

**PR-LSAMP 2003-04 ANNUAL REPORT
YEAR 3 OF PHASE III**

	Page
I. Introduction	2
II. Major Accomplishments of Year 3	4
III. Alliance Participants and Collaboration with other NSF Programs	5
IV. Activities and Findings	9
Activity #1 – Development of Interactive Web-Based Learning to Master Difficult Physics Concepts	9
Activity #2 – Development of Electronic Modules to Expand Interdisciplinary Capabilities of STEM Students	14
Activity #3 – Development of Information Technology Skills in STEM Students	19
Activity #4 – Scale-up of Successful Teaching & Learning Strategies	23
Activity #5 – Pre-College to College: Induction into STEM Careers	25
Activity #6 – Undergraduate to Graduate: Research Opportunities and Mentoring Program	27
• PRISM	32
• Travel to Scientific Meetings	33
• NIST Summer Internships	34
• Pfizer Fellowships	34
• FaST and SULI Summer Internships	35
Activity #7 – Bridge-to-the-Doctorate Program	36
V. Special Initiatives Co-sponsored by PR-LSAMP in Year 3	39
VI. Other Institutional Initiatives to Strengthen Undergraduate STEM Education	42
VII. Contributions to the Development of Human Resources	47
• Baccalaureate STEM Degrees Awarded	47
• Enrollment in STEM Disciplines	50
• PhD STEM Degrees	51
VIII. Dissemination, Publications and Products	55

I. Introduction

Established in 1991, the Puerto Rico Louis Stokes Alliance for Minority Participation is an alliance of the major institutions of higher education on the Island that offer baccalaureate degrees in science, technology, engineering and mathematics (STEM). The goals of PR-LSAMP are to increase the effectiveness and efficiency of undergraduate STEM education by transforming the teaching and learning culture of the participating institutions, so as to increase the number of STEM BS graduates, and to increase the number of BS graduates that enroll in graduate school and eventually complete a PhD in a STEM field.

Phase III objectives

1. To increase the number of STEM BS graduates from 2,771 to 3,600, which will more than double the Phase I baseline figure of 1,709
2. To increase to 50% the percent of BS graduates from UPR institutions who enter graduate schools, and to 25% for those that graduate from the private institutions, and
3. To increase the number BS graduates from PR-LSAMP institutions that complete a doctoral (Ph.D.) degree, either locally or nationally, from 239 to 300 by year 5.

Phase III Activities

1. Development of an assessment system to measure effectiveness of the General Physics course and of interactive web-based modules to master hard to teach concepts in Physics.
2. Development of electronic modules to expand the interdisciplinary capabilities of undergraduate STEM students to further enhance their preparation for graduate studies
3. Development of Information Technology skills in STEM students so they are capable of making effective and more critical use of accurate and valid information in their professional lives.
4. Scaling-up of the teaching/learning strategies that have proven successful in improving student performance in STEM courses, through a professional development program and an Annual Best Practices Conference.
5. A Pre-College to College Bridging Component to motivate high school students to pursue STEM careers.

6. A research and mentoring program to provide a undergraduate STEM students with key skills and guidance to improve their preparation and motivation for graduate studies
7. A Bridge-to-the-Doctorate Program to increase the number of PR-LSAMP baccalaureate degree holders that continue and complete graduate degrees in STEM fields

II. Major Accomplishments of Year 3 of Phase III

1. In academic year 2003-04, PR-LSAMP institutions awarded 3,123 baccalaureate degrees in STEM disciplines. This represents an 82% increment in the number of BS degrees awarded, as compared with 1,709 degrees awarded in 1991, the PR-LSAMP baseline year.
2. In 2003, 27% of the 11,815 BS degrees awarded in STEM fields to Hispanics nationwide, were awarded by PR-LSAMP institutions (3,207).
3. STEM undergraduate enrollment at PR-LSAMP institutions has increased from 12,572 in 1992 to 27,068 in the Fall of 2003. This represents a 115% increment.
4. Seventeen percent (17%) of the Hispanics who received a PhD nationwide in a natural science field, from 1997 to 2002, received their BS degree from a PR-LSAMP institution.
5. Thirteen percent (13%) of the Hispanics who received a PhD nationwide in engineering, from 1997-2002, received their BS degree from a PR-LSAMP institution.
6. The three graduate campuses of the University of Puerto Rico awarded a total of 23 PhD degrees in STEM fields in academic year 2003-04.
7. Twelve additional Bridge-to-the Doctorate Fellowships were awarded at UPR-Mayaguez for a total of 22 PR-LSAMP-BDP fellowships.
8. In academic year 2003-04, PR-LSAMP awarded 482 stipends (\$385,000) to undergraduate STEM students to participate in research experiences. Also, 456 stipends (\$91,200) were awarded by PR-LSAMP to researchers to cover laboratory materials for PR-LSAMP participants.
9. Two hundred and four (204) high school participants benefited from workshops and field trips to strengthen their academic preparation and motivate them to pursue science and math degrees at the college level.
10. Five hundred and forty-five (545) freshman STEM students participated in workshops held by the PR-LSAMP Mentoring Program at the different institutions.
11. In this year's Puerto Rico Interdisciplinary Scientific Meeting (PRISM), 229 undergraduate STEM students presented to peers and faculty members their research projects.
12. Twenty nine (29) undergraduate STEM students received PR-LSAMP travel stipends (\$15,670) to present their research projects in national conferences.

13. The National Institute of Standards and Technology provided \$38,338 to six undergraduate STEM students to participate in research experiences at their main site with nationally recognized scientists.
14. PR-LSAMP institutions secured \$32M in external and institutional funds to implement educational projects geared at strengthening STEM education at their institutions.
15. Eleven fellowships were awarded by Pfizer Corp. to Organic Chemistry and Pharmaceutical Sciences majors.
16. PR-LSAMP received a \$30,000 supplemental award to participate in the FaST and SULI Programs, a collaborative effort between NSF and DoE. One professor and four students from UPR-Mayaguez participated in these two programs.
17. One hundred and forty (140) STEM faculty members from 17 institutions attended de PR-LSAMP 2003 Annual Best Practices Conference to improve students academic performance.

III. Alliance Participants and Collaboration with Other NSF Programs

Participating Institutions

The University of Puerto Rico at Río Piedras
The University of Puerto Rico at Mayaguez
The University of Puerto Rico at Humacao
The University of Puerto Rico at Cayey
The University of Puerto Rico at Aguadilla
The University of Puerto Rico at Arecibo
The University of Puerto Rico at Bayamón
The University of Puerto Rico at Ponce

The Inter American University at Bayamón
The Inter American University Metropolitan Campus
Pontifical Catholic University of Puerto Rico
The Polytechnic University of Puerto Rico

PR-LSAMP Staff

The UPR Resource Center for Science and Engineering serves as the umbrella organization in this alliance, promoting the maximum collaboration of all institutions and synergy of efforts. The Project Investigator is Dr. Manuel Gómez, Director of the UPR Resource Center for Science and Engineering. The Co-PI and Coordinator at the Central

Administration is Dr. Ana C. Piñero, Associate Director for the UPR Resource Center for Science and Engineering. She is responsible for the overall administration of the project and for the close articulation of PR-LSAMP with other systemic endeavors, such as PR-ATE, Title V-USDE, PR-AGEP, and EPSCoR. The Assistant Coordinator is Prof. Javier Figueroa, who is also responsible for the implementation of the Bridging, Mentoring and Professional Development Components. The Management Coordinator is Mrs. Ana Feliciano, responsible for the administrative and budgetary aspects of the project, and the Secretary, Ms. Liz Bultrón. They are all located at the UPR Resource Center for Science and Engineering main facility at the UPR-Rio Piedras Campus.

The Dean of Science and the Dean of Engineering at the participating institutions are the local Co-PI's, responsible for directly overseeing the implementation of PR-LSAMP strategies, and articulating them with other STEM reform initiatives at the institution. In institutions where the organizational structure does not provide for a science or engineering dean, the academic dean is the Co-PI. A STEM faculty member is appointed at each institution by the dean to serve as the PR-LSAMP Liaison Officer, responsible for the on-site implementation of the program. The PR-LSAMP Liaison Officers are:

Dr. María S. Baez, UPR-Río Piedras (Chemistry)
Dr. José R. López, UPR-Mayaguez (Physics)
Dr. Denny S. Fernández, UPR-Humacao (Biology)
Prof. Luis Pérez, UPR-Cayey (Physics)
Dr. Migdalia Sotomayor, UPR-Aguadilla (Biology)
Dr. Maiella Ramos, UPR-Arecibo (Chemistry)
Dr. Orlando González, UPR-Bayamón (Biology)
Dr. Rafael Canales, UIA-Bayamón (Mathematics)
Dr. Gaddier de Jesús, UIA-Metro (Biology)
Dr. Carmen Ascencio, Pontifical Catholic University (Biology)
Dr. Kay Berkling, Polytechnic University (Engineering)

Information on the PR-LSAMP staff is found in the web page (www.prlsamp.org).

The PR-LSAMP Advisory Board met on January 28, 2004 to discuss progress achieved, and to provide recommendations to the PR-LSAMP staff. The Chancellors of UPR-Rio Piedras, UPR-Humacao and IAU-Bayamón shared with the Board members the significant impact PR-LSAMP has had in strengthening STEM education at their institution. Mrs. Jeanne Narum, Director of Project Kaleidoscope, shared with the audience the project's national agenda to strengthen STEM education. The deans of natural sciences, engineering, and academic affairs from the different PR-LSAMP institutions joined the project's staff and liaison officers in this important annual event.

“It is clear that the program sets high standards with clear objectives and meaningful “expectations of excellence. The program is organized with a comprehensive plan to address all stages of academic development and professional training in a well integrated fashion... It is clear that the process of attribution and accountability is creating an institutional shift to improve the effective success of graduation rate as well as increasing

enrollment in the network of PR-LSAMP institutions.... NSF would well note that Puerto Rico is applying with great leadership and rigor the type of standards and approaches that work: teamwork, leadership, communication, experiential/relevant learning, and high standards of excellence... I commend the PR-LSAMP Program for a very successful and impressive set of accomplishments. Your program is well positioned to have great impact in advancing Hispanic minority participation as excellent leaders in science and engineering throughout the US, the Caribbean Basin, the Hemisphere, and beyond... Anson H. Hines, PR-LSAMP Advisory Board member, the Smithsonian Environmental Research Center”

Other Collaborating Organizations

The Universidad Central del Caribe Medical School and the UPR Medical Sciences Campus provide students with research opportunities, particularly to biology and chemistry majors. The National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce and the Smithsonian Institute provide students with research experiences during the summer.

Collaboration with Other NSF Sponsored Programs

The Resource Center for Science and Engineering (RCSE) of the University of Puerto Rico is the grantee for PR-LSAMP. In this Alliance, RCSE serves as the umbrella organization, promoting the maximum collaboration of all institutions and synergy. The RCSE coordinates all major STEM systemic educational reforms on the Island, therefore, it provides for an integrated, systemic strategy to increase participation of Puerto Rican students in the STEM pipeline. At the K-12 level, the RCSE is developing a Distance Learning Program for K-12 Science and Math Teachers. The first of its kind in Puerto Rico, the program makes use of distance learning technologies, and one of its key features is the integration of high-level learning computer technologies (mind tools) to train participants in the use of these tools to enhance the teaching and learning process. The project is currently being implemented in 82 schools, covering all educational levels, with the potential to impact over 1,500 teachers.

At the undergraduate level, in addition to PR-LSAMP, the RCSE implemented the Puerto Rico Advanced Technological Education (PR-ATE), funded by NSF. The goal of the project is to improve undergraduate education in the fields of Electronics. PR-ATE is being implemented at three PR-LSAMP institutions: UPR-Humacao, UPR-Bayamón, and UPR-Aguadilla. The thrust of the program is to align the undergraduate electronics curriculum with the national standards in Electronics. In this third and last year of the project the results achieved include: Ten web-based modules were developed to enhance the Electronics curriculum (English and Spanish versions); the development of a cadre of experienced module developers at each of the institutions, and the effective incorporation of technology to enhance the learning process.

