

**STRATEGIC PLAN FOR THE DEPARTMENT OF BIOLOGY**  
**Faculty of Natural Sciences**  
**University of Puerto Rico**  
**Rio Piedras Campus**  
**2007-2017**

**Approved by the Department 14 December 2006**

**MISSION**

The Department of Biology of the Faculty of Natural Sciences offers a quality education at undergraduate and graduate levels in basic and applied areas of biology that guides students toward the development of an integral vision of knowledge through academic and research opportunities. Our mission is to develop students in specialties in Biology with the necessary competence to pursue graduate studies or become professionals in the labor force; to position graduates at the vanguard of their field with the capacity to communicate effectively; to discover and apply knowledge scientifically; to respond to the demands of a changing society by arriving at solutions to biological problems both locally and globally; and to foster an academic and institutional environment that foment a community of learning and research.

**GOAL 1 – RESEARCH**

**Achieve innovative and continuous generation of knowledge through thoughtful and creative research that will contribute to the advancement of Biology.**

**Objectives**

- Strengthen research and creative thinking in Biology
- Carry out research that will contribute to knowledge in biological sciences with particular emphasis on eight intersecting areas: Ecology, Systematics and Conservation; Neuroscience; Cellular and Molecular Biology; Behavior; Neuroscience; Development; Microbiology; Evolution and Genetics; Science Education.
- Reinforce links and develop collaborative projects in research with other departments and programs within campus and with other universities and research centers in Puerto Rico and around the world
- Disseminate knowledge generated by our faculty, students, and off-island collaborators through high-quality peer-reviewed publications.
- Effectively communicate our research findings with society in general.
- Create an environment that is conducive for stimulating new discoveries.

**Strategies of action**

- Develop, upgrade and maintain research and communications infrastructure.
- Maintain research time as part of the regular academic load of tenured and tenure-track faculty members.
- Expect all faculty recruitment to add depth and breadth in research activities in the Department.
- Advocate a grants management office.
- Encourage and facilitate interdisciplinary research projects within campus and the university system and with other universities and research institutions world-wide.
- Promote the use of all common facilities to encourage greater academic interaction with other institutions and the business community.
- Use popular media and government channels to educate a broader public concerning biological progress spanning issues relevant to the quality of life of individuals to the functional health of the planet.
- Periodically assess our objectives and strategies for their implementation.

### **Implementation of strategies**

Our strategies are designed to facilitate our goal to achieve creative and productive research that will contribute to the advancement of Biology. Research within the Department of Biology covers much of the breadth of the field, from molecules and cells to ecosystems and landscapes, applied to basic science, and science education. Funding for research programs of Biology faculty members comes from external funds, primarily NIH and NSF, and from institutional funds much of which are negotiated to facilitate and amplify funded projects. Our major research areas and their intersections are the following:

### **Research Thrust Areas**

***Cellular and Molecular*** -- The Biology Department has identified the area of Cellular/Molecular Biology as an area for future growth. Presently, researchers in this area are interested in various aspects of gene expression, including the identification and characterization of genes and their products associated with particular biological processes as well as the mechanisms that regulate mRNA and protein levels. Others use molecular biological techniques for population analyses, species characterization, and applications to microbial and ecological studies. Investigators share common equipment facilities such as cell tissue culture, microarrays, confocal microscope, gene sequencing and genomics, proteomics among others. This group has strong interactions with other scientists on the island particularly with those in the Basic Science departments at the University of Puerto Medical School and with colleagues on the mainland. Students trained in this area are well prepared to participate in the emerging biotech industry of Puerto Rico.

***Behavior*** -- Behavioral studies are concerned with what animals do in their environment, and are therefore a link between the nervous system and the ecosystem. Some of our faculty members dissect brain mechanisms of behavior while others investigate behavioral components using traditional model organisms. Integrative studies extending from field observations to molecular mechanisms of behavior are carried out on non-traditional model organisms. Increasingly all behavioral work in the department is being examined in an evolutionary context. Behavioral researchers in our department are part of a broader network in Puerto Rico that includes scientists at the Institute of Neurobiology and Caribbean Primate Center.

