

# Research Profile 2004-2005

University of Puerto Rico  
Mayagüez Campus

## Mission

To promote research and creative endeavors to meet the needs of our local and international society while preserving, transmitting, and advancing knowledge.



## Values

Tradition  
Commitment  
Integrity  
Diversity  
Excellence  
Leadership  
Innovation

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**Dr. Jorge I. Vélez Arocho**  
UPRM Chancellor

## MESSAGE FROM THE CHANCELLOR

At the end of the second semester of the academic year 2004-2005, we received our reaccreditation by the Middle States Commission on Higher Education. In the preparatory process for the re-accreditation, UPRM renewed its pledge to support and advance research as a key component of our mission. Our University is dedicated to implement these commitments and to work together to foster a better research environment at UPRM. Moreover, we emphasized the importance of informing all our stakeholders of our research objectives, goals and progress; particularly the Research and Development Board, with experts across boundaries, who are invited to assess our research initiatives.

Accountability in the university environment is defined as being answerable for the successful discharge of the mission of the institution. This is characterized as the extent to which administrators are open, quick to respond and accountable, and the level to which the university research management reflects the needs of those to whom management is accountable in the discharge of its mission. The Institute for Social and Ethical Accountability in the United Kingdom summarizes the importance of accountability as follows: "It is proposed that those in positions of authority should publicly account for their actions, decisions, as well as the use of public resources. The information revealed by systems of accountability, it is argued, will permit the electorate to judge the quality of policies and the integrity of implementation so that those most able and honest can be selected to manage. Public reporting leads to the selection of policies that will promote development and ensures that membership resources are used to yield their greatest return on investment at advancing the mission".

However, accountability is more than just reporting outcomes. At UPRM, it is part of the Continuous Improvement Educational Initiative (CIEI) to improve performance. It is focused on identifying proposed outcomes, ensuring the dimension of actual performance and recognizing responsibility for using this information as the foundation for creating changes to accomplish projected outcomes. Reporting includes comparing existing results to intended objectives while planning for continuous improvement and performance trends over time.

It is an essential factor of the principles of our university to validate the outcomes of our research and educational programs systematically. To realize our aims, at this point, UPRM will report on the evolution and progress of our research. This annual document intends to illustrate the types of research activities and processes that UPRM has in place in responding to stakeholders' concerns; and presents information about how UPRM is advancing in its research mission.

## **RESEARCH AND DEVELOPMENT CENTER**

The vision of the Research and Development Center at the Mayagüez Campus of the University of Puerto Rico (UPRM) is to be the institution preferred by academia, government and the private sector for conducting research and development in Puerto Rico. To pursue this vision, its mission is to stimulate, manage, and provide a strategic direction to Research and Development activities at UPRM. Its aim is to create and develop a scientific, technological and entrepreneurial ecosystem to serve the community, the nation, and the world.

Aside from managing the physical infrastructure that supports Research and Development activities, the Center works towards the procurement of external funds for the operation and implementation of the strategic plan, and administers these funds in compliance with local, state, and federal regulations. Consistent growth over the last six years has shown almost a one hundred percent (100%) increase in the acquisition of external funds, and the future looks even brighter. The Center is responsible for the dissemination of these Research and Development activities to the academic community as well as to the public community.

**Dr. Fernando Bird-Picó**  
Director  
email: [fbird@uprm.edu](mailto:fbird@uprm.edu)



## **AGRICULTURAL EXPERIMENT STATION**

The College of Agricultural Sciences is especially proud of being the center of excellence for Tropical Agricultural Research within the Land-Grant College and University System in the Caribbean. Its mission is to foster competitive and sustainable agricultural production through technological innovation and the development of cutting-edge production technologies.

People at the College of Agricultural Sciences regard its vision of shaping an increasingly competitive agricultural producer as a labor that must perfectly integrate teaching, extension, and research. The aim of the College of Agricultural Sciences is to use the Experiment Station, the Extension Service, and their academic programs to promote economic and social development through a viable and vibrant agricultural sector. The faculty and researchers believe and recognize the multifunctional nature of agriculture. They view agriculture in the twenty-first century as: a protector of environmental resources; a sentinel for a healthy and prosperous rural way of life; a source of panoramic delight and soul enriching cultural experiences for our people; as well as a source for employment. In essence, the vision of the College of Agriculture is to be a vital force for nurturing economic development in harmony with the conservation of our natural resources and with the protection of the fragile tropical environments of Puerto Rico.

