

The Need for Informal Education Opportunities in Science and Mathematics in Puerto Rico

To ensure educational excellence for all students, the Resource Center for Science and Engineering of the University of Puerto Rico (RCSE-UPR) partnered with the State Department of Education (PRDE) to spearhead the systemic reform of K-12 science and mathematics education with the support of the National Science Foundation (NSF). This initiative is now implementing Phase II, scaling-up the standards-based curriculum through a whole school strategy, which has impacted close to 50% of all the schools in the 1,573 school system. The public educational system in Puerto Rico serves around 600,000 Hispanic students, of which over 85% come from families who are considered poor according to Federal standards. The effectiveness of the PR-SSI reform strategies in the improvement of student performance is well documented through a multi-tiered assessment system which incorporates indicators based on national standards, including instruments equated with the Third International Mathematics and Science Study (TIMSS) and the National Assessment of Educational Progress (NAEP) (Gómez, 2000; 1998; RCSE, 2000).

Through the development of the systemic reform, it has become increasingly evident that the time required to learn science and mathematics effectively goes beyond that provided by school. Furthermore, to fully promote self-directed learning it is fundamental to afford experiences in which students pursue their own interests and individual needs outside of the academic context. In Puerto Rico, after-school activity for informal learning is scarce for the vast majority of the underserved student population. Most of the available after-school programs are for the elementary level, and have a recreational or cultural focus, or are university induction programs for upper level high school students. There is a significant lack of opportunities for students to explore and understand their own environments by applying knowledge gained in school to other contexts and problem solving situations, therefore enhancing the overall learning process for all students. Few students have the opportunity to learn science and mathematics by engaging in long-term scientific inquiry processes, other than the few students who participate in the science fairs. Besides being critical to in depth learning of science and mathematics, participation in research is also key to enhancing the preparation of students for careers in these fields. The state government's plan to strengthen the Islands' socioeconomic development through supporting the growth of science and technology industry with R&D activity emphasizes the need for increased human resources at various levels in SMET fields (Gómez, 1999; RCSE 1999). To strengthen informal science education, it is necessary to ensure community involvement as partners in the educational reform. The active local efforts to strengthen the quality of education and support expanded and diverse educational experiences, particularly for underserved students, are central to achieve educational equity (NSF, 2000). Our target population are public school students in grades 8 to 10, late middle school to junior high school, when it is early enough to have a timely impact on students future development.

Through this proposal we seek to build upon and extend the advances of the PR-SSI in the context of the formal education system, by providing informal enrichment opportunities that are articulated with the systemic reform, to nurture students as future SMET professionals. This initiative will take advantage of the extensive and strong partnerships already forged among the major stakeholders of the PR-SSI reform at all levels of the educational system. PR-ASCEND will be developed as an integral part of the PR-SSI in progress in Puerto Rico, co-sponsored by

the National Science Foundation (NSF) since 1992 (RCSE, 1992-2000). As a catalyst for the transformation of the educational system on the Island, the PR-SSI has brought together the main stakeholders in K-12 education to develop a shared vision of science and mathematics education, and design and implement key strategies to achieve this vision. The guiding vision of the PR-SSI is based on constructivist educational principles and tenets, and is aligned with the national standards for science and mathematics. It includes emphasis on depth of understanding of the major concepts in each discipline, development of higher order thinking skills through inquiry-based and discovery methods, integration of knowledge through connections within and between disciplines, and meaningful learning of conceptual knowledge through direct experiences within the context of the student's daily life (NRC, 1996; 1999).

Goals and Objectives:

The main goals of PR-ASCEND are to develop and provide informal SMET learning experiences for 450 underserved students that 1) Enhance students' learning of important SMET concepts within the context of the real world; 2) Increase their motivation and skills for lifelong learning of science and mathematics; 3) Attract more minority, low-income students into advanced studies and careers in these fields; and 4) Build the support and collaboration of multiple sectors in informal science education initiatives. The general objectives of this project are:

- 1) To engage students in a year-long active exploration and discovery learning experience through which they will significantly improve their conceptual understanding of fundamental knowledge in SMET, in alignment with the national standards of science and mathematics education;
- 2) To develop participants' knowledge and skills in scientific research methodology through their research of real world problems of their interest under the guidance of experts in each field;
- 3) To increase participants' knowledge of SMET careers in diverse settings and to develop key skills that will enhance their preparation as competent future professionals in these fields;
- 4) To involve university faculty, parents, teachers, scientists industrialists and other community representatives as collaborators and co-learners in the scientific research process and in organizing experiences leading to increased scientific literacy and a lifelong learning disposition towards SMET.

