

EDUCATION FLIGHT PROJECTS (EFP)
INTERNATIONAL SPACE STATION NATIONAL LABORATORY EDUCATION (ISSNLE)

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

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PROJECT DESCRIPTION

Education Flight Projects (EFP) and International Space Station National Laboratory Education (ISSNLE) are NASA Office of Education projects, managed by the Teaching From Space office at the NASA Johnson Space Center. The projects work closely together on education activities that highlight the Agency's missions and connect education audiences to NASA content, people, and facilities. This synergistic approach promotes a flow of information that enhances both projects. Through this sharing of information and resources, efficiencies and opportunities emerge which ultimately result in a richer learning experience for students and educators. The activities involve students and educators in hands-on experiences and research applications in space and on Earth. 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 and ISSNLE provide opportunities for students and educators to interact with NASA researchers, scientists, and engineers.

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

EFP and ISSNLE partner to manage NASA-unique opportunities for students and educators that utilize the ISS. The activities are diverse and allow students to engage in NASA missions through hands-on authentic experiences. During live, in-flight education downlinks and Amateur Radio on the ISS (ARISS) contacts, astronauts answer questions from K-16 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 Sally Ride EarthKAM missions a year, students use the ISS as a research platform as they program a camera onboard the ISS to capture and study images of Earth.

The projects work together to coordinate Education Payload Operations, or EPOs, which are 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 students and educators.

Through ISSNLE, K-16 students and educators have direct access to the ISS for use as a learning laboratory. High school and university teams design, propose, and fabricate experiments and hardware for flight on the ISS. Throughout the process, students are mentored by technical professionals and NASA subject matter experts. These opportunities build problem-solving, teamwork, and technical communication skills as groups of students first collaborate on concepts, generate proposals, and finally build, troubleshoot, and execute their research plans. Student participation generates increased self-efficacy in terms of professional and academic self-confidence, a better understanding of individual strengths (and weaknesses), and a clearer picture of the opportunities which will be available through pursuit of a STEM career. In FY2013, ISSNLE engaged learners in five long-duration activities that were hands-on and research based. One activity, the Fluids Education Experiment, engaged students at Purdue University and North Carolina A&T as they built an experiment to test complex mathematical codes used in computer models of fluid physics. The student developed experiment will fly onboard the ISS in 2014.

EFP provides educator professional development, both face-to-face and electronically, that 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 FY2013, the EFP MicroGravity eXperience (Micro GX)

engaged educators in a 6-month immersion course focused on microgravity that included a Reduced Gravity flight week at the Johnson Space Center.

In FY2013, EFP collaborated with Lockheed Martin and the National Institute of Aerospace to develop and launch the Exploration Design Challenge (EDC) – a premier NASA Education STEM engagement activity that ties to Exploration Flight Test 1 (EFT-1) of the Orion spacecraft. The EDC challenges K-12 students around the world to think like scientists to overcome one of the major hurdles for deep space, long-duration space flight – protecting astronauts from radiation.

To improve access to NASA content and education resources, EFP developed and maintains ten websites in the NASA portal. Seven of the websites are “one-stop-shopping” topic-specific websites for educators and students that include lesson plans, interactive multimedia resources, and NASA research. Combined, EFP websites had over 2.1 million page views in FY2013.

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.

As EFP and ISSNLE mature, the projects pay dividends. In FY2013, the Dryden Flight Research Center was able to offer 12 educators the chance to participate in Airborne Research Experiences for Educators (AREE) through its EFP built infrastructure; students in Wise County, VA participated in the Student Spaceflight Experiments Program (SSEP) and credit their involvement to the interest sparked by their In-flight Education Downlink experience; and a team of former Micro GX teachers showcased what they learned about microgravity in an article published in *The American Biology Teacher*.

PROJECT GOALS

EFP is focused on increasing 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 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.

ISSNLE is focused on developing internal and external partnerships that increase the utilization of the ISS to provide NASA unique hands-on and research based learning opportunities for K-16 students. ISSNLE provides the Agency with outstanding opportunities to motivate students to pursue Science, Technology, Engineering, and Mathematics (STEM) careers and studies.

