The Ana G. Méndez University System (AGMUS) and the Student Research Development Center (SRDC) are proud to host the Winter 2010 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

Communication Convention Center
Guaynabo, Puerto Rico

December 11, 2010
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table of Contents</td>
<td>1</td>
</tr>
<tr>
<td>NSF/AGMUS/SRDC Mission, Executive Summary and Goals</td>
<td>2</td>
</tr>
<tr>
<td>Conference at a Glance</td>
<td>3</td>
</tr>
<tr>
<td>Message from the Vice President for Planning and Academic Affairs:</td>
<td>4</td>
</tr>
<tr>
<td>Dr. Jorge L. Crespo Armaiz</td>
<td></td>
</tr>
<tr>
<td>Message from the Chancellor of Universidad Metropolitana:</td>
<td>5</td>
</tr>
<tr>
<td>Dr. Federico M. Matheu</td>
<td></td>
</tr>
<tr>
<td>Message from the Chancellor of Universidad del Turabo:</td>
<td>6</td>
</tr>
<tr>
<td>Dr. Dennis Alicea</td>
<td></td>
</tr>
<tr>
<td>Message from the Chancellor of Universidad del Este:</td>
<td>7</td>
</tr>
<tr>
<td>Lcdo. Alberto Maldonado</td>
<td></td>
</tr>
<tr>
<td>Message from the President of Polytechnic University:</td>
<td>8</td>
</tr>
<tr>
<td>Mr. Ernesto Vázquez</td>
<td></td>
</tr>
<tr>
<td>Message from the Director and Principal Investigator:</td>
<td>9</td>
</tr>
<tr>
<td>Dr. Juan F. Arratia</td>
<td></td>
</tr>
<tr>
<td>AGMUS Profile and Prologue</td>
<td>10</td>
</tr>
<tr>
<td>Keynote Speaker</td>
<td>11</td>
</tr>
<tr>
<td>Research Mentors Bio Sketches</td>
<td>12</td>
</tr>
<tr>
<td>Institute of Mathematics Ad</td>
<td>14</td>
</tr>
<tr>
<td>Schedule of Events</td>
<td>15</td>
</tr>
<tr>
<td>Abstracts:</td>
<td></td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>34</td>
</tr>
<tr>
<td>Computer Science</td>
<td>49</td>
</tr>
<tr>
<td>Mathematics</td>
<td>71</td>
</tr>
<tr>
<td>Engineering</td>
<td>83</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>91</td>
</tr>
<tr>
<td>Index of Presenters</td>
<td>94</td>
</tr>
</tbody>
</table>
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), which is part of the Ana G. Méndez University System, is the entity that continues the MIE strategy by impacting students from the AGMUS and universities across the nation, as well as pre-college students from the Puerto Rico Educational System. Two NSF grants, the AGMUS Institute of Mathematics and the Caribbean Computing Center for Excellence are the funding tools to implement the mission of the Student Research Development Center in Puerto Rico.

EXECUTIVE SUMMARY

The Model Institutions for Excellence ended in 2009. It was 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. Now, with the NSF grants, the AGMUS Institute of Mathematics and the Caribbean Computing Center for Excellence, the MIE goals are reaching institutions outside the AGMUS campuses in Puerto Rico and the US Virgin Islands.

GOALS

The main goal of the Pre-College Research Symposium is to: encourage pre-college research with research mentors; develop students’ written and oral communication skills; provide a forum 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 2010 PRE-COLLEGE RESEARCH SYMPOSIUM**

**CONFERENCE AT A GLANCE**

<table>
<thead>
<tr>
<th>SATURDAY, DECEMBER 11, 2010</th>
<th>COMMUNICATIONS CONVENTION CENTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 – 8:00 a.m. Registration</td>
<td>Fuente Room</td>
</tr>
<tr>
<td>Breakfast</td>
<td>Gazebo Fuente</td>
</tr>
<tr>
<td>Poster Session Set-Up</td>
<td>Mosaico Room</td>
</tr>
<tr>
<td>7:30 – 8:00 a.m. Judges Meeting</td>
<td>Sendero Verde Room</td>
</tr>
<tr>
<td>8:00 – 8:30 a.m. Opening Ceremony</td>
<td>Galería Room</td>
</tr>
<tr>
<td>Keynote Speaker: Dr. Bryan A. Ballif The University of Vermont</td>
<td></td>
</tr>
<tr>
<td>8:30 – 10:30 a.m. Poster Session</td>
<td>Mosaico Room and Fuente Room</td>
</tr>
<tr>
<td>10:30 – 10:45 a.m. Coffee Break</td>
<td>Gazebo Fuente/Galeria</td>
</tr>
<tr>
<td>10:50 – 1:30 p.m. Oral Research Presentations: Oral Session 1</td>
<td>Sendero Verde Room</td>
</tr>
<tr>
<td>Oral Session 2</td>
<td>Galería Room</td>
</tr>
<tr>
<td>Oral Session 3</td>
<td>Fuente Room</td>
</tr>
<tr>
<td>1:30 – 3:00 p.m. Lunch</td>
<td>Gazebo Fuente/Galeria</td>
</tr>
</tbody>
</table>

**WORKSHOPS FOR SCIENCE AND MATH TEACHERS**

| 2:00 – 4:00 p.m. Workshops: COMPUTER APPLICATIONS FOR PLASMA ENGINEERING | Fuente Room |
| DYNAMICS MATHEMATICS WITH GeoGebra | Sendero Verde Room |

| 3:00 – 3:30 p.m. Award Ceremony and Closing Remarks | Galería Room |
| 3:30 p.m. Symposium Adjourns | |

---

3
December 11, 2010

Dear Summer Research Symposium Participants:

The Ana G. Méndez University System (AGMUS) is proud to be part of the Winter 2010 Pre-College Research Symposium organized by the AGMUS Student Research Development Center, a leading organization implementing early scientific research activities in Puerto Rico.

In order to promote the participation of young aspiring Hispanics into the Science, Technology, Engineering and Mathematics (STEM) fields, the AGMUS Saturday Academy Program and its partner institutions of the Caribbean Computing Center for Excellence (CCCE) Alliance have focused on strengthening the students’ skills with research experiences and outcomes disseminated in oral and poster presentations in English. This conference is designed to motivate pre-college students and undergraduates to pursue careers in STEM fields.

We truly appreciate the support provided by the National Science Foundation through the CCCE Alliance and the Institute of Mathematics grants, the student researchers and the mentors who guided the students at AGMUS and the CCCE Alliance facilities supporting this novel enterprise to produce young researchers.

Congratulations to the participants for their outstanding research projects.

Sincerely yours,

Jorge L. Crespo Amáiz, Ph. D.
Vice President for Planning and Academic Affairs
December 11, 2010

Dear students, teachers and parents:

Universidad Metropolitana has been a pioneer in helping undergraduates and pre-college students from Puerto Rico to search for opportunities and careers in science, technology, engineering and mathematics (STEM) fields. I would like to welcome you to the Winter 2010 Pre-College Research Symposium. Furthermore, our congratulations to all of you who have participated in this Winter 2010 Pre-College Research Symposium experience.

The Student Research Development Center of the Ana G. Méndez University System (AGMUS) organized the Symposium to showcase the research work of the Puerto Rico Pre-College Program. This new avenue will bring together the talent of high school students and freshman and sophomore university students from the AGMUS System.

These interesting projects that you have prepared are true testimonials of this wonderful episode in your journey through high school and early college life. I am positive that this experience will spark further interest in higher education and a fascination with research and inquiry.

Yours truly,

Federico M. Matheu, Ph. D.
 Chancellor
November 12, 2010

Dear students, teachers and parents:

Universidad del Turabo has been a pioneer in assisting pre-college students of Puerto Rico to search for opportunities and careers in science, technology, engineering and mathematics (STEM) fields. I would like to welcome you to Universidad del Turabo, an institution committed to disseminate and create knowledge for the benefit of our society. Furthermore, our congratulations to all of you who have participated in the Winter 2010 Pre-College Research Symposium.

You have engaged in the fascinating world of research at a very young age. This adventure for most of you represents a sign of hope for the future for all fields of science, technology, engineering and mathematics. Hopefully, this experience will open your horizons permitting you to seriously consider a potential career as scientists and engineers.

The interesting projects that you have prepared are true testimonials of this wonderful episode in your journey through high school. I am positive that this experience will spark further interest in a college education and a fascination with research and inquiry.

Yours truly,

[Signature]

Dennis Alicea, Ph. D.
Chancellor
November 23, 2010

Dear students, teachers and parents:

Universidad del Este (UNE) has been a pioneer in helping pre-college students from Puerto Rico to search for opportunities and careers in science, technology, engineering and mathematics (STEM) fields. I would like to welcome you to Universidad del Este, an institution committed to disseminate and create knowledge for the benefit of our society. Furthermore, our congratulations to all of you who have participated in this Winter 2010 Pre-College Research Symposium.

You have engaged in the fascinating world of research at a very young age. This adventure for most of you represents a sign of hope for the future for all fields of science, technology, engineering and mathematics. Hopefully, this experience will open your eyes to a potential career as scientists and engineers.

These interesting projects that you have prepared are true testimonials of this wonderful episode in your journey through high school. I am positive that this experience will spark further interest in a college education and a fascination with research and inquiry.

Yours truly,

[Signature]
Alberto Maldonado-Ruiz, Esq.
Chancellor
November 30, 2010

Dear students, teachers and parents:

Polytechnic University of Puerto Rico is one of the leading institutions specialized in providing career exposure to the fields of science, technology engineering and mathematics (STEM) to Puerto Rico’s pre-college students.

More than ever, students need to gain a realistic perspective of a career field before deciding to further studies in a particular discipline.

I want to congratulate all of you, who participated and received guidance from faculty experts in this Winter 2010 Pre-College Research Symposium. I hope this first experience in scientific research will motivate and drive you to achieve excellence in the discipline of your choice.

The projects presented at this Research Symposium are a proof of the unbounded potential our students have as developers of scientific knowledge and their undeniable capability to improve the quality of life for ourselves and future generations in our island and throughout the world.

I am confident that this experience will increase your interest on becoming a professional in one of the STEM disciplines.

Sincerely,

[Signature]

Ernesto Vazquez-Barquet
President

EVB/pg
December 11, 2010

Pre-College Students:

The Winter 2010 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 2010, more one-hundred seventy-eight 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, UNE, Universidad del Turabo, Polytechnic University, the University of Puerto Rico at Humacao and Mayaguez, and Inter-American University at San Germán and Metro, with the guidance and mentorship of professors and student research mentors in one-hundred thirty four research projects in the areas of biological sciences, computer sciences, mathematics and Engineering.

One of the objectives of the Winter 2010 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 2010 Saturday Academy Program and the Winter 2010 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 2010 Saturday Academy Program and the Winter 2010 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 (AGMUS) is home to approximately 42,620 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, Dr. 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 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. It has also been transformed with faculty research mentors who 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, are paving the way for research-oriented activities for the benefit of Puerto Rico and the US Virgin Islands 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 at Universidad Metropolitana. 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 2010 showcases the research experiences of 178 pre-college students from public and private high schools from the Metropolitan San Juan area. The mentorship of faculty and undergraduate research mentors made possible the concretization of the research projects. Their results are documented in the pages of these proceedings.

The National Science Foundation, The AGMUS Institute of Mathematics, the Ana G. Méndez University System, the Student Research Development Center and institutions of the Caribbean Computing Center for Excellence across Puerto Rico and the US Virgin Islands are proud of the research work conducted by the pre-college participants. We hope this Symposium will be a vehicle by which the scientific productivity of high school students from Puerto Rico and the US Virgin Islands will be disseminated in future years.
KEYNOTE SPEAKER

Dr. Bryan Ballif is the Co-Director of the Vermont Genetics Network Proteomics Facility since 2008 and is an Assistant Professor of Biology since 2006. His focus of interest is the studies of molecular mechanisms of cell signaling with an emphasis on signal transduction pathways regulating mammalian brain development. He earned his doctoral degree in 2001 from Harvard University where he studied the molecular mechanisms of cell survival. He then studied for two years at the Fred Hutchinson Cancer Research Center where he pursued interests in signaling mechanisms of the developing brain. Just prior to his appointment to the Department of Biology, Dr. Ballif trained for three years at Harvard Medical School in mass spectrometry-based proteomics where he began developing and applying these tools to his interests. Along with biochemical and cell biological approaches, mass spectrometry-based proteomics remains an integral part of his research. Dr. Ballif teaches introductory biology and molecular signaling mechanisms in developmental neurobiology.
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.

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

Dr. César Bandera 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. Bandera’s 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 multiaucuity properties prevalent in vertebrate vision. Since the peak of broadband multimedia investments by the telecommunications industry, Dr. Bandera 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. Bandera 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. Bandera 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.
The history of the AGMUS Institute of Mathematics began on September 1, 2008 when the National Science Foundation awarded UMET a five-year grant for $2,100,000 to implement a program to enhance bio mathematics at the Ana G. Méndez University System. The grant created a BS in Bio-Mathematics with scholarship opportunities for students with a GPA of 3.00 or higher and a commitment to pursue graduate studies in partner institutions in the US mainland. During the summer, math scholars will travel to research institutions in the US mainland to work in research for a period of 8-10 weeks. A pre-college research agenda will be implemented on Saturdays under the Saturday Academy of the Student Research Development Center (SRDC) of the Vice-Presidency for Planning and Academic Affairs. Scholars of the AGMUS Institute of Mathematics will present research outcomes in symposia at the pre-college and undergraduate levels.

**SCHOLARSHIP PROGRAM**

- Scholarship for the cost of Registration*
- Stipend of $400*
  
  *This stipend is computed according to the student GPA and is subject to renovation in accordance with academic progress.

**ELIGIBILITY**

- Be admitted at the Department of Science and Technology at UMET in the Bachelor Degree in Bio-Mathematics.

**New Students**

- Have a general high school average (GPA) of 3.00 or higher
- Score of 600 or higher in the math section of the College Board Exam.

**Transferred Students**

- Have a general high school average (GPA) of 3.00

For more information contact:

Wanda I. Rodríguez Lugo  
Coordinator of Institute of Mathematics  
Tel: (787) 766-1717 x6009  
Fax: (787)751-5386  
Email. um_wrodrigu@suagm.edu  
institute.math@gmail.com
SCHEDULE OF EVENTS

SATURDAY, DECEMBER 11, 2010

COMMUNICATION CONVENTION CENTER

7:00 – 8:00 a.m.

POSTER SESSION SET-UP
Continental Breakfast
REGISTRATION

Mosaico and Fuente Rooms
Galería Lobby
Gazebo Galería

POSTER SESSION SET-UP

8:00 – 8:30 a.m.

OPENING CEREMONY

Galería Room

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

Keynote Speaker: Dr. Bryan Ballif
University of Vermont

8:30 – 10:00 a.m.

POSTER SESSION

MOSAICO AND FUENTE ROOMS

BIOLOGICAL SCIENCES
COMPUTER SCIENCES
APPLIED MATHEMATICS
ENGINEERING

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

BIOLOGICAL SCIENCES

Abner Alemán, Calasanz School, San Juan, Puerto Rico. (1)
Analysis of Evolutionary Changes of the Phenylalanine Hydrxylase Gene

Noemí Aybar, Secundaria de la Universidad de Puerto Rico School, San Juan, Puerto Rico. (2)
Comparison of the High Quality of Water at Señorial Stream and Riveras Stream

Eric Benítez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. (3)
What is the Effect of Poison Ivy to Physical Contact with the Skin
Marimar Benítez, University Gardens School, San Juan, Puerto Rico. (4)

Comparative Study of Different Species with the NF1 and NF2 Genes

Salimar Cordero, Secundaria Universidad de Puerto Rico School, San Juan, Puerto Rico. (5)

The Comparison Between the Chemical Composition of the Jatropha Podagrica and the Jatropha Curcas and their Viability in the Production of Biodiesel

Brianna González, Elizabeth Torres, San Antonio Abad School, Humacao, Puerto Rico. (6)

Psychrobacter Protein Analysis Using Pymol

Gilberto Jiménez, CROEM School, Mayaguez, Puerto Rico. (7)

Wireless Signals and Their Effects on the Germination of Phaseolus Vulgarus

Glory López, Bautista de Carolina Academy, Carolina, Puerto Rico. (8)

Evolutionary Study of the PHD Finger Protein 8

Vivianna Mas, Calasanz School, Carolina, Puerto Rico. (9)

Bioinformatics Study of the FMR1 Gene in Fragile X Syndrome

Valerie Mejía, Calasanz School, San Juan, Puerto Rico. (10)

Analysis of the Chemical Characteristics of the FBN1 FRIBILLIN-1 Gene Using Bioinformatic Tools

Valeria Muñoz, Puertorriqueño de Niñas School, San Juan, Puerto Rico. (11)

The Relationship Between Two Orders of Macroinvertebrates, Trichoptera and Diptera

Frances Negrón, Levittown Baptist Academy, Toa Baja, Puerto Rico. (12)

Comparison, Visualization, and Alignments of Sequences in Breast Cancer 1 and 2, Early Onset
Diana M. Pabón, University of Puerto Rico Secondary School, San Juan, Puerto Rico.  

The Effect of the Invasive Species the Molothrus Bonariensis on the Native Species of the Agelaius Xanthomus of Puerto Rico  

Thalía Rivera, Caguas Military Academy, Caguas, Puerto Rico.  

Evaluations of Genetic Mutations of Homo sapiens Beta Globin Sickle Cell Disease  

Sharelys Román, Avance 2000 School, San Juan, Puerto Rico.  

Study of the Physical and the Chemical Characteristics of Amyloid Beta (A4)  

Netsha J. Santiago, Caguas Private School, Caguas, Puerto Rico.  

Analysis and Study of Amino Acid Changes in the Niemann-Pick Disease  

Alejandro Torres, Calasanz School, Carolina, Puerto Rico.  

Comparative Analysis of Amino Acid Sequence in Coagulation Factor VIII  

Gladynel Trinidad, Avance 2000 School, Bayamón, Puerto Rico.  

Bioinformatic and Evolutionary Analysis of the HFE Gene  

Yimari Vargas, San Antonio Abad School, Caguas, Puerto Rico.  

Charcot-Marie-Tooth Disease, Analysis of GAP Junction Beta 1 Gene Sift Evaluation  

COMPUTER SCIENCES  

Fabiola Agramonte, María Reina Academy, San Juan, Puerto Rico.  

How Aerosol’s Sprays Affect the Atmosphere
Amarilis Araya, José Aponte de la Torre School, Carolina, Puerto Rico. (21)

The Importance of Web Traffic Analysis for Online Business

Fernando Araya, José Aponte de la Torre School, Carolina, Puerto Rico. (22)

Functioning of a Robot’s Control and Logic System

Melissa Calderón, Tiffany Cruz, Inter-American School, San Germán, Puerto Rico. (23)

Dissections of Two Polygons to One

Diego Camacho, Notre Dame School, Caguas, Puerto Rico. (24)

Jenipher González, Bautista de Caguas School, Caguas, Puerto Rico.

Demand Response Automated Alert System

Odemaris Carrasquillo, José E. Aponte de la Torre School, Carolina, Puerto Rico. (25)

A Computational Tool for Water Sampling Analysis

Cristian Claros, San Jorge Academy, San Juan, Puerto Rico. (26)

Jean Guma, San Ignacio School, San Juan, Puerto Rico.

Observations on the Performance Tool Passmark Test Used in Windows XP

Ricardo Collazo, Edwin Cruz, St. Mary’s School, Carolina, Puerto Rico. (27)

The Robot Industry

Jairo A. Cruz, Discípulos de Cristo Academy, Bayamón, Puerto Rico. (28)

A mining Robbotic System

Lina Daza, Inter-American School, San Germán, Puerto Rico. (29)

How Are the Greaco-Latin Squares Used for the Design of a Computer Game Using Alice?
Carlos Feliciano, Hazel Cruz, St. Mary’s School, Carolina, Puerto Rico. (30)

Artificial Intelligence: Development of Knowledge

José G. García, José E. Aponte de la Torre School, Carolina, Puerto Rico. (31)

Development of a Medical Application Using Android Operating System Eclipse IDE

Sergio L. Hernández, Bautista de Levittown School, Toa Baja, Puerto Rico. (32)

Know your Neighbor

Ana N. Longo, María Reina Academy, San Juan, Puerto Rico. (33)

Ocean Cleaner Robot

Linnette López, Isabel Flores School (34)

The Cation-π Interaction of Guanidinium+, CA++ and Be++ with Benzene and Two Models of Amino Acids

Miridaliz Lorenzo, Ilka V. Walker, SESO, Mayaguez, Puerto Rico. (35)

Study and Frequency of Illegal Downloading of Music Using Limewire Versus ITunes

Ginexis Marrero, Homeschool, Bayamón, Puerto Rico. (36)

Are We Someday Be Safe?

Kimberly Millán, José E. Aponte de la Torre School, Carolina, Puerto Rico. (37)

Importance of a Blog’s Privacy Settings

Adriana Morales, Espíritu Santo School, San Juan, Puerto Rico. (38)

Othoniel Rodríguez, Bautista de Puerto Nuevo School, San Juan, Puerto Rico.

Observations on the Performance Tool Passmark Test Used in Windows XP
Cristina Morales, Libre de Música Ernesto Ramos Antonini, San Juan, Puerto Rico.

Albert Santiago, María Teresa Piñeiro School, San Juan, Puerto Rico.

Encrypting Information Webpage

Davette Nazario, Homeschool, Carolina, Puerto Rico.

Use of a Robotic System to Assist on Water Sampling Process and Analysis

Edwin Negrón, Bárbara Ann Roessler Academy, San Juan, Puerto Rico.

The Bee on My Behivee

Jariel Ortiz, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

The Evolution of Video Game Development

Gabriel Pagán, Joffre Gómez, Inter-American School, San Germán, Puerto Rico.

Text Stadistics

Vanessa Pagán, SESO School, Mayaguez, Puerto Rico.

Cobb’ Angle Vs. X-Rays

Ignacio Pérez, Gustavo Marrero, St. Mary’s School, Carolina, Puerto Rico.

Web Browser Comparison

Robert Pérez, CROEM School, Mayaguez, Puerto Rico.

Digital Graphics and Displays of Chemical Ingredients of Selected Cosmetics and Products for Personal Care

Alejandro Ramos, American Military Academy, Guaynabo, Puerto Rico.

Raysmarie Figueroa, Gilberto Concepción de Gracia School, San Juan, Puerto Rico.

Rubik's Cube
Jonathan Gadiel Ramos, Nuestra Señora de Altagracia, San Juan, Puerto Rico.  
Alexander Reyes; Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Theoretic Case Study on the Impact of HTML 5

Laura Reguero, María Reina Academy, Carolina, Puerto Rico.  
Effects of Contamination of Marine Life

Stephan E. Remy, José Aponte de la Torre School, Carolina, Puerto Rico.  
Motorized Orthosis for the Rehabilitation of Patients with Lower Limbs Restricted Mobility

Sebastián J. Rivera, Nikos M. Linares, Inter-American School, San Germán, Puerto Rico.  
Computer Program to Encipher Using the Turning-Grille Method

Laura Roldán, José Aponte de la Torre School, Carolina, Puerto Rico.  
A Web-Based Tool for Water Sampling Analysis Research Projects

Gabriel Román, Giancarlo Santini, St. Mary’s School, San Juan, Puerto Rico.  
Mobile Phones and Technology

Andros Rosa, San Ignacio School, San Juan, Puerto Rico.  
Yoilina Hernández, Bautista de PuertoNuevo Academy, San Juan, Puerto Rico.  
Performance Testing in Single Core
Axel A. Sánchez, Barbara Ann Roessler Academy, San Juan, Puerto Rico.  
Christian González, Gabriela Mistral High School, San Juan, Puerto Rico.

Automatic Alert System

Fernando Sánchez, Petra Mercado Bougart School, Humacao, Puerto Rico.  
Wi-Fi Location

Rosangelie Soto, Andrea M. Devaris, Inter-American School, San Germán, Puerto Rico.  
Algorithm for the Empirical Formular of a Compound

Rafael Suárez, Josefina Barceló School, San Juan, Puerto Rico.  
Free vs Paid Security Protection

Marco A. Sueiro, Dra. Wilma Chávez, Avance 2000 School  
Universal Wish List Application

Orlando J. Torres, St. Francis School, Carolina, Puerto Rico.  
Making an Environmental Web Page

Nathalie C. Velázquez, Inter-American School, San Germán, Puerto Rico.  
The Koch Snowflake

Alejandro Vélez, SESO School, Mayaguez, Puerto Rico.  
Spectroscopic Analysis to Gain Information About the UV Blocking Properties of Sunblocks and Sunscreens

Julio Viera, Dr. Juan José Osuna School, San Juan, Puerto Rico.  
Ángel Andino, Santa Gema School, Carolina, Puerto Rico.  
Vector Solution Website
Jussan J. Villegas, Josefina Barceló School, San Juan, Puerto Rico. (65)

Threat in Simple Software

APPLIED MATHEMATICS

Loammi M. Birriel, Ángel P. Millán Rohena School, Carolina, Puerto Rico. (66)

Mutations from the COL7AI in Collagen VII

Aldrin M. Cañals, Marimar Méndez, Calasanz School, Carolina, Puerto Rico. (67)

How are Humans Affected by Plastics Molecules?

