websites include lesson plans, interactive multimedia resources, and NASA research. Together, the EFP websites received over 1.3 million page views in FY2012.

In FY2012, TFS continued management of all ISS National Laboratory K-12 education activities. The office facilitated the on-orbit operations for the Space Lab Challenge, a partnership between NASA, Google, YouTube, BioServe, and Space Adventures. This challenge gave US and international high school students the opportunity to design experiments for astronauts to conduct on board the ISS. As part of its National Laboratory responsibilities, TFS continued support of the LEGO collaboration which began in FY2011. EFP developed the procedures and provided real time console support for LEGO payload operations. Video footage of ISS crewmembers operating the LEGO payload is available on the LEGO website.

EFP manages NASA-unique opportunities for educators and students that utilize the ISS. During live, in-flight education downlinks and Amateur Radio on the ISS (ARISS) contacts, astronauts answer questions from K-12 students. Host organizations are selected through a competitive proposal process. Downlinks and ARISS contacts are part of well-defined education plans developed by these organizations. During four EarthKAM missions a year, student participants direct a camera on the ISS to take photographs of specific locations on Earth. The entire collection of EarthKAM images is available in a searchable EarthKAM image archive. This image collection and accompanying learning guides and activities are extraordinary resources to engage students in Earth and space science, geography, social studies, mathematics, communications, and art.

The project coordinates on-orbit education activities including payloads and demonstrations onboard the ISS. These on-orbit education activities are used, both internally and externally, in the creation of education resources for educators and students.

EFP is also responsible for the design, development, and execution of comprehensive long-term national education plans associated with specific spaceflight missions, particularly those on which an educator astronaut flies. In FY2012, EFP initiated and led a team of NASA Education project managers across the Agency to collaborate on an education plan template for ISS Expeditions. The effort started in response to the ISS Expedition 31/32 mission that included educator and astronaut, Joe Acaba, and grew into a framework for future missions. The plan serves as a comprehensive overview of efforts to deliver and promote NASA-unique STEM activities while providing a strong connection to the ISS.

EFP serves as the primary NASA Office of Education interface to the Astronaut Office and facilitates communication between the two organizations. The office frequently offers support and guidance to astronauts and astronaut office management on education-related activities and questions.

PROJECT GOALS

EFP is focused on increasing K-12 student interest and achievement in STEM. The project achieves this goal by offering unique NASA experiences to students and educators. Recognizing that hands-on, interactive, and authentic experiences are effective learning tools, EFP provides the Agency with outstanding opportunities to inspire, engage, and educate the Nation's students and educators. Student and educator participation in NASA-unique education flight activities directly contributes to NASA Education efforts to attract and retain students in STEM disciplines and strengthen NASA and the Nation's future workforce.

The vision for EFP is to: *Facilitate education opportunities that use the unique environment of spaceflight, other flight platforms, and NASA research facilities.*

The project will meet the following objectives:

1. Develop and provide NASA-unique experiences, opportunities, content, and resources to educators and students to increase K-12 student interest in STEM disciplines.
2. Build internal partnerships with NASA Program Offices, NASA Education programs, NASA Center Education offices, and external partnerships with formal and informal education communities to create unique learning opportunities and professional development experiences.

PROJECT BENEFITS TO OUTCOME 2

EFP goals align to Outcome 2 in the 2011 NASA Education Strategic Coordination Framework (www.nasa.gov/offices/education/performance/strategic_framework.html).

EFP directly contributes to: *Outcome 2 – Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.*

EFP reaches K–12 educators and students through authentic, real-world, hands-on, and interactive education flight activities. The project offers "as only NASA can" experiences that focus on STEM disciplines and highlight NASA missions, content, and careers. The project collaborates with other NASA Education projects, Mission Directorates, Center Education offices, and external partners to increase the value and scope of these activities.

In FY2012, EFP significantly contributed to Outcome 2 through educator and student involvement in education flight activities. The project encourages participants to use these high visibility experiences to engage greater numbers of educators and students, the media, the community, families, and legislators involved in NASA missions. The project is innovative, continually seeking new ways to improve and enhance the value of project activities and incorporate current trends in the use of multimedia and new technologies to engage greater numbers of educators and students. Because many EFP activities are dependent on mission operational requirements, the total number of participants may vary each fiscal year.

The project continually evaluates its activities to insure that they are effective and successfully support Outcome 2. EFP works with each project activity to improve its individual contributions to Outcome 2. EFP provides guidance on requirements, expectations, and data collection, which result in increased benefits to Outcome 2.

