

Puerto Rico Space Grant Consortium  
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## 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 Grant Consortium funded at a level of **\$575,000** for fiscal year 2011.

## PROGRAM GOALS

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

- Objective 1: Provide fellowships and scholarships to STEM students participating in projects pertinent to NASA
- Objective 2: Strengthen existing graduate programs by sponsoring research travel and internships at NASA centers for students and faculty
- Objective 3: Provide research experiences to STEM undergraduates at four-year colleges

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

- Objective 1: Provide seed grants in areas relevant to NASA as evidenced by collaborations with NASA centers.
- Objective 2: 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.

- Objective 1: Provide a range of professional development workshops for in-service and pre-service teachers.

- Objective 2: 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.

- Objective 1: Involve mass media in the dissemination of news about NASA accomplishments and NASA spinoffs that enhance our quality of life.
- Objective 2: 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 PRSGC's Fellowship Program, NASA Centers Internships and hands-on hardware CubeSat Project were hired in STEM positions, as follows:
  - a. Samelys Rodríguez is working at NASA Goddard Space Flight Center.
  - b. Jason Trinidad is working at NASA Goddard Space Flight Center.
  - c. José G. Lagares is working at NASA Johnson Space Flight Center.
  - d. Roberto Acevedo is working at Honeywell Support and Testing Division.
  - e. Juan G. Cruz is working at Georgia Tech Space Systems Design Laboratory.
- Teams supported by PRSGC won awards in the college and high school divisions of the 19th annual NASA Great Moonbuggy Race at the U.S. Space & Rocket Center in Huntsville, Alabama. Organized by NASA's Marshall Space Flight Center in Huntsville, the race challenges students to design, build and race lightweight, human-powered buggies. Traversing the grueling half-mile course, which simulates the cratered lunar surface, race teams face many of the same engineering challenges dealt with by Apollo-era lunar rover developers at the Marshall Center in the late 1960s. The winning teams post the fastest vehicle assembly and race times in their divisions, with the fewest on-course penalties. The team from Petra Mercado High School in Humacao, Puerto Rico won first place in the high school division. Finishing in second place this year in the high school division was Colegio Nuestra Señora del Perpetuo Socorro in Humacao, Puerto Rico. University of Puerto Rico at Humacao won second place in the college division. The winning teams outraced more than 80 teams from 20 states, Puerto Rico, Canada, Germany, India, Italy, Russia and the United Arab Emirates.

## PROGRAM BENEFIT TO OUTCOME 2

PRSGC supported 3 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 students participate in challenging "hands-on, mind-on" activities in Science, Technology, Engineering, and Math (STEM). The program provides students with 25 hours of stimulating STEM experiences over the course of one week. STARBASE Puerto Rico has become a place to provide premier teaching experiences to pre-service teachers as part of their training to become teachers prepared to educate the highly skilled American workforce that can meet the advanced technological requirements of our Nation.

## PROGRAM BENEFIT TO OUTCOME 3

PRSGC provided expertise and partially supported the initial conceptualization and fund raising campaign design of a new Science Museum/Center to be established in Puerto Rico under the name of *EcoExploratorio de Puerto Rico*. It will be Puerto Rico's premier science and technology education center and will serve as an extension to the formal science and math classroom education, a science-based research facility, a center of scientific and technology exchange with the world. This first-of-its-kind initiative will engage the community in exploring science, technology and the environment and will ensure that the students of Puerto Rico become inspired to explore, share and protect the unique natural environment of their island home. As the meeting point or center of gravity for local, national and international scientists and partnerships, the EcoExploratorio will position Puerto Rico as the scientific destination of the Caribbean. The spectacular facility will include both indoor and outdoor gathering and entertainment spaces, interactive exhibits, presentation spaces and visitor amenities designed to attract and engage visitors. The fund raising campaign started with a \$650,000 grant from the Puerto Rico Government Development Bank (GDB). The Government of Puerto Rico has recognized the importance of science education and the science museum's leadership to galvanize support and accelerate the exciting community transformation at the convention district, where the EcoExploratorio will be located. The GDB commitment to the project's design phase is the jumpstart of the fundraising campaign to obtain \$50M from private and non-profit institutions that is required to build and outfit the EcoExploratorio. With this initial funding, the EcoExploratorio is on track to be a stand-out destination, inspiring visitors to learn, share and embrace science and technology. The new museum is slated to break ground by the end of 2015.