Yanira Castelló, Universidad del Este, Carolina, Puerto Rico. (68)

Computational Analysis of Amino Acids Changes in the MEN1 Gene

Lorianie Colón, Yuliam Pedraza, San Juan Apóstol y Evangelista School, Caguas, Puerto Rico. (69)

A Mathematical Model to Compare the Mexican Population Living in Mexico and the Immigrants in USA

Nicole M. Colón, Notre Dame School, Caguas, Puerto Rico. Grace M. Fontánez, Petra Mercado Bougart School (70)

Proportional Relationship Between Hand Distension and biological Variables

Natasha D. García, Dr. Juan José Osuna School, San Juan, Puerto Rico. (71)

The Effect of Light Pollution on Sea Turtles in Puerto Rico.

José González, José Aponte de la Torre School, Carolina, Puerto Rico. (72)

Amino-Acid Changes in the Protein SCN5A

Juan M. González, Mayra A. Quiles, Caguas Military Academy, Caguas, Puerto Rico. (73)

Research on the Development of the Hand
Irene Hammel, María Reina Academy, Carolina, Puerto Rico. (74)

Measuring Base Running Efficiency

Rafael Martínez, Antonio Fernos Isern Vocational High School, Juncos, Puerto Rico.

Jennifer M. Reyna, Petra Mercado School, Humacao, Puerto Rico.

A Mathematical Model to Determine the Time of Decease

Sarah Matos, Barbara Ann Roessler Academy, San Juan, Puerto Rico. (76)

Effect of Cooking Methods on the Reduction of Vitamin C

Juan C. Pérez, José Aponte de la Torre School, Carolina, Puerto Rico. (77)

Solar Energy System Feasibility Study

Lorena Pérez, María Reina Academy, Carolina, Puerto Rico. (78)

The Effects of the New Contributive Reform

Valerie Pérez, Castillo Fuerte School, Carolina, Puerto Rico. (79)

Mutations in the MYH7 Gene

Tiffany Reyes, Castillo Fuerte School, San Juan, Puerto Rico. (80)

Meningioma


Marcus I. Arroyo, Josefina Barceló School, Guaynabo, Puerto Rico.

Green Robot

Rebecca E. Rosado, José Aponte de la Torre School, Carolina, Puerto Rico (82)

Analysis of the Amino Acids Changes in the ACVRL1 Gene
(Activin a Receptor Type II – Like1)
Yanitzia D. Rosario, Ángel P. Millán School, Carolina, Puerto Rico. (83)

Osteogenesis Imperfect is a Congenital Diseases

Daniel Solís, Commonwealth Parkville School, San Juan, Puerto Rico. (84)

Galapagos Tortoise and Their Population

Stephanie Torres, José Aponte de la Torre School, Carolina, Puerto Rico. (85)

Computational Analysis of AAChanges on the NPC1 Gene

ENGINEERING

Edwin J. Alvarado, Diego Santana and Irisbelle García, Caguas, Military Academy, Caguas, Puerto Rico. (86)

Object Identification Using the Tekkotsu’s Sift Tool

Jean Carlos Bernal, San Juan Apóstol y Evangelista School, Caguas, Puerto Rico.
Raúl Vázquez, Commonwealth High School, Guaynabo, Puerto Rico. (87)

Single Langmuir Probe Plasma Density and Temperature Measurement

Yarib Berríos, Steven Díaz, Caguas Military Academy, Caguas, Puerto Rico. (88)

Digital Logic Implementation of Synchronized Semaphores

Daniela Díaz, María Reina Academy, San Juan, Puerto Rico. (89)

Crop Making Robot

William Ferrer, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. (90)

Measurement of Glow Discharge Temperature and Density Using Lab View and Single Langmuir Probe with a Sweep Voltage from -25 to 50
Joan García, Pedro Orona, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Measurement of Glow Discharge Temperature and Density Using Lab View and Single Langmuir Probe with a Sweep Voltage from -25v to 25v

Rubén García, Xavier Figueroa, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Using Labview an a Single Langmuir Probe to Measure Glow Discharge Plasma Parameters with a Voltage Sweep from -25volts to 25volts

Elizabeth Maysonet, María Reina Academy, Carolina, Puerto Rico.

Automatic Fishing Net

Mario Medina, Ricardo Borralí, Miguel Such Vocational School, San Juan, Puerto Rico.

Observations on the Performance Tool Passmark Test Used in Windows XP

Alberto Mulero, Alexander Ortiz, and Juan P. Sánchez, Notre Dame School, Caguas, Puerto Rico.

Programming Logic and Algorithm Planning


Simulation and Probability Analysis of the Game of Roulette

Karen M. Rivera, Kimberly Velázquez, Caguas Military Academy, Caguas, Puerto Rico.

Simulation and Probability Analysis of the Game of Craps

María E. Roldán, María Reina School, Carolina, Puerto Rico.

Nail-Painting Robot

Jennifer L. Rosa, Notre Dame School, Caguas, Puerto Rico.

MATLAB Implementation of Image Compression Applying Singular Value Decomposition
Carlos Saladini, Notre Dame School, Caguas, Puerto Rico.
Yaichael Rodríguez and Alejandro Rivera, Caguas Military Academy, Caguas, Puerto Rico.

Algorithm Planning for Programming of Robots

Elvin Torres, Bautista de Caguas Academy, Caguas, Puerto Rico.

Cronix Portable Web Browser
Chairperson: Dr. Ángel Arcelay
Universidad del Este

**BIOLOGICAL SCIENCES**

10:50 – 11:00 a.m. **Marcos J. Ayala**, University Gardens School, San Juan, Puerto Rico.

NALP1 Vitiligo Gene Analysis by Genedoc and Mega4

11:00 – 11:10 a.m. **Laura A. Belmar**, University High School, San Juan, Puerto Rico.

The Evaluation of Poor or Healthy Water in the Señorial Strem

11:10 – 11:20 a.m. **Sofía Carrasquillo**, Secundaria Universidad de Puerto Rico School, San Juan, Puerto Rico.

How Does the Nematode *Trichuris trichiura* Affect Its Host by Transmiting Trichuriasis?

11:20 – 11:30 a.m. **Pablo González**, Notre Dame School, Caguas, Puerto Rico.

SIFT Analysis of the Retinoblastoma Protein

11:30 – 11:40 a.m. **Adriana M. Mejía**, Episcopal Cathedral School, San Juan, Puerto Rico.

Microsporum Gypseum Infecting Humans and Pets

11:40 – 11:50 a.m. **Astro Muñoz, Sebastián Santiago**, Notre Dame School, Caguas, Puerto Rico.

Infrared Spectroscopy

11:50 – 12:00 a.m. **Juan J. Rivera**, José de la Torre School, Carolina, Puerto Rico

The Global Warming Simulator and Work out Plan

12:00 – 12:10 a.m. **Nicolle Rosa**, Levittown Baptist Academy, Toa Baja, Puerto Rico.

Amino Acid Conservation of Sickle-Cell Anemia an Beta Thalassemia
ENGINEERING

12:10 – 12:20 a.m.  
**Edrick Alvarado, Kevin Vargas,** CROEM School, Mayaguez, Puerto Rico.

The Relationship Between Solar Activity and the Amount of Cosmic Ray Air Showers

12:20 – 12:30 a.m.  
**José Mora,** San Ignacio School, San Juan, Puerto Rico.  
**Ricardo Rodríguez,** San Jorge Academy, San Juan, Puerto Rico


12:30 – 12:40 a.m.  
**Gabriel Reilly, Orlando Torres,** Espiritu Santo School, San Juan, Puerto Rico.

Plasma Density and Temperature Measurements with a Single Langmuir Probe
<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:50 – 11:00 a.m.</td>
<td><strong>Alfredo A. Aldebol</strong>, Inter-American School, San Germán, Puerto Rico.</td>
<td>The Algorithm on Fast Exponentiation of Algebraic Numbers</td>
</tr>
<tr>
<td>11:00 – 11:10 a.m.</td>
<td><strong>Héctor Aponte</strong>, José E. Aponte de la Torre School, Carolina, Puerto Rico.</td>
<td>Using Python to Generate 3D Computer Graphics</td>
</tr>
<tr>
<td>11:10 – 11:20 a.m.</td>
<td><strong>Néstor Carrasco</strong>, Petra Mercado Bougart School, Humacao, Puerto Rico.</td>
<td>SYNCOP: Software for Calculating the Synthetic Protein Cost</td>
</tr>
<tr>
<td>11:20 – 11:30 a.m.</td>
<td><strong>Yamileika Cruz</strong>, Isabel Flores School, Humacao, Puerto Rico.</td>
<td>Probing the Cation-PI Interaction of Metal (NH4+, Mg++, Na+) Ions with Benzene and Two Models of Amino Acids</td>
</tr>
<tr>
<td>11:30 – 11:40 a.m.</td>
<td><strong>Kevin Estrada</strong>, Barbara Ann Roessler Academy, San Juan, Puerto Rico.</td>
<td>The Windows Stealth Attack</td>
</tr>
<tr>
<td>11:40 – 11:50 a.m.</td>
<td><strong>Yaritza Flecha, Karina García</strong>, Petra Mercado Bougart School, Humacao, Puerto Rico.</td>
<td>Animation Principles Applied to a 3D Bouncing Ball</td>
</tr>
<tr>
<td>11:50 – 12:00 a.m.</td>
<td><strong>Alberto Gómez</strong>, Carvin School, Inc, Carolina, Puerto Rico.</td>
<td>Developing Educational Tools Using Alice</td>
</tr>
<tr>
<td>12:00 – 12:10 a.m.</td>
<td><strong>Adrianna Lebrón, Leila Alicea</strong>, St. Mary’s School, Carolina, Puerto Rico.</td>
<td>Human-Computer Interaction in Daily Life</td>
</tr>
</tbody>
</table>
12:10 – 12:20 a.m. Carlos Malavé, SESO School, Mayaguez, Puerto Rico.

HTML5 Vs Flash

12:20 – 12:30 a.m. Christian Rivera, Levittown Baptist Academy, Levittown, Toa Baja, Puerto Rico.


Analyzing Traffic Flow

12:30 – 12:40 a.m. Gilberto Robles, Bautista de Levittown School, Toa Baja, Puerto Rico.

Encripting Information Web Page

12:40 – 12:50 m. Luis F. Rodríguez, Dra. Wilma Chávez, Avance 2000 School,

Introduction to HTML

12:50 – 1:00 p.m. Álex Sánchez, Barbara Ann Roessler Academy, San Juan, Puerto Rico.

The Anatomy of a Virus

1:00 – 1:10 p.m. Joseph Santiago, Petra Mercado Bougart School, Mayaguez, Puerto Rico.

Dynamics: Rigid Body Simulation

1:10 – 1:20 p.m. Julio Valdés, SESO School, Mayaguez, Puerto Rico.

Testing Web Browsers for Everyday Use Efficiency

1:20 – 1:30 p.m. Nicole Vélez, Espíritu Santo School, San Juan, Puerto Rico.

Observations on the Performance Tool Passmark Test Used in Windows XP
10:50 – 11:00 a.m. **Rafael Cañals**, Calasanz School, Carolina, Puerto Rico.

Natural or Artificial Tanning, Which is Better?

11:00 – 11:10 a.m. **Alfonso Figueroa**, Inter-American School, San Germán, Puerto Rico.

Triangles with Integer Sides and Area

11:10 – 11:20 a.m. **Viviana Lebrón**, Calasanz School, Carolina, Puerto Rico

Are We Really Protected from Bacteria?

11:20 – 11:30 a.m. **Elvin A. Méndez**, José Aponte de la Torre School, Carolina, Puerto Rico.

Computational Study of AA Changes on ABCC8 Gene

11:30 – 11:40 a.m. **Melinda Vargas**, San Antonio Abad School, Caguas, Puerto Rico.  
**Jennifer Patritti**, Manuela Toro Morice, Caguas, Puerto Rico.

Non Stop Decomposition

11:40 – 11:50 a.m. **Virginia Vélez**, Castillo Fuerte School, Carolina, Puerto Rico.

The Effects of Dystrophin in Muscle
1:30 – 3:00 p.m.  LUNCH                      Gazebos Galería and Galería Lobby

3:00 – 3:30 p.m.  AWARD CEREMONY
                  AND CLOSING REMARKS                      Galería Room

2:00 p.m. – 4:00 p.m.  WORKSHOP FOR SCIENCE AND MATH TEACHERS
                       “Dynamics Mathematics with GeoGebra”
                       Dr. Luis de la Torre, Professor of Mathematics, Universidad Metropolitana

                       “Computer Applications for Plasma Engineering”
                       Dr. Ángel González, Professor of Engineering, Polytechnic University

4:00 p.m.  SYMPOSIUM ADJOURNS
ABSTRACTS
BIOLOGICAL SCIENCES

ANALYSIS OF EVOLUTIONARY CHANGES OF THE PHENYLALANINE HYDROXYLASE GENE

Abner Alemán, Calasanz School, San Juan, Puerto Rico.
Research Mentor: Dorielys M. Valentín, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

Phenylketonuria (PKU) is an inherited genetic disease in which the body cannot process part of a phenylalanine (Phe) protein. Phenylketonuria is caused by the phenylalanine hydroxylase gene, which leads to mental retardation, skin disorders, epilepsy, microcephaly and a musty odor. The affected person inherits two traits, one from each parent who are the carriers and usually do not have the symptoms. BLAST (Basic Local Alignment Search Tool) was used to find regions of local similarity between sequences, and Tcoffee for the computation of multiple sequence alignment. The programs used were GenDoc which is a multiple sequence alignment editor and MEGA 4 (Molecular Evolutionary Genetic Analysis), an integrated tool for conducting automatic and manual sequence alignment, inferring phylogenetic trees and mining web-based databases. MEGA 4 was used to make two phylogenetic trees at the maximum and the minimum. The maximum phylogenetic tree showed that Mus musculus and Rattus norvegicus are the most similar, while Camponotus floridanus is the least similar, and the minimum phylogenetic tree showed that Mus musculus and Rattus norvegicus are the most similar, while the Gossisna morsitans morsitans is the least. GeneDoc showed that the percentage of conservation of the amino acid is 56%. This percentage of conservation shows that this gene sequence has changed, but it has not changed so drastically throughout the years.

NALP1 VITILIGO GENE ANALYSIS BY GENEDOC AND MEGA4

Marcos J. Ayala, University Gardens School, San Juan, Puerto Rico.
Research Mentor: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

Vitiligo is a skin condition in which there is loss of pigment from areas of the skin, resulting in irregular white patches that feel like normal skin. Vitiligo appears to be an acquired condition and can appear at any age. The cause of vitiligo is unknown. Vitiligo is a disease in which the melanocytes of the skin are destroyed. This happens when a person's immune system reacts against the body’s own organs or tissues. The purpose of this investigation is to determine the percentage of conservation in the amino acid sequence in this genetic disease. The tools used to obtain the results were MEGA 4, which is a program that induces phylogenetic trees and GeneDoc, which is a multiple sequence alignment editor. The minimum phylogenetic tree is a comparison between the protein sequences on the species. The maximum phylogenetic tree is an evolutionary comparison between the species. In both the maximum and minimum trees, Macaca mulatta and Bos taurus are the most similar, and Callicebus moloch is the least similar. According to GeneDoc, the most present amino acids in the sequences were leucine, glutamic acid and serine. In the gene NALP1, the percentage of conservation found was approximately 12%. In conclusion, the percentage of conservation shows that the sequence of the amino acids in NALP1 has changed as the years have passed.
COMPARISON OF THE HIGH QUALITY OF WATER AT SEÑORIAL STREAM AND RIVERAS STREAM

Noemí Aybar, Secundaria de Universidad de Puerto Rico School, San Juan, Puerto Rico.

Research Mentor: Raquel Castañeda, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Natalia C. Santiago, Universidad Metropolitana, San Juan, Puerto Rico.

Macroinvertebrates are organisms that lack a backbone and mainly obtain their food through leaves and algae present in an aquatic environment. They have an ability to attach themselves onto rocks and in some species the adult female drags herself into the water to attach her eggs to stones on the bottom. These insects are bio-indicators of the high or poor water quality. The objective of this study was to capture macroinvertebrates, and to identify them. The high water quality of two streams was compared in this research: The Riveras and the Señorial streams high water quality in Riveras. The insect used as a bio-indicator of the high water quality at these Streams is the family baetidae, which is a large and diverse family in Neotropical countries. The order ephemeroptera, where the family baetidae is placed, is one of the aquatic insects that often go through many nymph stages and are the only insects that have two flying stages. There were water samples taken using whirl packs from both streams mentioned above, to obtain the macroinvertebrates. Then they were stored in 100% ethanol to preserve them. Moreover, there was an analysis of phosphorus taken as accompanying data. The graphs demonstrate the involvement of phosphorus with the high water quality.

THE EVALUATION OF POOR OR HEALTHY WATER IN THE SEÑORIAL STREM

Laura A. Belmar, University High School, San Juan, Puerto Rico.

Research Mentor: Raquel Castañeda, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Natalia Santiago, Universidad Metropolitana, San Juan, Puerto Rico.

Macroinvertebrates are biotic elements present in an aquatic environment that are very sensitive to water pollution, so biologists can learn a lot about the environmental conditions in a water body from the abundance of certain types of these organisms. Macroinvertebrates are also aquatic insects that feed on the phosphorus nutrients from a water body. Because they are encountered in almost every single water body, they are relatively easy to identify and are easy to obtain with simple hand nets. They are also perfect bio-indicators. The purpose of this research was to investigate the water quality of the Señorial Stream by identifying the macroinvertebrates that live in it. This was done by using the ones from the order Trichoptera, Ephemeroptera, Diptera and Coleoptera. When they were obtained from the stream, they were placed on ethanol, brought to the laboratory to be identified and classified by their order and family, thus, revealing the water conditions of the stream. The results were presented in graphs that revealed the comparison between the total of macroinvertebrates that bio-indicate good or poor water quality with the level of phosphorus.
WHAT IS THE EFFECT OF POISON IVY TO PHYSICAL CONTACT WITH THE SKIN

Eric Benítez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Raquel Castañeda, Universidad Metropolitana, San Juan, Puerto Rico.

In this investigation it was found that the plant, poison ivy, poison is seriously effective and the skin of humans and animals. In human skin causes blisters, rash, itching, and various skin irritations. The same thing happens in animals. This plant is not in Puerto Rico, but in the U.S.. It can grow in home gardens, around lakes and forests. Clinging to trees can grow, or they can grow individually. Its color changes depending on time of year it is. You can be up to six feet tall. Poison ivy contains a substance called urushiol, this is what causes you irritation. To exterminate it is not as easy as cut, but you have to apply a specific chemical. If you are silent and the oil of the plant on clothing, you should dump it. If you are silent and the skin would have to wash the area immediately with soap and water. Then you’d have to go to a doctor to prescribe you some medicine depending on the severity of the wound.

COMPARATIVE STUDY OF DIFFERENT SPECIES WITH THE NF1 AND NF2 GENES

Marimar Benítez, University Gardens School, San Juan, Puerto Rico.

Research Mentor: Dorielys M. Valentín, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

Neurofibromatosis (NF) is a hereditary genetic disorder or a mutation in the genetic material that causes tumors to grow on neural cell tissues, producing skin and bone deformities. Scientists have classified the disorders as neurofibromatosis type 1 (NF1) and neurofibromatosis type 2 (NF2). The NF1 gene is located on chromosome 17, and NF2 is located on chromosome 22. The purpose of this research was to determine the percentage of conservation in the amino acid sequence of each disorder by means of bioinformatics tools. Molecular Evolutionary Genomic Analysis (MEGA 4) is a tool used to align sequences and build trees to show relationships among sequences. It was used to create two phylogenetic trees; the minimum (comparison between the protein sequences on the species) and the maximum (an evolutionary comparison between the species). In the minimum phylogenetic tree of NF1 the most similar species were Hydra magnipapillata and Ciona intestinalis, and the least similar was Ailuropoda melanoleuca, and in the maximum phylogenetic tree of NF1 the most similar species were Hydra magnipapillata and Homo sapiens, and the least similar was Monosiga breviscola. In the minimum phylogenetic tree of NF2 the most similar species were Ailuropoda melanoleuca and Equus caballus, and the least similar was Xenopus laevis, and in the maximum phylogenetic tree of NF2 the most similar species were Oryctolagus cuniculus and Equus caballus, and the least similar was Xenopus laevis. Genedoc, a multiple sequence alignment editor, was used to determine the percentage of conservation of amino acids in the disorders. According to Genedoc, the most present amino acid in all the sequences of NF1 was leucine and in NF2 were leucine, glutamic acid and lysine. With Genedoc, it was determined that in the NF1 sequence of amino acids the percentage of conservation was 0.16 %, but in NF2 the percentage of conservation was 86% in the species studied. In conclusion, the percentage of conservation showed the amino acids conserved through the evolution of species. The results show that NF1 had changed rapidly and NF2 has remained more conserved.
HOW DOES THE NEMATODE *TRICHURIS TRICHIURA* AFFECT ITS HOST BY TRANSMITTING TRICHURIASIS?

**Sofia B. Carrasquillo**, Secundaria Universidad de Puerto Rico School, San Juan, Puerto Rico.

Research Mentor: Natalia Santiago, Universidad Metropolitana, San Juan, Puerto Rico.

Nematodes are parasitic worms that can vary in different aspects. These worms even depend on other live organisms. *Trichuris trichiura* is a type of nematode that can produce the infection Trichuriasis. The purpose of this research was to collect and analyze information for Trichuriasis in different types of resources. The information revealed the infection can only be gained by having some type of hand or food contact from soil contaminated by feces (excrement). The infection can spread inside the body to the colon, cecum, appendix and rectum. The patient may feel asymptomatic (with no symptoms) at first, but when it develops it can get severe. Between the symptoms there can be gastrointestinal problems, bloody diarrhea, tenesmus (cramps), appendicitis, growth retardation, weight loss, nutritional deficiencies, and anemia. Children are the most infected population, since they play with dirt a lot. Even if the lifetime of a nematode is one year, during its stay the female still plants eggs, making it a non-stopping cycle until treated. The nematode can be treated with two different medicines, Mebendazole and Albendazole. The infection can be prevented by being cautious with the surroundings which includes cleaning the hands frequently, washing food before eating, and watching children’s activities.

**THE COMPARISON BETWEEN THE CHEMICAL COMPOSITION OF THE JATROPHA PODAGRICA AND THE JATROPHA CURCAS AND THEIR VIABILITY IN THE PRODUCTION OF BIODIESEL**

**Salimar Cordero**, Secundaria Universidad de Puerto Rico, San Juan, Puerto Rico.

Research Mentor: Raquel Castañeda, Universidad Metropolitana, San Juan, Puerto Rico.  
Research Mentor Assistant: Natalia Santiago, San Juan, Puerto Rico.

Many different countries in the world are putting a lot of effort to find better sources used to produce biodiesel for commercial use. One of the plants that is considered for the production of biodiesel is the *Jatropha curcas*. The research consisted of comparing *Jatropha curcas* with another plant of the same family which is the *Jatropha podagrica* to find out why one of the plants is considered a good source of biodiesel while the other is not. The information found using different articles and websites on the Internet was that the *Jatropha curcas* and the *Jatropha podagrica* have many traits in common.
PSYCHROBACTER PROTEIN ANALYSIS USING PYMOL

Brianna González, Elizabeth Torres, San Antonio Abad School, Humacao, Puerto Rico.

Research Mentor: Dr. Fabio Alape, University of Puerto Rico, Humacao, Puerto Rico.
Research Mentor Assistant: Glorimar Castro Noriega, University of Puerto Rico, Humacao, Puerto Rico.

Psychrobacter genus is composed of psychrophiles bacteria that can live in different extremely cold habitats, and are the living organisms that are more similar to extraterrestrial life. The biggest differences between Psychrobacter species are their proteome. Therefore, a well analysis of their proteome is required. We analyze the differences between Psychrobacter cryohalolentis K5 and Psychrobacter sp. PRwf-1. Using bioinformatics tools, as PyMOL, we observed the differences between their properties (e.g. hydrophobic/hydrophilic). Until now, we do not have greatest differences between the above proteins. As a future work, we can create PyMOL algorithms to decrease the time effort spends in the analysis of protein, and implement these algorithms to analyze another Psychrobacter. Analysis of the differences in protein structures and compositions of the two species on study lead to the growth of scientific knowledge, and a better understanding of the extraterrestrial bacteria life.

SIFT ANALYSIS OF THE RETINOBLASTOMA PROTEIN

Pablo González, Notre Dame School, Caguas, Puerto Rico.

Research Mentor: Argenys Robles, Universidad del Turabo, Gurabo, Puerto Rico.

Homo Sapiens Retinoblastoma, 1(RB1)mRNA, or Retinoblastoma for short, is a gene that encodes a protein which is a negative regulator of the cell cycle (helps maintain a normal cell division rate) and was the first tumor suppressor gene found. Retinoblastoma is a rapidly developing cancer that affects 1 in every 15,000 live births; most of these are children between the ages of 2 to 6 years old. The objective of this research was to verify if different changes in amino acid positions will increase or decrease the mutation effects. To accomplish this, the Sorting Intolerance From Tolerance or (SIFT) program was used. Its main purpose or function is to use sequence homology to predict whether an amino acid substitution will affect protein function and hence, potentially alter phenotype. With the information obtained from the program, a position of the gene was taken from 1 to 20 to study changes in the amino acids. They were separated into groups of five and the intolerance percent in each group was retrieved. The results were that the different changes make the gene 38 percent intolerant to amino acid changes. This means that this gene has a low percent of intolerance. It can be assumed that the gene resists changes without being harmful. In conclusion if the amino acids in these are altered or changed, the affected individual will not worsen.
WIRELESS SIGNALS AND THEIR EFFECTS ON THE GERMINATION OF PHASEOLUS VULGARUS

Gilberto Jiménez, CROEM School, Mayaguez, Puerto Rico.