PROJECT ACCOMPLISHMENTS

Summary

In FY2012, EFP activities utilized unique NASA assets, including content, facilities, and people to facilitate 100+ on-orbit education activities, 7 air and ground based activities, and one under water activity. Together, EFP activities engaged 6,938 educators and 115,304 students. Additionally, through 9 EFP managed websites and online collaborative activities, EFP contributed to over 27 million page views of NASA content. The project touched nearly every state in the US as well as 25 foreign countries.

FY2012 EFP activities are summarized below by location.

EFP Activities in Space

- Amateur Radio on the International Space Station (ARISS) gives students around the world a chance to use ham radio to talk with ISS crewmembers. In FY2012, ARISS conducted approximately 80 contacts reaching approximately 1,500 educators and 23,000 students in 16 countries. One of these contacts targeted girls attending engineering camp sponsored by the Women in Engineering @ Rochester Institute of Technology in New York and allowed the girls to chat with female astronaut and ISS Commander Sunita Williams.
- Education Payload Operations and Demonstrations bring astronauts on the ISS into the classroom to demonstrate STEM concepts in a microgravity environment. These simple demonstrations are filmed and used in NASA education videos and on websites. In FY2012, EFP partnered with Public Broadcasting Systems (PBS) to use EFP on-orbit videos as a part of "Teacher's Domain," a free digital media service for educational use. EFP facilitated 7 on orbit videos or "lessons from space" during FY2012 and the videos have received over 14,000 views on NASA websites.
- International Space Station Earth Knowledge Acquired by Middle School Students (ISS EarthKAM) allows middle school students the opportunity to program cameras to take pictures of Earth. The photographs are used to support classroom curriculum in Earth and space science, geography, social studies, and mathematics. In FY2012, ISS EarthKAM conducted 3 missions that included 273 educators and 23,721 students from 41 states and 26 countries.
- LEGO on-orbit payload operations were successfully executed. In 2010, NASA and the LEGO Group signed a Space Act Agreement stating that selected LEGO models would be flown to the ISS and educational demonstrations would be performed by the crewmembers with the models. In FY2011 the payload was flown and, in FY2012, a series of on orbit operations took place which EFP managed – including writing procedures, training crewmembers, and providing on-console support. During FY2012, the LEGO website that features the on-orbit videos received over 3 million page views.
- Live In-flight Education Downlinks are similar to video conferences and provide US students and educators with an opportunity to have real time interface with ISS crewmembers as they orbit the Earth. In FY2012, EFP managed 13 downlinks that reached 1,029 educators and 19,222 students in 10 states and the District of Columbia. Of these 13 downlinks, three were requests from Members of Congress; one, hosted by the US Department of Education, targeted children from military families; and another, in partnership with LaRC, Summer of Innovation, and Univision, connected Hispanic ISS crewmember Joe Acaba with Hispanic students and resulted in a Virginia Hispanic Chamber of Commerce "Bridge Builder Award" for LaRC Director Lesa Roe.
- Science Off the Sphere is an EFP facilitated partnership with the American Physical Society (APS) in which ISS Astronaut Don Pettit examines how microgravity affects scientific principles. This video series features unique physics experiments performed on the ISS using everyday objects. APS, the professional society for physicists, shared new "Science Off the Sphere" videos every other Thursday on its outreach website, Physics Central. The website also features educational content on the physics topics demonstrated in space by Pettit and facilitates a physics-oriented challenge question based on the experiments. The video episodes received over 1 million views during FY2012.
- Spaced Out Sports is a partnership with the Stennis Space Center education team and challenged middle school students to design a new sport that astronauts can play in microgravity. The activity

engaged 440 educators and 2,351 students as they utilized the ISS to learn about Newton's Laws of Motion.

- Space Lab Challenge is a partnership between NASA, Google, YouTube, BioServe, and Space Adventures in which high school students around the world designed experiments to be conducted in microgravity. In FY2012, EFP represented NASA throughout the various challenge phases and worked with the ISS Program Office and the Astronaut Office to facilitate on orbit taping of the winning experiments by astronauts on the ISS. The challenge culminated in an EFP facilitated live chat between Astronaut Sunita Williams onboard the ISS and student designers of the winning experiments. Over 8,500 students from 80 countries participated in the challenge. The YouTube Space Lab channel that hosted the competition had over 50 million video views and the live event with Astronaut Williams had over 552,000 views.
- The Transit of Venus event in June 2012 brought an opportunity for EFP to partner with the Science Mission Directorate to deliver a NASA unique opportunity for students and teachers. ISS Astronaut and amateur astronomer Don Pettit agreed to take the first ever pictures of the Transit of Venus from the vantage point of the Cupola window on the ISS. Never before have pictures been taken of a Venus Transit celestial event from this altitude. EFP worked with astronauts and the NASA Crew Earth Observation Office to coordinate the on-orbit activities. The event was streamed live to stations all over the world and the ISS captured images were available on websites which received over 22 million page views.