**Dr. John A. Fernandez Van Cleve**  
Dean and Director  
<http://www.uprm.edu/agricultura/>





## RESEARCH HIGHLIGHTS

### AGRICULTURAL SCIENCES

Technological innovation and the development of cutting-edge production technologies are at the core of the College of Agriculture's research programs in Tropical Agriculture. Each year, students and faculty from the Departments of Agronomy and Soils, Agricultural Engineering, Agricultural Economics and Rural Sociology, Animal Sciences, Horticulture, and Crop Protection carry out over 200 research projects using federal and state funding. The College's investment in agricultural research averages \$22 million per year, a third of which comes from USDA formula and competitive sources.

Current research is focused on nine strategic areas: Natural Resources & the Environment, Plant Sciences, Animal Sciences, Pest Management & Biological Control, Engineering and Biosystems, Food Products, Agricultural Economics, Human Nutrition, and Rural Sociology. Given the great volume and complexity of our creative work, the publication of scholarly research is a top priority at the College, with over 140 publications per year many in peer-reviewed journals of international stature. The College is also proud to sponsor the 90 year-old *Journal of Agriculture of the University of Puerto Rico*, an internationally acclaimed source of technical and scientific information about tropical agriculture. The College also serves as host to several important professional societies, such as: the *Caribbean Food Crops Society*, an international association of Caribbean agricultural scientists; and the '*Sociedad Puertorriqueña para las Ciencias Agrícolas*'.

Most research in the College of Agriculture is conducted under the support of the Agricultural Experiment Station (AES). Funded in 1910, the AES currently has 80 full or part-time research scientists working in six agricultural research stations and two Research Centers spread throughout Puerto Rico. Close cooperation and integration exists between the AES and its sister units: the Agricultural Extension Service and Academic Programs to carry out the College's research, teaching and extension missions. In addition, the AES maintains excellent collaborative ties with research partners in USDA, U.S. EPA, the Puerto Rico Department of Agriculture, the P.R. Environmental Quality Board, the Universities of Florida, Iowa, Virgin Islands, and Guam, along with collaborators from other prestigious national and international higher-learning institutions.

Graduate and undergraduate research is a rapidly growing segment of the College's research portfolio. Currently, over 200 graduate and undergraduate students participate in the College's research program, and many are financially supported through institutional research assistantships and fellowships. Recently, the College of Agriculture created the competitive '*Arturo Roque Undergraduate Research Fellowship Program*', which provides achieving undergraduate students with research funding and a stipend to stimulate interest amongst our students in creativity and innovation through agricultural research.

## ARTS AND SCIENCES

## RESEARCH HIGHLIGHTS

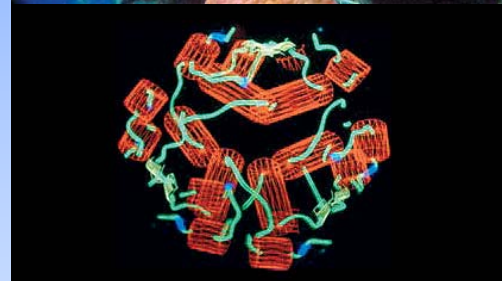
The distant sounds of far away pulsars, the beauty and usefulness of thin films, the work, life and times of Don Miguel de Cervantes, the ecology of coral reefs, the complexity of mathematical models, protein and molecular visualization, the promise of nanotechnology, the future of biotechnology and the whims of human behavior are but a handful of the rich diversity of research areas of the College of Arts and Sciences.