Research Mentor: Peter Van Der Meer, University of Puerto Rico, Mayaguez, Puerto Rico.

Wireless local area network (WLAN), better known as Wi-Fi ®, is now very common around us. The demand and implementation of wireless capabilities on devices is growing. The signals are radio waves that travel through the air and are a form of radiation. These waves sent by a router are approximately 2.4 GHz, and this is considered the amount of electromagnetic energy transmitted to the environment. A lot is being said about the effect of wireless signals on animal cells and investigations that relate the exposure to such radiation with cancer and other ailments in our society. Despite the number of studies, little is known about their effects on plant cells. Plants are or may be affected by the same range of animal diseases. One of the possible effects is a decrease in growth or a low production of fruits on which society depends for a healthy diet. This research focused on the effects of the Wi-Fi ® signals on the germination process of bean seeds, which is a very common cultivated vegetable around the world.

EVOLUTIONARY STUDY OF THE PHD FINGER PROTEIN 8

Glory López, Bautista de Carolina Academy, Carolina, Puerto Rico.

Research Mentor: Dorielys M. Valentín, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

PHD Finger Protein 8, commonly known as Cleft Lip, is a condition where the upper lip is split. In some cases there could also be a Cleft Palate where the palate is split and there is also a bilateral cleft (two-sided). Even though many people are trying to find a way to prevent it and are unsuccessful, treatments for this genetic disorder are available. The program BLAST (Basic Local Alignment Search Tool) was used to find regions of local similarity between sequences. It compared nucleotide or protein sequences to sequence databases and calculate the statistical significance of matches. The program TCOFFEE was used to create a multiple sequence alignment. In order to determine evolutionary changes in the PHD Finger Protein 8, the percentage of conservation between evaluated species and to determine conserved amino acids with their corresponding position, GeneDoc was used, a Full Featured Multiple Sequence Alignment Editor, and MEGA4 (Molecular Evolutionary Genetic Analysis), an integrated tool for conducting automatic and manual sequence alignment by inferring phylogenetic trees. With the minimum phylogenetic tree the evolutionary analysis of protein sequence between the species was found, and the result was that the most similar species were Oryctolagus Cuniculus and Bos Taurus and the least similar species was Mus Musculus. The maximum phylogenetic tree provided the comparison between species, and the results were that the most similar species were Oryctolagus Cuniculus and Bos Taurus and the least similar was Danio Rerio. In the GeneDoc program we the percentage of conservation in the sequence which was 52% was found. The results of this research suggest that the species studied had suffered changes because the amino acids were not conserved. This may be due to evolutionary changes.
BIOINFORMATICS STUDY OF THE FMR1 GENE IN FRAGILE X SYNDROME

Vivianna Mas, Calasanz School, Carolina, Puerto Rico.

Research Mentor: Dorielys M. Valentín, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

Fragile X is a genetic disorder that causes mental impairment. This condition is caused by a change in the gene FMR1 (that is located in the X chromosome), that causes mental impairment. The FMR1 gene is a protein for the brain development. This is the most common cause of inherited mental impairment. The purpose of this work was to determine the percentage of conservation and evolutionary changes in the FMR1 gene. Two programs used were: MEGA4 and GeneDoC. The Molecular Evolutionary Genetics Analysis (MEGA) is a software application designed for comparative analysis of homologous gene sequences. It was used to compare the FMR1 gene with different species by inferring phylogenetic trees at the maximum and the minimum. In the maximum phylogenetic tree Mus musculus and Rattus norvegicus are the most similar, while Homo sapiens and Ailuropoda melanoleuca are the less similar. In the minimum phylogenetic tree Sus scrofa and Bos taurus are the most similar, while Oryctolagus cuniculus and Pan troglodytes are the less similar. Genedoc is a program used to determine the percentage of amino acid conservation in the sequence. According to Genedoc, the percentage of conservation of amino acid is 66%. In conclusion, the gene can tolerate some change, yet other amino acids may be essential to the function or structure of the protein, hence this may be due to evolutionary changes that the FMR1 gene has suffered.

MICROSPORUM GYPSEUM INFECTING HUMANS AND PETS

Adriana M. Mejía, Episcopal Cathedral School, San Juan, Puerto Rico.

Research Mentor: Raquel Castañeda, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Natalia Santiago, Universidad Metropolitana, San Juan, Puerto Rico.

Dermatophytosis is a disease that affects cats, dogs, and humans causing red circular infections that affect the scalp, the body, particularly the groin, the feet and the nails, because the fungi feed on keratin, and this material can be found in the outer layer of skin, hair, and nails. It is very common among children, but it can affect people of all ages, as well as animals. One is at risk when exposed to an infected person, animal or spore within the environment. It is found in moist terrains, such as soil and concentrates on sewers. Rats are main carriers of the fungus. Conditions that impair the function of the immune system include poor nutrition and severe, generalized infections. The most efficient precautions are avoiding the act of sharing clothing, sports equipment, towels, or sheets as well as avoiding walking barefoot on the beach and in locker rooms. After being exposed to places where the potential of being infected is great, one should wash with an anti-fungal soap. Most importantly, one must avoid touching pets with bald spots, as they are often carriers of the fungus. In terms of the protein’s alignments, certain databases were used, such as Tcoffee. In this database, the sequences of proteins of different organisms were aligned to see the similarities among them. Another program was GeneDoc, which serves the purpose of showing the conservation, quality, and other characteristics of the aligned sequences. This investigation was done in order to gain information on how to prevent Dermatophytosis, its symptoms and the role cytokine has in this disease.
ANALYSIS OF THE CHEMICAL CHARACTERISTICS OF THE FBN1 FRIBILLIN-1 GENE USING BIOINFORMATIC TOOLS

Valerie Mejía, Calasanz School, San Juan, Puerto Rico.

Research Mentor: Dorielys M. Valentín, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

Marfan syndrome is an inherited disease that affects the connective tissue of the body. It also affects the eyes and the blood vessels. It is caused by a mutation in the fibrillin gene (fibrillin FBN-1). This gene plays an important role in the development of the body. People with Marfan syndrome are loose jointed, very tall, and thin; have long arms, legs, and toes. This project is going to search the percentage of conservation using bioinformatic tools. Genedoc was used to determine the evolutionary changes of the fibrillin FBN-1. The results in this program show that 56% of the amino acids are conserved. The program MEGA4 (Molecular Evolutionary Genetic Analysis) used in this research, is an integrated tool for conducting automatic and manual sequence alignment by inferring phylogenetic trees. In the maximum phylogenetic tree it was found that Sus scrofa and Nematostella vectensis were the most similar species, while Mus musculus was the least and in the minimum tree it was found that Homo sapiens and Mus musculus were the most similar species, while Tetraodon nigroviridis was the least similar. The results of this investigation show that the amino acids have not stayed conserved. This may be because of evolutionary changes through the years.

INFRARED SPECTROSCOPY

Astro Muñoz, Sebastián Santiago, Notre Dame School, Caguas, Puerto Rico.

Research Mentor: Schatzi Miranda, Universidad del Turabo, Gurabo, Puerto Rico.

Spectroscopy was originally the study of the interaction between radiation and matter as a function of wavelength (λ). Infrared refers to that part of the electromagnetic spectrum between the visible and microwave regions. Electromagnetic spectrum refers to the seemingly diverse collection of radiant energy, from cosmic rays to X-rays to visible light to microwaves, each of which can be considered as a wave or particle traveling at the speed of light. Infrared spectroscopy offers the possibility to measure different types of atomic bond vibrations at different frequencies. Especially in organic chemistry the analysis of IR absorption spectra shows what types of bonds are present in the sample. This project demonstrates how infrared radiation is absorbed by the Ethanol and Anthracene substances. The radiation resulted in vibrations on the molecule which can be theoretically deduced from the groups that compose the molecule. The project projected visually the vibrations on these substances using Spartan and graphs produced by a Fourier transform Infrared Spectrometer IFTR.
THE RELATIONSHIP BETWEEN TWO ORDERS OF MACROINVERTEBRATES, TRICHOPTERA AND DIPTERA

Valeria Muñoz, Puertorriqueño de Niñas School, San Juan, Puerto Rico.

Research Mentor: Raquel C. Castañeda, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Natalia C. Santiago, Universidad Metropolitana, San Juan, Puerto Rico.

Macroinvertebrates are bio-indicators of the water quality in a stream due to their sensibility to any change in the composition of the water. These insects live in aquatic environments and feed on the phosphorus present in it. Diptera and Trichoptera are two orders of these animals that indicate poor and good water quality respectively. The purpose of collecting these biotic elements is that they can be used to identify the purity of the water running in the Señorial and Riveras streams. The presence of a particular family group will show the water quality in each of the streams. Water samples were taken in order to collect the macroinvertebrates; they were then stored in 100% ethanol in order to preserve them. An analysis of Phosphorus (P) was also done for further data. The graph represents the complex relationship between the available phosphorus and the abundance of excellent and poor water quality indicators. It was found that the patron between Trichoptera and phosphorus is very strong since these organisms feed on this available element. While on the contraire the patron between Diptera and phosphorus is very weak, thus implying a decay on the availability of phosphorus.
COMPARISON, VISUALIZATION, AND ALIGNMENTS OF SEQUENCES IN BREAST CANCER 1 AND 2, EARLY ONSET

Frances Negrón, Levittown Baptist Academy, Toa Baja, Puerto Rico.

Research Mentor: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

Breast Cancer 1, Early Onset (BRCA1) is a protein-coding gene. The BRCA1 encodes nuclear phosphoprotein that plays a role in maintaining genomic stability. Breast Cancer 2, Early Onset (BRCA2) is a protein-coding. Mutation in this gene generally exhibits loss of heterozygosis of the wild-type allele. BRCA1 and BRCA2 are both tumor suppressors’. Mutation in these genes have been related to other hereditary cancer. The objectives in this research were to determine the evolutionary changes in the BRCA1 and BRCA2 gene, percentage of conservation between evaluated species, and conserved amino acids. The programs that were used in the research were GeneDoc and MEGA4. GenDoc is a program used for the comparison, visualization and alignments of the species that edits the alignments of the sequence. The Molecular Evolutionary Genetics Analysis (MEGA) version 4.0 is software that compares DNA or protein sequences of homolog species to estimate evolutionary rates using phylogenetic trees. There are two types of phylogenetic trees, the maximum and the minimum. In the maximum there is a comparison in the species; and the minimum is a protein comparison between the chosen species. GeneDoc showed that the percentage of conservation between evaluated species in BRCA1 was 14%, and in BRCA2 was 25%. In MEGA4, the maximum phylogenetic tree in BRCA1 showed that Homo sapiens and the Pan troglodytes are the most similar, and Gorrilla gorilla and Pongo pygmaeus are the ones that do not relate much with the others. The results in the minimum phylogenetic tree in BRCA1, showed that the Homo sapiens and the Pan troglodytes are very related, while Otolemur crassicaudatus is unrelated. The maximum phylogenetic tree in BRCA2 showed that Pan troglodytes and the Cricetulus griseus are the most related in the protein, and the Chlorocebus aethiops and Canis lupus are related between them, but not very much with the first two already mentioned. The results in the minimum phylogenetic tree in BRCA2 showed that the Pan troglodytes and Canis lupus familiaris are similar in the species, while Cricetulus griseus is not similar between the species. In conclusion, GenDoc presents a low percentage of conservation suggesting that the BRCA1 and BRCA2 protein can tolerate changes in its structure. MEGA4 shows that the relation between each species and the protein is similar. These results may give more insight into BRCA1 and BRCA2 proteins.

THE EFFECT OF THE INVASIVE SPECIES, THE MOLOTHRUS BONARIENSIS, ON THE NATIVE SPECIES OF THE AGELAIUS XANTHOMUS OF PUERTO RICO

Diana M. Pabón, University of Puerto Rico Secondary School, San Juan, Puerto Rico.

Research Mentor: Natalia Santiago, Universidad Metropolitana, San Juan, Puerto Rico.

In Puerto Rico, several species have been introduced to the island. One of these species is the Shiny Cowbird, which affects the native Yellow Shouldered Blackbird. The purpose of this study was to find the effect this species has on the Yellow Shouldered Blackbird and learn ways to control the Cowbirds’ parasitism. j. Research revealed that the Shiny Cowbird is a South American bird that has spread throughout the Caribbean and all the way up to Florida. It lays its eggs in other birds’ nests, endangering their own. The Yellow Shouldered Blackbird has become an easy target for the Shiny Cowbird. Due to this, the once widespread Yellow Shouldered Blackbird is now restricted to a small area, this being the small islands of Mona and Monito. The bird has become endangered and has a very small and fragmented population.
THE GLOBAL WARMING SIMULATOR AND WORK OUT PLAN

Juan R. Rivera, José de la Torre School, Carolina, Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.

The Global Warming Simulator is an educational system that will provide the audience a virtual experience on the consequences of the global warming problem. The main purpose of the simulator is to create awareness of the natural phenomena that have been happening more frequently during the last years as a result of the major climate changes that have occurred in the planet, and also to advise people on how they can help to diminish human actions that affect nature. This Simulator was controlled with a GUI.

EVALUATIONS OF GENETIC MUTATIONS OF HOMO SAPIENS BETA GLOBIN
SICKLE CELL DISEASE

Thalia Rivera, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Argenys Robles, Universidad del Turabo, Gurabo, Puerto Rico.

The gene NM_000518 or better known as beta globin works with the transportation of oxygen from the lungs to various peripheral tissues using the red blood cells as its carrier. The alpha and beta loci determine the structure of the two types of polypeptide chains in the adult hemoglobin. Mutant beta globin causes sickle cell anemia while the absence of beta chain causes beta zero thalassemia. Reduced amounts of detectable beta globin cause beta plus thalassemia. These diseases can cause severe symptoms such as when red blood cells assume an abnormal, rigid sickle shape which decreases the cell’s flexibility and results in a risk of various complications: sickle cell disease, also excess alpha globin chains accumulate in the developing erythroid precursors in the marrow which leads to a vast increase in erythroid apoptosis that causes severe microcytic hypo chromic anemia: thalassemia. These diseases are just some of the mutations that happen to the gene. The program SIFT was used to tamper with the gene to see if it is tolerant or intolerant to changes in its amino acids. The program showed that the gene Homo Sapiens Beta Globin is 78% intolerant meaning that any change in its amino acids would cause severe damages in the gene.
STUDY OF THE PHYSICAL AND THE CHEMICAL CHARACTERISTICS OF AMYLOID BETA (A4)

Sharelys Román, Avance 2000 School, San Juan, Puerto Rico.

Research Mentor: Dorielys M. Valentín, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

Alzheimer is a disease in which one of the proteins that influence in its expression is amyloid beta (A4). At present, scientists have been trying to find a cure for this disease that has no cure. This disease is distinguished and differentiated by memory loss of the person. The People with this disease are around 60-65 years old. The elderly people with this disease have the tendency of suffering from pains and sometimes the symptoms are so strong that they end up in bed, living their last years There. The purpose of this research was to evaluate the amino acid sequence for amyloid beta (A4), by means of bioinformatics tools. To carry out the research, certain programs were used such as: GeneDoc, a full featured multiple sequence alignment editor and analyzer, and MEGA 4 (Molecular Evolutionary Genetics Analysis) which was used to conduct automatic and manual sequence alignment and inferring phylogenetic trees. The program MEGA4 provides two types of phylogenetic trees, the maximum (which is the comparison of the species) and the minimum (a protein comparison). In both the maximum and the minimum phylogenetic trees the most similar species were Homo sapiens and Pan Troglodytes and the least similar was Monodelphis Domestica. The conservation of percentage of amino acids was provided by the GeneDoc program. The results in GeneDoc showed that 56% of amino acids was conserved. These results suggest that alteration in the sequence of amyloid beta (A4) might not affect its structure and function, since the sequence has changed throughout time.
Sickle-cell anemia and Beta thalassemia are two genetic disorders developed in the gene HBB. Sickle-cell anemia is caused when the glutamic acid found in the sixth position of the normal human hemoglobin beta chain is replaced by the amino acid valine. Beta thalassemia is caused by the lack of one, or both, of the two beta globin chains present in a normal hemoglobin molecule. These two genetic disorders can combine when one of the parents is dominant for sickle-cell anemia and the other for beta thalassemia. This condition is known as sickle beta thalassemia and its patients suffer a more intense pain than sickle-cell patients and than those with beta zero thalassemia, which means that the patient has no beta globin chains. The purpose of this research was to determine the percentage of conservation in the amino acid sequence of these two genetic disorders, when comparing those of a Homo sapiens to nine other species. The analysis of the amino acid sequence in these disorders was studied through MEGA4, which infers phylogenetic trees, and through Genedoc, a multiple alignment visualization tool which was used to determine the percentage of conserved amino acids. The results obtained from these analyses demonstrate that, for sickle-cell anemia, in the maximum phylogenetic tree, which establishes a comparison between species, the most similar were the Camponotus floridanus and the Culex quinquefasciatus, while the least similar was the Drosophila yakuba. The minimum phylogenetic tree for sickle-cell anemia demonstrates that the species with the most similar amino acid sequences are the Tetraodon nigroviridis and the Drosophila yakuba, while the least similar is the Ailuropoda melanoleuca. The amino acid sequence was only 2% conserved between species for sickle-cell anemia. For beta thalassemia, the maximum phylogenetic tree shows that the most similar between species are the Papio anubis and the Macaca tonkeana and the least similar is the Callicebus moloch. The amino acid sequence for beta thalassemia is 53% conserved between species.
ANALYSIS AND STUDY OF AMINO ACID CHANGES IN THE NIEMANN-PICK DISEASE

Netsha J. Santiago, Caguas Private School, Caguas, Puerto Rico.

Research Mentor: Argenys Robles, Universidad del Turabo, Gurabo, Puerto Rico.

Millions of people have died from Niemann-Pick Disease (NP). It refers to a group of inherited metabolic disorders known as leukodystrophies or lipid storage diseases in which harmful quantities of fatty substance (lipids) accumulate in the spleen, liver, lungs, bone marrow, and the brain. It is caused by mutations in the NPC1, NPC2, and SMPD1 genes. Estimates of 1 from 40,000 persons have been diagnosed with NP, all from different ages, sexes, and races. There are four types of classifications. Type A, the most common, occurs in infants that rarely live beyond 18 months. Type B often occurs in pre-teen years. Type C is usually related to the age of the onset. Type D has only been found in the French Canadian population of Yarmouth County, Nova Scotia. The symptoms of this disease are enlargement of the liver and spleen and may cause appetite, abdominal distention and pains, making the stomach look inflated. Other symptoms are unsteady gait, slurring of speech and discoordinated swallowing. The study of gene mutations is important tool in the field of genetic diseases. This work allowed the examination changes in the amino acids using SIFT. The objective of this work was to use Sorting Intolerant From Tolerant (SIFT), in which this program made changes on amino acids, predicting levels of tolerance and intolerance, showing the genes with a mutation in which one could see whether the mutation of the disease would make a difference, making it worse, or if it did not make a difference. The results show low percentage of amino acids, showing that 20% is intolerant leaving 80% as tolerant. In conclusion, even with the changes of amino acids, this disease had a low percentage of intolerance and will not make a difference in the disease.

COMPARATIVE ANALYSIS OF AMINO ACID SEQUENCE IN COAGULATION FACTOR VIII

Alejandro Torres, Calasanz School, Carolina, Puerto Rico.

Research Mentor: Dorielys M. Valentín, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

Hemophilia is a rare genetic disease which mainly affects men, it slows the blood clotting process. The clotting factor is a protein needed for normal blood clotting. Clotting is the process by which the blood changes from a liquid to a solid state in order to stop bleeding. People with this condition experience prolonged bleeding or oozing when following a surgery, getting a tooth pulled out or a simple injury. It is an inherited disease in which the female acts like the carrier. If the disease is not treated and controlled, it can lead to arthritis or a person might die from a hemorrhage when injured. The purpose of this research was to evaluate the hemophilia by means of bioinformatics tools. The Molecular Evolutionary Genomic Analysis (MEGA 4) is a program that compares the sequence of homologous genes and proteins of different species. With MEGA4, two phylogenetic trees were created; the minimum that is the comparison of the proteins between species, and the maximum which is the comparison between species. In the minimum phylogenetic tree Homo sapiens and Callicebus moloch were the most similar, while Oxyuranus scutellatus and Pseudonaja textilis were the least similar. In the maximum phylogenetic tree, Callicebus moloch and Xenopus laevis were the most similar, while Pan Troglodytes was the least similar. Genedoc is a program used to determine the percentage of amino acid conservation. According to Genedoc, the percentage of conservation was 2%. The results of this study revealed that the sequence has changed through time.
BIOINFORMATIC AND EVOLUTIONARY ANALYSIS OF THE HFE GENE

Gladynel Trinidad, Avance 2000 School, Bayamón, Puerto Rico.

Research Mentor: Dorielys M. Valentín, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Dinorah Carrión, Universidad Metropolitana, San Juan, Puerto Rico.

HFE is a gene that can cause hemocromatosis. The disease is inherited when passing the HFE gene makes the body store too much iron. The excess iron can damage organs and tissue. Hereditary Hemocromatosis is a health problem inherited from the parents. It can be called “Iron overload”. Symptoms differ from person to person. Side effects can be diabetes, weak heart, problems with glands and joints. The purpose of this research was to evaluate Hereditary Hemocromatosis by means of bioinformatics tools. Molecular Evolutionary Analysis (MEGA4) is a program that was used to compare the sequence of the HFE gene and the proteins of different species to create two different phylogenetic trees; the minimum (comparison of the proteins between species) and the maximum (comparison between species). In both the maximum and the minimum trees the most similar species were *Equus Caballus* and *Sus scrofa*, while the least similar was *Airulopoda melanoleuca*. Genedoc, a full featured multiple sequence alignment editor and analyzer, was also used. With Genedoc it was found that the percent of amino acid conservation in the sequence was 26%. In conclusion, the results suggest that there are certain conserved amino acids because they may be important for the function of the HFE gene, and that there are various evolutionary differences between species.

CHARCOT-MARIE-TOOTH DISEASE, ANALYSIS OF GAP JUNCTION BETA 1 GENE SIFT EVALUATION

Yimari Vargas, San Antonio Abad School, Caguas, Puerto Rico.

Research Mentor: Argenys Robles, Universidad del Turabo, Gurabo, Puerto Rico.

The Gap Junction Beta 1 gene can induce Charcot-Marie-Tooth disease. The Charcot-Marie-Tooth disease is a rare disease which may be seen in 1 of 2,500 people worldwide. The Charcot-Marie-Tooth disease’s symptoms usually begin in late childhood or early adulthood. The conditions of this disease are loss of muscle tissue and touch sensation, predominantly in the feet and legs but also in the arms and hands. Other symptoms are foot-drop walking gait, foot bone abnormalities, high arches and hammertoes, problems with balance, problems with hand function, occasional lower leg and forearm muscle cramping, less of some normal reflexes, scoliosis, and sometimes breathing difficulties. The objective of this research was to examine amino acids using SIFT, which predicts whether an amino acid substitution can affect protein function and also determine the tolerance and intolerance level in amino acid changes using the value of 0.05 as mark for point of differentiation. In the Gap Junction gene, positions 1 through 20 where chosen for the analysis of amino acid changes. The SIFT prediction showed that this gene has a 55% level of intolerance and 45% of tolerance, which means that the gene in the first positions has a tendency of not resisting changes on amino acids. Due to the high intolerance level, an apparent mutation was made and negatively affected protein function. In conclusion, in the majority of cases mutations on this gene can induced malign effects on the development of the disease.
ABSTRACTS

COMPUTER SCIENCES

HOW AEROSOL’S SPRAYS AFFECT THE ATMOSPHERE

Fabiola Agramonte, María Reina Academy, San Juan, Puerto Rico

Mentors: Isis Laham, Dr. Angel Arcelay, Universidad del Este, Carolina, Puerto Rico.

The project will study how the atmosphere is affected every year with aerosols sprays. Aerosols are classified into subgroups such as fumes, dust, mists, and sprays that can affect the environment. Aerosols cause big environmental problems, including air pollution and destruction of ozone which is a natural component of Earth’s atmosphere.

THE ALGORITHM OF FAST EXPONENTIATION OF ALGEBRAIC NUMBERS

Alfredo A. Aldebol, Inter-American School, San Germán, Puerto Rico

Research Mentor: Guillermo Mejía, Inter-American University, San Germán, Puerto Rico.

The power of an integer, \( a^n \pmod{m} \), can be determined by the algorithm of fast exponentiation. This algorithm uses the binary expansion of the exponent \( n = \sum d_i 2^i \) and finds the power by multiplying the powers \( a^{2^i} \), for \( d_i = 1 \). These powers are calculated fast by iterated squares of \( a \pmod{m} \). This algorithm is essential in the algorithms of number theory. This algorithm was used to prove that some integers are Carmichael numbers, which are pseudo primes, but not primes.

