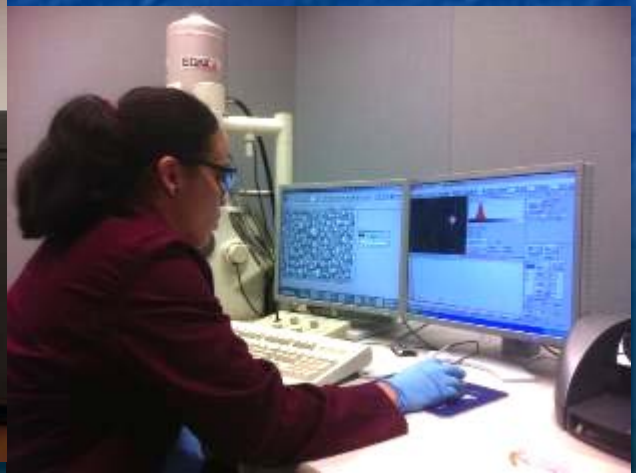
msrc
MOLECULAR SCIENCES
RESEARCH CENTER

Molecular Sciences Research Center (MSRC)
"UPR Translational Research"

Office of the Vice President for Research and Technology

Jose A. Lasalde-Dominicci, Ph.D.



UPR: Role in development of technological innovation and knowledge economy in PR

UPR is the major provider of:

- High caliber scientific, professional and intellectual resources, most with international recognition
- Advanced laboratory facilities for research and teaching as well as state of the art infrastructure and instrumentation
- Superior technical personnel and methodologies
- Institutional funds (matching funds, seed monies, etc.) for research and training projects in areas driving Puerto Rico's developmental initiatives
- Highly developed mentoring, and support for the advancement of junior research faculty and students in research programs

UPR Productivity: Publications, citations and institutional ranking

[According to the Web of Knowledge & SCIMAGO Institutions Rankings.]

- 2008-2012, UPR Published over 4,600 scientific papers.
- An increase of 211% since 2000.
- 88.1% of all publications in PR.
- ~50% of the publications were on the top 25% scientific journals.
- In 2012, there were 17, 378 citations of UPR scientific publications.
- UPR positioned:
  a) 1 in 11 institutions of higher learning in PR,
  b) 26 in Latin America,
  c) 53 in Iberoamerica (which include Spain and Portugal).
  d) 780 among the more than 3,000 universities in the world.

UPR PATENTS (APPROVED AND UNDER STUDY BY THE US PATENT AND TRADEMARK OFFICE)

Since 1998,

- 59 patents have been fully approved (of these 26 were obtained since 2008 and 7 in 2014)
- 11 patents were obtained in collaboration with other institutions; and
- 7 licensing agreements have been negotiated.

During the last five years, UPR submitted to USPTO:

- 124 invention disclosures and
- 108 patent applications.

UPR Investments in R&D : Comparatives based on NSF data

R&D expenditures for 2011 totaled $131 Millions

At **UPR :**

- Medical Sciences Campus invested $64 Millions (ranked 178)
- Mayagüez Campus invested $34 Millions (ranked 230)
- Río Piedras Campus invested $32 Millions (ranked 235)

Investments and results in US mainland comparable institutions

UCSF invested $109 Millions (in FY 2012); executed 42 licenses, created 3 startups, applied for 22 patents and was issued 11.

BYU invested $37Millions; executed 34 licenses, created 5 startups, applied for 62 patents and was issued 10.

UNC invested $28Millions; executed 20 licenses, created 3 startups, applied for 63 patents and was issued 9.

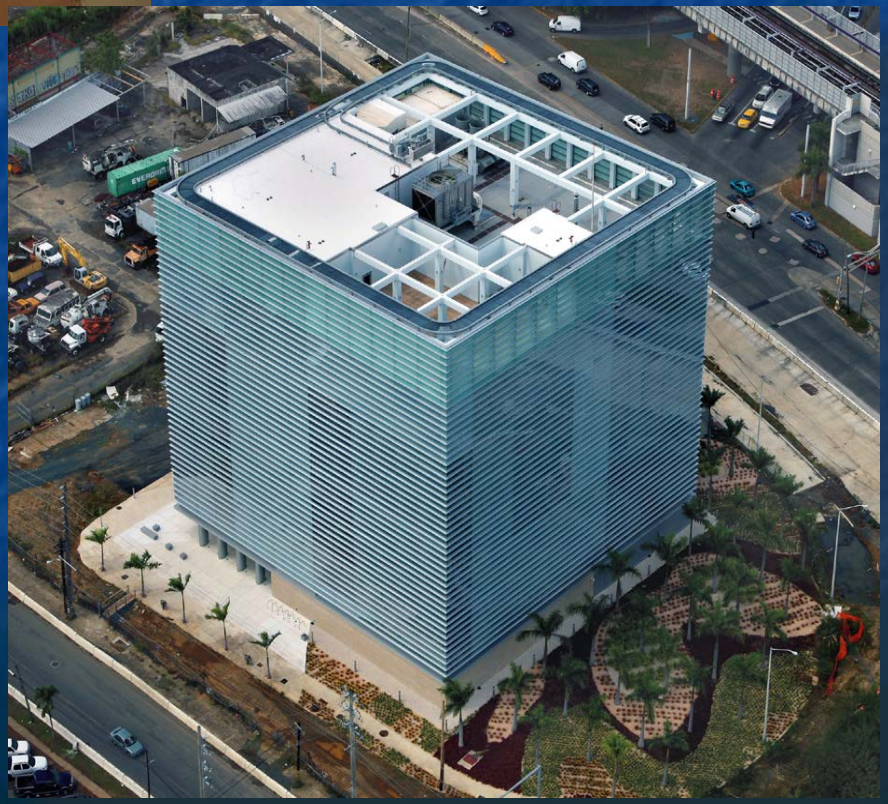
RECENT EFFORTS TO HARMONIZE OUR LEGAL SYSTEM WITH NEW ECONOMIC MODELS

- UPR has a clear vision in terms of its role as an entrepreneurial and innovation hub for Puerto Rico through tech transfer and commercialization initiatives.

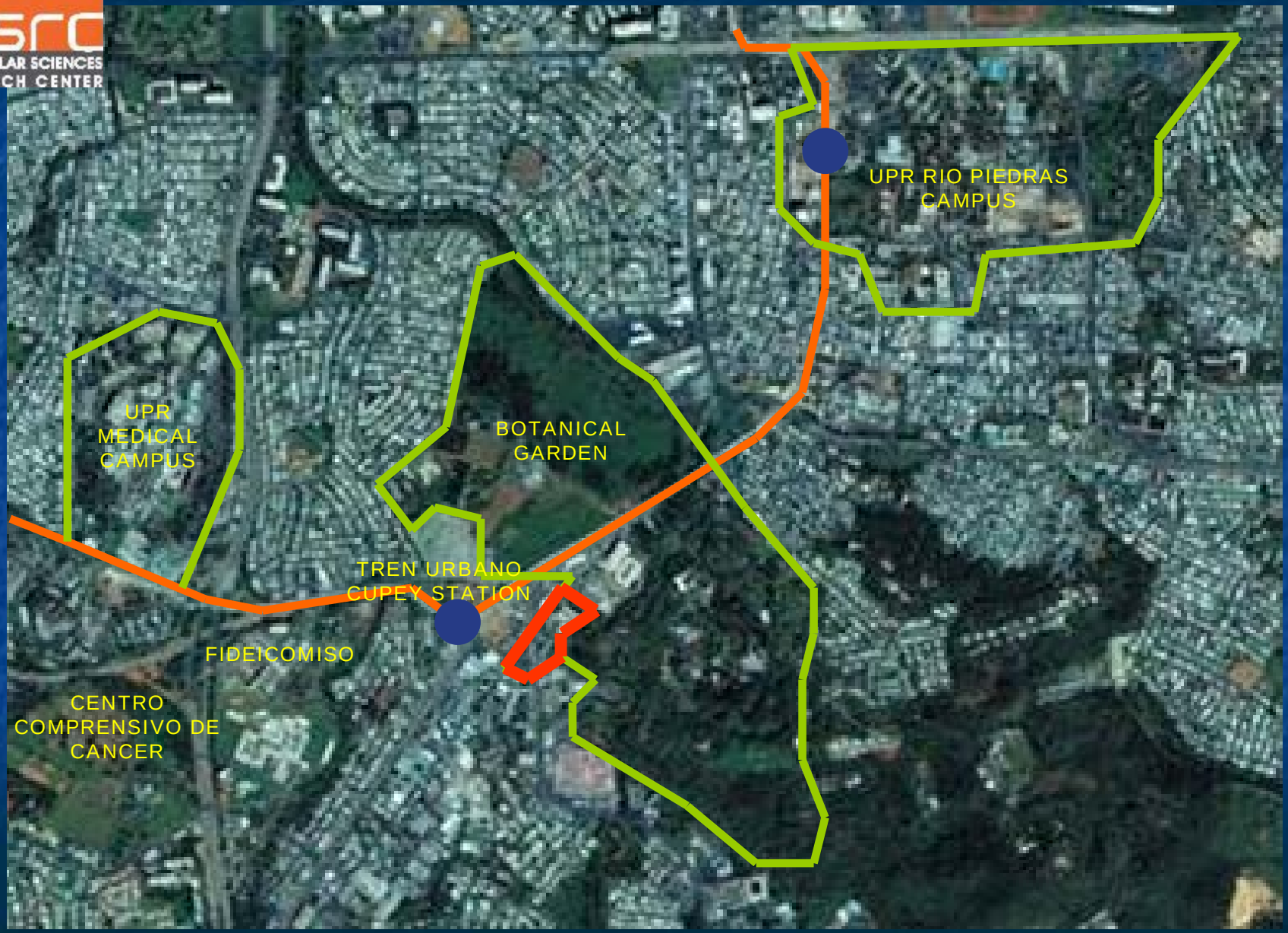
- However, it was only as recent as October 2010 that our Legislature enacted Law 150, a piece of legislation that finally allows for the active participation of UPR academics, professors, and researchers in the development of Intellectual Property (IP) and the commercialization of technology.

Molecular Sciences and Research Center

The UPR Molecular Sciences and Research Center is a 152,000 sq. ft. advanced research facility with laboratories conducting basic and translational biomedical research in the areas of protein structure and dynamics, molecular biology, genomics, proteomics, bioimaging, pharmacogenetics, and neurosciences. Inaugurated in 2011 it now houses over 300 researchers, students and technicians.



Anchored by three campuses of UPR



Mission

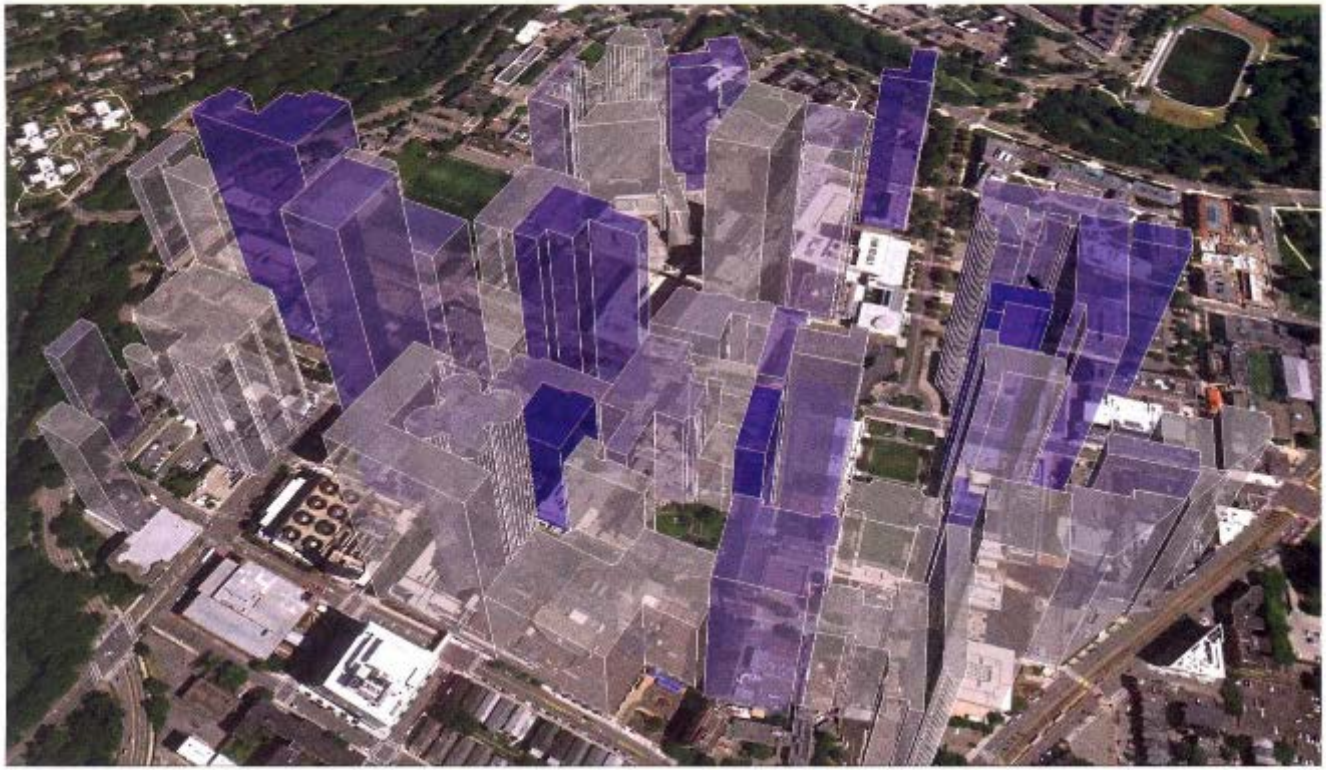
- The primary goal of the MSRC is to produce a significant **increase in competitively funded forefront scientific research by scientists at UPR**.
- The MSRC would generate the UPR System's **first multidisciplinary environment, designed to meet the needs of cutting-edge research** in Puerto Rico for the foreseeable future.
- The MSRC's **new research space design paradigm** features standardization, flexibility and adaptability, systems integration, and ease of sharing equipment and human resources.