Intended Student Outcomes: Students who participate in this project will demonstrate measureable gains in:

- 1) Conceptual understanding of major concepts in various fields with emphasis on an interdisciplinary perspective, including the following fields: Physical Sciences, Earth Sciences, Environmental Sciences, Biology, Mathematics, Astronomy, Marine Sciences, Technology and Engineering;
- 2) Conceptual understanding of the scientific research process and the ability to design and undertake a basic scientific research project to develop knowledge and solutions to real world problems, including skills in posing questions, formulating problems, experimental design; control of variables, uncertainty in measurements; organization and analysis of data; reaching valid conclusions; and presentation of logical arguments.

- 3) Knowledge about specific career options of their interest in the fields of science and mathematics, the kind of work they entail and the academic requirements to enter the field;
- 4) Ability to work productively in teams, using leadership and collaboration skills to accomplish tasks;
- 5) Ability to communicate with others about the work they have done, in both spoken and written forms, and be able to prepare effective multimedia presentations;
- 6) Improved self esteem and confidence in their potential and strengths as future scientists and mathematicians;
- 7) Enhanced motivation and proactive engagement in multiple self-directed learning activities related to science and mathematics;
- 8) Ability to use multiple technologies such as graphing calculators, databases, computer programs, and electronic communication for learning as learning and research tools;
- 9) Ability to manage scientific information, and to use critical judgement in evaluating the scientific merit of research results;
- 10) Practical knowledge of basic scientific instrumentation, and of laboratory processes used in diverse fields, and skills in those appropriate for students ages.

Project Design

The PR-ASCEND will offer informal learning opportunities for 150 students each year, divided into five groups of 30 students who will attend one of the **five University of Puerto Rico sites** located around the Island, including the RCSE facilities at the Río Piedras and Mayaguez Campuses, and the UPR at Arecibo, Ponce and Humacao (to be explained ahead). **RECRUITMENT:** Each year for three years, during the months of April and May, 150 students will be selected as participants, for an average of 30 per site. Students from grades 8 to 10 will be targeted, to ensure some age heterogeneity within the sites. To facilitate the recruitment of students, each site will target around five neighboring secondary schools with higher concentrations of low-income students that participate in the PR-SSI and where there are science clubs. The current partnership with the PR Department of Education through the PR-SSI will facilitate direct access to the schools and the collaboration of school principals and teachers to recruit the students. The program will be announced to students in these schools, and applications will be distributed for participation. Applicants will be asked to write a one page letter expressing their motivation to participate in PR-ASCEND, and presenting their interest in a particular topic in science, mathematics, and engineering, and to provide a letter from parents or caregivers stating their commitment to facilitate and promote the applicants's consistent participation in the program throughout the school year and summer. The project staff will evaluate the applications and select those candidates which express greatest interest in participating. Those who qualified but were not selected will be placed on the priority list for the subsequent years.

Through PR-ASCEND all participants will experience inquiry-based learning of fundamental SMET concepts within their local context, followed by their involvement in a specific team-based research project of their selection, through which they will learn about scientific research as a way of exploring and discovering, and problem solving. The PR-ASCEND will build on the conceptual knowledge students who are in 8th to 10th grade are learning in school, according to the PR-SSI. For this we have established collaboration with Dr. Héctor Joel, PR-SSI K-12 Curriculum Coordinator and his staff. The project will allow students to understand these global concepts within the local context of the Island and their own

communities. To study these concepts, the project will use a set of broad themes that allow for interdisciplinary understanding of concepts and which take advantage of research opportunities and the science rich environment available on the Island. Students will participate in six main project components:

