THE ANA G. MÉNDEZ UNIVERSITY SYSTEM (AGMUS) AND THE STUDENT RESEARCH DEVELOPMENT CENTER (SRDC) AGMUS INSTITUTE OF MATHEMATICS CARIBBEAN COMPUTING CENTER FOR EXCELLENCE ARE PROUD TO HOST THE

SPRING 2011 PRE-COLLEGE RESEARCH SYMPOSIUM

SHOWCASING MINORITY HIGH SCHOOL STUDENTS’ MENTORED RESEARCH

Leadership at SUAGM Vice Presidency for Planning and Academic Affairs

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

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

CARIBE HILTON HOTEL

SAN JUAN, PUERTO RICO

May 14, 2011
# TABLE OF CONTENTS

Table of Contents.................................................................................. 2

Ana G. Méndez University System (AGMUS) Profile ......................... 3

Conference at a Glance ...................................................................... 4

Message from the Vice President for Planning and Academic Affairs
   Dr. Jorge Crespo............................................................................. 5

Message from the Chancellor of Universidad Metropolitana
   Dr. Federico Matheu ....................................................................... 6

Message from the Chancellor of Universidad del Turabo
   Dr. Dennis Alicea........................................................................... 7

Message from the Chancellor of Universidad del Este
   Alberto Maldonado, Esq................................................................. 8

Message from the Director and Principal Investigator
   Dr. Juan F. Arratia ......................................................................... 9

Prologue ............................................................................................. 10

Keynote Speakers ............................................................................. 11

Workshop Speakers ......................................................................... 13

Research Mentors ........................................................................... 14

AGMUS Institute of Mathematics................................................... 20

Caribbean Computing Center for Excellence (CCCE) Alliance.......... 21

Workshop “Exploring Computing Science”...................................... 22

Workshop “Dynamic System and Modeling Using VENSIM”........... 23

Schedule of Events ......................................................................... 24

Abstracts:

   Biological Sciences................................................................. 43
   Chemistry ................................................................................. 69
   Computer Sciences............................................................... 72
   Applied Mathematics............................................................ 92
   Engineering ............................................................................ 101
   Environmental Sciences......................................................... 102

Acknowledgments .......................................................................... 103

Index of Presenters ......................................................................... 105
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 in the Caribbean for students to foster interest in undergraduate education, particularly in STEM fields, and set national research standards for pre-college research presentations.
SATURDAY, MAY 14, 2010

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<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tr>
<td>7:00 – 8:00 a.m.</td>
<td>Registration, Breakfast, Poster Session Set-Up</td>
<td>San Cristóbal Foyer, San Gerónimo Foyer, San Gerónimo A and C</td>
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<td>7:30 – 8:00 a.m.</td>
<td>Judges Meeting</td>
<td>San Cristóbal BCD</td>
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<tr>
<td>8:00 – 8:20 a.m.</td>
<td>Opening Ceremony, Keynote Speaker: Dr. Hilda Colón, Special Assistant to the AGMUS President</td>
<td>San Gerónimo B</td>
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<td>8:20 – 10:40 a.m.</td>
<td>Poster Session</td>
<td>San Gerónimo A and C</td>
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<td>10:40 – 10:50 a.m.</td>
<td>Coffee Break</td>
<td>San Cristóbal Foyer</td>
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<tr>
<td>10:30 – 11:00 a.m.</td>
<td>Public Exhibition of Poster Presentations</td>
<td>San Gerónimo A and C</td>
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<tr>
<td>11:00 – 1:00 p.m.</td>
<td>Oral Research Presentations, Session I, Session II, Session III, Session IV</td>
<td>San Cristóbal A, San Cristóbal EFG, San Gerónimo B, San Cristóbal BCD</td>
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<tr>
<td>1:00 – 2:00 p.m.</td>
<td>Lunch, Speaker: Dr. Thomas Windham, Past Senior Advisor to NSF Director</td>
<td>San Gerónimo B</td>
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WORKSHOPS FOR SCIENCE AND MATH TEACHERS

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<thead>
<tr>
<th>Time</th>
<th>Workshop: Dynamic System and Modeling Using Vensim Software, Dr. Luis de la Torre</th>
<th>Location</th>
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<tr>
<td>1:00 – 5:00 p.m.</td>
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<td>San Cristóbal A</td>
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<tr>
<td>1:00 – 5:00 p.m.</td>
<td>Workshop: Exploring Computing Science, Mr. David Bernier and Mr. John Landa</td>
<td>San Cristóbal EFG</td>
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2:00 – 3:00 p.m. | Award Ceremony and Closing Remarks

3:00 p.m. | Symposium Adjourns
May 14, 2011

Dear Symposium Participants:

The Ana G. Méndez University System (AGMUS) is proud to be part of the Spring 2011 Pre-College Research Symposium organized by the AGMUS Student Research Development Center, a leading organization implementing early scientific research activities in Puerto Rico.

The Saturday Academy Program at AGMUS focuses on strengthening the students’ skills in research principles and outcomes disseminated in oral and poster presentations in English. This conference is designed to motivate pre-college students to pursue careers in STEM fields. It is an excellent way of promoting the participation of young aspiring Hispanics into the Science, Technology, Engineering and Mathematics (STEM) fields.

We truly appreciate the support provided by the National Science Foundation, the student researchers and the mentors who guided the students at the different facilities and supported this novel enterprise to produce young pre-college researchers.

Congratulations to the participants for their scientific research projects.

Sincerely yours,

[Signature]

Jorge L. Crespo Arroyo, Ph. D.
Vice President for Planning and Academic Affairs
May 14, 2011

Dear students, teachers and parents:

Welcome to Universidad Metropolitana, a pioneer in helping pre-college students from Puerto Rico to search for opportunities and careers in the science, technology, engineering and mathematics (STEM) fields. We are an institution committed to disseminate and create knowledge for the benefit of our society.

Our congratulations to all of you who have participated in this Spring 2011 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,

Federico M. Matheu, Ph. D.
Chancellor
May 14, 2011

Dear participants,

On behalf of Universidad del Turabo, I congratulate all of you who have worked very hard during this academic semester on scientific projects. The research outcomes of your hard work will be the highlight of the Spring 2011 Pre-College Research Symposium held at the Caribe Hilton Hotel in San Juan, Puerto Rico, an event organized by the Student Research Development Center of the Ana G. Méndez University System (AGMUS).

I am very impressed and at the same time very pleased with the quality of the research projects presented by such a talented group of student researchers. It is both a privilege and an honor to have contributed to the development of scientific research skills in your development as young scientists. These experiences will pave the way for your future careers in the fields of science, technology, engineering and mathematics (STEM).

We have encouraged you in your work and thank all of those who have supported you to continue providing our youth with unique opportunities that foster research and knowledge. Universidad del Turabo looks forward to continuing its preparation of scientific minds for our future generations.

Congratulations to all the participants for your excellent research projects. We thank all of the faculty mentors for their commitment and contributions in the development of the future scientists and engineers of our nation.

Sincerely,

Dennis Alicea, Ph.D.
Chancellor
May 14, 2011

Dear students,

The Ana G. Méndez University System (AGMUS) and Universidad del Este (UNE) welcome you to the Spring 2011 Pre-College Research Symposium held at the Caribe Hilton Hotel in San Juan, Puerto Rico. AGMUS is proud to host this annual event organized by the Student Research Development Center.

The Spring 2011 Pre-College Research Symposium promotes the participation and supports the efforts of high school students who have dedicated many hours in the preparation of research projects in science. They have worked hard in the investigations and will share the outcomes of those experiences as a contribution that will inspire others and help improve knowledge in the scientific community.

We appreciate the support provided by the research mentors who guided the students at Universidad del Este facilities and set the foundation for the fruitful research experiences that our students completed. We feel proud of their accomplishments and know that we have provided a pathway to a future career in science.

Yours truly,

[Signature]

Alberto Maldonado-Ruiz, Esq.
Chancellor
May 14, 2011

Dear Pre-College Students:

The Spring 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 January 2011, all of you, more than one-hundred seventy-one pre-college students from sixty private and public high schools in Puerto Rico worked long hours in the research laboratories of the campuses of AGMUS, Polytechnic University, Inter-American University-San Germán and Metro, the University of Puerto Rico-Mayagüez-Humacao and Cayey, and the University of the Virgin Islands with the guidance and mentorship of twenty-two professors and student research mentors in one-hundred forty research projects in the areas of biological sciences, chemistry, applied mathematics, computer sciences, engineering and environmental sciences.

One of the objectives of the Spring 2011 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, research 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 Spring 2011 Saturday Academy Program and the Spring 2011 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 and student research mentors for their effort and commitment to implement the Spring 2011 Saturday Academy Program and the Spring 2011 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.
Executive Director and Principal Investigator
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.