Vision / Mission

Principles:

- Strengthen research infrastructure and research disciplines of tradition in PR as foundations of a **knowledge-based economy**.
- Bridge basic research disciplines with clinical research to **foster Translational Research** and **Technological Innovation**.
- Develop world-wide recognized **Research Centers in areas of Cutting-Edge Scientific Impact** through high level of intra- and inter-institutional collaborations.
- Develop partnerships and collaborations with industry.
- Enhance **UPR's intellectual property (IP) portfolio** and the commercialization of research inventions in PR.
- Enrich our society with an "**open research culture**" by exposing research activities, new technology, training opportunities and discoveries.

23/30 DECEMBER 2010 | VOL 468 | NATURE | 1011



A schematic of the Longwood campus of Harvard Medical School shows the mean number of publication citations originating from each building (height), and the proportion of publications in each building where first and last authors work (grey is low, blue is high). Statistically, bluer buildings are also higher.

BIBLIOMETRICS

Love thy lab neighbour

Getting closer to your collaborators boosts a paper's citations.

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MOLECULAR SCIENCES RESEARCH CENTER

Phase 1

Initial Construction Occupancy: equipment & scientists

Phase 2

In vivo Experimentation & Innovation Ecosystem Foundation

Phase 3

Consolidation and Integration of Research Centers

PHASE 1

~20 Research Group Collaboration (2nd floor)

- **Proteomic and Mass Spectrometry Facilities**
- **XPS & Electron Microscopy and**
- **Nikon Center of Excellence Bio-imaging**
- **Surface Microscopy & Spectroscopy-MCC Facility**
- **NMR's Facility (*including 700MHz NMR*)**

MSRC Research Centers

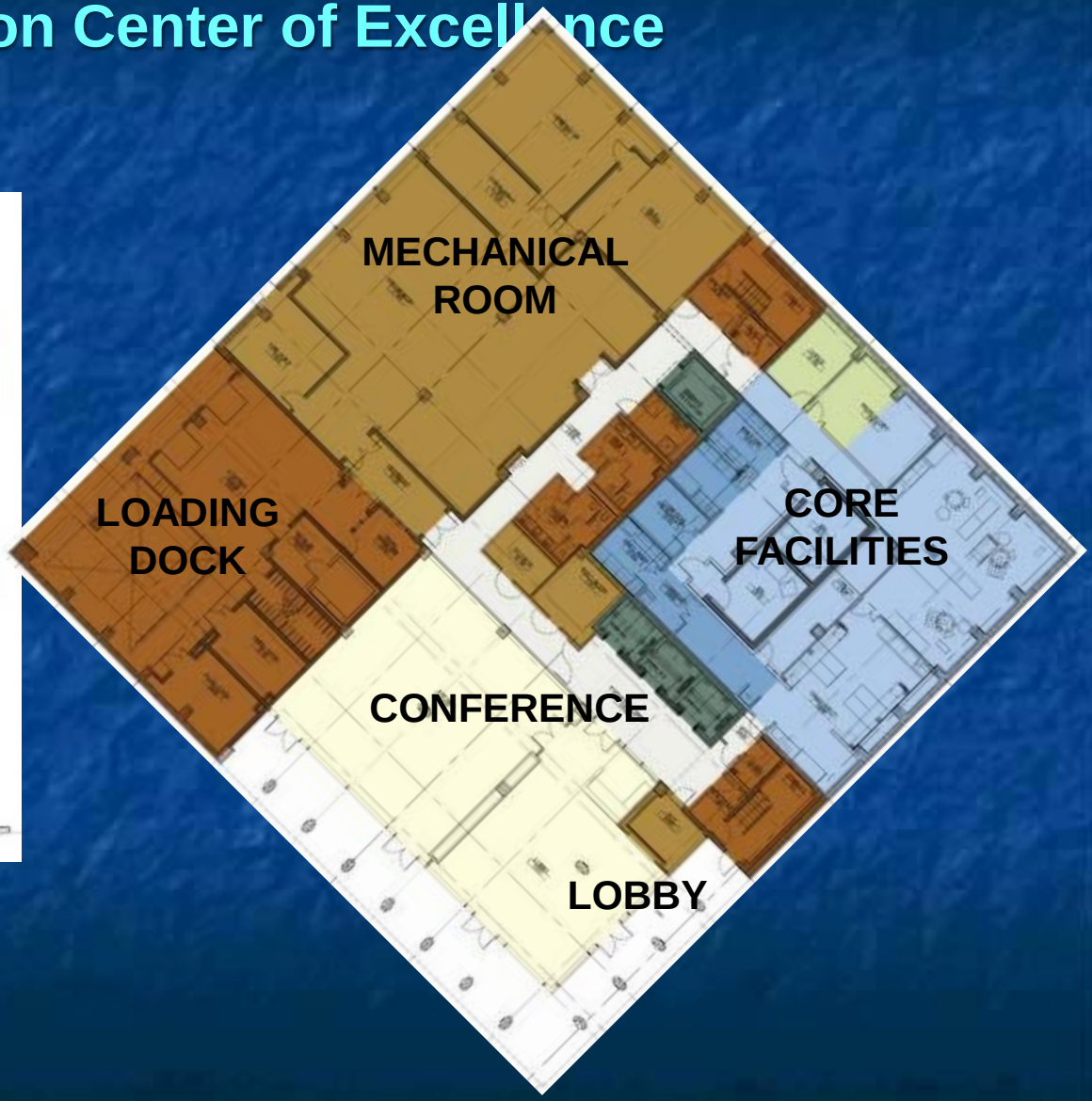
8	Open Terrace
7	Pre-Clinical Animal Facilities
6	Neuroplasticity / Chemical Synthesis
5	UPR TTIO, Incubator Floor
4	Neurodegenerative Diseases
3	Nanotechnology/Renewable Energy
2	Macromolecules/ Natural Products/ Nanotech/ Drug Deliv./ Genomics
1	Nikon Center of Excellence, Electron Microscopy, 700MHz NMR, MCC and Proteomics

Phase II
Floors 5-7
08/2015-11/2016
Starting Construction

Phase III
Floors 3-4
06/2016-07/2017
Pending

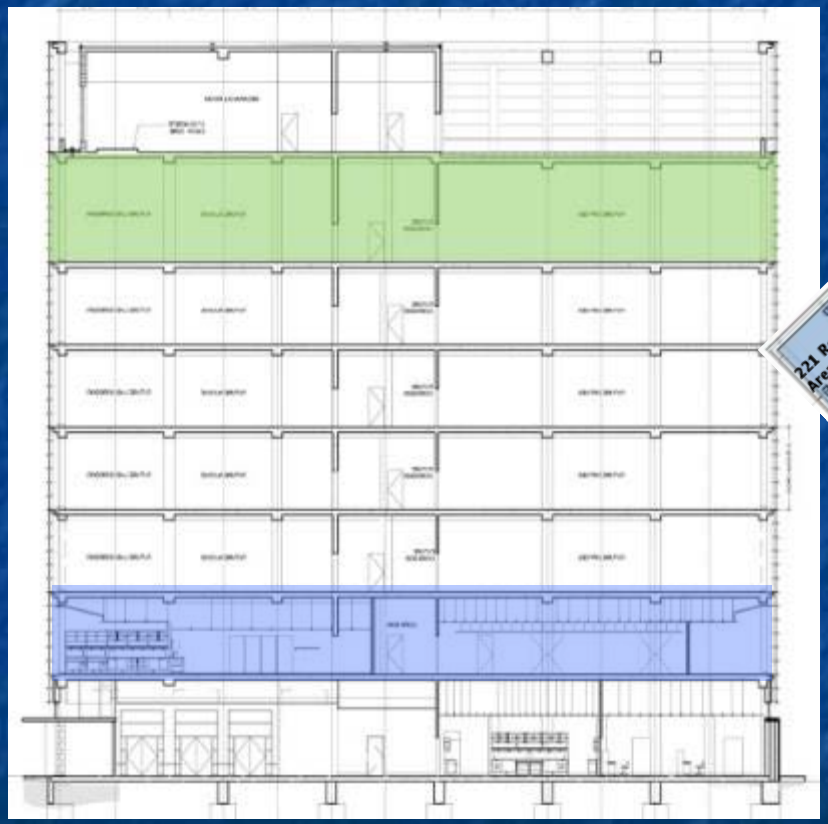
Phase I
Floors 1-2
10/2011-6/2013
COMPLETED

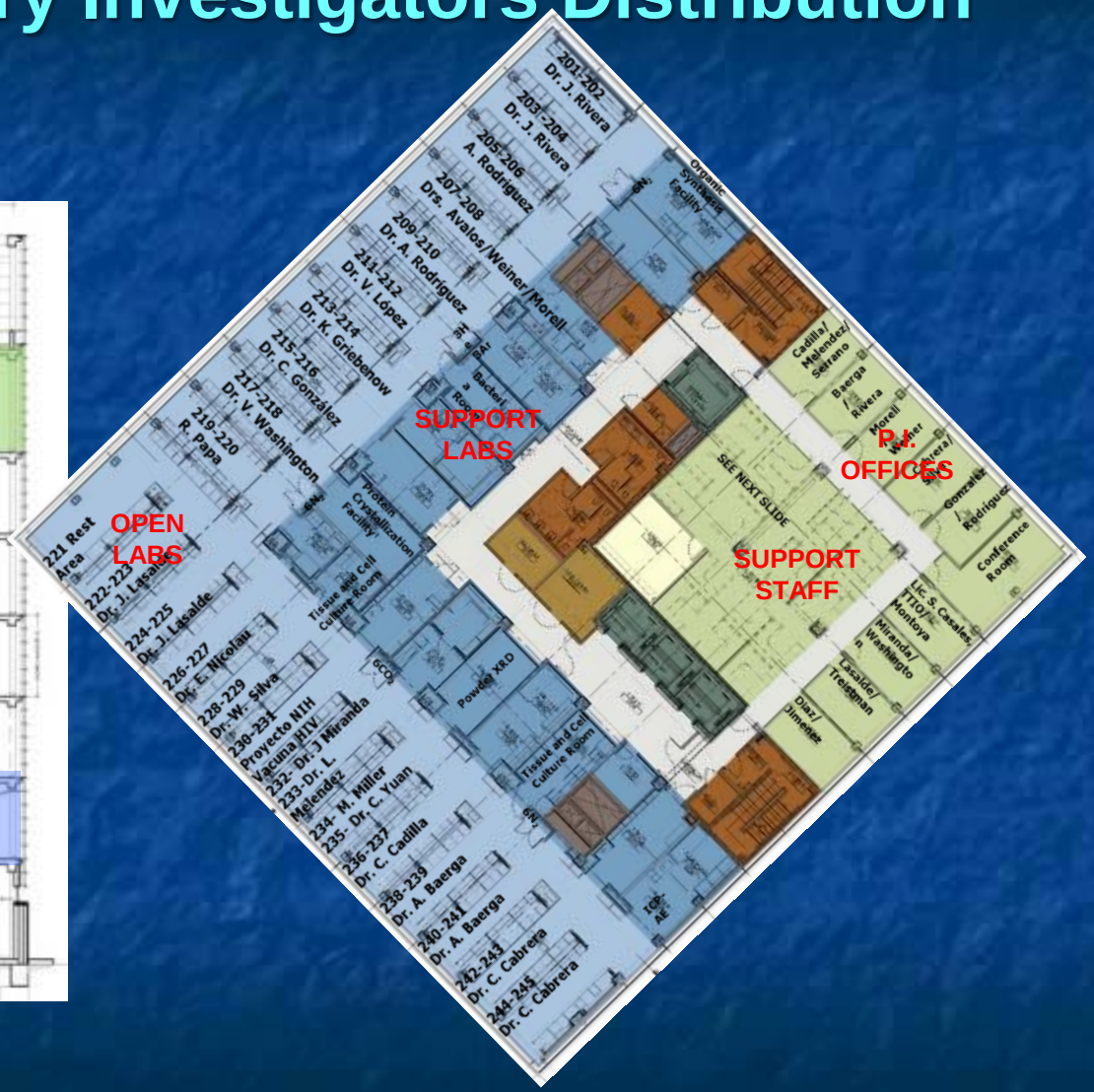
First Floor: Lobby, Conference Room and CORE Facilities, Proteomics, NMR, Surface Analysis and Nikon Center of Excellence



Second Floor

Multidisciplinary Investigators Distribution





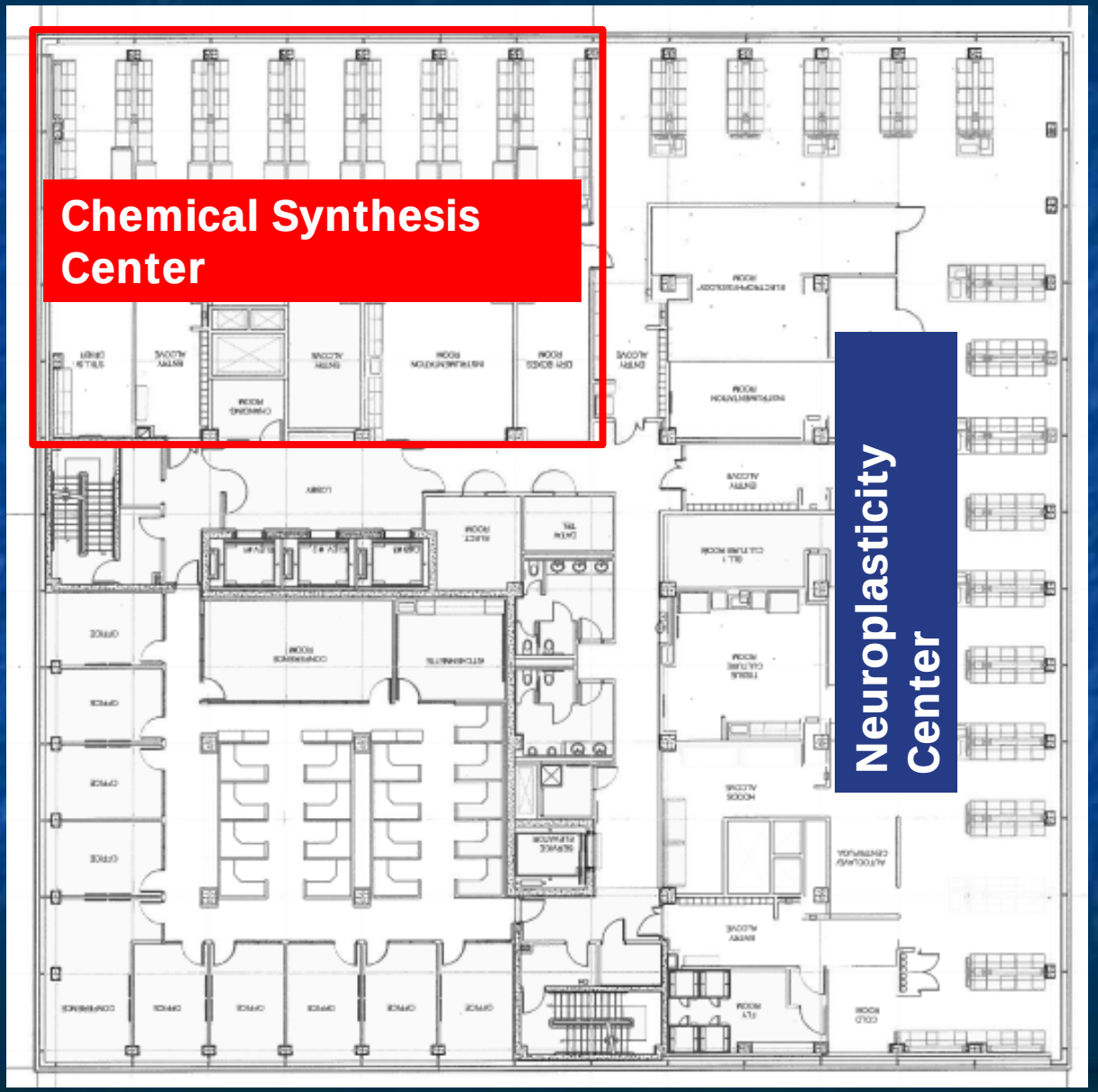
Occupancy of the MSRC: Equipment & Scientists 03/2012-Present