- 1) **A two-week Summer Immersion Science Camp** in which students will engage in diverse inquiry activities related to the main SMET topics, to promote a common core of fundamental concepts and understanding of the inquiry approach as the basis for research projects they will undertake during the academic year. Students will learn about the fundamental concepts immersed in various "real world laboratories" sessions.
- 2) **Academic Year Research:** During the academic year, students will carry out team-based research projects to explore a problem of their own selection. Forming teams, students will continue to learn about the scientific research methodology and experimental design by carrying out their projects with the assistance of scientist advisors. This component includes Saturday sessions and after-school activities.
- 3) **Presentations of Research Projects:** All teams will engage in various presentations of their work to various audiences. Through the project, they will learn skills and techniques for preparing and offering effective presentations of their projects in multiple formats.
- 4) **SMET Career Explorations:** Participants will interact with scientific advisors from both the public and private sector who will familiarize students with their work, serve as role models, and assist them in exploring career options in these fields;
- 5) **Communities of Learners:** Students will form communities of learners at various levels- from their immediate research team to the local community and to the project-wide level, to engage in collaborative learning as a fundamental activity in the development of scientific knowledge.
- 6) **Parental, Teacher and Community Involvement:** Parents, teachers, school district administrators, and numerous other community members will be recruited to participate with students in their research projects, and will learn how to support students learning experiences at home, school and the community.

PR-ASCEND will provide **over 210 hours of direct engagement in informal learning experiences** for participants, in addition to substantial activities they will carry out on their own time on a group or individual basis. The fundamental instructional approach of the program to achieve the expected student outcomes is learning by inquiry- students will be guided in observing phenomena and formulating questions that pose a problem suitable for scientific research, and will engage in designing and conducting a research project to address that question. During the summer, students will be guided more formally through the process, using interactive demonstrations to model the inquiry process. Later, during the academic year, students directly undertake a scientific research project appropriate for their age, with the support and guidance of the site coordinator and scientific advisors. The instructional strategy of cooperative learning groups will be integrated throughout the project, assisting students to develop their research projects as a team where everyone needs to work and learn.

A group of broad interdisciplinary themes that allow for connections between the local context and global environment, have been selected to be emphasized in PR-ASCEND to enhance understanding of key concepts, to induct students in the scientific inquiry process and to familiarize them with the options they will have from which to select a problem for their research project:

- I. **Ecosystems:** Puerto Rico is a small Island (approximately 9,000 sq.kilometers) within which exists tremendous ecological contrast. The identification and characterization of the highly diverse tropical ecosystems found in the different regions of the Island. These include rain and xerophitic forests, coral reefs and mangroves, sea grass fields. analyzing the impact of human activity in the ecosystem.
- II. **Natural Water Resources:** The rich and diverse water resources existing in Puerto Rico, including rivers, sea, underground springs, estuaries, lakes, coastal waters and wetlands and their importance to life will be studied. The Island's central mountain range serves as a barrier for trade winds which in turn create a rain shadow in the southern region. Major river flow on a northernly course, with very few flowing south. The difference between both regions accounts for the formation of diverse ecological systems.
- III. **Caribbean Geomorphology:** The origin of the Caribbean region, with emphasis on local particular geological formations- from the central mountain range, and the limestone (karstic) region in the northern zone of the Island, to river deposits in the south and prominent pillow lava deposits in the southern central region. Puerto Rico constitutes a vast geological laboratory that can be easily covered without having to travel extensively to find these unique features.
- IV. **Industrial Technology and Production Processes:** Technological applications of science in the production process in diverse industrial settings: manufacturing, biotechnology, telecommunications, electronics and others will be studied.
- V. **Tropical Weather and Global Climate:** Weather phenomena that occur in tropical zones and how it is affected by global climate changes. Emphasis will be given to the study of the ocean as a stabilizer of weather conditions and as a reservoir of heat energy that nurtures severe storms. Phenomena such as El Niño and La Niña, and hurricanes will be studied.
- VI. **Antillean Biodiversity:** The Antillean Archipelago is the region with the second highest biodiversity on Planet Earth. The project will focus on various life forms within their environments, to identify elements that affect their sustainability. Emphasis will be placed on the rainforest, and the xerophitic forest, two contrasting land environments with a magnificent display of life, and on coral reefs as a rich marine environment.