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.

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 Spring 2011 showcases the research experiences of one-hundred seventy-one (173) 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 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 Saturday Academy Spring 2011 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.
Dr. Hilda Colón Plumey has experienced a long and varied professional career. In recent years she has served as special Assistant to the President of the Ana G. Mendez University System in the Development of Science. This role began after a 33 year career in the Higher Education Public Sector in Puerto Rico.

Dr. Colón Plumey went through all the academic ranks in the Department of Biology at the University of Puerto Rico, in Humacao (UPR-H), where she retired from in 2009. From 2002 to 2009 she was the Chancellor of the University of Puerto Rico in Humacao.

During her years as Chancellor, as well as before, UPRH attained local and national recognition for the emphasis and achievements in areas such as: external funds from US agencies, specialized program accreditation and recognition as a Model for Student Success by different agencies and bodies. Her accomplishments were recognized and published by the Institute for Higher Education Policy (IHEP) in Washington, DC.

As Chancellor of UPRH, Dr Colón Plumey was nominated four times for the work developed to bring the University as a Model Institution of Excellence by the Latin American Institutions of ODAEE (Organización de las Américas para la Excelencia Educativa) and for the award: SAPIENTIAE by Consejo Iberoamericano en Honor a la Calidad Educativa.

In her previous years as a faculty member and while also serving in a private university system in Puerto Rico, she always experienced the highest sense of pride in being a regular member of My Community both in the academic and external areas, and as a Biology Professor whose interest was advancing teaching and learning while conducting research in the areas of assessment and advisement in General Education.

During Dr. Colón Plumey’s period as UPRH Chancellor, the institution became #13 in securing external research funds among all HIS’s in the United States, even though it is an undergraduate institution. She considers this to be probably her greatest accomplishment in the Science and Research area.
Thomas L. Windham, Ph. D.

Thomas L. Windham, Ph.D was part of the National Science Foundation (NSF) as Senior Advisor for Science and Engineering Workforce and was the Foundation’s focal point in addressing issues, strategies, and programs centering on improving the participation of underrepresented groups in science and engineering. Windham served as a member of the Director’s immediate staff and participated in policy development, strategic planning, and building broad organizational consensus. His responsibilities included overseeing NSF’s efforts to broaden the participation of persons from America’s underrepresented groups in science, engineering, mathematics and technology. Before his tenure at NSF, Windham served as director and principal investigator of the Significant Opportunities in Atmospheric Research and Science (SOARS) program www.ucar.edu/soars. SOARS is a multifaceted, multi-ethnic, multi-cultural science research and undergraduate and graduate student learning community at the University Corporation for Atmospheric Research (UCAR) and National Center for Atmospheric Research (NCAR), Boulder, CO. In December 2001, Windham received The Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring in Washington, D.C. on behalf of the SOARS program. Windham was born in Harlem and is a graduate of New York City’s High School of Music and Art. He received his Ph.D. in social-personality psychology at the University of Colorado (CU) Boulder, under Professors Stuart Cook and John Forward. Additional professional training includes postdoctoral study in Clinical and Descriptive Psychology at the Linguistic Research Institute, Boulder, under Professor Peter Ossorio. Windham earned the Specialist in Education graduate degree from CU Denver, and MS and BA degrees in psychology from New Mexico Highlands University, Las Vegas.

Windham’s career track includes positions as a licensed clinical and organizational psychologist, mentor, educator, and CEO of a comprehensive community mental health center. Windham’s community service includes Distinguished Visitor for the American Psychological Association, President of the Boulder Valley School District Board of Education, and invited Science Education Columnist for The Boulder Daily Camera. Windham also served as a member of the CU Alliance for Graduate Education and the Professoriate (AGEP) Advisory Committee, the CU Graduate School Dean’s Advisory Committee, NSF’s Alan T. Waterman Award Committee, Committee on Equal Opportunities in Science and Engineering, and Geosciences Directorate Advisory Committee, and the I Have a Dream Board of Directors, Boulder, CO. Windham currently serves as a member of the American Meteorological Society Board on Women and Minorities. In 1997 Windham was awarded Boulder County’s Ninth Annual Multicultural Award for Science. January 2003 Windham received The Boulder Daily Camera Pacesetter Award for Science, Medicine and Health.
WORKSHOP SPEAKERS

David Bernier

David Bernier is the Program Manager for the Computer Science Project at the University of California, Los Angeles, in the Graduate School of Education and Information Studies. As the Program Manager, David works to facilitate and support several National Science Foundation grants related to broadening the participation of young women and underrepresented populations in computer science particularly the work with Exploring Computer Science — www.exploringcs.org.

David works directly with teachers, students, teacher-coaches, evaluators, and industry professionals to design, implement and evaluate project goals. Prior to this position David was a teacher, instructional coach, curriculum developer, consultant and provider of professional development for the Los Angeles Unified School District and several curriculum publishers — skills and experiences that he utilizes in this position.

John Landa

John Landa is currently a Computer Science Coach supporting other LAUSD teachers in their Exploring Computer Science classes. He has a BS in Electrical Engineering/Computer Science from UC Berkeley. John started his career as a software engineer and is a former dot-comer. Following that he became a teacher of math and computer science including Advanced Placement Computer Science. John also has experience teaching Exploring Computer Science at South East High, an inner city school in the Los Angeles Unified School District. John was a contributing writer to the Exploring Computer Science curriculum writing the Scratch unit.
RESEARCH MENTORS

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

Principal Investigator
AGMUS Institute of Mathematics
Caribbean Computing Center for Excellence
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. From 1998 to 2006, he was 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 has been 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.

Yvonne Avilés

Yvonne Avilés has a B.S and an M.S. both in Computer Engineering, both from the University of Puerto Rico in its Mayaguez Campus. In 2000 she started her career as a Software Engineer in the Research and Development Group for Lucent Technologies in North Andover, MA. Within Lucent she also worked in the hardware division as a Verification Engineer. Later, she felt the pull of the academic environment and she pursued a teaching career at Inter American University of Puerto Rico in San Germán as a Computer Science Professor. Ms. Avilés teaches computer programming, computer graphics, and discrete mathematics at the undergraduate level.
Dr. César Banderas studied his Bachelor’s and Master’s Degrees in Electrical Engineer at the University of Buffalo in New York and was certified in Executive Development at the Harvard School of Management in Boston, Massachusetts. He is the President of BanDeMar Networks, a minority owned small company specializing in advanced video solutions for e-learning markets. Dr. Banderas’ technical background is in active perception, which combines real-time computer vision and other sensor modalities with machine learning and behavioral control. He is interested in all aspects of active vision, including algorithms for signal processing and control, sensor VLSI, and multiprocessing architectures. His experience in active perception comes largely from his work in foveal vision, which exploits in the machine setting the multiacuity properties prevalent in vertebrate vision. Dr. Banderas has been active in the field of pervasive rich media, which endeavors to provide spatiotemporally coordinated multimodal streams to an audience with diverse demographics, player platforms and channel access (e.g., broadband-connected PCs, wireless PDAs, set-top boxes). In 1990, Dr. Banderas formed a research department at Amherst Systems dedicated to the development and application of active vision. This work yielded operational platforms with algorithms for video understanding and automaton behavior control, matching multiprocessor architectures, and smart VLSI imaging sensors (imagers with monolithic signal processing). He has had profit/loss responsibility, and was able to secure external funding for all R&D (over twenty customer grants and contracts) while exceeding growth and profit estimates. To date, this active vision research has yielded six Ph.Ds and four M.S. degrees, several patents, the 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 the Johnson Space Center. In 2001, he formed a research department at Manhattan-based Sorceron (now BanDeMar) dedicated to the synthesis and delivery of object-oriented rich media. As CTO, Dr. Banderas is member of the Association for Computing Machinery, Institute of Electrical and Electronics Engineers, and the International Society for Optical Engineering.