- Issued over 300 Access Cards, presently:
  - 20 Investigators, 68 graduate students
  - 24 postdocs, 23 lab technicians
  - 41 undergraduates, 10 staff personnel.
- Five integrated Core facilities at the MSRC.
- Over 5 Millions in new lab equipment.
- Construction of Neuroplasticity & Chemical synthesis 6th floor will begin in Aug 2015. Will take 15 months.
- Construction Pre-Clinical Vivarium 7th floor- will begin in Aug 2015. Will take 15 months.
- Technology Incubator floor, 4th floor- PR Science Trust fund allocation of $3.7 million. Construction should start late 2015 and will take 12 months.

Sixth Floor - PHASE 2

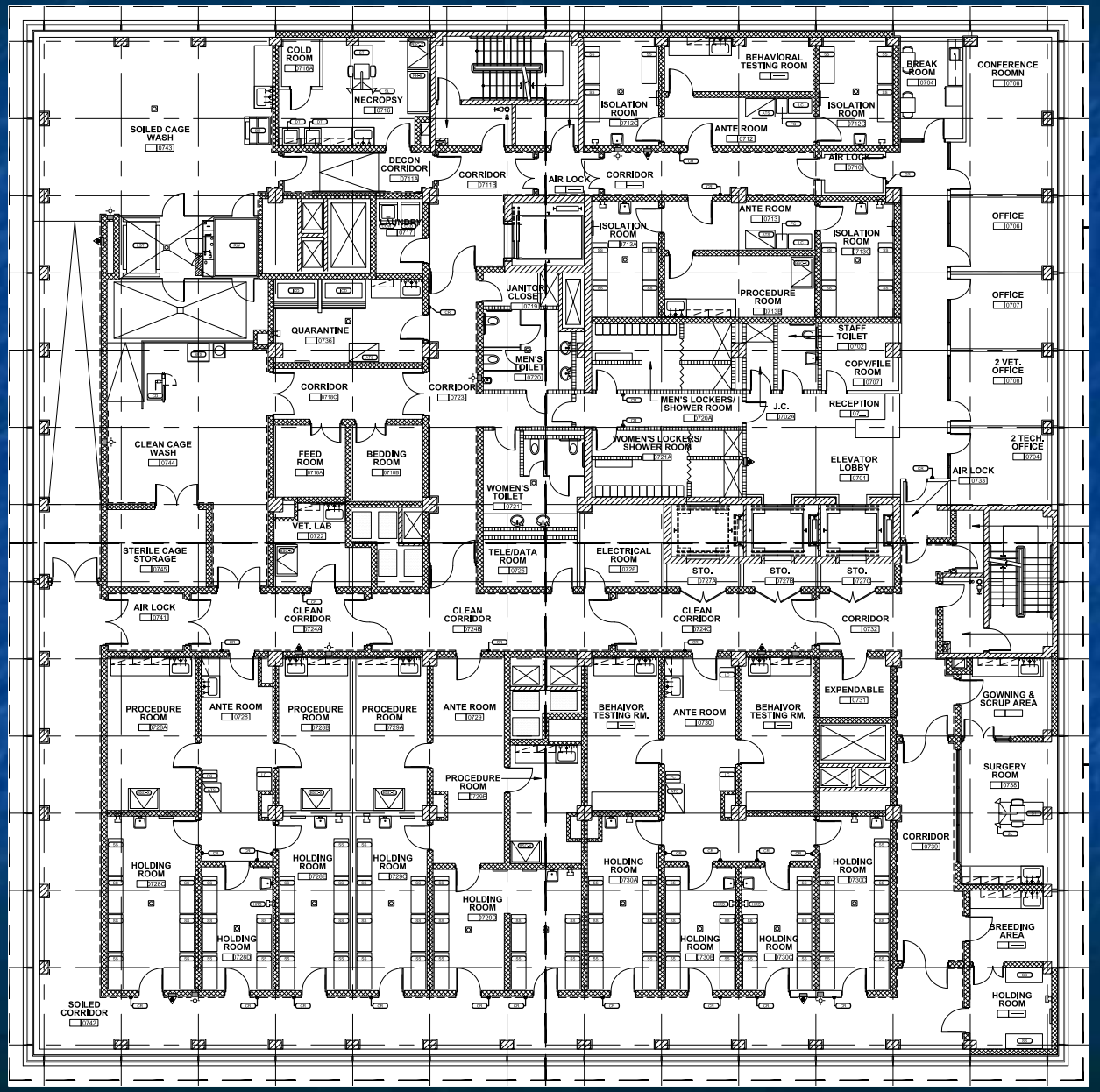
6st Floor Preliminary sketch

Chemical Synthesis and Neuroplasticity Centers



Seventh Floor - PHASE 2

7th Floor Vivarium sketch

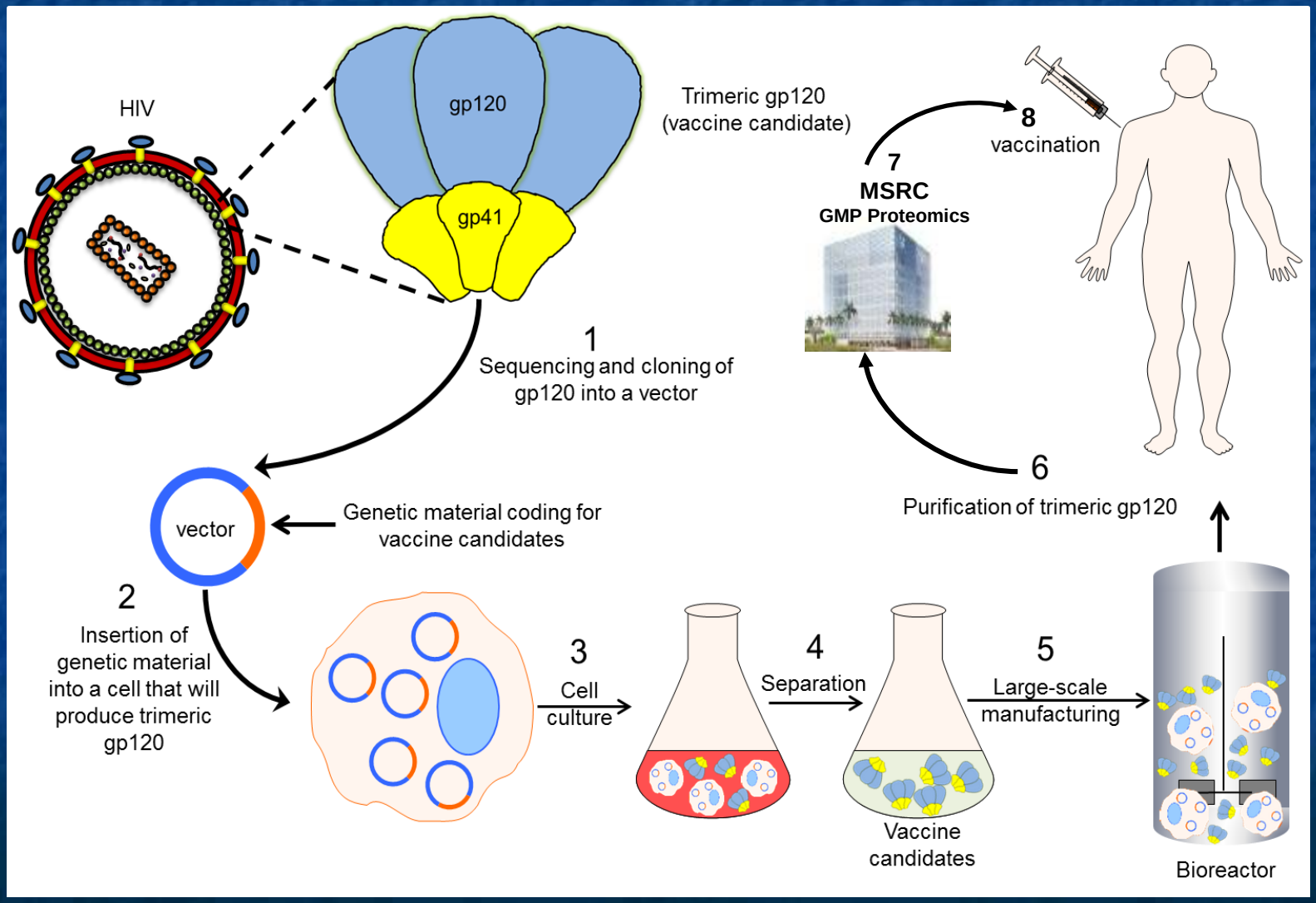


"MSRC Multidisciplinary Initiatives"

- Sequencing & Genomics Facility
- Proteomics Facility
- Technology Transfer and Innovation Office
- Natural Products Center
- Clinical Bioreagent Center (CBC) on HIV vaccine
- Materials Characterization Center
- Molecular Sciences Drug Discovery Center
- Nikon Center of Excellence in Microscopy
- Neuroplasticity Center (Cobre Grant)
- Chemical Synthesis Center
- Small Animal Pre-clinical Research Facility
- Incubator Floor under the TTIO

A prophylactic strategy to prevent HIV infection

Goal: To produce immunogens under good manufacturing practices that will induce broadly neutralizing antibodies.



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RECINTO DE CIENCIAS MÉDICAS
UNIVERSIDAD DE PUERTO RICO

RESEARCHERS FROM UPR MEDICAL SCIENCE CAMPUS AND RIO PIEDRAS CAMPUS

CIFUPR
Confocal Imaging Facility at UPR

IFN

LAB ENZYMOLOGY
ECB
CHEMICAL BIOLOGY

Electrochemistry Interface Laboratory

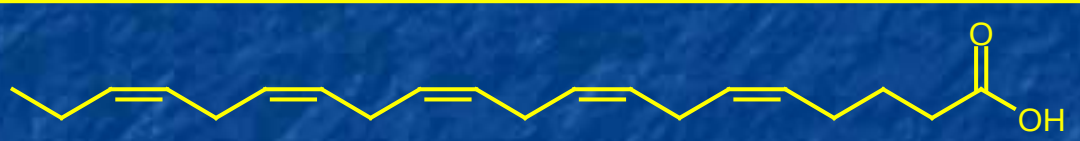
Marine Natural Products
University of Puerto Rico

MATERIALS CHARACTERIZATION CENTER
MCC
NMR · SMS · MS · XRD

NASA
UPR-RIO PIEDRAS

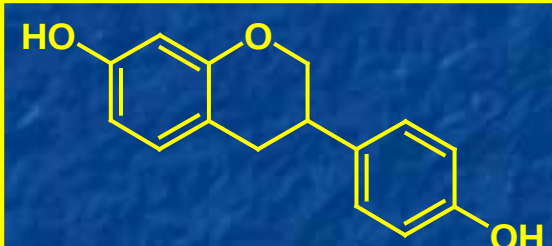
Biosynthesis of Natural Products: Biomedical and Industrial Applications

Abel Baerga-Ortiz, PhD
Department of Biochemistry



Eicosapentaenoic Acid, 20:5

Omega-3 fatty acids: a scaffold for new bioactivity



Equol

A metabolite from beans with estrogen-like properties.

The Baerga group is interested in the chemical mechanisms by which bacterial metabolites are made.

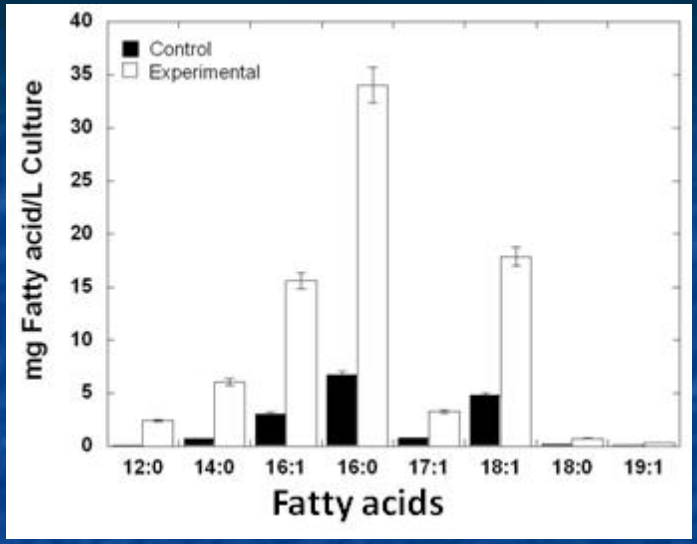
Some of these metabolites have medical or industrial applications.

Colibactin

A novel bacterial toxin from the human intestinal flora

Palmitica Bio Inc.

