

# FY 2019 Year 5 Extension Annual Performance Document

## **Puerto Rico Space Grant Consortium Lead Institution: University of Puerto Rico – Resource Center for Science and Engineering**

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Grant Number: NNX15AI11H

Lines of Business (LOBs): NASA Internships, Fellowships, and Scholarships; STEM Engagement; Institutional Engagement; Educator Professional Development

### **A. 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 \$760,000 for fiscal year 2019.

### **B. PROGRAM GOALS:**

The goal of Puerto Rico Space Grant Consortium (PRSGC) is to increase the research, education and workforce development capabilities pertinent to NASA in Puerto Rico, and contribute to the Nation's science and technology enterprise. In order to accomplish this goal, PRSGC pursues the following Specific, Measurable, Appropriate, Realistic, and within a Time Frame (SMART) objectives:

1. Promote a strong science, technology, engineering, and mathematics education base from elementary through secondary levels while preparing teachers in these grade levels to become more effective at improving student academic outcomes:
  - 1,000 teachers participate in workshops that make use of NASA content and NASA educational materials.

- 80% of these teachers incorporate NASA-related science topics and content in their classrooms
  - 5,000 elementary and secondary students directly participate in NASA STEM engagement activities.
  - 50 pre-college students participate in NASA STEM summer programs
2. Contribute to the solving of Mission Directorate challenges
    - The Internships, Fellowships, Scholarships, Higher Education, and Research Infrastructure components contribute to achieving the goals of the NASA Mission Directorates.
  3. Establish and maintain a network of universities in the jurisdiction with interests and capabilities in aeronautics, space and related fields:
    - Maintain a functional consortium with nine Hispanic-serving institutions, including two research-intensive public universities, four four-year public colleges, and three private universities.
  4. Encourage cooperative programs among universities, aerospace industry, and government agencies:
    - Provide five research seed grants to faculty members in areas relevant to NASA as evidenced by collaborations with NASA centers.
    - Support four college-level hands-on hardware projects: Cube Sat, Rock Sat, Robotics, Solar Energy, and Lunar Rover projects.
  5. Encourage interdisciplinary training, research and public service programs related to aerospace:
    - Support the training of ten pre-service teachers as general public educators through internships at science museums and similar facilities.
    - Reach to 30,000 members of the general public with NASA-related content and activities.
  6. Recruit and train U.S. citizens, especially women, underrepresented minorities, and persons with disabilities for careers in aerospace science and technology:
    - Provide six internships, sixteen fellowships and twenty-four scholarships for U.S. citizen college STEM students to work at NASA centers or participate in NASA-related projects.
    - Provide significant experiential STEM training activities to 80 U.S. citizen college STEM students.
    - 99% of these interns/fellows/students belong to underrepresented minorities.
    - 30-40% of these of these interns/fellows/students are women.
    - Students with disabilities are especially encouraged to apply to these programs and reasonable accommodation is provided as needed.

7. Develop innovative and integrated plans to advance aerospace knowledge and expand related activities

- PRSGC has taken an active role in the implementation of Puerto Rico's Aerospace Vision Plan. This is a 5-year plan that provides a growth strategy and integration roadmap for the jurisdiction's aerospace enterprise stakeholders.

**C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS:**

1) Program Benefits to Higher Education: A total of 49 students (all U.S. citizens, 98% Hispanic) participated in PRSGC's internships, fellowships and scholarships program. They had excellent academic and research progress and successfully moved on to the next academic year or to the next step in their professional career. One example of a successful next-step story is the following:

Omar Vega-Manzano obtained a PhD in Chemical Physics from UPR Rio Piedras and was hired as scientist by the U.S. Navy. He leads Team So-MAD (Sonar Magnetic Anomaly Detector) that recently proposed a prototype underwater detector consisting of an eight-sensor circular array that was designed and printed in the NAWCAD Innovation Hub (iHub). Team So-MAD was one of the two teams chosen for the Innovation Challenge 5, where developmental employees use unconventional and innovative ways to solve a challenge from the fleet.

2) Program Benefits to Pre-college Education: The Integrated Science Multi-use Laboratory (ISMuL) is an innovative, multilevel, multidisciplinary, and interdisciplinary facility located in UPR Arcibo that is designed to promote the advancement of STEM education. They offered an array of hands-on educational STEM activities that impacted 800+ pre-college students. One of such innovative STEM activities was the Computer Science for Girls Academy for girls between 14-16 years interested in STEM. During the 80 contact-hours of the Academy, the participating girls: were given conferences and workshops about jobs in computer science; had interaction with college students and professionals experienced in science computations who served as role models; learned individual and team work to do 3D animations, programming, and a robot; had the opportunity to share and explore their interest in computers and computer science with other girls; used Alice, Lego Mindstorms and Arduino platforms among other strategies to learn about computing-like swarm robotics (used in NASA Swarmathon Project). They also learned about some amazing NASA projects and their impact in the community through interactions with scientists and engineers. A total of 20 Hispanic U.S. citizen girls from seven municipalities participated in this academy.