USING PYTHON TO GENERATE 3D COMPUTER GRAPHICS

Hector Aponte, Jose E. Aponte de la Torre School, Carolina, Puerto Rico

Student Mentor: Lorna E. Salaman-Jorge, Universidad del Este, Carolina, Puerto Rico.

Python is a programming language used for mathematics and scientific applications and Blender is a software package used to make 3D graphics. Blender uses Python to develop scripts, which are high-level programming tools. Python is not commonly associated with computer graphics. A series of programs on Blender were developed to demonstrate the capabilities for 3D computer graphics. In all cases, the portion using Python was analyzed and improved each time as new features were implemented. A general analysis revealed that Python is a powerful tool for generating computer graphics reducing the time it takes to achieve a certain programming goal, and improving the efficiency for many 3D graphic application.
**THE IMPORTANCE OF WEB TRAFFIC ANALYSIS FOR ONLINE BUSINESS**

**Amarilis Araya, José Aponte de la Torre School, Carolina, Puerto Rico.**

Research Mentor: Lorna Salamán, Universidad del Este, Carolina, Puerto Rico.

Research Mentor Assistant: Giancarlo Mendoza, Universidad del Este, Carolina, Puerto Rico.

The measurement of web traffic, the amount of visitors and visits that a website receives, is crucial for the success of any online business. It provides fundamental information about the users’ behavior while they are interacting with the content. There are several tools that can be used to gather data and information related to web traffic. If a website lacks a mechanism to analyze it, the effectiveness of it could diminish and its goals would be unattained. For online businesses, knowing such kind of information is vital. Google Analytics is software that measures Web traffic. Through complex algorithms and database programming, it processes data and generates reports that provide valuable information about the quantity of visitors and the visits in general. To prove the importance of web traffic analysis, the software was installed to a website. When reports were analyzed, the derived conclusion was that such tools can help businesses make better decisions and achieve their goals.

**FUNCTIONING OF A ROBOT’S CONTROL AND LOGIC SYSTEM**

**Fernando Araya, Jose E. Aponte de la Torre School, Carolina, Puerto Rico.**

Student Mentor: Lorna E. Salaman-Jorge, Universidad del Este, Carolina, Puerto Rico.

The control and logic systems of a robot are essential components of any robotic system. At peak performance the robot can complete assigned tasks efficiently. To understand how a control and logic system work, an educational robotics system can be used. For this research, the VEX Robotics System’s microcontroller and logic components were verified using different parameters: microcontroller model, battery’s charge level, and type of tires. An analysis of the performance of the robot using them, revealed that if the combination of the most advanced model of the microcontroller, a fully-charged battery, and omni-wheel tires are used, the robot’s control and logic system are more effective.

**DISSECTIONS OF TWO POLYGONS TO ONE**

**Melissa Calderón, Tiffany Cruz, Inter-American School, San Germán, Puerto Rico.**

Research Mentor: Dr. Alvaro Lecompte, Inter-American University, San Germán, Puerto Rico.

In a lost book, the architect Ernest I. Fresse explained how to make dissections of polygons in an elegant way. In the Freese method, two regular polygons are transformed into one of double size. Calculations were made with the computer on how to do the drawing of the cuttings, and of the rearrangement. The calculations were done easier in the complex plane and showed in detail the symmetries involved in Freese’s dissection.
DEMAND RESPONSE AUTOMATED ALERT SYSTEM

Diego Camacho, Notre Dame School, Caguas, Puerto Rico.

Jenipher González, Bautista de Caguas School, Caguas, Puerto Rico.

Research Mentor: Schatzi Miranda, Universidad del Turabo, Gurabo, Puerto Rico.

Demand Response (DR) is the change in electricity consumption on the demand side in response to fluctuating electricity costs or other incentives and rewards when the user reduces demand in periods of high demand to lower the peaks of consumption and alleviate stress on the grid. This project demonstrated the effects of such a program when put into place in Puerto Rico where electricity consumption is high and so is the cost per KWh. A program simulated communications via TCP/IP between a smart meter and a main console that controls the information on energy consumption in a household to produce reports and send alerts to the user announcing an emergency on the grid. All power consuming appliances acted as clients to this network sending information via wireless containing information on the amount of electricity they were using. These smart appliances had the ability to be switched on and off from power savings mode, which would enable them turn off automatically in case of a grid emergency. These emergencies alerted the user to lower consumption at that time to lower the stress on the power grid, and sent another alert once the emergency passed. This program will lower the incidence of blackouts on the Island and will bring economic relief to both the power company and its customers.

SYNCOP: SOFTWARE FOR CALCULATING THE SYNTHETIC PROTEIN COST

Néstor Carrasco, Petra Mercado Bougart School, Humacao, Puerto Rico.

Research Mentor: Glorimar Castro Noriega, University of Puerto Rico, Humacao, Puerto Rico.

SynCoP is a bioinformatics software that helps calculate the biosynthetic cost of proteins. This software was built for calculating the synthetic cost of proteins and also helps to predict which proteins are benefitted by natural selection. This software is based on Java and Perl computer languages. Java derives from C and C++ syntax, but has a simpler object model and fewer low-level facilities, while Perl is a high level programming language. The results were that SynCoP saved time and work, making it a reliable bioinformatics tool. SynCoP will be published on the Internet so that it can be downloaded and used freely. This bioinformatics tool is a great help since it should open new paths for scientists and their investigations, lowering time and work when it comes to calculating the synthetic protein cost.
A COMPUTATIONAL TOOL FOR WATER SAMPLING ANALYSIS

Odemaris Carrasquillo, José E. Aponte de la Torre School, Carolina, Puerto Rico.

Student Mentor: Lorna E. Salaman-Jorge, Universidad del Este, Carolina, Puerto Rico.

Water monitoring provides information about water quality and helps with the improvement of environmental pollution problems. Water quality assessment requires precision in order to obtain reliable information and avoid factors due to mistaken data that could affect the water sampling process. Because of its relevance, the data gathered during the monitoring process needs to be precisely analyzed. Among several computational tools available for the data collection, many are expensive and others do not allow customization to a specific research project. An alternative computational tool has been developed with this research project, through simple computer programming using Microsoft Excel macros (which is based on Visual C programming language. The tool was adapted to a water monitoring research project in order to demonstrate its functionality. The computational tool uses Microsoft Excel macros to generate graphs and charts specially adapted to the project. If a computational tool using Microsoft Excel macros improves the quality of water sampling data analysis, then the use of customized computational tools will be efficient and of great benefit for water monitoring research projects.

OBSERVATIONS ON THE PERFORMANCE TOOL PASSMARK TEST USED IN WINDOWS XP

Cristian Claros, San Jorge Academy, San Juan, Puerto Rico.
Jean Guma, San Ignacio School, San Juan, Puerto Rico.

Research Mentor: Joaquin Rivera, Polytechnic University, San Juan, Puerto Rico.

Pass Mark is a software tool that tests the performance of the motherboards parts (tested 2D & 3D Graphic card, Memory or RAM, CPU, Hard disk, CD Drive and finally the Motherboard.) Giving it a test the computer will run at its peak if its processors present a rating to demonstrate how good the processor is. With a higher rating the better processor speed is given a heads up on the motherboard and is highly efficient. The fact that Windows XP is a stable Operating System, it allows this project to demonstrate that Windows XP OS meets equal performance criteria in difference Core architectures. During this research, 3 different types of cores (Single, Dual and Quad) were run and the average between Single and Dual (with the same RAM capacity and the same operating system) were almost the same result, although the Dual Core had a small edge over the Single Core and Quad had a higher rating due to its four (4) processors. In summary, the test showed that a comparison between different computers with different operating systems had the same results with a small difference in time processing.
THE ROBOT INDUSTRY

Ricardo Collazo, Edwin Cruz, St. Mary’s School, Carolina, Puerto Rico.

Research Mentor: Irma Álvarez, Inter-American University-Metro Campus, San Juan, Puerto Rico.
Research Mentor Assistant: Ángel Caraballo, Inter-American University-Metro Campus, San Juan, Puerto Rico.

This robotics research was based specifically on robot usage in industries around the world. The relationship between robot usage and job loss in industries was explored. A survey was conducted to assess the opinion on these topics of industry administrators in Puerto Rico. After the survey was completed, a brief summary was written about the different opinions of the industry personnel.

A MINING ROBOTIC SYSTEM

Jairo A. Cruz, Discípulos de Cristo Academy, Bayamón, Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Giancarlo Mendoza, Universidad del Este, Carolina, Puerto Rico.

This project proposes a more effective method to be used in the location of metals or minerals using robotic machines. It was developed in places where an engineer would use a robot with sensors that would slowly scan where to extract the metals and what the preferred places for excavation are. The robot needed the following parts: a detector of metals, off-road base, rotating parts, spotlights, and other sensors to scan the environment. A program was used to send commands to the robot. The robot was placed in the place desired. Then it analyzed the area with the metal detector. When it found the metal or mineral desired, the robot stopped moving, and scanned the area to spot the exact location of the metal or mineral.

PROBING THE CATION-PI INTERACTION OF METAL (NH4+, MG++, NA+) IONS WITH BENZENE AND TWO MODELS OF AMINO ACIDS

Yamileika Cruz, Isabel Flores School, Humacao, Puerto Rico.

Research Mentor: Katherine Calderón Mojica, University of Puerto Rico, Humacao, Puerto Rico.

Density functional (DFT) calculations have been carried out to study the cation-p interactions of Mg^{++} and Na^{+} ion with benzene and two model amino acids, Tryptophan and Histidine. The compound 3-methyl indole are considered as the model systems for tryptophan as the rest of the amino acid side chain of these compounds are inconsequential in such cation-p interactions. The interactions were further studied between NH4^{+} and the modeled p-systems to study the difference between the classical cation-p and the stronger metal cation-p interactions. The natures of these interactions are further analyzed through the computed infrared spectra and electrostatics.
HOW ARE THE GREACO-LATIN SQUARES USED FOR THE DESIGN OF A COMPUTER GAME USING ALICE?

Lina V. Daza, Inter-American School, San Germán, Puerto Rico.

Research Mentor: Yvonne Avilés, Inter-American University, San Germán, Puerto Rico.

How are the Greaco-Latin Squares used for the design of a computer game using Alice? A long time ago Leonhard Euler (1707-1783), a Swiss mathematician and physicist, studied and demonstrated methods for the construction of Graeco-Latin Squares. This structure consists of the use of the Latin alphabet in large caps letters and the Greek alphabet in small caps. If there is an element in a row, this one cannot be repeated in the same row, and if it is placed in a column, the same rule applies. Based on this work, a game was created using the Alice program in which the player has to complete a square arrangement under two conditions: letters and colors. The game has a square 5x5 matriz form. The player has to set up the whole square based on the elements that the computer will gave him/her and has to finish the square correctly.

THE WINDOWS STEALTH ATTACK

Kevin Estrada, Bárbara Ann Roessler Academy, San Juan, Puerto Rico.

Research Mentor: Joel Rivera, Universidad Metropolitana, San Juan, Puerto Rico.

Rootkits have the potential to cause a lot of damage. Not only can they conceal their own files, they can also hide malware, such as viruses and spyware, written to work with them. The particularly scary thing about rootkits is that they are virtually invisible to users. Moreover, they are invisible to traditional anti-virus programs, and easy-to-use tools for discovering their presence have not been available.

ARTIFICIAL INTELLIGENCE: DEVELOPMENT OF KNOWLEDGE

Carlos Feliciano, Hazel Cruz, St. Mary’s School, Carolina, Puerto Rico.

Research Mentor: Dr. Ángel Caraballo, Inter-American University-Metro, San Juan, Puerto Rico. Research Mentor Assistant: Prof. Irma G. Álvarez, Inter-American University-Metro, San Juan, Puerto Rico.

This project investigates how the lack of knowledge about artificial intelligence robots has affected the acceptance of them in our daily life. After years human have tried to invent a machine that can facilitate our lives. A machine that can do the chores that we sometimes don’t have the time to do them. Humans haven’t integrated the use of robots in our society. Can we say that this has to do with information they know about them?
ANIMATION PRINCIPLES APPLIED TO A 3D BOUNCING BALL

Yaritza Flecha, Karina García, Petra Mercado Bougart, Humacao, Puerto Rico.

Research Mentor: Alex J. Camacho Martínez, University of Puerto Rico, Humacao, Puerto Rico.

This presentation is about how to do a 3D bouncing ball. This is a basic exercise in animation. To do this I use the Maya program. Even that it is a computer program; I used the animations principles and applied it to Maya to make a 3D bouncing ball. After making the ball bounce and make it looks the more real as possible, I gave it color and texture. This will teach how important the basics principles are to make a 3D animation.

DEVELOPMENT OF A MEDICAL APPLICATION USING ANDROID OPERATING SYSTEM ECLIPSE IDE

José G. García, Jose E. Aponte de la Torre School, Carolina, Puerto Rico

Student Mentor: Lorna E. Salaman-Jorge, Jose E. Aponte de la Torre School

Android Operating System (OS) features are used to develop a wide rage of software applications. It uses an Integrated Develop Environment (IDE) known as Eclipse, a kind of text editor that makes simple the development of applications using programming languages such as Java. Both, Android OS and Eclipse IDE, have been used to develop thousands of applications that are available through the Android Marked for distribution. In addition to diabetes, there are hundreds of applications related to the medical and health fields. Statistics have shown that thousands of Hispanic people are affected by diabetes, a medical condition. Therefore, the objective of this research project was to develop a bilingual (English and Spanish) Android-based medical application to assist diabetes patients in different aspects of their treatment and in preventive areas such as recommended exercises and diet.

DEVELOPING EDUCATIONAL TOOLS USING ALICE

Alberto Gómez, Carvin School, Inc, Carolina, Puerto Rico.

Research Mentor: Lorna Salamán, Universidad del Este, Carolina, Puerto Rico.

Graphic demonstrations can be developed through the use of an object-oriented programming language such as Java. Chemistry is an area that usually presents its concepts in an abstract manner. The purpose of this study was to develop simple educational demonstrations using Alice, a Java application, to help students grasp and apply concepts in chemistry.

KNOW YOUR NEIGHBOR

Sergio L. Hernández, Bautista de Levittown School, Toa Baja, Puerto Rico.

Research Mentor: Joel Rivera, Universidad Metropolitana, San Juan, Puerto Rico.

When people talk about botnets, they are usually talking about a group of computers infected with the malicious kind of robot software, the bots, which present a security threat to the computer owner. Once the robot software (also known as malicious software or malware) has been successfully installed in a computer, this computer becomes a zombie or a drone, unable to resist the commands of the bot commander.
HUMAN-COMPUTER INTERACTION IN DAILY LIFE

Adrianna Lebrón, Leila Alicea, St. Mary’s School, Carolina, Puerto Rico.

Research Mentor: Dr. Ángel L. Caraballo, Inter-American University-Metro, San Juan, Puerto Rico.
Research Mentor Assistant: Prof. Irma G. Álvarez, Inter-American University-Metro, San Juan, Puerto Rico.

Nowadays, children and computers interact daily. Schools promote and provide usage of computers. Furthermore, schools are starting to make it obligatory that students make every project, essay or presentation in the computer. Daily interactions for children include the use of many social networking websites such as: Facebook, MySpace, Twitter, and others, which have them use the computer for other purposes. The focus of this research was how many daily hours does a child interact with a computer, and how does it affect with school work, friends, family, etc. The research consisted of a questionnaire answered by students from different grades. It provided a more solid idea of how many time students are exposed to computers on a daily basis. The results of this research describe the behavior of students as they interact with computers in their daily life.

OCEAN CLEANER ROBOT

Ana N. Longo, María Reina Academy, San Juan, Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.

Popular and most visited beaches around the world receive a high volume of visitors. On the other hand, people visiting the beaches are careless and do not bother to pick up the trash. Conditions to maintain beaches and keep them safe are a difficult and expensive task. Many schools and organizations plan events to clean the beaches. Nevertheless, the help from organizations is not enough to solve the problem. As an end result, the water nearby the beaches is also full of this trash and garbage. The main goal of this project is to design a robot which can go underwater and clean it up. This robot would function alone; it would not have to be controlled by someone above the water. This robot would be neutrally buoyant and have special arms that it will use to pick up the trash it finds.

THE CATION-PI INTERACTION OF GUANIDINIUM+,CA++ AND BE++ WITH BENZENE AND TWO MODELS OF AMINO ACIDS

Linnette López, Isabel Flores School,

Research Mentor: Katherine Calderón Mojica, University of Puerto Rico, Humacao, Puerto Rico.

Density functional (DFT) calculations have been carried out to study the cation-p interactions of Mg++, and Be++ and Guanidinium ion with benzene and two model amino acids, Tryptophan and Tyrosine. The compounds p-methyl phenol and 3-methyl indole are considered as the model systems for tyrosine and tryptophan as the rest of the amino acid side chain of these compounds are inconsequential in such cation-p interactions. The interactions were further studied between Guanidinium and the modeled p-systems to study the difference between the classical cation-p and the cation-p interactions of the metals. The nature of these interactions are further analyzed through the computed infrared spectra and electrostatics.

56
STUDY AND FREQUENCY OF ILLEGAL DOWNLOADING OF MUSIC USING LIMEWIRE VERSUS ITUNES

Miridaliz Lorenzo, Ilka V. Walker, SESO School, Mayagüez, Puerto Rico.

Research Mentor: Dr. Peter van Meer, University of Puerto Rico, Mayagüez, Puerto Rico.

Many people believe that Limewire is illegal, but it is not. This program was created to allow people to share files with other people. Limewire is considered illegal, when copyrighted materials are shared. For example, the download of music is illegal. Ever since Limewire was created, many people started to download pirated music instead of purchasing them. In programs like ITunes, music needs to be bought for downloading. The amount of purchases made legally has declined in comparison to previous years due to illegal downloads. Surveys were created to collect data on how many people downloaded illegal music and how many did it legally. This survey also asked how many times per week the students downloaded music and which program they chose; either ITunes or Limewire? These were given out to one-hundred random high school students, from ninth grade through tenth grade. The results were analyzed and compared whether or not there is a high percentage of illegal downloads or legal downloads are accomplished in high school students. It’s predicted that high school students will use more Limewire than ITunes because students prefer to use another program through which they can download the same media for free, be it legally or legally. Results are not collected as a consequence that the project has not been finished.

HTML5 VS. FLASH

Carlos Malavé, SESO School, Mayaguez, Puerto Rico.

Research Mentor: Peter Van Der Meer, University of Puerto Rico, Mayaguez, Puerto Rico.
Research Mentor Assistant: Alvin Peralta Betancourt, University of Puerto Rico, Mayaguez, Puerto Rico.

HTML5 is the new coding language for designing webpages. A survey conducted revealed that HTML5 does have a bright view for the upcoming days on the online market that may influence customers’ experience when buying online. Today, web designers use Adobe Flash to create dynamic webpages that capture the attention of customers on the web. The research conducted showed that users with no advanced knowledge of computer science or computer-related themes were attracted to the way HTML5 interacted with them, revealing that Flash is not the only one with the power and resources to prepare a dynamic interactive graphical design that intrigues the user’s attention. Flash gives the designer or the developer the ability to work and create dynamic interactive webpages just as HTML5, except for the need to buy extra software and perform other downloads of software such as Flash Player. For users, the interactive experience may not have too much difference in comparison from each other, but for web designers it will make a difference at least in their budgets and working time. Although, not many surveyors were computer oriented people, they were fascinated with the result of the Wilderness Downtown Project from Google making HTML5 a great source for web designers to reach their customers and Internet users in a better way.
ARE WE SOMEDAY BE SAFE?

Ginexis Marrero, Homeschool, Bayamón, Puerto Rico.

Research Mentor: Joel Rivera, Universidad Metropolitana, San Juan, Puerto Rico.

Even though spyware has not been around as long as viruses, it is beginning to make its mark with computer security breaches. Spyware can collect personal data from a users’ computer. If not taken care of spyware can cause delayed processing of many applications. Spyware has begun to cause more problems than viruses. There are many forms of spyware ranging from mild to severe. Since spyware is causing so much grief, laws are being enacted to prevent companies from taking advantage of people with their spyware. People can fight back for their computer by installing anti-spyware software.

IMPORTANCE OF A BLOG’S PRIVACY SETTINGS

Kimberly Millán, José E. Aponte de la Torre School, Carolina, Puerto Rico

Student Mentor: Lorna E. Salaman-Jorge, Universidad del Este, Carolina, Puerto Rico.

A blog is a website that collects articles of the same topic and arranges them as they become old. Mainly it is categorized as a personal website. When an article is posted, readers can view it and comment about it. One known issue concerning blogs is their privacy settings, including the posting of certain kinds of statements that might be classified as defamation, and the lack of strict mechanisms to avoid the disclosure of personal information. To study the perception viewers and authors have about its privacy settings, persons from different age levels and genders were interviewed. After analyzing the data, it can be concluded that most viewers and users perceive that blog’s privacy settings need to be improved depending on the topic and type of information it presents.

OBSERVATIONS ON THE PERFORMANCE TOOL PASSMARK TEST USED IN WINDOWS XP

Adriana Morales, Espíritu Santo School, San Juan, Puerto Rico.
Othoniel Rodríguez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Joaquín Rivera, Polytechnic University, San Juan, Puerto Rico.

Quad core computers contain four processors that can be considered a part of a multi core processors family. There is hardly any doubt that the performance of Quad Core computers is faster than that of Dual core computers. However, the performance of the Quad Core depends on the type of programs that are run and the algorithms that are used by the programs. Pass Mark Performance Test is an easy benchmarking tool that allows to quickly assess the performance of the computer. There are different types of reliability tests that can determine if the computer is running at its peak performance, compared to other computers with almost the same specifications under stated conditions for a specified period of time. This investigation demonstrated that the same computer had similar performance scores, and allowed to see the reliability of the tests. The PassMark Performance Test was run three times in a Quad Core computer, obtaining an efficient average of 910.00 in the three tests. Quad core computers were more highly efficient when compared to other computers with two cores or similar specifications.
**ENCRYPTING INFORMATION WEBPAGE**

**Cristina Morales,** Libre de Música Ernesto Ramos Antonini, San Juan, Puerto Rico.
**Albert Santiago,** María Teresa Piñeiro School, San Juan, Puerto Rico.

Research Mentor: Jesse Jiménez, Universidad Metropolitana, San Juan, Puerto Rico.

Encryption is the process in which information that is considered important is turned into unreadable text; it is a form of security used to transfer or to store information that may not be accessed or read by other persons. The process consists of using mathematical formulas to encrypt the desired information and another mathematical formula is used to decrypt. This way the process used to encrypt the information may be known and that way the process can be reverted to access the information in a secure way. A simple web page was created that was used to gain access to this tool. The Visual Studios 2010 with NET Framework tool was used for the creation of this web page. To create the algorithms a back-end coded in the programming language C# was used.

**USE OF A ROBOTIC SYSTEM TO ASSIST ON WATER SAMPLING PROCESS AND ANALYSIS**

**Davette Nazario,** Homeschool, Carolina, Puerto Rico.

Research Mentor: Lorna Salamán, Universidad del Este, San Juan, Puerto Rico.
Research Mentor Assistant: Giancarlo Mendoza, Universidad del Este, San Juan, PR 00928

The purpose of this study was to use of a robotic system to assist on the water sampling process and analysis. The robot will expedite the process because normally a drawing of the water processing area is used to make sampling. This drawing process is not precise and will be improved by the robot action. The robot will expedite the steps while being in an acrylic capsule that can float and investigate in the sampling area. An imaging process will be taken and recorded by the camera of the robot. This technology will show what happens with the water and may be the best steps taken to clean that water body and then also to help the environment. An actual effect of this process could be to reduce global warming.

**THE BEE ON MY BEHIVEE**

**Edwin Negrón,** Barbara Ann Academy, San Juan, Puerto Rico.

Research Mentor: Joel Rivera, Universidad Metropolitana, San Juan, Puerto Rico.

On the World Wide Web there are attacks against computer systems every day. Companies cannot afford to allow their systems be compromised, as this can result in serving malicious content to customers, or leaking customer's data. A honeypot is valuable as a surveillance and early-warning tool for the industry. Honeypots helps companies create decoy servers to gather information regarding an attacker or intruder into their systems and keep them out of any sensible and valuable information. Creating the honeypot or “eage” is simple, having baited and the trap in place for the hacker, which will be the task.
THE EVOLUTION OF VIDEO GAME DEVELOPMENT

Jariel Ortiz, Bautista de Puerto Nuevo School, San Juan, Puerto Rico.

Research Mentor: Prof. Irma G. Álvarez, Inter-American University-Metro, San Juan, Puerto Rico.

Throughout the ages of video games there have been different advances in technology that have led to the further development and elaboration of video games. In this investigation, different factors were found that have led to the further elaboration of the video game’s design and development process and how these factors have led to the elaboration of the technologies implemented, such as the use of engines and programming to make the game, that is to say, to further elaborate the concept of the video game itself, such as its graphics, gameplay, etc. The development process is also carried out by many people, as opposed to the early 1980’s where the process could be carried out by a single person which could be either a lead designer, developer or programmer with rare exception in which all of them collaborated to make the game and would only take a few months to do so. Presently the process could take from up to a few months to a year or more depending on the content of the game.

TEXT STATISTICS

Gabriel Pagán, Joffre Goméz, Inter-American School, San Germán.

