THE
ANA G. MÉNDEZ UNIVERSITY SYSTEM (AGMUS)
AND THE
STUDENT RESEARCH DEVELOPMENT CENTER (SRDC)

ARE PROUD TO HOST THE

WINTER 2008 PRE-COLLEGE RESEARCH SYMPOSIUM

SHOWCASING MINORITY HIGH SCHOOL STUDENTS' MENTORED RESEARCH

Leadership at SUAGM Vice Presidency for Planning and Academic Affairs

Mr. Jorge L. Crespo Armáiz
Vice President for Planning and Academic Affairs

Juan F. Arratia, Ph. D.
Student Research Development Center
Executive Director

UNIVERSIDAD METROPOLITANA CAMPUS

SAN JUAN, PUERTO RICO

January 31, 2009

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National Science Foundation
AGMUS Institute of Mathematics
Student Research Development Center
Ana G. Méndez University System

MISSION

The Model Institutions for Excellence (MIE) award granted by the National Science Foundation helped transform Universidad Metropolitana (UMET) into a nationally recognized undergraduate research institution, and a model in science, technology, engineering and mathematics (STEM). Mentoring of undergraduates and pre-college students by research mentors was the cornerstone of the MIE Project. We believe that creative research is one of the best ways to prepare students to become persistent and successful in graduate school and professional careers. Today, the Student Research Development Center (SRDC) is the entity that continues the MIE strategy by impacting students from the AGMUS System and universities across the nation, as well as pre-college students from the Puerto Rico Educational System.

EXECUTIVE SUMMARY

The MIE entered its thirteenth and final year of a cooperative agreement between the National Science Foundation and UMET. The primary goal of the cooperative agreement was to increase the number of BS degrees granted to underrepresented students in STEM fields at Universidad Metropolitana. In order to increase the number of BS degrees transferred to graduate school, we will continue with the strategy of an early undergraduate research program and partnership with key research institutions in the US mainland, Puerto Rico and abroad. Research mentoring will be the central component of the knowledge transfer and creative thinking activities at AGMUS. Cooperative and collaborative learning strategies, presentations at scientific conferences, scientific writing and co-authorship, technology literacy, and preparation for graduate school are activities that are transforming the philosophy of the institution.

GOALS

The main goal of the AGMUS Pre-College Research Symposium is to: encourage pre-college research with research mentors; develop students' written and oral communication skills; provide a forum in Puerto Rico for students to foster interest in undergraduate education, particularly in STEM fields; and set national research standards for pre-college research presentations.

ANA G. MENDEZ UNIVERSITY SYSTEM
STUDENT RESEARCH DEVELOPMENT CENTER
AGMUS INSTITUTE OF MATHEMATICS

WINTER 2008 PRE-COLLEGE RESEARCH SYMPOSIUM

CONFERENCE AT A GLANCE

SATURDAY, JANUARY 31, 2009	**UMET AMPHITHEATER**
7:00 – 8:00 a.m.	Poster Session Set-Up/Continental Breakfast/ Registration, Muñiz Suffront Building Lobby
8:00 – 8:30 a.m.	Opening Ceremony Keynote Speaker Dr. Juan Ramón Pardo Instituto de Estructura de la Materia Consejo Superior de Investigaciones Científicas, Madrid, España "Moléculas en el Espacio"
8:30 – 10:00 a.m.	Poster Session, Muñiz Suffront Building Lobby
10:00 – 11:30 m.	Oral Research Presentations
11:30 – 12:30 p.m.	Award Ceremony and Closing Remarks
12:30 – 1:00 p.m.	Brunch
1:00 p.m.	Symposium Adjourns
WORKSHOP	
1:00 – 3:30p.m.	Introduction to Scientific Computing Using MATLAB Room IC-301

Developing Minds Through
Research Experiences

January 31, 2009

Pre-College Students:

The Winter 2008 Pre-College Research Symposium is the culmination of the activities and dissemination process of the Saturday Academy Program of the Ana G. Méndez University System (AGMUS). For a period of four months, since August of 2008, more than forty pre-college students from private and public high schools in Puerto Rico worked long hours in the research laboratories of the Departments of Science and Technology at UMET with the guidance and mentorship of five college professors and student research mentors in thirty-four research projects in the areas of biological sciences, computational chemistry, bioastronomy, atmospheric sciences (Global Microscope), and applied mathematics.

One of the objectives of the Winter 2008 Pre-College Research Symposium is to offer young motivated high school researchers the opportunity to learn and to practice their communication skills in a formal professional scientific meeting. A second objective is to give high school students of Puerto Rico a forum for the presentation of the results and findings of their research projects to teachers, researcher mentors, family members, and the university community at large.

The Ana G. Méndez University and the Student Research Development Center are proud of the results obtained by the pre-college students and their mentors in the Fall 2008 Saturday Academy Program and the Winter 2008 Pre-College Research Symposium. I hope your experience inspires you and your peers to select science, technology, engineering or mathematics as your field of study in the near future.

My sincere appreciation goes to the Student Research Development Center staff, student research mentors and faculty from Arizona State University, the New Jersey Institute of Technology, and the Spanish Research Council (CSIC) for their effort and commitment to implement the Fall 2008 Saturday Academy Program and the Winter 2008 Pre-College Research Symposium. This event would not have been possible without the ongoing support of the National Science Foundation and the NASA Puerto Rico Space Grant Consortium.

Sincerely yours,

Juan F. Arratia, Ph. D.
Director and Principal Investigator

ANA G. MÉNDEZ UNIVERSITY SYSTEM (AGMUS)

As an Educational Institution

The Ana G. Méndez University System is home to approximately 40, 000 undergraduate and graduate students who are mainly underrepresented low-income minority students from the Metropolitan San Juan area in Puerto Rico. Three institutions form the AGMUS University System: Universidad Metropolitana (UMET), Universidad del Este (UNE), and Universidad del Turabo (UT). UMET has been a teaching institution since its foundation in 1948. Today, however, its philosophy has been changing to address the students' study needs and the requirements of society. Our President, Mr. José F. Méndez, has set the agenda to have it become the best undergraduate research institution in Puerto Rico. Additionally, the President has set the goal to implement the MIE best practices at UNE and UT and transform AGMUS into a leading undergraduate research institution through the creation of the Student Development Center at the Vice Presidency for Planning and Academic Affairs. The Executive Director of the Student Research Development Center is Dr. Juan F. Arratia, who has set to accomplish this goal by 2010.

As an Undergraduate Research Institution

In 1995, UMET was selected by the National Science Foundation as a Model Institution for Excellence (MIE) school. At that time, a five-year Cooperative Agreement for more than $11 million was signed between UMET and the NSF. A second Cooperative Agreement was signed on October 1, 2000 for an additional three years and for $7.5 million. The third phase of the MIE grant for $2.5 million for three additional years was awarded on October 1, 2003. The main objective of the relationship with NSF has been to transform UMET into a model for Hispanic Serving Institutions in the nation. Our major goal has been to increase the number of BS degrees granted by UMET, to transfer a significant number of science students to graduate school, and to enroll them in Ph. D. programs to fulfill the goals and aspirations of a greater participation of minorities in the science, mathematics, and engineering fields. After 13 years of funding, UMET has been transformed through the MIE activities by producing an effective pipeline from pre-college to undergraduate, and from undergraduate to graduate school for hundreds of underrepresented minorities from Puerto Rico.

UMET has been transformed by the MIE Project into a leading national undergraduate and pre-college research institution where faculty research mentors are helping science students create knowledge and disseminate creative thinking among the members of the university and pre-college community. Our undergraduate and pre-college research program, sponsored by the National Science Foundation and NASA, is paving the way for research-oriented activities for the benefit of Puerto Rico students.