## PROGRAM ACCOMPLISHMENTS

- **Outcome 1:** *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals*
  - a. Fellowships/Scholarships Program: PRSGC provided full support (stipend and tuition) to 20 students during the 2011-2012 academic year: 12 PhD students, 3 MS students, and 5 BS. 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, Astrochemistry, Electrochemistry, Bioremediation, Nanotechnology, Photovoltaic Cells, Fuel Cells, Catalysts, Biosensors, and Atmospheric Aerosols. 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 12 students in research internships during the 2011-2012 academic year. The host research centers include: Glenn Research Center, Kennedy Space Center, Langley Research Center, Goddard Space Flight Center, Johnson Space Center, Ames Research center, Jet Propulsion Lab, University of California at Berkeley, Connecticut Center for Advanced Technology, Institute for Functional Nanomaterials, and Center for Advanced Nanoscale Materials. Projects supported through the Internship Program include these topics: Small Satellite Development and Building, Development of Fuel Cells and Rechargeable Batteries, Management and Mitigation Strategies of Water Resources, Study of Solvent Effects on Materials Wearing, Development of Nanomaterials for Sensor Applications.
  - c. Research Infrastructure Development Projects: PRSGC supported 5 research seed projects relevant to NASA in collaboration with NASA centers. A total of 5 faculty members and 5 research 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. The following institutions collaborated in the research seed projects: NASA Marshall Space Flight Center, NASA Goddard Space Flight Center, NASA Glenn Research Center, University of California at Berkeley, Boston University, University of Central Florida, Florida Space Grant Consortium. The research infrastructure projects were done in collaboration with NASA centers on the following subjects: High Resolution Electron Microscopies, Computational Materials Science, Nanomaterials for Aerospace Applications, New Energy Conversion Materials, Fabrication of Aerogels for Insulation Applications, Satellite Engineering, and Bringing Research into the Classroom.

- **Outcome 2:** *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty*
  - a. Hardware Projects for Undergraduate Students: PRSGC supported 5 hands-on hardware projects that involved 125 students and 8 faculty members. They were developed by 4 different affiliate institutions: University of Puerto Rico at Río Piedras, University of Puerto Rico at Humacao, Interamerican University of Puerto Rico, University of Puerto Rico at Bayamón. The participating affiliate institutions received expertise and support from: NASA Goddard Space Flight Center, NASA Marshall Space Flight Center, NASA Wallops Flight Facility, National Undergraduate Research Observatory, and the University of California at Berkeley. The Higher Education projects included: Solar MiniCart Competition, Aero Design Competition, A satellite engineering course using the CubeSat platform, two meteorology instrumentation courses using the RockSat platform, The Great Moonbuggy Race. 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 3 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 students participate in challenging "hands-on, mind-on" activities in Science, Technology, Engineering, and Math (STEM). The program provides students with 20-25 hours of stimulating experiences. STARBASE Puerto Rico became a place to provide premier teaching experiences to pre-service teachers a part of their training to become teachers prepared to educate the highly skilled American workforce that can meet the advanced technological requirements of our Nation.
  - c. Experimental Astronomy Research Experience for Undergraduate Students: PRSGC supported 10 students to do 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. PRSGC NASA Summer STEM Academy: PRSGC ran the selection process for the 2012 PRSGC NASA Summer STEM Academy. A total of 215 applications were received; 15 female and 15 male students were selected. The Summer STEM Academy is a two-week on-campus residential experience developed to provide middle school students with: a) first-hand interactions with NASA and university scientists and engineers, and STEM college students who will serve as positive role models and mentors; and b) activities designed to refine their study skills and enhance their awareness of NASA projects and careers in order to empower them with the necessary tools to achieve their full potential and inspire them to pursue STEM careers.
- e. Pre-College Projects: A range of training activities were implemented in order to provide the in-service teachers, pre-service teachers, and pre-college students with NASA content and NASA educational materials. A total of 55 workshops/conferences were carried out that involved 12 affiliate institutions: UPR-Mayaguez, UPR-Río Piedras, UPR-Humacao, UPR-Arecibo, UPR-Carolina, Ana G. Méndez System, Interamerican University, PR NASA Explorer School, Arecibo Observatory, PR Department of Education, Univision-PR, StarBase-PR. The activities also involved the participation of non-affiliate organizations: NASA Goddard Space Flight Center, NASA Kennedy Space Center, NOAA, PR Department of Education, PR Seismic Web, PR Emergency Management Office. College faculty and students help organize the pre-college activities, exert leadership in their implementation, and also become participants who benefit from the activity.