Alex J. Camacho Martinez
Alex J. Camacho Martinez has a B.A. in Applied Physics to Electronics, University of Puerto Rico at Humacao, and a M. A. in Communications with a specialization in Media and Contemporary Culture from the University of the Sacred Heart, Puerto Rico. He is currently studying a DBA in Information Systems, School of Business and Entrepreneurship, Turabo University. He has taken courses in Computer and Multimedia Education; in modeling and 3D animation at Planet Digital Education, Autodesk Training Center in Orlando, Fl, USA. He has also taken courses in animation with Adobe Flash and graphic design with Adobe Photoshop. Over the years he has worked for several federal proposals as a technology consultant for teachers of the public and private school systems as well a web designer. He has designed and conducted workshops and lectures on topics in areas of new media and its impact on education and collaborative work, and also in computer animation and web design.
Luis Ángel Lebrón Marrero
As an undergraduate student that is looking forward to graduate school, he is particularly interested in studying the mechanisms of pathogenesis of hard to treat viruses to develop new drugs and treatment. The work in labs exposes him to different experiences and allows him to develop independent critical thinking, sometimes taking risk in the bench. He has had the opportunity of mentoring high school students in a pre-college institute in 2006 and worked with them intensely. To be a student participant in the undergraduate research program MBRS-RISE at Universidad del Este has been a rewarding experience for him, where he has been preparing for graduate school and for a future career in science. He is currently working in a project in which the main goal is the sequencing and analysis of the 24.5 MDa native conjugative plasmid of Neisseria gonorrhoeae. This plasmid is associated with the dissemination of antibiotic resistant in Puerto Rico. His work has helped him learn lab techniques such as DNA extraction, bacterial transformation, cell culture and cloning. He has presented his research at several conferences outside Puerto Rico and has been awarded a prize for best poster presentation. He has attended workshops in proteomics, functional genomics and real time RT-PCR that have enriched his research skills. He likes teaching and inspiring young students to pursue their goals. He wishes to inspire others the same way he was inspired by his professors and his family.

Eduan E. Martínez Soto
Eduan Martínez is a sophomore at Universidad Metropolitana. His research experience was in the fall of 2008 and the spring of 2009 in the Saturday Academy Pre-College Program at Universidad Metropolitana. He conducted two research projects: “Mathematical Representation of the Efficiency of Attention Deficit Disorder Treatment” and “The Dengue, a Mortal Epidemic,” presented on January 31, 2009 and May 23, 2009 at the Pre-College Research Symposium of the Ana G. Mendez University System in San Juan, Puerto Rico. He also conducted the research project, “Mathematical Quantum Gravity Research” with Dr. Martin Engman. He entered the AGMUS Institute of Mathematics in the Bio-Mathematics BS at Universidad Metropolitana in the fall of 2009. From June 2010 to August 2010 he went to Beaverton, Oregon, to participate in a summer internship at the Center for the Coastal Margin Observation & Prediction of the Oregon Health & Science University. He conducted the research “QA/QC Data Analysis & Procedure Development” with Mr. Charles Seaton, his mentor. In his second year at the university he became a research mentor of the Saturday Academy Program. He was the President of the AGMUS American Mathematical Society of the AGMUS Institute of Mathematics. In September 2010, he traveled to the SACNAS Conferences at Anaheim, California to present his project. In January 2011 he presented his poster: “QA/QC Data Analysis & Procedure Development” at the Joint Mathematics Meetings Conferences in New Orleans, Louisiana. He wants to help and motivate young people to choose careers in Mathematics.
Melissa Martinez Trinidad

Melissa Martinez Trinidad is an undergraduate student from the Department of Mathematics-Physics of the University of Puerto Rico at Cayey. She is currently a graduating senior and a math tutor. Melissa originally entered UPR-Cayey in the Natural Sciences General Program with an interest to study Pharmacy. Due to a research held at The University of Iowa Summer Research Experience for Undergraduates, she changed majors. She spent three years with the Natural Sciences Department and two years as an undergraduate math major. During those two years Melissa went to eight different mathematical conferences and participated in three different research projects. Three of the conferences were in P.R. and the others took place in the United States. She has won three different Scholarship Awards from participating in Summer Research Experiences for Undergraduates. Those Scholarships came from the National Alliance for Doctoral Studies in the Mathematical Sciences. One of them was to hold a mathematical conference at the University of Puerto Rico at Cayey. Therefore she was one of the three organizers of the ¿Hay Futuro en las Matematicas? conference in the fall of 2010. Melissa’s current research interests are in mathematical biology and algebraic topology.

Prof. Guillermo Mejía

Assistant Professor (full time) since 1976, with areas of expertise in C++, Visual Basic, ASP.NET, Intel Assembly Language, Visual C++, and Object-oriented programming. His teaching interest was at first in Electronics, although he later changed his attention to Networks and multiprogramming. He has been teaching computer programming at Inter American University in Puerto Rico since 1985, and has been always working with students interested in Computer Science careers.

Jonathan Otero Suárez

Jonathan Otero Suárez is a computer programmer at EVERTEC Inc in San Juan, PR. At EVERTEC he is responsible for the development and support of internet banking software. Jonathan has a B.S in Computer Science from Univeersidad Metropolitana, an AGMUS institution. His background is in Java, and has worked a great deal in C languages, Visual Basic, and a variety of scripting languages. His hobbies include watching movies and playing chess.
Dr. Marlio Paredes  
Professor, School of Science and Technology  
Universidad del Turabo  

Dr. Paredes was born in Cali, Colombia. He has a B.S. and an M.S. in Mathematics, both from Valle in Cali, Colombia. In 2000 he obtained a Ph.D. in Mathematics from the State University of Campinas in Brazil and his specialization area is Differential Geometry and its applications. He has published several scientific papers in specialized journals; his research work is in a variety of areas such as Combinatorics, Differential Geometry, Differential Equations, Applied Mathematics and Mathematical Education. In 2001 he published a paper with Professor Brendan McKay from Australian National University and as a consequence he was included in the famous Erdös Number List (http://www.oakland.edu/enp/) obtaining Erdös Number 2. He has taught and conducted research at universities in Colombia (Universidad del Valle and Universidad Industrial de Santander), Brazil (State University of Campinas) and Puerto Rico (Universidad del Turabo). He has lectured and given conferences in Colombia, Brazil, México, Puerto Rico, Canada and United States. Dr. Paredes has held academic positions such as Director of the School of Mathematics and Research Director of the Faculty of Science at Universidad Industrial de Santander, Colombia. At this moment he is Co-PI of the NSF project BPC-A: Caribbean Computing Center for Excellence at Universidad del Turabo and also he is Mathematics curriculum specialist of the Turabo Math and Science Alliance (AMCT, Spanish acronym).

PIETER L. VAN DER MEER

After obtaining a Master’s Degree in Civil Engineering with a major in Transportation using Geographic Information Systems (GIS) as an analysis tool, Pieter Van der Meer joined the University of Puerto Rico at Mayagüez as a GIS Specialist. He became a facilitator, coordinator and Lab Instructor of the Laboratory for Applied Remote Sensing and Image Processing (LARSIP) from NASA, located within the facilities of the Department of Electrical and Computer Engineering at the University of Puerto Rico, Mayagüez Campus. He was instrumental in creating a “Research Culture” in LARSIP during the summer and between semesters by starting and continuing a LARSIP Summer Research Program for high school and undergraduate students during the 1990s. The high school students were attending various high schools in the Mayagüez and San Germán areas. The emphasis of the research program was on hands-on training in the use of computers and on research topics using the Internet. In addition, the students were required to prepare abstracts and papers and give presentations to their colleagues at conferences about their topic of interest. In 1998, he was instrumental in receiving the five-year (later extended to seven) Partnership for Spatial and Computational Research (PaSCoR) award from NASA to provide undergraduate students the opportunity to experience for the first time on the Mayagüez Campus an academic environment for multidisciplinary training in several faculties: College of Agricultural Sciences, Arts and Sciences and Engineering as desired by the Accreditation Board of Engineering and Technology, also called ABET 2000. Through PaSCoR, the next generation of multidisciplinary Scientists and Engineers received a well balanced education of theory in several disciplines together with a strong component of hands-on training and practice. The intend was and still is to prepare the students adequately for the real world without extensive additional education and training at the company’s or government’s expense.
Jonathan Vargas Rodríguez
Jonathan Vargas-Rodríguez is currently pursuing a B.S. in Computer Engineering at Universidad del Turabo. He is currently in his third year of studies. Jonathan has experience programming in C/C++, Java, UNIX-like operating systems handling and web programming components such as HTML, XHTML, CSS, JavaScript, JavaServer Pages & Servlets. In 2009, Jonathan attended a two-week training focused on materials engineering research at the Center for Materials Science and Engineering (CMSE) at the Massachusetts Institute of Technology (MIT), and continued to work over the summer at the Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) at the University of Massachusetts, Amherst, where he worked with graduate student Rafael Medina designing and troubleshooting a graphical user interface to control T/R modules over computer commands. In January 2010, Jonathan joined the Caribbean Computing Center for Excellence (CCCE) and started working with high school students in engineering-related fields and modeling analysis in computer programs.