Arts and Sciences is the College with the largest portfolio of funded research at the University and the highest numbers of patents, mostly from the Physics Department. Under the rubric of research, we include scientific investigations, creative work, and innovative teaching projects, including assessment. Most of our funded efforts are in the following thrust areas: Science and Mathematics Education, Detection of Explosives, Environmental Sciences, Biotechnology, Ecosystems and Conservation, Ocean Processes, Nano-technology and Advanced Materials, Human Behavior and Energy. Our researchers, faculty, graduate and undergraduate students are at the forefront of research in areas such as: tsunamis, nanotechnology, proteins, oceanic processes, bio-markers, coral reefs, applied economics, literature of the diaspora, disasters, monitoring of seismic activity, biodiversity and physical oceanography.

Our recent dramatic growth in funded research is mostly due to the efforts of the Chemistry Department, and the Department of Marine Sciences, the first Ph.D. program on campus, and the host of the Coral Reef Ecosystem Studies Program (funded by NOAA), and the Caribbean Coral Reef Institute. Our College is leader in educational efforts in Science and Mathematics, with programs such as: Science on Wheels, Global Learning and Observation to Benefit the Environment and the Alliance for Learning in Math and Science.

Arts and Sciences builds its research portfolio on the tenet that research is an essential component of the academic experience of our students. For that reason we developed a number of programs for the mentorship of undergraduate and graduate students in research.

The booming activity at our centers features links and partnerships with other departments, colleges, universities, industry and government agencies in the pursuit for excellence in multi-disciplinary and interdisciplinary efforts in scientific research, education and outreach. Key research centers include: Center of Biomedical Research Excellence, Center for Applied Social Research (CISA), Molecular Modeling and Visualization Center, Chemical Imaging Center, Center for Chemical Sensor Development for Detection of Explosives, Center for Computational Sciences, Center for Ethics in the Professions, Computational and Statistical Learning for Knowledge Discovery.





## RESEARCH HIGHLIGHTS

### BUSINESS ADMINISTRATION

The College of Business Administration exists to develop an ethical professional for the business world who is able to make significant contributions to enterprises or to create a new business. We develop research and dissemination activities focused on the needs of Puerto Rico and the Caribbean.

Our research activities are mostly related to entrepreneurial issues, such as: financing, community development, education, creativity and innovation. Other research initiatives are geared to statistical education and ethical issues. Some of the research work has been presented by our faculty at international conferences. Graduate students are highly encouraged to perform research work with faculty support.

Our main goal is to reach accreditation by the Association to Advance Collegiate Schools of Business (AACSB). To accomplish this initiative, a new state-of-the-art building of 125,000 square feet will house several centers that will support our mission and all efforts toward accreditation:

1. A **Research Center** furnished with high tech equipment will allow access to sophisticated databases and research resources, comparable with those existent in top business schools in the United States. The Center's mission is to encourage and support the creation and disclosure of all research initiatives of our faculty and graduate students. Among the Center's outcomes, we expect to have research work published in well-known journals.
2. The **Business Center** will be the place to encourage the entrepreneurial spirit. The Center will help to channel, through industry support, marketable business ideas from students. The Business Center will provide high tech equipment to help students in the creation and development of their own business.
3. A **Technology Based Entrepreneurship Center** will provide a means to encourage entrepreneurial creativity and innovation through business ideas based on technology. Once an idea turns marketable, the Business Center might ease the creation and development of the new business.

## ENGINEERING

## RESEARCH HIGHLIGHTS

Research and Development at the undergraduate and graduate levels is a critical component of the College of Engineering at the University of Puerto Rico at Mayagüez (UPRM). It provides students with unique experiences in the latest state of the art developments. During the last two decades the College of Engineering has evolved from a traditional teaching and community service emphasis to a balanced portfolio that also includes a strong research component. Research funding has increased to an approximately 10 million dollars per year level. Over 400 graduate students and 1,000 undergraduate students participate in research and development projects every year.

During the last ten years the external Research and Development funding at the College of Engineering increased at a 25% compounded growth rate. The department of Electrical and Computer Engineering has been instrumental for this growth. The present research projects at the College of Engineering are divided into five major areas: Environmental, Energy/Power, Infrastructure, Climate Change and Information Technology. These areas, in addition to Bioengineering and Materials, were designated as strategic at the College of Engineering. The latter two were added based on the funding level opportunities that are expected for these areas in the near future.