Research Mentor: Guillermo Mejía, Inter-American University, San Germán, Puerto Rico.

A program was written to calculate the statistics of letters, syllables or words in a long Spanish language text. These statistics are very useful in cryptography as a base to some methods of cryptanalysis. In this work, some texts by Gabriel García Márquez and another of Pablo Coehlo were analyzed. In future research, a study will try to ascertain if these statistics can be used as a kind of digital print of an author.

COBB’ ANGLE VS X-RAYS

Vanessa Pagán, SESO School, Mayaguez, Puerto Rico.

Research Mentor: Peter Van der Meer, University of Puerto Rico, Mayaguez, Puerto Rico.
Research Mentor: Alvin Peralta, University of Puerto Rico, Mayaguez, Puerto Rico.

Cobb’s Angle is used to measure the severity of scoliosis in the spine. There is the forward bend test, as well as x-rays and Cobb’s Angle. Cobb’s angle is a test in which the radiologist uses a special protractor to measure the degrees of scoliosis and to see the severity of the person’s spine. X-rays were taken of fifteen girls, each girl having scoliosis Both X-rays and Cobb Angles determine if a patient has scoliosis. There is a more efficient option. Using Cobb Angle to measure the spine, one may determine if an x-ray or Cobb angle has the most accurate answer. Cobb’s Angle is a math and science project in which vertical lines are created across the vertebrae. Teens are more at risk of getting scoliosis because of the active sports they are in such as ballet, gymnastics and swimming. Ages ten to twenty-one are at greater risks because before the age ten or after the age twenty individuals play less sports. Cobb’s Angle and x-rays are going to be used to determine whether a machine is more useful to diagnose scoliosis or handwritten work is better. X-rays are also an alternative but there is a more effective way. If the results show that using Cobb Angle is more efficient to check than an X-ray if there is scoliosis an X-ray machine is not necessary to detect scoliosis. The Cobb Angle may come out more efficient because it needs a special protractor that is accurate in measuring scoliosis. Results have not been reported because the project has not been completed.
WEB BROWSER COMPARISON

Ignacio Pérez, Gustavo Marrero, Saint Mary’s School, Carolina, Puerto Rico.
Research Mentor: Dr. Angel Caraballo, Inter-American University-Metro, San Juan, Puerto Rico.

The purpose of this experiment was to find the best overall browser by submitting five of the most used browsers to existing tests and benchmarks to determine which of them is the most efficient. The tests and benchmarks used were Acid3 test, Peacekeeper “The Browser Benchmark” test, and Memory consumption test. The Acid3 test checks how well a web browser follows certain selected elements from web standards, especially relating to the Document Object Model (DOM) and JavaScript. The Peacekeeper test compares different browsers to find out which one offers the best performance on the PC. The memory consumption test shows how much of the computer’s RAM is being used on the browser.

DIGITAL GRAPHICS AND DISPLAYS OF CHEMICAL INGREDIENTS OF SELECTED COSMETICS AND PRODUCTS FOR PERSONAL CARE

Robert Pérez, CROEM School, Mayaguez, Puerto Rico.

Research Mentor: Peter Van Der Meer, University of Puerto Rico, Mayaguez, Puerto Rico.

Cosmetics and personal care products such as soap, shampoo, lotions, deodorant, etc. have become a necessity in our culture. Without these, one cannot find a way to look good, smell good, and feel good. The problem is that the consumers buy these cosmetics without a broad view of the chemical contents in them. Money is being paid for products that contain chemicals that are composed of elements and compounds that are dangerous to a person’s health. The use of some of these chemicals is necessary for mass production of certain products at a relatively affordable price, but some companies produce their cosmetics with high contents of harmful chemicals and sell them at very high prices because they tend to be cost-effective. The question is, do people want to pay more for a product that is slowly affecting their health because of its cost effectiveness, or do they really want to know what is in the products that they buy and how it is affecting them?

RUBIKS CUBE

Alejandro Ramos, American Military Academy, Guaynabo, Puerto Rico.
Raysmarie Figueroa, Gilberto Concepción de Gracia School, San Juan, Puerto Rico.

Research Mentor: Jesse Jiménez, Universidad Metropolitana, San Juan, Puerto Rico.

The Rubik’s cube is a puzzle in three dimensions. It has six faces and each face has a different color (white, red, blue, orange, green and yellow) and each face turns independently. The objective is to ensure that all faces are a solid color (white, red, blue, orange, green and yellow). A website will be created using as “environment” Visual Studio 2010 with NET Framework for building this site and to create algorithms to be used a “back-end” that will be encoded using the C# programming language.
THEORETIC CASE STUDY ON THE IMPACT OF HTML 5

Jonathan Gadiel Ramos, Nuestra Señora de Altagracia, San Juan, Puerto Rico.
Alexander Reyes, Bautista de Puerto Nuevo Academy, San Juan Puerto Rico.

Research Mentor: Karlo E. Meléndez, Universidad Metropolitana, San Juan, Puerto Rico.

This project studied the impact that HTML5 will have on the Internet over the existing solutions for HTML4.1 and XHTML today. Specifically, the project studied the changes in the embedding of video information in websites. Presently, the most common way of doing this is through a Flash Plugin, but HTML5 hopes to change that with native technologies. The goal of the project was to compare the difference between these two approaches and find the advantages and disadvantages of each approach. Although not as pivotal to the project, the impact of other advances in the coming HTML5, such as geolocation, and interactive websites running on HTML5 will also be studied and explored.

CONSEQUENCES OF CONTAMINATION ON MARINE LIFE

Laura Reguero, María Reina Academy, Carolina, Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.

Contamination harms the environment around us. Humans, one way or another, are the ones that cause it. Contamination and pollution kill animals in the oceans all around the world, and soon most species will be extinct. The purpose of this project was to find out how much time will it take certain species to be extinct because of contamination, based on information on how they are disappearing. The sea turtle is the species under research in. It is the hypothesis of this study that a decrease in contamination for marine life will not allow this species to become extinct.

MOTORIZED ORTHOSIS FOR THE REHABILITATION OF PATIENTS WITH LOWER LIMBS RESTRICTED MOBILITY

Stephan Elias Remy, José E. Aponte de la Torre School, Carolina, Puerto Rico.

Student Mentor: Lorna E. Salamán-Jorge, Universidad del Este, Carolina, Puerto Rico.

Lower limbs restricted mobility is usually a result of some kind of nervous system condition. When it is temporary, an effective rehabilitation program is essential. Such programs include a series of exercises that need to be repeated at a specific pace. Usually patients depend on a physical therapist to perform them, especially at the initial phase of the process. Sometimes the patient is not able to perform the rehabilitation exercises by himself/herself or the physical therapist is not available. In such cases, a motorized orthotic device could be used. For this research project, a prototype of such device was partially developed and initial tests were performed. Results demonstrated that if a motorized orthotic device is used as part of the treatment in a patient with lower limbs restricted mobility, then the rehabilitation progress time is considerably reduced.
ANALYZING TRAFFIC FLOW

Christian Rivera, Levittown Baptist Academy, Levittown, Toa Baja, Puerto Rico.

Research Mentor: Jonathan Otero, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Karlo Meléndez, Universidad Metropolitana, San Juan, Puerto Rico.

This project was based on the traffic flow in Puerto Rico, using data and information from previous research and studies. Traffic Flow is a pattern of the way people move through an area. In Puerto Rico, one problem is the large amount of traffic congestion that occurs during mornings and evenings. The goal of this research was to show people different perspectives in relation to traffic flow and find ways to modify and help alleviate the problem. Information was researched and various theories and methods about it, like The Traffic Flow Theory and information from the Department of Transportation were found. A create traffic simulator was created to represent an abstraction of what could be the source of the problem and hopefully find a viable solution. It is expected hope that the traffic simulator will help improve the problems with the traffic flow in Puerto Rico and perhaps the world.

COMPUTER PROGRAM TO ENCIPHER USING THE TURNING-GRILLE METHOD

Sebastián J. Rivera, Nikos M. Linares, Inter-American School, San Germán.

Research Mentor: Guillermo Mejía, Inter-American University, San Germán, Puerto Rico.

A computer program was done to encipher and decipher messages using the Turning Grille method described by S. Fratini, which is a variant of the classical method of Girolamo Cardano. The message is coded by a permutation of its characters in blocks of 64. The block is written in a grid 8 x 8, and a grille of holes let 16 of them visible at a time. The rotation of the grille clockwise by a quarter of turn let the rest of the characters appear step by step in groups of 16, in a very mixed way, so that it is very difficult to know the message without the knowledge of the grille. Variants of this method were used during the world wars and are still on the base of cryptography. The problem consists of a plaintext written on an 8x8 table placing one letter on each cell. This text then is placed on the same table but with the letters in random order. A program should be able to rearrange these letters and show the original plaintext. An original program will have an 8x8 table that is going to be used for entering text. This program will put those letters in a different order in such a way that it is not readable. The reader does not suspect that there is a text is hidden on those letters. This same program will then put the letters on the original order showing this text.

ENCRYPTING INFORMATION WEB PAGE

Gilberto Robles, Bautista de Levittown School, Toa Baja, Puerto Rico.

Research Mentor: Jesse R. Jiménez, Universidad Metropolitana, San Juan, Puerto Rico.

Encryption is the process in which information that is considered important is turned unreadable. The process consists in using mathematical formulas to encrypt the desired information. Another mathematical formula is used to decrypt. A simple web page was used to gain access to this tool. Visual Studios 2010 with .NET Framework was used for the creation of this web page. To create the algorithms a back-end coded in the programming language C# was used.
INTRODUCTION TO HTML

Luis F. Rodríguez, Dra. Wilma Chavez, Avance 2000 School,
Research Mentor: Jonathan Otero, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Karlo E. Meléndez, Universidad Metropolitana, San Juan, Puerto Rico.

The purpose in this project was to better show others the process used to create a website using HTML. The strategy used to evaluate two different approaches was giving a written tutorial and a video tutorial, giving each audience a test that shows how much each has learned from their respective mediums. To get an accurate information, tests on HTML were given to people who did not have previous knowledge about HTML or making web pages. This technique was used to prove which medium is more efficient in teaching others about HTML and websites.

A WEB-BASED TOOL FOR WATER SAMPLING ANALYSIS RESEARCH PROJECTS

Laura Roldán, José Aponte de la Torre School, Carolina, Puerto Rico.
Research Mentor: Lorna Salamán, Universidad del Este, Carolina, Puerto Rico.

The Streams Project is an effort by VT EPSCoR to collect long-term, high-quality data on streams. These data are used in combination with many existing data sets to understand how the watershed works and to find solutions to the pollution in our waterways. Comparing and sharing this data is very important for finding strategic solutions to water related problems. This process may be difficult when calculating or reporting large quantity of information. As an approach to solve this problem, an informational website for water sampling analysis research projects was elaborated. This web-based tool will help answer and solve problems by looking at your data in a way that is quickly understood and easily shared. By this mean, students will have more access to address complex issues threatening different types of streams.
MOBILE PHONES AND TECHNOLOGY

Gabriel Román, Giancarlo Santini, St. Mary’s School, San Juan, Puerto Rico.

Research Mentor: Dr. Ángel L. Caraballo, Inter-American University-Metro, San Juan, Puerto Rico.
Research Mentor Assistant: Prof. Irma G. Álvarez, Inter-American University-Metro, San Juan, Puerto Rico.

Nowadays the number of young children with cell phones is increasing every year. A couple of years ago, to be the owner of a cell phone, one had to work hard for it and had to be more mature, with an age of 15 years or more. This motivated the youngster to see if a high number of people have cell phones. Today, the children between the ages of 8 and 10 have cell phones. In the year 1990, 12.4 million people worldwide had cellular subscriptions. By the end of 2009, only 20 years later, the number of mobile phone subscriptions worldwide reached approximately 4.6 billion, 370 times the 1990 number.

PERFORMANCE TESTING IN SINGLE CORE

Andros Rosa, San Ignacio School, San Juan, Puerto Rico.
Yoilina Hernandez, Bautista de Puerto Nuevo School, San Juan, Puerto Rico.

Research Mentor: Joaquín Rivera, Polytechnic University, San Juan, Puerto Rico.
Research Mentor Assistant: Benedict Candelaria, Polytechnic University, San Juan, Puerto Rico.

In the computer area a single core is used that contains one processor that can be considered a part of a multiple core processor family. There is hardly any doubt that the performance of a single core computer is slower than that the new family of dual core computers. There are different types of performance tests that can determine if the computer is running at its peak performance compared to other computers with almost the same specifications under stated conditions for a specified period of time. In this study, the Pass Mark Performance Test was used as an easy benchmarking tool that allows the quick assessment of the computer performance. It compares it to a number of standard “baseline” computer systems. The purpose of this study was to use PassMark to compare performances of three similar computers with Single Core. The computers were tested on CPU, 2D & 3D video graphics and memory and presented decent CPU and 2D graphics ratings, but since it was a single core computer, memory and 3D graphics ratings were lower than expected. The result could be possible flaws or leaks on the software program and hardware specifications.

THE ANATOMY OF A VIRUS

Alex Sánchez, Bárbara Ann Roessler Academy, San Juan, Puerto Rico.

Research Mentor: Joel Rivera, Universidad Metropolitana, San Juan, Puerto Rico.

As in controlling the spread of real diseases, the key to an effective defense against computer viruses is to understand the cause and mechanism of infection, not to focus on the symptoms. A computer virus that erases a user's files may seem very different from one that merely prints out the occasional annoying message, but chances are, they both got into the system in a similar fashion. Learning the composition of a virus help to stop it and fight the threat before it spreads.
AUTOMATIC ALERT SYSTEM

Áxel A. Sánchez, Barbara Ann Roessler Academy, San Juan, Puerto Rico.
Christian González, Gabriela Mistral High School, San Juan, Puerto Rico.

Mentores: Jonathan Otero, Karlo E. Meléndez Peña, Universidad Metropolitana, San Juan, Puerto Rico.

The goal of this project was to create an automated system that sends informational alerts whenever a disaster or crisis takes place to those subscribed to the system. An alert is to be issued when a crisis reaches a level of impact that might influence other nations or people not localized to that area. A program was created using Java that simulates a disaster happening somewhere in the world and sends an alert related to this incident to those subscribed to the system via an electronic mailing list and a remote SMTP (Simple Mail Transfer Protocol) server. It is expected that through this system may be raised awareness about the need of such a system to be implemented internationally.

WI-FI LOCATION

Fernando Sánchez, Petra Mercado Bougart School, Humacao, Puerto Rico.

Research Mentor: Edwin Flores, University of Puerto Rico, Humacao, Puerto Rico.

This investigation project we tried to know how to locate where are the Wi-Fi users connected. Knowing what each thing does and figuring out how to translate them in our purpose. This help us to know which unauthorized person is using your network or in case of an emergency find the nearest person to help you.

DYNAMICS: RIGID BODY SIMULATION

Joseph Santiago, Petra Mercado Bougart School

Research Mentor: Alex J. Camacho Martinez, University of Puerto Rico, Humacao, Puerto Rico.

The purpose of this project was to develop a 3D animation that could move and interact with certain types of situations. How is an animation made? It required the use of Autodesk Maya. By simulating different kinds of objects, a sequence was animated that showed how a ball could react when it impacted a certain type of box. The animation required the simple use of geometrical figures bended to a joint in order to create a rigid body. Once the designing took place, the parts of the animation were moved and that movement was captured, thus creating an animation.

ALGORITHM FOR THE EMPIRICAL FORMULA OF A COMPOUND

Rosangelie Soto, Andrea M. Devaris, Inter-American School, San Germán, Puerto Rico.

Research Mentor: Yvonne Avilés, Inter-American University, San Germán, Puerto Rico.

The Integrated Development Environment (IDE) “Raptor” was used to generate the C++ code of an algorithm to obtain the chemical empirical formula of a compound given the masses of its elements. The algorithm uses the molecular masses of the elements in the compound to find the moles of each element, and then the proportions in small integer numbers between them, to finally produce the empirical formula. In this way, the simple ideas of the algorithm can be compared with its actual code in the computer language.
FREE VS PAID SECURITY PROTECTION

Rafael Suárez, Josefina Barceló School, San Juan, Puerto Rico.

Research Mentor: Joel Rivera, Universidad Metropolitana, San Juan, Puerto Rico.

It is important to maintain an effective package of security tools on a computer. A range of free alternatives to commercial products have left many users wondering whether it is worth paying or not for good security and protection. Free applications are now available from a range of vendors that cover anti-virus and anti-malware protection as well as firewalls. Windows has its own built-in firewall that many now use by default as a way to save money. Free applications do not have a range of features and technologies that are found in commercial packages, as well as helpful “extras” that can take the hassle out of tasks such as data backup and system optimization.

UNIVERSAL WISH LIST APPLICATION

Marco A. Sueiro, Dra. Wilma Chavez, Avance 2000 School

Research Mentor: Jonathan Otero, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Karlo E. Meléndez, Universidad Metropolitana, San Juan, Puerto Rico.

The main goal in this project was to create an application that handles a person’s wish list of products, without being tied to a particular site or online storefront. This will allow users to keep track of a variety of items across a variety of product ranges without committing to one site. Products from sites can be added manually by typing in the details of the product (such name, price and description), or by dragging an URL from a site onto the program, which will extract the information of the product from the URL. The program will save each user’s wish list locally and allow multiple wish list files to be stored and loaded, to allow people to better organize and keep track of desired products from their online or offline stores.

GLOBAL WARMING SIMULATOR WEB SITE

Orlando J. Torres, St. Francis School, Carolina, Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Giancarlo Mendoza, Universidad del Este, Carolina, Puerto Rico.

Overpopulation and misuse of natural resources results in global warming and extensive damage to the environment. The main purpose of this project was to make people aware that all actions from human activities towards the planet eventually result in benefits or damages. People need to become aware of the consequences from the misuse of natural resources, resulting in permanent damages. Globalization has demonstrated the effective use of the Internet for worldwide information exchange. Through a web site people may be informed of the importance of protecting the Earth. The site presents and explains a Global Warming Simulator to be developed by a teammate. This site will make people aware of the necessity to keep the environment safe.
TESTING WEB BROWSERS FOR EVERYDAY USE EFFICIENCY

Julio Valdés, SESO School, Mayaguez, Puerto Rico.

Research Mentor: Dr. Peter Van der Meer, University of Puerto Rico, Mayaguez, Puerto Rico.
Research Mentor: Alvin Peralta, University of Puerto Rico, Mayaguez, Puerto Rico.

People all over the world browse the web on a daily basis. The way they browse may be more efficient if they have knowledge of which browser serves their purposes the best. If browsers are tested for efficiency then, Mozilla Firefox is the most efficient when viewing videos and during online gaming, Google Chrome is the most efficient when chatting and researching, Opera is the most efficient when using e-mail, and Safari is the most efficient when socially networking. Google Chrome is the most efficient browser overall. All criteria will be tested by taking commonly used websites and measuring their speed in each of the different browsers. Furthermore a survey will be conducted to investigate how many people use which of the most commonly used browsers. When a survey is conducted on college students and professors regarding which web browser they use the most and the reason why they use it the most, then the most popular browser will be Internet Explorer because it is included in most computers. Exploring this information can help people all over the world enjoy a better browsing experience.

THE KOCH SNOWFLAKE

Nathalie C. Velázquez, Inter-American School, San Germán, Puerto Rico.

Research Mentor: Yvonne Avilés, Inter-American University, San Germán, Puerto Rico.

The method of Lindenmayer, (L-system) to write fractals was implemented in a program written in Mathematica. This program was used to generate the Koch Snowflake, a well know fractal in an hexagonal pattern. This program can be easily modified for other L-systems, which are used in algorithmic biology to understand the morphology of living systems.
SPECTROSCOPIC ANALYSIS TO GAIN INFORMATION ABOUT THE UV BLOCKING PROPERTIES OF SUNBLOCKS AND SUNSCREENS

Alejandro Vélez, Southwestern Educational Society


A spectrometer is a device that is used to measure light over a specific portion of the electromagnetic spectrum. It is typically used in spectroscopic analysis to study the interaction between radiation and matter. In this experiment a spectrometer will be used to study the ultraviolet (UV) radiation blocking properties of sunblock and sunscreen products. These products claim to protect the skin from the harmful effects of overexposure to UV rays. It is important to test these products to determine if they truly do so and to determine which are the most effective. In the experiment, different types of sunblocks and sunscreens will be dissolved in alcohol and placed in a beaker for light to shine on it. The light that enters the substance and the light that exits the substance will each be measured using the spectrometer. UV light exiting the substance will be divided by the UV light entering the substance in order to calculate the transmissivity of UV light. The lower the transmissivity of UV light, the more effective the sunblock or sunscreen product is at protecting against UV radiation. It was hypothesized that sunblocks will allow less UV light through than sunscreens, because sunblocks are made of metallic materials that reflect UV radiation, while broad spectrum sunscreens are made out of chemicals that absorb UV radiation. Also, if the transmissivity of typical sunblock and the new nanoparticle sunblock are compared, then they should be similar, because they both contain the same active ingredients. The higher the SPF number of a particular sunblock or sunscreen product, the less UV light it should let through when compared to another sunblock or sunscreen of the same type, but with a lower SPF number. Waterproof sunblocks and sunscreens should have similar transmissivities to typical sunblocks and sunscreens, because they contain the same active ingredients. The experiment will be performed to support these hypotheses.

OBSERVATIONS ON THE PERFORMANCE TOOL PASSMARK TEST USED IN WINDOWS XP

Nicole Vélez, Espíritu Santo School, San Juan, Puerto Rico.

Research Mentor: Joaquín Rivera, Polytechnic University, San Juan, Puerto Rico.

Different types of performance tests can determine if a computer is running at its peak performance compared to other computers with almost the same specifications under stated conditions for a specified period of time. Passmark Software that is software tool that tests the performance in the Computer was used in this investigation. The PassMark Performance Test was run in three Quad Core computers three times. Making those Quad Core Computers highly efficient compared to other computers with two cores or similar specifications. The purpose of this research was to find if the same computers would have equal performance score, and to see the reliability of the tests. Because those Quad core computers have the same configuration, Passmark Test was performed three times, giving the results in between 897.0 to 962.0 that demonstrate that the Quad Core presents similar results, thus opening possible inquiry in the Passmark Software program variability execution and/or the Quality of Hardware components.
VECTOR SOLUTION WEBSITE

Julio Viera, Dr. Juan José Osuna School, San Juan, Puerto Rico.
Ángel Andino, Santa Gema School, Carolina, Puerto Rico.

Research Mentor: Jesse Jiménez, Universidad Metropolitana, San Juan, Puerto Rico.

The purpose of this project is to create a website to help figure out vectors; that is, a page for easy troubleshooting of vectors as unit vectors, the direction in which vectors go and the time it takes to get from their inception to the end. Visual Studio 2010 with NET Framework will be used as the "environment" to build these pages and to create algorithms. A "back-end" that will be encoded using the C# programming language will be used.

THREAT IN SIMPLE SOFTWARE

Jussan J. Villegas, Josefina Barceló School, San Juan, Puerto Rico.

Research Mentor: Joel Rivera, Universidad Metropolitana, San Juan, Puerto Rico.

Malware is not what it was. With a clear goal-oriented organization, it has evolved into an industry specializing in all types of computer crime in which significant benefits flow back to its creators. Spammers, phishers, scammers and malware developers in general have teamed up to strengthen its infrastructure and increase resources to achieve major networks as a platform to organized crime. Malware has now reached a point of sophistication that has managed to stand up to the antivirus industry. Users, although not perceived as threats epidemics a few years ago, are now suffering from significant levels of infection that directly affect their pockets.
APPLIED MATHEMATICS

MUTATIONS FROM THE COL7A1 IN COLLAGEN VII

Loammi M. Birriel, Ángel P. Millán Rohena School, Carolina, Puerto Rico.

Research Mentor: Carol J. Díaz, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

The gene COL7A1 encodes the alpha chain of collagen type VII. The protein functions as anchoring fibrils between the outer epithelium and underlying stroma. Mutations in this gene are associated with all forms of dystrophic epidermolysis bullosa. Epidermolysis Bullosa is a rare and heterogeneous group of inherited disorders characterized by a marked fragility of the skin and mucous membranes. One reason for the emergence of this disease is the lack or paucity of anchoring fibrils. The objective of this research was to learn more about the effects of this mutation in humans, and the effects and causes of the disease when this mutation occurs. The SIFT program was used in this study to predict whether an amino acid substitution affects protein function so users can prioritize substitutions. The first twenty positions of the protein were used for the analysis in SIFT. The results obtained by SIFT showed that 33% of the changed amino acids were tolerant and 67% were intolerant. This indicates that there is a high probability that the change of amino acids in the first 20 positions results in a mutation; therefore altering the function of the protein and causing any form of dystrophic epidermolysis bullosa.

HOW ARE HUMANS AFFECTED BY PLASTICS MOLECULES?

Aldrin M. Cañals, Marimar Méndez, Calasanz School, Carolina, Puerto Rico.

Research Mentor: Maxine González, Universidad Metropolitana, San Juan, Puerto Rico.