Melinda Vargas
Melinda Vargas is a high school senior at Colegio San Antonio Abad, Humacao, Puerto Rico. Since January 2010, she has been working with the Saturday Academies, first at Universidad de Puerto Rico, Humacao, and then at Universidad del Turabo, Gurabo, Puerto Rico. During the summer, she participated at the University of California Los Angeles (UCLA) Center of Embedded Networked Sensing (CENS) High School Scholars Program. She has acquired programming skills in Java, and experience in computer science and in the biomathematics field. She has presented her investigations at AGMUS Research Symposia, 2010 Summer@CENS Poster Symposium, and 68th Joint Annual Meeting of The National Institute of Science (NIS) Beta Kappa Chi (BKX). This year Melinda won the National Center for Women & Information Technology (NCWIT) Aspirations in Computing Puerto Rico Award. In August 2011, she will be starting her bachelor’s degree in biomathematics with a minor in programming at Universidad Metropolitana(UMET).

Edgardo Luis Vázquez Rodríguez
Edgardo Luis Vázquez Rodríguez studied at Saint Francis School in Carolina. His hobbies include playing the trumpet in big bands, jazz orchestras, and popular music orchestras. From playing the trumpet, Edgardo has participated in numerous international jazz festivals including the Heineken Jazz Festival (held in Puerto Rico) and the International Jazz Festival from Carolina. In June 2007, he was admitted in the first extracurricular specialized school of science, mathematics, technology and languages in Carolina. This specialized school helped Edgardo realize and reach his potential in Mathematics. He conducted a pre-college research in the area of genomics titled “A Computational Study of Amino Acid Substitution in the SMPD1 Gene” in the Saturday Academy Pre-College Program at Universidad Del Este. He then presented it in the Winter 2009 Pre-College Research Symposium at Universidad Metropolitana. He also conducted another research in genomics under the same Program titled A Computational Study of Amino Acid Substitution in the RASAL 1 Gene.” He presented his second research at the Spring 2010 Pre-College Symposium at the Condado Plaza Hotel. In the summer of 2010 he conducted his third research under an internship sponsored by the AGMUS Institute of Mathematics Program at Universidad Metropolitana. The research was Pandemic of AH1N1 Influenza Virus and Vaccination Effectiveness.” Edgardo is currently a mentor in the Saturday Academy in the area of genomics and is studying Bio-Mathematics at Universidad Metropolitana with a full scholarship from the National Science Foundation.
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

Web Page: http://www.suagm.edu/umet/im/
CARIBBEAN COMPUTING CENTER FOR EXCELLENCE
CCCE Alliance

STUDENT RESEARCH DEVELOPMENT CENTER
“Developing Minds Through Research Experiences”

Pre-College Research Program

• GPA ≥ 3.0

• Research Methodology

• Up-to-date computer sciences and information technology fields

• Development of Poster/Oral Presentations

• Participation in Symposia (Outreach)

• Summer Internships

Benefits:
• $1,600 stipend for undergraduate
• $2,000 stipend for graduate

Requirements:
• GPA ≥ 3.0
• Commitment to pursue graduate studies
• Commitment to work in research projects in semester and summer

For more information contact:
Luis F. Font
CCCE Coordinator
Tel. (787)766-1717 ext. 6945
lufont@suaqm.edu
http://ccce.suaqm.edu

Scholarship Program
Ana G. Méndez University System
Vice Presidency for Planning and Academic Affairs
Student Research Development Center
CARIBBEAN COMPUTING CENTER FOR EXCELLENCE

Invite you to attend the Workshop:

“Exploring Computing Science”

Topics:
- Human Computer Interaction
- Problem Solving
- Web Design
- Introduction to Programming
- Robotics
- Computing Applications

Offered by Mr. David Bernier and Mr. John Landa
Computer Teachers at the Los Angeles School District,
Los Angeles, California

Place: Caribe Hilton Hotel
Date: May 14, 2011
Time: 1:00-5:00pm

*This workshop is exclusively for computing high school teachers*

For further information call: Luis F. Font, CCCE Coordinator by email lufont@suagm.edu or (787)766-1717 ext. 6945.
Ana G. Méndez University System
Vice Presidency for Planning and Academic Affairs
Student Research Development Center
AGMUS Institute of Mathematics

Invite you to attend the Workshop:

“DYNAMIC SYSTEM AND MODELING USING VENSIM”

Topics:
- Exponentially growing populations
- Predator and prey populations
- Infectious disease

Offered by Dr. Luis de la Torre
Mathematics and Computer Science Professor, Universidad Metropolitana

Place: Caribe Hilton Hotel
Date: May 14, 2011
Time: 1:00-5:00pm

*This Workshop is for 10-12 math and science teacher*

For registration go to: http://www.suagm.edu/umet/im/registration/
For further information call: Wanda I. Rodriguez,
AGMUS Institute of Mathematics Coordinator
by email um_wrodrigu@suagm.edu or (787)766-1717 ext. 6009.
SCHEDULE OF EVENTS

SATURDAY, MAY 14, 2011
CARIBE HILTON HOTEL

7:00 – 8:00 a.m. POSTER SESSION SET-UP
Breakfast
REGISTRATION

8:00 – 8:20 a.m. OPENING CEREMONY

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

Keynote Speaker: Dr. Hilda Colón
Special Assistant to the AGMUS President

8:20 – 10:40 a.m. POSTER SESSION
SAN GERÓNIMO A AND C

BIOLOGICAL SCIENCES, CHEMISTRY,
COMPUTER SCIENCES, APPLIED MATHEMATICS
ENGINEERING

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

BIOLOGICAL SCIENCES

Brayan Alvarado, Antilles Military Academy, Trujillo Alto, Puerto Rico. 1

Fragile X Syndrome and FMR-1 Mutation

Karla Alverio, Thomas Alva Edison School, Caguas, Puerto Rico. 2

Analysis of the Hydrogenase Enzyme in a Diversity Microbial Pool

Jorge Bauzó, Santiago Apóstol School, Bayamón, Puerto Rico. 3

Energetic Possibilities of Solanum tuberosum

Ronmy L. Cáceres, Emilio R. Barceló, San Juan, Puerto Rico. 4

What Variables Influence Diabetes Susceptibility?
Aldrin M. Cañals, Marimar Méndez, Calasanz School, San Juan, Puerto Rico.

Does Stretching the Back Affect Spine Functions?

Zahira C. Caraballo, Lourdes School, San Juan, Puerto Rico.

Hutchinson-Gilford Progeria Syndrome: A Neurocutaneous Disorder

Lizander Carrasquillo, Corporativa de Integración Social Academy, San Juan, Puerto Rico.

Degenerative Disease of Neuromuscular Type Called Amyotrophic Lateral Sclerosis

William A. Castillo, Dr. Pedro Perea Fajardo School, Mayagüez, Puerto Rico.

3D Representation of the Photochemical Properties of Melanin as a Cancer Inhibitor

María A. Claudio, Katia V. López, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Presence of Coliforms in Regular Water and Bottled Water

Christian Díaz Rivera, Caguas Military Academy, Caguas, Puerto Rico.

HIV Envelope Glycoprotein (ENV) Sequence Between Patients in Puerto Rico

Carola Figueroa, Marista School, Caguas, Puerto Rico.

Mutations in Calpain 3 Using a Modeling Program

Valerie Flores, Thomas Alva Edison School, Caguas, Puerto Rico.

Single Nucleotide Polymorphism in the Different Classes of Dopamine Receptors


The Types of Soils and Crops in Mayagüez and Cabo Rojo
Keishla González, San Antonio Abad School, Humacao, Puerto Rico.

Proteomic Analysis of the *Psychrobacter arcticus*

Charlotte Grau, Barbara Ann Roessler Academy, San Juan, Puerto Rico.

Analysis of Evolutionary Changes of the Diphtheria Toxin

Carlos Guillen, Nuestra Señora de Guadalupe School, San Juan, Puerto Rico.

The Turner Syndrome


Wireless Signals and their Effects on Germination of the *Phaseolus vulgaris* and *Capsicum annum*

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

Changes in the HGD Homogenisate 1,2 – Dioxygenase Protein

Natalie López, Inmaculada Academy, Mayagüez, Puerto Rico.

HTLV-1 Leukemia/Lymphoma Virus and how it can Affect Cancer Growth

Alexandra Maldonado, San Benito School, Mayagüez, Puerto Rico.

Resistance to Antibiotic Treatment on Humans Due to the Rapid Evolution of Bacteria

Delmarie Marrero, Levittown Baptist Academy, Levittown, Puerto Rico.

Bioinformatic Analysis of the Shiga Toxin

Kevin J. Marrero, San Benito School, Mayagüez, Puerto Rico.

The Effect of Videogames on the Prefrontal Cortex
Vivianna M. Más, Calasanz School, San Juan, Puerto Rico.

Analysis of Evolutionary Changes of Hexosaminidase A in TAY-Sachs Disease

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

Comparative Analysis of Amino Acid Sequence in HHV6A and HHV6B

Stephanie Meléndez, Episcopal Cathedral School, San Juan, Puerto Rico.

