Puerto Rico Space Grant Consortium
Lead Institution: University of Puerto Rico
Director: Gerardo Morell
Telephone Number: 787-282-7047
Consortium URL: www.prsgc.upr.edu
Grant Number: NNX10AM80H

PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Puerto Rico Space Grant Consortium is a Designated Consortium funded at a level of $575,000 for fiscal year 2013.

PROGRAM GOALS

Goal A: Increase the number of students pursuing undergraduate and graduate studies in STEM areas.

Objectives:

- Provide fellowships and scholarships to STEM students participating in projects pertinent to NASA.
- Strengthen existing graduate programs by sponsoring research travel and internships at NASA centers for students and faculty.
- Provide research experiences to STEM undergraduates at four-year colleges.

Goal B: Enhance PR's research capability and infrastructure in areas relevant to NASA.

Objectives:

- Provide seed grants in areas relevant to NASA as evidenced by collaborations with NASA centers.
- Promote college-level hands-on hardware projects: such as robotics, balloon sat and rock sat projects.

Goal C: Infuse pre-college education with exciting STEM activities to increase students' interest in STEM careers.

Objectives:

- Provide a range of professional development workshops for in-service and pre-service teachers.
- Promote the incorporation of NASA-related science topics and content in the pre-college classrooms through teacher workshops that make use of NASA content and NASA educational materials.

Goal D: Disseminate exciting information about NASA to the general community to build support for the enhancement of STEM education and research.

Objectives:

- Involve mass media in the dissemination of news about NASA accomplishments and NASA spinoffs that enhance our quality of life.
- Support the training of pre-service teachers as general public educators through internships at science museums and similar facilities.

PROGRAM BENEFIT TO OUTCOME 1

Students that participated in Puerto Rico Space Grant Consortium's Programs and NASA Internships were hired by NASA, other federal agencies, the aerospace industry or the academia, as follows:

- Phillip Mejías (NASA Langley Intern) is a Software Developer at NASA Dryden Flight Research Center.
- Brian De León (NASA Johnson Intern) is a Pathways Intern at NASA Marshall.
- Dennis Negrón (NASA Space Grant Research Assistant) was hired by the Department of Defense.
- Gustavo Galán (NASA Space Grant Research Assistant) is a Civil Engineer with the U.S. Army Corps of Engineers.
- David Cuevas (NASA Space Grant Fellow) is a Geologist at the U.S. Environmental Protection Agency.
- Luis Santiago (NASA Space Grant Fellow) is an Engineer at Honeywell Aerospace.
- Jason Trinidad (NASA Space Grant Fellow) is a Robotics Software Engineer at LEIDOS Corp.
- Javier Espinosa (NASA Space Grant Research Assistant) is a Software Engineer at Harris RF Communications Corp.
- Carlos Pérez (NASA Space Grant Fellow) is a Mechanical Engineer at InfoTech Aerospace Corp.
- Fernando Aponte (NASA Space Grant Research Assistant) is a Geotechnical Engineer at Terracon Consulting Engineers & Scientists.
- Ana Camerón-Soto (NASA Space Grant Fellow) is Assistant Professor at the University of Puerto Rico, Mayagüez Campus
- Maider Marín-McGee (NASA Space Grant Fellow) is Adjunct Professor at Northern Kentucky University.

PROGRAM BENEFIT TO OUTCOME 1 (continuation)

The Team of the University of Puerto Rico at Humacao won the College Division of the new NASA Rover Challenge (formerly NASA Great Moonbuggy Race) that was held April 10-12, 2014, at the U.S. Space and Rocket Center in Huntsville, Alabama. Organized by NASA's Marshall Space Flight Center, the NASA Rover Challenge is focused on designing, constructing and testing technologies for mobility devices to perform in different environments, and provides valuable experiences that engage students in the technologies and concepts that will be needed in future exploration missions. Rovers are human-powered and carry two students, one female and one male, over a half-mile obstacle course of simulated extraterrestrial terrain of craters, boulders, ridges, inclines, crevasses and ruts. Each student team of six members is responsible for building their own rover, and the two course drivers must be chosen from the team. As part of the challenge, and before traversing the course, unassembled rover entries must be carried by the drivers to the course starting line with the unassembled components contained in a volume of 5x5x5 feet (dimension requirements). At the starting line, the entries are assembled, readied for racing, and evaluated for safety.