Some plastics are derived from petroleum oil and other natural substances that do not have a fixed boiling point and have a elasticity and flexibility that allow you to mold them. Recycling is a good option because every time that the plastic is recycled it is supposed to come with less plastic molecules (Sea Studios Foundation et al. 2008). For this investigation, an expanse research was done about the topic including videos, models and PDF documents that where searched on the extensive internet, books, health magazines and newspapers. A consultation was made with a gastroenterologist, who explained what happened or the reaction of the plastic in the stomach and possible diseases or benefits. The plastic can cause cancer, especially in the breast. The doctor explained that the heat caused the plastic to release a toxic chemical that leads to breast cancer. This toxic chemical is the same chemical found in the tissues of the breast infected with cancer (Dr. Edward Fujimoto et al. 2010). The plastic affected the immune system because it started affecting different organs, then lowered the platelet and caused, a immune disorder or endometriosis. (There are three main diseases that ingesting plastic can cause. The plastic is mainly composed of polystyrene, which is also mainly composed at carbon and hydrogen and it is a polymer. The dioxin is composed of carbon, hydrogen and chlorine. These components can be found in the water every time that the water is evaporated and blends with the plastic components. Based on the information the plastic is composed of very complex particles and it’s derived from petroleum. The stomach cannot digest the petroleum or the plastic so it is toxic and dangerous to human being. The plastic then stays in the stomach for a long time and starts to decompose, but not to digest. Then the reaction with the stomach juices begins and various diseases symptoms start to show.
NATURAL OR ARTIFICIAL TANNING, WHICH IS BETTER?

Rafael Cañals, Calasanz School, San Juan, Puerto Rico.

Research Mentor: Maxine González, Universidad Metropolitana, San Juan, Puerto Rico.

Skin is complex but what we all see about it is an outer layer that contains melanin which protects the body against the sunray and also protects from all dangers and risks it is exposed to day by day. Sun exposure is necessary for good health; it boosts your strength, your bones, and may lower your risk for certain cancers. Ironically it also puts any individual at risk of getting skin cancer and cataracts, among others. The purpose of this research was to prevent the high percentage of people with diseases caused by excessive sun exposure and thus increase people’s awareness of the importance of this neglected human body shield. An extensive research will be done for the purpose of acquiring more knowledge on the subject. Information on specific cases and consequences of both types of burn, tanning beds and sunburn, helped to compare the number of people who die or are diagnosed with different types of skin cancer, from the simplest to the most serious. There are various types of skin cancer; this research shows that indoor tanning increases the risk of squamous cell and melanoma skin cancers which are the worst of all. The conclusion of this research is that both, the excessive use of tanning beds and the excessive exposure to UV rays can cause harmful effects on an individual. Tanning beds are more commonly used and unfortunately has the worst consequences. Providing the correct information of how to prevent these consequences is the best way of stopping the abundant use of this deadly fashion.

COMPUTATIONAL ANALYSIS OF AMINO ACIDS CHANGES IN THE MEN1 GENE

Yanira Castelló, Universidad del Este, Carolina, Puerto Rico.

Research Mentor: Carol Díaz, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

Multiple Endocrine Neoplasia Type 1 is an inherited disorder that causes tumors in the endocrine glands and the duodenum, the first part of the small intestine. It is a recognizable syndrome in which persons develop tumors of the parathyroid glands, the enteropancreatic neuroendocrine system, the anterior pituitary gland, and the skin. Patients with multiple endocrine neoplasia Type 1 inherit a mutation in a tumor suppressor gene called MEN1 on band 11q13. The MEN1 gene encodes a protein, menin, whose functions are still being elucidated. Menin appears to be located mostly in the nucleus, where it has multiple binding partners, including junD and members of histone methyltransferase complexes. To carry out this investigation the program SIFT was used which is Single nucleotide polymorphism (SNP) studies and random mutagenesis projects that identifies amino acid substitutions in protein-coding regions. Each substitution has the potential to affect protein function. SIFT (Sorting Intolerant From Tolerant) is a program that predicts whether an amino acid substitution affects protein function so that users can prioritize substitutions for further study. We have shown that SIFT can distinguish between functionally neutral and deleterious amino acid changes in mutagenesis studies and on human polymorphisms. We hypothesize that changes in amino acid positions involves changes from DNA bases that cause the tumors. The predictions infer that there was a 45% tolerant and a 55% intolerant for the amino acid changes.
A MATHEMATICAL MODEL TO COMPARE THE MEXICAN POPULATION LIVING IN MEXICO AND THE IMMIGRANTS IN USA

Lorianie Colón, Yuliam Pedraza, San Juan Apóstol y Evangelista School, Caguas, Puerto Rico.

Research Mentor: Dr. Marlio Paredes, Universidad del Turabo, Gurabo, Puerto Rico.

The classical Malthus Model was used to study the growth of population in Mexico during the last 30 years and compared with data from the World Bank. In 1798 the Economist Thomas R. Malthus, in his essay "An Essay on the Principle of Population," posited a mathematical model of population growth. The model, though simple, has become a basis for most future modeling of biological populations. Finally, we the population of Mexican immigrants in USA is included and compared with the population living in Mexico.

PROPORTIONAL RELATIONSHIP BETWEEN HAND DISTENSION AND BIOLOGICAL VARIABLES

Nicole M. Colón, Notre Dame School, Caguas, Puerto Rico.
Grace M. Fontánez, Petra Mercado Bougart School, Caguas, Puerto Rico.

Research Mentor: Maggie Delgado, Universidad del Turabo, Gurabo, Puerto Rico.

The size of the hand has always been associated with some biological effects such as growth or hereditary genes. This study aimed to find a relationship beyond that purpose. This study was conducted among 13 females between the ages of 15 to 18 years, from the Hispano-American ethnic group. A ruler was used to measure the hand distension in which the thumb was placed on zero, stretching the hand to the maximum right site. A questionnaire was also administered to get the rest of the data, such as age and height of each individual. The information was evaluated in Microsoft Offices Excel 2007, where main, standard deviation and Pearson coefficient were obtained from it to analyze the results. The results of this research could test the relationship between the hand distention and biological variables. Through this could show that as the individual grows, her hands size and the distension of it increases.

TRIANGLES WITH INTEGER SIDES AND AREA

Alfonso Figueroa, Inter-American School, San Germán, Puerto Rico.

Research Mentor: Guillermo Mejía, Inter-American University, San Germán, Puerto Rico.

An algorithm to find triangles with integer sides and area was implemented in the programming language Mathematica. Triangles with integer sides have been known for centuries, and are called Heronians. If in addition the area that is the height is also an integer, they can be easily plotted as every coordinate of the vertices is rational. In the algorithm, the wanted triangle is divided in two right triangles, where each one is Pythagorean (right integer sided). Pythagorean triples are readily generated in the computer, and joining them in pairs by a common leg we obtain our triangle. Then a table for some small triangles, their angles and coordinates were generated.
THE EFFECT OF LIGHT POLLUTION ON SEA TURTLES IN PUERTO RICO

Natasha D. García, Dr. Juan José Osuna School, San Juan, Puerto Rico.

Research Mentor: Eduan Martínez, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Maxine González, Universidad Metropolitana, San Juan, Puerto Rico.

This research shows how light pollution affects the sea turtles in Puerto Rico. Light pollution is the alteration of light levels in the outside door environment; it affects the sea turtles in many ways. One of the worst effects is that light pollution interferes with the turtle’s ability to find a safe nesting area for its eggs. This causes a decrease in their population, which has been 99% since the 17th century. The purpose of this research was to prove that light pollution is one of the principal causes affecting the survival and behavior of sea turtles in Puerto Rico. Multiple beaches in Puerto Rico were visited in order to obtain field data to be compared to that found in many environmental reports. The Department of Environmental and Natural Resources served as a main source of information. It was expected to prove that light pollution is the principal factor affecting the survival of sea turtles. Some beaches in Puerto Rico have outdoor light that affect the way and the area where sea turtles lay there eggs. A campaign to change outdoor lighting in beaches in Puerto Rico is recommended. The relevant agencies recommendations should put their plans into action to improve the deteriorating conditions in both the flora and fauna of the environment caused by light pollution. Experts need to be consulted to improve the light sources on the outdoor environment and make a better place for animals and humans, without affecting them.

AMINO-ACID CHANGES IN THE PROTEIN SCN5A

José González, José E. Aponte de la Torre School, Carolina, Puerto Rico.

Research Mentor: Carol Díaz, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

The SCN5A is an integral membrane protein and a tetrodotoxin-resistant voltage-gated sodium channel subunit. This protein is found primarily in cardiac muscle and is responsible for the initial upstroke of the action potential in an electrocardiogram. Defects in this gene are a cause of long QT syndrome Type 3 (LQT3), an autosomal dominant cardiac disease. The principal objective of this study was to evaluate this protein to calculate probabilities of tolerant and intolerant amino acid substitution using the SIFT software. SIFT is a sequence homology-based tool that sorts intolerant from tolerant amino acid substitutions and predicts whether an amino acid substitution in a protein will have a phenotypic effect.
RESEARCH ON THE DEVELOPMENT OF THE HAND

Juan M. González, Mayra A. Quiles, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Maggie Delgado, Universidad del Turabo, Gurabo, Puerto Rico.
Research Mentor Assistant, Grace Delgado, Universidad del Turabo, Gurabo, Puerto Rico.

It has been proven that the human being grows in size if it follows a certain lifestyle like eating healthy and staying in shape. The purpose of this study was to prove a theory that a hand can grow and have a great distention by searching for the relations that can make this possible. The relations can be by the height and age. This research was conducted among male teenagers between the ages of 15-17, examining the previous terms mentioned and using various items such as an inch ruler, a science notebook and a pen. The response or results were that at higher height a less distention the person has and that a higher altitudes greater distension. After collecting the data, the Microsoft Excel program was used to make all calculations and analyze the results. The mathematical process revealed that the hypothesis was totally false and that taller men have less hand distention.

MEASURING BASE RUNNING EFFICIENCY

Irene Hammel, María Reina Academy, Carolina, Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.

The goal of this project was to demonstrate which way is faster to get to first and second base when playing baseball. A fast running to second base will ensure a run. It is proposed that a straight and a half-circle way may both be used to run the bases. The two options would be running straight to first base and then taking a 90° turn to reach second base or running forming a half circle, but still touching first base. In the first option, the distance is shorter, but one needs to stop completely in first base and accelerate again to reach second base. In the second option the distance is longer, but the advantage is that one does not have to accelerate, decelerate, and accelerate again. It was concluded that the best option will depend on the ability of the runner to accelerate and decelerate in order to reach the second base.
ARE WE REALLY PROTECTED FROM BACTERIA?

Viviana Lebrón, Calasanz School, Carolina, Puerto Rico.

Research Mentor: Eduan Martínez, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Maxine González, Universidad Metropolitana, San Juan, Puerto Rico.

Bacteria are a large group of single-celled prokaryote microorganisms. Various commercial hard-surface cleaners have been evaluated for their efficacy in killing bacteria capable of causing food-borne infection (Hoikyung Kim et al. 2007). During this experiment, different procedures were used to test the efficacy of disinfectants (Bert van Klingeren et al. 2007). Every day two swabs were taken from the skin, one before taking a shower and one after, for six days. These were analyzed to see the type of bacteria that inhabit the skin and how ordinary soap will sanitize properly; and if in different days that changes. It was predicted that ordinary soap will sanitize to a point were the skin will be protected for a while, but it is not a protection that will deliver a safer way of living without bacteria. The bacteria on the swabs taken on the skin changed depending on the days on which they were taken. When these were tested and compared to the clean skin, although it was expected to see a difference in the cleanliness of the skin, it was not 100% clean. The study revealed that a person bathing himself with soap once a day or even multiple times a day will never be fully protected because the soap itself can carry bacteria. This means that no one will ever be completely protected from bacteria.

A MATHEMATICAL MODEL TO DETERMINE THE TIME OF DECEASE

Rafael Martínez, Antonio Fernos Isern Vocational High School, Juncos, Puerto Rico.
Jennifer M. Reyna, Petra Mercado School, Humacao, Puerto Rico.

Research Mentor: Dr. Marlio Paredes, Universidad del Turabo, Gurabo, Puerto Rico.

This project is an investigation to see how a differential equation may help determine the time of the death of a person. This may help resolve events like crimes or suicides. It consists of using Newton’s Law of Cooling which with temperatures and time can predict which ever of these variables. Newton’s Law of Cooling makes a statement about an instantaneous rate of change of the temperature which is proportional to the difference in the surroundings. When this verbal statement is translated into equations, we arrive at a differential equation. The solution to this equation will then be a function that tracks the complete record of the temperature over time.
EFFECT OF COOKING METHODS ON THE REDUCTION OF VITAMIN C

Sarah Matos, Barbara Ann Roessler Academy, San Juan, Puerto Rico.

Research Mentor: Eduan Martínez, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Maxine González, Universidad Metropolitana, San Juan, Puerto Rico.

Eating fruits and vegetables is an excellent way to provide the body with a healthy and balanced amount of vitamins. These may be eaten raw or cooked. However, vitamins may be lost during the process of cooking the produce. Vitamin C is the most easily destroyed vitamin because it is: a water-soluble vitamin, it is destroyed by oxygen, and heat that exceeds 70˚F. The purpose of this experiment was to corroborate how much Vitamin C is lost during the process of cooking fruits and vegetables by steaming them. To do so, first, a vitamin C indicator must be made in order to test each fruit or vegetable before and after cooking them. The fruit that will be used is an orange and the vegetable that will be used is a green bell pepper. Several drops of the orange and green bell pepper extract will be poured into individual vitamin C indicators until they lose their royal blue color. Then, the orange and green bell pepper will be steamed separately for ten minutes. Next they will be squeezed to get their extract after being cooked. Several drops will be poured into individual vitamin C indicators until they lose their royal blue color. Each step will be repeated three times with both the orange and the green bell pepper. It is expected that the orange and the green bell pepper will lose about 60% of their vitamin C after being steamed. The results may vary; however, if they do lose a substantial amount of vitamin C, it will prove that when consuming cooked fruits or vegetables people are not getting the amount of vitamin C into their body that they think they are consuming. It will also prove that it is better to eat uncooked and fresh produce.

COMPUTATIONAL STUDY OF AA CHANGES ON ABCC8 GENE

Elvin A. Méndez, José Aponte de la Torre School, Carolina, Puerto Rico.

Research Mentor: Carol Díaz, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

The protein encoded by is a member of the ATP-binding cassette transporters. This protein is involved in multi-drug resistance and functions as a modulator of ATP-sensitive potassium channels and insulin release. Mutations and deficiencies in this protein have been observed in patients with hyperinsulinemic hypoglycemia of infancy, an autosomal recessive disorder of unregulated and high insulin secretion. Mutations have also been associated with non-insulin-dependent diabetes mellitus type II, a metabolic disorder that is characterized by high blood glucose in the context of insulin resistance and relative insulin deficiency. The objective of this research was to examine changes on the amino acids using SIFT, which predicts whether an amino acid substitution can affect protein function. It also determines the tolerance and intolerance level on amino acid changes. 20 positions of the protein were selected with an average of 21% of amino acid changes that were tolerant and a 79% of amino acids changes that were intolerant. This meant that a high percentage of amino acid changes did not resist the changes and therefore caused a mutation.
SOLAR ENERGY SYSTEM FEASIBILITY STUDY

Juan C. Pérez, José Aponte de la Torre School, Carolina, Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.

A solar is a module that takes energy from solar radiation. The term includes solar collectors used to produce hot water and the photovoltaic panels used to generate electricity. Photovoltaic panels are formed by numerous cells that convert sunlight into electricity. These solar panels are a solution to substitute the fuel produced from crude oil. The main objective of this project was to conduct a feasibility study on the replacement of the electricity that comes from the Power Authority in Puerto Rico (AEE for its acronym in Spanish) with a system that includes solar panels and photovoltaic cells to produce the energy that a house needs.

THE EFFECTS OF THE NEW CONTRIBUTIVE REFORM

Lorena Pérez, María Reina Academy, Carolina Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.

The governor of Puerto Rico proposed a new contributive reform. It is supposed to benefit individuals as well as corporations. Puerto Ricans do not know whether or not the reform will be favorable for them, for it has positive changes as well as negative ones. The first phase of this reform has been approved (Senate Bill 1888). The purpose of this project was to study the effects of the Senate Bill 1888 on individuals from different income sectors.

MUTATIONS IN THE MYH7 GENE

Valerie Pérez, Castillo Fuerte Academy, Carolina, Puerto Rico.

Research Mentor: Carol Díaz, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

MYH7 is a gene that encodes a myosin heavy chain beta isoform that is primarily expressed in the heart. This gene provides instructions to build up a protein called cardiac beta-myosin heavy chain (MHC-β). MHC-β is a hexameric protein that codifies for proteins in normal heart ventricle. A change in the relative abundance of this protein correlates with the contractile velocity of cardiac muscle. Mutations in the MHC- β protein are associated with Hypertrophic Cardiomyopathy or HCM the most frequent cardiac hereditary disease. HCM is a condition in which the heart muscle becomes thick. This thickening is usually asymmetrical; meaning one part of the heart is thicker than the other and makes it difficult for blood to leave the heart, thus forcing it to work harder. Symptoms of HCM are most commonly chest pain, dizziness, fainting (especially during exercise), heart failure and high blood pressure, among many others. This disease occurs in 1 out of 500 people and often is a disease that goes undiagnosed and causes confusion among physicians. HCM at present is a chronic disease without a known cure, although there are a number of treatments available that may alter its course. The objective of this investigation was to calculate the probabilities that a mutation may occur inthe MYH7 protein using SIFT. Sorting Intolerant From Tolerant (SIFT) is a program that predicts if an amino acid substitution will affect protein function. When the changes in amino acids occurred, it was found that 57% of the changed amino acids were tolerant and 43% were intolerant.
MENINGIOMA

Tiffany Reyes, Castillo Fuerte School, San Juan, Puerto Rico.
Research Mentor: Carol Días, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

The gene adaptor protein complex 1 is codified by the clathrin protein. The gene is found in the Golgi complex and the protein helps to form the complex. A malfunction on clathrin and a mutation of the gene produce deficiency on the Golgi complex. This faults causes a common brain tumor called meningioma. Symptoms of meningioma may include headaches, vomiting, visual problems, changes in behavior, epilepsy, pain, loss of sensation or weakness in the arms and legs, loss of control over bladder or bowel, slurred speech, loss of coordination and memory loss, and difficulty writing. The exact cause that makes the tumor grow was investigated by using the SIFT program and past studies by professionals. Scientists consider the possibilities that some hormones and radiation exposure, especially in the face, may increase the risk and growth of meningiomas. These theories are still being studied.

GREEN ROBOT

Marcus I. Arroyo, Josefina Barceló School, Guaynabo, Puerto Rico.

Research Mentor: Eduan Martínez, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Raúl Colón, Universidad Metropolitana, San Juan, Puerto Rico.

The green robot is made with lemons as a remedy to prevent environmental pollution. The problem is that it takes many lemons to produce more voltage. The purpose of this work was to preserve the environment and to invent a new way to get renewable energy use and discard leaving alkaline batteries use which pollutes the environment. The process is carried out by using recycled materials to reach the goal, which protecting the environment. The results are expected to get is that the green robot works with the energy emitted by the lemons. It may conclude that this experiment will make a good cause for humanity as well as for the environment.
ANALYSIS OF THE AMINO ACIDS CHANGES IN THE ACVRL1 GENE (ACTIVIN A RECEPTOR TYPE II-LIKE1)

Rebecca E. Rosado, José Aponte de la Torre School, Carolina, Puerto Rico.

Research Mentor: Carol Díaz, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

The gene ACVRL1 (activin A receptor type II-like 1) is a receptor. It acts as a "lock" waiting for a specific protein, called its ligand, to serve as the "key." In the case of the ACVRL1 protein, the ligand is called transforming growth factor beta. The interaction between these proteins plays a role in the development of blood vessels. Mutations for this gene are involved in the specialization of new blood vessels into arteries or veins. The disease associated with this gene is Hereditary Hemorrhagic Telangiectasia, better known as Osler-Weber-Rendu syndrome. Each year there are 1-2 cases per 100,000 affected with this syndrome. The treatment for this syndrome is surgery in the area affected, endovascular embolization and estrogen therapy.

In this study the changes in amino acids positions were analyzed. The program SIFT, a program that predicts the changes in the positions of amino acids and infers the changes as tolerant or intolerant. SIFT uses a margin that indicates that below 0.05 it is intolerant. 20 positions were randomly selected for changes on the SIFT program. The predictions infer that there were 58.5% tolerant and 41.5% intolerant. For future research, this will be useful to establish an evolutionary analysis of the gene and diseases associated with it.

OSTEOGENESIS IMPERFECT AS A CONGENITAL DISEASE

Yanitzia D. Rosario, Ángel P. Millán School, Carolina, Puerto Rico.

Research Mentor: Carol Díaz, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

The alpha 2 chain of collagen type I triple helix is made up of two alpha1 chains and one alpha2 chain of collagen fiber. The protein encoded by the gene acts as a fibril collagen formation found in most connective tissues and is abundant in bone, cornea, dermis and tendon. When mutation occurs in the protein, it cannot perform its function and does not allow production of collagen and an additional protein is what gives bones its strength. The disease associated with the gene is osteogenesis imperfecta mutation. The symptoms may include blue tint in the sclera of the eyes, multiple bone fractures and loss of hearing. The tool used in this research was SIFT, a program that predicts whether an amino acid substitution affects the function of proteins so that users can prioritize substitutions for further study. Results obtained by SIFT showed that 21% of the changed amino acids were intolerant to the change.
GALAPAGOS TORTOISE AND THEIR POPULATION

Daniel Solís, Commonwealth Parkville School, San Juan, Puerto Rico.

Research Mentor: Eduan Martínez, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Maxine González, Universidad Metropolitana, San Juan, Puerto Rico.

The Galapagos tortoises are a distinct species that lives only in the Galapagos Islands. Through many years, there have been changes to the tortoises’ population and their nesting grounds. If these changes continue, then the species will possibly face extinction. The purpose for this investigation was to calculate the changes that are happening and determine the factors that caused it. Data was acquired regarding the population and the nesting grounds. It was then analyzed to determine the factors. From analyzing the data, it was inferred that the population has been decreasing throughout the years as a result of recent human development activities. Because of human interference in the island’s ecosystem, the Galapagos tortoise’s reproduction rate is affected, thus decreasing their population.

COMPUTATIONAL ANALYSIS OF AA CHANGES ON THE NPC1 GENE

Stephanie Torres, José Aponte de la Torre School, Carolina, Puerto Rico.

Research Mentor: Carol Díaz, Universidad del Este, Carolina, Puerto Rico.
Research Mentor Assistant: Edgardo Vázquez, Universidad del Este, Carolina, Puerto Rico.

The protein encoded by this gene is a multi-pass membrane protein. It contains a conserved N-terminal Niemann-Pick C1 (NPC1) domain and a putative sterol-sensing domain which includes a motif functioning as a plasma membrane to trans-Golgi network transport signal in other proteins. This protein takes up free cholesterol into cells through vesicular endocytosis and plays a critical role in the absorption of intestinal cholesterol. It also has the ability to transport alpha-tocopherol (vitamin E). This protein transports low-density lipoproteins to late endosomal/lysosomal compartments where they are hydrolyzed and released as free cholesterol. Defects in this gene cause Niemann-Pick type C disease, a rare autosomal recessive neurodegenerative disorder characterized by over accumulation of cholesterol and glycosphingolipids in endosomal/lysosomal compartments. The objective of this research was to examine changes on the amino acids using SIFT, which can predict whether an amino acid substitution can affect protein function. It also determines the tolerance and intolerance level on amino acids changes. The first 20 positions of the protein were selected for the research. Results obtained showed that averages of 78% of amino acids changes are tolerant and a 22% of amino acids changes are intolerant. This means that low percentage of amino acids changes do not resist the changes and therefore cause a mutation.

NON STOP DECOMPOSITION

Melinda Vargas, San Antonio Abad School, Caguas, Puerto Rico.
Jennifer Patritti, Manuela Toro Morice School, Caguas, Puerto Rico.

Research Mentor: Dr. Marlio Paredes, Universidad del Turabo, Gurabo, Puerto Rico.

There are many products that are disposed daily, not being aware of the time they take to fully decompose. Through the calculations of half life, the time that a substance takes to decompose can be determined. Half life is the time required for half the quantity of a substance to be eliminated by normal biological processes. The purpose of this research was to investigate a hypothetic example of a landfill was used to predict the decomposition time of the sample through mathematical equations. Taking the results to create awareness and emphasize the importance of recycling.
THE EFFECTS OF DYSTROPHIN IN MUSCLES

Virginia Vélez, Castillo Fuerte School, Carolina, Puerto Rico.

Research Mentor: Carol Díaz, Universidad del Este, Carolina, Puerto Rico.