PROLOGUE

The sponsorship of the National Science Foundation has been fundamental for the implementation of the Pre-College Program at the Ana G. Méndez University System (AGMUS) at Universidad Metropolitana (UMET). For thirteen years, the Model Institutions for Excellence (MIE) Project organized the Saturday Academy Program. In 2006, a new dimension was established with the dissemination of the MIE best practices into Universidad del Turabo and Universidad del Este (UNE) under the Student Research Development Center. The main goal of this program is to motivate high school students to pursue careers in science, technology, engineering and mathematics at the BS and graduate levels. The Saturday Academy Program usually extends for sixteen weeks during the months of August through December. Students from public and private schools, enrolled in grades 10, 11 and 12, conduct research under the mentorship of faculty and student research mentors from AGMUS and institutions in the US mainland and abroad. More than two thousand pre-college students have learned the fundamentals of scientific research through their participation in the Saturday Academy Program at AGMUS. For the last six years, a symposium has been organized to present the results of this activity to the university community and to motivate other Puerto Rican students to engage in scientific research.

The Winter 2008 Pre-College Research Symposium held at the campus of Universidad Metropolitana on January 31, 2009 showcases the research experiences of forty-three (43) pre-college students from seventeen high schools in Puerto Rico. Thirty-four research projects are presented at the Symposium in the form of posters and oral presentations. The mentorship of five faculty and student research mentors from the Department of Science and Technology at UMET made possible the concretization of the research projects. Their results are documented in the pages of this booklet.

The National Science Foundation, NASA/Puerto Rico Space Grant Consortium, the Ana G. Méndez University System, and the Student Research Development Center are proud of the research work conducted by the Saturday Academy Winter 2008 participants. We hope this Symposium will be a vehicle by which the scientific productivity of high school youngsters from Puerto Rico will be disseminated in future years.

KEYNOTE SPEAKER

Dr. Juan R. Pardo-Carrión
Spanish Research Council (CSIC)

Dr. Juan R. Pardo-Carrión is a Research Scientist at the Consejo Superior de Investigaciones Científicas (CSIC) in Spain. He has an MS in Fundamental Physics and another one in Astrophysics from Complutense University in Madrid. His doctorate is in Astrophysics and Spatial Techniques from Pierre et Marie Curie University in Paris. His doctoral dissertation was on “Studies of the Terrestrial Atmosphere Through Observations in Longitudes of Millimetric and Submillimetric Wavelenghts.” He has published many referreed articles and book chapters. His most recent publications include: "Tentative detection of phosphine in IRC+10216" (2008); "Understanding the chemical complexity in Circumstellar Envelopes of C-Rich AGB stars: the case of IRC+10216" (2008); "Detection of circumstellar CH2CHCN, CH2CN, CH3CCH, and H2CS" (2008); and "Development of precipitation retrievals at millimeter and sub-millimeter wavelengths for geostationary satellites" (2008). Dr. Pardo has made contributions to several areas of radiative transfer and remote sensing mainly through developing the "Atmospheric Transmission at Microwaves" (ATM) model. He has participated in a series of experiments aimed at refining our understanding of the longwave spectrum of the atmosphere and the planets using a Fourier Transform Spectrometer installed at the Caltech Submillimeter Observatory in Hawaii. Besides, he has conducted studies using different longwave telescopes aimed at determining the physical and chemical conditions of Galactic molecular clouds and circuestellar envelopes, achieving a wide experience in the observational techniques involved in ground-based millimeter and submillimeter astronomy. He has conducted observations at Guadalajara and Granada in Spain, Plateau de Bure in France, Kitt Peak in Arizona, and Mauna Kea, Hawaii. His research interests include: Fourier Transform Spectroscopy, Observational Techniques in Submillimeter Astronomy, Microwave and IR spectroscopy, Interstellar and circumstellar media, Radiative transfer in planetary atmospheres, Terrestrial and planetary remote sensing from ground and satellite platform and Electromagnetic scattering by hydrometeors. Dr. Pardo holds the office of vice-mayor of his home town (Fuentealbilla, Spain) and is in charge of education and culture. He is deeply involved in numerous projects to promote culture among people of all ages.

WORKSHOP SPEAKER

Reynaldo Castro-Estrada
Ph.D. Candidate
Arizona State University

Reynaldo Castro Estrada was born in San Juan, Puerto Rico. He is a PhD Candidate student in the program of Applied Mathematics in Life and Social Sciences and obtained his Masters in Mathematics from Arizona State University. He completed his Bachelor degree in Computer Science from Universidad Metropolitana in San Juan, Puerto Rico. He is a graduate of the Vocational Technical High School, Trujillo Alto, Puerto Rico. Reynaldo Castro-Estrada has worked in a number of important internships such as NASA, Goddard Space Flight Center located in Greenbelt, Maryland and in The Center of Nonlinear Studies at Los Alamos National Lab. His research interest is in Numerical Analysis, Social Network Analysis, Math Biology and Dynamic Systems. He has also made contributions to different research work such as "*Coherence Resonance in the SIR model via Stochastic Parametric Forcing," "Deterministic Approach to the Spread of Rumors" and "Building mixture trees from binary sequence data."* He has had several honors and awards including the DOD-Air Force Office of Scientific Research Grant Research Assistantship in 2007 and the Alfred P. Sloan Foundation Minority PhD Program award in 2006. He was also awarded a Minority Participation Fellowship Bridge to doctorate from 2004 to 2006. Reynaldo is now looking forward to complete his PhD. He is planning to work with the U.S. federal government or as a professor in the academia.

Workshop: **Introduction to Scientific Computing using MATLAB**

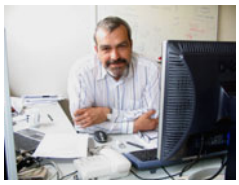
This workshop consists in how interdisciplinary studies can solve important research problems in our lives, such as outbreak diseases (measles, chickenpox, HIV), demography populations, spread of information, etc. These kinds of problems have been attacked with the sound scientific knowledge to construct mathematical models, which can explain the problem in a simple way. These mathematical models require different types of computational algorithms to solve the problem. This workshop is divided into two parts: (i) a PowerPoint presentation that will show how to study in detail these scientific problems in an interdisciplinary level. (ii) the use of a computer lab. to simulate a few mathematical models applied to biology. The visualization of mathematical models and solutions will be accomplished by means of the MATLAB Software.

RESEARCH MENTORS

Dr. Juan F. Arratia
Executive Director
Student Research Development Center

Principal Investigator
AGMUS Institute of Mathematics
Universidad Metropolitana

Dr. Juan F. Arratia was born in Pomaire, Chile. He graduated from Universidad Técnica del Estado with a BS in Electrical Engineering in 1973. He was awarded an MSc in Engineering from Louisiana Tech University, Ruston, Louisiana, in 1979 and a Ph.D. in Electrical Engineering from Washington University, St. Louis, Missouri in 1985. He has taught and conducted research at universities in Chile (Universidad Técnica del Estado and Universidad Austral de Chile), Puerto Rico (Universidad Interamericana de Puerto Rico and the University of Puerto Rico-Mayaguez), and in the US mainland at Washington University, St. Louis, and Louisiana Tech University, Ruston, Louisiana. He has lectured and given conferences on advanced automation, robotics, vision systems, artificial intelligence, total quality management and science and engineering education in Chile, Bolivia, Ecuador, Guatemala, Panama, Mexico, Brazil, Nicaragua, Perú, Canada, Spain, the Netherlands, Turkey, Japan, Philippines, Singapore, Australia, China, Puerto Rico and in the US mainland. He was the Advanced Manufacturing Manager for Medtronic, Inc., a leading pacemaker company, and is a consultant in advanced automation for pharmaceutical and medical devices companies in Puerto Rico. Since 1998, he has been the Director and Principal Investigator of the Model Institutions for Excellence (MIE) Project, a National Science Foundation sponsored program based at Universidad Metropolitana in San Juan, Puerto Rico. Since 2007, he is the Executive Director of the Ana G. Méndez University System (AGMUS) Student Research Development Center, designed to disseminate MIE best practices at Universidad del Turabo and Universidad del Este. In November 2007 he was awarded the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring at a ceremony in the White House in Washington DC.