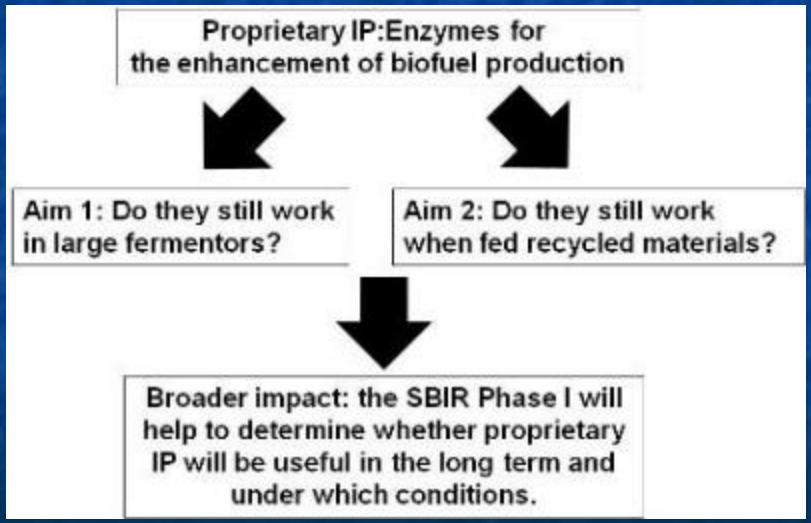
Founders: Abel Baerga Ortiz, PhD. and Delise Oyola Robles (UPR-Ciencias Médicas)



Research Focus: Palmitica Bio develops enzymes and bacterial cell lines for the production of biofuels and other natural products.

Intellectual Property: The co-owners have filed for joint patents to protect the discovery of two different enzyme systems for biofuel production.

Funding status: Applied for Phase I Small Business Innovation Research (SBIR) Funds ($150,000) from the NSF. Pending.



Carlos R. Cabrera
Carlos.cabrera2@upr.edu

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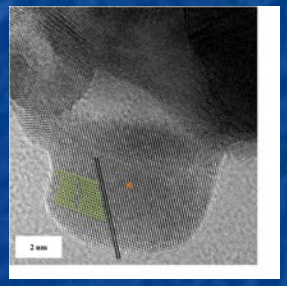
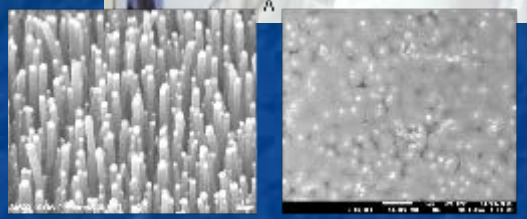
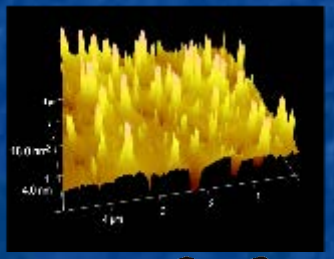
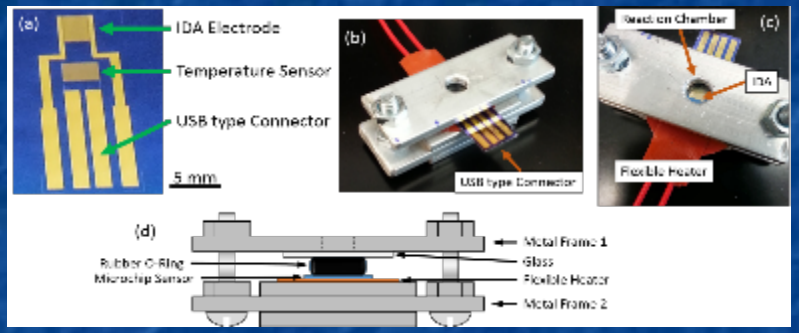
Electrochemical Biosensors

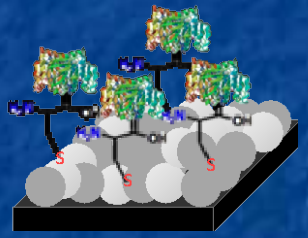


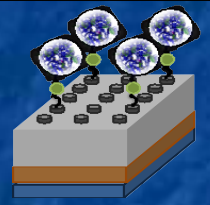
MICROFABRICATION











Enzyme-Palladium Nanoparticle Based Electrode

Interdigital Au Electrode Microarray

Enzyme- Carbon Nanofiber Based Electrode

Funds:

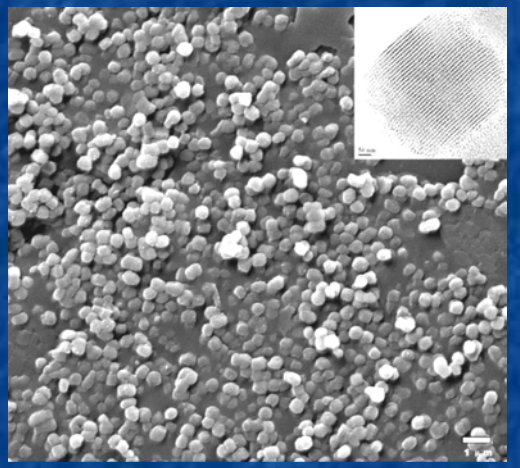
Recent Publication

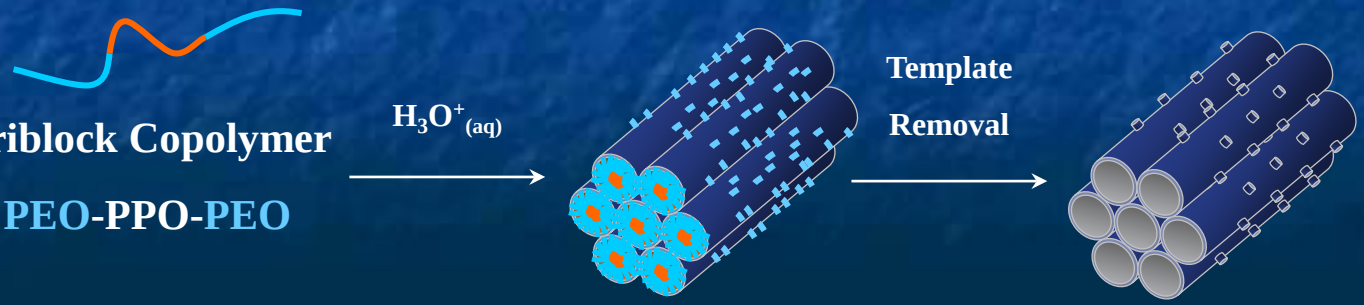
"Cunci, L.; Martinez-Vargas, M.; Cunci, R.; Gomez-Moreno, R.; Perez, I.; Baerga-Ortiz, A.; Gonzalez, C.I.; Cabrera, C.R., "Real-Time Detection of Telomerase Activity in Cancer Cells using Label-Free Electrochemical Impedimetric Biosensing Microchip", RSC Advances 2014, 4, 52357–52365 .

Pasquale F. Fulvio

pasquale.fulvio@upr.edu

- Hydrothermal synthesis of Functional Ordered Mesoporous Silica Particles for smart drug delivery:
  - Adsorption parameters (surface area, pore volumes, pore widths)
  - Particle size and morphology
  - Surface Functionality: chain length Si-R-SH
  - “One-Pot” vs. Post-Synthesis modification
- Impact:
  - Drug release profile of Cytochrome C
  - Cytotoxicity

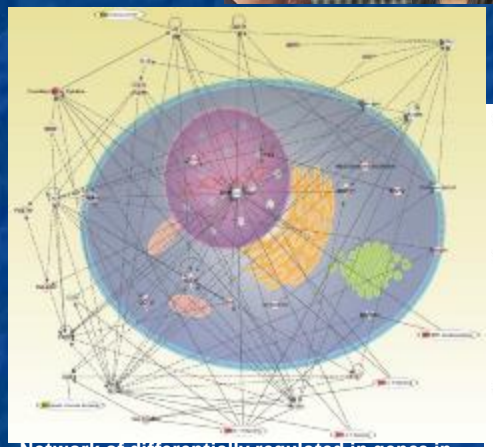




University of Puerto Rio School of Medicine
Departments of Biochemistry and Pediatrics

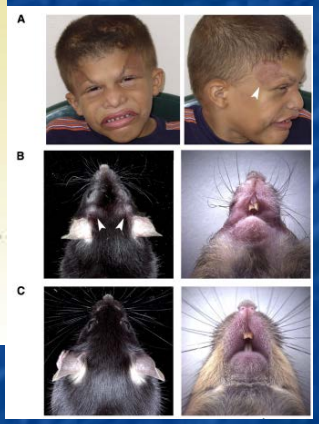
Dr. Carmen L. Cadilla's Lab – Human Molecular Genetics

- We study rare diseases that affect the Puerto Rican population such as the Hermansky Pudlak (HPS) and Setleis Syndromes.
- We have identified the gene for Setleis Syndrome with our Collaborators from Mount Sinai School of Medicine, TWIST2.*
- We would like to collaborate with MSRC Investigators in order to better understand the proteins involved in the molecular processes affected in these disorders. We also collaborate with the Hereditary Diseases Program of the University Pediatric Hospital, directed by Dr. P. Santiago Borrero, in assessing the impact of rare diseases in our population.
- Our studies will focus on identifying proteins interacting with HPS proteins, the composition of the ceroid-like substance and understanding the mechanisms employed by TWIST2 in the proper development of skin, eyelid meibomian glands and the facial structures affected in Setleis syndrome.
- Excellent animal models of these two disorders exist and will be used for functional studies.



Network of differentially regulated in genes in human skin fibroblasts from Setleis Syndrome patients vs. normal PR controls identified by microarray analysis

Puerto Rican Setleis Syndrome Patient, Twist2 KO and WT mice



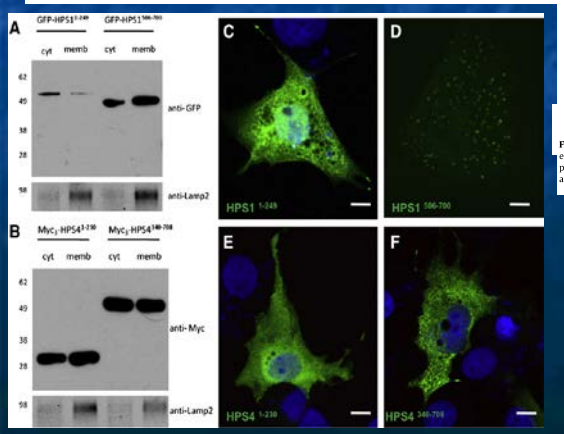
The American Journal of Human Genetics *87*, 1–8, August 13, 2010

Homozygous Nonsense Mutations in *TWIST2* Cause Setleis Syndrome

Turgut Tukel,[1,5,7] Dražen Šošić,[2,5] Lihadh I. Al-Gazali,[3] Mónica Erazo,[1] Jose Casasnovas,[4] Hector L. Franco,[4] James A. Richardson,[2] Eric N. Olson,[2] Carmen L. Cadilla,[4,6] and Robert J. Desnick[1,6,*]

Nonsense mutations of the bHLH transcription factor TWIST2 found in Setleis Syndrome patients cause dysregulation of periostin

Hector L. Franco[a], Jose J. Casasnovas[a], Ruth G. Leon[b], Robert Friesel[b], Yongchao Ge[c], Robert J. Desnick[d], Carmen L. Cadilla[a,*]

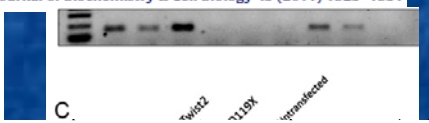


A divalent interaction between HPS1 and HPS4 is required for the formation of the biogenesis of lysosome-related organelle complex-3 (BLOC-3)

Carmelo Carmona-Rivera [a,b,1], Dimitre R. Simeonov [b], Nicholas D. Cardillo [b], William A. Gahl [b], Carmen L. Cadilla [a,*]

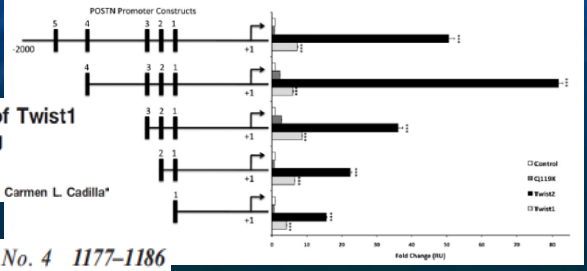
Biochimica et Biophysica Acta 1833 (2013) 468–478

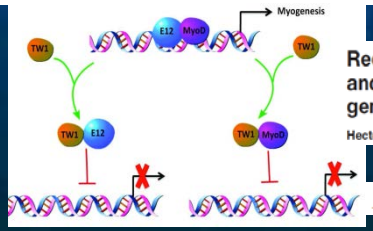
The International Journal of Biochemistry & Cell Biology 43 (2011) 1523–1531



(B) Representative semi-qPCR of ChIP DNA corresponding to E-box 1 of the POSTN promoter.

Fig. 6. TWIST2 transcriptionally activates the POSTN promoter. Deletion constructs of the POSTN promoter was transfected by nucleofection (AMAXA) together with plasmids encoding TWIST1, TWIST2, or Q119X. TWIST2 significantly activates the POSTN promoter when compared to Q119X and Twist1. Maximum activation is observed for the promoter with 4 out of the 5 E-boxes in place. Error bars represent standard deviation, and means that were statistically significant from the control were highlighted with asterisks (*** $p < 0.001$).