Dystrophin is the largest protein found in nature and it is made and used by muscle cells. The exact role of dystrophin is unclear, but in many ways, it is the substance that anchors the internal structure of the cell, making it stronger and stable. The absence of this protein is believed to cause muscular dystrophies, such as Duchenne muscular dystrophy (DMD) and Becker muscular dystrophy (BMD). These genetic disorders are due to an error in one or more of the genes responsible for making this complex component of muscle cells called dystrophin. DMD is the most severe form of muscular dystrophy occurring at a frequency of about 1 in 3,500 newborn males; it usually affects only boys. DMD is caused by a defective gene in the X chromosome that leads to the inability to produce dystrophin. The Becker muscular dystrophy is a benign and less severe form of DMD involving a slow worsening of the muscle from the legs and pelvis. Becker muscular dystrophy is a hereditary x-linked disease characterized by the alteration, deficiency, and abnormal molecular weight of the dystrophin gene. Unlike DMD, the dystrophin protein is not missing in BMD but is not normal either. The SIFT Program was used to conduct this research to predict whether an amino acid substitution will affect protein function and then, possibly alter the phenotype. The conclusion is that out of 400 amino acids in the first twenty positions of the protein, 255 (64 %) were intolerant to the changed amino acids.
ENGINEERING

OBJECT IDENTIFICATION USING THE TEKKOTSU'S SIFT TOOL

Edwin Alvarado, Diego Santana and Irisbelle García, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Joehan Carrasquillo, School of Engineering, Universidad del Turabo, Gurabo, Puerto Rico.

When humans learn about an object, they learn what it looks like and, generally, the object is associated with a visual memory or textual memory. Later in life, assuming that the human still remembers about the object, the object can be remembered by the association that was created in the human’s memory. The Tekkotsu framework can mimic this behavior, through the SIFT tool, converting an image into data and storing it into a database so that it can access it later. To use SIFT, an effective step-by-step robot programming (called behavior) must be used to be able to implement SIFT effectively. Through this project a behavior that can be used for identifying objects, emulating the observation–association technique humans have, has been created to use this technique in robots.

THE RELATIONSHIP BETWEEN SOLAR ACTIVITY AND THE AMOUNT OF COSMIC RAY AIR SHOWERS

Edrick Alvarado, Kevin Vargas, CROEM School, Mayaguez, Puerto Rico.

Research Mentor: Peter Van Der Meer, University of Puerto Rico, Mayaguez, Puerto Rico.

Primary cosmic rays can interact with nucleons on Earth's upper atmosphere. Showers occur when these primaries are extremely energetic and produce large numbers of secondary particles (mostly pions and kaons). The secondary promptly decay into the particles that strike Earth's surface. During a shower, thousands of these particles can strike an area as large as several square kilometers nearly simultaneously. Cosmic rays are energetic particles originating from outer space that impinge on Earth's atmosphere and cause a cosmic ray shower. About 89% of all the incoming cosmic ray particles are simple protons, with nearly 10% being helium nuclei (alpha particles), and slightly under 1% are heavier elements; electrons (beta particles) constitute about 1% of galactic cosmic rays. The results of this research indicate that the amount of solar activity can affect the amount of cosmic ray showers because of the amount of protons released from solar activity.
SINGLE LANGMUIR PROBE PLASMA DENSITY AND TEMPERATURE MEASUREMENT

Jean Carlos Bernal, San Juan Apóstol y Evangelista, Caguas, Puerto Rico.
Raúl Vázquez, Commonwealth High School, Guaynabo, Puerto Rico.

Research Mentor: Franklyn Colmenares, Polytechnic University, San Juan, Puerto Rico.

Plasma is the most common form of matter in space and it is used on Earth for various things; for example, producing light and strengthening objects. This form of matter is an ionized gas, which occurs when a gas has its atom divided in electrons and ions. The purpose of this experiment was to find the measurements of the density and temperature of plasma. The way to achieve this was by using a Single Langmuir Probe inserted in the center of the electrode. In this experiment, the Single Langmuir Probe, the PUPR plasma machine (which happens to be the biggest machine to produce plasma in the Caribbean), the LabView program and the Langmuir theory to create and measure glow discharge plasma were used. To produce the purest plasma a high vacuum environment must be achieved inside the machine, which is done by using pumps. After all the air was vacuumed out, the gas was injected (in our case nitrogen) and the electrode (which is a cube, since in previous studies it was proven to create the most plasma) was moved into the middle of the machine. By charging the electrode negatively at a voltage of -400v and using the machine as the positive electrode, plasma discharge was created. This effect caused the cascade effect of the electrons knocking other electrons out of their orbits and starting the effect all over again. The problem encountered was that LabView did not calculate the Glow Discharge properties as expected. To solve this problem we decided to calculate this data ourselves and compare it to Lab View data. In conclusion, LabView need to be modified to make it possible to calculate the real Glow Discharge measurement.

DIGITAL LOGIC IMPLEMENTATION OF SYNCHRONIZED SEMAPHORES

Yarib Berríos, Steven Díaz, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Jonathan Vargas, Universidad del Turabo, Gurabo, Puerto Rico.

Transistor-transistor technology (TTL) refers to the technology for designing and fabricating digital integrated circuits that employ logic gates consisting primarily of bipolar transistors. This technology can be used to design many different systems, such as a synchronized semaphore. Using counters, a number distribution can be established for each of the system states (red, green and yellow lights). Using the circuit minimization technique called Karnaugh’s map, a minimized logic function was established for each traffic light to turn on in its established time, and turn off during other light’s established time. The circuit in MULTISIM was simulated and it was demonstrated than the time for each light may be increased by decreasing the frequency of an alternate voltage source rather than redesigning the circuit.

CROP MAKING ROBOT

Daniela Díaz, María Reina Academy, San Juan, Puerto Rico.

Mentors: Isis Laham, Dr. Angel Arcelay, Universidad del Este, Carolina, Puerto Rico.

A robot is a machine designed to execute one or more tasks repeatedly, with speed and precision. There are as many different types of robots as there are tasks for them to perform. The Crop Making robot was designed with the purpose of cultivating and planting seeds. The main objective was to make this process easier and faster due to the decrease of planting in the island of Puerto Rico.
MEASUREMENT OF GLOW DISCHARGE TEMPERATURE AND DENSITY USING LABVIEW AND SINGLE LANGMUIR PROBE WITH A SWEEP VOLTAGE FROM -25 TO 50

William Ferrer, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Franklyn Colmenares, Polytechnic University, San Juan, Puerto Rico.

What is plasma? Plasma is the fourth state of matter through the eyes of anyone but it is actually the first state through science, and this is how it came to be important at many universities including in Puerto Rico. The physical properties of plasma are an ionized gas consisting of equal concentrations of positive and negative charges and a large number of neutral species. In the simplest case, it is formed by applying a potential difference of -500v to a few 100v, between two electrodes that are inserted in a chamber. The chamber is filled with nitrogen at a pressure of 2.62^2 torr to atmospheric pressure. The purpose of this study at the Polytechnic University of Puerto Rico was to compare the differences of temperature and density of plasma. The program used was LabView, in which the values found were different from the ones found by the researcher. This is because the program was designed to calculate the properties of plasma in the ECR (Electron Cyclotron Resonance). The density and temperature values obtained were 20.4499 ev and 0.11935056 cm^-3 respectively, versus the values given by the program which were 4.51825 ev and 1.3714E+9 cm^-3. The difference is clearly seen because although the Single Langmuir curve characteristic is correct, the values used by the LabView algorithm seem incorrect. The other groups used different runs of voltage to see if the graphic was variable enough or if the voltage discharge varied in any form.

MEASUREMENT OF GLOW DISCHARGE TEMPERATURE AND DENSITY USING LABVIEW AND SINGLE LANGMUIR PROBE WITH A SWEEP VOLTAGE FROM -25V TO 25V

Joan García, Pedro Orona, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Franklyn Colmenares, Polytechnic University, San Juan, Puerto Rico.

What is plasma? Plasma is the fourth state of matter through the eyes of anyone but it is actually the first state through science and this is how it came to be important at many universities including in Puerto Rico. At the Polytechnic University of Puerto Rico were comparing the differences of temperature and density of plasma. The program being used its called LabView, in which the values founded were different from the ones found on our own. This is because the program was designed to calculate the properties of plasma in the ECR (Electron Cyclotron Resonance). The density and temperature values obtain were 0.4630573 ev 3.908674639 cm^-3 versus the values given by the program 4.51825 ev 1.37148E+9 cm^-3 its clearly seen the difference on which they differ, although the Single Langmuir curve characteristic is correct the values used by the LabView algorithm seems incorrect. The other groups use different runs of voltage to see if the graphic is variable enough or if the voltage discharge varied in any form.
 USING LABVIEW AN A SINGLE LANGMUIR PROBE TO MEASURE GLOW DISCHARGE PLASMA PARAMETERS WITH A VOLTAGE SWEEP FROM -25 VOLTS TO 25 VOLTS

Rubén García, Xavier Figueroa, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. Research Mentor: Franklyn Colmenares, Polytechnic University, San Juan, Puerto Rico.

The PUPR (Polytechnic University of Puerto Rico) has developed an extracurricular activity in which high school students can participate in the aid of the study of plasma. Plasma is the fourth state of matter. better known among some scientists as the first state of matter. The objective in this investigation was to study the density of plasma in the PUPR Plasma Machine using a single Langmuir probe in different areas of the electrode (rectangular shaped artifact used to confine plasma in a uniform way). In order to achieve this goal, the LabView program was used. This program improves the speed of gathering information to find a more precise result of an investigation. To accomplish the objective of this experiment, a plasma was needed to be made in the electrode using the PUPR Plasma Machine to make the measurements. The plasma was needed to be as pure as possible so that the results could be more accurate. After calculating and analyzing the results, it was noticed that the results were not similar to the ones expected. The program LabVIEW was not prepared to obtain the density of plasma at the temperature of glow discharge. After correcting the problem later, the experiment was retried and followed correctly according to the steps. Using a pressure of 2.64 x 10^-2 and a voltage starting from -25v and ending at a voltage of 25v, the group was able to receive a density of 4.56426E-18 Ne.

AUTOMATIC FISHING NET

Elizabeth Maysonet, María Reina Academy, San Juan, Puerto Rico

Research Mentors: Isis Laham, Dr. Angel Arcelay, Universidad del Este, Carolina, Puerto Rico

Nowadays, fishing requires more than one person to pull up the net jam-packed with fishes. The number of fishermen required to do this task depends on the quantity or weight of the fish. More fishermen are needed to lift the net when catching bigger fish. Recreational fishing does not present a problem, but commercial fishing companies need a gainful of fishes and a number of fishermen involved. Consequently, more hands are needed to fulfill the catch which increases the payroll. If the task of throwing and lifting the fishnet is done automatically, it will only require one employee. That will reduce the labor cost and makes the task more efficient. The purpose of this study was to propose designing a robot that will throw and lift the net by means of a tackle-block. When the SONAR (Sound Navigation and Raging), a sensor that detects fish, produces a sound and the fisherman pushes a button, it will activate the robot and the net will be dropped from the boat. Then, when a sensor detects the maximum weight, it will lift the net. The hypothesis is based on the idea that the AFN (Automatic Fishnet) will solve the problem for the cost-effective use of men during commercial fishing.
OBSERVATIONS ON THE PERFORMANCE TOOL PASSMARK TEST USED IN WINDOWS XP

Mario Medina, Ricardo Borralí, Miguel Such Vocational School, San Juan, Puerto Rico.
Nicole Vélez, Espíritu Santo School, San Juan, Puerto Rico.

Research Mentor: Joaquin Rivera, Polytechnic University, San Juan, Puerto Rico

There are various reliability tests that verify if the computer used is performing as required under the stated conditions for a certain period of time. The Passmark Test was performed three times, giving the results in between 897.0 to 962.0.

MEASUREMENT OF GLOW DISCHARGE TEMPERATURE AND DENSITY USING LABVIEW AND SINGLE LANGMUIR PROBE WITH A SWEEP VOLTAGE OF -25 VOLTS AND 25 VOLTS

José Mora, San Ignacio School, San Juan, Puerto Rico.
Ricardo Rodríguez, San Jorge Academy, San Juan, Puerto Rico.

Research Mentor: Franklyn Colmenares, Polytechnic University, San Juan, Puerto Rico.

Plasma consists of ionized gas whose ions and electrons are free to move. The type of plasma created was glow discharge; this happens when positive and negative charges collide, that causes an emission of light. The basic process for creating Glow Discharge is: Insert an electrode inside the PUPR Plasma Machine, make the PUPR Plasma Machine go into vacuum, insert nitrogen gas inside the PUPR Plasma Machine with a pressure of 2.98^2 torr, and pass a negative electric charge of -400 volts through the electrode. The technology used to measure the plasma was using a Single Langmuir Probe. It works by inserting an electrode and observing the flow of the current. The purpose for doing this is to calculate the temperature and density of the Plasma with the given information of the LabView program. The result was that the Machine worked and plasma was created in the electrode showing purple emissions of light. By doing the calculations manually, it was proven that the program’s (LabView) algorithm for measuring the plasma’s density and temperature using glow discharge isn’t reliable. LabView gave a density and temperature of 1.28739E+08 and 3.79761 respectively, while the manual calculations gave a density and temperature of 44.2 and 34.6 respectively.
With different problems come different kinds of reasoning and point-of-views that determine the possible solutions and the most convenient solution of said problems. The way this is done goes deep into the very way a person lives his/her life. What the person does and why he/she does it is a question that is valid at the moment that the person is looking for solutions to their problems, making questions to get answers and finding answers to previously stipulated problems. This way of thinking can be taught to that person. In robotics this information can be used to make solutions to problems which are manifested in form of behaviors, step-by-step instructions that are made so that the robot can solve a problem or complete a task at hand. The reasoning behind the steps and the reason they are put together in the manner they are put together must be formed in a way that it solves the problem and/or completes the task in a convenient way. What is convenient...? The very same reason for this project.

SIMULATION AND PROBABILITY ANALYSIS OF THE GAME OF ROULETTE


Research Mentor: Jonathan Vargas, Universidad del Turabo, Gurabo, Puerto Rico.

The game of roulette is a gambling game that involves a spinning wheel with 38 compartments where the ball can stop. The player can bet on a compartment or a set of compartments, and wins when the ball falls into said compartment or compartments. The purpose of this research was to simulate the game in MATLAB and verify different outcomes for different sets of values. Results provided by simulation were compared with results calculated from the theoretical model equations. Verification as to whether the theoretical estimations were true to a simulated outcome were made.
PLASMA DENSITY AND TEMPERATURE MEASUREMENTS WITH A SINGLE Langmuir Probe

Gabriel Reilly, Orlando Torres, Espíritu Santo School, San Juan, Puerto Rico.

Research Mentor: Franklyn Colmenares, Polytechnic University, San Juan, Puerto Rico.

In the PUPR Plasma Lab it was decided to measure the temperature and density of a plasma created in a cube shaped electrode. Plasma is created when one isolates a gas and ionizes its atoms. A single Langmuir probe sends the information that it gathers from the plasma to LabView. LabView is a program that is used to collect and calculate data from the plasma, using a special algorithm. As an experiment it was decided to try and measure the density and temperature of the plasma with LabView. But because the program was limited by its initial algorithm to just collect the characteristics of the plasma, the results the program returned were unreliable. Therefore, Microsoft Excel was chosen to calculate the results from the single Langmuir probe characteristic curve taken from LabView. In this program, the voltage and current data were used to calculate the natural logarithms of the current. A graph of the curve that was formed from the natural logarithms was plotted. After removing the noise of the machine (which greatly interfere with the results), the necessary information to find the slope (tan Θ) was found. The slope of the graph was obtained by using the trend line command in Microsoft Excel, and with the equation of this line, the slope was found. This value was consequently plugged in (along with the other values needed) into the proper equations so that the temperature and density of the plasma could be obtained.

SIMULATION AND PROBABILITY ANALYSIS OF THE GAME OF CRAPS

Karen M. Rivera, Kimberly Velázquez, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Jonathan Vargas, Universidad del Turabo, Gurabo, Puerto Rico.

The game of craps is a casino game played with two dice. To win the game, the player must obtain a total value of seven or eleven; if not, the user must keep playing and obtain the same value to win. Theoretically, the user has a greater probability of losing after each dice throw. The purpose of this study was to simulate the game in MATLAB to demonstrate that the probabilities of winning the game decrease after each throw.

NAIL-PAINTING ROBOT

María E. Roldán, María Reina School, Carolina, Puerto Rico.

Research Mentor: Isis Laham, Universidad del Este, Carolina, Puerto Rico.

Modern technology can be applied to almost every aspect of human activity. Among those, personal needs are a focus of developing technology. This project aims to design a robotic system that will be able to paint finger nails. In the same way, the system will provide an ideal length, contour of the finger nail, and color according to the hand size and skin color. The robot will measure the hand and nail size of the person and will provide recommendations for size, color, and contour of the nail. The nail polish for this robot could come in cartridges and can be changed whenever the person wishes to paint her nails. It is our hypothesis that recommendations from the robot will provide the best fit for nail, color and contour according to a person’s hand.
MATLAB IMPLEMENTATION OF IMAGE COMPRESSION APPLYING SINGULAR VALUE DECOMPOSITION

Jennifer L. Rosa, Notre Dame School, Caguas, Puerto Rico.

Research Mentor: Jonathan Vargas, Universidad del Turabo, Gurabo, Puerto Rico.

Singular value decomposition (SVD) is a fundamental concept in linear algebra. Some uses of the singular value decomposition can be found in image processing, pattern recognition, noise reduction, robotics, information retrieval and latent semantic indexing. The SVD can be used in compression and manipulation of digital images. The purpose of this project was to create a routine script in MATLAB that could compress an image and produce a new image that requires less memory storage capacity, as well as apply other effects to the picture.

ALGORITHM PLANNING FOR PROGRAMMING OF ROBOTS

Carlos Saladini, Notre Dame School, Caguas, Puerto Rico.
Yaichael Rodríguez and Alejandro Rivera, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Joehan Carrasquillo, School of Engineering, Universidad del Turabo, Gurabo, Puerto Rico.

In every scientific problem there is a question: How things happen and why do they happen are influential in understanding and forming this question? In the world of robotics the problem-solving technique that is meant to lead to a behavior, the step-by-step instruction so that the robot can find a solution to a problem or to perform a task, is always begun with a question. In this project the research for tools and ways of thinking are essential in order to be able to solve the problems at hand and find answers to the questions which come with the problem. There can be many paths that lead to the same answer and the path that is chosen can influence the success of a small problem but it can also mean the failure of the bigger problem. This is why one must choose wisely; not always the most efficient way, but the most convenient path in order to gain the success being looked for.

CRONIX POTABLE WEB BROWSER

Elvin Torres, Bautista de Caguas School, Caguas, Puerto Rico.

Research Mentor: Jonathhan Vargas, Universidad del Turabo, Gurabo, Puerto Rico.

A web browser is software applications to receive and present information from the World Wide Web (WWW) used for many computers owners on the world. Sometimes problems arise on the systems like default browser crashes, or missing files, or the browser stops working due to virus or malware activity. While there exist many portable web browsers, they can take a long time to install on a flash drive, and also a long time to execute. The objective of the research was to design a web browser that is fast, simple and has minimum storage requirement on the disk drive, codename Cronix. If any of these problems occur, Cronix can be run from a flash drive or another external storage drive, occupying less disk space and running faster than other portable browsers.
ACKNOWLEDGMENTS

Faculty research mentoring is the main driving force behind the scientific products (posters and oral presentations) presented in this symposium. Our greatest appreciation and gratitude to all the mentors who took part in the Winter 2010 Pre-College Research Symposium by working and training the next generation of scientists whose efforts are presented in this booklet, as well as to the many other faculty members who support the Student Research Development Center and its goals and objectives. Our most sincere thanks are also extended to the following individuals who helped to make this Winter 2010 Pre-College Research Symposium possible.

Keynote Speaker:

Dr. Bryan Ballif  
University of Vermont

Workshop Speaker:

Dr. Luis de la Torre  
Universidad Metropolitana

Dr. Ángel E. González-Lizardo  
Polytechnic University

Judges and Session Chairmen:

Ms. Widad Abdalla, UPR-Cayey  
Mr. Luis A. Alemán, Inter-American University-Metro  
Mr. Rafael Aparicio, UPR-Río Piedras  
Ms. Keila E. Arroyo, Inter-American University-Metro  
Ms. Sara Ávila, Polytechnic University  
Mr. Gaddiel Ayala, UMET  
Ms. Viviana Beltrán, UPR-Río Piedras  
Ms. Jeselyn Calderón, UMET  
Mr. Jorge R. Castro, UT  
Ms. Luz Milbeth Cumba, UMET  
Ms. Alexandra De La Rosa, Universidad Central del Caribe  
Mr. Moisés Delgado, UPR-Río Piedras  
Mr. Rubén Díaz, UMET  
Mr. Roy González, Inter-American University-San Germán  
Mr. Luis Á. Lebrón, UNE  
Mr. Julio C. León, UT  
Mr. Junxian Ma Cao, UPR-H  
Ms. Ilyana Y. Martinez, UT  
Ms. Judyann Meléndez, UPR  
Mr. Antonio L. Mojica – UPR-H  
Mr. Richard Morales, Inter-American University-San Germán
Ms. Kaisa Muller, UMET
Ms. Yiria E. Muñiz, José Aponte de la Torre School
Mr. Jhonny E. Navarro, UPR-Río Piedras
Dr. Santander Nieto, UT
Mr. Raymond Nieves, UT
Mr. Luis M. Ortiz, UMET
Mr. Max Pagán, UMET
Mr. Manuel Pérez, UMET
Mr. Gabriel Porrata, UPR-Cayey
Ms. Alba M. Restrepo, UT
Ms. Karoline Ríos, UMET
Mr. Carlos Rivera, UMET
Ms. Lorangelly Rivera, UMET
Ms. Raquel Rivera, UT
Ms. Vanessa Rivera, UPR-Río Piedras
Mr. Amir Rodriguez, Inter-American University
Ms. Weyshla Rodríguez, UMET
Mr. Yadiell Sanabria, Inter-American University-San Germán
Mr. Abner Santana, UPR-H
Ms. Kamil M. Suliveres, UNE
Dr. José Torres González, UNE
Dr. José Valles, Inter-American University-Metro
Mr. Emanuel Vázquez, UNE
Ms. Leisa Vélez, UPR-Aguadilla
Dr. Luis M. Vicente – Polytechnic University
Mr. Eduardo E. Villalba, UMET

Research Mentors:

Prof. Irma Álvarez, Inter-American University-Metro
Prof. Ivonne Avilés, Inter-American University-San Germán
Dr. Juan F. Arratia, Ana G. Méndez University System
Dr. César Banderas, New Jersey Institute of Technology
Prof. Alex Camacho, University of Puerto Rico-Humacao
Dr. Ángel Caraballo, Inter-American University-Metro
Dr. Carlos Castillo-Chávez, Arizona State University
Eng. Franklin Colmenares, Polytechnic University
Prof. Edwin Florez, University of Puerto Rico-Humacao
Dr. Sudhir Kumar, Arizona State University
Prof. Isis Laham, Universidad del Este
Prof. Guillermo Mejía, Inter-American University-San Germán
Dr. Marlio Paredes, Universidad del Turabo
Eng. Joaquín Rivera, Polytechnic University
Prof. Lorna Salamán, Universidad del Este
Prof. Pieter van der Meer, University of Puerto Rico-Mayaguez
**Student Research Mentors:**

Joehan Carrasquillo, Universidad del Turabo  
Raquel Castañeda, Universidad Metropolitana  
Grace Delgado, Universidad del Turabo  
Carol Díaz, Universidad del Este  
Jesse Jiménez, Universidad Metropolitana  
Eduan Martínez, Universidad Metropolitana  
Schatzi Miranda, Universidad del Turabo  
Jonathan Otero, Universidad Metropolitana  
Joel Rivera, Universidad Metropolitana  
Armenys Robles, Universidad del Turabo  
Dorielys Valentín, Universidad Metropolitana  
Jonathan Vargas, Universidad del Turabo

**Student Assistants:**

Katherine Calderón, University of Puerto Rico, Humacao  
Ubec Carambot, University of Puerto Rico-Mayaguez  
Dinorah Carrión, Universidad Metropolitana  
Glorimar Castro, University of Puerto Rico, Humacao  
Maxine González, Universidad Metropolitana  
Giancarlo Mendoza, Universidad del Este  
Karlo Meléndez, Universidad Metropolitana  
Alvin Peralta, University of Puerto Rico-Mayaguez  
Natalia Santiago, Universidad Metropolitana  
Edgardo Vázquez, Universidad del Este

**Symposium Staff:**

Dr. Ángel Arcelay, CCCE, Co-PI  
Dr. Gladys Bonilla, Professor and SRDC Consultant  
Dr. Marlío Paredes, CCCE, Co-PI  
Ms. Thelma Graniela, SRDC  
Ms. Zulma Irizarry, SRDC  
Ms. Ivette Miranda, SRDC