Dr. José Cernicharo Quintanilla
Spanish Research Council (CSIC)

Dr. José Cernicharo Quintanilla studied his Bachelor's and Master's Degrees in Physics at Universidad Complutense de Madrid and his Ph.D at the Université de Paris VII. He has worked in the Observatories of Meudon (1979, 1981-1982), Bordeaux (1980-1981), Grenoble (1982-1988), Institut D'astrophysique de Paris, Max Planck Institut Fur Radioastronomie in Germany, Observatoire de Bordeaux, IRAM, the Yebes Astronomical Center, Institute of Technology of California (CALTECH), INAOE in Puebla, Mexico, Observatoire de Paris, and at the CSIC. His most recent publications for 2008 include: A Detailed Analysis of the Dust Formation Zone of IRC+10216 Derived from Mid-IR Bands of C_2H_2 and HCN; Detection of Circumstellar CH_2CHCN, CH_2CN, CH_3CCH, AND H_2CS; Search for Anions in Molecular Sources: C_4H^- Detection in L1527; Discovery of C_3N^- in Space; The Molecular Hydrogen Explorer H2EX; Physical Parameters for Orion KL from Modelling its ISO High Resolution Far-IR CO Line Spectrum; Tentative Detection of Phosphine in IRC +10216; Formation of Simple Organic Molecules in Inner T Tauri Disks; Solving Radiative Transfer with Line Overlaps Usin the Gauss-Seidel Algorithms; Star Formation in the Trfid Nebula Cores and Filaments; and Millimetron-A Large Russian-European Submillimeter Space Observatory. He has offered many conferences in schools, universities, astronomy associations, at national meetings, cultural associations and in different countries. His scientific research has been in the news in Europe, in the Science journal, and in local and international newspapers.

Cesar Banderas, Ph.D.
New Jersey Institute of Technology
Bandemar Networks, Inc.

Dr. César Banderas studied his Bachelor's and Master's Degrees in Electrical Engineer at the University of Buffalo in New York and was certified in Executive Development at Harvard School of Management in Boston, Massachusetts. He is the President of BanDeMar Networks, a minority owned small company specializing in advanced video solutions for e-learning markets. Dr. Banderas' technical background is in active perception, which combines real-time computer vision and other sensor modalities with machine learning and behavioral control. He is interested in all aspects of active vision, including algorithms for signal processing and control, sensor VLSI, and multiprocessing architectures. His experience in active perception comes largely from his work in foveal vision, which exploits in the machine setting the multiacuity properties prevalent in vertebrate vision. Since the peak of broadband multimedia investments by the telecommunications industry, Dr. Banderas has been active in the field of pervasive rich media. This field endeavors to provide spatiotemporally coordinated multimodal streams to an audience with diverse demographics, player platforms and channel access (e.g., broadband-connected PCs, wireless PDAs, set-top boxes). In 1990, Dr. Banderas formed a research department at Amherst Systems dedicated to the development and application of active vision. This work yielded operational platforms with algorithms for video understanding and automaton behavior control, matching multiprocessor architectures, and smart VLSI imaging sensors (imagers with monolithic signal processing). He has had profit/loss responsibility, and was able to secure external funding for all R&D (over twenty customer grants and contracts) while exceeding growth and profit estimates. To date, this active vision research has yielded six Ph.D. and four M.S. degrees, several patents, highest distinction in the Air Force Small Business Innovative Research Accomplishments Report to the U.S. Congress, a Small Business of the Year nomination from Rome Lab, and the 1999 NASA Space Act award from Johnson Space Center. In 2001, he formed a research department at Manhattan-based Sorceron (now BanDeMar) dedicated to the synthesis and delivery of object-oriented rich media. As CTO, Dr. Banderas is member of the Association for Computing Machinery, Institute of Electrical and Electronics Engineers, and the International Society for Optical Engineering.

Dr. Sudhir Kumar
Arizona State University

Dr. Sudhir Kumar is professor of biology at Arizona State University, where he teaches undergraduate-level evolutionary biology and graduate-level evolutionary genomics classes. He is a standing member of the NIH review panel and a member of many journal editorial boards, including Molecular Biology and Evolution, Genome Research, Evolutionary Bioinformatics Online, and Gene: Functional Genomics. Dr. Kumar is currently the webmaster for the Society for Molecular Biology and Evolution and the American Genetic Association. He received his B.E. in Electrical/Electronics Engineering and M.Sc. in Biological Sciences from the Birla Institute of Technology and Sciences in India, and his Ph.D. in Genetics from Pennsylvania State University.

Dr. Kumar leads a team of interdisciplinary scientists who are developing new computer-based methods of studying and analyzing the tens of thousands of genes in humans and related species, enabling researchers to learn their functions and origins. Dr. Kumar is a renowned expert in the field of evolutionary bioinformatics, who received an Innovation Award in Functional Genomics from the Burroughs Wellcome Fund in 2000. In 2004 he joined the elite ranks of most-cited researchers, being among the top ten in number of citations in the field of computer science over the last decade. Among his more than 70 papers and books are three "Hot Papers," which were cited among the most of any in their fields.

Dr. Kumar is an interdisciplinary scientist who brings the problem-solving skills from his undergraduate engineering background together with his knowledge of evolutionary genetics from his doctoral work to tackle long-standing problems in functional genomics and evolutionary biology. He has made pioneering efforts in developing bioinformatics tools and databases for the analysis of gene expression patterns from early stages of the fruit fly development. He has also conducted breakthrough work using protein molecular clocks to illuminate the Evolutionary Timescale of Life. Over the last decade, Dr. Kumar has led the team that developed the Molecular Evolutionary Genetics Analysis (MEGA) software in order to make useful methods of comparative sequence analysis easily accessible to the scientific community for research and education. His research is funded by National Institutes of Health and the National Science Foundation, among other agencies.

ANA G. MENDEZ UNIVERSITY SYSTEM
UNIVERSIDAD METROPOLITANA

AGMUS INSTITUTE OF MATHEMATICS

BS Degree in Applied Mathematics *

Bio-Mathematics

Benefits:

- National Science Foundation Scholarship for up to $4,000/year
- Tutoring, mentoring and academic advising through AGMUS Institute of Mathematics
- Summer Research Internship opportunity at major US universities: Arizona State University, Rice University, University of California at Berkeley, Howard University, Cornell University, among others
- Transfer to Master and Ph.D Program in Biomathematics at US research institutions after graduation
- Pre-College Program starts in September 2008

* Submitted to the Council on Higher Education (CHE)

For more information, please contact Dr. Juan F. Arratia, Executive Director, Institute of Mathematics, Tel. (787) 766-1717 Ext. 6000, email: um_jarratia@suagm.edu,
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Sistema Universitario
Ana G. Méndez

SCHEDULE OF EVENTS

SATURDAY, JANUARY 31, 2009 — UNIVERSIDAD METROPOLITANA

7:00 – 8:00 am. **POSTER SESSION SET-UP** — **LOBBY MUÑIZ SOUFFRONT BUILDING**
Continental Breakfast
REGISTRATION

POSTER SESSION SET-UP

8:00 – 8:30 a.m. **OPENING CEREMONY** — **AMPHITHEATER**

Welcome : Dr. Juan F. Arratia
Executive Director
Student Research Development Center

Keynote Speaker: Dr. Juan R. Pardo-Carrión,
Spanish Research Council (CSIC)

8:30 – 10:00 a.m. POSTER SESSION — LOBBY MUÑIZ SOUFFRONT BUILDING

BIOLOGICAL SCIENCES
COMPUTATIONAL CHEMISTRY/ BIOASTRONOMY
ATMOSPHERIC SCIENCES (GLOBAL MICROSCOPE)
APPLIED MATHEMATICS

Chairperson: Dr. Juan F. Arratia
Executive Director
Student Research Development Center