Each of the themes will allow for learning of numerous key SMET concepts, and the themes allow for students to learn the concepts in multiple contexts. Among the concepts to be emphasized in the different themes are: systems and models; ecosystems; tropical systems; interactions and patterns; sources and transformation of energy; light; sound; heat; physical and chemical properties of matter; force and movement; mechanical force; pressure; kinetics; biological oxygen demand; equilibrium; biotic and abiotic components; the life cycle; habitats; species equilibrium; population dynamics; conservation and change; adaptation; rate of change; symbiosis, parasitism; genetic drift; transport and mixing processes; fresh water quality; pH; the chemical constituents of water; sedimentation; siltation; analysis of plant nutrients and pigments; the rock cycle; crystallography; tectonic plates; subduction; erosion, atmosphere; weather and climate; variables; probability; mathematical models and others.

This following section provides more description of each of the project components:
Two-week Summer Immersion Camp: This component will initiate students into explorations in the interdisciplinary themes and the scientific inquiry process. Participants will engage in explorations based on the scientific methodology in the broad themes through structured

activities prepared by the Site coordinators and scientists. Coordinators will make presentations on the various themes to promote discussion among students leading to the formulation of questions for more depth of understanding of each theme. Discussions with experts in the different themes will be carried out on site as well as through teleconferences and electronic communications. Using students questions, they will be guided in carrying out searches in the scientific literature and Internet, and will participate in field trips to sites in which exploration, observation and data collection activities will be carried out, followed by laboratory sessions and analysis of data. Each site will carry out around 4-5 field trips covering the main themes, **selecting some of the sites** from among the following available sites for "outdoor" exploration and discovery activities in relation to the main themes and concepts:

1. The El Yunque National Rainforest, located in the central eastern region. An Informal education center has been developed there, and there are scientific research projects going on including the NSF Long Term Ecological Research;
2. The Arecibo Observatory, of the National Astronomy and Ionosphere Center, is located in the northern karst region. It has a Visitor and Educational Facility with interactive exhibits, and displays of the research conducted at the Observatory, and tours about the radiotelescope.
3. The Camuy Cave System, located in the northern limestone region, one of the largest cave systems in the western hemisphere, which offers organized tours and a small exhibition hall.
4. The Cabezas de San Juan Mangroves Reserve at the eastern coast, managed by the Puerto Rican Conservation Trust. Offers educational tours of nature trails and has several exhibit areas.
5. The University of Puerto Rico Botanical Garden in the San Juan Metropolitan Area. The Garden is the site of the International Institute of Tropical Forestry, which sponsors community education activities and research by the USDA, and the Agricultural Experimental Station.
6. Numerous nature preserves such as the Gúanica Dry Forest, and the Carite Rainy Forest, both administered by the State Department of Natural Resources;
7. The Magueyes Island Marine Laboratories, on the southwestern coast, administered by the Mayaguez Campus, with research funded by Sea Grant;
8. The San Cristobal Canyon, located in the central igneous mountain region. This project is in an incipient stage. Educational facilities will be built in the near future;
9. The Piñones Mangrove Forest Information Center: located in the northeastern seashore, a seven mile nature trail has been opened, and an information Center for exhibits and educational activities.
10. The Aguadilla (Ramey) Solar Observatory, located on the western coast, has substations around the world and maintains continuous study of the sun on a 24 hour basis and serves as a source of data for weather predictions for space flights.
11. Numerous high-tech industries and academic laboratories in which the applications of science and technological systems will be explored, and students will become familiarized with several important research projects being conducted at the laboratories.

In addition to these sites, other sites will be identified at the local community/regional level that are close to the and participants' schools and homes, to carry out the project activities according to the students' research projects.

A group of scientists will be available as resources for presentations and as advisors to the participants. The majority of the following scientists have been actively involved in educational reform as resources for curricular development and professional development, and have long term experience with formal and informal education activities for low-income minority students.