APERT Syndrome: A Mutation in the FGFR2 Gene

Adriana Morales, Espíritu Santo School, San Juan, Puerto Rico.

Analysis of the Huntington Disease Protein Using Bioinformatics Tools

Elizabeth Muñiz, Calasanz School, San Juan, Puerto Rico.

Bioinformatics and Evolutionary Analysis of HFE Gene

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

Evaluation and Bio-Informatics of the GSTP1 and GSTM1 Using ClustalW2, Genedoc and Mega4


Analysis of HLA Protein in Celiac Disease Using Bioinformatics Methods

Litza N. Pabón, Calasanz School, San Juan, Puerto Rico.

Bioinformatics Studies of Down Syndrome Using EST2 and DYRK1A Proteins

Yan C. Ramos, Del Pilar School, Canóvanas, Puerto Rico.

Analysis of the Disease Resistance Gene RPS4 in Arabidopsis thaliana
Stephanie M. Rivera, Jorge Rosario, University Gardens School, San Juan, Puerto Rico.

The Effect of Temperature Over Macroinvertebrate Abundance of Two Streams in San Juan, Puerto Rico

Lorena V. Rodríguez, San Antonio Abad School, Humacao, Puerto Rico.

Proteomic Analysis of the Psychrobacter cryohalolentis K5

Natalia Rodríguez, Carvin School, Inc., Carolina, Puerto Rico.

Wilson’s Disease

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

Gene and Genome Based Bioprospecting

Nicolle A. Rosa, Levittown Baptist Academy, Toa Baja, Puerto Rico.

Geothermal Comparison of the Wastewater Treatments Process Between Puerto Rico and California

Sylvette Rosario, Carvin School, Carolina, Puerto Rico.

Evolutionary Study and Analysis of A-Kinase Protein in TNE Long QT Syndrome

Joseph Santiago, Petra Mercado School, Humacao, Puerto Rico.

Using Biosyncop to Create a Synthetic Protein Cost’s Data Base

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

Monooxigenase Analysis in Bacteria and Fungi with an Insight in Bioremediation

Alejandro Torres, Calasanz School, San Juan, Puerto Rico.

Evolutionary Study of the HIV-1 Gene
Elizabeth Torres, San Antonio Abad School, Humacao, Puerto Rico.

Analysis of the Properties of the *Psychrobacter SP. PRWF-1* Proteins


The Effect of Indicences of Muons as Cosmic Rays Air Shower During the Day Over the Earth and Solar Flares

Adelfa A. Vera, University High School, San Juan, Puerto Rico.

Lysosomal Storage Disease Called TAY Sachs

CHEMISTRY

Christian Acevedo, Dr. Pedro Perea Fajardo Vocational School, Mayagüez, Puerto Rico.

Is Acetaminophen Dangerous?

Zaibeth Díaz, Bautista de Caguas School, Caguas, Puerto Rico.

Analysis of the Functional Group of the Active Ingredient Caffeine (MIDOL) Using Infrared Spectrum and Gauss View Program

Linnette López, Isabel Flores High School, Humacao, Puerto Rico.

Visualization of the Component Nabumetone (Relafen) Using the Infrared Spectrum Technique (FT-IR Spectrum)

Rocío del Mar Méndez, Bautista de Caguas School, Caguas, Puerto Rico.

Study of the Functional Group that Contains the Active Ingredient Lorazepam (Ativan) Using the Infrared Spectrum


The Effect of Lead in Lipstick to Human Health
Stephanie Vargas, San Benito School, Mayagüez, Puerto Rico.  
Effects on Laser Teeth Whitening vs. Home Whitening Kits

COMPUTER SCIENCES

Fabiola Agramonte, María Reina Academy, Carolina, Puerto Rico.  
Using Archimedes’ Principle to Help People Enjoy Water Sports Safely

Alfredo Aldebol, Inter-American School, San Germán, Puerto Rico.  
Finding Carmichael Numbers

Yaromic Alemañy, Lola Rodríguez High School, San Germán, Puerto Rico.  
Map Mashups for Visualization of Statistical Data

Marysol Alméstica, St.Croix Educational Complex, the Virgin Islands, St. Croix.  
A Comparison of Performance of Symmetric and Asymmetric Encryption Algorithms for Smartphone Applications

Ángel Andino, San Gema School, Carolina, Puerto Rico.  
Mind Creeper

Jean C. Bernal, San Juan Apóstol School, San Juan, Puerto Rico.  
Effects of the Crossover Rate and Mutation Rate in the Optimization Behavior of a Genetic Algorithm Solution of the Radio Tower Location Problem

Melissa Bramble, St. Croix Educational Complex, the Virgin Islands, St. Croix.  
St. Croix Educational Complex Tutoring for Kids

Rafael Cabrera, Levittown Baptist Academy, Toa Baja.  
The Internal Structure of Video Games
Melissa Calderón, Inter-American School, San Germán, Puerto Rico.

Symmetry of the Legs in Primitive Pythagorean Triples

Cristian Claros, San Jorge Academy, San Juan, Puerto Rico.

Effects of Mutation Rate and Population Size in the Optimization Behavior of a Genetic Algorithm Solution of Advertising Media Selection

Kayra Clouden, Sheniah Campbell, St. Croix Educational Complex, the Virgin Islands, St. Croix.

How Gaming can be used as a Teaching Tool

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

A Mining Robotic System

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

Factorization of Hypotenuses of Primitive Pythagorean Triples

Lina V. Daza, Inter-American School, San Germán, Puerto Rico.
Valerie Vázquez, Presbyterian Academy, San Germán, Puerto Rico.

A Computer Game Based on Graeco-Latin Squares

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

Primes and Factorization in the Gaussian Integers

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

Statistical Patterns of Texts as a Proof of Authorship

Edwin J. González, Bautista de Caguas Academy, Caguas, Puerto Rico.

3D Visualization of a City
Random Sudoku Generator

William Guzmán, Santiago Apóstol School, Fajardo, Puerto Rico.  
Computerized Model of the Human Internal Plasma Filtration System

K’Jani Hall, Danté Hall, St. Croix Educational Complex, the Virgin Islands, St. Croix.  
Which is Easier to Use, Alice or Game Maker?

Whitney Lambert, Steven Browne, St. Croix Educational Complex, the Virgin Islands, St. Croix.  
Voice Recognition for Mobile Applications

Stacy Lloyd, Janice Acevedo, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.  
Clustering Classification for Wine Data Set Using K-Means and K-Medians Algorithm

Víctor López, Rexville High School, Bayamón, Puerto Rico.  
Unit Converter

José O. Maestre, CIEM Private School, Carolina, Puerto Rico.  
Javascript Arithmetic Equations Game

Dan-L Martínez, C.I.E.M. Private School, Carolina, Puerto Rico.  
HTML: Random Numbers

Gustavo A. Martínez, Homeschool, Carolina, Puerto Rico.  
Simple Unit Conversion Tool
Jeancarlo Martínez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Biko McMillan, St. Croix Educational Complex, the Virgin Islands, St. Croix.
Integration of Encryption and Speech Recognition to Improve Security of Mobile Applications

Cristina Morales, Ernesto Ramos Antonini School, San Juan, Puerto Rico.
Alberto Santiago, María Teresa Piñero School, Toa Baja, Puerto Rico.

Music Rookie

Charlott Morel, San Jorge Academy, San Juan, Puerto Rico.
Influence of the Genetic Algorithm’s Crossover Rate and Mutation Rate in the Search for a Solution to the Traveling Salesman Problem (TSP)

Davette Nazario, José de la Torre School, Carolina, Puerto Rico.
Glycemic Index Calculator Program

Kevin Ortega, Santiago Apóstol y Evangelista School, San Juan, Puerto Rico.
Success Outcome of Video Games

Giovanni Pacheco, San Ignacio School, San Juan, Puerto Rico.
Influence of Mutation Rate and Population Size on the Optimization Behavior of a Genetic Algorithm Solution of the Traveling Salesman Problem (TSP)

Kiddany Pérez, Levittown Baptist Academy, Toa Baja, Puerto Rico.
Game Programming for the Average Person
Denny S. Ramírez, Mónica I. Adorno, Josefina Barceló
School, Guaynabo, Puerto Rico. 84

Success Factors of Web Sites

Emily M. Rivera, Yolianna Hernández, Bautista de
Puerto Nuevo Academy, San Juan, Puerto Rico. 85

Clustering the Ionosphere’s Type

Juan Rivera, Ángel David School, San Juan, Puerto Rico. 86

The Global Warming Effects Simulator

Robinson Rivera, San Jorge Academy, San Juan, Puerto Rico. 87

Influence of the Genetic Algorithm’s Crossover Rate and
Population Size on the Search for a Solution to the
Advertising Campaign