The vision for ISSNLE is to: *Share the International Space Station with educators and students to provide opportunities to participate in our mission, foster innovation, and contribute to a strong STEM workforce.*

The project will meet the following objectives:

1. Seek partnerships to develop and execute education activities that utilize the unique capabilities of the ISS.

2. Provide ISS unique opportunities for K-16 students to engage in authentic NASA-related mission-based research and development activities.

PROJECT BENEFITS TO NASA EDUCATION OUTCOMES

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.*

ISSNLE goals align to Outcome 1 in the 2011 NASA Education Strategic Coordination Framework (www.nasa.gov/offices/education/performance/strategic_framework.html).

ISSNLE directly contributes to Outcome 1 - *Contribute to the development of the STEM (Science, Technology, Engineering, Mathematics) workforce in disciplines needed to achieve NASA's strategic goals, through a portfolio of investments.*

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

In FY2013, EFP and ISSNLE significantly contributed to Outcomes 1 and 2 through educator and student involvement in education flight activities and research. The projects encourage 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 projects are 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.

The projects continually evaluate activities to insure that they successfully support Outcomes 1 and 2. Information, including number of teachers and students served, participant feedback, and student experiment summaries, is collected and documented to determine effectiveness and make improvements.

PROJECT ACCOMPLISHMENTS

Summary

In FY2013, EFP and ISSNLE activities utilized unique NASA assets including content, facilities, and people to facilitate 100+ space and Earth based activities. Together, EFP and ISSLE activities engaged 17,027 educators and 201,888 students. Additionally, EFP engaged 2,058 educators and 107,423 students through the Exploration Design Challenge. Through 10 EFP managed websites, EFP contributed to over 2 million page views of NASA content. EFP touched nearly every state in the US as well as 54 foreign countries.

FY2013 EFP and ISS NLE activities are summarized below.

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 FY2013, ARISS conducted approximately 80 contacts reaching approximately 9,500 educators and 40,272 students in 20 countries. An ARISS contact hosted by the Flagler School District in Florida was cited in the district's annual State of Education Address as a highlight in their quest to create a culture of innovation.
- Education Payload Operations (EPO) and Demonstrations bring astronauts on the ISS into the classroom to demonstrate STEM concepts. These simple demonstrations, designed by educators to effectively address classroom needs, are filmed on-orbit and delivered via NASA education videos and websites. In FY2013, EFP completed six new EPO videos that include demonstrations of how the

transfer of energy drives the motion of matter and how a water drop interacts with dual electric fields. The complete collection of 40 EPO videos received 77,408 plays in FY2013.

- Sally Ride Earth Knowledge Acquired by Middle School Students (Sally Ride 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 FY2013, ISS EarthKAM conducted 4 missions that included 1,289 educators and 101,462 students in 49 states and 51 countries.
- 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 FY2013, EFP managed 15 downlinks that reached 627 educators and 22,228 students in 11 states and the District of Columbia. Of these 15 downlinks, one was a request from a Member of Congress; one was hosted by the US Department of Education at the Smithsonian Air and Space Museum; and three showcased Destination Station exhibits across the country. The downlink hosted by the US Department of Education allowed 10,000 students who participated in the Student Spaceflight Experiments Program (SSEP) – an on-orbit educational research opportunity that allows students to design and send experiments to the space station - the opportunity to speak live with astronaut Sunita Williams after she recently activated some of the experiments.
- The Exploration Design Challenge is underway. The challenge, which launched in March 2013, ties to Orion and challenges students to build a radiation shield that can stand up to long duration space exploration. All participants will have their names flown on Orion's Exploration Flight Test 1 and one high school team will fly their design. EFP is collaborating with Lockheed Martin and the National Institute of Aerospace to develop and implement the challenge. In March, NASA Administrator Charles Bolden and NASA Associate Administrator for Education Leland Melvin participated in a kick-off event hosted at the Johnson Space Center and coordinated by EFP. To date, over 100,000 students around the world have registered to participate in the challenge.