List of Possible Scientific/Academic Advisors that are available to PR-ASCEND

1. Dr. Brad Weiner, Principal Investigator, PR-EPSCoR and NASA Capability Enhancement Grant, Professor of Chemistry-Physics at the Río Piedras Campus;
2. Dr. Ariel Lugo, Director, International Institute for Tropical Forestry, USDA
3. Dr. Ana Guadalupe, Professor of Chemistry at the UPR-Río Piedras, Project Director of Research Experiences for Undergraduates;
4. Dr. José Alonso, PhD. in Astronomy, Director of the Visitor Center at the Arecibo Observatory;
5. Dr. Josefina Arce, Principal Investigator of the PR Collaborative for Teacher Preparation (PR-CETP) and Professor of Chemistry at the University of Puerto Rico in Río Piedras;
6. Dr. Deborah Moore, Professor of Mathematics at UPR-Mayaguez, and Co-Principal Investigator of PR-CETP;
7. Dr. José Colucci, Ph.D. in Engineering, has served as scientific advisor for students at all levels.
8. Professor Ada Monzón, M.S. Meteorologist involved in K-12 education, is part of the newscast of the Public Broadcasting Channel.
9. Dr. Osvaldo Rosario, Researcher in the field of environmental contaminants, Executive Director of Industry/University Consortium (INDUNIV); and professor of chemistry at the UPR- Río Piedras;
10. Dr. Hernán Santos, Ph.D. in Geology and professor at the UPR-Mayaguez Campus, has been active in K-12 teacher education in this field.;
11. Dr. Manuel Gomez, Professor and Researcher in the field of Physics, Vice President of the UPR, Director of the RCSE, and member of the Governors Science and Technology Board

After completing the initial theme-based exploration activities, students will be asked to select a particular area they would like to learn more about, related to one or more of the broad themes studied. Teams will be formed according to the topic of interest, made up by 5-6 students, preferably from the same school, for a total of five to six teams per site. These teams will explore their particular interests for carrying out their research project, and the site coordinator will facilitate decision-making in selecting a specific and manageable problem for their project to be carried out during the year. As an assignment after the Summer Camp, students will be encouraged to think about how they will design their research project and to bring specific ideas for the start of the academic year component which is dedicated to the design and implementation of a team-based research project. The site coordinators will promote the analysis of the topics selected by teams in terms of: 1) relevance of the science and mathematics concepts to the daily life on the Island; 2) articulation with national educational science and mathematics standards, what they are learning in the classroom; 3) the ability to tap on local resources and strengths available in their region; and 4) potential to analyze from an interdisciplinary perspective, including science and mathematics.

School year session- Team Based Research Implementation: The school year session will begin with a three-day workshop, Principles of Scientific Research as Inquiry, through which teams will be guided in planning their research projects, taking students from problem formulation to the design of experimental methodology, and data collection methods. After this initial workshop, at least two five-hour Saturday sessions per month will be carried out at each project site, to provide participants with ongoing structured support for the implementation of their projects and to offer activities to further learning in important concepts related to the projects. Workshops on specific phases of the scientific research process such as formulation of hypotheses; analysis of scientific literature; experimental design; design of research instruments and data collection; use of specific scientific instrumentation; probability and statistical analysis; data organization and analysis; drawing valid conclusions; and presenting research results. The site coordinator will work closely with all teams (about five per site) monitoring the progress of all teams to ensure

that all students are engaged and they are working productively. Coordinators will serve as liaison between students and valuable resources they can use to enrich their research, provide them academic assistance with content and learning experiences and resources that will enhance their conceptual knowledge and scientific research skills, and. All sites will provide participants with a core of basic activities to promote the development of inquiry skills, critical thinking, and collaborative work, as fundamental to the successful implementation of their projects. The site coordinator will assist teams in identifying and bringing in scientist advisors who will guide them and ensure the scientific soundness of their efforts. The Coordinator will also procure the materials and access to scientific instrumentation for students to carry out their projects.