At the graduate level, RCSE coordinates the Puerto Rico Experimental Program to Stimulate Competitive Research (PR-EPSCoR), co-funded by NSF. PR-EPSCoR is strengthening the Puerto Rico scientific community by increasing the number of competitive researchers and building a sustainable infrastructure for competitive research at the main research universities. PR-EPSCoR has been fundamental in improving the quality of research training in the Island's main STEM Ph.D. programs by providing research opportunities to students in areas that are critical to local as well as national interests, and by providing fellowships to graduate students and supporting post-doctoral positions. In addition, the NSF sponsored Alliance for Graduate Education and the Professorate (AGEP) provides fellowships to doctoral STEM students and has in place an effective Mentoring and TA Training Program. AGEP fellows serve as mentors to undergraduate and BDP PR-LSAMP participants. Another project is Partnerships for Innovation (PFI), which aims at developing entrepreneurial skills in undergraduate STEM students and development of new PhDs of relevance to innovation: Materials Science, Computational Science and Engineering, and Medical Biotechnology.

The coordination of these systemic initiatives by the RCSE has promoted the articulation of the pipeline as a unified and coherent effort, fostering a shared vision, the transfer of educational strategies, the cross-fertilization of efforts and the pooling of resources among all levels of the pipeline, leading to a synergistic effect that is critical for achieving lasting change.

IV. Activities and Findings

Activity #1 – Measuring Students Mastering of Concepts and Skills in Introductory Physics Course, and Development of Interactive Web-based Modules to Master Difficult Physics Concepts

(1) Description of Activity #1:

Activity #1 aims at:

- The development of an assessment system to measure effectiveness of the General Physics course.
- The development of a series of short digital videos for demonstrations and lab activities
- Design and development of modules that make use of the inquiry method for students to master hard to learn Physics concepts.
- Design and development of a website for the project.
- Training of faculty members on the use of the materials developed for the project and in the creation of their own educational materials

(2) Findings for Activity #1 (Year 3):

Assessment of student's learning

To determine success in moving students from one state to the other, it was considered of utmost importance to be able to measure as precisely as possible, the students' initial cognitive state. This state is being defined along three domains: concepts, skills and attitudes. Standardized instruments are being used for each domain. All of these instruments had been incorporated in web format so students can take the test using web browser technology. The on-line assessment system, developed locally at UPR Cayey, organizes test data and results in four profiles: student, section, institution and semester (this one includes data and results for all institutions who took the test online during a particular semester).

In the conceptual domain there are three instruments already online. The first instrument, is the "Force Concept Inventory" developed by David Hestenes et al, and has 30 items organized into six dimensions that define the force concept, the central element in the Newtonian paradigm and was created to probe student's beliefs on this matter. This instrument is considered by the physics educational community as the most reliable tool to measure conceptual change in Newtonian Mechanics. Most importantly, the wrong answers to each item, help to identify the most commonly held alternate conceptions

(also called preconceptions or misconceptions) by students entering the General Physics course. These are thought to be the main cause for students' low achievement in Physics.

The second instrument measures the use of basic mechanics conceptual knowledge in problem solving. This instrument is administered online at the end of the course. The results of this test are used to define the final cognitive state of the students. The two instruments together provide a more complete picture on conceptual development and its application to problem solving. The third one deals with Resistive DC Circuits and is the first instrument incorporated into the system to measure conceptual change in General Physics II (second semester course). This instrument was developed and published recently in the American Journal of Physics by a faculty member from the Physics Department of North Carolina State University (NCSU). Permission was granted to use our Spanish version of the instrument in this project, and a copy will be provided to NCSU for dissemination to other institutions. This test was administered to two course sections at the end of the second semester of 2003-04 to identify common alternate conceptions present after course instruction. It will be administered to all Physics II course sections during the second semester of 2004-05. Results will be presented in next year's report.

In the skills domain, four more instruments are already online. Three of these instruments taken from the Physics Suite have been adapted to measure skills that are necessary to understand the basic concepts covered in the General Physics Course: measurement (gathering, analyzing and comparing sets of data); graphical representation of motion, and basic vector algebra. They have been revised and converted to web format. The fourth instrument is on formal reasoning and measures student's basic reasoning skills, especially those required for science courses.

In the attitudes domain, only the Physics Expectations Survey (PES) is available online. This instrument is being used to measure students expectations of the General Physics course along six dimensions: (1) independence (beliefs on how physics is learned); (2) coherence (beliefs on the structure of knowledge); (3) concepts (beliefs on what the knowledge of physics should consist of); (4) reality (beliefs on the connection of physics and reality); (5) mathematics (beliefs on the role of math in the learning of physics); and (6) effort (beliefs on the type of activities and work needed to learn physics). Two more instruments are in the process of being translated and incorporated into web format. Some researchers argue that the student's tacit or explicit views of knowledge and learning have a direct, causal influence on his learning of physics.

This on-line assessment system has all the necessary components to provide a detailed profile of the student's cognitive state before and after instruction in General Physics. These profiles will be combined to provide a more accurate picture of the mental models (incorrect, partially correct and correct) common to the students before and after instruction. Knowledge about the alternate mental models is being used to create learning materials that will help students construct the scientifically correct models. Conceptual change and course effectiveness is being determined using quantitative measures of the two states.

The UPR-Cayey On-line Assessment System (UPR-COAS)

This system is unique in Puerto Rico and has been dramatically improved in several areas. It is an open source application that was developed locally to administer online assessment instruments using web browser technology, and to organize and analyze the data using new ideas on the learning process, and new quantitative methods to measure change using pre and post tests and surveys. UPR-COAS facilitates the administration, management and analysis of test results through a web-based interface and across multiple test sites. It was developed to facilitate the collaboration of different higher education institutions in the administration of standardized assessment instruments, data analysis and sharing of results.

COAS has three stable components: security, test management and database management. The security component allows protecting and managing administrative tasks, and user account management with three levels: Administrator, Coordinator and Instructor. This component also allows the creation of units (institutions) where users will be created, tests administered and data analyzed and saved.

The system also has a forum for faculty members participating in the project to share ideas about the project or to report system problems. There is a logging system that allows project administrators to see user activity. An online instructions manual is available for instructors and students. This system can be enhanced as professors incorporate their own assessment instruments.

The tests and questionnaires can be edited on line using a web browser. If a faculty member identified an error and has editing privileges he can modify the question or questions immediately for the next test administration. The web interface allows faculty members to examine the exam from a student standpoint (Take the Test). It allows faculty members to identify problems such as: information organization and presentation per page (layout), grammar, clarity and others; before the test is administered for the first time. Also it is a way of evaluating the functionality of the system in terms of: sending the information from the student machine to the server and organizing and analyzing the data.

Faculty members that had conducted or are conducting manual administration (paper and pencil) of the Force Concept Inventory (FCI) or any other multiple choice assessment instruments can use the system to analyze their data, following the on-line instructions provided for that purpose. This capacity will allow PR-LSAMP to gather data from previous research efforts sponsored by the program so as to increase the database of students who has taken the tests (sample size) and the number of participating institutions. For example, in 1997 the program conducted an island wide assessment of the General Physics course and they use the FCI to measure conceptual change. This data can be incorporated into the system for further analysis.

To identify the presence of common mental models among students a new multiple choice test analysis tool known as concentration analysis has been incorporated in web format. This tool is useful when each item alternative correspond to different mental models common to the students in the conceptual domain under study.

Administration of Assessment Instruments

Currently two PR-LSAMP institutions, three courses and eight professors are using COAS. Three different assessment instruments (Measurements, FCI and PES) were administered to almost 200 students. **FCI** and **PES** were also administered at UPR-Rio Piedras. This is allowing PR-LSAMP to gather data on whether students at other institutions face similar problems to the ones identified initially at UPR Cayey; if problems vary by institution, and most importantly, how to articulate efforts to maximize the effectiveness of Physics courses at all institutions.

The FCI was administered to two course sections of students registered in the Physics I course at UPR-Cayey in 2003-04 (56 students) and to five sections in 2004-05 (131 students). These results are identical to the ones obtained in years one and two - the average percent of correct answers by dimension was around 22% indicating that incoming freshman students that register in the General Physics Course at UPR-Cayey do not understand the Newtonian Paradigm. After several years of analysis a clear pattern of performance emerges along the different dimensions of the force concept. Students have little or almost no knowledge of the Newtonian paradigm, especially they have serious problems with Kinematics, Superposition and the Force Law; probably associated with common alternate conceptions. A similar pattern was found for the students who took the test at UPR Rio Piedras. These preliminary results at UPR Rio Piedras seem to indicate that a similar patter will be found at other PR-LSAMP institutions.

To identify the alternate conceptions most commonly held by students, the distribution of incorrect answers is been analyzed by group, and by all groups taking the FCI. Information is been extracted about the most common alternative conceptions per group and to all groups, and how they vary per semester and institution. A five page summary of the results obtained from the administration of FCI at UPR Cayey this semester (2004-2005) was sent to the three professors that are teaching General Physics I. Emphasis was given to the most common alternate conceptions found in the population of students. The pattern was completely similar to the one found in year 2. Faculty members are expected to use this knowledge to develop learning experiences that take into consideration the presence of alternate models and use the proper strategies to produce conceptual change. Currently, results form UPR Cayey and UPR Rio Piedras are being analyzed to identify common alternate conceptions present in both student populations prior to instruction.

This year the PES instrument will be administered before and after taking the General Physics course. This year PES is being administered to several course sections at UPR Rio Piedras. Comparative studies are being conducted to identify common negative attitudes and beliefs in the two student populations.

The physics faculty at UPR Cayey is now aware of the serious problem the presence of alternate conceptions and negative attitudes and beliefs toward physics posed in learning new material. The knowledge gained is being used in the development of learning materials that address these issues. Several of these materials will be used during year four to help students overcome their alternate conceptions in Kinematics and the Second Law. If effective, these materials and procedures will serve as models to deal with other common alternate conceptions and beliefs.

Materials Development

During this year, a new set of digital video clips was created to study and understand two dimensional motions; such as, projectiles and motion in a circle. Another set of digital video clips deal with oscillatory motion. The website that is been developed will allow users to access the short videos and answer a series of questions that will guide them in the process of knowledge construction (concept or skill). The first module “Galileo’s Problem” will be tested during this year. The second module on “One Dimensional Motion”, dealing specifically with the concepts of position, velocity and acceleration incorporates several of the video clips produced during the first and second years. This module is in DVD format and can take students from two to five hours to complete. It can be use in a local machine, network environment and DVD player. This module will also be tested during this year.

Activity #2 - Development of Electronic Modules to Expand Interdisciplinary Capabilities of STEM Students – Dr. Manuel Reyes, UPR-Río Piedras

(1) Description of Activity #2:

Activity #2 aims at the design and implementation of computer modules for three introductory science courses, General Biology, College Physics and General Chemistry. The educational objective of each module is to develop or enhance conceptual understanding and critical thinking skills using a fictional yet plausible environment through which concepts from Biology, Chemistry and Physics can be explored. Each module contains three basic elements: an introduction, interactive activities, and assessment activities (exercises/conceptual test), so students have the opportunity to apply the concepts they have learned and measure their progress before taking the tests. The exercise section involves cognitive skills such as knowledge, application, analysis or synthesis. Many of the exercises provide some sort of feedback that varies with the users' responses according to pre-identified misconceptions. In cases where users show poor skills or lack of fundamental knowledge, the module will guide them through a problem solving analysis, and send them back to an applicable exercise. Students will go through these modules in synchronization with the class discussion and laboratories.

At the end of Year 4, all three modules will communicate with each other to reinforce the integration of concepts from the three main disciplines, so students will have the opportunity to test their mastering of specific interdisciplinary concepts.

(2) Findings for Activity #2 (Year 3):

Table 1 summarizes the project's progress to date and includes projected activities for Year 4.