EFP Activities on Earth

- EFP Micro GX for K-12 Educators invites any US educator to propose, design, fabricate, fly, and evaluate a reduced gravity investigation. In FY2013, EFP used feedback from the FY2011 and FY2012 flight weeks to strengthen the impact of the flight experience. The 33 selected educators participated through an online learning environment prior to flight; involved their students in the design and fabrication of experiments, and traveled to the Johnson Space Center to test their experiments on a NASA Reduced Gravity flight. Teachers returned to their hometowns and shared their experiences through staff trainings, school district meetings, community fairs, and education conferences. Using this comprehensive model, 2,225 educators and 11,414 students learned about microgravity.
- 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. WISH 2013 engaged 251 girls from across the US.
- Education websites are developed and maintained by EFP. In FY2013, EFP continued to update these sites with new content and also launched the *Exploration Design Challenge* website within the *Space Life Sciences* website. 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 FY2013, EFP managed 10 websites that received approximately 2.1 million page views.

ISS National Laboratory Education Activities

- The Fluids Education Experiment utilizes the ISS as a research platform to learn about and test complex mathematical codes used in computer models of fluid physics. Undergraduate students at Purdue University and North Carolina A&T State University designed an experiment that is scheduled for flight on the ISS in early 2014. In September, a group of the students traveled to the Johnson Space Center where they spent time in the ISS training mock-up to gain knowledge about the environment in which their experiment will be operated. TFS worked closely with the students to prepare and manifest their experiment for flight. In FY2013, over 350 students were involved in the Fluids Education Experiment.
- Pioneering Mars is an ISS student research activity that teams high school and university students in Mississippi and Alabama with scientists working on NASA's Mission to Mars project. Throughout the

year, students engaged in brainstorming and experiment design sessions and 1-g test experiments. The Pioneering Mars activity will utilize the ISS as a research platform to determine if algae can grow in a Martian-like environment; information that could be used to benefit future missions to Mars. As part of the activity, the team created a comprehensive curriculum and activity guide centered on the Pioneering Mars experiment. The guide is aligned with the Common Core and Next Generation Science Standards and leads students through the processes of researching and synthesizing information, as well as developing critical thinking skills. In FY2013, Pioneering Mars touched nearly 1,000 educators and students.

- Behavior of Organic Solvents in Water Under Zero-G is an activity that engages students in inquiry based learning as they conduct a long term experiment design and analysis project that utilizes the unique facilities of the ISS. Undergraduate students at Gadsden State Community College in Alabama designed the experiment and initially tested it on a Zero-g flight. TFS has worked closely with the group to prepare and manifest their experiment for flight in 2014.
- Nano Lab Plant Growth Chamber is an activity that brings together Texas high school students involved in NASA's High School Students United with NASA to Create Hardware (HUNCH) program and students at Texas A&M University to develop a Nano Racks Plant Growth Chamber experiment. The high school students designed a water injection system for a plant growth chamber and the university students developed the microcontroller portion of the experiment. Through support from TFS, the experiment is manifested for flight on the ISS in 2014. In FY2013, 29 students engaged in the Nano Lab Plant Growth Chamber activity.
- The Robotics, Ocean, Microgravity Explores (ROME) Challenge is a collaboration between San Jacinto College Aerospace Academy and NASA. It provides middle school students in Texas and Iowa with an experiential learning opportunity as they develop robots for use in a microgravity environment. The students used underwater robotic technology to design and build their robots and then came to the Johnson Space Center to test their robots in the Neutral Buoyance Laboratory. In FY2013, nearly 500 students participated in ROME.

PROJECT CONTRIBUTIONS TO PERFORMANCE MEASURES

APG 6.1.2.2: ED-13-3 Conduct no fewer than 200 interactive K-12 student activities that leverage the unique assets of NASA's mission.

- In FY2013, the projects conducted 99 events that allowed K-12 students to interact real-time with crew and hardware onboard the International Space Station.
- The Exploration Design Challenge leverages Orion to engage K-12 students in the engineering design process.

APG 6.1.2. Provide NASA experiences that inspire student interest and achievement in STEM disciplines.