BIOLOGICAL SCIENCES

Frances Negrón, Bautista de Levittown School, Toa Baja, Puerto Rico. **(1)**

Hereditary Diseases Caused by Mutations in KCNQ1

Gilberto Robles, Bautista de Levittown School, Toa Baja, Puerto Rico. **(2)**

Evaluating NF1 Gene with SIFT and the Mega 4 Program

Zashari Brainin, Bautista de Levittown School, Toa Baja, Puerto Rico. **(3)**

Piebaldims Disease Caused by Mutations in Kit Gene

Mariela Rivera, San Vicente de Paúl School, San Juan, Puerto Rico. **(4)**

Porphyria: A Disease Caused by a Mutation in Gene HMBS

Tatiana Rosado, Bautista de Levittown School, Toa Baja, Puerto Rico. **(5)**

Study of Mutations in MUT: Lead Cause of Methylmalonic Acidemia

Stephany González, Bautista de Levittown School, Toa Baja, Puerto Rico. **(6)**

Mutations in HGD Gene Causing Alkaptonuria

Lorena Serrallés, San Vicente de Paúl School, San Juan, Puerto Rico. **(7)**

Analysis of Mutations of the Gene GJB1 in Humans

COMPUTATIONAL CHEMISTRY/BIOASTRONOMY

Carmen J. Reyes, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(8)**

Computational Study of Acetic Acid – CH_3C00H Found in Sagittarius B-2

Josean E. Lugo, San Juan Apóstol and Evangelista School, San Juan, Puerto Rico. **(9)**

Computational Study of Ethenon – H_2CCO – Found in Sagittarius B2

Gabriel Díaz, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(10)**

Computational Study of Acetone-$CH_3)_2CO$-Found in Sagittarius B2

Jann R. López, Nuestra Señora de la Altagracia School, San Juan, Puerto Rico. **(11)**

Computational Study of Sodium Cyanide – H_2CNH Found in Saggitarius B2

Miguel Durán, Nuestra Señora de Guadalupe School, San Juan, Puerto Rico. **(12)**

Computational Study of Etheneimine H_2CCNH Detected in Sagittarius B-2

Jonathan Irizarry, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(13)**

Computational Study of Formic Acid-HCOOH Found in Sagittarius B2

Natalia González, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(14)**

Computational Study of Vinyl Cyanide – C_2H_3CN Found in SGR B2 and TMC-1

ATMOSPHERIC SCIENCES (GLOBAL MICROSCOPE)

Lemuel A. Rosa and **Carlos Cabrera,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(15)**

Land Surface Temperature

Paola Güisao and Claudia Güisao, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(16)**

Chlorophyll Concentration

Julyannette O'Neill, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(17)**
Nicole Serrano, Berwind High School, San Juan, Puerto Rico.

The Effect of Solar Insolation on Global Warming

Andrea Jiménez and **Sarielis Carrasquillo,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(18)**

Northern Hemisphere Snow Cover and Ice Extent

Gilmarie López and **Priscilla M. Milán,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(19)**

Sea Surface Temperature

Hernando Rivera and **Orlando de la Rosa,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(20)**

Cloud Optical Thickness

Tatiana Zambrano, Miguel Such Vocational High School, San Juan, Puerto Rico. **(21)**

Study of Land Surface Temperature at Night

APPLIED MATHEMATICS

Nicole J. Flores, Bautista de Levittown School, Toa Baja, Puerto Rico. **(22)**

Learning About Bulimia and Mathematical Modeling

Yea Jin Ko and **Juan Rosa,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **(23)**

Modeling Aging Process of Cells Using MATLAB

Jennifer Gil, Carvin School, Inc., Carolina, Puerto Rico. **(24)**
Eduan Martínez, Bilingüe Padre Rufo School, San Juan, Puerto Rico.

Mathematical Representation of the Efficiency of Attention Deficit Disorder Treatment

10:30 – 11:40 a.m.	**ORAL PRESENTATIONS** BIOLOGICAL SCIENCES COMPUTATIONAL CHEMISTRY/ BIOASTRONOMY ATMOSPHERIC SCIENCES (GLOBAL MICROSCOPE) APPLIED MATHEMATICS

Chairperson: Lic. Luisa Mercado
Universidad Nacional de Ingeniería, Nicaragua

BIOLOGICAL SCIENCES

10:00 – 10:10 a.m. **José A. Arroyo,** Bautista de Levittown School, Toa Baja, Puerto Rico.

Albinism Disease Caused by Mutations in OCA2 and GPR143

10:10 – 10:20 a.m. **Susana Soto,** Bautista de Levittown School, Toa Baja, Puerto Rico.

Evaluation of Differences in the JAG1 Mutations

10:20 – 10:30 a.m. **Sebastián González,** Ramón Vila Mayo High School, San Juan, Puerto Rico.

Effect of PTEN Mutations on Cancer

COMPUTATIONAL CHEMISTRY/BIOASTRONOMY

10:30 – 10:40 a.m. **Amanda M. Rolón,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Computational Study of Sodium Cyanide-NACN Found in the Egg Nebula

10:40 – 10:50 a.m. **Luis O. Betancourt,** Thomas Alva Edison School, Caguas, Puerto Rico.

Computational Study of Formyl Cyanide – HC(0)CN – Found in SGR B-2

10:50 – 11:00 a.m. **Camila del Mar Rodríguez,** Colegio Puertorriqueño de Niñas, San Juan, Puerto Rico.

Computational Study of Hydroxymethylium – H_2COH+ Found in Multiple Places in Space

ATMOSPHERIC SCIENCES (GLOBAL MICROSCOPE)

11:00 – 11:10 a.m. **Pedro Jiménez** and **Jesús O'Neill,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Displaying Regional Information on the Global Microscope in Picture-In-Picture Format

11:10 – 11:20 a.m. **Alan D. Bernier** and **Rubén García,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

How Plants are Affected by Climate Change

APPLIED MATHEMATICS

11:20 – 11:30 a.m. **Christian Moctezuma,** Bautista de Levittown School, Toa Baja, Puerto Rico.

Mathematical Representation of the Efficiency of Attention Deficit Disorder Treatment

11:30 – 11:40 a.m. **Franco Del Valle,** Petra Zenón de Fabery Vocational School, Trujillo Alto, Puerto Rico.

Fundaments of Dynamic Systems Applied to Robot Modeling

11:40 – 12:30 m. **AWARD CEREMONY AND CLOSING REMARKS** **AMPHITHEATER**

12:30 – 1:00 p.m. **BRUNCH** **GAZEBOS**

1:00 p.m. **SYMPOSIUM ADJOURNS**

1:00 – 3:30 **WORKSHOP "INTRODUCTION TO SCIENTIFIC COMPUTING USING MATLAB"** **ROOM IC-302**

ABSTRACTS
BIOLOGICAL SCIENCES

HEREDITARY DISEASES CAUSED BY MUTATIONS IN KCNQ1

Frances Negrón, Bautista de Levittown School, Toa Baja, Puerto Rico.

Research Mentors: Dr. Juan F. Arratia, Executive Director, Student Research Development Center, Ana G. Méndez University System, San Juan, Puerto Rico; Dr. Sudhir Kumar, Department of Biology, Arizona State University, Tempe, Arizona.
Student Research Mentor: Cristina Rivera, Universidad Metropolitana, San Juan, Puerto Rico.

Diseases are caused 90% of the time by mutations in the genome. The KCNQ1 gene, which is located in chromosome 11, was studied. Some of the mutations found that affected this gene are: S140G; V205M; W248F; V254M; I313K; T322M; A341V; M520R; P448R; V417M; A49T. Mutations in this gene are associated with hereditary long QT syndrome, Romano-Ward syndrome, Jervell and Lange-Nielsen syndrome and familial atrial fibrillation. These syndromes cause electrocardiography, syncopal attacks, congenital sensor neural and hearing loss symptoms. The SIFT program was used to search for the severity of those mutations, if they are going to be tolerated or not by a person. After that the MEGA4 program was used to compare the human gene with other species to study the evolution of the human genome through time.