PROGRAM BENEFIT TO OUTCOME 2

The NASA Aerospace Educational Laboratory (AEL) located at the University of Puerto Rico, Arecibo Campus, engaged 410 participants in real world challenges pertaining to Aeronautics and Space Exploration during the 2013-2104 academic year. The AEL is a state-of-the-art, electronically enhanced, computerized classroom that puts cutting-edge technology at the fingertips of middle and high school students and teachers. It houses real aerospace hardware and software including an Advanced Flight Simulator, a research wind tunnel, a short-wave radio receiver, and hand-held global positioning systems, or GPS, for aviation. In ten unique workstations, participants explore technology through hands-on, minds-on activities that model real-world challenges in aerospace. All of the participants were Hispanic U.S. citizens, 71% from public schools and 29% from private schools from all geographical areas of the Jurisdiction. After completing the AEL experience, 69% of the participating students indicated interest in pursuing STEM careers, a significant increment from the initial 45%.

PROGRAM BENEFIT TO OUTCOME 3

The Puerto Rico Astronomy Society Affiliate implemented a comprehensive agenda of outreach activities and monthly nightly observation educational activities for the general public known as “Star Parties” reaching a total of 10,000 participants from the general public. The activities were themed based on recent astronomy events observable in Puerto Rico, such as: Blood Moon or Lunar Eclipse, Partial Solar Eclipse, Venus Transit, and Solar Spots.

PROGRAM ACCOMPLISHMENTS

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals. (Employ and Educate)*

a. Fellowships/Scholarships Program: PRSGC provided full support (stipend and tuition) to 29 college students during the 2013-2014 academic years: 14 PhD students, 6 MS students, and 9 BS. The demographics of the student fellows are 100% Hispanic US citizens, 55% male and 45% female. The recipient students participated in NASA-related projects developed by researchers in the Jurisdiction in collaboration with NASA centers. The participating projects include topics in: Astrophysics, Civil & Environmental Engineering, Computer Science, Control Systems, Electrochemistry, Nanotechnology, Fuel Cells, Materials Science, Theoretical Physics, Marine Science, Inorganic Chemistry and Biochemistry. The collaborating research centers include: Marshall Space Flight Center, Kennedy Space Center, Glenn Research Center, Langley Research Center, Goddard Space Flight Center, Johnson Space Center, Ames Research Center, Institute for Functional Nanomaterials, Center for Advanced Nanoscale Materials, and Jet Propulsion Lab.

b. Research Internships Program: PRSGC supported a total of 13 students doing research internships during the academic semesters and summer session. The award covered travel costs and full stipend during the internship period. The host research centers include: Langley Research Center, Goddard Space Flight Center, Johnson Space Center, Ames Research center, Wallops Flight Facility, and Argonne National Lab.

c. Research Infrastructure Development Projects: PRSGC supported 10 seed projects relevant to NASA in collaboration with NASA centers. A total of 11 faculty members and 7 college students participated in these projects. The seed projects involved the participation of 4 affiliate member institutions: University of Puerto Rico at Mayagüez, University of Puerto Rico at Río Piedras, University of Puerto Rico at Bayamón and University of Puerto Rico at Humacao. The following institutions collaborated in the seed projects: NASA AMES, NASA Goddard Space Flight Center, NASA Langley Research Center and NASA Kennedy Space Flight Center, Center for Advanced Nanoscale Materials, and the Institute for Functional Nanomaterials.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty. (Educate and Engage)*

a. Hardware Projects for Undergraduate Students: PRSGC supported 5 hands-on hardware projects that involved 142 students and 8 faculty members. They were developed by 3 different affiliate institutions: University of Puerto Rico at Río Piedras, University of Puerto Rico at Humacao, Inter American University of Puerto Rico. The participating affiliate institutions received expertise and support from: NASA Goddard Space Flight Center, NASA Marshall Space Flight Center, NASA Wallops Flight Facility and National Undergraduate Research Observatory. The Higher Education projects included: development of a satellite engineering course using the CubeSat platform (40), two meteorology instrumentation courses using the RockSat platform (60), the NASA Rover Challenge (5), and emergency communications experimental balloon (37). By participating in these projects, the students gained technical knowledge relevant to NASA and became better prepared to lead a successful career in STEM.