One of the most important components in the research activities at the College of Engineering is the existence of several centers that foster a research culture between professors, departments, students and research support staff. Some of these include:

- Collaborative Adapting Sensing of the Atmosphere
- Program in Research in Computing and Information Sciences and Engineering
- Center for Power Electronics
- Water Resources Research Institute
- Civil Infrastructure Research Center
- Transportation Technology Transfer Center
- UPRM Model Factory

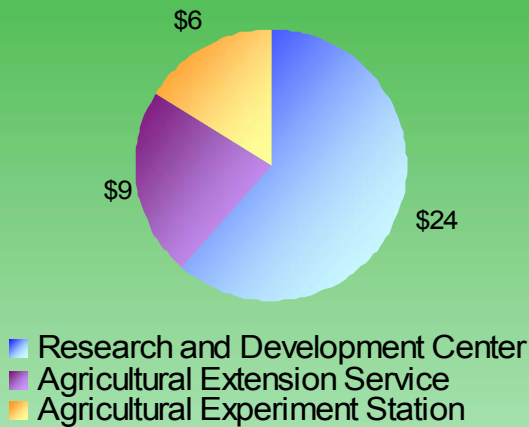
Most of these centers are multidisciplinary and have close interactions with the industrial sector. They have been an integral part of the level of growth in research activities at the College of Engineering.

During the next five years, the Associate Dean of Engineering for Research Office will focus on enhancing and facilitating multidisciplinary research activities not only among the departments of the College of Engineering but also across other colleges. This will include not only expanding and refocusing the administrative support infrastructure but also developing a research portfolio that establishes strategic areas consistent with the mission and direction of the UPR.



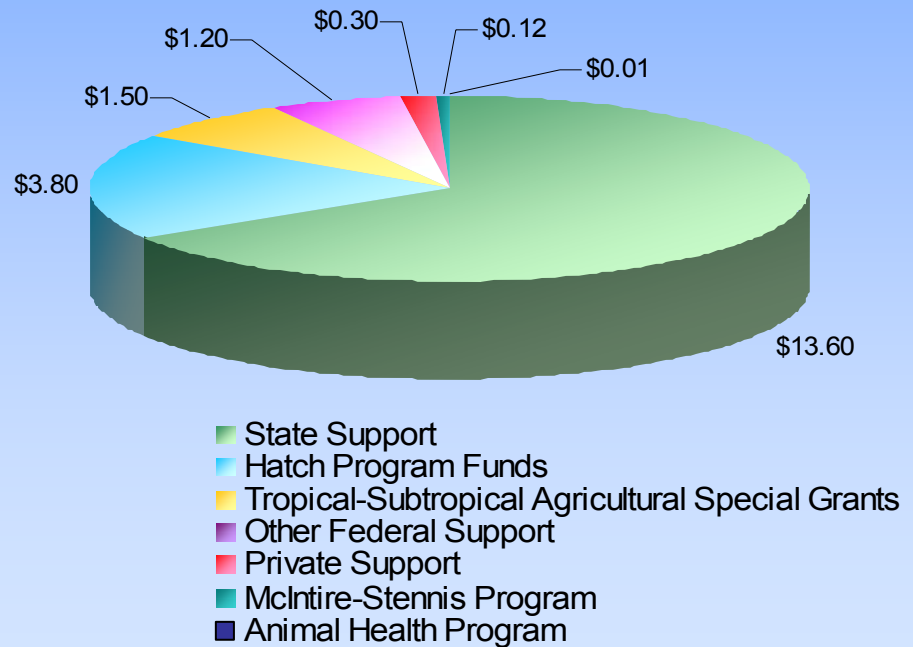
## FACTS AND FIGURES 2003 – 2004

**External research funds 2003-2004  
(in millions of dollars)**



*There are 145 research projects sponsored by the Agricultural Experiment Station.*