ALBINISM DISEASE CAUSED BY MUTATIONS IN OCA2 AND GPR143

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The objective of this project is to learn about the gen Oca2 type 2 or GPR142 type 1. These are the genes that cause albinism. Albinism is a genetic disease that shows congenital absence of melamine pigment in the skin and affects humans and animals. This genetic condition is caused by the mutation of the gene Oca2 type 2 or the GPR143 type 1. Persons who have this disease should not be exposed for much time to sunlight. The gene Oca2 is located in chromosome 11. Mutations affect the protein Tyrosine. Most people affected by this disease are Latins, both males and females. The SIFT program was used to study the severity of changes in amino acids and if they are tolerated or not by humans. The goal also was to see how the gene has evolved comparing it with other species in a time change frame.

EFFECT OF PTEN MUTATIONS ON CANCER

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The PTEN (phosphatase and tensin homolog) gene provides instructions for making a protein that is found in almost all tissues in the body. This protein acts as a tumor suppressor, which means that it helps regulate the cycle of cell division by keeping cells from growing and dividing too rapidly or in an uncontrolled way. The PTEN enzyme acts as part of a chemical pathway that signals cells to stop dividing and triggers cells to undergo a form of programmed cell death called apoptosis. These functions prevent uncontrolled cell growth that can lead to the formation of tumors. Mutations in this gene contribute to the development of multiple advanced cancers. The program SIFT (Sorting Intolerant From Tolerant) was used to predict whether an amino acid substitution affects protein function based on the sequence and the physical properties of amino acids. Homolog species were chosen and analyzed using MEGA4 (Molecular Evolutionary Genetics Analysis 4) to see if there is an evolutionary change in the different species throughout time. MEGA4 is an integrated tool used for sequence alignment, phylogenetic trees, and estimating rates of molecular evolution, among others features. The species chosen to be compared to humans were the *Bos taurus* (bull), *Drosophila melanogaster* (fruit fly), *Canis lupus familiaris*, *Mus musculus*, and *Macaca mulatta*. Moreover, Grantham's distance, the biochemical distance between amino acids, was calculated between the original amino acid and the mutated amino acids. Mutations were evaluated and all of these mutations had a score of 0.00, meaning that these mutations are not tolerable. These suggest that the amino acids are essential to the protein function or structure due to the score given by SIFT.

EVALUATING NF1 GENE WITH SIFT AND THE MEGA 4 PROGRAM

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The NF1 gene locus on chromosome 15 is responsible for the neurofibromatosis type 1 disease that is the cause of several mutations; for example, the exon 4. Neurofibromatin cause a several skin problems like having coffee stains all over the patient's body. The neurofibromatosis disease develops non cancerous tumors called neurofibromas and develops a cancerous tumor that develops near the spinal cord or along nerves called malignant peripheral sheath tumors. Using the SIFT program, the severity of the mutations causing this hereditary diseases was predicted. This program tells us if the mutations are going to be tolerated or not by the person who has it. After searching for the tolerating of the mutations, MEGA 4 was used to compare the evolution of this gene with other species to search how much the human genome was evolved with time.

PIEBALDIMS DISEASE CAUSED BY MUTATIONS IN KIT GENE

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Piebaldism is a rare autosomal dominant disorder of melanocyte development characterized by a congenital white forelock and multiple symmetrical hypopigmented or depigmented macules. The underlying defect is possibly related to the differentiation and migration of melanoblasts, as well as to defective development of the neural crest (neurocristopathy). Piebaldism is due to an absence of melanocytes in affected skin and hair follicles as a result of mutations of the *KIT* proto-oncogene, located in chromosome 4 (Locus 4q11-q12). Using SIFT program, the severity of changes in amino acids that leads to mutations was predicted. The fact of whether changes are going to be tolerated or not by humans was studied. Another important part of our research was to compare the KIT gene in humans with the same gene in other species to study the evolution of it through time.

EVALUATION OF DIFFERENCES IN THE JAG1 MUTATIONS

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Mutations in Jagged 1(JAG1) gene lead to Alagille syndrome, which is an inherited autosomic dominant disease defined by the shortage of the hepatic ducts, along with anomaly in multiple organs and systems. It is diagnosed during childhood because of the detection of cardiac malformation. This syndrome causes abnormalities of the liver, heart, skeleton, eye, kidneys, physical appearance, and sometimes even mental retardation. The program SIFT (Sorting Intolerant From Tolerant) was used to study the severity of changes in amino acids and if these mutations are tolerable or not to the protein function and structure. A search for other homolog species was conducted. Using MEGA4 (Molecular Evolutionary Genetics Analysis 4), the evolutionary change in the JAG1 protein of the following species was compared: *Rattus norvegicus*, *Mus Musculus*, *Bos Taurus*, *Pan Troglodytes*, and *Ovis Aries*. Each substitution was evaluated for biochemical severity using Grantham distance, the distance between the original amino acid and the mutated amino acid. MEGA4 was used to do a protein alignment of these sequences. Of the mutations evaluated by SIFT, 78% were not tolerable. Theses results may imply that these amino acids are very important for the function of the protein.

PORPHYRIA: A DISEASE CAUSED BY A MUTATION IN GENE HMBS

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The HMBS gene provides instructions for the production of an enzyme called hydroxymethylbilane synthase. This enzyme is responsible for the third step in the production of heme, the iron-containing part of hemoglobin. Hemoglobin is the oxygen-carrying protein in red blood cells. When a mutation occurs in gene HMBS, it produces porphyria. This disease makes the skin look burned. The tolerance of the mutation was evaluated using an algorithm in computer version called SIFT (Sorting Intolerant from Tolerant). SIFT is a program used to evaluate the tolerance of an amino acid substitution in the protein sequence. Moreover, an alignment of the animals selected was done to compare the differences and similarities such as conserved sites. Homolog species selected for the alignment were *B. taurus* (bull), *R. norvegicus* (rat) and *M. musculus* (mouse). Grantham's distance was calculated. This calculates the biochemical distance between amino acids. After the probabilities of the tolerance in the mutations were verified, the results were that all mutations studied were tolerable. This may mean that any amino acid substitution may be tolerable and it could not be terminal to the function of the protein. It could be implied that the person with these mutations can survive because the proteins will complete their job. Nevertheless, this does not let off the patient without any kind of symptoms related to this disease.

ANALYSIS OF MUTATIONS OF THE GENE GJB1 IN HUMANS

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Gap junction protein beta 1 (GJB1) gene, located in chromosome X (locus Xq13.1), is responsible for changes in the muscles, tissues and nerves. GJB1 encodes a member of the gap junction protein family, membrane-spanning proteins that assemble to form gap junction channels that facilitate the transfer of ions and small molecules between cells. Mutations in GJB1 gene cause X-linked Charcot-Marie-Tooth, an inherited peripheral neuropathy disease. Charcot-Marie-Tooth disease is a neurological hereditary disorder that affects the muscle and sensorial nerves. Several mutations in GBJ1 were found. Mutations in GJB1 were analyzed using SIFT, Sorting Intolerant From Tolerant. SIFT analyzes the level of tolerance in mutations of GJB1. The program MEGA4 (Molecular Evolutionary Genetics Analysis 4) was then used to choose five animals d: *Mus musculus*, *Bos taurus*, *Equus caballus*, *Macaca mulatto* and *Canis lupus familiaris* and later do an alignment. Mega is a program used to analyze the proteins of genes, to verify their similarities and differences using the mutations, Grantham's distance, the original amino acid and the mutated one. After evaluating the mutations using SIFT, more than 50% were tolerable, meaning that the mutations found may not be conserved since they can suffer mutations.