b. Pre-service Teacher Experience: PRSGC supported 2 pre-service STEM teachers to obtain an innovative teaching experience at STARBASE Puerto Rico. STARBASE is a premier educational program, sponsored by the Office of the Assistant Secretary of Defense for Reserve Affairs. At STARBASE, pre-college students participate in challenging "hands-on, mind-on" activities in STEM. The program's curriculum provides 25 hours of stimulating experiences divided in five weekly visits. STARBASE Puerto Rico training site to provide premier teaching experiences to pre-service teachers in order to prepare them to educate the highly skilled American workforce that can meet the advanced technological requirements of the Nation.

c. Experimental Astronomy Research Experience for Undergraduate Students: PRSGC supported 10 students to do mentored undergraduate research at the National Undergraduate Research Observatory (NURO). NURO is a consortium of primarily undergraduate education institutions from around the country, both public and private, that have joined together to provide training and research experiences for their students. Together they share 120 nights per year on Lowell Observatory's 31-inch telescope, with instrumentation and observer support provided by Northern Arizona University through its Department of Physics and Astronomy. Astronomers and students at the member schools collaborate on key research projects through NURO.

d. Summer STEM Academy for Pre-college Students: The University of Puerto Rico at Arecibo Affiliate implemented a Summer STEM Academy to motivate pre-college students to study careers in STEM with innovative and modern workshops and topics that they do not get in a traditional classroom. A total of 25 students from 8th grade participated in the Academy. Conferences and workshops included the following topics: Robotics, Geology, Chemistry, Ecology, Fractals, Science and Technology Aerospace, Engineering, Astrobiology and Astronomy.

e. Saturday Robotics Academy for Pre-college Students: This Saturday Robotics Academy was offered by the University of Puerto Rico at Arecibo Affiliate to a total of 20 students of 7^{th}-8^{th} grade from eight different public and private schools of the Department of Education of Puerto Rico. The Lego Mindstorm 9797 robot was used as a tool to present basic STEM concepts, such as velocity, force, gear, efficient design and programming. They had experiences in the solution of problems while working as teams. The goal was to foster an early interest in STEM careers.

f. Training Activities for Educators: A range of training activities were implemented in order to provide new NASA content and NASA educational materials to in-service teachers, pre-service teachers, and informal educators. A total of 988 educators attended these training activities and 75% of them reported bringing some of the new science content learned into their teaching. College faculty and students helped to organize the pre-college activities, exerted leadership in their implementation, and also became participants who benefited from the activity. The training activities were carried out by 10 affiliate institutions: UPR-Mayaguez, UPR-Río Piedras, UPR-Humacao, UPR-Arecibo, Ana G. Méndez System, Interamerican University, PR NASA Explorer School, PR Department of Education, Univision-PR, StarBase-PR. The activities also involved the participation of non-affiliate organizations: NASA Dryden, NASA Goddard Space Flight Center, NASA Kennedy Space Center, NOAA, PR Department of Education, PR Seismic Web, PR Emergency Management Office.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission. (Engage and Inspire)*