Redundant or separate entities?—roles of Twist1 and Twist2 as molecular switches during gene transcription

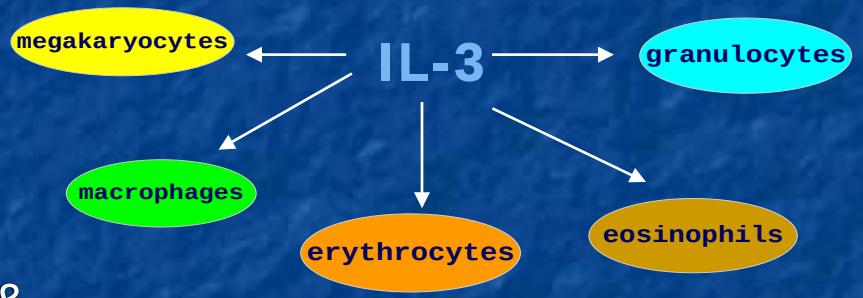
Hector L. Franco, José Casasnovas, José R. Rodríguez-Medina and Carmen L. Cadilla*

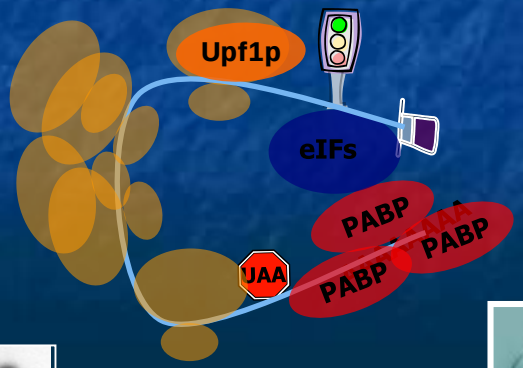
Nucleic Acids Research, 2011, Vol. 39, No. 4 1177–1186

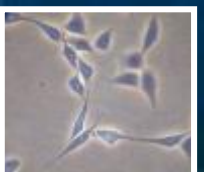
González's Lab: RNA Biology and Post-Transcriptional Control

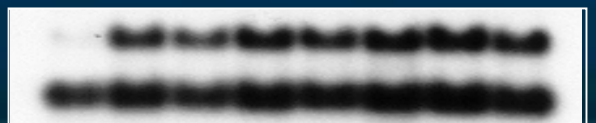
cigonzal@gmail.com

- **Research interests**
  - mRNA stability and translational control of cytokines, prions, nonsense-mediated mRNA decay pathway, microRNAs and cancer.
- **Main techniques & instrumentation**
  - qRT-PCR, Northern & Western Blots, luciferase assays, molecular cloning & mutagenesis, protein purification, phosphorylation analysis.
  - Phosphorimager, illuminometer, mass spectrometer, confocal microscope, real-time PCR, protein purification, tissue culture room.



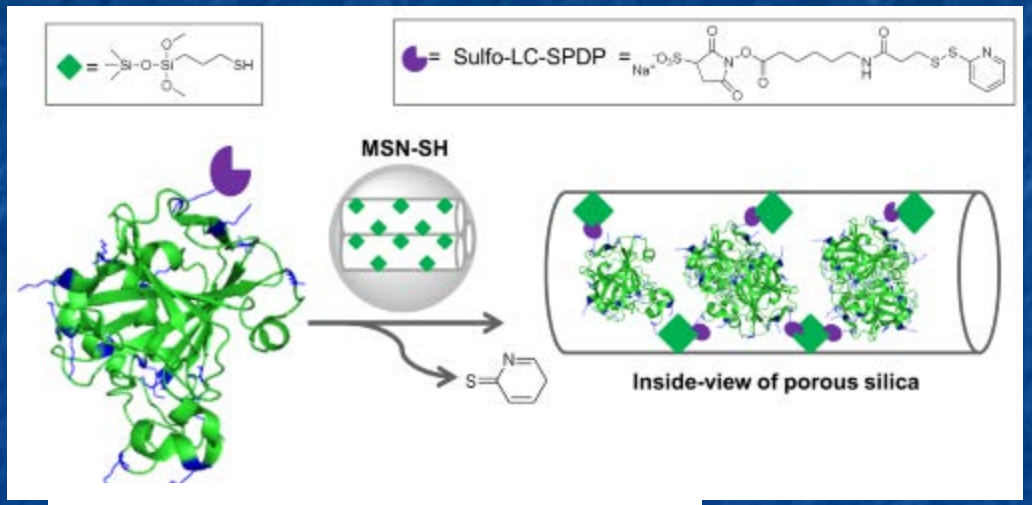




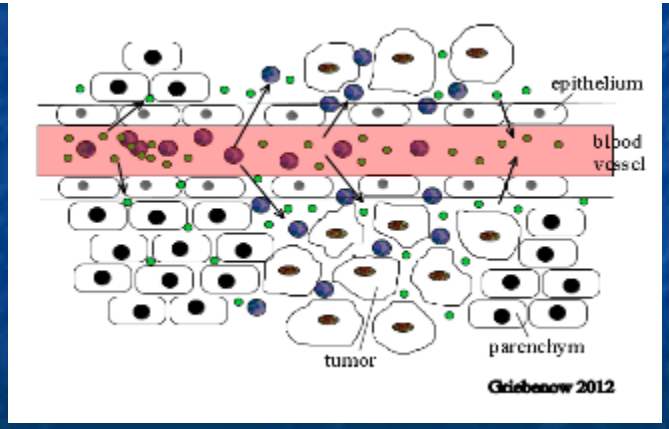


Griebenow Laboratory: Modern Targeted Cancer Medicines

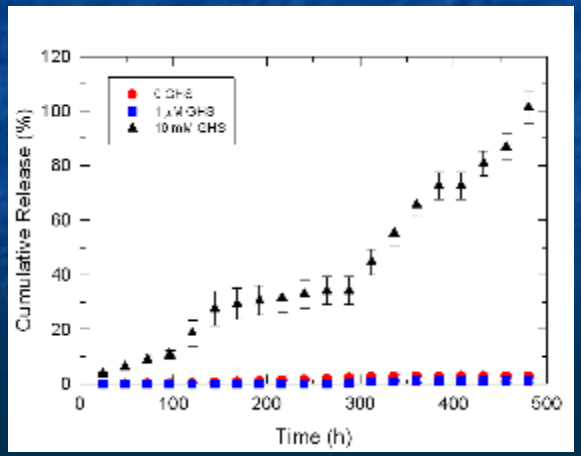
(Mendez et al., Bioconjugate Chemistry 2012)



An apoptosis inducing protein is immobilized in silica nano-spheres via a smart bond system. Homing ligands will be bound to this system next.



The drug is released under cellular conditions, (triangles) but not extra-cellular conditions.

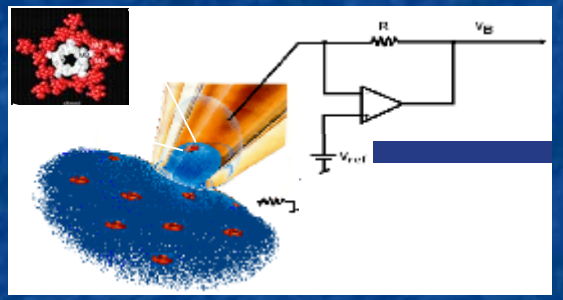


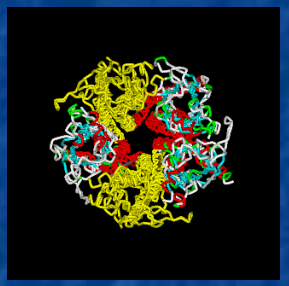
Nanoparticles accumulate in tumors by the enhanced permeation/retention effect which is based on the leaky blood vessels.

Lasalde Laboratory

- **Research interests**
  - To understand the structural, molecular and functional basis for acetylcholine channel-receptors related diseases.
  - Biophysics, Biochemistry, Structural and Molecular Biology, Neurodegenerative Diseases

- **Main techniques & instrumentation**
  - Confocal, fluorescence and TIRF microscopy; electrophysiology; FRAP; molecular biology; transgenic mice models; protein crystallization, membrane lipids composition by HPLC/MS



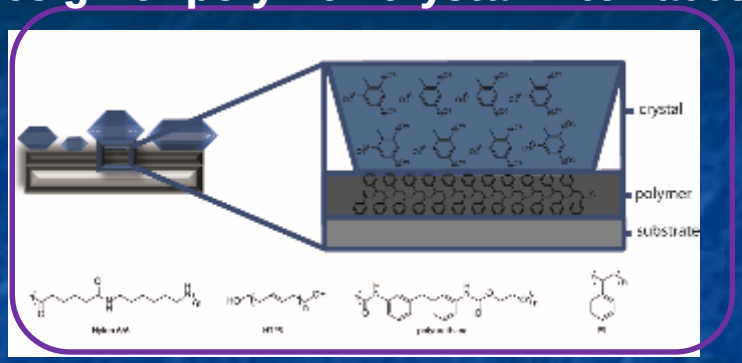


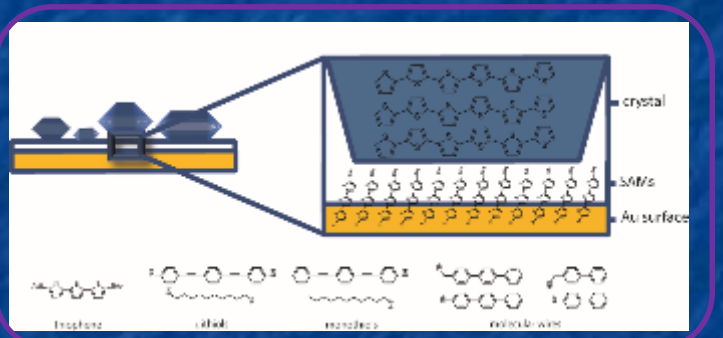
- **Recent publications**
  - Up-regulation of the neuronal nicotinic receptor α7 by HIV glycoprotein 120: potential implications for HIV-associated neurocognitive disorder. Ballester LY, Capó-Vélez CM, García-Beltrán WF, Ramos FM, Vázquez-Rosa E, Ríos R, Mercado JR, Meléndez RI, Lasalde-Dominicci JA. J Biol Chem. 2012 Jan 27;287(5):3079-86 PMID:22084248
  - Effects of lipid-analog detergent solubilization on the functionality and lipidic cubic phase mobility of the Torpedo californica nicotinic acetylcholine receptor. Padilla-Morales LF, Morales-Pérez CL, De La Cruz-Rivera PC, Asmar-Rovira G, Báez-Pagán CA, Quesada O, Lasalde-Dominicci JA. J Membr Biol. 2011 Oct; 243(1-3):47-58. Sep 16. PMID:21922299

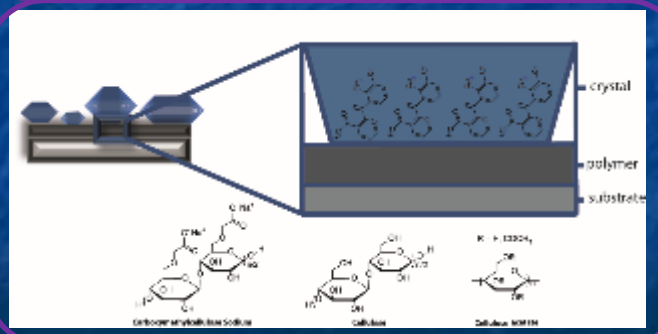
Design, Applications, and Mechanistic Studies of Crystallizations on Polymers

Prof. Vilmalí López-Mejías
Department of Chemistry
University of Puerto Rico-Río Piedras

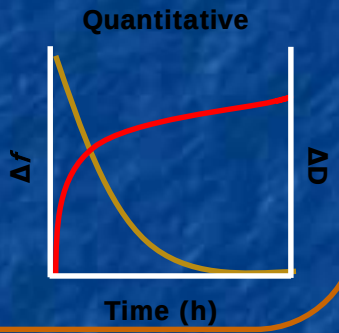
Design of polymer-crystal interfaces







Mechanistic studies



Applications of polymer-crystal interfaces

López-Mejías, V.; Kampf, J. W.; Matzger, A. J., *J. Am. Chem. Soc.*, 2009, *131*, 4554–4555.
López-Mejías, V.; Kampf, J.W., Matzger, A. J., *J. Am. Chem. Soc.*, 2012, *134*, 9872-9875.
McClelland, A.A.; López-Mejías, V.; Matzger, A.J.; Chen, Z., *Langmuir*, 2011, *27*, 2162–2165.
López-Mejías, V.; Knight, J. L.; Brooks, C. L. III; Matzger, A. J., *Langmuir*, 2011, *27*, 7575–7579.
López-Mejías, V.; Myerson, A. S.; Trout, B. L., *Cryst. Growth & Des.*, 2013, *13*, 3835–384.
Eral, B.H.; López-Mejías. V.; Doyle, P.S.; Myerson, A.S.; Trout, B.L., *Cryst. Growth & Des.*, 2013, *ASAP*.

Biomedical Applications of Nanostructured Materials

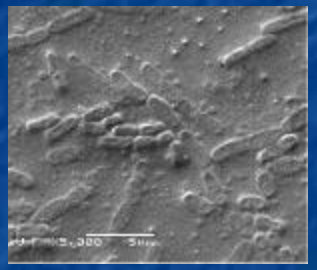
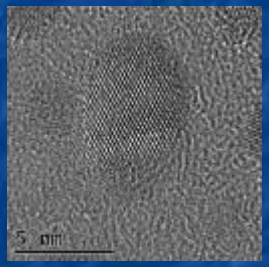
1) **Bactericide Properties of Ag-Diamond and Ag-Graphene Composites:** We developed novel bactericide coatings by incorporating silver (Ag) nanoparticles into Diamond and Graphene films. Ag nanoparticles were incorporated into these films during synthesis and their surface bactericidal properties are tested using a modified JIS-Z-2801 protocol designed to quantitatively test the ability of surfaces to inhibit the growth of microorganisms. Other surfaces, such as copper and glass are employed as comparison standards.

2) **Graphene Quantum Dots as Nanoprobes in High-contrast Bioimaging:** We developed a new method for the synthesis of Graphene Quantum Dots (GQDs) that are soluble in water and show strong intrinsic fluorescence in the visible region. We tested their suitability for confocal microscopy applications and found that bacteria have a strong affinity for the GQDs, thus enhancing their imageability under the confocal microscope at 405, 488 and 561 nm excitation wavelengths. No signs of photobleaching were observed at all during one hour of continuous irradiation. The GQDs are non-toxic, thus suitable for biological applications, such as biomolecular analysis by fluorescence resonance energy transfer and cancer cell imaging.

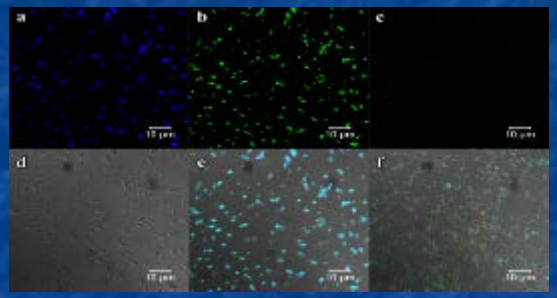
3) **Bifunctional Nanoparticles for Bioimaging and Hyperthermia Therapy:** We developed bifunctional luminescent-ferromagnetic nanoparticles of magnetite with Mn-doped ZnS. The measured M-H hysteresis loops demonstrate that ZnS:Mn nanoparticles exhibit ferromagnetic ordering below 30 K, unlike its bulk counterpart. Their biocompatibility and ability to cross the cell membrane will be used for bioimaging combined with hyperthermia therapy or thermotherapy. Once inside the target cells, these nanoparticles can be driven with an external field, producing localized heating (about 113˚ F) that can damage or kill cancer cells with minimal injury to healthy tissues.