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

- Informal Education Projects: 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 PR 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, conferences open to the public, and demonstration/ information booths in malls. A total of 8 public-at-large NASA enrichment activities were carried out that involved 7 affiliate institutions: PR Astronomy Society, Univision-PR, UPR-Río Piedras, UPR-Mayaguez, UPR-Bayamón, Interamerican University of PR, PR NASA Explorer School. The activities also involved the participation of NASA centers and non-affiliate organizations participating: NASA Kennedy Space Center, NASA Goddard Space Flight Center, Chicago Museum of Science and Industry, National Oceanic and Atmospheric Administration PR Office, PR Department of Education, Municipality of Guaynabo, Puerto Rico Seismic Web, PR Emergency Management Office.

## PROGRAM CONTRIBUTIONS TO PART MEASURES

- Student Data and Longitudinal Tracking:
  - a) Total number of awards = 175
    - Fellowship/Scholarship = 20
    - Internships = 12
    - Research Infrastructure = 5
    - Higher Education = 138
  - b) 100% of awardees kept good academic progress in the 2011-2012 academic year.
  - c) 26 awardees that graduated accepted job positions in STEM (100%).
  - d) 149 awardees (85%) are moving on to their next academic year or to study an advanced degrees in STEM.
  
- Diversity: 94% of the awardees (164) are Hispanic. Their gender distribution of the awardees is as follows: 56% (98) female, 44% (77) male.
  
- Minority-Serving Institutions: 11  
These minority-serving affiliate institutions are strategically located, covering all geographical regions and socio-economic levels across the Jurisdiction.
  
- Course Development: 1  
(CINA 5990: Physics Applied to Archeology and Art at UPR Río Piedras)
  
- The ratio of funds leveraged by NASA funding support is 1:1  
(\$575,0000 from NASA and \$575,000 from UPR).
  
- NASA Education Priorities:
  - Twenty long duration (greater than or equal to 2 days in length) professional development workshops for teachers were provided. Of the 395 participants, 90% reported using NASA resources in their classroom instruction.
  - Twenty short duration (less than 2 days in length) professional development workshops for teachers were provided. Of the 411 participants, 90% reported using NASA resources in their classroom instruction.
  - Fifteen short-duration student-based projects were supported that attracted around 1,350 elementary and secondary students in total. All of the students expressed interest in STEM careers.
  - A total of 8 public-at-large NASA instructional and enrichment activities were carried out that attracted around 4,500 pre-college student participants among the attendees.

## IMPROVEMENTS MADE IN THE PAST YEAR

PRSGC continued the process of shifting the emphasis of higher education projects towards NASA-related research experiences and hands-on hardware projects during FY2011. Projects that fall in these categories are particularly effective for preparing the students to achieve high goals, such as working in the aerospace industry and completing advanced STEM degrees.

## 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
- UPR-Río Piedras: hardware projects, undergraduate research, graduate research, in-service teacher training, pre-college education, outreach projects
- UPR-Humacao: hardware projects, undergraduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- UPR-Cayey: undergraduate research, in-service teacher training, pre-college education, outreach projects
- UPR-Arecibo: hardware projects, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- UPR-Carolina: undergraduate research, pre-college education, outreach projects
- UPR-Bayamón: hardware projects, undergraduate research, pre-college education, outreach projects
- Ana G. Méndez University System: hardware projects, in-service teacher training, pre-college education, outreach projects
- Interamerican University of PR: hardware projects, undergraduate research, in-service teacher training, pre-college education, outreach projects
- PR NASA Explorer School: hardware projects, in-service teacher training, pre-college education, outreach projects
- National Astronomy and Ionosphere Center: undergraduate research, graduate research, in-service teacher training, pre-college education, outreach projects
- PR Department of Education: in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- Univision-PR: undergraduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- StarBase-PR: in-service teacher training, pre-service teacher training, pre-college education