Table 1
Progress in Development of Modules
to Expand the Interdisciplinary Capabilities of STEM Students
UPR-Rio Piedras

Activity	Level of Achievement	Status or Completion Date
<p>Module Pre-Design 1. Identify Goals/Expected Outcomes</p> <p>2. Objectives</p> <ul style="list-style-type: none"> a. Concepts b. Skills c. Content d. Context 	<p>1. By Subject: 100% for Biology, Chemistry and Physics</p> <p>2. By Subject: 100% for Biology, Chemistry and Physics</p>	<p>1. Accomplished</p> <p>2. Accomplished</p>

<p>Module Design Develop/Write</p> <ol style="list-style-type: none"> 1. Instructional Strategy 2. Navigation Structure 	<ol style="list-style-type: none"> 1. By Subject: 100% for Biology, Chemistry and Physics 2. By Subject: 100% for Biology, Chemistry and Physics 	<ol style="list-style-type: none"> 1. Accomplished 2. Accomplished
<p>Module Pre-Production (Blueprint)</p> <ol style="list-style-type: none"> 1. Write general introduction 2. Write the script for each module section 3. write activities to develop pre-identified skills <ol style="list-style-type: none"> a. design activity set-up b. develop simulations 4. Write information for conceptual background 5. Write module exercises/problems <ol style="list-style-type: none"> a. identify common misconceptions linked to the problem b. write specific feedback message according to possible user wrong responses c. provide additional help or links to information pertaining the problem solution strategy or conceptual framework d. Interdisciplinary integration of all three modules component 6. Interdisciplinary integration of all three modules 	<ol style="list-style-type: none"> 1. By subject: Biology 100%; Chemistry 100%; Physics 100% 2. By subject: Biology 100%; Chemistry 100%; Physics 100% 3. By subject: Biology 100%; Chemistry 100%; Physics 100% 4. By subject: Biology 80%; Chemistry 100%; Physics 100% 5. By subject: Biology 70%; Chemistry 100%; Physics 100% 6. 30% 	<ol style="list-style-type: none"> 1. Accomplished 2. Accomplished 3. Accomplished 4. 09/30/04 5. 09/30/04 6. 12/16/04
<p>Module Production (Electronic Media Transfer)</p> <ol style="list-style-type: none"> 1. Provide training to programmers 2. Design/construct the webpage with the project's general information and links to each module 3. Develop methodology to create the scenario for each subject 4. Develop a general methodology to create the required images for each module 5. Incorporate conceptual information 	<ol style="list-style-type: none"> 1. 100% 2. 100% 3. 100% 4. 100% 5. 80% (Biology 80%; Chemistry 100%; 	<ol style="list-style-type: none"> 1. Accomplished 2. Accomplished 3. Accomplished 4. Accomplished 5. 09/15/04

<p>6. Adapt blueprint simulations to incorporate animations, data gathering and processing</p> <p>7. Incorporate practice problems and/or exercises with feedback and help</p>	<p>6. Physics 90%) Biology 100%; Chemistry 100%; Physics 100%</p> <p>7. Biology 70%; Chemistry 100%, Physics 90%</p>	<p>6. Accomplished</p> <p>7. 09/30/04</p>
<p>Module Assessment</p> <p>1. Provide criteria for experimental and control groups selection</p> <p>2. Design specifications tally for post-tests</p> <p>3. Construct question bank for post-tests</p> <p>4. Review post-tests</p> <p>5. Construct post-tests</p> <p>6. Construct student profile questionnaire</p> <p>7. Validate module:</p> <p> a. Construct expert-user questionnaire</p> <p> b. Construct end-user questionnaire</p> <p> c. Test modules</p> <p>8. First full trial</p> <p>9. Second full trial</p> <p>10. Determine outcomes</p> <p> a. Exam questions</p> <p> b. Student questionnaire</p> <p> c. Parallel course performance assessment (experimental vs control groups)</p>	<p>1. 100%</p> <p>2. 100%</p> <p>3. 100%</p> <p>4. 33%</p> <p>5. 33%</p> <p>6. 100%</p> <p>7. 66% (a. 100%; b. 100%; c. 33%)</p> <p>8. 33%</p> <p>9. 0%</p>	<p>1. Accomplished</p> <p>2. Accomplished</p> <p>3. Accomplished</p> <p>4. 12/16/04</p> <p>5. 12/16/04</p> <p>6. Accomplished</p> <p>7. Status:</p> <p> a. accomplished</p> <p> b. accomplished</p> <p> c. Chemistry accomplished; Biology Fall/2004; Physics Fall 2004</p> <p> d. Chemistry accomplished; Biology Fall 2004; Physics Fall 2004</p> <p>8. Status:</p> <p> a. Chemistry accomplished; Biology Spring 2005; Physics Spring 2005</p> <p>9. Status</p> <p> a. Chemistry Fall 2004; Biology Summer 2005; Physics Summer 2005</p> <p>10. End of Summer 2005</p>

<p>Dissemination to other PR-LSAMP Institutions</p> <ol style="list-style-type: none"> 1. Design Dissemination Plan 2. Write User's Manual 3. Provide workshop to other institutions 	<ol style="list-style-type: none"> 1. 50% 2. 20% 3. 0% 	<ol style="list-style-type: none"> 1. Summer 2004 2. Chemistry Summer 2004; Biology and Physics Fall 2004 3. Chemistry Fall 2004; Biology and Physics Spring 2005.
<p>Production and Assessment of Interdisciplinary Module</p>	<p>15%</p>	<p>Fall 2005</p>

Overall, it is estimated that the module development work is 88% complete. It is expected that by the end of Year 3 (October 31, 2004) all modules will be completed. This will provide for ample time for pilot testing during the Fall 2004 semester and have by January 2005 the first full student trial for the Biology and Physics modules. In the Fall 2004 semester the second full student trial is being conducted for the Chemistry module.

Seven complete interactive activities for the Physics module are ready for use, both through the Internet or locally in a personal computer. These activities have been used during the last year by six professors of the Physical Sciences Department at UPR-Rio Piedras impacting more than 500 students.

During the Summer of 2004 three tutorials for the Biology module were prepared (one about the nature of light; one on photosynthetic pigment, and one on the photosynthesis process). Also, two interactive activities involving oxygen production in the photosynthesis process and the measurement of photosynthetic yield were developed. A problem set at the end of each section has been incorporated into these electronic materials so students can measure their progress.

During Year 3 the Chemistry module was pilot tested twice. Pilot Test #1 was a preliminary tested the functionality of the module and its impact, as perceived by the end-users. During Pilot Test #2 recommendations from period one were incorporated and pre and post tests were administered to measure the performance and added value of the module. Item analysis suggested that 40% of the questions from both pre and post tests should be reviewed and modified to produce a reliable instrument of learning achievement.

A similar assessment plan will be implemented with the Biology and Physics components once each module is fully developed. In both cases, pilot testing and full trials will be done in the context of the introductory courses (General Biology/College Physics). A

reasonable timeframe for those activities is the 2004 fall term (for pilot testing and validation) and the 2005 Spring term (for the 1st trial).

The modules will be available to other Universities after each of the first trials. Training sessions will be designed, including the development of a users' manual to accompany the developed software.

Activity #3 - Development of Information Technology Skills in STEM Students Dr. Omar Hernandez, UIA-Bayamón

(1) Description of Activity

The aim of Activity #3 is to develop electronic modules to assist STEM students on becoming fluent in information technology (**FITness**), so that they are able to evaluate, distinguish, learn, and use new information technology as appropriate to their own personal and professional activities. Emphasis will be placed in the development of the intellectual capabilities, so they develop research, filtering and analysis skills to make effective and more critical use of accurate and valid information. Training of faculty members from all STEM disciplines on the use and integration of the modules into STEM courses, will be conducted. Inter-American University-Bayamón is the lead institution in this initiative.

(2) Findings for Activity #3 (Year 3):

Thirty six modules have been designed and are currently in different developmental phases (7 are ready to be published; 18 are in design evaluation; 4 are in design, and 6 are being programmed). Although most modules cover all three FITness components (Information Technology Skills [ITS]; Information Technology Concepts [ITC], and Intellectual Capabilities [IC]), each cover a specific objective under a component. Table 2 presents the title of the modules, the professor who designed it, the STEM area, the FITness objective and the status.

**Table 2
FITness Modules Developed by UIA -Bayamón
by Title, STEM Area, FITness Objective and Development Status**

Title	Designer	STEM Area	FITness Objective	Status
Types of microscopes	Dr. Serrano	Biology	ITS - Using the Internet to find information and resources	Ready to be published
Virtual Botany	Dr. Serrano	Biology	ITS - Using the Internet to find information and resources	Ready to be published
Historic facts in Engineering	Dr. Cintrón	Engineering	ITS - Using the Internet to find information and resources	Design evaluation
Microsoft Equation 3.0	Prof. Miller	Chemistry	ITS - Using a word processor to create a text document	Design evaluation
Cost-Volume-	Prof. Muñoz	Engineering	ITS - Using a spread sheet to	Programming

Profit Analysis			model process or financial tables	
Database Design	Prof. Nieves	Technology	ITS - Using a database system to set up and access useful information	Design evaluation
Searching the Infotrack databank	Ms. Villamil	Information Technology	ITS -Using a database system to set up and access useful information	Design evaluation
Searching for Measuring Tools	Prof. Miller	Chemistry	ITS - Using instructional materials to learn how to use new applications or features	Design evaluation
Knowing the Personal Computer	Prof. Marrero	Technology	ITC – Computers	Ready to be published
Programming Operators	Prof. González	Technology	ITC – Algorithmic thinking and programming	Design evaluation
Programming a calculator using high level language	Prof. Galvis	Technology	ITC - Algorithmic thinking and programming	Design evaluation
How to develop a web portal	Prof. Marrero	Information Technology	IC – Organize and navigate information structures and evaluate information	Ready to be published
Planning a Multimedia Presentation	Ms. Padilla	Information Technology	IC- Organize and navigate information structures and evaluate information	Ready to be published
Using Boolean operators to find information on databases and the Internet	Prof. Rodriguez	Information Technology	IC - Organized and navigate information structures and evaluate information	Design evaluation
Citing electronic sources using APA style	Prof. Rosa	Information Technology	IC - Communicate to other audiences	Programming
Assessing research articles in databases	Dr. Ballesteros	Chemistry	IC - Communicate to other audiences	Programming

How to write an essay	Ms. Padilla	Information Technology	IC - Communicate to other audiences	Ready to be published
Physics in Biology	Dr. Fábregas	Biology	ITS - Using the internet to find information and resources	Design evaluation
The cell in genetic engineering	Dr. Serrano		ITS - Using the Internet to find information and resources	Design evaluation
Volcanoes	Dr. Roe	Geology	ITS - Using the Internet to find information and resources	Programming
Distance calculations between countries using Calculus	Prof. Miranda	Mathematics	ITS - Using the Internet to find information and resources	Ready to be published
Transformation of functions	Prof. Coutin	Mathematics	IC - Engaged in sustained reasoning	Ready to be published
Limits of functions	Prof. Sierra	Mathematics	IC - Engaged in sustained reasoning	Design evaluation
Riemman areas	Prof. Toro	Mathematics	IC - Engaged in sustained reasoning	Design evaluation
Using Excel Graphics	Prof. Rodriguez	Mathematics	ITS Using a graphics and/or artwork package to create illustrations or other image-based expressions of ideas	Design evaluation
Recording digital sound	Prof. Pintado	Information Technology	IC - Communicate to other audiences	Design evaluation
Working with Story Board	Prof. Vizcarrondo	Information Technology	IC - Communicate to other audiences	Design evaluation
Variance Analysis	Prof. Muñoz	Engineering	ITS – Using a spreadsheet to model simple processes or financial tables	Design evaluation
Photosynthesis	Dr. Serrano	Biology	IC - Organize and navigate information structures and evaluate information	Design evaluation

Nonmenclature	Prof. Miller	Chemistry	ITS – Using instructional materials to learn how to use new applications or features	Design
Earthquakes	Prof. Roe	Geology	ITS - Using the Internet to find information and resources	Programming
Selection Structures	Prof. González	Technology	ITS - Using a computer to communicate with others	Design
Knowing Windows XP Tools	Prof. Marrero	Technology	ITS - Using basic operating system features	Programming
Configuration of the components of a personal computer	Ms. Padilla	Technology	ITS - Using basic operating system features	Programming
Effective presentations	Prof. Vizcarrondo	Information Technology	ITC- Digital representation of information	Design
Digital Photography	Prof. Pintado	Information Technology	ITC- Digital representation of information	Design

During Year 4 the following activities will be conducted: programming of the designed exercises for the STEM courses; publish the modules on the web; train STEM faculty on the use of the modules and their integration into STEM courses, and distribution of modules to all PR-LSAMP institutions.