<u>EFP Activities Above the Ground</u>

- Airborne Research Experiences for Educators and Students (AREES) is an EFP collaboration activity with DFRC and offers a suite of professional development experiences, trainings, and student opportunities that focus on NASA aeronautic research missions. Participants engage with NASA subject matter experts, develop curriculum, pilot STEM elective courses at their schools, and some are selected to join a NASA ER-2 Earth Science mission in which they collect airborne data. In FY2012, AREES introduced the Student Flight Mission Challenge that gave students the opportunity to investigate, design, and present a solution to a real-world problem to expand our understanding of earthquakes.
- EFP Reduced Gravity Flight Weeks for K-12 Educators invites any US educator to propose, design, fabricate, fly, and evaluate a reduced gravity investigation. In FY2012, EFP used feedback from the FY2011 flight weeks to strengthen the impact of the flight experience. The 34 selected educators participated through an online learning environment prior to flight; involved their students in the design and fabrication of experiments, and performed community outreach sessions to share what they learned. Using this comprehensive model, 769 educators and 3,011 students learned about microgravity and the activity received Desire2Excel Award recognition. As part of the FY2012 EFP flight week, EFP partnered with the National Federation of the Blind (NFB) to fly the NFB Executive Director so he could explore first-hand how educators and students who are blind may participate in future flight weeks.
- Student Launch Projects is an ongoing partnership with Marshall Space Flight Center (MSFC) in which middle and high school students compete to design, build, and launch a reusable rocket to 1 mile above ground. FY2012 participants included 25 educators and 96 students from across the country.

<u>EFP Activities on the Ground</u>

- Astro Camps for Military Children provides hands-on learning activities for children whose parents are in the military. The camps are based on NASA content and use NASA education resources. The camps were conducted in partnership with the NASA Stennis Space Center (SSC) and were held at military installations in the SSC region. In FY2012, 77 students participated in EFP Astro Camps.
- Dropping in a Microgravity Environment (DIME) and What If No Gravity (WING) activities use the NASA Glenn Research Center drop towers to test student experiments involving physical science and microgravity. Student teams develop proposals and build their experiments and then test their hypothesis using NASA research equipment. FY2012 participants included 32 educators and 197 students.
- Education websites are developed and maintained by EFP. In FY2012, EFP continued to improve these sites with new features and updates and also launched two topic focused websites – *Microgravity* and *Teach the International Space Station*. All of the EFP websites are designed for teachers by teachers and include easy to find resources including lesson plans, science and research information, and multimedia content. In FY2012, EFP managed 9 websites that received approximately 1.3 million page views.

- Exploration Design Challenge is under development in FY2012. The challenge, which will launch in FY2013, ties to Orion and challenges students to build a radiation shield that can stand up to long duration space exploration. EFP is collaborating with Lockheed Martin and the National Institute of Aerospace to develop and implement the challenge. In September 2012 EFP facilitated a radiation lesson from space as Astronaut Sunita Williams demonstrated radiation detection techniques on the ISS and talked about the importance of ISS radiation research to future space exploration missions. The videotaped lesson will be used to promote the challenge.
- Food for Thought developed curricula resources centered on food safety, nutrition, and the science behind space food. The curricula supported a partnership with the FIRST LEGO League (FLL) Food Safety challenge in which students design and build a robot to assist with food safety. The US winners of the challenge traveled to JSC in July of 2012 for tours and meetings with NASA subject matter experts from the Food Lab, Nutritional Biochemistry Lab, Microbiology Lab and the Robotics group. The students also presented their winning robot design to a panel of astronauts. In FY2012, over 12,000 students were exposed to NASA unique content through Food for Thought.
- Women in STEM High School Aerospace Scholars (WISH) engaged high school girls in an on-line community where they completed 10 NASA focused lessons, chatted with NASA subject matter experts, and competed for the opportunity to attend the summer academy hosted at JSC. The White House Council on Women and Girls cited WISH in their April 2012 report, "The Key to an Economy Built to Last" as a program that encourages girls to pursue STEM careers. WISH 2012 engaged 135 girls from 22 states.

EFP Activities Below the Surface

- The NASA Extreme Environment Mission Operations (NEEMO) 16 mission engaged educators and students in a 2-week mission to simulate an asteroid landing. While the crew lived under water, they introduced the "Science Under Pressure" challenge, a series of educational experiments developed by EFP. Throughout the mission, the topside team and the aquanauts performed and recorded a series of science experiments and students were invited to predict the outcome of each experiment through a number of social media outlets.

PROJECT CONTRIBUTIONS TO PART MEASURES

EFP significantly contributes to NASA Education's FY2012 APGs.