Sebastián J. Rivera, Nykos Linares, Inter-American
School, San Germán, Puerto Rico. 88

Permutations with the Turning Grille

Othoniel J. Rodríguez, Bautista de Puerto Nuevo
Academy, San Juan, Puerto Rico. 89

Effects of the Crossover Rate and Population Size
Parameters of the Genetic Algorithm when it is used to Find
Solutions to the Traveling Salesman Problem

Joshua M. Rolón, Levittown Baptisp Academy, Toa Baja, Puerto Rico. 90

X Change

Axel Sánchez, Barbara Ann Roessler Academy, San Juan, Puerto Rico. 91

Theoretically Analyzing Geolocations

Julio E. Sepúlveda, Nicole Arroyo, San José School, San
Germán, Puerto Rico. 92

A Flight Through Modern Engineering
Carlos Sosa, San Ignacio School, San Juan, Puerto Rico.  
Effects of a Radio Tower and the Population it Reaches in the Optimization Behavior of a Genetic Algorithm Solution of the Range Problem

Rosangelie Soto, Inter-American School, San Germán, Puerto Rico.  
Recognizing Perfect Squares in the Gaussian Integers

Nathalie C. Velázquez, Inter-American School, San Germán, Puerto Rico.  
Multiplication of Pythagorean Triples as a Complex Multiplication of Gaussian Integers

Sabrina White, Renisha Underwood, Ahriyah Fearon, Jaleel Benjamin, St. Croix Educational Complex, the Virgin Islands, St. Croix.  
Wall Hugging with a Blind Side

APPLIED MATHEMATICS

Marcus I. Arroyo, Josefina Barceló High School, San Juan, Puerto Rico.  
How Does Oxytocin Affect Humans?

Joseph Colón, Christian Rodríguez, Manuela Toro Morice School, Caguas, Puerto Rico.  
The Logistic Population Model and the United States Case

Kenneth Hicks, Santiago Apóstol School, Fajardo, Puerto Rico.  
An Excel Statistical Analysis of a Battery Toxicity

Sarah D. Matos, Barbara Ann Roessler Academy, San Juan, Puerto Rico.  
The Effect of Music While Exercising

Juan C. Pérez, Gilberto Concepción de Gracia School, Carolina, Puerto Rico.  
Feasibility Study to Evaluate Wind Power as a Solution to Produce Electric Power
Ana Ramírez, La Piedad School, Trujillo Alto, Puerto Rico.

Analysis of the Amino Acids Changes in the Coagulation Factor VII Protein

Alexander Reyes, Emanuel Pagán, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Population Growth: Puerto Rico vs Arizona

Kevin J. Rosario, Bonifacio Sánchez Jiménez High School, Cayey, Puerto Rico.

The Best Investment

Saúl Santiago, Bonifacio Sánchez Jiménez School, Cayey, Puerto Rico.

Tangle Analysis of Protein-DNA Complexes Abstract

Isamar Vives, Yelitza Aponte, Bonifacio Sánchez Jiménez High School, Cayey, Puerto Rico.

Probability of False Positives in a Drug Test

Gerardo Zayas, Juan C. Negrón, Bonifacio Sánchez Jiménez High School, Cayey, Puerto Rico.

Analysis of Methods to Solve Systems of Equations

ENGINEERING

Julio A. Cedeño, University Gardens High School, San Juan, Puerto Rico.

Study of Biogas Levels in Residential Septic Tanks: Design of a Prototype to Maximize the Production of Biogas as an Alternative Energy Source

Michael Hicks, Santiago Apóstol School, Bayamón, Puerto Rico.

A Model for Changes in Surface Tension Due to Magnetization

10:40 a.m. – 10:50 a.m. COFFEE BREAK
10:30 a.m. – 11:00 a.m. PUBLIC EXHIBITION OF POSTER PRESENTATIONS
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presentation Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00 – 11:10 a.m.</td>
<td>Edwin Alvarado, Caguas Military Academy, Caguas, Puerto Rico.</td>
<td>Phylogenetic Analysis of Beta Lactamase in Pathogenic Bacteria</td>
</tr>
<tr>
<td>11:20 – 11:30 a.m.</td>
<td>José Colón, Caguas Military Academy, Caguas, Puerto Rico.</td>
<td>Phylogenetic Analysis of Collagen Sequences Among Chordates</td>
</tr>
<tr>
<td>11:30 – 11:40 a.m.</td>
<td>Ediel E. Corujo, Antilles Military Academy, Trujillo Alto, Puerto Rico.</td>
<td>The Neurological Disease Called Huntington</td>
</tr>
<tr>
<td>11:40 – 11:50 a.m.</td>
<td>Melanie Cruz, Antilles Military Academy, Trujillo Alto, Puerto Rico.</td>
<td>Is it an Alien? Is it a Fish Boy? Or is it Just a Genetic Disorder Called Ichthyosis?</td>
</tr>
<tr>
<td>11:50 – 12:00 m.</td>
<td>José Iglesias, La Piedad School, Trujillo Alto, Puerto Rico.</td>
<td>Angelman Syndrome: The Happy Baby Syndrome</td>
</tr>
<tr>
<td>Time</td>
<td>Presenters</td>
<td>Title</td>
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</tr>
<tr>
<td>11:00 – 11:10 a.m.</td>
<td><strong>Gabriela Martínez</strong>, La Piedad School, Trujillo Alto, Puerto Rico.</td>
<td>Mutations from the APC Gene in the APC-Protein</td>
</tr>
<tr>
<td>11:10 – 11:20 a.m.</td>
<td><strong>Elvin A. Méndez</strong>, José Aponte de la Torre School, Carolina, Puerto Rico.</td>
<td>Computational Study of AA Changes on the ATM Gene</td>
</tr>
<tr>
<td>11:20 – 11:30 a.m.</td>
<td><strong>Damarys M. Ramos</strong>, Barbara Ann Roessler Academy, San Juan, Puerto Rico.</td>
<td>Which Pain Reliever has a Faster Dissolution Time: Brand or Generic?</td>
</tr>
<tr>
<td>11:30 – 11:40 a.m.</td>
<td><strong>Nicolle A. Rosa</strong>, Levittown Baptist Academy, Toa Baja, Puerto Rico.</td>
<td>Bioinformatics Analysis and Comparison of PBP1 and PBP5</td>
</tr>
<tr>
<td>11:40 – 11:50 a.m.</td>
<td><strong>Jorge Rosado</strong>, Antilles Military Academy, Trujillo Alto, Puerto Rico.</td>
<td>The Mutation of the X Chromosome Causes AARSKOG Syndrome</td>
</tr>
<tr>
<td>11:50 – 12:00 m.</td>
<td><strong>Angélica Serrano</strong>, Lurgea Central College, Toa Baja, Puerto Rico.</td>
<td>Study and Analysis of the ASPA Gene in Canavan Disease</td>
</tr>
</tbody>
</table>
Chairperson: **Ms. Evelyn Haddock**, Inter-Metro

**COMPUTER SCIENCES**

11:00 – 11:10 a.m. **Jean Paul Álvarez**, Santa Rosa School, Bayamón, Puerto Rico.

Life Ratio of Factors that Cause Hepatitis Using Clustering Algorithms

11:10 – 11:20 a.m. **Nishmar Cestero**, Episcopal Cathedral School, San Juan, Puerto Rico.

Real-Time Chat Translation

11:20 – 11:30 a.m. **Bryan Claudio, Camille A. Price**, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Breast Cancer Patterns in Clustering

11:30 – 11:40 a.m. **Manuel Díaz**, San Ignacio School, San Juan, Puerto Rico.

Behavior of the Genetic Algorithm When the Population Size and Cross-Over Rate are Modified When Solving the Portfolio Balancing Problem

11:40 – 11:50 a.m. **Xavier Figueroa, Miguel Almodóvar**, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Finding Protein Concentration Site in Yeast Through the Process of Clustering

11:50 – 12:00 m. **Diego E. González, Miguel A. Martell**, San José School, San Germán, Puerto Rico.

Engineering in Ancient Times

12:00 – 12:10 m. **Alejandro Ramos**, American Military Academy, Guaynabo, Puerto Rico.

Measure PIC
12:10 – 12:20 m.  **Héctor Ramos**, San Jorge Academy, San Juan, Puerto Rico.

Effects of Cross-Over Rate and Population Size on the Behavior of a Genetic Algorithm Solution to the Radio Towers Placement Problem

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

Algorithm Working in a Maze

12:30 – 12:40 m.  **Gilberto Robles**, Levittown Baptist Academy, Toa Baja, Puerto Rico.