Activity #4 – Strengthening the Teaching and Learning Process in STEM Courses – Professional Development Activities for STEM faculty.

(1) Description of Activity #4:

The thrust of this activity is to train faculty members on strategies that have proven successful in strengthening the teaching and learning process in STEM courses. An Annual Best Practices conference is held to provide a forum for faculty members to share with their colleagues their initiatives in improving students' academic performance.

(2) Findings for Activity #4 (Year 3):

The Systems Dynamic Institute

In 2001, PR-LSAMP began to sponsor a series of workshops on the application of systems dynamic to the teaching process, as part of its efforts to disseminate among PR-LSAMP institutions successful best practices to enhance the teaching and learning process. As a result of these workshops, a group of faculty members have joined efforts to create The Systems Dynamic Institute. The goal of the Institute is to create a critical mass of practitioners of systems dynamic modeling to transform the teaching and learning culture in the universities. Effective systems dynamic modeling provides a high level of understanding of the interaction of the parts and the behavior of the system as a whole. Developing the students' capacity for model building is accomplished by having them actually construct the models and perform the simulations. Twelve professors are working under the leadership of Dr. Joaquín Medín in the development of the Institute. Soon the PR-LSAMP webpage will include a link to the Institute's page, which will include the Institute's activities, reference materials, and a collection of models that could be easily down loaded and/or simulated through the Internet. In 2003-04 four workshops (three basic and one advanced) were offered on the use of the STELLA program, to a total of 48 faculty participants.

One of the basic workshops was offered to twelve undergraduate STEM students participating in the PR-LSAMP undergraduate-to-graduate bridging component. These students were selected by six of the professors who are applying systems dynamic modeling in their courses and have the potential to go on to graduate school and could apply systems dynamic modeling to their research work. These undergraduate students were from four different PR-LSAMP institutions: UPR-Bayamón, UPR-Humacao, UPR-Rio Piedras, and IAU-Bayamón.

The other two basic workshops were offered to STEM faculty at two PR-LSAMP institutions who had not previously participated: Pontifical Catholic University and UPR-Mayaguez (Engineering). The advanced workshop was held at UPR-Aguadilla and was offered to faculty members who are using STELLA in their courses.

The Annual Best Practices Conference

For the past four years PR-LSAMP has been sponsoring an annual conference on Best Teaching and Learning Practices to Improve Students' Academic Performance. Over 140 STEM faculty members from 17 universities in Puerto Rico attended this year's event. The plenary speaker was Dr. Bruce Hannon from the University of Illinois at Urbana. The topic of the conference was "Dynamic Modeling in the Modern University: A Third Pillar of Education". A local panel of STEM professors shared with the audience their experience in applying systems dynamic to the teaching process. Presentors included Joaquín Medín (Physics), Deborah Parrilla (Biology), Noel Motta (Chemistry), Elio Ramos (Mathematics), Marc Legault (Physics) and Carmelo García (Chemistry).

This year the conference was a joint initiative with the Puerto Rico Advanced Technological Education (PR-ATE) Program. Project staff presented to the STEM faculty members present the web modules they are developing to strengthen Electronics education.

Using the NSF Science Digital Library (NSDL) to Enhance Computer Science Education

This workshop was co-sponsored by PR-LSAMP, CITIDEL and Project Kaleidoscope. Twenty-five professors from the different PR-LSAMP institutions attended the workshop. Participants learned techniques to develop and evaluate resources and strategies on integrating on-line resources into their courses.

Activity #5 - Pre-College to College: Induction into STEM Research

(1) Description of Activity

Activity #5 aims at developing a STEM Research Program for junior and senior high school students to learn the fundamental knowledge and skills to do scientific research. The goal is to motivate high school students to enter STEM college programs through active involvement in challenging and pertinent research activities that will strengthen their conceptual knowledge in STEM and familiarize them with the environment and ongoing research endeavors in STEM programs.

(2) Findings for Activity #5 (Year 3):

Five workshops were offered at eight schools with a total participation of 178 junior and senior high school students. The workshops were: 1) Organic Chemistry with emphasis on carbon synthesis molecules; 2) Mathematics with emphasis on the use of graphic calculators; 3) Biology with emphasis on endangered species and invertebrate zoology; 4) Physics with emphasis on application of physics concepts on daily life; and 5) Geology with emphasis on the geology of the Caribbean and the rock cycle. In addition to covering conceptual concepts in each of these areas, the professors included two sessions, one to discuss career opportunities in each of the fields, and strategies for a successful college life.

The eight high schools selected covered all island's regions: Francisco Morales (central mountain region); Tomás Ongay (northern region); Stella Márquez (southern region); Eloisa Pascual (northeastern region); Petra Zenón de Fabery (northern region); José E. Lugo (central mountain region); Juan J. Maunés Pimentel (eastern region), and Adela Rolón Fuentes (northern region).

The Summer Research Academy for High School Students

The central theme for this year 's academy was the Geology of Puerto Rico. Twenty six junior high school students from three different high schools participated in this two week academy. Three university professors and three high school teachers served as resources. The main objective of the academy was to promote in-depth understanding of the diversity of the main geological formations in Puerto Rico: the northern karst zone, the coastal alluvial plains, and the central igneous mountain range. The content of the workshop focused on the rock cycle, the geological time scale, and the exact identification of the mineral composition of the rocks. This was accomplished through four field trips around the island. As a result of the workshop, high school students were able to identify the three types of rocks (igneous, metamorphic, sedimentary) and their mineral composition. The pedagogical strategy was based on a "hands on" approach through field trips and laboratory activities. During the two weeks, the geological concepts were integrated with chemistry and math activities in the lab. In the

mathematics and chemistry activities, graphing calculators TI-83 with sensors (pH, salinity, dissolved oxygen, and motion) were used.

This year PR-LSAMP invited Dr. Hernán Santos, an internationally recognized paleontologist, to emphasize on the historical fossil record of the northern part of the Island. The field trip where students were able to collect fossils became the highlight of this year's academy. Students were able to collect marine turtle fossils from the cretaceous period (65 million years ago!).

Activity #6 - Undergraduate to Graduate: Research Opportunities and Mentoring Program to Strengthen Students Academic Preparation for Graduate Studies

(1) Description of Activity #6:

Research stipends are awarded annually to students for research experiences during the academic year and the summer at local and national universities and laboratories. As part of this component, PR-LSAMP provides participants with travel stipends to present their research projects at national conferences. An annual local activity, the Puerto Rico Interdisciplinary Scientific Meeting (PRISM), co-sponsored by PR-LSAMP allows students from across the island to come together and share their research projects and experiences. Prior to this event, students are helped by faculty mentors to prepare for their oral presentation.

The mentoring program aims at establishing a web of mentoring relationships among the faculty, graduate students, upper level undergraduate students and lower division undergraduate students to enhance synergy between programs. Faculty mentors supervise student mentors and also participate in directly assisting students. Mentors also plan and offer a series of workshops each semester to address general areas of difficulty encountered by students. A two week Summer Bridging Seminar is conducted in which mentors are assigned to their students to get to know them and establish a working relationship, and to familiarize students with the overall services and activities of the component.

(2) Findings for Activity #6 (Year 3):

Undergraduate Research Experiences

During academic year 2003-04 and during Summer 2004, PR-LSAMP awarded 482 stipends to STEM undergraduate majors to participate in research experiences at local research laboratories. Also, 456 stipends were awarded to the researchers to cover laboratory materials to be used by the students during their research experiences (\$200 per student), as shown in Table 3.

Table 3
PR-LSAMP Undergraduate Research Experiences

Institution	# of Stipends Awarded to (Students)*	# of Stipends Awarded to Researchers*	\$ Awarded to Students	\$ Awarded to Researchers for lab materials	Total \$ Awarded per Institution
UPR-Rio Piedras	127	121	\$101,600	\$24,200	\$125,800
UPR-Mayaguez	153	141	\$122,400	\$28,200	\$150,600
UPR-Humacao	94	86	\$75,200	\$17,200	\$92,400
UPR-Cayey	15	15	\$12,000	\$3,000	\$15,000
UPR-Bayamón	8	8	\$6,400	\$1,600	\$8,000
UPR-Arecibo	34	34	\$27,200	\$6,800	\$34,000
UPR-Aguadilla	8	8	\$6,400	\$1,600	\$8,000
UPR-Ponce	8	8	\$6,400	\$1,600	\$8,000
Pontifical Catholic Univ.	8	8	\$6,400	\$1,600	\$8,000
UIA-Metro	3	3	\$2,400	\$600	\$3,000
UIA-Bayamón	24	24	\$19,200	\$4,800	\$24,000
TOTAL	482	456	\$385,600	\$91,200	\$476,800

* This figure is not headcount. A student and a researcher may participate more than once during the academic year and Summer research experiences

Undergraduate to Graduate Bridging Component

Ten workshops were offered to 35 undergraduate STEM students at UPR-Rio Piedras in a sustained one-year effort to strengthen their academic preparation and encourage them to continue on into graduate studies. Table 4 presents the title of the workshop, the name of the resource professor and the resource person's institution.

An integral part of each workshop is to present the application of the topic to graduate school, particularly on research opportunities at the graduate level. PR-LSAMP allocated \$30,823 of which \$26,900 was for stipends for participants. All students attended all workshops.

Table 4
Undergraduate to Graduate Bridging Component at UPR-Rio Piedras
Academic Year 2003-04

Workshop	Speaker	Resource Institution
How to read a Scientific Paper	Dr. Juan Torres	UPR-Bayamón
Nanotechnology: Research and Future	Dr. Carlos Cabrera	UPR-Rio Piedras
Puerto Rican Chitons (mollusks)	Dr. Cedar Garcia	UPR-Humacao
Basic Astronomy with emphasis on the concepts of scale and time	Prof. Esteban Araya	UPR-Rio Piedras
General Relativity: From Einstein to Present	Dr. Jaime Ponce de León	UPR-Rio Piedras
Writing Skills for Scientific Publications	Dr. Juan Torres	UPR-Bayamón
Tropical Weather and Climate	Ada Monzón	Meteorologist with Univisión Channel
Atmospheric Phenomena such as Hurricanes, Tropical Storms, and Trade Winds	Ada Monzón	Metereologist with Univision Channel
Puerto Rican Arthropods	Dr. Juan Torres	UPR-Bayamón
Preparing for the GRE	Dr. Julio Rodriguez	UPR-Rio Piedras

Summer Internship at the Smithsonian Institute

One of the collaborating partners of PR-LSAMP is the Smithsonian Institute. This summer two students from UPR-Arecibo participated in a research internship at the Smithsonian Environmental Research Center under the mentorship of Dr. Patrick Megonigal. Both students worked on the nutrient cycles on temperate wetlands. As a result, Dr. Megonigal visited PR to become familiar with tropical wetlands, particularly Creek Tiburones at Arecibo. Because of the biological diversity of this particular wetland, Dr. Megonigal has requested that the 2005 Worldwide Symposium on Wetlands be conducted in Puerto Rico. If approved, PR-LSAMP will be actively involved in this significant scientific event.