STUDY OF MUTATIONS IN MUT: LEAD CAUSE OF METHYLMALONIC ACIDEMIA

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Methylmalonic acidemia is an inherited disorder in which the body is unable to process certain proteins and fats properly. Mutations in the MUT (methylmalonyl Coenzyme A mutase) gene and other genes are the cause for methylmalonic acidemia. The MUT gene provides instructions for making an enzyme called methylmalonyl CoA mutase that works with vitamin B12 to break down several amino acids, certain lipids, and cholesterol. Mutations alter the enzyme's structure or reduces the amount of the enzyme, which prevents these molecules from being broken down properly. As a result, a substance called methylmalonyl CoA and other potentially toxic compounds can accumulate in the body's organs and tissues, causing the signs and symptoms of methylmalonic acidemia. SIFT, Sorting Intolerant from Tolerant, is a program that is used to anticipate how a certain substitution can affect a protein function. It calculates the effect of a substitution by comparing the conserved sites with the mutation. Conserved sites are amino acids that tend to stay the same throughout time. Another program was used to compare the human protein to homolog species to evaluate any change that may have occurred during time. The program used was MEGA 4 (Molecular Evolutionary Genetics Analysis 4). The homolog species were *G. gallus*, *R. norvegicus*, *B. Taurus*, *O. cuniculus*, and *D. rerio*. After evaluating the amino acid substitution, only 2% of the mutations were tolerant. This may suggest two things: the protein may be much conserved or the mutations analyzed have amino acids that may be essential to the protein function or structure.

MUTATIONS IN HGD GENE CAUSING ALKAPTONURIA

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The HGD gene is an instructor for the making of the enzyme homogentisate oxidase, whose role is in the function of the liver and kidneys. Mutations in this gene are the molecular cause of Alkaptonuria. Alkaptonuria is an inherited condition that causes urine to turn black when exposed to air. This condition is inherited when both copies of the gene in each cell have mutations. People with Alkaptonuria typically develop arthritis and ochronosis, a buildup of dark pigment in connective tissues such as cartilage and skin. Mutations in the HGD gene impair the enzyme's role in this process. As a result, a substance called homogentisic acid, which is produced as phenylalanine and tyrosine, are broken down and accumulate in the body. Excess homogentisic acid and related compounds are deposited in connective tissues, which causes cartilage and skin to darken. Homogentisic acid is also excreted in urine, making the urine turn dark when exposed to air. Using SIFT (Sorting Intolerant From Tolerant), the severity of changes in amino acids in HGD was analyzed. The human protein sequence was compared with homolog species, *Mus musculus*, *Danio reiro*, *Rattus norvegicus*, and *Pongo abelli*, using the MEGA 4(Molecular Evolutionary Genetics Analysis 4) program to see how the HGD gene has evolved with time. Morever, Grantham's distance was found. The Grantham distance is the biochemical change given in form of a number between the original amino acid and the mutated one. After evaluating the mutations found, none of the mutations were tolerable; meaning that the protein structure may change as well as the function. This may mean that the amino acid may not tolerate a change because it has a specific position on the sequence.

COMPUTATIONAL CHEMISTRY/BIOASTRONOMY

COMPUTATIONAL STUDY SODIUM CYANIDE-NACN FOUND IN THE EGG NEBULA

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The purpose of this project was to learn about the existence of NaCN in space and to create a 3-D model of sodium cyanide – NaCN using software Gaussview to later use these models in the computational chemistry software Gaussian 03 to be able to calculate energetic and the optimized state of the molecule. The calculations were based upon the difference in temperature and pressure between Earth and the Egg Nebula. Sodium Cyanide was detected by B. E. Turner, T. C. Steimle, and L. Meerts in the Egg Nebula. The Egg nebula is a bipolar proto-planetary nebula characterized by its series of bright arcs and circles surrounding the central star. Sodium Cyanide is an inorganic highly toxic salt and is used mainly in gold mining. From the outcome of the research and simulation a relationship was established between temperature and the energies. The zero point energy remains constant unaffected by temperature or pressure. The enthalpy and energy showed an inversely proportional behavior to temperature, and Gibbs free energy behaved directly proportional to temperature. During this investigation basic concepts of chemistry were learned by the group to understand how to correctly model a molecule based on its formula.

COMPUTATIONAL STUDY OF SODIUM CYANIDE – H_2CNH FOUND IN SAGGITARIUS B2

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Sodium Cyanide also known as methanimine was first detected by P. D. Godfrey, R. D. Brown, among others in the molecular cloud called Sagittarius B-2. Sagittarius B-2 is a dense Hll region and the richest concentration of molecules located near the center of the Milky Way Galaxy. The molecule methanimine H_2CNH can react with hydrogen and then water to form glycine, a simple amino acid. The second objective of the project was to develop a 3-D model of the molecule in the software Gaussview with the purpose to use it in computational chemistry calculations using the software Gaussian 03, to find its most stable state and the energies. The calculations were done using the different temperatures and pressure of Earth and Sagitarius B-2. These calculations resulted in a difference in the energetics for the molecule in the different areas such as zero point energy, and the enthalpy. In this investigation several tutorials about Gaussian 03 and Gaussview were provided to understand the procedure.

COMPUTATIONAL STUDY OF ACETIC ACID – CH_3COOH FOUND IN SAGITTARIUS B-2

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The objective of the project was to learn about the existence of the molecule of acetic acid (CH_3COOH) in space, and the development of a 3-D molecule using the modeling software GaussView. The molecule was found in Sagittarius B-2, a giant molecular cloud of gas and dust that is located near the center of our Galaxy. The reported temperature of this region is 300 Kelvin (27 °C). Using the 3-D model the most stable state of the molecule and then find its energies were calculated. The different temperature and pressure of the regions were used as parameters for the calculation. Acetic acid is an important industrial chemical; the primary use of this chemical is in the manufacture of different products. An example of its products is the reaction of cellulous and acetic acid to yield cellulose acetate, which is used to make films and textiles. From the investigation and computer simulations, a relationship was established between temperature and the energies. The zero point energy remains constant unaffected by temperature or pressure. The enthalpy and energy showed an inversely proportional behavior to temperature, and Gibbs free energy behaved directly proportional to temperature. During this investigation, basic chemistry concepts were provided to understand how to correctly model a molecule based on its formula.

COMPUTATIONAL STUDY OF ETHENON – H_2CCO – FOUND IN SAGITTARIUS B2

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This project is about the existence of Ethenone (H_2CCO) in space, a molecule found in Sagittarius B2 (Sgr B2). Sgr B2 is a massive molecular cloud complex located near the center of our Galaxy, about 26,000 light-years away. This region has a temperature of 300 Kelvin/ 27 Celsius and it will be used as a parameter for the calculations. Many different types of interstellar molecules have been identified within Sagittarius B2, including Ethenone. Ethenone, also known as Ketene, is a pungent, toxic, colorless gas. In this project H_2CCO was modeled using 3-D software called GaussView. Afterwards the molecule was used in computational chemistry calculations using Gaussian 03. The calculations allowed to find more about the molecule including its energetics and optimized state. From the investigation, a relationship was established between temperature and the energies. The zero point energy remained constant unaffected by temperature or pressure. The enthalpy and energy showed an inversely proportional behavior to temperature, and Gibbs free energy behaved directly proportional to temperature. During this investigation basic chemistry knowledge was provided and it was possible to understand how to correctly model a molecule based on its formula.

COMPUTATIONAL STUDY OF ACETONE-$(CH_3)_2CO$-FOUND IN SAGITTARIUS B2

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The purpose of this study was to learn about the molecule Acetone $(CH_3)_2CO$ in space and to develop a computational model. This molecule was found in Sagittarius B2 by F. Combes, M. Gerin, A. Wooten, among others. Sagittarius B2 is a massive, dense HII region and molecular cloud complex located near the center of our Galaxy. In the dense region of the molecular cloud the temperature is 300 Kelvin (27 C). This region is the richest concentration of molecules of our galaxy. Acetone is a colorless, mobile, flammable liquid. Acetone is highly miscible and also serves as an important solvent. The molecule of acetone was made into a 3-D model using the software GaussView and was used for computational chemistry calculations to find the most stable state and its energy using Gaussian 03. The parameters for these calculations are the difference in temperature and pressure between Earth and Sagittarius B-2. The investigation established a relationship between temperature and the energies. The zero point energy remains constant unaffected by temperature or pressure. The enthalpy and energy showed an inversely proportional behavior to temperature, and Gibbs free energy behaved directly proportional to temperature. During this investigation basic chemistry concepts were provided and it was possible to understand how to correctly model a molecule based on its formula.