Number Wizard
<table>
<thead>
<tr>
<th>Time</th>
<th>Session IV - MATHEMATICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00 – 12:40 m.</td>
<td>Chairperson: Mr. Ángel González, Polytechnic University</td>
</tr>
<tr>
<td></td>
<td><strong>ORAL PRESENTATIONS</strong></td>
</tr>
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<td><strong>SAN CRISTOBAL BCD</strong></td>
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<td><strong>MATHEMATICS</strong></td>
</tr>
<tr>
<td>11:00 – 11:10 a.m.</td>
<td><strong>Rafael V. Cañals</strong>, Calasanz School, San Juan, Puerto Rico. Adriana M. Mejía, Episcopal Cathedral School, San Juan, Puerto Rico.</td>
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<tr>
<td></td>
<td>You Are What You Eat</td>
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<td></td>
<td>Analysis of the CYBB Gene Deficiency Decoding the Cytochrome B-245 Protein</td>
</tr>
<tr>
<td>11:20 – 11:30 a.m.</td>
<td><strong>Natasha de los A. García</strong>, Dr. Juan José Osuna School, San Juan, Puerto Rico.</td>
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<td></td>
<td>How Does a Star Become a Black Hole?</td>
</tr>
<tr>
<td>11:30 – 11:40 a.m.</td>
<td><strong>Viviana M. Lebrón</strong>, Calasanz School, San Juan, Puerto Rico.</td>
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<tr>
<td></td>
<td>Mathematical Representation of the Efficiency of Deficit Disorder Treatment Using ADD</td>
</tr>
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<td></td>
<td>H1N1-Sir Model</td>
</tr>
<tr>
<td>11:50 – 12:00 m.</td>
<td><strong>Jennifer Patritti</strong>, Manuela Toro Morice School, Caguas, Puerto Rico.</td>
</tr>
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<td></td>
<td>Modeling the Puerto Rican Population</td>
</tr>
<tr>
<td>12:00 – 12:10 m.</td>
<td><strong>Laura Roldán, Isardo Braveman</strong>, José Aponte de la Torre School, Carolina, Puerto Rico.</td>
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<td>Maracuto Stream Project: Comparison of Total Phosphorous, Macro-Invertebrates, and the Impact of Land Use on Water Quality</td>
</tr>
</tbody>
</table>
12:10 – 12:20 m.  
Alex R. Sánchez, Barbara Ann Roessler Academy, San Juan, Puerto Rico.

Unshaken Videos

12:20 – 12:30 m.  
Elizabeth Torres, Bonifacio Sánchez Jiménez School, Cayey, Puerto Rico.

Model of Marine Animals

ENVIRONMENTAL SCIENCES

12:30 – 12:40 m.  
Bryanda Díaz, Saint Francis School, Carolina, Puerto Rico.

A Model of Poisoning by Mercury in Humans
FRAGILE X SYNDROME AND FMR-1 MUTATION

Brayan Alvarado López, Antilles Military Academy, Trujillo Alto, Puerto Rico.

Research Mentor: Natalia Santiago, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Luis M. Ortiz, Universidad Metropolitana, San Juan, Puerto Rico.

In the year 1969, the fragile X syndrome or the Martin-bell syndrome was found on one of the chromosomes. The gene that was found was the FMR-1 and the protein was FMRP. The physical characteristics of these symptoms are a narrow and elongated face, large ears, high arched palate, flat feet and extremely flexible joints, men with larger testicles usually after puberty and signs of other behavior like the lack of attention, difficulty for them to learn to talk or walk sensitivity to light, sound, texture and other behaviors. This syndrome can be diagnosed by blood analysis, which has 4 phases: the first is a normal stage that is 6 to 45 repetitions, next is 45 to 55 repetitions, the pre-mutation from 55 to 200 repetitions and 200 repeats mutation. Pubmed was the program used to find the protein, then EBI was used to find the similarity of the proteins with two programs NCBI Blast and Clustal W2. GeneDoc was used to find the alignment of the amino acid. The syndrome was found on the X chromosome. Protein Alignments in Gene Doc revealed that the FMRP protein had a 85.06 percent of conservation between its different isoforms. Future work will be to study more information about the syndrome and why it happens, and find other species that can transport this syndrome. In conclusion, FMRP has been able to conserve itself throughout human evolution.

PHYLOGENETIC ANALYSIS OF BETA LACTAMASE IN PATHOGENIC BACTERIA

Edwin Alvarado Rodríguez, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Luis Lebrón Marrero, Universidad del Turabo, Gurabo, Puerto Rico.

Bacterial Infections are the most common types of infections in humans. When the organism that is causing the infection is unknown, a broad-spectrum antibiotics are used to see if the infection is decimated or eliminated completely. Some of these antibiotics have a structural similarity called a beta-lactam ring. Beta-lactam antibiotics include antibiotics from the penicillin, cephalosporin, carbapenem, and monobactam families. Even though beta-lactam antibiotics are greatly effective, their prowess is becoming rather limited among an increasing number of bacterial species. Several species of bacteria produce a very specific protein that targets the beta-lactam ring in the aforementioned antibiotics and dissolves the beta-lactam ring; rendering the antibiotic useless. In this study the Beta lactamase protein sequence of various bacteria was compare using multiple sequence alignment and phylogenetic trees to evaluate its evolutionary change.
ANALYSIS OF HYDROGENASE ENZYME IN A DIVERSITY MICROBIAL POOL

Karla Alverio Valle, Thomas Alva Edison School, Caguas, Puerto Rico.

Research Mentor: Luis Lebrón Marrero, Universidad del Turabo, Gurabo, Puerto Rico.

Cyanobacteria have unicellular and colonial species. Colonies can form filaments; some show the ability to differentiate into several different types of cell types; vegetative cells, photosynthetic cells, akinetes and heterocyst. Every day more people get more worried with finding new renewable energy sources to move cars or other machines, to work, and for living. Biodiesel has been presented as a viable option that may reduce the use of petroleum. Some advantages are: the use of non-comestible organisms, algae created in non-agricultural soil that absorb carbon dioxide from the air, and solar light (UV rays), the only thing needed to produce biofuels. A search was conducted in the worldwide database for the sequence of a hydrogenase enzyme and Blast and multiple sequence alignments were done. Understanding the catalytic mechanism of hydrogenase might help scientists design clean biological energy sources, such as algae, that produce hydrogen.

ENERGETIC POSSIBILITIES OF SOLANUM TUBEROSUM

Jorge Bauzó Rodríguez, Santiago Apóstol School, Bayamón, Puerto Rico.

Research Mentor: Prof. Gerson Restrepo, Universidad del Este, Carolina, Puerto Rico.

Some foods have been shown to have electrical properties. This is the case of the lemon or potatoes which exhibit voltages between 1.8 VDC for Solanum tuberosum (potato) and 1.9 VDC for lemon. The fact that these foods exhibit electrical properties is influenced by a variety of minerals including PO4 and Mg. Equally important is the compartmentalization structure involved in these foods. It is of importance to study this electrical property in potatoes to try to envision new methods of producing electricity cleanly, portably, innovatively. To this aim samples of potatoes were taken and carefully sliced to avoid the loss of electrical properties and measured voltage as a function of mass. Voltages were measured with a DC voltmeter while the mass was measured by a laboratory balance. Results confirmed results from the literature that revealed that the voltage increases as a function of mass. A comparison is presented between these measurements and measurements taking into account the compartmentalization structure of the potato.

WHAT VARIABLES INFLUENCE DIABETES SUSCEPTIBILITY?

Ronny Lenny Cáceres Maldonado, Emilio R. Delgado School, San Juan, Puerto Rico.

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

Diabetes is a chronic disease characterized by high levels of sugar in the blood. This can be caused by too little insulin, which is produced by the kidney. Diabetes has become in recent years an epidemic that affects over 150 million people worldwide. In case of the Pima tribe, it is said that this disease can be caused by genetic problems since they have married within their own members. This investigation tried to confirm if the diabetes in the Pima group is caused by a genetic problem or not. The first step was to seek information on what diabetes is and gather information related to this disease. Using the Internet as the base of the investigation, as well as science books, programs such as MEGA4, NCBI, and PubMed, it was hypothesized that diabetes is not transmitted by the genetic code. The intention of the investigation was to determine if this was true or false. Similarities between the human and other organisms such as Mus musculus were also observed in terms of the protein structure. The results revealed that diabetes was not a genetic problem among that population.
DOES STRETCHING THE BACK AFFECT SPINE FUNCTIONS?

Aldrin M. Cañals Pérez, Marimar Méndez Echevarría, Calasanz School, San Juan, Puerto Rico.