Mentoring Program

Twenty-two professors and 77 upper level STEM students from seven different institutions served as PR-LSAMP mentors to 588 freshman STEM students. These professors offer basic STEM courses such as General Chemistry, General Biology, Pre-Calculus, Calculus I, Graphic Engineering, and Introduction to Engineering. This program benefits the freshman students enrolled in their courses. Table 5 presents the name of the mentors, the number of peer mentors and participants per institution

Table 5
Name of Professors and Number of Peer Mentors and Participants
By PR-LSAMP Institution 2003-04

UIA-Bayamón		
Name of Professor	Peer Mentors	Participants
Julián A. Rivera	3	10
Ana M. Lugo Chinchilla	2	12
Juan M. Barbosa Concepción	3	5
Zulma Rivera	3	10
Luis E. Vazquez	2	10
Ruben Flores	2	7
Maritza Zambrana	4	4
Juan. C. Garcia	4	7
Caroline Gonzalez	2	5
Sub-total	25	70
UIA-Metro		
Marta Rosas Cancio	2	37
Ernesto Torres	6	19
Sub-total	8	56
UPR-Aguadilla		
Carlos Gómez Jiménez	2	5
Osvaldo Martínez	3	9
Carlos Ruiz Martínez	3	11
Sub-total	8	25
UPR-Arecibo		
José Arbelo García	5	70
Ana M. García	5	84
Sub-total	10	154
UPR-Bayamón		
Yolanda Vélez	5	31
Sub-total	5	31
UPR-Mayaguez		
Lolita Rodriguez	5	152
Fernando Souto	4	27
Pedro Rivera	5	31
David Suleiman	5	22
Abner Rodriguez	2	20
Sub-total	21	252
Total	77	588

All 588 freshmen students took the core mentoring workshops included in the PR-LSAMP program to strengthen study skills, time management skills, test-taking skills, and cooperative learning. In addition to these core-mentoring workshops, each

participating institution programmed and offered workshops to meet specific needs or interests of their students. Table 6 presents a sample of the workshops offered at each of the institutions.

Table 6
Workshops Offered by Institution as Part of the PR-LSAMP Mentoring Program
2003-04

UIA-Bayamón
(1) Molecular Techniques for the Histology Course (2) Preparation for GRE (3) Summer Research Opportunities at local and mainland institutions (4) Eight field trips to Pfizer Pharmaceutical (5) A Forum on Biotechnology (6) STEM Careers (7) Power Point Seminar
UIA-Metro
Mentoring on-line using the WEB-CT Platform
UPR-Aguadilla
(1) Establishing Priorities and Time Management (2) Effective Study Techniques (3) The 4 th Symposium on Student Research (4) Strengthening Your Self-Esteem (5) How to be an effective mentor in Chemistry and Biology
UPR-Arecibo
(1) Basic Skills in Microbiology Techniques (2) The Use of the GPS and the Compass as Tools for Ecological Research (3) The Microbiologist in an Industrial Setting (4) Preparing for Graduate Studies Entrance Exams
UPR-Bayamón
(1) How to resolve equations using the graphic calculator (2) How to use the library and multimedia facilities (3) How to Manage Stress (4) Calculus Review

UPR-Mayaguez

- (1) Becoming familiar with the institution
- (2) Coop Learning Techniques
- (3) How to take the Chemistry I Exam
- (4) Becoming an Excellent Mentor
- (5) Visit to the Natural Products Research Laboratory
- (6) Study Skills for Organic Chemistry
- (7) Introduction to Java Servlets
- (8) How to Apply to Graduate School
- (9) The Role of the Chemical Engineer in Industry
- (10) How to Develop a Resume

In the case of UPR-Mayaguez, four peer mentors are now pursuing doctoral studies in Chemical Engineering at different Mainland Institutions: Misael Avilés, University of South Carolina; Gabriel Rodriguez, University of Wisconsin; Eduardo Vasquez and Charlene Rincón, Georgia Tech. University.

PRISM

The Puerto Rico Interdisciplinary Scientific Meeting (PRISM) is the annual island wide forum for undergraduate science, technology, engineering and mathematics (STEM) students to present their research projects. For the past 12 years, PR-LSAMP has co-sponsored this activity, together with the local chapter of the American Chemical Society.

On March 2004, 229 undergraduate STEM majors (186 in science, 41 in engineering and 2 in mathematics) from the different PR-LSAMP institutions presented their research projects to an audience of approximately 600 students and faculty members. The largest number of presentations (68) was in the field of Life Sciences, with UPR-Mayaguez having the largest number of student presenters in all fields.

This year, the invited Plenary Speaker at PRISM was Dr. Nicholas Turro, the William P. Schweitzer Professor of Chemistry at Columbia University. The Title of his presentation was *Paradigms Lost and Found: Examples of Science Revolutionary and Science Pathological (and How to Tell the Difference)*. Dr. Turro is the author of “Modern Molecular Photochemistry”, the standard text in the field. In 2002 he was awarded one of the NSF Director’s Award for Distinguished Teaching Scholars, for the development of computer-based models for undergraduate chemistry studies and for developing mentoring programs that involve undergraduate students as collaborators on faculty research. Dr. Turro is a cutting-edge researcher who is leading advances in the use of photochemistry and spectroscopy to reveal the structure and dynamics of supramolecular systems.

Abstract of Conference

Paradigms Lost and Found: Examples of Science Revolutionary and Science Pathological (and How to Tell the Difference)".

The path of scientific research can be described in terms of the action of paradigms on the conduct of normal everyday science and puzzle generation and solution. When certain research appears to create anomalies and attracts the attention of a scientific community a scientific crisis results which may lead to a true scientific revolution and paradigm shift or pathological science that is then ignored by the community. Until the situation is settled by the community it may be very difficult to distinguish revolutionary science from pathological science. Some guides on how to recognize the differences and how to avoid pathological science are suggested.

Travel to Scientific Meetings

During this year PR-LSAMP provided a total of \$15,670 in travel stipends for students to present their research projects in national conferences. A total of 29 STEM students from six PR-LSAMP institutions benefited from this PR-LSAMP initiative. Examples of national forums attended are the Annual Biomedical Research Conference for Minority Students, SACNAS, the ACS Annual Meeting, the American Society for Microbiology Meeting, AIChE Annual Student Conference, and the Biophysical Society Annual Meeting.

Table 7 presents by institution the number of students that received travel stipends and total amount of funds awarded.

Table 7
Travel Stipends Awarded to Present Research Projects at National Forums 2003-04

Institutions	Number of Participants	Funds Awarded (\$)
UPR-Mayaguez	11	\$6,700
UPR-Rio Piedras	4	\$1,720
UPR-Humacao	8	\$4,000
UPR-Cayey	3	\$1,600
PUCPR	1	\$500
UPR-Ponce	2	\$1,150
Total	29	\$15,670

NIST Summer Internships

Since Phase I the National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce, has been providing summer research experiences to PR-LSAMP students. During the Summer of 2004, six students from UPR-Mayaguez participated in the 9 to 12 week Summer Internship Program. NIST provided a total of \$38,338 to cover stipends, housing, and travel expenses. This internship provides students with the opportunity to work in research projects with mainland STEM students and nationally recognized researchers. Of this year's participants, four went on to pursue doctoral studies (one in Biomedical Engineering; one in Astronomy –Arizona State; one in Theoretical Physics – University of Illinois at Urbana, and one in Medical Physics at the University of Wisconsin-Madison). The remaining two returned to UPR-Mayaguez to complete their senior year. Both the PR-LSAMP Assistant Coordinator and the PR-LSAMP Management Coordinator attended the end of the Summer conference (SURF) at the NIST headquarters in Gaithersburg, Maryland, where 100 students presented their research work. Table 8 presents the name of the PR-LSAMP participants and the title of their research projects.

Table 8
NIST Summer of 2004
Name of PR-LSAMP Participants and Research Projects

Name of Student	Title of Research Project
Veronica Rodriguez Rivera	Phase Behavior of Mixed Lipid Bilayered System
Angel L. Villalain Garcia	Authentication and Authorization in a Distributed Computer Server
Angel Fuentes Figueroa	Testing Software Packages for Gamma-Ray Spectrometry Measurements Using germanium Detectors
Angélica Pérez Andújar	Test Report of Radiation Detectors Against the ANSI N42.32, N42.34, and N42.35 Standards
Miguel A. Morales	Phase Diagram of a Gas of Atomic Bosons, Atomic Fermions, and Heteronuclears Molecules
Claribel Acevedo Vélez	Automation of the NIST Hydrometers Calibration Service

Pfizer Fellowships

PR-LSAMP joined effort with Pfizer Corporation and 11 STEM students are currently benefiting from a Pfizer fellowship. Pfizer two areas of thrust are Organic Chemistry and Pharmaceutical Sciences. Students are awarded a fellowship to cover their cost of studies and to conduct research with a selected UPR faculty mentor. Table 9 presents fellowship recipients, institution and thrust area.

Table 9
Pfizer 2003-2004 Fellowship Recipients and Thrust Area

Name of Students	Institution	Thrust Area
Rebeca Cabán	UPR-Rio Piedras	Organic Chemistry
Evelyn Cordones	UPR-Humacao	Pharmaceutical Sciences
Jesús Cruz	UPR-Medical Sciences	Pharmaceutical Sciences
Lisa del Valle	UPR-Medical Sciences	Pharmaceutical Sciences
Oscar García	UPR-Humacao	Organic Chemistry
Elvin Igartúa	UPR-Mayaguez	Pharmaceutical Sciences
Fernando Martínez	UPR-Rio Piedras	Pharmaceutical Sciences
Eduardo Morales	UPR-Humacao	Organic Chemistry
Yatsandra Oyola	UPR-Rio Piedras	Organic Chemistry
Luis Seda	UPR-Rio Piedras	Organic Chemistry
Javier Vázquez	UPR-Medical Sciences	Pharmaceutical Sciences

FaST (Faculty and Student Teams) and SULI (Science Undergraduate Laboratory Internships)

PR-LSAMP received a \$30,000 Supplemental award to participate in the NSF and DoE Collaborative Initiatives FaST and SULI. During the Summer of 2004 Dr. Luis Rivera, professor of Chemistry at UPR-Mayaguez, and three of his undergraduate students conducted research through the FaST Program at the Argonne National Laboratory. Dr. Rivera has been working at UPR-Mayaguez in nanotechnology projects. During the Summer of 2004, Dr. Rivera and his three undergraduate students worked in the design, synthesis and characterization of nanostructured materials incorporating biomolecule arrays that exploit the capabilities of biological molecules to store and transduce energy.

The fourth student, Emil Hernández, also an undergraduate chemistry major, conducted research in the area of material sciences at the Lawrence Berkeley National Laboratory through the SULI Program

Activity #7 - Bridge to the Doctorate Program

In August 2003, NSF awarded a supplement award to PR-LSAMP to provide BS graduates, participants in PR-LSAMP, fellowships to continue graduate studies in a STEM field, at UPR-Rio Piedras. Table 10 presents the names of the students selected, the institution from where they received their BS degree, and the STEM field in which they are pursuing a PhD degree.

Table 10
Bridge to the Doctorate Fellows (Cohort #1)
Fall 2003

Name of Participant	BS Degree Granting Institution	PhD Major
Azlin M. Biaggi Labiosa	UPR-Rio Piedras	Physical Chemistry
Daniel Caballero Rivera	UPR-Rio Piedras	Biochemistry
Betzaida Castillo Cruz	UPR-Humacao	Biochemistry
Omar A. Cruz Nieves	UPR-Rio Piedras	Biochemistry
Agustín Díaz Díaz	UPR-Rio Piedras	Inorganic Chemistry
Luzed Diaz Pérez	UPR-Rio Piedras	Cellular Molecular Biology
Marilyn García Arriaga	UPR-Rio Piedras	Organic Chemistry
Karilys González Nieves	UPR-Rio Piedras	Inorganic Chemistry
Jessica Oyola Cintrón	UPR-Rio Piedras	Chemical Physics
Yamaris Pacheco Moctezuma	UPR-Rio Piedras	Biochemistry.