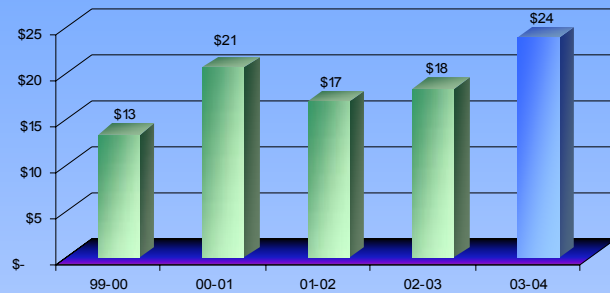
**Research funds obtained by the College of Agricultural Sciences, including the Agricultural Extension Service and the Agricultural Experiment Station (in millions of dollars)**



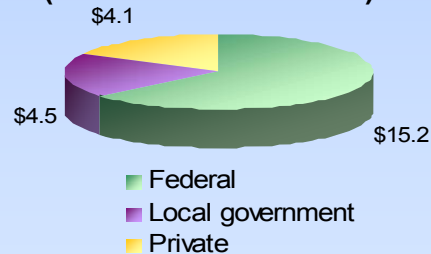


## FACTS AND FIGURES 2003 – 2004

### Fiscal Year Distribution of External Funding received by Research and Development Center (in millions of dollars)



### Sources of External Funding received by Research and Development Center (in millions of dollars)



### Main Research Sponsors

#### Federal Agencies

- Department of Defense (DOD)
- Environmental Protection Agency (EPA)
- National Aeronautics and Space Administration (NASA)
- National Institutes of Health (NIH)
- National Oceanic and Atmospheric Administration (NOAA)
- National Science Foundation (NSF)
- United States Department of Agriculture (USDA)
- United States Department of Energy (USDOE)
- United States Department of Transportation (USDT)

#### State Agencies

- Aqueduct and Sewer Authority (AAA)
- Department of Agriculture (DA)
- Department of Education (DE)
- Department of Natural Resources (DRN)
- Department of Transportation (DOT)

#### Private Organizations

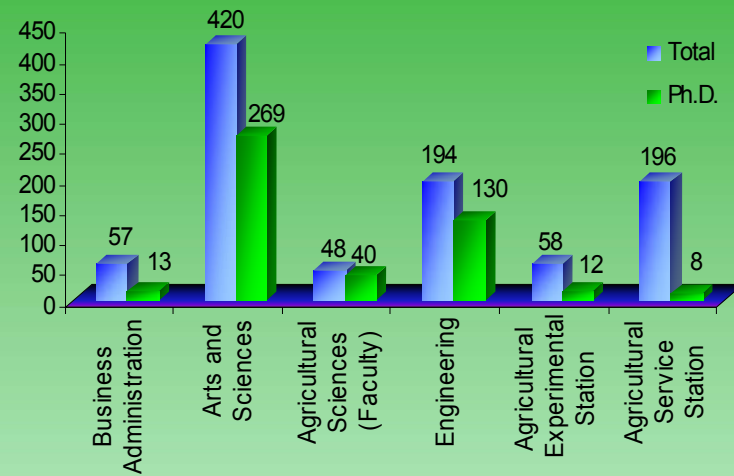
- Abbot
- Amgen
- Baxter
- General Motors
- Hewlett Packard
- Johnson & Johnson
- Lilly del Caribe
- Medtronic
- Merck, Sharp, Dohme
- Microsoft
- Texas Instruments
- United Technologies

## FACTS AND FIGURES 2003 – 2004

**Top Ten Departments Awarded External Funding 2003-04**

Rank	Department	Amount
1	Electrical & Computer Engineering	\$ 4,357,367
2	Marine Sciences	\$ 4,319,778
3	Chemistry	\$ 3,907,011
4	Civil Engineering	\$ 2,852,298
5	Sea Grant	\$ 2,131,289
6	Mathematics	\$ 1,933,558
7	Physics	\$ 1,428,064
8	General Engineering	\$ 1,398,902
9	Biology	\$ 1,362,163
10	Chemical Engineering	\$ 1,060,450
	<b>Total</b>	<b>\$24,750,885</b>