***Development*** -- Several investigators in the Department of Biology share a common interest in studying developmental processes, in particular the identification of genes and proteins that affect development. Other areas of interest include the embryogenesis and regeneration of the muscular and nervous systems, the genetics of aging and studies on differential gene expression during development.

***Neuroscience*** -- The Biology Department has an active group of researchers with interests in the field of Neuroscience. The group encompasses all aspects of the neurosciences, from the molecular to the organismal level. Particular strengths are in areas of ion channel molecular structure-function relationships, developmental neuroscience and studies in higher brain functions such as learning and drug addiction. Investigators share common equipment facilities such as, animal care facilities, cell culture, microarrays, confocal microscope, gene sequencing among others. Similarly, they have joined efforts to successfully obtain funding from NSF and NIH. The neuroscience group in the Biology Department maintains strong interactions with other scientists on the island (particularly with those at the Institute of Neurobiology and in the basic science departments of the University of Puerto Rico Medical Sciences campus) and on the mainland

***Microbiology*** -- The Department of Biology has a dynamic group of researchers examining the impact of soil use in the tropics on the soil microbiota and microbial quality of tropical waters, ecological and evolutionary interactions between mycorrhizal fungi and orchids, the microbial composition of specialized foregut structures in animals, and the genetic variability of gastric *Helicobacter pylori* strains. Collaborations with colleagues in other thrust areas, EPA scientists, and microbiologists at UPR-Mayaguez and the UPR-Medical Sciences campuses add depth and breadth to these research programs.

***Ecology, Systematics and Conservation*** -- We have a diverse group of researchers addressing basic ecological, systematic and evolutionary issues concerning patterns and processes in aquatic, marine, and terrestrial tropical ecosystems with emphasis on the Neotropics. Ecologists work at population, community, ecosystem and landscape levels utilizing methodologies from global information systems to molecular techniques. The basic concepts are applied to create solutions for tropical forestry, conservation, restoration and bioremediation. Systematists employ traditional, phylogenetic and molecular techniques to examine taxonomic, evolutionary and phylogeographic problems in microbial, fungal, zoological and botanical systems. These studies are enhanced by close collaborations with scientists at UPR's Institute of Tropical

Ecosystem Studies, the USDA's International Institute of Tropical Forestry and Wood Products Laboratory.

***Evolution and Genetics*** – Lying at the intersection of all biological disciplines, including all those listed above, are evolution and genetics. Our faculty members study the patterns of evolution from the perspectives of history, diversity and geography. Some study the processes of evolution from ecological, developmental and genetical viewpoints. Others examine the causes and consequences of gene expression to ask basic questions of natural systems while our molecular biologists integrate genetics in their studies of biomedical issues. Methods of study run the gamut from morphological to molecular, using traditional to novel systems while asking basic to applied questions. Considerable cross-collaborations occur with the ecology, systematics and conservation thrust area.

***Science Education*** -- The Department of Biology has been enthusiastic about incorporating research into education, in keeping with the mission of the Department and the University. Several professors in our Department have been investigating how to increase student's conceptual understanding of biological concepts, and how to motivate them to participate in scientific research. One example is the Seamless Biology Classroom in which conference and laboratory instruction in Zoology and Botany are fully integrated.

### **Future Directions**

The operational model for the Department of Biology has been to maintain a balance among disciplines. To a large extent, the direction the Department takes is guided by the needs of both the undergraduate and graduate curricula yet much dialogue has centered on achieving a "critical mass" of investigators in a particular discipline. This is not just recasting the standard arguments to gain more colleagues in a particular area, but it is a real issue given the increasing need for multidisciplinary studies which necessitates collaboration among a group of researchers who have expertise in a diversity of techniques and sub-disciplines.