Supporting BDP Activities at UPR-Rio Piedras

Workshops and Field Trips

Thirteen workshops/field trips were conducted during the academic year 2003-04 (six during the first semester and seven during the second). The ten fellows attended all workshops. Table 11 presents the topics of the workshops and the resource professors

Table 11
Bridge-to-the Doctorate Supporting Activities at UPR-Rio Piedras
Workshops/Field Trips 2003-04

Topics	Resource
Successful Mentoring Strategies	Dr. Lizzette Velázquez – UPR-Rio Piedras
A Success Story: from Academia to Competitive Research	Dr. José Lasalde - UPR-Rio Piedras
Philosophy of Science Part 1	Dr. Alfredo Torruella - UPR-Rio Piedras
Philosophy of Science Part 2	Dr. Joaquín Medín - UPR-Bayamón
From an Academic Setting to an Industrial Setting: Differences in Expectation	Dr. Edgar Miranda - Bristol Myers Squibb
The Pharmaceutical Industry Chemistry Requirements for Optimum Quality: A field Trip	Dr. Edgar Miranda - Bristol Myers Squibb
BDP Fellows Present Their Research Work	Ten BDP Fellows and Thesis Advisors
Systems Dynamic Modeling	Dr. Joaquín Medín - UPR-Bayamón
Paleontology: Puerto Rican Fossils	Dr. Hernán Santos - UPR-Mayaguez
Field Trip to the PR Radio Observatory and Ionospheric Center in Arecibo	Dr. José Alonso – Scientific Educator of the Observatory
Identification of Post-Doctoral Opportunities and Strategies for a Successful Experience	Dr. Nicholas Turro - Columbia University
Conducting Materials Science Research with a Nobel Laureate: A Successful Puerto Rican Role Model	Dr. David Santiago - Stanford University
The PR-LSAMP Pipeline: From High School to Graduate School	Prof. Javier Figueroa, BDP Coordinator, Ten Fellows, Ten Undergraduate STEM Students and Ten High School Students

Visits to High Schools

Each BDP fellow visited each semester a high school participating in the PR-LSAMP Pre-college-to-College bridging component. As part of the workshops conducted by PR-LSAMP on Saturdays at the selected schools, the visiting BDP fellow shares with students their high school and undergraduate experiences, including preferred courses, teachers and professors that were their role models, and insights on how to succeed in a university environment. But most importantly, they serve as role models to these high school students, and motivated them to pursue careers in STEM fields.

Mentoring

Each BDP fellow is assigned an undergraduate STEM student and a high school student to work with him in his/her research project. High school students visit the BDP fellow lab an average of 20hrs a week where he/she becomes familiar with the research and develops basic research skills. One undergraduate PR-LSAMP student is also assigned to

work with the BDP fellow on his/her research. The three work as a team in a seamless pipeline from high school to graduate school. The BDP fellow serves as mentor and role model in this process.

BDP Fellowships at UPR-Mayaguez (Second Cohort – August 2004)

In August 2004, NSF awarded 12 Bridge-to-the-Doctorate (BDP) Fellowships at UPR-Mayaguez (Cohort #2). These 12 students initiated graduate studies at UPR-Mayaguez this semester (August 2004). Of the 12 fellows, nine are enrolled in master degree programs, with the intent of eventually obtaining a PhD degree, and three are enrolled in doctoral programs. Of the twelve, four are in Chemistry, two in Marine Sciences and six in Engineering. Eight are females and four are males. Table 12 presents the name of the fellows, the BS degree granting institution, and the program and field of study

Table 12
Bridge to the Doctorate Fellows at UPR-Mayaguez (Cohort #2)
Fall 2004

Name of Participant	BS Degree Granting Institution	Program/Field
Olga Abreu Vega	UPR-Mayaguez	MS/Marine Sciences
Deborah Acevedo Acevedo	UPR-Mayaguez	MS/Chemistry
Yashira Estrada Olavarria	UPR-Mayaguez	MS/Marine Sciences
Miguel Gonzalez Santiago	Inter American University	MS/Chemistry
Luis Gonzalez Solá	UPR-Mayaguez	MS/Civil Engineering
Laura Granell Ortiz	UPR-Mayaguez	MS/Chemistry
Yeira Padilla Luciano	UPR-Mayaguez	PhD/Chemical Engineering
Frances Ramirez Colón	UPR-Mayaguez	MS/Civil Engineering
Luis Rodriguez Garcia	UPR-Mayaguez	PhD/Civil Engineering
Priscila Santiago Torres	Pontifical Catholic U.	MS/Chemistry
Luis Serrano Velásquez	UPR-Mayaguez	MS/Civil Engineering
Sonia Vélez Poggi	UPR-Mayaguez	PhD/Chemical Engineering

Dr. Angel López is the on-site BDP Coordinator at UPR-Mayaguez. Together with Prof. Javier Figueria, the BDP Coordinator, are currently developing the calendar of activities for Year 1, which will include joint activities with fellows from Cohort 1.

V. Special Institutional Initiatives Co-Sponsored by PR-LSAMP During Year 3

The Pre-College Engineering Program (PCEP)

As in previous years, PR-LSAMP is one of the co-sponsors of the UPR-Mayaguez Pre-College Engineering Program. This two-week summer residential program is designed to introduce talented high school students to the engineering profession. The main objective of the program is to motivate participants to select and pursue careers in engineering. The program activities include a general orientation on the academic programs offered at UPR-Mayaguez, and specific orientations on the engineering disciplines prepared and offered by young engineering professors.

In 2004 three field trips were conducted, consisting of visits to different manufacturing plants, so participants had the opportunity to appreciate different engineering applications in the production of goods and services. Also, all participants were given the option to select two out of six engineering workshops that they would like to attend. Each of the workshops was related to one of the six engineering disciplines offered by the College of Engineering.

Another activity conducted was a design and creativity competition. Each team was assigned a design project, which included a detailed problem description, a set of specifications and rules, and a set of materials. The competition took place in the morning of the last day of the program and awards were given to all teams based on their design, creativity, and performance. Professors and graduate students served as judges.

A preliminary questionnaire (pre-test) is administered to each participant previous to any activity in order to collect data pertinent to career preferences, research awareness, and general family background. The collected data is compared to data collected through similar questionnaires (post-test) administered at the end of the summer session. The results show that there was a significant increase in the awareness reported by students regarding the different engineering disciplines. A significant increase is also evident in the participants' perception of the type of work performed by engineers.

The pre and post-test results also indicate that the program was successful in influencing the participant's decision to pursue an engineering career, in helping the participants to identify which engineering discipline they prefer, and in motivating the participants to pursue graduate degrees. Results indicate that at the end of the program 81.7% of the participants expressed their intention to pursue an engineering degree, compared to 71.7% prior to their participation in the program. Of the 17 participants that prior to the program indicated being interested in an engineering degree, but that were undecided regarding the specific discipline, 11 were able to focus their interest at the end of the program. Results also indicate that at the end of the program 15% wanted to pursue only a bachelor's degree, 32% a Master's degree, and 40% expressed an interest to pursue a doctoral degree.

An important accomplishment of the program has been the awards and scholarships that

some of the participants have received from the National Action Council for Minorities in Engineering (NACME-TechForce Pre-Engineering Award). Only 10 awards are made each year. Throughout its existence, the Pre-College Engineering Program has submitted ten nominations. Of the ten nominees, nine have received the awards.

Summer Pre-Calculus Program at UPR-Rio Piedras – For the past three Summers, PR-LSAMP has co-sponsored The UPR-Rio Piedras Mathematics Immersion Summer Program for incoming science and mathematics freshman students, and for incoming freshman students in the College of Education majoring as secondary school teachers in science and mathematics. The goal of the program is to increase their mathematics skills so they can succeed in the Calculus course. Students are administered a diagnostic test and are divided into groups based on the results: Level 1 [Remedial Math]; Level 2 [Remedial Math + Pre-Calculus I], and Level 3 [Remedial Math + Pre-Calculus I and II]. For four weeks, students in each class attended daily classes of two hours and 30 minutes each, and a 3-hour tutorial session daily. Tutors attended the class. Results for all students (335 science and math majors and 40 education majors) showed that of the 148 students enrolled in Level 1, 35% passed the course with a grade of A or B; for the 79 students enrolled in Level 2, 62% passed the Pre-Calculus I course with a grade of A or B, and for the 148 students enrolled in Level 3, 62% passed the Pre-Calculus I and II course with a grade of A or B.

Implementation of the Reformed Curriculum for Zoology and Botany Courses

PR-LSAMP co-sponsored this initiative at UPR-Rio Piedras, which aims at improving students learning of biology concepts and process skills through the integration of the laboratory and the lecture in the Botany and Zoology courses. Through this integration, the project expects to help students understand the correlation between theory and research, enhance conceptual understanding, develop laboratory skills, and increase their motivation towards learning Biology. Pre and post conceptual understanding tests revealed significant improvement on the mean number of correct answers in the post-test. Also, student performance on exams when compared with grades obtained by students in previous course sections taught by the professors in a traditional format, showed that students taking the reformed course performed better. A web-page was developed <http://www.cnet.upr.edu/biol/sbc> and it includes curricular materials developed, such as creative syllabi for integration of lab and lecture; laboratory exercises, classroom activities, webpage resources, assessment instruments, and class presentations.

IAU First Robotics Competition

This year PR-LSAMP co-sponsored the participation of a team of students and faculty members from Inter American University (IAU) Bayamón Campus at the 2004 Palmetto Regional FIRST Robotics Competition held in Columbia, South Carolina. A group of high school students and their mentors (faculty members) designed and built a robot in the given six-week timeframe, using a standard “kid of parts”. During this process students not only developed technical skills but also developed team-working skills. Eighteen students from four high schools participated in this year’s competition. In

addition to building the robot and presenting it in the national competition, students strengthened their knowledge through participation in the following workshops offered by faculty members from the IAU School of Engineering: Fundamentals of Robotics; Robot Controllers and Programming; Mechanical Design, and Engineering Methods and Idea Generation and Selection. Forty two teams participated in this national event.

Summer Transportation Institute at UPR-Mayaguez

PR-LSAMP co-sponsored the 2004 Summer Transportation Institute organized by the Civil Infrastructure Research Center at UPR-Mayaguez. The objective of the Institute is to expose a group of high school students to a variety of academic experiences designed to motivate them to pursue careers in engineering and the sciences related to the field of transportation. In addition to field trips, class sessions in transportation related topics are offered, science, math and technology skills are strengthened, and working sessions are conducted for project development. The Institute is a four-week non-residential program. PR-LSAMP co-sponsored the Summer Institute as part of its pre-college to college bridging program.

VI. Other Educational Initiatives at PR-LSAMP Institutions to Strengthen Undergraduate STEM Education

Tables 13 to 22 present other educational projects implemented in 2003-04 by PR-LSAMP institutions to strengthen STEM programs. Projects are presented by funding source and amount of funds assigned for that year.