Use of Technology and Scientific Instrumentation: Through their participation in the project, students will gain understanding of the technology of many advanced scientific instrumentation and skills in the use of several important instrumentation that is appropriate for their age level. Examples of the types of scientific instrumentation students will be learning to work with, according to the specific activities and projects they carry out at each site, are the following : graphing calculators with CBLs and sensors; ph meters; anemometers; barometers; altimeters; diameter basal height measuring tapes; clinometers, geographical position sensors (gps); CO2 fixative instruments; salinometers; water pressure measurers; satellite imaging; remote sensing instrumentation; hydrometers and hygrometers; Secchi disks; rosettes equipped with Niskin bottles, transectors, cuadrants; scanning electron & optic microscopes; protein separators; bottom corers; spectrophotometers; gas chromatographs; refractometers; & bathythermographs. Many of these instruments will be available at the laboratories of the project sites, including Marine Laboratories in Mayaguez and Humacao, which have small boats and large vessels (R/V Chapman).

The use of computer and Internet technology will be also emphasized throughout the project. In alignment with the constructivist principles of the PR-SSI educational framework, emphasis will be placed on the incorporation of those computer applications or "mindtools" which require students to think in meaningful ways to use the application to represent what they know. According to Jonassen (2000) "Mindtools are computer-based tools and learning environments that have been adapted or developed to functions as intellectual partners with the learner in order to engage and facilitate critical thinking and higher order learning". Among the computer mindtools we will be emphasizing in the project are databases; semantic networks; systems modeling tools, and visualization tools. Participants will have opportunities to learn about the use of diverse technologies for accessing and managing information, and for communications. Special educational computer software will be acquired to promote learning of concepts, and for students to analyze data and present their work.

Among the uses of computer and Internet that will be emphasized are the following:

- 1) for learning concepts through special educational software and theme-related Websites that provide access to exemplary materials
- 2) for doing research on specific topics, accessing literature and valuable data to determine what is known about a problem;
- 3) for analyzing and presenting data in graphic form;
- 4) for designing multimedia presentations to communicate their research work and disseminate their efforts;
- 5) for engaging in discourse about their work through electronic communication with peers and others from distant sites;

6) to communicate with site coordinators, scientific advisors and other electronic mentors; and
7) to reflect upon their learning experience through the development of electronic portfolios and reflexive diaries.

Students will also learn how to use digital cameras to document data and capture their work process, and incorporate visuals into their presentations.

While project meetings will be mostly on Saturdays at each site, additional after-school day sessions will also be programmed as necessary to continue the informal learning process as an ongoing experience that students take with them. Teams will continue to work on their projects between Saturday sessions, carrying out individual or group tasks, and the Site Coordinators will be available on a needs basis and will sustain regular communication with them through e-mail. Sites will organize the necessary field trips for the teams research projects.

Towards the second semester of the academic year, special sessions will be offered to participants on **how to prepare and offer effective presentations of their work**, including the preparation of the abstract, posters, oral and multimedia presentations and websites. Each team will be assisted in the development of their presentation using diverse computer software tools and to place it on-line. An annual meeting for the closing of the year will be celebrated in which teams present their work to each other, scientists and other advisors, parents, teachers, and community members. Each team must design, prepare and offer a formal presentation of their work. This experience will specially promote oral and written communication skills among participants.

SMET career exploration and preparation for work: Career exploration will be integrated throughout the summer immersion and team research project implementation, as scientists serve as role models and career options will be highlighted in field trips. In addition to the overall exposition of students to various career options, a series of special career exploration activities will be held with invited speakers related to the areas of interest of the participants. In these activities, the speakers interact informally with participants about their career plans and talk about the work they are doing. Arrangements will be made for participants to have the opportunity to do job shadowing with a scientist or SMET professional of their choice. Future possibilities for internships and/or cooperative work for participants will be explored, so that once they complete participation in PR-ASCEND they can continue their development in a new context in their communities or other organizations that allow them SMET experiences.