For the Department of Biology to remain at the vanguard of biological exploration and enhance the research status of the University, we will remain flexible in our approach to research as our strengths and weaknesses ebb and flow with the shifts in personnel that occur within the Department, Natural Sciences Faculty, and the local academic community. With constant changes in the manner by which the sciences are conducted and communicated on the global scale, the Department must be vigilant and responsive on a regular basis.

## **GOAL 2 – GRADUATE EDUCATION**

**Prepare Masters and Doctoral students in specialized biological areas with an integrative focus in fundamental and applied sciences, to solve immediate and emerging biological problems, particularly, but not exclusively, in the tropics using interdisciplinary approaches.**

### **Objectives**

- Aggressively recruit the best possible graduate students.
- Offer a sound and innovative curriculum in both fundamental and applied aspects of Biological Sciences.
- Create and maintain a core faculty representing a broad spectrum of disciplines.
- Provide and maintain an appropriate physical infrastructure and administrative organization necessary for all academic, administrative and research activities of the program.
- Facilitate interactions with the local and international scientific communities.

### **Strategies for action**

- Maintain an updated web site for both the Graduate Program and the Department.
- Send faculty to give seminars and attend graduate program “fairs” on the island and at national and international meetings.
- Send posters and brochures to specially targeted institutions.
- Offer specialized courses in Cell and Molecular Biology, Ecology, Systematics, Conservation, Evolution, Genetics, Neurobiology, Behavior, Microbiology and Developmental Biology.
- Maintain a novel course offering by evaluating the curriculum at regular intervals, frequently updating courses, and creating new courses as new issues arise and shifts in disciplines take place.
- Evaluate recruitment needs each year to either replace parting members, or to augment existing expertise.
- Evaluate faculty participation in the Graduate Program to maintain high standards of research productivity, mentorship and teaching.
- Develop and sustain firm alliances with national and international institutions and government agencies to facilitate collaborative efforts in research and graduate education.
- Support student participation at national and international professional and scientific meetings, publication of student research, and enrollment in workshops and courses offered by Organization for Tropical Studies and other organizations
- Increase availability of fellowships and assistantships by writing proposals to external funding sources that provide training programs in support of student research.
- Advocate competitive student services and stipend levels congruent with cost-of-living realities and graduate student standards across the nation.

### **Implementation of strategies**

The web site has been implemented and is under constant improvement. We update our brochures and posters to maximize accuracy of content and we regularly send them to institutions in this hemisphere. We need to more aggressively make our presence known in the

local media and local institutions by communicating our most exciting research accomplishments and graduate research opportunities.

The Department of Biology is strongly committed to support the development and training of students in academic fields related to our core areas. We offer an average 12 graduate courses per year, some of which are offered every other year. "Topics in Modern Biology" is a keystone course, which is offered each year and alternates between Cellular/Molecular Biology and Ecology/Systematics. The course is structured to highlight 8-12 world-renowned researchers who each provide a week of classes, seminars and workshops.

Courses are constantly being created or radically modified, and over a period of 5 years (2001-2006) twelve were added or changed while another twelve were either dropped or suspended. This process continues annually.

Every three years the Graduate Program Committee assesses the activity of each member of the Graduate Program and makes recommendations directly to the Professor, Department Director and the Personnel Committee.

The Director of the Department is an ad hoc member of the Graduate Program Committees so all discussion and decisions are communicated directly to him/her. The Director and Coordinators of the Graduate Program and Undergraduate Program meet periodically to assure communication across programs.

Input for recruitment strategies can be communicated directly to the Department Director during Program meetings or discussed during Departmental meetings.

The Graduate Program receives a budget from the Central Administration of the University of Puerto Rico for our Intercampus Ph.D. program. These monies are largely used to support student travel to present their work at national and international meetings and to participate in workshops and courses in the United States and other countries. With additional support from the Faculty of Natural Sciences, we maintain membership in the Organization for Tropical Studies and support students to attend their courses world wide.