Table 13 - UPR-Aguadilla

Project Description	Sponsor	Amount of Funds
Transferring Technology into the Classroom	PR Higher Ed. Council	\$79,879
SPAC – Development of Science Knowledge and Skills	PRDE	\$204,131
Title V – New Pathways to Learning: Moving Faculty and Students to the Forefront of Multimedia Educational Technology	USDE	\$395,655
Advanced Technological Education (participating institution in a UPR Consortium)	NSF	\$20,340
Summer Internships for STEM students at different local and mainland Institutions	Several	\$12,700
Total		\$735,419

Table 14 - UPR-Arecibo

Project Description	Sponsor	Amount of Funds
Arecibo Geosciences Diversity Program	NSF	\$96,411
Improving Academic Outcomes for Science and Math Students through the Use of Technology	USDE	\$100,000
Transition to Research Careers	NIH	\$25,506
Integrating Concepts, Processes and Standards through Authentic Assessment and Multiple Intelligences	--	\$9,203
The Use of the Graphing Calculator TI-86 and TI-89 in the Classroom and the Laboratory	--	\$8,295
Laboratory equipment for Chemical Physics Course	Merck Sharpe & Dohme	\$2,000
Total		\$241,415

Table 15 - UPR-Bayamón

Project Description	Sponsor	Amount of Funds
Improvement to the Electronics Laboratory	UPR	\$100,000
Advanced Technological Education	NSF	\$13,997
Use of Multimedia, Internet and Phase Microscope for Microbiology laboratory	UPR	\$30,000
Title V – Strengthening Student Academic Achievement in Science Courses	USDE	\$179,732
Total		\$323,729

Table 16 - UPR-Cayey

Project Description	Sponsor	Amount of Funds
Ethics in Ecology: A humanistic perspective on the environment	Humanities Foundation	\$11,214
MBRS RISE		\$1,699,629
Transformation of Laboratory Exercises into a Meaningful Experience	Howard Hughes Inst.	\$500,000
Teacher Recertification in English and Math	PRDE	\$2,216,000
Puerto Rico Math and Science Partnership	NSF	\$1,142,613
Technology and Office Administration Program: A model for service learning		\$34,550
Teacher Excellence Award	Johnson & Johnson	\$5,000
Learning through an investigative approach: Inquiry-based Physics and chemistry using technology	PR Council on Higher Ed.	\$97,060
Integrating Chemistry and Mathematics through research based on simulations	PR Council on Higher Ed.	\$79,909
Strategies to Diversify Teaching	PRDE	\$500,000
A virtual community to integrate technology into the classroom	PRDE	\$296,845
Collaborative Title V Strengthening Developing Institutions	USDE	\$599,999
Developing Collaborative Computer Based Lab Using the web	USDE	\$299,901
Acquisition of Scanning Electron Microscope for Materials Research and Education	NSF	\$262,000
MBRS	NIH	\$1,699,629
Total		\$9,444,349

Table 17 - UPR-Rio Piedras

Project Description	Sponsor	Amount of Funds
The Seamless Biology Classroom: An Integration of Conference and Laboratory Instruction in Botany and Zoology	NSF	\$81,974
Enhancement of Excellence in Research at UPR-RP (SCORE)	NIH	\$174,970
Upgrading Biomedical Facilities at UPR-Rio Piedras	NIH	\$748,812
PR-CETP Comprehensive Summative Evaluation	NSF	\$396,695
Upgrade Laboratories Facilities at UPR-Rio Piedras (Supplement to RISE Project)	NIH	\$188,171
Bridges to the Baccalaureate at UPR-Rio Piedras	NIH	\$215,040
Scholarship for Environmental Studies	Ford Int.	\$5,000
Title V Collaborative Strengthening Developing Institutions	USDE	\$150,000
CREST	NSF	\$999,999
Puerto Rico Math and Science Partnership	NSF	\$1,395,471
Teacher Certification Project	PRDE	\$731,600
RISE	NIH	\$1,305,926
Algebras and Dynamical Systems: Classifications and Applications	NSF	\$76,194
Research and Math Academies for the K-3 level	PRDE	\$175,616
An Integrated Math Curriculum for K-9 Teachers	PRDE	\$227,965
Infrastructure for New Program in Computer Science CISE	NSF	\$304,472
MARC U-Star and Development Programs	NIH	\$49,945
Support Enhancement Excellence in Research	NIH	\$2,626,336
Total		\$7,227,850

Table 18 - UPR-Mayaguez

Project Description	Sponsor	Amount of Funds
Mathematics and Science through Technology	PR Higher Ed Council	\$55,840
Center for Curricular Innovation in the Teaching of Chemistry	PRDE	\$155,560
Materials Science and Engineering Education Improvement for a Hispanic Serving Institution	DOD-Army	\$78,184
HBCU/MI Proposal for Student Summer Research Internship Program	DOD-Army	\$197,205
Transformation of Physics Teaching Laboratories and Outreach Program	DOD-Army	\$394,603
Curriculum Integration through Solar Education Program	DOD-NASA	\$58,388
Partnership for Space Science Education and Research	DOD-NASA	\$264,996
Space Information Laboratory	DOD-NASA	\$326,307
MARC Honors Program	DOD-NASA	\$125,919
Scholarships for Disadvantaged Students	NIH	\$436,305
Integrating Science and Management in the Caribbean	NOAA	\$280,023
To develop and establish a meteorology/atmospheric science degree program	NOAA-SG	\$100,000
Marine Education	NOAA	\$99,698
Marine Outreach Program	NOAA	\$234,151
Bioengineering research and education (BREED)	NSF	\$99,722
Graduate and Undergraduate Students Enhancing Science and Technology in K-12 Schools (GUEST K-12)	NSF	\$452,776
Puerto Rico Math and Science Partnership	NSF	\$381,060
Puerto Rico Math and Science Partnership Participant Support	NSF	\$1,314,183
Synergistic Partnership for Research and Education on Functional and Nanostructured Materials	USDA	\$144,748
Improving Math and Science Performance and Current Animal Science Students	USDA	\$23,900
Improving Math and Science Performance in the College of Agriculture	USDA	\$149,528
Graduate Chemical Engineering	Sloan Found.	\$270,000
Sloan Scholar Program	Sloan Found.	\$4,000
Program to increase the number of graduates from biology and chemistry going on for PhD	Sloan Found.	\$360,000
A curriculum in engineering for non-engineers	Eli Lily	\$20,095
Atmospheric Sciences Center	Howard Hughes	\$260,045
Support of a distance education master of engineering in chemical engineering	Merck Sharp & Dohme	\$32,517
High schools outreach program	“	\$5,000
Summer Transportation Institute		\$2,000
Central New York and PR-Mayaguez Alliance for Graduate Education and the Professoriate	Syracuse Univ.	\$100,000
Advance Institute for Transportation Education	Univ. of Miami	\$10,000
Research Experiences for Undergraduates	Virginia Polytechnic	\$14,600
Research Fellowships	“	\$94,000
Undergraduate Biological Sciences Education Program	UPR	\$50,000
Total		\$6,955,353

Table 19 - UPR-Humacao

Project Description	Sponsor	Amount of Funds
Sea Grant Marine Education	NOAA	\$49,698
Women Education Equity Acat Program	USDE	\$134,959
Participation in UPR-Rio Piedras CREST Program	NSF	\$33,293
Participation in PR Science and Math Partnership	NSF	\$1,142,613
Internships in Industry	Bristol Myers	\$17,100
MBRS	US HHS	\$1,106,140
Student Support Services	USDE	\$356,323
Talent Search	USDE	\$250,261
Development of Communication Competencies	USDE	\$342,348
Ronald McNair Post Bac. Achievement Program	USDE	\$179,965
Upward Bound	USDE	\$234,624
Total		\$3,847,324

Table 20 - Pontifical Catholic University of P.R.

Project Description	Sponsor	Amount of Funds
A Multimedia Program to Facilitate Retention and Academic Performance of Minority Students in Entry-level Math and Sciences Courses	USDA	\$150,000
MARC Honors Program	NIH	\$723,104
MSEIP Teaching Through Videoconferencing and Teaching On-line	USDE	\$104,704
Puerto Rico Space Grant Consortium	NASA	\$10,000
Sponsored Research Office, Extramural Associates Research Program	NIH	\$55,200
Title V Using Technology for Academic Improvement	USDE	\$420,094
TitleV Improving Academic Outcomes Through a Technology Based Consortium	USDE	\$540,000
Total		\$2,003,102

Table 21 - IAU-Bayamón

Project Description	Sponsor	Amount of Funds
Summer Program Initiative to introduce middle school children to STEM disciplines and professions	NASA/UTSA	\$100,000
Development and enhancement of rural business and commercial initiatives	USDA	\$50,000
Development and enhancement of business and commercial initiatives that are technology-based	SBA and other	\$140,000
Development of a technology-based initiative that merges corporate with campus resources	PRIDCO	\$100,000
Upward Bound Math and Science	USDE	\$218,545
Student Support Services to assist low-income students in pursuing STEM careers	USDE	\$225,554
Title V Strengthening Institutions	USDE	\$493,526
Total		\$1,327,625

Table 22 - IAU-Metropolitan Campus

Project Description	Sponsor	Amount of Funds
Using technology in the classroom to enhance the teaching and learning process	PRDE	\$139,250
Promoting Environmental Careers Through an Integrated Approach	EPA	\$15,000
Total		\$154,250

VII. CONTRIBUTIONS TO THE DEVELOPMENT OF HUMAN RESOURCES

Baccalaureate Degree Production at PR-LSAMP Institutions

In academic year 2003-04, PR-LSAMP institutions awarded 3,123 baccalaureate degrees in science, technology, engineering, and mathematics (STEM) disciplines. This represents an 82% increment from the 1,709 degrees in 1991. **In this 13-year period, PR-LSAMP institutions have awarded a total of 35,843 BS degrees in STEM fields.** Table 23 presents the number of STEM degrees awarded per year of award.

Table 23
BS STEM Degrees Awarded by PR-LSAMP Institution by Year of Award

Year of Award	Number of STEM BS Degrees Awarded
1990-91	1,709
1991-92	1,840
1992-93	1,896
1993-94	2,086
1994-95	2,281
1995-96	2,674
1996-97	2,754
1997-98	2,726
1998-99	2,789
1999-00	2,771
2000-01	2,893
2001-02	3,094
2002-03	3,207
2003-04	3,123
TOTAL	35,843

Table 24 presents the total number of baccalaureate degrees awarded during Phase I and Phase II (5-year periods each), and the number of degrees that have been awarded so far by PR-LSAMP institutions during Years 1, 2 and 3 of Phase III. Table 25 presents by PR-LSAMP institution the percent increment from baseline year.

Table 24
Number of Baccalaureate Degrees Awarded by PR-LSAMP Institution
Phase I, Phase II, and Phase III

Institution	1991-95 Phase I (5 yrs)	1996-01 Phase II (5 yrs)	2003-04 Phase III (3 yrs)
UPR-Rio Piedras	1740	2136	1215
UPR-Mayaguez (Sc)	1392	2718	1464
UPR-Mayaguez (Eng)	2726	3919	2012
UPR-Humacao	475	873	327
UPR-Cayey	445	840	394
UPR-Arecibo ¹	120	597	318
UPR-Bayamon ¹	165	603	487
UPR-Ponce ¹	35	157	73
UPR-Aguadilla	--	199	262
Turabo U. (Sc) ²	121	125	--
Turabo U. (Eng) ²	7	97	--
CUE ³	--	35	--
UMET ⁴	105	24	--
Sacred Heart Univ. ⁵	229	35	--
Pontifical Catholic U.	628	1278	434
Inter American U.	1624	2971	1359
Polytechnic Univ. ⁶	--	--	1079
TOTAL	9,812	16,607	9,424

¹Entered PR-LSAMP in 1994; ²left PR-LSAMP in 2000; ³entered PR-LSAMP in 1996; ⁴participated in PR-LSAMP from 1997-00; ⁵participated in PR-LSAMP from 1991-96; ⁶entered PR-LSAMP in 2002

Table 25
Percent Increment in BS Degrees by PR-LSAMP Institution from Baseline Year to 2004

Institution	Baseline Years	Year 2004	Percent Increase
UPR-Rio Piedras	327	382	16%
UPR-Mayaguez (Sc)	200	441	120%
UPR-Mayaguez (Eng)	516	622	20%
UPR-Humacao	69	106	53%
UPR-Cayey	90	112	24%
UPR-Arecibo ¹	76	115	51%
UPR-Bayamon ¹	81	197	143%
UPR-Ponce ¹	21	27	28%
UPR-Aguadilla ²	12	160	123%
Pontifical Catholic U.	118	146	25%
Inter American U.	286	435	23%
Polytechnic Univ. ³	360	380	20%
TOTAL	2,156	3,123	44%

¹Baseline year is 1994; ²Baseline year is 1996; ³Baseline year is 2002. For all other institutions, baseline year is 1991

Table 26 presents the total degrees awarded per STEM discipline, in Phase I and Phase II; and the STEM degrees awarded in Years 1, 2 and 3 of Phase III.