- Over 80% of educators involved in ARISS, Downlinks, and EarthKAM, indicated that participation in these activities will be effective in increasing their students' interest in STEM topics.

APG 6.1.2.1. Provide higher education students with authentic NASA mission-based opportunities that build knowledge and skills needed for STEM careers.

- University students across the country worked with technical professionals and NASA subject matter experts to design and build STEM related experiments that will fly onboard the International Space Station.

APG 6.1 Improve retention of students in STEM disciplines by providing opportunities and activities along the education pipeline.

- Nearly half of students involved in ARISS, Downlinks, and EarthKAM, indicated that participation in these experiences made them more interested in a STEM career.

APG 6.1.1. *Provide quality STEM curricular support resources and materials.*

- Nearly 70% of educators involved in ARISS, Downlinks, and EarthKAM, indicated that they will be more effective in teaching STEM concepts introduced through these experiences.

IMPROVEMENTS MADE IN THE PAST YEAR

In FY2013, EFP and ISSNLE identified and implemented innovative ways to deliver quality activities and resources while operating with reduced budget and staff. By developing process efficiencies and leveraging new and existing partnerships, educator participation increased by 145% and student participation by 75%.

A major contributor to this increase in participation is Sally Ride EarthKAM. In FY2013, the projects collaborated with the NASA Public Affairs Office and activity partner Sally Ride Science to design and implement a revitalized promotion campaign. Components included NASA TV interviews with past EarthKAM participants, expanded social media, and a redesign of the Sally Ride Science managed EarthKAM website. As a result, EarthKAM experienced a 242% increase in educator participation and a 328% increase in student participation. Website statistics show that approximately 80% of the FY2013 EarthKAM participants were new this year; proof that improvement efforts reached educators and students in a big way.

ISSNLE underwent a leadership change and a subsequent analysis of all activities with a focus on how to strengthen the educational quality and reach of the project. For the first time, the ISS National Laboratory portfolio produced measureable results through five well-defined, long-duration activities that offered high school and university students hands-on research opportunities using NASA-unique resources that include the International Space Station and astronaut training facilities.

EFP strengthened its role in education outreach support for astronauts. In response to the increased number of virtual astronaut public appearances, EFP worked with the Astronaut Office and the ISS Program Office to develop education demonstration kits and items that work well in the virtual format and help astronauts share NASA's vision for future space exploration. EFP also developed a process to proactively search the astronaut public appearance request data base and offer attending astronauts support specific to their education audience.

Additionally in FY2013, the ARISS website was re-designed, promotion products were created to appeal to targeted audiences, and social media was enhanced through additional imagery and varied communications.

PROJECT PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

EFP/ISSNLE management works closely with Oklahoma State University (OSU), through the Teaching From Space (TFS) Cooperative Agreement (#NNX09AC24A), on all elements of the projects. OSU provides the highly skilled TFS staff that is responsible for daily EFP and ISS National Laboratory Education operations. OSU supports major project initiatives as well as the continuous evaluation of the project's activities.

EFP and ISSNLE recognize 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 projects also seek opportunities to work with NASA Center Education offices and Mission Directorates to develop and deliver NASA unique activities. The project works closely with appropriate NASA Program and Project Offices, to identify flight opportunities, content, and subject matter experts to participate in the project's activities. EFP and ISSNLE also collaborate with external education organizations to expand the scope and value of its activities. Key internal and external partners in FY2013 included: US Department of Education, Sally Ride Science, Lockheed Martin, National Institute of Aeronautics (NIA), Ilan Ramon Foundation, Purdue University, North Carolina A&T State University, University of South Alabama, Gadsden State Community College, San Jacinto College, European Space Agency (ESA), Canadian Space Agency (CSA), Russian Federal Space Agency, National Science Teachers Association (NSTA), National Center for Earth and Space Education (NCESE), ISS Program Office, NASA Education Technology Services (NETS), NASA Digital Learning Network (DLN), NASA eProfessional Development, NASA

Educator Resource Center Network, High School Students United with NASA to Create Hardware (HUNCH), NASA Human Exploration and Operations Mission Directorate, NASA Museum Alliance, National Air and Space Museum, Space Center Houston.