COMPUTATIONAL STUDY OF FORMIC ACID–HCOOH FOUND IN SAGITTARIUS B2

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Formic acid (HCOOH or CH^2O^2) is a hot core molecule, first detected in the Sagittarius B2 cloud by B. Zuckerman. The Sagittarius B2 is a dense molecular cloud complex and the biggest concentration of molecules in our Galaxy. In this region the temperature has been recorded to be 300 Kelvin (27°C). The number of observed isotopic transitions in the detection of Formic Acid is too small for it to be conclusive. One of the objectives of the project was to discover how the molecule behaves in space. Additionally, the Gaussian 03 and the GaussView software were used. These programs allowed for the creation of a 3-D model of the molecule. When using the 3D version of the molecule, computational chemistry calculations were performed in order to find its most stable state and its energies. From the investigation, a relationship was established between temperature and the energies. The zero point energy remained constant unaffected by temperature or pressure. The enthalpy and energy showed an inversely proportional behavior to temperature, and Gibbs free energy behaved directly proportional to temperature. During this investigation basic chemistry concepts were provided and it was possible to understand how to correctly model a molecule based on its formula.

COMPUTATIONAL STUDY IF FORMYL CYANIDE - HC(0)CN – FOUND IN SGR B-2

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The purpose of this project was to study the existence of formyl cyanide, also known as cyanoformaldehyde, HC(0)CN. Cyanoformaldehyde was detected in Sagittarius (Sgr B2); a massive, dense Hll region and a molecular cloud complex located near the center of our Galaxy. This region is the richest concentration of molecules in the Milky Way Galaxy and it has a reported temperature of 300 K (27 °C). Cyanoformaldehyde is a planar asymmetric top molecule composed of two functional groups that are among the ones most commonly found in the interstellar medium. In the project the energy levels of cyanoformaldehyde were calculated and worked with using the most optimized state of the molecule which was modeled using Gaussview and calculated using Gaussian 03. These calculations used the difference in temperature and pressure between the two environments as parameters. From the investigation, a relationship was established between temperature and the energies. The zero point energy remains constant unaffected by temperature or pressure. The enthalpy and energy showed an inversely proportional behavior to temperature, and Gibbs free energy behaved directly proportional to temperature. During this investigation basic chemistry knowledge was provided and it was possible to understand how to correctly model a molecule based on its formula.

COMPUTATIONAL STUDY OF ETHENEIMINE H_2CCNH, DETECTED IN SAGITTARIUS B-2

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The purpose of this project was to learn about the existence of the H_2CCNH etheneimine molecule in space and to make a 3D model of this molecule using the Gaussview software. This molecule also known as ketenimine was detected in Sagittarius B-2, a giant star-forming molecular cloud of gas and dust. In this region about 90 percent of the interstellar molecules contain carbon, which is required for a molecule to be classified as organic. The mass of the interstellar cloud is 99 percent gas and one percent dust. Afterward, a computational chemistry calculation in Gaussian 03 was run to find the energy and the optimized state using the different temperatures and pressures. From the investigation, a relationship was established between temperature and the energies. The zero point energy remained constant unaffected by temperature or pressure. The enthalpy and energy showed an inversely proportional behavior to temperature, and Gibbs free energy behaved directly proportional to temperature. During this investigation basic chemistry concepts were provided and it was possible to understand how to correctly model a molecule based on its formula.

COMPUTATIONAL STUDY OF VINYL CYANIDE- C_2H_3CN, FOUND IN SGR B2 AND TMC-1

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Student Research Mentor: Germán P. Castillo, Universidad Metropolitana, San Juan, Puerto Rico.

The purpose of this research was to learn about the existence of the C2H3CN Vinyl Cyanide molecule in space and to make a 3D model of this molecule using the software Gaussview. Vinyl cyanide, also known as acrylonitrile, is a pungent-smelling, colorless liquid often yellow due to impurities. This molecule was detected in Sagittarius B2 and Taurus Molecular Cloud 1 (TMC-1) by H. E. Matthews and T. J. Sears. TMC-1 has a temperature of 100K (-173°C) and is one of a group of clouds of gas and dust, it contains only 1 solar mass of material and is one of the coldest molecular clouds known. TMC-1 contains some of the most complex interstellar molecules yet identified due to its stability for many years without forming stars. From the investigation, a relationship was established between temperature and the energies. The zero point energy remained constant unaffected by temperature or pressure. The enthalpy and energy showed an inversely proportional behavior to temperature, and Gibbs free energy behaved directly proportional to temperature. During this investigation basic chemistry concepts were provided and it was possible to understand how to correctly model a molecule based on its formula.

COMPUTATIONAL STUDY OF HYDROXYMETHYLIUM - H_2COH^+ FOUND IN MULTIPLE PLACES IN SPACE

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The purpose of this project was to learn about the existence of the hydroxymethylium H_2COH^+ molecule in space and to model this molecule to identify its energies. The molecule H_2COH^+ was found toward Sgr B2, Orion KL, W51, and possibly in NGC 7538 and DR21 (OH). Sgr B2, one of the places where the molecule is found, is a massive, dense *HII region (A volume of space where the hydrogen in the interstellar medium is in an ionized rather than a neutral state) and molecular cloud complex located near the center of our Galaxy. It is the richest concentration of molecules in the Milky Way Galaxy. The second objective of this research was to model the molecule using GaussView software to obtain a 3-D model that was used to make computational chemistry calculations in order to learn about the molecule energy levels.

ATMOSPHERIC SCIENCES (GLOBAL MICROSCOPE)

LAND SURFACE TEMPERATURE

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The global microscope is a tool that can be used to display an image or video by projecting the image or video on it. This project was about land surface temperature (energy) during the day. In this experiment the team worked with the interactions and energy fluxes between the ground and the atmosphere during the day. Temperature is a measure of how warm or cold an object is. In order to get a land surface temperature, the earth's land temperature during the day is used when the Sun's rays warm Earth. The team used measures from NASA TERRA satellites system that had been taken from 2007-08. The team's objective was to inform people about what the land surface temperature is and how it affects the earth. Windows Movie Maker was used to visualize the data from NASA sources to create a model and were displayed using the Global Microscope.

CHLOROPHYLL CONCENTRATION

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The purpose of this study was to visualize if chlorophyll concentration changes throughout the seasons. There has been research looking for information on the structure of chlorophyll, the changes during the four seasons (summer, spring, fall, winter), and what are some reasons for its seasonal changes of its concentration. Chlorophyll can be found in oceans, plants, algae, land, etc. It is also known that chlorophyll is made up of hydrogen, oxygen, magnesium, carbon, and nitrogen. Using data from NASA TERRA satellites, images of the changes during a period of time were collected to make a movie clip to see the changes and the clip will be projected on the Global Microscope which will serve as an educational tool.

THE EFFECT OF SOLAR INSOLATION ON GLOBAL WARMING

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The purpose of this study was the effect of global warming, one of the main subjects of dispute in the science community all over the world. It is suspected that solar insolation affects global warming. The Sun emits energy in the form of electromagnetic radiation. The amount of electromagnetic radiation received on the Earth is controlled by the angle of inclination of its axis, the state of the atmosphere, altitude, and geographic location. Human activities are responsible for most of the global warming and contribute by enhancing Earth's natural greenhouse effect. The software Movie Maker was used as a tool for this investigation to display the amount of electromagnetic energy (solar radiation) on the surface of the earth. The data used was collected by the NASA TERRA satellite. Because different scientific groups believe the Earth is getting warmer, due to a Sun's brightness increase, and others believe the greenhouse effect could be the cause, this makes an interesting issue for research.