We offer financial support to all our graduate students in the form of Teaching or Research Assistantships. We aggressively seek graduate student funding through individual grants and through participation in "group grants" such as NSF-CREST and NIH-RISE. We notify all students of funding opportunities and encourage them to apply for all of which they may qualify.

We fully support student petitions for improvement of services and stipend levels, and lobby the Administration for such improvements ourselves.

### **Future directions**

Evaluate recommendations of external evaluation committees and design strategies for their implementation.

### **GOAL 3 – UNDERGRADUATE EDUCATION**

**To prepare undergraduate students in biological science with the necessary competence to pursue graduate studies or become professionals in the labor force; to position graduates at the vanguard of their field with the capacity to communicate effectively; to discover and apply knowledge scientifically; to respond to the demands of a changing society by arriving at solutions to biological problems both locally and globally.**

#### **Objectives**

- Offer a solid base in Biology, with two tracks: integrative biology and molecular and cell biology.
- Develop mastery of written and oral expression in Spanish and English.
- Develop competency in the search and use of information.
- Develop expertise in Biology that provides the basis for continuous and independent learning through research, critical thinking and intellectual curiosity.
- Develop competent, responsible and ethical leaders committed to society.
- Provide and maintain an academic offering that responds to the changes in biology, science education and the community.
- Promote an institutional climate that foment dialogue and interchange of ideas among all components
- Provide appropriate physical infrastructure for field, laboratory and classroom learning experiences.

#### **Strategies for Action**

- Offer a sound and innovative curriculum in the two thrust areas fully integrated with other disciplines that will prepare students for graduate or professional studies and will enable them to enter the labor force.
- Create and regularly offer a broad spectrum of challenging undergraduate electives not only to add breadth and depth to student's academic experiences, but also to solidify their communication skills in English and Spanish.
- Develop mechanisms and opportunities to enhance student participation in postgraduate programs.
- Offer student participation on Undergraduate Committee.
- Recruit faculty to provide broader representation of tenured and tenure-track professors in undergraduate courses and in the academic and administrative affairs of the Department.
- Encourage and facilitate faculty initiatives to apply pedagogy that promotes student engagement in their own learning, conceptual understanding, and development of research skills through challenging laboratory experiences.

#### **Implementation of Strategies**

The new curriculum has been approved and now the courses are being described or redesigned. This is a continuously evolving process.

All faculty members are encouraged to offer core undergraduate courses as well as occasional electives. In this way, students have an opportunity to interact with a broad spectrum of faculty. We recruit temporary personnel to contribute across all levels of teaching, to provide fresh perspectives, meet demands as they arise, and to offer a broad spectrum of options for our students.

We seek funding from NSF, NASA, NIH, and non-government sources to improve infrastructure and learning opportunities.

Addition of an undergraduate student to the Undergraduate Program Committee requires approval at the Department level and will be placed on the agenda for a meeting in the near future.

A recruitment plan has been approved and has provided us with the flexibility to meet the shifting needs of all components to the Department's academic offerings.

#### **GOAL 4 – FACULTY**

**Faculty members of the Department of Biology will have the highest academic preparation and will be recognized in their respective areas by engaging in innovative research and teaching.**

##### **Objectives**

The Department of Biology will:

- add faculty to reinforce and amplify research thrust areas and academic offerings at both undergraduate and graduate levels
- recruit only faculty with the highest academic degree in their area.
- encourage faculty activities that result in the dissemination of their work to obtain international recognition for excellence in research and other creative endeavors.
- strive to perform the highest quality teaching, using creative techniques to engage students.
- expect and promote all faculty members to engage in teaching, research and other creative scholarly activities, and participate in department affairs and community services.
- expect faculty to seek external funding to enhance research and education.
- maintain a competitive yearly sabbatical program to encourage professional development and international collaborations.