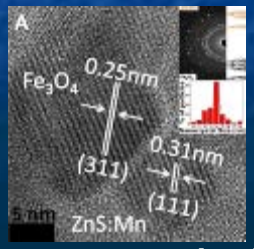
G. Morell B.R. Weiner J. Avalos

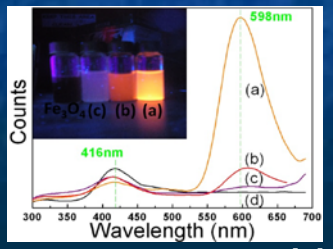



Dead Bacteria on Nanodiamond Graphene Quantum Dot



Confocal Microscopy Images of Bacteria with Graphene Quantum Dots





Ferromagnetic-Fluorescent Nanoparticles for Bioimaging and Hyperthermia Therapy

Stelzer Research Group

email: torsten.stelzer@upr.edu, **phone:** 787-758-2525 ext. 5418

Research Interests

- Small-scale, continuous, pharmaceutical manufacturing
  - Purification, separation, formulation
  - Integration of sensors and detectors for process analytical technology (PAT)
- Crystallization from solution and melt of small & macro (protein) molecules
  - Nucleation and control of polymorphism
  - Liquid-liquid phase separation and its control
  - Novel continuous formulation techniques
  - Development and optimization of continuous processes
- Process intensification
  - Development of new manufacturing methods (multifunctional, hybrid)
- Case studies

- Lack of research
- Apply to small & macro (protein) molecules

Piñero's Lab

Coordination Chemistry

Dr. Dalice M. Piñero Cruz

- **Research Interests**

  Our efforts are directed towards the synthesis of metal complexes and multidimensional networks for their application in *Materials Science and Nanomedicine*. At the Molecular Science Center we will be working on the projects: (1) *Molecular Magnets and Nanomaterials for applications in memory devices following a Rotationally-Oriented Ligand Design (ROLD) approach*, and (2) *Multimodal theranostic nanoprobes for non-invasive bioimaging and photothermal treatment of cancer* . The latter will be performed in collaboration with Dr. Arthur Tinoco.

- **Students at the MSB site:** Keily Gutiérrez, **Gellyz González, Nataniel Medina, Priscilla Rodríguez, Alexis Guzmán and Jean Marcos Vidal**

- **Main Techniques & Instrumentation**

  Organic and Inorganic synthesis including air sensitive techniques, Single Crystal X-ray Diffraction, NMR/IR/UV-Vis Spectroscopy, Electrochemistry and Spectroelectrochemistry, Contrast Agent Analyzer

Darlene Santiago, Ph.D.

Assistant Professor
Industrial Pharmacy
Pharmaceutical Sciences
School of Pharmacy
UPR Medical Sciences Campus

Scientific Endeavors at MSRC

- Physico-chemical characterization of amorphous drug formulations to correlate molecular mobility with crystallization kinetics.
- Empirical predictive modeling of Hot Melt Extrusion (HME) by characterization of flow properties of pharmaceutical amorphous melt.

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RECINTO DE CIENCIAS MEDICAS
UNIVERSIDAD DE PUERTO RICO

ENGINEERING RESEARCH CENTER FOR
STRUCTURED ORGANIC PARTICULATE SYSTEMS
RUTGERS UNIVERSITY
PURDUE UNIVERSITY
NEW JERSEY INSTITUTE OF TECHNOLOGY
UNIVERSITY OF PUERTO RICO AT MAYAGÜEZ

Nicolau's Research Group

"Designing and building the next-generation of bio-polymeric self responsive coatings"

Eduardo Nicolau

eduardo.nicolau@upr.edu

Research interests: **Study and evaluation of biopolymeric-nanomaterials constructs for applications in water purification and biomedical devices**

- **Preparation of interfaced bionanomaterials for responsive (reactive) water purification membranes**
- **Development of point-of-use sensors for the detection of emerging contaminants and metabolites.**
- **Bionanomaterials for bone tissue engineering and repair**

Main techniques & instrumentation:

FTIR, Raman, Zeta potential, DSC, TGA, UV, AFM Rheology and X-ray techniques. Cell culture and microbiological assays.

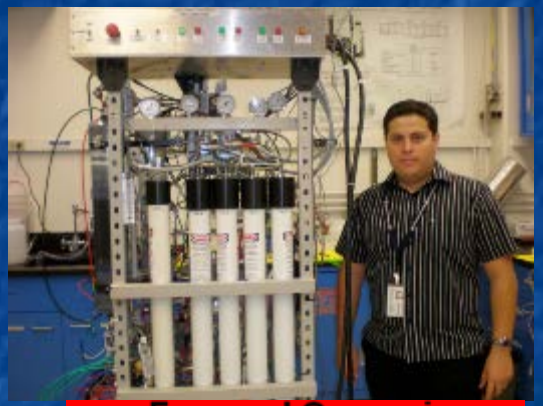
Current Projects at MSRC:

- *Modification of cellulose nanocrystals moieties with nanomaterials as templates for the fabrication of water purification reactive membranes*
- *Synthesis and characterization of polymer interfaced bone-morphogenetic protein (BMP-2) assemblies for bone tissue engineering applications: A chemical and biological assessment*
- *Evaluation of gold nanoparticles-aptamers colloidal structures for the specific determination of arsenic trioxide in water via electrochemical and spectroscopic techniques*
- *Synthesis and characterization of polymer-based forward osmosis membranes and their auto-tunable anti-fouling and anti-adsorption properties*

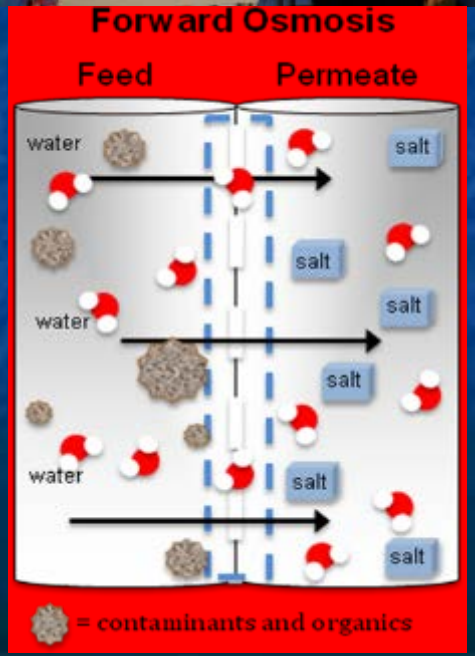
Advanced Nanomaterials and Technologies, Inc. (AnTEK, Inc.)

Dr. Eduardo Nicolau

Small Business Concern (SBC) dedicated to the research and development of materials and technologies for applications in electrical energy generation and wastewater purification.



- **NASA Applications:**
  - Forward Osmosis Secondary Treatment unit currently being developed at NASA Ames
  - NASA is moving to FO since it is an energy passive technology, thus this research has direct application to the next generation of water purification systems that NASA will be launching in the future.
  - Power generation from human wastes.
- **Non-NASA Applications:**
  - Military operations for portable water purification systems
  - Medical devices, for catheters and other invasive devices that are known to be prone to bacterial growth.

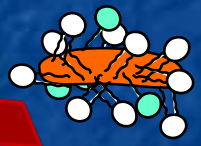


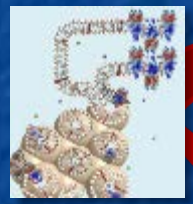
Characterization of appropriate lipid-analog detergent conditions for purification of stable and functional nicotinic acetylcholine receptor from *Torpedo californica* for X ray crystallography

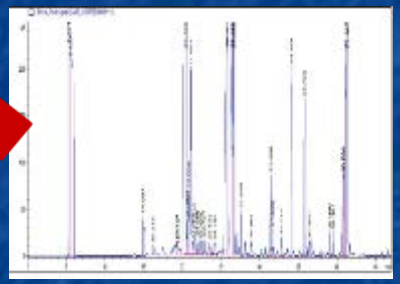
Dr. Orestes Quesada
UPR-RP

Many health conditions like Parkinson and Alzheimer's disease have been linked with malfunctions of the nicotinic acetylcholine receptor (nAChR), in addition it has been found that nAChRs play an important part in locomotor activities and mood behavior. The potential of developing knowledge and new drug treatments for conditions linked to nAChRs functionality are limited by the lack of high resolution X-ray Structure of the nAChR. Even with the efforts of several laboratories around the world using different techniques in order to obtain suitable crystals for the diffraction of a stable and functional nAChRs, the X-ray Structure of the nAChR has not yet achieved. Our goal is to determine the proper detergent conditions for nAChR extraction that lead to a functional and stable receptor for crystallization. To achieve this goal, the lipid composition of both native *Torpedo* tissue and each of the detergent-solubilized nAChR preparations that yield functional receptors will be analyzed using gas chromatography mass spectrometry (GC/MS) and high performance liquid chromatography mass spectrometry (HPLC-MS) to determine the cholesterol, phospholipid head group, and acyl composition in the detergent-solubilized nAChR. These experiments will provide the information required for a comprehensive lipid-based study based on correlations with functional activity of the detergent extracted nAChRs.

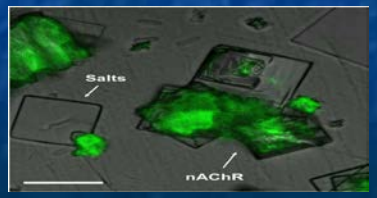
msrc
MOLECULAR SCIENCES RESEARCH CENTER



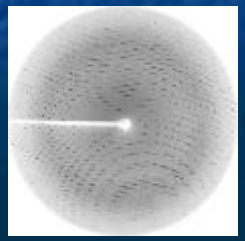




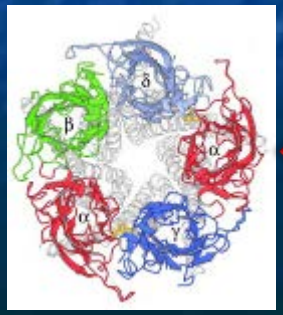
Argonne
NATIONAL LABORATORY



Potential nAChR crystals formed in the LCP

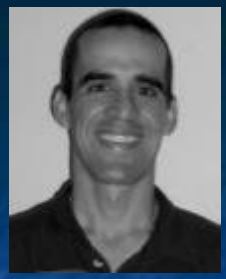


Argonne APS 23-ID-D



Drugs design for targeting nAChRs related diseases based on a functional X-ray structure

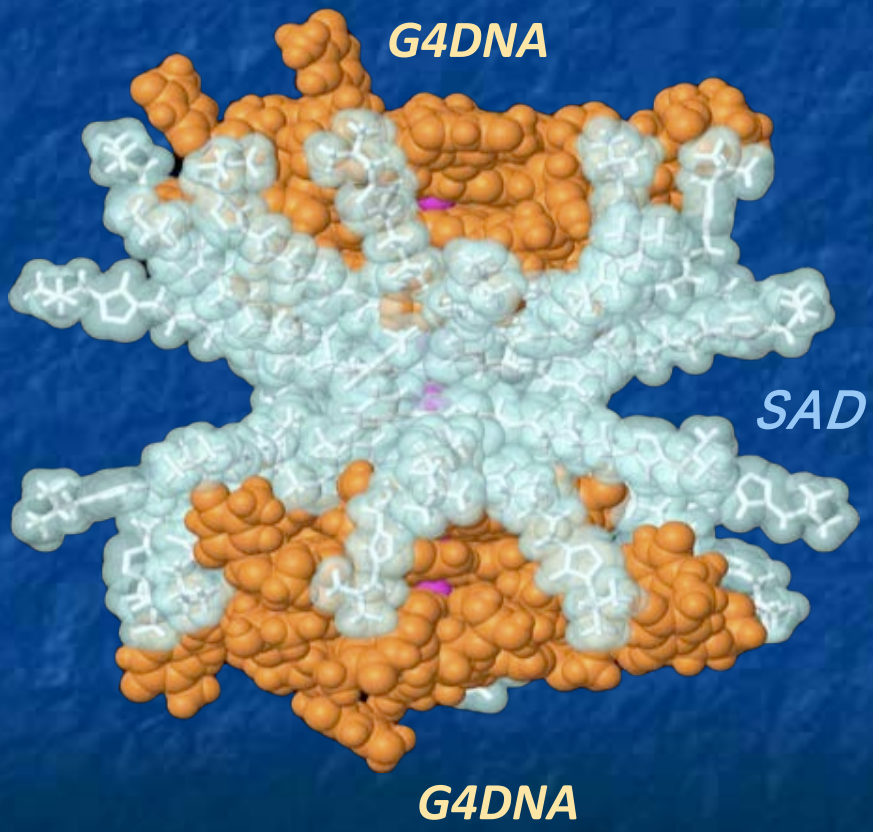
Self-Assembled Drugs (SADs)



José M. Rivera

Prototype SAD to target G-quadruplex DNA

- G-quadruplex DNA (G4DNA)
  - More than 300,000 potential G4DNA sites in the human genome
  - Great need for developing selective ligands
    - To elucidate it biological role in health and disease
  - Important & recently identified target against cancer
- G4DNA recognition by our ***SADs***
  - High Specificity
  - High Affinity
  - Novel strategy for drug development

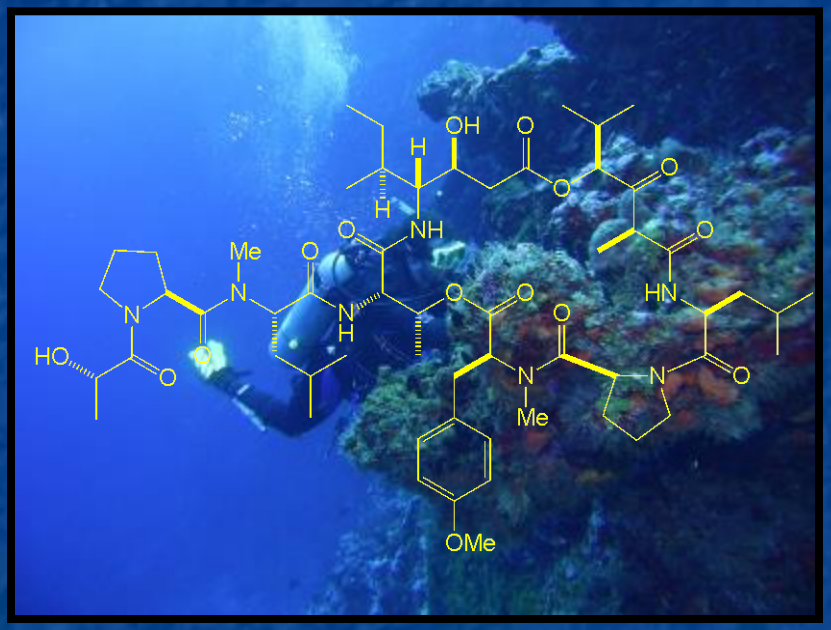


Rodríguez's Lab

Marine Natural Products Chemistry

abimael.rodriguez1@upr.edu

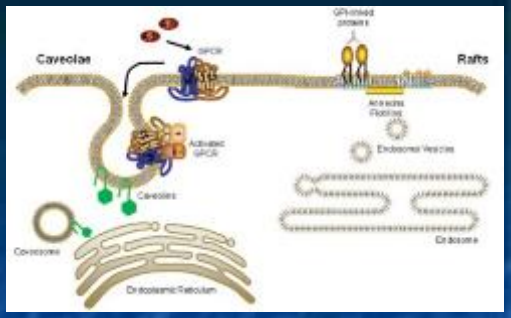
- **Research interests**
  - Collection of marine invertebrates, extraction, purification, structure elucidation, and synthesis of bioactive marine natural products.
- **Main techniques & instrumentation**
  - HPLC, HPLC/MS, CC, SEC, IEC
    ^{1}H and ^{13}C NMR, MS, IR, UV and X-ray diffraction techniques.