**Ph.D. faculty 2003-2004**



**Creative Endeavors**

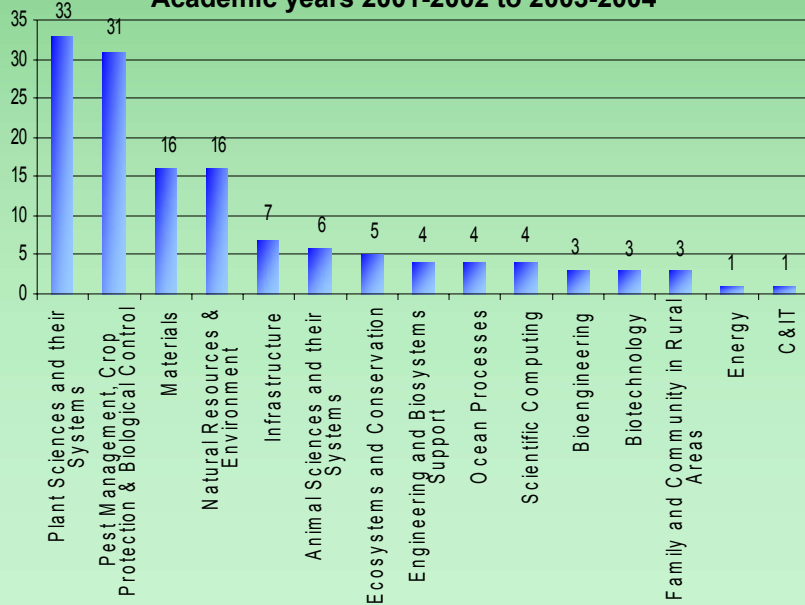


## AWARDS AND DISTINCTIONS

- *Presidential Early Career Award for Scientists and Engineers*
- *2004 Department of Agricultural Honor Award for Protecting and Enhancing the Nation's Natural Resource Base and Environment.*
- *Distinguished Professor Award.*
- *Bert and Lucy Williams Student Achievement Award.*
- *NSF Career*
- *Walter Fee Outstanding Young Power Engineer Award*
- *NASA Faculty Award for Research*

## PUBLICATIONS

**Peer Reviewed Publications  
Academic years 2001-2002 to 2003-2004**



## PATENTS

Method for making beam splitters and partially transmitting normal incidence mirrors for soft x-rays (No. 5080739)

Tunable gamma ray source (No. 5274689)

Method and apparatus for removing material from a target by use of a ring-shaped elliptical laser beam and depositing the material onto a substrate (No. 5405659)

Unipolar blocking method and apparatus for monitoring electrically charged particles (No. 5475228)

Lens for depositing target material on a substrate (No. 5557471)

Organic crystalline films for optical applications and related methods of fabrication (No. 5746823)

Long persistence blue phosphors (No. 6117362)

Organic crystalline films for optical applications and related methods of fabrication (No. 6198530)

Phosphors with long persistent green phosphorescence (No. 6267911)

Apparatus and method for pulsed laser deposition of materials on wires and pipes (No. 6534134)

Organic crystalline films for optical applications and related methods of fabrication (No. 6608205)

Sampling Probe (No. 6644137)

## RESEARCH CENTERS AT UPRM

- Beef Cattle Group: <http://www.uprm.edu/wciag/anscience/gtbc/index.html>
- Center for Applied Social Research (CISA): <http://www.uprm.edu/socialsciences/cisa.htm>
- Center for Chemical Sensor Development for Explosives: <http://academic.uprm.edu/ccsde/>
- Center for Computing Research and Development (CECORD): <http://mayaweb.upr.clu.edu/cecord/cecord.html>
- Center for Hemispherical Cooperation in Research & Education for Engineering and Applied Sciences (CoHemis): <http://www.ece.uprm.edu/cohemis/>
- Center for Internet Enhanced Teaching: <http://www.uprm.edu/socialsciences/ceci.htm>
- Center for Power Electronics Systems (CPES): <http://cpes.vt.edu>
- Center for Subsurface Sensing and Imaging System (CenSSIS): <http://larsip.uprm.edu/~censsis/>
- Civil Infrastructure Research Center (CIRC): <http://ce.uprm.edu/>
- Climate Change Studies in the Caribbean (NASA-EPSCOR): <http://www.cmg.uprm.edu/>
- Collaborative Adapting Sensing of the Atmosphere (CASA): <http://casa.ece.uprm.edu>
- Community Development University Institute: [www.uprm.edu/comunidades](http://www.uprm.edu/comunidades)
- Computer Aided Instructional Delivery Laboratory: [http://civil.uprm.edu/html/LABORATO/CAIDEL\\_L.HTM](http://civil.uprm.edu/html/LABORATO/CAIDEL_L.HTM)
- Coastal Training Program (COSTAS): <http://ctp.uprm.edu>
- Food Safety Learning Institute of the Americas: <http://www.uprm.edu/agricultura/cita/>
- Heat and Mass Transfer Research Laboratory (HMTRL): <http://mayaweb.upr.clu.edu/engineering/inme/heat/>
- High Energy Physics: <http://charma.uprm.edu/index2.html>
- Hispanic Studies books: <http://www.uprm.edu/hispanicos/>
- Industrial Biotechnology Learning Center: <http://www.uprm.edu/biotech/lcen.html>

