

Puerto Rico Space Grant Consortium
Lead Institution: University of Puerto Rico
Director: Gerardo Morell
Telephone Number: (787) 282-7047
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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 2016.

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

- 4,000 elementary and secondary students directly participate in NASA STEM engagement activities.
2. 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 eight Hispanic-serving institutions, including two research-intensive public universities, three four-year public colleges, and three private universities.
 3. Encourage cooperative programs among universities, aerospace industry, and government agencies:
 - Provide two research seed grants to faculty members in areas relevant to NASA as evidenced by collaborations with NASA centers.
 - Support three college-level hands-on hardware projects: Cube Sat, Rock Sat, and Lunar Rover projects.
 4. Encourage interdisciplinary training, research and public service programs related to aerospace:
 - Support the training of four pre-service teachers as general public educators through internships at science museums and similar facilities.
 - Involve one radio station in the dissemination of news about NASA accomplishments and NASA spinoffs that enhance our quality of life.
 5. Recruit and train U.S. citizens, especially women, underrepresented minorities, and persons with disabilities for careers in aerospace science and technology:
 - Provide four internships, fourteen fellowships and sixteen 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 150 U.S. citizen college STEM students.
 - 99% of these interns/fellows/students belong to underrepresented minorities.
 - 50% 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.

C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS

Sample Success Stories from PRSGC Higher Education Participants during FY 2016:

- Adalis Fabre: Graduated as STEM Teacher and was appointed Lead Instructor at StarBase-PR of the Department of Defense.
- Alexis Orengo: Graduated from BS in Physics and was hired as TV Weather Reporter.
- David Aponte: Graduated from Electrical Engineering and was hired by Baxter.
- Grace Rodríguez: Graduated from Mechanical Engineering and was hired by Amgen.
- Héctor Carrasco: Graduated from Electrical Engineering and is now working for Pfizer.
- Jaaziel Hernández: MS student in Marine Science who obtained the Martin Fellowship to work at the Naturalis Biodiversity Center in Netherland.
- Jorge González: Graduated from Electrical Engineering and was hired by the PR Public Broadcasting Corporation.
- Keren Valentín: Graduated from Chemical Engineering and was hired by Intel.
- Lizmarie Rivera: Graduated from PhD in Chemistry as was appointed Assistant Professor at Inter American University.
- Luis Ruiz: Graduated as Software Engineer and was hired by PACIV.
- Miguel Figuerola: MS student in Marine Science who obtained the NOAA - Sea Grant Kanuss Fellowship of the Coral Reef Conservation Program.
- Nicole Pintado: Graduated as STEM Teacher and was appointed Lead Instructor at StarBase-PR of the Department of Defense
- Yaichael Rodríguez: Graduated from Computer Engineering and was hired by VPNet.

D. PROGRAM ACCOMPLISHMENTS

- NASA Internships, Fellowships, and Scholarships:

PRSGC provided full support (stipend and tuition) to 23 Fellowship college students during the 2016-2017 academic years: 10 PhD students, 4 MS students, and 9 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: 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, Ames Research Center, and the Institute for Functional Nanomaterials.

PRSGC supported 1 graduate and 5 undergraduate students to attend research internships in NASA Centers during the 2016 summer session. The internship award covered travel costs and full stipend during the internship period. The host research centers included: Ames Research Center, Glenn Research Center, and Goddard Space Flight Center.

PRSGC provided scholarships to 18 students to do research during summer and/or the academic year in areas relevant to NASA, including: Rechargeable Battery, Super Capacitors, Graphene Synthesis and Device Fabrication, Biomedical Applications of Nanoparticles, and Nanomaterials for Environmental Remediation.

- Higher Education projects:

PRSGC supported five hands-on hardware projects that involved 79 students and 8 faculty members. They were developed by three different affiliate institutions: University of Puerto Rico at Río Piedras, Inter American University of Puerto Rico, University of Puerto Rico at Humacao, 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, High Altitude Student Platform (HASP), 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 25 college students who participated in research infrastructure projects. The projects involved the participation of three affiliate member institutions: 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, NOAA Earth System Research Laboratory, the National Undergraduate Research Observatory, the University of Miami, and the Institute for Functional Nanomaterials.

PRSGC supported three 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.

PRSGC provided travel expenses to 14 students to attend Science and Technology Conferences in Mainland U.S. in order to present their research work and disseminate the results. The conferences attended include: Materials Research Society Meeting, American Meteorological Society Meeting, American Chemical Society Meeting, American Physical Society Meeting, Electrochemical Society Meeting.

- Precollege projects:

PRSGC supported 9 pre-service STEM teachers to obtain an innovative teaching experience at STARBASE Puerto Rico and the National Astronomy and Ionosphere Center (i.e., Arecibo Observatory). These facilities have become training sites 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.