- **Recent publications**
  - Rodríguez, A.D. et al. *Angew. Chem. Int. Ed*. 50, 8134 (2011)
  - Rodríguez, A.D. et al. *Nat. Chem.* 5, 510 (2013)
  - Rodriguez, A.D. et. al. Bioorg Med Chem Lett 24, 344 (2014)

Walter I. Silva, Ph.D.

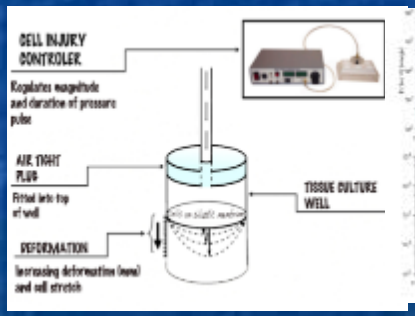
Professor Department of Physiology
Ph.D., 1986, Mount Sinai School of Medicine, NY
(787) 758-2525 Ext. 1608
walter.silva@upr.edu



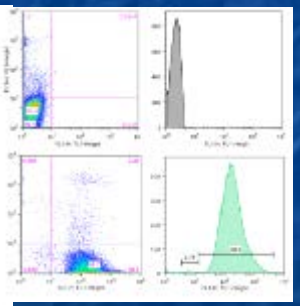
Laboratory of Membrane Raft Associated Proteins

Our laboratory focuses in understanding the mechanisms underlying signaling and trafficking of membrane-raft associated proteins. We use various types of glial cells including rat & human derived gliomas, and rat neuronal & astrocytic primary cultures. Glial cells responses can be both protective and degenerative in nature, depending on their spatiotemporal chemical environment and the localization of certain proteins in the plasma membrane. Thus, understanding protein membrane residency & trafficking, and how this affects signal transduction is imperative as it might shed light into how roles may be tipped into glio/neuro protection. In our studies, we use several techniques:

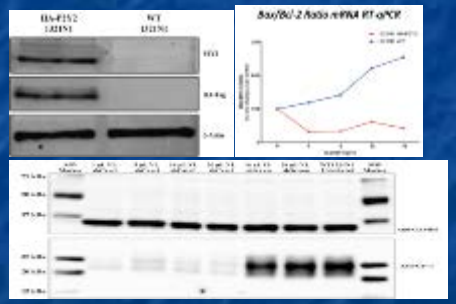
Cellular Injury



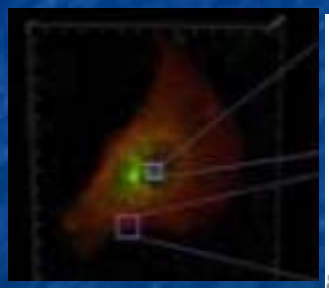
FACS



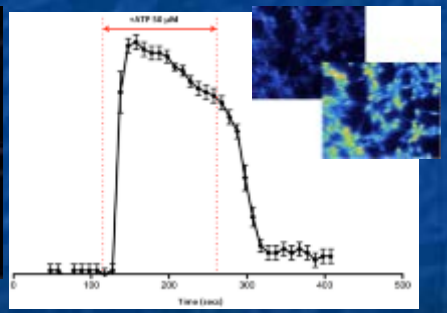
Gene Expression & Silencing



ICM



Ca^{2+} Imaging



Recent Publications:

Salgado IK, Serrano M, García JO, Martínez NA, Maldonado HM, Báez-Pagán CA, Lasalde-Dominicci JA, Silva WI. *SorLA in Glia: Shared Subcellular Distribution Patterns with Caveolin-1.* Cellular & Molecular Neurobiology (2011).

Nieves-Cintrón, Madeline, Daniel Caballero-Rivera, Walter I. Silva, Manuel F. Navedo, and José A. Lasalde-Dominicci. *Functional Contribution of α3L8′ to the Neuronal Nicotinicα3 Receptor.* Journal of Neuroscience Research (2008).

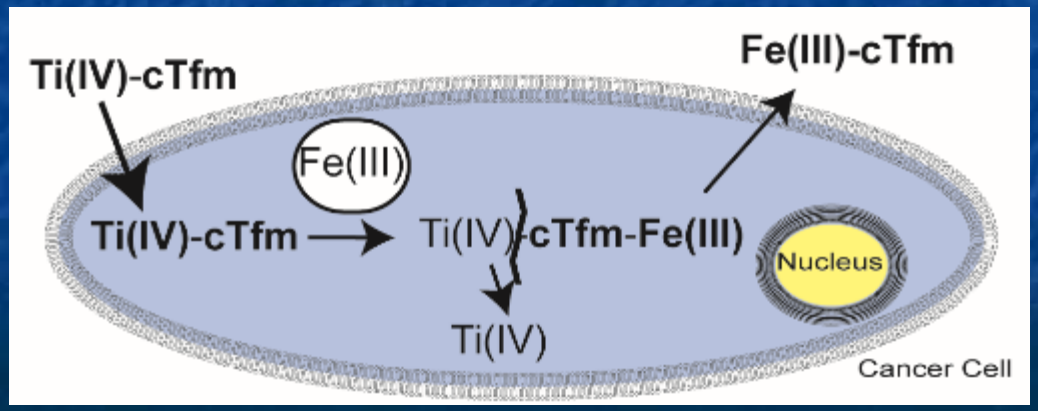
Silva, W. I., H. M. Maldonado, G. Velázquez, J. O. García, and F. A. González. *Caveolins in Glial Cell Model Systems: From Detection to Significance.* Journal of Neurochemistry (2007).

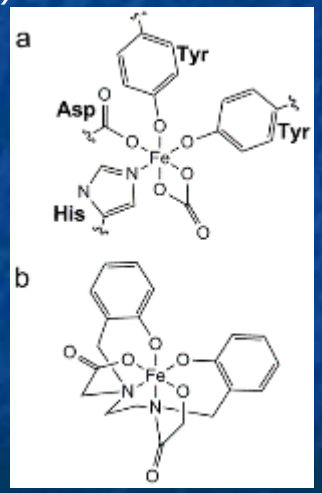
Developing Ti(IV)-Based Anticancer Drugs using Chemical Transferrin Mimetics

Arthur Tinoco

We seek to revolutionize the design of Ti(IV)-based anticancer drugs:

1. Using chemical transferrin mimetic (cTfm) ligands, which stably transport Ti(IV) into cells and release Ti(IV) to bind and deplete cells of Fe(III). This work will couple coordination chemistry and cell-based assays.
2. Bioconjugating bioactive proteins and peptides to the cTfm moieties to facilitate passive and active targeting of cancer cells. MALDI TOF experiments will provide for structure confirmation.
3. Performing metallomics studies to determine the intracellular molecular targets of Ti(IV) to improve the drug design using the MSRC mass spectrometry facilities.





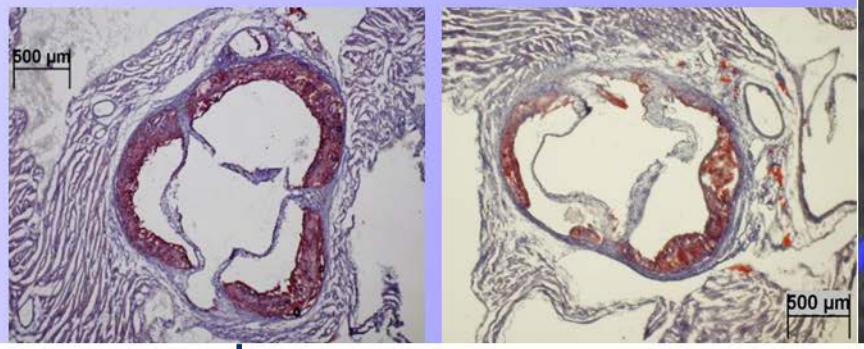
a. The transferrin metal binding site
b. A cTfm representative.

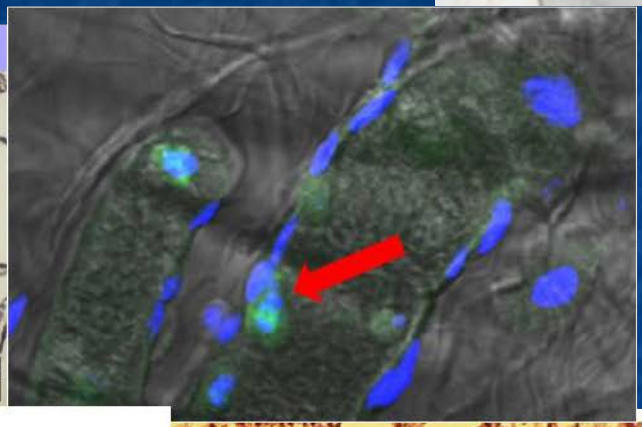
Dr. A. Valance Washington Laboratory

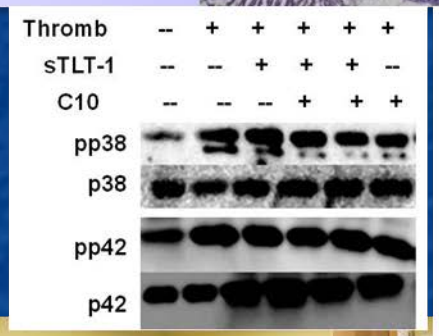
Cardiac Physiology

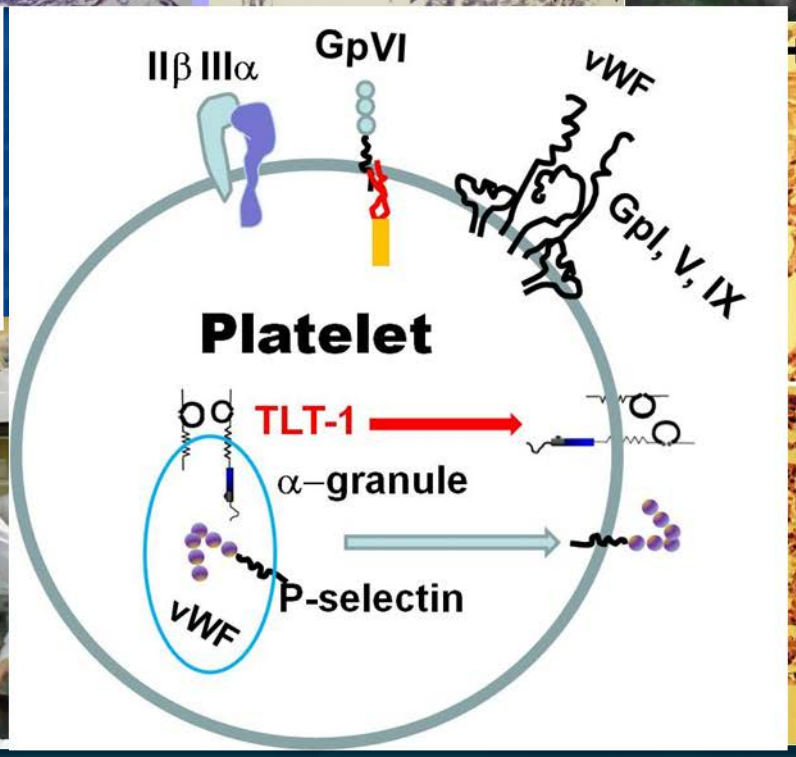
Ph.D., 1998; Southern Methodist University, Dallas, TX

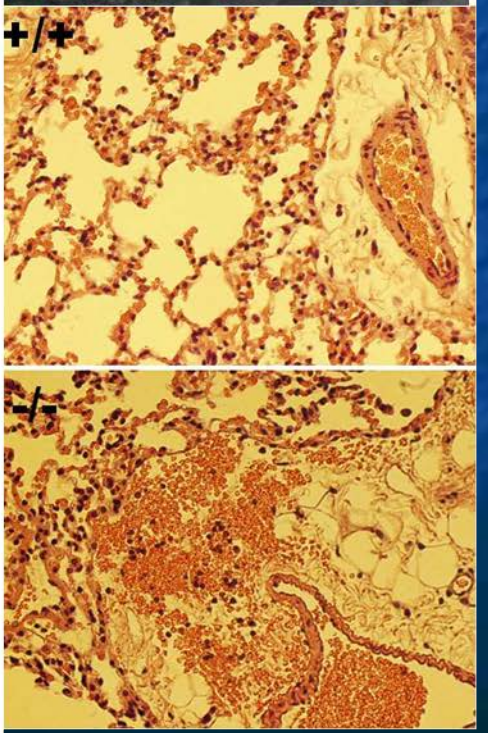
12 wks HFD











MSRC Research Instrumentation

Characterization Techniques:

- Bruker Aeon 700 MHz NMR System
- JEOL Scanning Electron Microscope with EDAX detector
- Physical Electronics Auger Spectroscopy Model PHI 600
- Physical Electronics X-ray photoelectron Spectroscopy Quantum 200
- Physical Electronics X-ray photoelectron Spectroscopy PHI 5600 with SIMS
- Thermo Scientific Nicolette FTIR Microscope coupled to Raman
- Bruker ATR-FTIR
- Bruker Atomic Force Microscope with STM and bipotentiostat capability
- Perkin Elmer Thermogravimetric Analyzer with Autosampler Model STA 6000
- Rikagu X-ray diffraction unit for thin films and powders.