## RESEARCH CENTERS AT UPRM

- Isla Magueyes Laboratories and Field Station: <http://cima.uprm.edu/facilities/index.html>
- Laboratory for Applied Remote Sensing and Image Processing (LARSIP): <http://larsip.uprm.edu/>
- National Oceanic and Atmospheric Administration - Cooperative Remote Sensing Science and Technology Center: <http://ece.uprm.edu/noaa-crest/>
- Partnership for Spatial and Computational Research (PaSCOR): <http://www.ece.uprm.edu/pascor/>
- Program for Research in Computing and Information Sciences and Engineering (PRECISE): <http://precise.ece.uprm.edu/>
- Protein Research Center: <http://cobre2.uprm.edu/>
- Providing Resources Of Major Impact in Science Education (PROMISE): <http://www.uprm.edu/promise/>
- Puerto Rico Transportation Technology Transfer Center: <http://civil.uprm.edu/html/centers.htm>
- Puerto Rico and Virgin Islands Climatology Center: <http://cima.uprm.edu/>
- Puerto Rico Water Resources Research Institute (PRWRI): <http://mayaweb.upr.clu.edu/rumhp/prwri/>
- Research Instrumentation Center: <http://www.uprm.edu/wquim/>
- Sea Grant Program: <http://seagrants.uprm.edu/>
- Scientific Computing: [http://www.math.uprm.edu/~dbollman/SCIENTIFIC\\_COMPUTING/lab/index.html](http://www.math.uprm.edu/~dbollman/SCIENTIFIC_COMPUTING/lab/index.html)
- Seismic Network: <http://redsismica.uprm.edu/english/>
- Tropical Center for Earth and Space Studies (TCESS): <http://tcess.uprm.edu>
- Tsunami Warning and Mitigation Program: <http://poseidon.uprm.edu/>
- UPRM Model Factory: <http://ininweb.uprm.edu/index.asp>

## THE FUTURE

### ***Biotechnology Center for Research and Bioprocess Training***



Promote research in order to improve and develop manufacturing processes in the areas of cellular culture and protein purification. It will be a resource to provide training to personnel working in the pharmaceutical and bio-technological industry. This center will contribute to the socio-economic development of Puerto Rico.

### ***Caribbean Coral Reef Institute***

Define and understand causes and effects of coral reef degradation in order to provide information and tools to stop and revert the damage of these ecosystems.



### ***Agroindustrial Innovation and Technology Center***



Provide the needed infrastructure for the technological and scientific development in the production of safe and nutritious food for Puerto Rico.

Other centers that are in process of development are the Oceanography Building and the Bio-optic Oceanography Building.

UPRM recently established a task force committee with the objective of designing a methodology to measure research activity and identify focus areas. The members of this committee are the Associate Deans for Research in each Faculty. The strategic research areas preliminary identified are: Environmental; Infrastructure; Materials; Climate Changes; Science and Math Education; Plant Sciences and their Systems; Pest Management, Crop Protection and Biological Control; Energy; C&IT; Ecosystem and Conservation; Biotechnology; Animal Sciences and their Systems; Bioengineering; Homeland Security; Natural Resources and Environment; Ocean Processes; Human Behavior; Engineering and Biosystems Support; Health; Entrepreneurship; Scientific Computing; Agricultural Economics, Markets and Policy; Seismic; Family and Community in Rural Areas; Pharmaceutical Products and Processes; Astrophysics; Food Products: Development, Processing, Quality and Delivery; Biomedical and Human Nutrition and Food Safety.