**Symposium Coordinators:**

Dr. Juan F. Arratia, Executive Director, Student Research Development Center  
Mrs. Wanda Rodríguez, Coordinator AGMUS Institute of Mathematics  
Mr. Luis F. Font, Coordinator Caribbean Computing Center for Excellence
<table>
<thead>
<tr>
<th>NAME</th>
<th>SCHOOL</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabiola Agramonte</td>
<td>María Reina Academy, San Juan, Puerto Rico</td>
<td>17, 49</td>
</tr>
<tr>
<td>Alfredo Aldebol</td>
<td>Inter-American School, San Germán, Puerto Rico</td>
<td>30, 49</td>
</tr>
<tr>
<td>Abner Alemán</td>
<td>Calasanz School, San Juan, Puerto Rico</td>
<td>15, 34</td>
</tr>
<tr>
<td>Leila Alicea</td>
<td>St. Mary’s School, Carolina, Puerto Rico</td>
<td>30, 56</td>
</tr>
<tr>
<td>Edrick Alvarado</td>
<td>CROEM School, Mayaguez, Puerto Rico</td>
<td>29, 83</td>
</tr>
<tr>
<td>Edwin J. Alvarado</td>
<td>Caguas, Military Academy, Caguas, Puerto Rico</td>
<td>25, 83</td>
</tr>
<tr>
<td>Angel Andino</td>
<td>Santa Gema School, Carolina, Puerto Rico</td>
<td>22, 70</td>
</tr>
<tr>
<td>Héctor Aponte</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>30, 49</td>
</tr>
<tr>
<td>Amarilis Araya</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>18, 50</td>
</tr>
<tr>
<td>Fernando Araya</td>
<td>José Aponte de La Torre School, Carolina, Puerto Rico</td>
<td>18, 50</td>
</tr>
<tr>
<td>Marcus I. Arroyo</td>
<td>Josefina Barceló School, Guaynabo, Puerto Rico</td>
<td>24, 79</td>
</tr>
<tr>
<td>Marcos J. Ayala</td>
<td>University Gardens School, San Juan, Puerto Rico</td>
<td>28, 34</td>
</tr>
<tr>
<td>Noemi Aybar</td>
<td>Secundaria Universidad de Puerto Rico School, San Juan, Puerto Rico</td>
<td>15, 35</td>
</tr>
<tr>
<td>Laura A. Belmar</td>
<td>University High School, San Juan, Puerto Rico</td>
<td>28, 35</td>
</tr>
<tr>
<td>Eric Benítez</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>15, 36</td>
</tr>
<tr>
<td>Marimar Benítez</td>
<td>University Gardens School, San Juan, Puerto Rico</td>
<td>16, 36</td>
</tr>
<tr>
<td>Jean Carlos Bernal</td>
<td>San Juan Apóstol y Evangelista School, Caguas, Puerto Rico</td>
<td>25, 84</td>
</tr>
<tr>
<td>Yarib Berrios</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>25, 84</td>
</tr>
<tr>
<td>Loammi M. Birriel</td>
<td>Angel P. Millán Rohena School, Carolina, Puerto Rico</td>
<td>23, 71</td>
</tr>
<tr>
<td>Ricardo Borrallí</td>
<td>Miguel Such Vocational School, San Juan, Puerto Rico</td>
<td>26, 87</td>
</tr>
<tr>
<td>Melissa Calderón</td>
<td>Inter-American School, San Germán, Puerto Rico.</td>
<td>18, 50</td>
</tr>
<tr>
<td>Diego Camacho</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>18, 51</td>
</tr>
<tr>
<td>Aldrin M. Cañals</td>
<td>Calasanz School, Carolina, Puerto Rico</td>
<td>23, 71</td>
</tr>
<tr>
<td>Rafael Cañals</td>
<td>Calasanz School, Carolina, Puerto Rico</td>
<td>32, 72</td>
</tr>
<tr>
<td>Néstor Carrasco</td>
<td>Petra Mercado Bougart School, Humacao, Puerto Rico</td>
<td>30, 51</td>
</tr>
<tr>
<td>Odemaris Carrasquillo</td>
<td>José E. Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>18, 52</td>
</tr>
<tr>
<td>Sofía Carrasquillo</td>
<td>Secundaria Universidad de Puerto Rico School, San Juan, Puerto Rico</td>
<td>28, 37</td>
</tr>
<tr>
<td>Yanira Castelló</td>
<td>Universidad del Este, Carolina, Puerto Rico</td>
<td>23, 72</td>
</tr>
<tr>
<td>Cristian Claros</td>
<td>San Jorge Academy, San Juan, Puerto Rico</td>
<td>18, 52</td>
</tr>
<tr>
<td>Ricardo Collazo</td>
<td>St. Mary’s School, Carolina, Puerto Rico</td>
<td>18, 53</td>
</tr>
<tr>
<td>Lorianie Colóm</td>
<td>San Juan Apóstol y Evangelista School, Caguas, Puerto Rico</td>
<td>23, 73</td>
</tr>
<tr>
<td>Nicole M. Colón</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>23, 73</td>
</tr>
<tr>
<td>Salimar Cordero</td>
<td>Secundaria Universidad de Puerto Rico, San Juan, Puerto Rico</td>
<td>16, 37</td>
</tr>
<tr>
<td>Edwin Cruz</td>
<td>St. Mary’s School, Carolina, Puerto Rico</td>
<td>18, 53</td>
</tr>
<tr>
<td>Hazel Cruz</td>
<td>St. Mary’s School, Carolina, Puerto Rico</td>
<td>19, 54</td>
</tr>
<tr>
<td>Jario A. Cruz</td>
<td>Discípulos de Cristo Academy, Bayamón, Puerto Rico.</td>
<td>18, 53</td>
</tr>
<tr>
<td>Tiffany Cruz</td>
<td>Inter-American School, San Germán, Puerto Rico.</td>
<td>18, 50</td>
</tr>
<tr>
<td>Yamileika Cruz</td>
<td>Isabel Flores School, Humacao, Puerto Rico.</td>
<td>30, 53</td>
</tr>
<tr>
<td>Lina Daza</td>
<td>Inter-American School, San Germán, Puerto Rico.</td>
<td>18, 54</td>
</tr>
<tr>
<td>Ester M. De Jesús</td>
<td>Dra. Wilma Chávez Avance 2000, Toa Alta, Puerto Rico</td>
<td>31, 63</td>
</tr>
<tr>
<td>Andrea M. Devaris</td>
<td>Inter-American School, San Germán, Puerto Rico.</td>
<td>22, 66</td>
</tr>
<tr>
<td>Daniela Díaz</td>
<td>María Reina Academy, San Juan, Puerto Rico.</td>
<td>25, 84</td>
</tr>
<tr>
<td>NAME</td>
<td>SCHOOL</td>
<td>PAGES</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Steven Díaz</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>25, 84</td>
</tr>
<tr>
<td>Kevin Estrada</td>
<td>Barbara Ann Roessler Academy, San Juan, Puerto Rico</td>
<td>30, 54</td>
</tr>
<tr>
<td>Carlos Feliciano</td>
<td>St. Mary’s School, San Juan, Puerto Rico</td>
<td>19, 54</td>
</tr>
<tr>
<td>William Ferrer</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>25, 85</td>
</tr>
<tr>
<td>Alfonso Figueroa</td>
<td>Inter-American School, San Germán, Puerto Rico</td>
<td>32, 73</td>
</tr>
<tr>
<td>Raysmarie Figueroa</td>
<td>Gilberto Concepción de Gracia School, San Juan, Puerto Rico</td>
<td>20, 61</td>
</tr>
<tr>
<td>Xavier Figueroa</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>26, 86</td>
</tr>
<tr>
<td>Yaritza Flecha</td>
<td>Petra Mercado Bougart School, Humacao, Puerto Rico</td>
<td>30, 55</td>
</tr>
<tr>
<td>Grace M. Fontánez</td>
<td>Petra Mercado de Bougart School</td>
<td>23, 73</td>
</tr>
<tr>
<td>Michael Fontánez</td>
<td>Manuela Toro Morice School, Caguas, Puerto Rico</td>
<td>26, 88</td>
</tr>
<tr>
<td>Irisbelle García</td>
<td>Caguas, Military Academy, Caguas, Puerto Rico</td>
<td>25, 83</td>
</tr>
<tr>
<td>Joan García</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>26, 85</td>
</tr>
<tr>
<td>José G. García</td>
<td>José E. Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>19, 55</td>
</tr>
<tr>
<td>Karina García</td>
<td>Petra Mercado Bougart School, Humacao, Puerto Rico</td>
<td>30, 55</td>
</tr>
<tr>
<td>Natasha D. García</td>
<td>Dr. Juan José Osuna School, San Juan, Puerto Rico</td>
<td>23, 74</td>
</tr>
<tr>
<td>Rubén García</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>26, 86</td>
</tr>
<tr>
<td>Alberto Gómez</td>
<td>Carvin School, Inc, Carolina, Puerto Rico</td>
<td>30, 55</td>
</tr>
<tr>
<td>Joffre Gómez</td>
<td>Inter-American School, San Germán, Puerto Rico</td>
<td>20, 60</td>
</tr>
<tr>
<td>Brianna González</td>
<td>San Antonio Abad School, Humacao, Puerto Rico</td>
<td>16, 38</td>
</tr>
<tr>
<td>Christian González</td>
<td>Gabriela Mistral High School, San Juan, Puerto Rico</td>
<td>22, 66</td>
</tr>
<tr>
<td>Jenipher González</td>
<td>Bautista de Caguas School, Caguas, Puerto Rico</td>
<td>18, 51</td>
</tr>
<tr>
<td>José González</td>
<td>José E. Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>23, 74</td>
</tr>
<tr>
<td>Juan M. González</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>23, 75</td>
</tr>
<tr>
<td>Pablo González</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>28, 38</td>
</tr>
<tr>
<td>Jean Guma</td>
<td>San Ignacio School, San Juan, Puerto Rico</td>
<td>18, 52</td>
</tr>
<tr>
<td>Irene Hammel</td>
<td>María Reina Academy, Carolina, Puerto Rico</td>
<td>24, 75</td>
</tr>
<tr>
<td>Sergio L. Hernández</td>
<td>Bautista de Levittown School, Toa Baja, Puerto Rico</td>
<td>19, 55</td>
</tr>
<tr>
<td>Yoilina Hernández</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>21, 65</td>
</tr>
<tr>
<td>Gilbert Jiménez</td>
<td>CROEM School, Mayaguez, Puerto Rico</td>
<td>16, 39</td>
</tr>
<tr>
<td>Adrianna Lebrón</td>
<td>St. Marys’s School, Carolina, Puerto Rico</td>
<td>30, 56</td>
</tr>
<tr>
<td>Viviana Lebrón</td>
<td>Calasanz School, Carolina, Puerto Rico</td>
<td>32, 76</td>
</tr>
<tr>
<td>Nilka M. Linares</td>
<td>Inter-American School, San Germán, Puerto Rico</td>
<td>21, 63</td>
</tr>
<tr>
<td>Ana N. Longo</td>
<td>María Reina Academy, San Juan, Puerto Rico</td>
<td>19, 56</td>
</tr>
<tr>
<td>Glory López</td>
<td>Bautista de Carolina Academy, Carolina, Puerto Rico</td>
<td>16, 39</td>
</tr>
<tr>
<td>Linnette López</td>
<td>Isabel Flores School</td>
<td>19, 56</td>
</tr>
<tr>
<td>Miridaliz Lorenzo</td>
<td>SESO School, Mayaguez, Puerto Rico</td>
<td>19, 57</td>
</tr>
<tr>
<td>Carlos Malavé</td>
<td>SESO School, Mayaguez, Puerto Rico</td>
<td>31, 57</td>
</tr>
<tr>
<td>Ginexis Marrero</td>
<td>Homeschool, Bayamón, Puerto Rico</td>
<td>19, 58</td>
</tr>
<tr>
<td>Gustavo Marrero</td>
<td>St. Mary’s School, Carolina, Puerto Rico</td>
<td>20, 61</td>
</tr>
<tr>
<td>Rafael Martinez</td>
<td>Antonio Fernos Isern Vocational High School, Juncos, Puerto Rico</td>
<td>24, 76</td>
</tr>
<tr>
<td>Vivianna Mas</td>
<td>Calasanz School, San Juan, Puerto Rico</td>
<td>16, 40</td>
</tr>
<tr>
<td>Sarah Matos</td>
<td>Barbara Ann Roessler Academy, San Juan, Puerto Rico</td>
<td>24, 77</td>
</tr>
<tr>
<td>Elizabeth Maysonet</td>
<td>María Reina Academy, Carolina, Puerto Rico</td>
<td>26, 86</td>
</tr>
<tr>
<td>Mario Medina</td>
<td>Miguel Such Vocational School, San Juan, Puerto Rico</td>
<td>26, 87</td>
</tr>
<tr>
<td>Adriana M. Mejía</td>
<td>Episcopal Cathedral School, San Juan, Puerto Rico</td>
<td>28, 40</td>
</tr>
<tr>
<td>Valerie Mejía</td>
<td>Calasanz School, San Juan, Puerto Rico</td>
<td>16, 41</td>
</tr>
<tr>
<td>Elvin A. Méndez</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>32, 77</td>
</tr>
<tr>
<td>Marimar Méndez</td>
<td>Calasanz School, San Juan, Puerto Rico</td>
<td>23, 71</td>
</tr>
<tr>
<td>NAME</td>
<td>SCHOOL</td>
<td>PAGES</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Kimberley Millán</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>19, 58</td>
</tr>
<tr>
<td>José Mora</td>
<td>San Ignacio School, Guaynabo, Puerto Rico</td>
<td>29, 87</td>
</tr>
<tr>
<td>Adriana Morales</td>
<td>Adriana M. Morales, Espíritu Santo School, San Juan, Puerto Rico</td>
<td>19, 58</td>
</tr>
<tr>
<td>Cristina Morales</td>
<td>Libre de Música Ernesto Ramos Antonini, San Juan, Puerto Rico</td>
<td>20, 59</td>
</tr>
<tr>
<td>Edwin Mulero</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>26, 88</td>
</tr>
<tr>
<td>Astro Muñoz</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>28, 41</td>
</tr>
<tr>
<td>Valeria Muñoz</td>
<td>Puertorriqueño de Niñas School, San Juan, Puerto Rico</td>
<td>16, 42</td>
</tr>
<tr>
<td>Davette Nazario</td>
<td>Homeschool, Carolina, Puerto Rico</td>
<td>20, 59</td>
</tr>
<tr>
<td>Edwin Negrón</td>
<td>Barbara Ann Roessler Academy, San Juan, Puerto Rico</td>
<td>20, 59</td>
</tr>
<tr>
<td>Frances Negrón</td>
<td>Levittown Baptist Academy, Toa Baja, Puerto Rico</td>
<td>16, 43</td>
</tr>
<tr>
<td>Edwin Jr. Núñez</td>
<td>Manuela Toro Mourice School, Caguas, Puerto Rico</td>
<td>26, 88</td>
</tr>
<tr>
<td>Pedro Orona</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>26, 85</td>
</tr>
<tr>
<td>Alexander Ortiz</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>26, 88</td>
</tr>
<tr>
<td>Jariel Ortiz</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>20, 60</td>
</tr>
<tr>
<td>Diana M. Pabón</td>
<td>University of Puerto Rico Secondary School, San Juan, Puerto Rico</td>
<td>17, 43</td>
</tr>
<tr>
<td>Gabriel Pagán</td>
<td>Inter-American School, San Germán, Puerto Rico</td>
<td>20, 60</td>
</tr>
<tr>
<td>Vanessa Pagán</td>
<td>SESO School, Mayaguez, Puerto Rico</td>
<td>20, 60</td>
</tr>
<tr>
<td>Jennifer Patritti</td>
<td>Manuela Toro Morice, Caguas, Puerto Rico</td>
<td>32, 81</td>
</tr>
<tr>
<td>Yuliam Pedraza</td>
<td>San Juan Apóstol y Evangelista School, Caguas, Puerto Rico</td>
<td>23, 73</td>
</tr>
<tr>
<td>Ignacio Pérez</td>
<td>St. Mary’s School, Carolina, Puerto Rico</td>
<td>20, 61</td>
</tr>
<tr>
<td>Juan C. Pérez</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>24, 78</td>
</tr>
<tr>
<td>Lorena Pérez</td>
<td>María Reina Academy, Carolina, Puerto Rico</td>
<td>24, 78</td>
</tr>
<tr>
<td>Robert Pérez</td>
<td>CROEM School, Mayaguez, Puerto Rico</td>
<td>20, 61</td>
</tr>
<tr>
<td>Valerie Pérez</td>
<td>Castillo Fuerte Academy, Carolina, Puerto Rico</td>
<td>24, 78</td>
</tr>
<tr>
<td>Mayra A. Quiles</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>23, 75</td>
</tr>
<tr>
<td>Alejandro Ramos</td>
<td>American Military Academy, Guaynabo, Puerto Rico</td>
<td>20, 61</td>
</tr>
<tr>
<td>Jonathan G. Ramos</td>
<td>Nuestra Señora de Altagracia, San Juan, Puerto Rico</td>
<td>21, 62</td>
</tr>
<tr>
<td>Laura Reguero</td>
<td>María Reina Academy, Carolina, Puerto Rico</td>
<td>21, 62</td>
</tr>
<tr>
<td>Gabriel Reilly</td>
<td>Espíritu Santo School, San Juan, Puerto Rico</td>
<td>29, 89</td>
</tr>
<tr>
<td>Stephan E. Remy</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>21, 62</td>
</tr>
<tr>
<td>Alexander Reyes</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>21, 62</td>
</tr>
<tr>
<td>Tiffany Reyes</td>
<td>Castillo Fuerte School, San Juan, Puerto Rico</td>
<td>24, 79</td>
</tr>
<tr>
<td>Jennifer M. Reyna</td>
<td>Petra Mercado School, Humacao, Puerto Rico</td>
<td>24, 76</td>
</tr>
<tr>
<td>Alejandro Rivera</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>27, 90</td>
</tr>
<tr>
<td>Christian Rivera</td>
<td>Levittown Baptist Academy, Toa Baja, Puerto Rico</td>
<td>31, 63</td>
</tr>
<tr>
<td>Juan R. Rivera</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>28, 44</td>
</tr>
<tr>
<td>Karen M. Rivera</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>26, 89</td>
</tr>
<tr>
<td>Sebastián Rivera</td>
<td>Inter-American School, San Germán, Puerto Rico</td>
<td>21, 63</td>
</tr>
<tr>
<td>Thalia Rivera</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>17, 44</td>
</tr>
<tr>
<td>Gilberto Robles</td>
<td>Bautista de Levittown School, Toa Baja, Puerto Rico</td>
<td>31, 63</td>
</tr>
<tr>
<td>Luis F. Rodríguez</td>
<td>Dra. Wilma Chávez, Avance 2000 School</td>
<td>31, 64</td>
</tr>
<tr>
<td>Othoniel Rodriguez</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico</td>
<td>19, 58</td>
</tr>
<tr>
<td>Ricardo Rodriguez</td>
<td>San Jorge Academy, San Juan, Puerto Rico</td>
<td>29, 87</td>
</tr>
<tr>
<td>Yaichael Rodriguez</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>27, 90</td>
</tr>
<tr>
<td>Luis D. Rojas</td>
<td>Wilma Chávez Avance 2000 School, Toa Alta, Puerto Rico</td>
<td>24, 79</td>
</tr>
<tr>
<td>Laura Roldán</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>21, 64</td>
</tr>
<tr>
<td>NAME</td>
<td>SCHOOL</td>
<td>PAGES</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>María E. Roldán</td>
<td>Nail-Painting Robot</td>
<td>26, 89</td>
</tr>
<tr>
<td>Gabriel Román</td>
<td>St. Mary’s School, San Juan, Puerto Rico</td>
<td>21, 65</td>
</tr>
<tr>
<td>Sharelys Román</td>
<td>Avance 2000 School, San Juan, Puerto Rico.</td>
<td>17, 45</td>
</tr>
<tr>
<td>Andros Rosa</td>
<td>San Ignacio School, San Juan, Puerto Rico</td>
<td>21, 65</td>
</tr>
<tr>
<td>Jennifer L. Rosa</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>26, 90</td>
</tr>
<tr>
<td>Nicolle Rosa</td>
<td>Levittown Baptist Academy, Toa Baja, Puerto Rico</td>
<td>28, 46</td>
</tr>
<tr>
<td>Rebecca E. Rosado</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>24, 80</td>
</tr>
<tr>
<td>Yanitzia Dainly</td>
<td>Angel P. Millán School, Carolina, Puerto Rico</td>
<td>25, 80</td>
</tr>
<tr>
<td>Carlos Saladini</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>27, 90</td>
</tr>
<tr>
<td>Alex Sánchez</td>
<td>Bárbara Ann Roessler Academy, San Juan, Puerto Rico</td>
<td>31, 65</td>
</tr>
<tr>
<td>Axel A. Sánchez</td>
<td>Barbara Ann Roessler Academy, San Juan, Puerto Rico</td>
<td>22, 66</td>
</tr>
<tr>
<td>Fernando Sánchez</td>
<td>Petra Mercado Bougart School, Humacao, Puerto Rico</td>
<td>22, 66</td>
</tr>
<tr>
<td>Juan P. Sánchez</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>26, 88</td>
</tr>
<tr>
<td>Diego Santana</td>
<td>Caguas, Military Academy, Caguas, Puerto Rico</td>
<td>25, 83</td>
</tr>
<tr>
<td>Albert Santiago</td>
<td>María Teresa Piñeiro School, San Juan, Puerto Rico</td>
<td>20, 59</td>
</tr>
<tr>
<td>Joseph Santiago</td>
<td>Petra Mercado Bougart School, Mayaguez, Puerto Rico</td>
<td>31, 66</td>
</tr>
<tr>
<td>Netsha J. Santiago</td>
<td>Caguas Private School, Caguas, Puerto Rico</td>
<td>17, 47</td>
</tr>
<tr>
<td>Sebastián Santiago</td>
<td>Notre Dame School, Caguas, Puerto Rico</td>
<td>28, 41</td>
</tr>
<tr>
<td>Giancarlo Santini</td>
<td>St. Mary’s School, San Juan, Puerto Rico</td>
<td>21, 65</td>
</tr>
<tr>
<td>Daniel Solis</td>
<td>Commonwealth Parkville School</td>
<td>25, 81</td>
</tr>
<tr>
<td>Rosangelie Soto</td>
<td>Inter-American School, Inter-American School, San Germán, Puerto Rico</td>
<td>22, 66</td>
</tr>
<tr>
<td>Rafael Suárez</td>
<td>Josefina Barceló School, San Juan, Puerto Rico</td>
<td>22, 67</td>
</tr>
<tr>
<td>Marco A. Sueiro</td>
<td>Dra. Wilma Chávez, Avance 2000 School</td>
<td>22, 67</td>
</tr>
<tr>
<td>Alejandro Torres</td>
<td>Calasanz School, Carolina, Puerto Rico</td>
<td>17, 47</td>
</tr>
<tr>
<td>Elizabeth Torres</td>
<td>San Antonio Abad School, Humacao, Puerto Rico</td>
<td>16, 38</td>
</tr>
<tr>
<td>Elvin Torres</td>
<td>Bautista de Caguas School, Caguas, Puerto Rico</td>
<td>27, 90</td>
</tr>
<tr>
<td>Orlando Torres</td>
<td>Espíritu Santo School, San Juan, Puerto Rico</td>
<td>27, 89</td>
</tr>
<tr>
<td>Orlando R. Torres</td>
<td>San Francis School, Carolina, Puerto Rico</td>
<td>22, 67</td>
</tr>
<tr>
<td>Stephanie Torres</td>
<td>José Aponte de la Torre School, Carolina, Puerto Rico</td>
<td>25, 81</td>
</tr>
<tr>
<td>Gladysnel Trinidad</td>
<td>Avance 2000 School, Bayamón, Puerto Rico</td>
<td>17, 48</td>
</tr>
<tr>
<td>Julio Valdés</td>
<td>SESO School, Mayaguez, Puerto Rico</td>
<td>31, 68</td>
</tr>
<tr>
<td>Kevin Vargas</td>
<td>CROEM School, Mayaguez, Puerto Rico</td>
<td>29, 83</td>
</tr>
<tr>
<td>Melinda Vargas</td>
<td>San Antonio Abad School, Caguas, Puerto Rico</td>
<td>32, 81</td>
</tr>
<tr>
<td>Yimari Vargas</td>
<td>San Antonio Abad School, Caguas, Puerto Rico</td>
<td>17, 48</td>
</tr>
<tr>
<td>Raül Vázquez</td>
<td>Commonwealth High School, Guaynabo, Puerto Rico</td>
<td>25, 84</td>
</tr>
<tr>
<td>Kimberly Velázquez</td>
<td>Caguas Military Academy, Caguas, Puerto Rico</td>
<td>26, 89</td>
</tr>
<tr>
<td>Natalie C. Velázquez</td>
<td>Inter-American School, San Germán, Puerto Rico</td>
<td>22, 68</td>
</tr>
<tr>
<td>Alejandro Vélez</td>
<td>Southwestern Educational Society</td>
<td>22, 69</td>
</tr>
<tr>
<td>Nicole Vélez</td>
<td>Espíritu Santo School, San Juan, Puerto Rico</td>
<td>31, 69</td>
</tr>
<tr>
<td>Virginia Vélez</td>
<td>Castillo Fuerte School, Carolina, Puerto Rico</td>
<td>32, 82</td>
</tr>
<tr>
<td>Julio Viera</td>
<td>Dr. Juan José Osuna School, San Juan, Puerto Rico</td>
<td>22, 70</td>
</tr>
<tr>
<td>Jussan J. Villegas</td>
<td>Josefina Barceló School, San Juan, Puerto Rico</td>
<td>23, 70</td>
</tr>
<tr>
<td>Ilka V. Walker</td>
<td>SESO School, Mayaguez, Puerto Rico</td>
<td>19, 57</td>
</tr>
</tbody>
</table>
We gratefully acknowledge the support and sponsorship of the Winter 2010 Pre-College Research Symposium from:

National Science Foundation (NSF)
National Aeronautic Space Administration (NASA)
Ana G. Méndez University System
Caribbean Computing Center for Excellence
AGMUS Institute of Mathematics
Puerto Rico Space Grant Consortium