Participation of Parents, Teachers and other Community members: Representatives from these three major groups will be integrated throughout the project. Community members include those representing groups such as youth organizations (boys/girls scouts and 4-H); professional associations such as the Puerto Rico Science Teachers Association and Science Clubs, and the American Chemical Society; municipal and other public and private agencies, businesses and community education centers. As mentioned before, they will be invited to participate in many project activities and volunteers will be recruited to collaborate with the site coordinators. Special activities will be held for these groups: 1) at the beginning of the project, each site will conduct an orientation sessions on the overall development of the project and the roles they can participate in; 2) they will be invited to be team members and to collaborate with participants in their research project; 3) periodic demonstration sessions will be offered to present the ongoing efforts and progress; 4) special activities will be developed to involve parents in the informal

learning experience, such as activities in which the household carries out simple experiments in the home or the community related to the project concepts and themes; 5) a three day workshop will be offered to the participants teachers to strengthen links between the formal and informal learning experiences, and to develop skills in which teachers can incorporate many of the activities and resources into the curriculum, as well as in strategies to develop similar informal education projects within their own schools. Periodically, each site will have open houses with demonstration sessions offered by the participants will also be held for broader audiences.

Communities of Learners: Throughout the project emphasis will be placed on the importance of building and participating in communities of learners at multiple levels, as a structure that enriches and promotes self-directed learning through interactions with others. The multiple levels at which communities of learners will be promoted in the project include: 1) the project- based teams which constitute the basic unit for a community of learners, 2) a site level community of all participants will constitute an intermediate community of learners, promoted through the frequent sharing of learning experiences at each site session; 3) the broader community of learners at the project-wide level with whom students will be encourage to communicate with electronically to share experiences and even to engage in collaborative research projects across sites. Finally, an islandwide community of learners will be promoted through two general project meetings to be held each year, one per semester, with all participants, and inviting participants parents, teachers, scientist and industrial mentors. As part of the community of learners, the Project will create a **Website** in which the main strategies and activities will be highlighted, and through which all participants from all sites can exchange information, concerns and experiences related to their projects during their development and to communicate with all other interested parties. All teams will be encouraged to present their projects on the Website.

Description of Project Sites:

PR-ASCEND will organize after-school informal SMET learning centers for students at **five main project sites** distributed throughout the Island. The main sites will be located within the University of Puerto Rico System Campuses including those at Río Piedras (in the San Juan metropolitan area); Arecibo (in the northern/central region); Humacao (in the eastern region), Mayaguez (in the western region), and Ponce (in the southern region). This distribution will ensure broad access to participants from diverse areas. Each of the sites has a series of features that make it a strategically appropriate place for the project:

- 1) The Resource Center for Science and Engineering (RCSE) of the University of Puerto Rico has its main site in the Rio Piedras Campus which was recently declared a **Research Type I Institution**. As a consortium of organizations, and the grantee for major systemic initiatives to develop a seamless K-16+ educational pipeline. The UPR-RP has doctoral programs in chemistry, physics, and biology, and ample, modern scientific laboratories such as the Materials Characterization Center co-sponsored by the Experimental Program to Stimulate Competitive Research (E PSCoR) and the state fund for R&D. The RCSE EPSCoR Program is developing research with funding from all the major federal agencies- NSF, EPA, NASA, DOD, DOE, and a grant from the Dept of Commerce to develop an Experimental Program to Stimulate Competitive Technology (EPSCoT) through which to promote academic-private entrepreneurships. The RCSE is also the site of the NASA Space Grant, which has several affiliates all around the Island, and offers numerous formal and informal education activities; The RCSE has its own activity rooms and laboratories, which will be available to PR-ASCEND students, and will make arrangements for access to Rio Piedras Campus facilities and particularly laboratories and computer facilities.

- 2) The RCSE at the UPR in Mayaguez will serve as a second site for PR-ASCEND. UPR at Mayaguez is the Land Grant Institution, which established the Agricultural Experimental and Extension Service, is a graduate institution that offers PhDs in Marine Sciences and Civil Engineering, and a masters program in Geology and other basic science and mathematics fields. Mayaguez also has broad participation in the RCSE-EPSCoR, as well as several other important research and science education initiatives. Given the strong collaboration between industry and academia in this region, the government is planning to establish a **Technology Corridor** in this area. The UPR at Mayaguez is the main site of the Sea Grant in Puerto Rico, which has numerous informal education activities. The UPRs Marine Science Program has a research and educational station at the Isla Magueyes Station that studies the ecologically rich region dotted by coral reef formation, mangrove forests and bioluminescent bays;