NORTHERN HEMISPHERE SNOW COVER AND ICE EXTENT

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The purpose was to investigate the changes in snow cover and sea ice extent in the Northern Hemisphere over time. These are caused by the changes in temperature each year. In this investigation project, the topic chosen was Snow cover and Sea Ice Extent. Snow cover has an influence on energy due to a vast amount of sunlight that hits the snow and is reflected back into space instead of warming the planet. To demonstrate these changes and describe them, a video clip was put together using Windows Movie Maker along with information gathered from different resources including the NASA website. The video's purpose was to project the images onto the Global Microscope. This would show the images in a three-dimensional perspective. The study outcome revealed that the snow cover and sea ice extent did not change much over time and the average temperature rate during the ten-year time period was 36°.

DISPLAYING REGIONAL INFORMATION ON THE GLOBAL MICROSCOPE IN PICTURE-IN-PICTURE FORMAT

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The purpose of this research was to visualize data collected from NASA TERRA satellites. The team's objective was to present the Earth's surface on the global microscope and display brief information on several countries along with videos on landmarks and other important locations in a picture-in-picture format. The way that format works is that once a country is chosen, a pop up box will appear near it showing the country's information, hence the name "picture-in-picture." The idea is to create a dynamic and entertaining learning experience which incorporates visuals along with sounds to educate people in a way that's interesting and appealing.

SEA SURFACE TEMPERATURE

Gilmarie López and **Priscilla M. Milán**, Bautista De Puerto Nuevo Academy, San Juan, Puerto Rico.

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The purpose of this project was to study the different sea surface temperatures through the year. It was conducted from January through September 2008. Temperatures vary in different parts of the ocean. In some parts of the ocean it is colder than in others. This data are used to help predict weather patterns, to track ocean currents, and to monitor El Niño and La Niña. Data from the NASA TERRA satellite was used to visualize the sea surface temperatures. The Windows Movie Maker software was used to make a video including different pictures of sea surface temperatures making them animated which helped study monthly temperature changes. The global microscope was then used as a tool to display these images in a user-friendly environment.

HOW PLANTS ARE AFFECTED BY CLIMATE CHANGE

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The focus of this work was to determine if the effect of global warming is affecting the growth rate around the world. This fits well with the information obtained from NASA which shows that the vegetation in the world has been increasing more and more each month. This research is about the changes in global vegetation. The main method of presenting the information is a video shown on the Global Microscope. This presentation will include the drastic changes in vegetation that have taken place during the past few months. It will reveal how global warming has affected the vegetation and vice-versa. Information obtained while conducting the research revealed that the number of plants has been increasing lately. It may be another effect of global warming. Another fact is that while large plants and trees are growing quite well, smaller plants are dying. This may be because smaller plants cannot handle more sunlight than usual. The importance of vegetation will be discussed during this research.

CLOUD OPTICAL THICKNESS

Hernando Rivera and **Orlando de la Rosa,** Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

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The purpose of this project was to study the optical thickness of clouds in terms of what absorbs radiation from the solar light in clouds. The intensity of the light is absorbed in thickness. The intensity can be calculated by means of formulas. A cloud is visible in a condensed mass of drops of water or ice crystals in the atmosphere on the outside of the earth. The mass absorbs certain materials between two levels that are well-known. Data collected by NASA TERRA satellites was used to make a video with Windows Movie Maker. A video was made that revealed the change of clouds during the months and the intensity of the radiation on the Earth. The information of this research was simulated and will be displayed in the Global Microscope.

STUDY OF LAND SURFACE TEMPERATURE AT NIGHT

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The Windows Movie Maker software was used to effectively display global LST (land surface temperature) information to educate society about the changes occurring, such as global warming, which is one of the main concerns in the scientific community. LST is an important factor controlling most physical, chemical and biological processes in the Earth. LST is measured in Celsius during the night. The National Aeronautics and Space Administration (NASA) takes an average of one satellite picture of LST (night) per month, which was used in this research. The reason behind this study is that temperature also influences weather and climate patterns.

APPLIED MATHEMATICS

LEARNING ABOUT BULIMIA AND MATHEMATICAL MODELING

Nicole J. Flores, Bautista de Levittown School, Toa Baja, Puerto Rico.

Research Mentor: Dr. Carlos Castillo-Chavez, Arizona State University, Tempe, Arizona.
Student Research Mentor: Hazel Ozuna Vázquez, Universidad Metropolitana, San Juan, Puerto Rico.

The objective of this project was to learn about Bulimia and develop a mathematical model to represent the increase of simple and advanced bulimia using the Simple Epidemiologic Model. Eating disorders are not something new, vomiting after overeating dates back to thousand years ago. Bulimia was described as a disorder for the first time in 1979. Bulimia occurs more among women than in men; it is also common in adolescents and can be culturally dependent. MATLAB was used to model and represent graphical solutions of the Epidemiological Model. The obtained equations were extrapolated using the MATLAB program. The results of this research will help to inform the public of the impact of bulimia in society.

MODELING AGING PROCESS OF CELLS USING MATLAB

Yea Jin Ko and **Juan Rosa**, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

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The aim of this project was to gain knowledge about the aging process of cells. Several theories, including telomere shortening, mitotic misregulation, free radical theory and many others, have been proposed as possible explanations for this phenomenon. The definition of aging is based on that aging is rarely agreed upon by researchers but includes all time-dependent processes that occur within an organism whether adverse or not. It is generally accepted among scientists that cellular aging is an irreversible process that is poorly understood. As a representation of the progression of the aging process of cells, a Simple Epidemiologic Model was used. MATLAB was used perform computationally intensive tasks faster than traditional programming languages such as C, C++, and Fortran. MATLAB was used to model and extrapolate the results. This project helped to study the aging process and how long it takes for a cell to age.

MATHEMATICAL REPRESENTATION OF THE EFFICIENCY OF ATTENTION DEFICIT DISORDER TREATMENT

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The aim of the research was to learn about what the Attention Deficit Disorder is and to construct a mathematical model to represent the efficiency of ADD treatments with a Simple Epidemiologic Model. Attention Deficit Disorder (ADD) is a neurobehavioral disorder very common among children; about 3% to 5% of the world's population has been diagnosed with this mental disorder. This disorder is characterized by a persistent pattern of impulsiveness and inattention, with or without a component of hyperactivity and it can disturb the child's education and social activity. ADD may continue throughout the person's life altering his or her behavior, which may become a problem with work and responsibilities of that person. Methods of treatment often involve some combination of medications, behavior modifications, life style changes, and counseling. The Simple Epidemiologic Model was used to represent the transition probabilities through different states in a population of children and the life span of the child. The MATLAB program was used for extrapolation of the obtained equations from the model. This simple model could be used to compare the efficiency of different ADD treatments and helps doctors and also parents to choose the correct treatment for the child.

FUNDAMENTS OF DYNAMIC SYSTEMS APPLIED TO ROBOT MODELING

Franco Del Valle, Petra Zenón de Fabery Vocational School, Trujillo Alto, Puerto Rico.
Research Mentor: Dr. Juan F. Arratia, Executive Director, Student Research Development Center, Ana G. Mendez University System, San Juan, Puerto Rico

The objective of this project is to learn the fundamentals of dynamics systems in order to generate a mathematical model for a robot system. The step to model a mechanical system is based on principles and mechanical laws like Newton's laws of motion, D'Alembert's principle, and Lagrange's among others. The mathematical model of a dynamic system will be represented by differential equations. In order to obtain a feasible solution of a mathematical model, Laplace transformations can generate a manageable answer as well as the Inverse Laplace methodology. The model used to understand this process was a simple mass-damping-spring system. Manual solutions were used to obtain the different modes of the system, especially solutions for a second degree equation. The next step was to graph linear motion coupled with numerical software, MATLAB, a general purpose tool to introduce the computing environment and programming language program commonly used for graphing mathematical equations and formulas. The experience of this project was a unique opportunity to understand the logic in the design of a mathematical model of a dynamic system using sophisticated equations and modern computing tools.

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