- STARBASE is a premier educational program, sponsored by the Office of the Assistant Secretary of Defense for Reserve Affairs. STARBASE focuses on elementary students, primarily fifth graders. The goal is to motivate them to explore Science, Technology, Engineering and Math (STEM) as they continue their education. The academies serve students that are historically under-represented in STEM. 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.
- The Arecibo Observatory is a radio telescope in the municipality of Arecibo, Puerto Rico. This observatory is operated by SRI International, USRA and UMET, under cooperative agreement with the National Science Foundation. The Observatory's Visitors Center consists of approximately 10,000 square feet of building and outdoor space. It houses 3,500 square feet of exhibits, a 100-person auditorium, a science store, and appropriate meeting rooms and office space. It also provides an observation platform that offers a beautiful view of the 305-meter radio telescope. The bilingual educational program centered on the theme "More Than Meets the Eye - Exploring the Invisible Universe", reflects the general idea that we can study our world with tools which extend our direct sensory experience. The program explores the unseen sky and, in particular, the objects that fall under the scrutiny of our radio telescope. Specifically, the program introduces visitors to the electromagnetic spectrum as a means of exploration, offers a framework of basic astronomy and atmospheric science, and provides understanding of the function and operation of the radio telescope. Some of Arecibo's most exciting new discoveries in the fields of radio astronomy, solar system radar astronomy and the earth's atmosphere are presented. In the auditorium, visitors can experience the scientific research facility of the Observatory as a dynamic organism through a 20 minute audiovisual show funded by the Angel Ramos Foundation entitled "A Day in the Life of the Arecibo Observatory". The show tells the story of the people who make Arecibo possible, from the guards and kitchen staff to the telescope operators, staff and visiting scientists.

The University of Puerto Rico at Arecibo Affiliate implemented a two session Summer STEM Academy to motivate pre-college students to study careers in STEM with innovative and modern workshops in topics that they don't explore in a traditional classroom. A total of 46 outstanding students from ages 12-16 participated in the two-session Academy. Conferences and workshops included the following topics: Robotics, Geology, Chemistry, Ecology, Fractals, Science and Technology Aerospace, Engineering, Astrobiology and Astronomy.

A Saturdays Robotics Academy was offered by the University of Puerto Rico at Arecibo Affiliate to 400 students of 7th-8th grade from public and private schools of the Department of

Education of Puerto Rico. The Lego Mindstorm 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. During the Academy, a video conference was held with Engineers Alex Bengoa and Notlim Burgos from NASA Kennedy Space Center.

The PRSGC 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. A total of 1,300 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, Ana G. Méndez System, Inter American University, PR Department of Education, EcoExploratorio, StarBase-PR. The activities also involved the participation of non-affiliate organizations: NASA Dryden, 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.

- 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 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 have been carried out throughout the 2016-2017 academic year attracting a total of around 55,000 participants. Six affiliate institutions participated in organizing the activities: PR Astronomy Society, EcoExploratorio, 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, NASA Ames Research Center, NASA Marshall Space Flight Center, Institute for Functional Nanomaterials, and the National Oceanic and Atmospheric Administration.

E. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS

- **Diversity:** Out of the 163 significantly-supported participants, 99% are Hispanic U.S. citizens. Their gender distribution is as follows: 38% female, 62% male.

- **Minority Serving Institution Collaborations: 8**
PRSGC encompasses eight minority-serving affiliate institutions that 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.
- **Office of Education Annual Performance Indicators:**
 - API 2.4.1: ED-16-1 47
 - API 2.4.2: ED-16-2 1,300
 - API 2.4.4: ED-16-4 151
 - API 2.4.5: ED-16-5 7,855

F. IMPROVEMENTS MADE IN THE PAST YEAR

PRSGC has refined its strategies by implementing Affiliate Meetings after each Spring and Fall National Space Grant Directors Meeting. These Affiliate Meetings are an excellent opportunity to inform the Consortium's members of recent news and changes to the Program. During the meetings, emphasis is made on NASA's priorities, funding regulations, and new reporting requirements. The meetings enable close interactions among affiliates and staff, allowing the Consortium to improve its projects, and steer the Program along the NASA priorities.

G. CURRENT AND PROJECTED CHALLENGES

The main challenge faced by PRSGC is the Jurisdiction's tight fiscal situation, which will make it very difficult for the Administration to provide in cash match in the future. To date, the President of the University of Puerto Rico has been providing the whole amount of required match in cash. We are currently working with the Administration to keep this commitment based on the excellent performance of the Consortium and the benefits to the Jurisdiction.

H. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

1. Ana G. Méndez University System (Private Hispanic Serving Institution, Four-year College): in-service teacher training, pre-college education
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-Cayey (Public Hispanic Serving Institution, Four-year College): in-service teacher training, pre-college education, outreach projects
11. UPR-Central Administration: lead institution and Jurisdiction-level management
12. 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
13. 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
14. UPR-Río Piedras (Public Hispanic Serving Institution, Research University): hardware projects, undergraduate research, graduate research