## GRADUATE STUDIES

The Mayagüez Campus of the University of Puerto Rico is an institution of excellence that attracts the best students of Puerto Rico and many Latin American countries. We have 1100 graduate students (30% international) participating in 25 graduate programs in Agriculture, Arts and Sciences, Business Administration, and Engineering. Doctoral programs are being developed in Biotechnology, Electrical Engineering, Mechanical Engineering, and Tropical Agriculture.

The Office of Graduate Studies implements regulations, provides guidance, prepares statistical reports, and develops a variety of projects, such as the initiative to publish all theses and dissertations on the Internet. Our website is a main component of our efforts; its goal is to advise prospective students, help active students facing the challenge of a quality education, and maintain contact with alumni who cherish their stay in Mayagüez and wish to remain linked to our institution.

**José A. Mari Mutt**  
Director  
grad@uprm.edu



The University of Puerto Rico at Mayagüez has a long history of excellence in graduate education. We have an assistantships program that benefits over 70% of the students, while they train to excel as teachers and researchers. Teaching is conducted in English and Spanish, providing an excellent opportunity to learn another language. Our website provides access to the application for admission, the graduate catalog, updated information about our programs, and links to all departments. We look forward to receiving your application!

<http://grad.uprm.edu>

### Master Programs

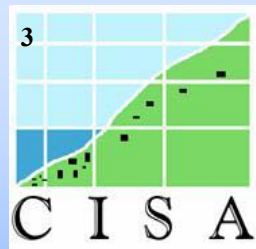
Agricultural Economics  
Agronomy  
Soils  
Agricultural Education  
Animal Husbandry  
Biology  
Business Administration  
Chemical Engineering  
Chemistry  
Civil Engineering  
Crop Protection

Electrical and Computer Engineering  
English  
Food Science and Technology  
Geology  
Hispanic Studies  
Horticulture  
Industrial Engineering  
Marine Sciences  
Mathematics  
Mechanical Engineering  
Physics

### Ph. D. Programs

Applied Chemistry  
Chemical Engineering  
Civil Engineering  
Computing and Information Sciences and Engineering  
Marine Sciences





## MULTIDISCIPLINARY RESEARCH CENTERS

*Knowledge + Creativity + Teamwork = Innovation*

1. **COSTAS** - Integrates a multi-disciplinary approach to higher learning and promote its application to environmental science and sustainable development.
2. **TCESS** - Conducts research and trains students in areas of interest to NASA strategic enterprises.
3. **CISA** - Promotes and coordinates the practical application of the expertise of the faculty of Anthropology, History, Political Sciences, Psychology and Sociology, for identification, analysis and mitigation of those problems and situations related to behavior, perceptions and social attitudes.
4. **UPRM Model Factory** - Integrates modern equipment, materials and people into a manufacturing system. Its mode of operation is through interdisciplinary working teams from several engineering and business disciplines.
5. **Community Development University Institute** - Provides research-participative action experiences to students of different faculties and departments. These initiatives strengthen the integral formation of students while accomplishing the mission of bringing the university to the community.
6. **CASA** - Revolutionizes the way we detect, monitor and predict atmospheric phenomena by creating a distributed collaborative adaptive sensor network that samples the atmosphere where and when end user needs are greatest.
7. **ConSSIS** - Develops information extraction algorithms for HIS data by optimal integration of physical models with the available spatial and spectral information.
8. **Sea Grant** - Promotes the conservation and sustainable use of coastal and marine resources in Puerto Rico, the U.S. Virgin Islands and the Caribbean region.

University of Puerto Rico at Mayagüez  
 PO BOX 9000  
 Mayagüez, PR 00681 -9000  
 787 - 832 - 4040  
 www.uprm.edu

Contents: Dr. Omell Pagán Parés.

Graphic Art: Eng. Nancy Méndez Vélez and Dr. Omell Pagán Parés

Photography: Mr. Carlos Díaz