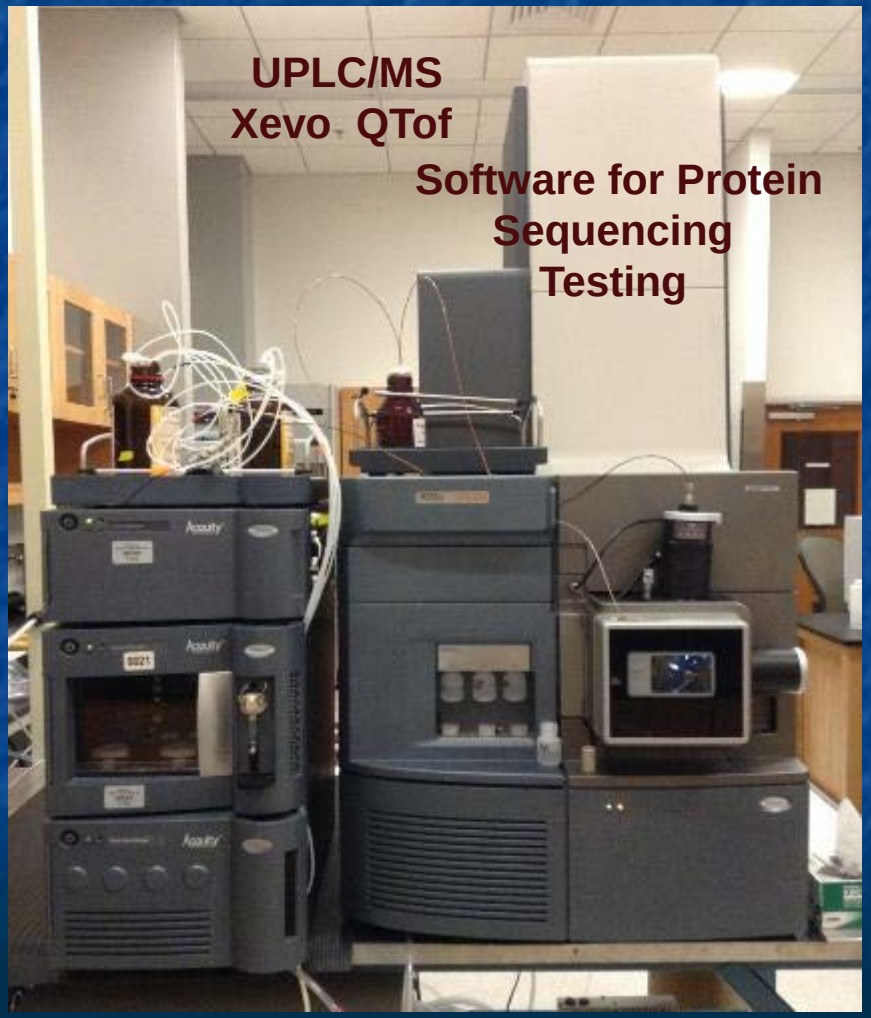
Analytical Techniques:

- Perkin Elmer Inductively Coupled Plasma-Atomic Emission Model OPTIMA 800
- Agilent GC-MS
- Waters Xevo Q-TOF UPLC-MS
- Bruker GC-MS with autosampler
- Bruker HPLC-MS with autosampler
- Shimadzu RF Fluorimeter
- Shimadzu Protein Sequencer

Other:

- Cryostats, Multipotentiostat/galvanostat
- Eppendorf Realplex EP mastercycler

Proteomics and Mass Spectrometry Facility



GC/MS/MS

Two (2) GC/MS/MS
MCC & Bruker Inst.
Collaboration

Equipment for Protein Sequencing Testing

High Throughput Protein Crystallization
(2nd Floor)

Mosquito - Nanodispensing robot

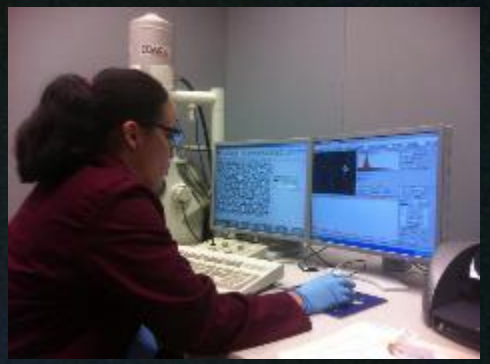
Nikon Center of Excellence in Microscopy/ Confocal Microscopes

msrc
MOLECULAR SCIENCES
RESEARCH CENTER

FTIR Microscopy

Scanning X-ray Photoelectron Microprobe PHI QUANTUM 2000

Scanning Electron Microscopes – MCC's Collaboration



Phase-2 NMR 700 MHz Facility

- Installed Sep 2014
- Appropriate space a and infrastructure
- High level of expertise

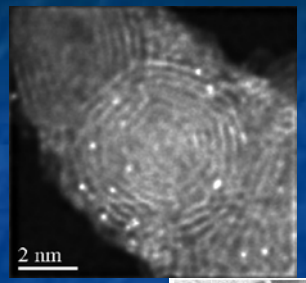
Nanoscopy Facility

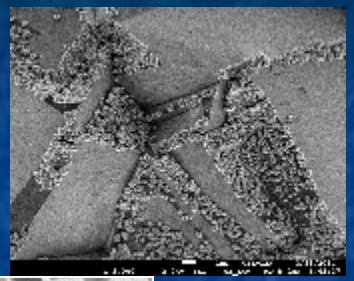
http://nanoscopy.ifn.upr.edu/

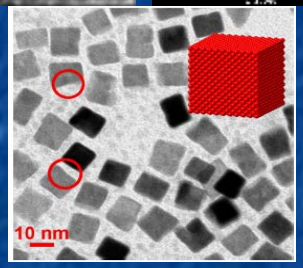
MOLECULAR SCIENCES RESEARCH CENTER

Zeiss LEO 922 EF TEM

LEICA EM UC6 ultra-microtome







JEOL-2100F TEM (UPR-M)

JEOL-9310 FIB system

JEOL-7500F SEM

JEOL-2200FS HRTEM

NSF

NASA

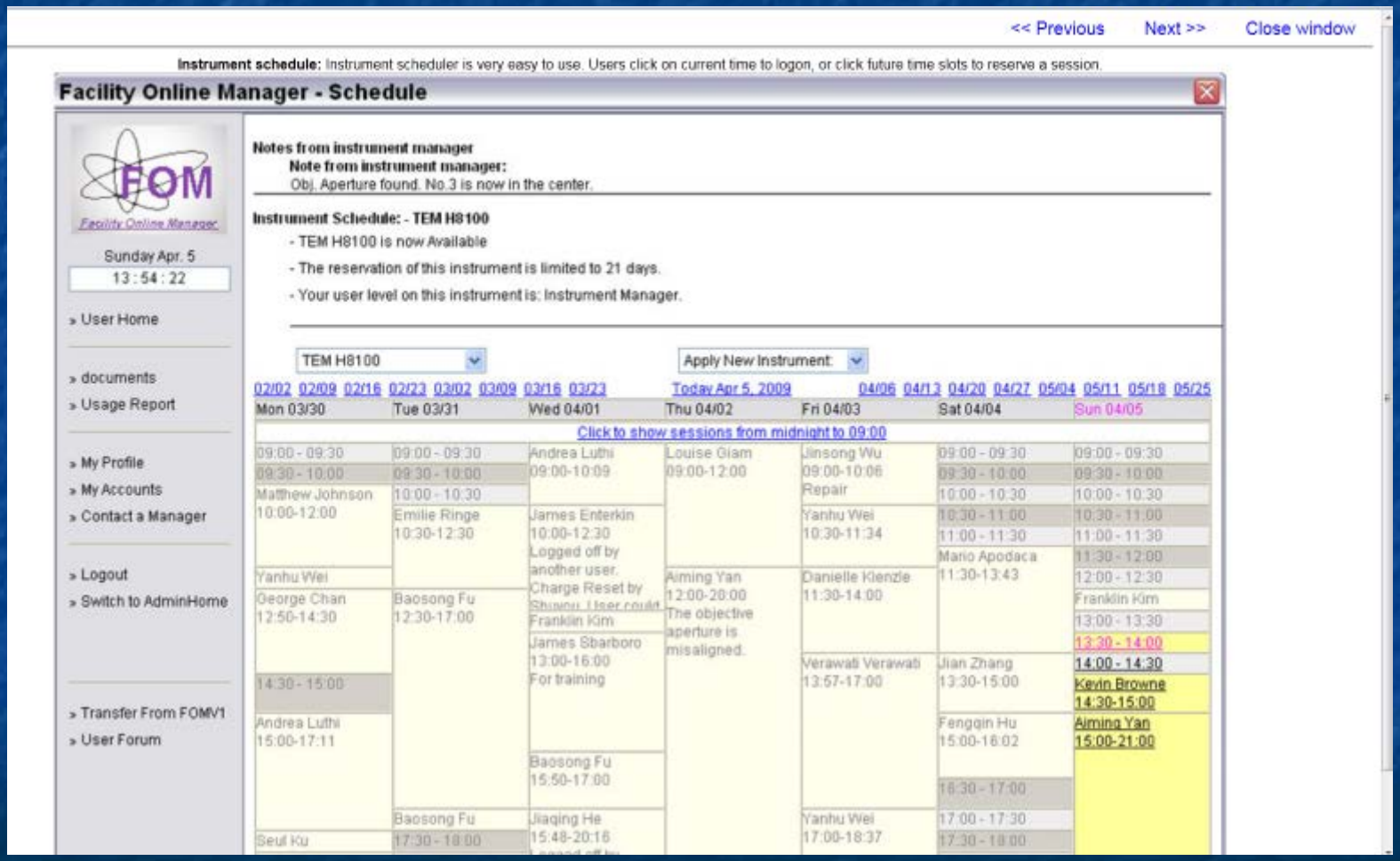
Other Instrumentation Phase-2:

Transmission Electron Microscopy

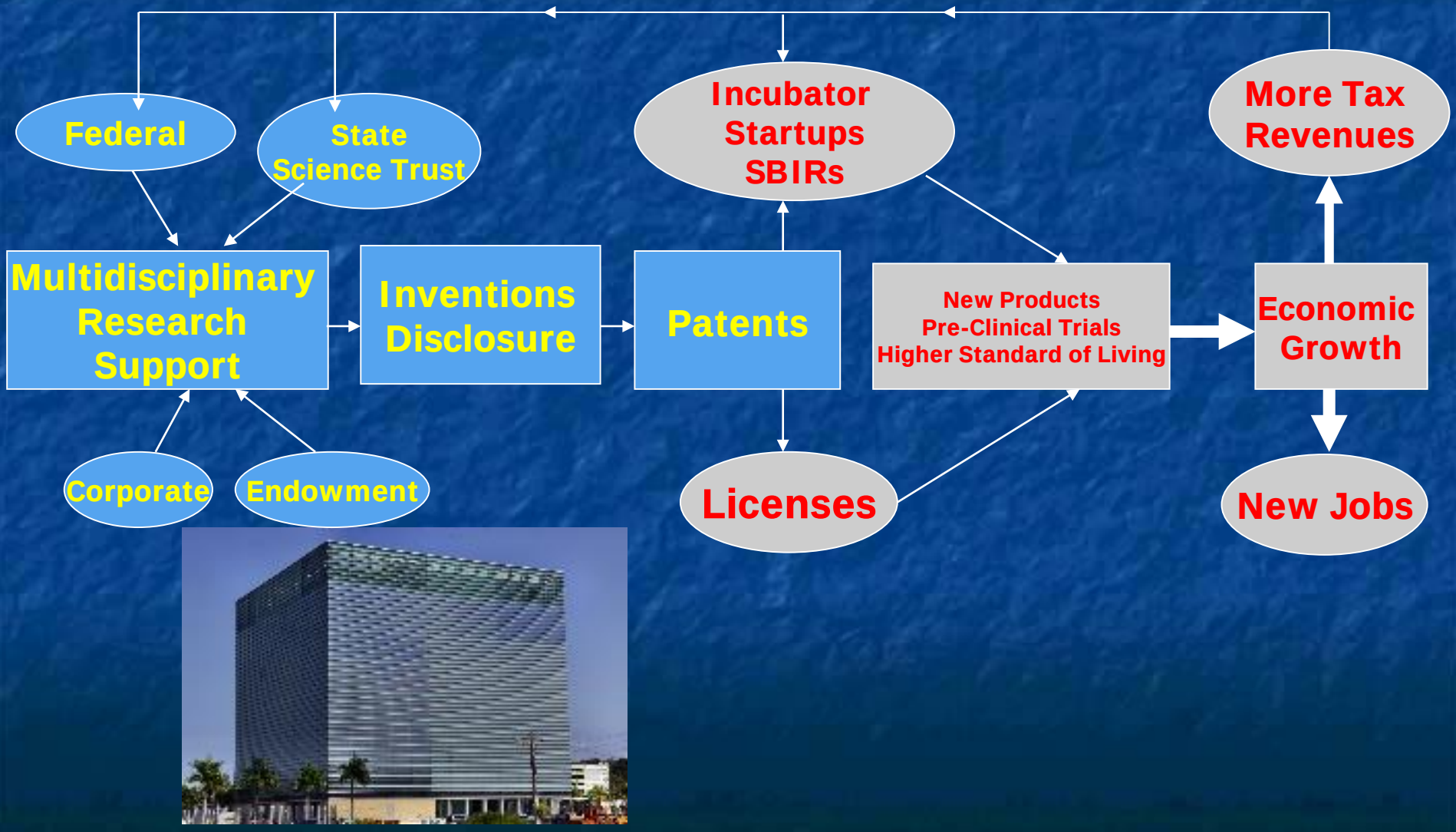
Scanning Electron Microscope

Transgenic MRI

MSRC Instrument Log-in and Management Platform_ FOM Networks System



Stages of UPR Technology Transfer:
From Research Support to Economic Growth



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