Table 26
STEM Baccalaureate Degrees Awarded by Discipline (1991-92 to 2003-04)

Discipline	1991-96 Phase I (5yrs)	1996-01 Phase II (5yrs)	2003-04 Phase III (3 yrs)
Chemistry	1181	2826	821
Physics/Astronomy	131	266	300
Mathematics	203	240	102
Life Science	2863	5459	3421
Computer Science	866	1188	974
Engineering	3009	3856	3260
Geosciences	57	54	35
Agricultural Sc.	377	533	372
Quality Control ¹	12	10	--
Other STEM ²	2134	610	--
Environmental Sc. ³	--	77	139
TOTAL	10,833	15,119	9,424

¹Quality Control degrees are now reported under Chemistry

²In 1997-98, NSF eliminated the " Other SMET" category; these degrees are now reported under the major science categories. The number of credits taken in these categories determined inclusion in life sciences, chemistry and engineering.

³Environmental Science was previously included under geosciences

SME Baccalaureate Degrees Awarded Nationwide

The most recent NSF data on BS degrees awarded nationally to underrepresented minorities is for academic year 2002-03, reporting year 2003. This data shows that a total of 25,100 BS degrees in STEM disciplines were awarded to underrepresented minorities in that year. Of this total, 11,815 degrees were awarded to Hispanics. In 2003, PR-LSAMP institutions awarded 3,094 baccalaureate degrees in STEM disciplines, accounting for 27% of the degrees awarded to Hispanics nationwide, as shown in Table 27.

Table 27
2003 STEM Baccalaureate degrees Awarded Nationwide to Underrepresented Minorities NSF Data

Discipline	Hispanics	Other Minority Groups	PR-LSAMP Institutions
Agricultural Sciences	521	596	130
Chemistry	560	622	264
Computer Science	1,812	3,312	344
Engineering	3,971	3,821	1,094
Environmental Science	154	150	30
Geosciences	102	59	6
Life Sciences	3,910	3,865	1,208
Mathematics	531	696	39
Physics/Astronomy	254	164	92
Total	11,815	13,285	3,207

Enrollment in STEM Disciplines at PR-LSAMP Institutions

During a 12-year period (1991 to 2003), PR-LSAMP institutions have more than doubled their STEM enrollment, from 12,572 in 1991-92 to 27,068 in the Fall of 2003, as shown in Table 28. Table 29 shows undergraduate enrollment by STEM discipline in the Fall 2003, and Table 30 presents STEM undergraduate enrollment by institution.

Table 28
Total Undergraduate STEM Enrollment By Academic Year
At Participating PR-LSAMP Institutions

STEM Undergraduate Enrollment	Academic Year
12,572	1991-92
14,557	1992-93
14,818	1993-94
16,344	1994-95
19,139	1995-96
23,159	1996-97
24,767	1998-99
23,476	1999-00
23,427	2000-01
26,524	2001-02
27,529	2002-03
27,068	2003-04

Table 29
FT/PT Undergraduate Enrollment at PR-LSAMP Institutions By STEM Discipline
Fall 2003

STEM Discipline	Undergraduate Enrollment 2003
Chemistry	1919
Physics/Astronomy/Electronics	1331
Mathematics	489
Computer Science	3641
Geosciences	111
Engineering	9133
Life Sciences	9134
Environmental Science	363
Agricultural Science	947
TOTAL ALL STEM DISCIPLINES	27,068

Table 30
Undergraduate STEM Enrollment by PR-LSAMP Institution Fall 2003

Institution	STEM Enrollment 2003
UPR-Rio Piedras	2536
UPR-Mayaguez	7884
UPR-Humacao	886
UPR-Cayey	897
UPR-Bayamón	1432
UPR-Arecibo	593
UPR-Aguadilla	1214
UPR-Ponce	646
Polytechnic University of PR	4067
Inter American University	5943
Pontifical Catholic University	970
TOTAL	27,068

Baccalaureate Graduates that Continue Graduate Studies

If we track the baccalaureate origin of the nationwide PhD recipients, the National Opinion Research Center (NORC), which reports Ph.D. data , shows for the years 1997 to 2002 that:

- 17% of the Hispanics (U.S. citizens) that obtained a **PhD in a Natural Science** field nationwide, received their BS degree from a PR-LSAMP institution (276 out of 1,620). UPR-Río Piedras and UPR-Mayaguez are the leading baccalaureate institutions of U.S. Hispanic Ph.D.'s in Science.
- 13% of the Hispanics that obtained a **PhD in Engineering** nationwide, received their BS degree from a PR-LSAMP institution (58 out of 421). UPR-Mayaguez is the leading baccalaureate institution of U.S. Hispanic Ph.D.'s in Engineering.

Table 31 shows the leading U.S. Baccalaureate Institutions of U.S. Hispanic Ph.D.'s in S&M fields for the 1996-2002, and Table 32 for Engineering fields.

Table 31
Top 25 Baccalaureate Institutions of U.S. Hispanic PhDs (U.S. Citizens Only)
Natural Sciences 1997-2002

Baccalaureate Origin Institution	Degrees Awarded	
1. University of Puerto Rico – Rio Piedras	159	PR-LSAMP Institutions UPR-Rio Piedras = 159 UPR-Mayaguez = 80 UPR-Cayey = 16 UPR-Humacao = 11 Pontifical Catholic U. = 10 Total = 276
2. University of Puerto Rico – Mayaguez	80	
3. Univ. of California at Berkeley	37	
4. University of Texas at Austin	32	
5. Cornell University – Endowed Colleges	29	
6. Univ. of California – Los Angeles	26	
7. Univ. of California – Davis	25	
8. Univ. of New Mexico – Main Campus	25	
9. Texas A&M University	23	
10. MIT	22	
11. Stanford University	22	
12. Univ. of Texas at El Paso	21	
13. Univ. of California – San Diego	21	
14. Univ. of California – Irvine	20	
15. New Mexico State Univ. – Main Campus	18	
16. Univ. of California – Santa Cruz	18	
17. Institution Unknown – U.S.	17	
18. University of Puerto Rico – Cayey	16	
19. University of Arizona	15	
20. University of Florida	14	
21. University of Illinois at Urbana	14	
22. University of Miami	14	
23. Florida International University	12	
24. St. Marys University	12	
25. Univ. of California – Santa Barbara	12	
Total Top 25 Institutions	704	
Total Doctorates Granted to Hispanics	1,620	

Source: NSF/NIH/USED/NEH/USDA/NASA, Survey of Earned Doctorates, selfa@norcmil.uchicago.edu

Other institutions in Puerto Rico whose BS graduates went on to receive a PhD during this period of time were: UPR-Humacao (11) and Pontifical Catholic University (10).

Table 32
Top 23 Baccalaureate Institutions of U.S. Hispanic PhDs (U.S. Citizens Only)
Engineering 1997-2002

Baccalaureate Origin Institution	Degrees Awarded
1. University of Puerto Rico – Mayaguez	51
2. MIT	25
3. Texas A&M University	14
4. Univ. of Texas at El Paso	14
5. Univ. of California at Berkeley	11
6. Univ. of California – Davis	10
7. Florida International University	9
8. University of Florida	9
9. Univ. of Illinois at Urbana	9
10. Rensselaer Polytechnic Institute	8
11. Univ. of New Mexico – Main Campus	8
12. California Institute of Technology	7
13. Cornell University – Endowed Colleges	7
14. New Mexico State Univ. – Main Campus	7
15. University of Miami	7
16. University of Puerto Rico – Rio Piedras	7
17. California Polytechnic State Univ. San Luis Obispo	6
18. Univ. of Texas at Austin	6
19. Univ. of Colorado at Boulder	6
20. John Hopkins University	5
21. Princeton University	5
22. Purdue University – Main Campus	5
23. Stanford University	5
Total Top 23 Institutions	241
Total Research Doctorates	421

Source: NSF/NIH/USED/NEH/USDA/NASA, Survey of Earned Doctorates, selfa@norcmail.uchicago.edu

At the local level, the University of Puerto Rico’s three graduate institutions, UPR-Rio Piedras, UPR-Mayaguez, and UPR-Medical Sciences awarded a total of 23 PhD degrees in 2004. Table 33 presents the number of PhD degrees awarded by these three campuses in 2003-04 by science and engineering field. Table 34 presents the number of PhD degrees awarded by the three campuses from 1990 to 2004.

Table 33
Number of PhD Degrees Conferred in 2003-04
by the University of Puerto Rico by Science and Engineering Field

Institution	Number of PhD Degrees	Science and Engineering
UPR-Rio Piedras	15	Biology (3) Physics (3) Chemistry (9)
UPR-Medical Sciences	2	Physiology (1) Biochemistry (1)
UPR-Mayaguez	6	Computational Sciences (1) Civil Engineering (2) Marine Sciences (2) Chemical Engineering (1)
Total	23	9 S&E Fields

Table 34
Number of PhD Degrees Conferred by the University of Puerto Rico
by Science and Engineering Field from 1990 to 2004

Academic Year	Number of PhD Degrees Conferred
1990	14
1991	9
1992	9
1993	17
1994	12
1995	10
1996	17
1997	16
1998	31
1999	22
2000	25
2001	36
2002	32
2003	30
2004	23
TOTAL	303

VIII. DISSEMINATION, PUBLICATIONS AND PRODUCTS

1. The PR-LSAMP web-page was re-designed, including a re-conceptualization of its structure, navigation system and attractiveness, to provide for a more effective interaction between users and the project. Special emphasis was given to the graphical elements included and the organization of the information by topic and page. New images were created, logos were improved, and animations were included. A series of documents that were in PDF were converted to HTML format to facilitate users access to specific information. The web-page includes now:
 - a. The Resource Center for Science and Engineering, the umbrella organization for the PR-LSAMP alliance, with links to other systemic projects coordinated by the RCSE
 - b. The Puerto Rico LSAMP Program
 - i. Organizational Structure
 - ii. Metrics
 - Enrollment
 - Degrees
 - Index of Course Efficiency
 - The PR-LSAMP Student Tracking System
 - iii. PR-LSAMP Main Events
 - iv. Curriculum and Teaching Strategies
 - v. Student Activities
 - vi. Bridge-to-the-Doctorate Program
 - vii. Skills for the Millenium
 - viii. PR-LSAMP Annual Reports
 - c. PR-LSAMP Institutions, with links to the institution's web-page
 - d. Forms for the different PR-LSAMP activities
 - e. Site Map
 - f. Staff
 - g. Contact Us
2. The Metrics Manual developed by PR-LSAMP is now in electronic format in the PR-LSAMP webpage. The Manual includes:
 - a. Introduction
 - i. What is a Retrospective Cohort Study and What are Its Advantages
 - ii. Data Used in the Retrospective Cohort Study, and Information Generated by Its Analysis
 - iii. Gatekeepers and Bottlenecks: Qualitative and Quantitative Metrics
 - b. Methodology
 - i. Recording and Tabulating the Data: Four Steps to a Retrospective Cohort Study
 - c. A Detailed Discussion of the Metrics: ICE Numbers, Stymie Rates, and Brain Drains
 - d. A Sample Report

3. Abstracts of research projects presented by STEM students at the 2004 Puerto Rico Interdisciplinary Scientific Meeting (PRISM) were included in the PR-LSAMP web-page. Also the abstract of Dr. Nicholas Turro, this year's plenary speaker, is included.
4. Abstracts of all presentations of the 2003 Best Practices Conference on Teaching and Learning
5. The PR-LSAMP System Dynamics Institute – Includes a description of the Institute. In 2004-05, users will have access to the Institute' site that will include: activities, reference materials, and a collection of models that could be easily downloaded and/or simulated through the Internet.
6. Dissemination of Puerto Rico's Systemic Educational Reform Projects at the 2004 American Association for the Advancement of Science (AAAS) and UNESCO Conference on the State of Science and Technology Education Worldwide (Paris, June 2004). Dr. Manuel Gómez, PR-LSAMP PI and Dr. Ana C. Piñero, PR-LSAMP Co-PI were invited by AAAS to present the systemic educational reform developed and implemented in Puerto Rico. Mr. Koichiro Matsuura, UNESCO's Director-General, Hon. Louise Oliver, U.S. Ambassador to the UNESCO, Dr. Gilbert S. Omenn, President-Elect AAAS, and Dr. Shirley Malcom, AAAS/EHR Director, opened the two day conference. Panelists included two Nobel Laureates, Dr. Leon Lederman and Dr. George Charpak.