3) Program Benefits to Informal Education: The Puerto Rico Astronomy Society implemented a comprehensive agenda of 30 outreach activities directly reaching 8,000+ participants from the general public, and indirectly reaching 50,000+ people through social media and mass media. The activities were themed based on recent astronomy events observable in Puerto Rico, such as: Blood Moon or Lunar Eclipse and Solar Spots. They also published *El Observador*, a 40-page quarterly magazine featuring the latest astronomy and space-related news. Each issue is mailed for free to over 100 schools, colleges, and the scientific community.

#### **D. PROGRAM ACCOMPLISHMENTS:**

- NASA Internships, Fellowships, and Scholarships:

PRSGC supported 7 college students to attend research internships at NASA Centers. One of the summer interns was invited to continue the project, and returned to participate in a second internship experience during the semester. The internship awards covered travel costs and full stipend during the internship period. The host research centers included: Ames Research Center, Marshall Space Flight Center, Glenn Research Center, and Goddard Space Flight Center.

PRSGC provided 14 fellowships to college students during. 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: Electrical, Mechanical & Environmental Engineering, Chemistry, Biology, Biotechnology, Marine and Environmental Sciences, and Technology. 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, and Ames Research Center.

PRSGC provided scholarships to 28 college students to do research during the academic year and/or summer in areas relevant to NASA, including: Rechargeable Battery, Super Capacitors, Graphene Synthesis and Device Fabrication, Biomedical Applications of Nanoparticles, Nanomaterials for Environmental Remediation, Multifunctional Oxide Thin Films, and Multiferroics with Magneto-electric Coupling.

- Higher Education projects:

PRSGC supported five hands-on hardware projects that involved 75 students and 8 faculty members. They were developed by four different affiliate institutions: University of Puerto Rico at Río Piedras, Inter American University of Puerto Rico, University of Puerto Rico at Humacao, University of Puerto Rico at Bayamón, and the Polytechnic University of Puerto Rico. The participating affiliate institutions received expertise and support from: NASA Goddard Space Flight Center, NASA Marshall Space Flight Center, and NASA Wallops Flight Facility. The Higher Education projects included: two meteorology instrumentation courses using the RockSat-X platform, Eclipse Ballooning Project, the Mars Rover Challenge, and a Capstone student program for the development of a robot prototype for future Mars Missions. Students participating in these projects, gained technical knowledge relevant to NASA and became better prepared to lead a successful career in STEM.

- Research Infrastructure projects:

PRSGC supported a total of 9 faculty members and 24 college students who participated in research infrastructure projects. The projects involved the participation of three affiliate member institutions: University of Puerto Rico at Mayaguez, University of Puerto Rico at Humacao, University of Puerto Rico at Río Piedras, and University of Puerto Rico at Cayey. The following institutions collaborated in the projects: NASA Ames Research Center, NASA Goddard Space Flight Center, NASA Glenn Research Center, NASA Johnson Space Center, and NOAA Earth System Research Laboratory.

PRSGC supported 4 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.

- Precollege projects:

The PRSGC affiliates implemented a range of training activities in order to provide new NASA content and NASA educational materials to in-service teachers, pre-service teachers, and informal educators. Over 1,500 educators attended these training activities and about 90% 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, Inter American University, PR Department of Education, EcoExploratorio, StarBase-PR. The activities also involved the participation of non-affiliate organizations: NASA Goddard Space Flight Center, NASA Kennedy Space Center, NASA Ames Research Center, NASA Marshall Space Flight Center, NOAA, PR Department of Education, PR Seismic Web, PR Emergency Management Office.

PRSGC supported 4 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 provided 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.

The Integrated Science Multi-use Laboratory (ISMuL) is an innovative, multilevel, multidisciplinary, and interdisciplinary facility of the UPR Arecibo Affiliate that is designed to promote the advancement of STEM education. They offered an array of hands-on educational STEM activities that impacted 820 pre-college students. One of such innovative STEM activities was the Computer Science for Girls Academy for girls between 14-16 years interested in STEM. During the 80 contact-hours of the Academy, the participating girls: were given conferences and workshops about jobs in computer science; had interaction with college students and professionals experienced in science computations who served as role models; learned individual and team work to do 3D animations, programming, and a robot; had the opportunity to share and explore their interest in computers and computer science with other girls; used Alice, Lego Mindstorms and Arduino platforms among other strategies to learn about computing-like swarm robotics (used in NASA Swarmathon Project). They also learned about some amazing NASA projects and their impact in the community through interactions with scientists and engineers. A total of 20 Hispanic U.S. citizen girls from seven municipalities participated in this academy.