##### **Strategies of Action**

- Help establish competitive salaries and adequate research facilities that will attract and retain well-established and promising faculty members.
- Attract and evaluate, through agile and effective recruitment, the best candidates according to the research and teaching needs of the Department.
- Recruit to meet the projected needs of departmental trajectories in basic or applied research and science education.
- Utilize available positions “plazas” to recruit tenure-track faculty and reduce the practice of utilizing such funds for temporary personnel.
- Promote faculty exchanges with peer institutions worldwide, and maintain an active presence of specialists from other universities and research organizations.

- Seek adequate space to provide research laboratories for each faculty member in which to conduct research and engage students in creative activities.

### **Implementation of strategies**

Closely work with UPR administration to improve faculty salary scales and improve existing facilities. Create attractive recruitment packages that provide adequate set-up, reduced teaching and enhanced salaries for the first year.

Actively seek external funding for research to provide additional salary compensation and improved laboratory facilities outside the resources of indirect cost allocations to the Faculty of Natural Sciences.

Recruit new faculty members according to the Department recruitment plan and by advertising in internationally recognized journals and electronic media. Evaluate faculty annually on the basis of merit as demonstrated in research, teaching, and service. Provide all new faculty members with the criteria for evaluation upon hiring and an established faculty “mentor”.

Actively seek funding for international collaborations, international scholar exchanges, hosting international symposia, and participating in international conferences.

Work closely with the UPR administration to create new, state-of-the-art laboratory space that will benefit all disciplines, and offer expertise during all phases to assist in realizing this goal.

Advocate a policy for salary enhancement based on merit.

### **GOAL 5. ADMINISTRATION**

**Develop and maintain an effective administrative structure that supports research, teaching, and community service.**

#### **Objectives:**

To encourage and maintain efficiency in our administrative processes both at our main offices and our managed facilities by attracting and maintaining qualified personnel; and

To prioritize Departmental human resources in accordance to our academic and research needs.

#### **Strategies of action:**

Develop and strengthen the administrative structure of the Department at all levels to ensure better continuity and efficiency in administrative processes.

Enhance interconnectedness among the Departmental units in Julio Garcia Diaz, Nuevo Ciencias Naturales, and Facundo Bueso.

Minimize bureaucracy insofar as possible by focusing on service to the faculty and students by relieving burdensome demands of administration.

Enhance or maintain the levels of excellence in our administrative processes.

### **Implementation of strategies:**

Produce a Departmental organogram so that the Departmental administrative structure is understood within the Department and the university community.

Develop a protocol that defines procedures and identifies resource persons for all issues that are related to facilities refurbishing, facilities maintenance, contracting, travel, and purchasing. Provide the protocols to all personnel of the Department and new hires.

Expand and optimize physical space options for teaching, research and administrative operations.

Actively advertise training and professional development programs for staff of the Department and provide the necessary release time and financial support to take advantage of these opportunities.

## **GOAL 6. INFRASTRUCTURE**

**Improve and expand facilities on and off campus to meet our goals for research, teaching, and public service that will enable the Department to fortify its academic reputation and position itself as a world leader in biological research.**

### **Objectives**

To upgrade research and teaching laboratories in Facundo Bueso, Julio Garcia Diaz and Nuevo Ciencias Naturales buildings.

Promote and improve Departmental common facilities including the Animal Care, Confocal Microscopy, Zoological Museum, Herbarium, Proteomics, Cell Tissue Culture and Microarray facilities as well as the Biology House in El Yunque and the Departmental boat.

Secure permanent space on campus and elsewhere to accommodate the current and anticipated needs of an expanding faculty, and increasing number of graduate students, postdoctoral fellows, and visiting professors.

### **Strategies and Implementation**

Take advantage of the current permanent improvement plan for the campus to obtain needed office and laboratory space for research, graduate students, teaching, and administration, including space in Plaza Universitaria and the Molecular Science building.

Actively seek internal and external funds for infrastructure improvements.

Include as matching funds infrastructure improvements for all new externally funded grants.

Develop a management plans for all common facilities of the Department.

Seek funding specific to teaching laboratory innovations that may include infrastructure improvements or an institutional match for them.