A range of educational projects targeted at the general public were implemented in order to bring NASA science and technology into the realm of the commonly heard of and spoken about topics in Puerto Rico with the purpose of: (a) planting the idea of pursuing STEM careers in children and youngsters and (b) increasing the overall societal esteem for STEM career paths, so that adults provide positive feedback to young people who express interest in STEM careers. The Informal Education Projects included astronomy observations for the community, NASA astronaut visits, conferences open to the general public, and demonstration/information booths in malls. The public-at-large NASA enrichment activities were carried out throughout the 2013-2014 academic year attracting a total of around 22,000 participants. Six affiliate institutions participated in organizing the activities: PR Astronomy Society, Univision- PR, UPR-Arecibo, UPR-Mayagüez, Ana G. Méndez, and UPR-Río Piedras. The activities also involved the participation of NASA centers and non-affiliate organizations: NASA Dryden, NASA Kennedy Space Center, NASA Glenn Research Center, Institute for Functional Nanomaterials, and the National Oceanic and Atmospheric Administration.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:**
  a) Total number of awards = 182
     – Fellowship/Scholarship = 78
     – Higher Education = 66
     – Research Infrastructure = 38
  b) 100% of the awardees kept good academic progress in the 2013-2014 academic year.
  c) 6 awardees (3%) have accepted job positions in STEM upon graduation.
  d) 6 awardees (3%) were admitted into advanced STEM degree programs after successfully completing the BS/BE degree.
  e) 170 awardees (94%) are successfully progressing towards their next academic year of study in their academic program.

- **Diversity:** 100% of the awardees (182) are Hispanic U.S. citizens. Their gender distribution is as follows: (80) 44% female, (102) 56% male.

- **Minority-Serving Institutions:** 10
  The ten minority-serving affiliate institutions are strategically located, covering all geographical regions and socio-economic levels across the Jurisdiction. All of the PRSGC projects and activities involve Minority-serving institutions and Hispanic U.S. citizens.

- **Course Development:** The Inter American University Affiliate developed these four new courses as part of a minor track in Aerospace Engineering:
  - Compressible Aerodynamics
  - High Speed Aerodynamics
  - Materials of Aerospace
  - Aerospace Structures

- **Funding leverage:**
  The ratio of funds leveraged by NASA funding support is 1:1
  ($575,000 from NASA and $575,000 from UPR).

- **NASA Education Priorities:**

  - Sixteen long duration (greater than or equal to 2 days in length) professional development workshops for teachers were provided. Of the 379 participants, 85% reported using NASA resources in their classroom instruction.

  - Ten short duration (less than 2 days in length) professional development workshops for teachers were provided. Of the 471 participants, 76% reported using NASA resources in their classroom instruction.

- Five long-duration student-centered projects were supported that attracted a total of around 1320 middle and high school students. A total of 1022 of these students expressed interest in pursuing STEM careers (77%).

- A total of thirty five public-at-large NASA instructional and enrichment activities were carried out that attracted a total of around 20,680 pre-college students among the attendees.

IMPROVEMENTS MADE IN THE PAST YEAR

The seed grant projects are now allowed to run for two years, instead of one. They are initially assigned 50% of the funding ($15,000) starting in June, so that they can start working on the project during summer. Then, they have to give a progress report in the following February, which is evaluated by the External Advisory Board. Based on the recommendations of the Board, the second half of the funding of the seed grant projects is approved and the project can then continue during the second year. The feedback from the Board helps to steer the seed grant projects in alignment with NASA priorities and Board members also help the Principal Investigators in making relevant connections/networking with NASA scientists and engineers.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

- UPR-Central Administration: lead institution and Jurisdiction-level management
- UPR-Mayagüez: undergraduate research, graduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- Mayagüez Planetarium: pre-college education, outreach projects
- UPR-Río Piedras: hardware projects, undergraduate research, graduate research, UPR-Humacao: hardware projects, undergraduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- UPR-Cayey: in-service teacher training, pre-college education, outreach projects
- UPR-Arecibo: in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- UPR-Bayamón: undergraduate research, pre-college education, outreach projects
- UPR-Carolina: pre-college education, outreach projects
- Ana G. Méndez University System: in-service teacher training, pre-college education
- Interamerican University of PR: hardware projects, undergraduate research
- PR NASA Explorer School: hardware projects, in-service teacher training, pre-college education, outreach projects
- Arecibo Observatory Visitors' Center: undergraduate research, graduate research
- PR Department of Education: in-service teacher training, pre-college education
- Univision-PR: undergraduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- EcoExploratorium: pre-college education, outreach projects, informal education
- StarBase-PR: pre-service teacher training, pre-college education

- **The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.**