- Informal Education projects:

PRSGC Affiliates implemented a range of educational projects targeted at the general public 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, conferences open to the general public, television and radio appearances, demonstration/information booths in malls, and the publication of *El Observador*, an Astronomy magazine. The public-at-large NASA enrichment activities have been carried out throughout the year attracting over 50,000 participants from the general public. Six affiliate institutions participated in organizing the activities: PR Astronomy Society, EcoExploratorio, UPR-Arecibo, UPR-Mayagüez, and UPR-Río Piedras. The activities also involved the participation of NASA centers and non-affiliate organizations: NASA Kennedy Space Center, NASA Glenn Research Center, NASA Ames Research Center, NASA Marshall Space Flight Center, and the National Oceanic and Atmospheric Administration.

**E. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS:**

- **Diversity:** 150 significantly-supported participants, all U.S. citizens, 98% Hispanic. Their gender distribution is as follows: 47% female, 53% male.
- **Minority Serving Institution Collaborations:** 9  
PRSGC encompasses 15 affiliate institutions, 9 of which are minority-serving colleges or universities. All of the PRSGC projects and activities involve minority-serving institutions and Hispanic U.S. citizens.
- **Office of Education Annual Performance Indicators:**
  - o API 3.3.3: STEM-19-1                      128
  - o API 3.3.5: STEM-19-5                      45

**F. IMPROVEMENTS MADE IN THE PAST YEAR:**

Dr. Noemi Cintron joined our team as Associate Director beginning in June 2019. Among other tasks, she will help us enhance the recruitment of female students into our NIFS, Higher Education, and Research Infrastructure components of the Consortium. She is well known in the higher education circle of the Jurisdiction and has vast experience working with college students while she was Associate Dean of Natural Sciences for nine years, experience that will benefit the networking and overall projection of the Consortium among female college students across Puerto Rico.

**G. CURRENT AND PROJECTED CHALLENGES:**

We stated last year that the main challenge faced by PRSGC is the Jurisdiction’s tight fiscal situation, which makes it very difficult for the UPR Administration to provide in cash match in the future. We are glad to report that the UPR President committed in writing to provide the whole amount of required match in cash for the new four-year cycle of Space Grant 2020-2024. We continue working with NASA, the UPR Administration, the Consortium Affiliates, and with the help of the External Advisory Board, to maintain the excellent performance of the Consortium and the benefits to the Jurisdiction and NASA. Now that this challenge is surmounted, the next challenge to be tackled is the lack of agility in the process of invoicing the funds to the Agency. We are having meetings with the upper administration to address this issue effectively in the near future.

## **H. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION:**

1. Ana G. Méndez University (Private Hispanic Serving Institution, Four-year College): undergraduate and graduate research
2. Arecibo Observatory Visitors' Center (Museum): undergraduate research, graduate research
3. EcoExploratorium (Museum): pre-college education, outreach projects, informal education
4. Inter American University at Bayamón (Private Hispanic Serving Institution, Four-year College): hardware projects, undergraduate research
5. Mayagüez Planetarium (Museum): pre-college education, outreach projects
6. Polytechnic University of Puerto Rico (Private Hispanic Serving Institution, Four-year College): hardware projects, undergraduate research, graduate research
7. PR Department of Education (State Government Agency): in-service teacher training, pre-college education
8. StarBase-PR (Federal Educational Facility): pre-service teacher training, pre-college education
9. UPR-Arecibo (Public Hispanic Serving Institution, Four-year College): in-service teacher training, pre-service teacher training, pre-college education, outreach projects
10. UPR-Bayamón (Public Hispanic Serving Institution, Four-year College): in-service teacher training, pre-college education, outreach projects
11. UPR-Cayey (Public Hispanic Serving Institution, Four-year College): in-service teacher training, pre-college education, outreach projects, undergraduate research
12. UPR-Central Administration: lead institution and jurisdiction-level management
13. UPR-Humacao (Public Hispanic Serving Institution, Four-year College): hardware projects, undergraduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
14. UPR-Mayagüez (Public Hispanic Serving Institution, Research University): undergraduate research, graduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
15. UPR-Río Piedras (Public Hispanic Serving Institution, Research University): hardware projects, undergraduate research, graduate research