APG 6.1.2.2: ED-12-5 600,000 elementary and secondary students participate in NASA instructional and enrichment activities

115,304 K-12 students participated in EFP activities during FY2012

APG 6.1.2.2: ED-12-6 85% of elementary and secondary students express interest in STEM careers following their involvement in NASA education programs

49% of students expressed interest in STEM careers after participating in a FY2012 EFP activity.

APG 6.1.1.1: ED-12-3 100,000 educators participate in NASA education programs

6,938 K-12 educators participated in EFP activities during FY2012

APG 6.2.1.1: ED-12-7 5,000 educators use NASA resources in their curricula after participating in NASA professional development

95% of educators who completed the 120 day survey indicated that they use NASA resources in their curricula after participating in an EFP activity.

IMPROVEMENTS MADE IN THE PAST YEAR

In FY2012, EFP identified and implemented innovative ways to incorporate new technologies in project activities. Utilizing findings from an in-depth evaluation of the FY2011 Reduced Gravity Flight Weeks, EFP introduced a Desire2Learn (D2L) online learning environment for the FY2012 Reduced Gravity Flight Week. The

project wanted to ensure that teachers master the concept of microgravity prior to flying so that their instruction to students would be enriched before, during, and after the flight. During their six-month D2L experience, educators received content training on elements necessary to understand and teach microgravity, exchanged ideas with NASA mentors and education specialists, and demonstrated student work.

In response to the growing research on how educators and students receive information, EFP joined the world of social media. The project now has a presence on Facebook, Twitter, NASAtalks, and NEON. Followers are multiplying exponentially. All EFP opportunities are promoted through our social media channels, in addition to the more traditional methods of websites and listservs.

Efficiencies were created by leveraging best practices across different activities within the EFP portfolio. In FY2012, the project used the successful In-flight Education Downlink proposal process as a model to strengthen the ARISS proposal process. Unlike the original ARISS application process, interested organizations now submit proposals directly to Teaching From Space during an open request for proposals. The proposals are evaluated on STEM education content and the use of the ARISS contact as a component of a comprehensive STEM education plan. During the two requests for proposals extended during FY2012, Teaching From Space received 237 inquiries and 52 completed proposals from education organizations.

The project also strengthened its business practices infrastructure. In FY2012, EFP designed, built, and implemented a Microsoft SharePoint team site. The site enables team members to work better, faster, and smarter – all in a collaborative, virtual environment. Custom features of the site include an innovation blog, a searchable image gallery, a records archive, and more. Activity sub-sites were added to enable TFS team members to easily access the information needed to support customers across the EFP portfolio.

In FY2012, the Teaching From Space office sought innovative, low or no cost ways to provide professional development opportunities for its team of former classroom educators. Each team member received cross training from other activity leads within the office. This resulted in broader skill sets and eliminated the potential for single point failures. Additionally, the education specialists and project coordinator participated in on-site and virtual professional development sessions offered through the NASA Johnson Space Center and Oklahoma State University.

PROJECT PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

EFP management works closely with Oklahoma State University (OSU), through the Teaching From Space (TFS) Cooperative Agreement (#NNX09AC24G), on all elements of the project. OSU provides the highly skilled TFS staff that is responsible for daily EFP operations. OSU supports major project initiatives as well as the continuous evaluation of the project's activities.

EFP recognizes that partnering with other NASA Education projects and activities is mutually beneficial and has the potential to increase the worth and reach of all associated projects and to result in enhanced continuity between NASA Education portfolio elements. The project also seeks opportunities to work with NASA Center Education offices and Mission Directorates to develop and deliver EFP activities. The project works closely with appropriate NASA Program and Project Offices, to identify flight opportunities, and content for and subject matter experts to participate in the project's activities. EFP also collaborates with external education organizations to expand the scope and value of its activities. Key internal and external partners in FY2012 included: Sesame Street, LEGO, US Department of Education, US Coast Guard, Sally Ride Science, YouTube and Google, National Federation of the Blind, Public Broadcasting System, American Physical Society, Lockheed Martin, NASA Endeavor Science Teacher Certificate Project, National Institute of Aeronautics (NIA), Japan Aerospace Exploration Agency (JAXA), European Space Agency (ESA), National Science Teachers Association (NSTA), ISS National Lab, ISS Program Office, NASA Education Technology Services (NETS), NASA Digital Learning Network (DLN), NASA eProfessional Development, NASA Educator Resource Center Network, NASA Aerospace Education Services, NASA Explorer Schools, Interdisciplinary National Science Project Incorporating Research and Education Experience (INSPIRE), NASA Human Exploration and Operations Mission Directorate, NASA Science Mission Directorate, NASA Museum Alliance, National Air and Space Museum, and Center Houston.