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

Nowadays people perform exercises without the proper care and knowledge of how the movement is done correctly. This is relevant to the actual investigation (eHow, Inc. et al. 2008). People need to be oriented on how to exercise without any tear, any spasm, paralysis or damage. One of the problems of doing a wrong exercise is that the result can be a temporary or permanent damage to the body. This research targeted the spinal area; it was selected because the spine has the central part of the nervous system called the spinal cord. Any damage done to the spine and its components can affect every part of the human body. The purpose of this study was to find out the correct movements when practicing a specific exercise. A survey was conducted on how people stretch their back and if they know what they are doing. Research was done on the Internet, and books were consulted; a graph provided information relating the position back with the Golden Rectangle and Spiral and the degrees that the spine can bend backwards. The majority of the people interviewed and surveyed did not know the correct way to stretch their backs without damaging the spine. Results from the research will be presented.

HUTCHINSON-GLIFORD PROGERIA SYNDROME: A NEUROCUTANEOUS DISORDER

Zahíra C. Caraballo, Lourdes School, San Juan, Puerto Rico.

Research Mentor: Natalia C. Santiago, Universidad Metropolitana, San Juan, Puerto Rico.
Research Assistant Mentor: Luis M. Ortiz, Universidad Metropolitana, San Juan, Puerto Rico.

Hutchinson-Gliford syndrome is a genetic condition that affects only children and makes them have the appearance of an old person. This is produced in the LMINA gene that provides instructions for making a protein called lamin A. This protein plays an important role in determining the shape of the nucleus within cells. The altered protein makes the nuclear envelope unstable and progressively damages the nucleus, making cells more likely to die prematurely. PubMed was used to find the Fasta format of the protein. EBI is a large bioinformatics center, which has connections with various universities in different countries of the world, and which is doing research on bioinformatics and was used to find the information about the genes. NCBI BLAST used to search for proteins and amino acids from other organisms that are compatible with humans. After searching these proteins, the Cluster W2 was used to find the alignment of the Fasta format and it was converted into a language that the program GeneDoc, the full-featured multiple sequence alignment editor, understands. Mega4 was used to compare the phylogenetic trees of humans with animals. Future plans are to keep working on this topic in a hospital to understand better the effect and to help these children have a happy life.
BIOSYNCO: SOFTWARE TO CALCULATE THE BIOSYNTHETIC COST OF PROTEINS

Néstor Carrasco, Petra Mercado School, Humacao, Puerto Rico.
Liz Malavé Rivera, Bautista de Caguas Academy, Caguas, Puerto Rico.

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

Natural selection favors mutations that increase the fitness of individuals. Each protein synthetized in a living cell has a biosynthetic cost that can be measured by the formula of Craig and Weber (1998): \( \sum (C_i \times F_i)/L \), where \( C_i \) is the appropriate cost of the amino acid \( i \), \( F_i \) is the frequency of the amino acid \( i \) and \( L \) is the protein length. Thus, mutations that result in amino acids that are biosynthetically inexpensive will be selected in energy-limited environments. BioSynCop, a software that calculates the biosynthetic cost of proteins, was developed. The program processes amino acid sequences in FASTA format and calculates the appropriate amino acid cost. The program was written in JAVA and is executable in Windows, MacOS X and Linux platforms. Results can be exported to a CSV format file that can be further processed in Microsoft Excel. The reliability and functionality of the program are currently being tested in order to examine the project’s cost minimization hypothesis using the genomes of Pseudomonas from different temperature niches. The source code will be made available to the public in the near future.

DEGENERATIVE DISEASE OF NEUROMUSCULAR TYPE CALLED AMYOTROPHIC LATERAL SCLEROSIS

Lizander Carrasquillo, Corporativa de Integración Social Academy, San Juan, Puerto Rico.

Research Mentor: Natalia Santiago, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Luis M. Ortíz, Universidad Metropolitana, San Juan, Puerto Rico.

The Amyotrophic lateral sclerosis is a disease that causes damage to the nerves and bones of the body. The disease is fatal and has no cure, but it has a treatment. The treatment uses a drug named Riluzole. The disease has a number of patients of around 20,000 – 30,000 and an around 5,000 patients get infected with it every year.

3D REPRESENTATION OF THE PHOTOCHEMICAL PROPERTIES OF MELANIN AS A CANCER INHIBITOR

William Andre Castillo Rivera, Dr. Pedro Perea Fajardo School, Mayagüez, Puerto Rico.

Research Mentor: Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.

Melanin is a substance that gives pigment, to the skin, hair and the iris of the eye. This substance is provided by skin cells that are called melanocytes, which are known to be pigment producing cells. Melanin also helps protect the skin against the sun (UV-A and UV-B rays). When you are under the sun, these cells start working, making pigments or “coloring” the skin. Besides the sunburn or suntan as a result from spending too much time in the sun, one may also develop different skin conditions such as melasma or even a skin cancer. To prevent this from happening and protect the skin from the sun’s rays, especially the UV-B, which is the most harmful or damaging, it is recommended to use a sunscreen or sunblock when exposed to the sun. The most important factor in this investigation is to see how melanin protects the skin against cancer. This investigation includes a brief explanation of previous skin cancer studies. It will include 3D graphics that represent the properties of melanin to help inhibit skin cancer. Besides the graphics, pictures of the most influencing skin cancers and brief information about them to become more familiar with this investigation are presented. Different sources such as scientific journals, interviews and Internet references were used to compile the information for this investigation.
PRESENCE OF COLIFORMS IN REGULAR WATER AND BOTTLED WATER

María A. Claudio Rodríguez, Katia V. López Martínez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

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

Planet Earth is surrounded by water. It is used daily, especially for cleansing and drinking purposes. Many people drink water without realizing the cleaning process of which water has to go through and if it is clean enough for the human system to use. This is why many people get sick, because if water is not well purified, many harmful germs invade the system and damage it. The objective of this work was to see how coliforms can affect potable drinking water. Studies have revealed that there is presence of \textit{E. coli} in bottled water. The 2007 report of Food Safety Authority of Ireland showed that 6.3\% of the bottled water in Ireland has more coliforms than water straight from the pipes. Also, different studies have said that some well-known brands have had \textit{E. coli} in them. Since, \textit{E. coli} is originally from the intestine, if digested in large quantities the organism could die. With this previous knowledge, one important question was: is regular water safer than bottled water? To conduct the statistic study, the program Microsoft Office Excel was used. For the future, water samples from water sources in Puerto Rico will be tested to see the amounts of \textit{E. coli} in the water.

PHYLOGENETIC ANALYSIS OF COLLAGEN SEQUENCES AMONG CHORDATES

José Colón Miranda, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Luis Lebrón Marrero, Universidad del Turabo, Gurabo, Puerto Rico.

Collagen is a protein secreted by cells of connective tissue such as fibroblasts and other cell types found in all animals. It is the most abundant component of skin and bones, covering 25\% of the total protein mass in mammals. Collagen, type I, alpha 1 (COL1A1) is a human gene that encodes the major component of type I collagen, the fibrillar collagen found in most connective tissues, including cartilage. Ehlers-Danlos syndrome is caused by mutations in the COL1A1 gene. This disorder instructs the cell to leave out a part of the pro-alpha1 (I) chain that contains a segment used to attach one molecule to another. This mutation substitutes the amino acid cysteine for the amino acid arginine at position 134 in the protein made by the gene. (The mutation can also be written as Arg134Cys). Multiple sequence alignment and phylogenetic analysis using (Rasmol) as a bioinformatics tool were used.
THE NEUROLOGICAL DISEASE CALLED HUNTINGTON

Ediel E. Corujo, Antilles Military Academy, Trujillo Alto, Puerto Rico.

Research Mentor: Natalia Santiago, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Luis M. Ortiz, Universidad Metropolitana, San Juan, Puerto Rico.

Huntington’s disease (HD) is a complex degenerative disorder that affects the central nervous system and leads to dementia. This disease is caused by an autosomal dominant mutation in the gene called Huntingtin (HTT). This condition is complex, with physical, psychological, psychiatric and social implications. As the disease progresses, the affected individual may develop epileptic seizures, emotional disturbances and behavioral changes. In this investigation different sources were used to find information about the disorder. At first Google was used to find important information and pictures about the disorder. Afterwards, Pubmed was used to find the proteins of the disease in the databases. Later, EBI was used to find the similar proteins among different organisms. Then, GeneDoc was used for the alignment of the amino acids. The alignment in Gene Doc of the HTT protein revealed that there was a 71.03 percent of conservation. This means that the gene had conserved itself throughout its evolution. In conclusion, this gene has various variants in different organisms, but it has been able to conserve itself. In the future, work will be conducted with degenerative diseases like this one. It is hoped that this investigation will help find treatments to help reverse the effects of degenerative diseases.

IS IT AN ALIEN? IS IT A FISH BOY? OR IS IT JUST A GENETIC DISORDER CALLED ICHTHYOSIS?

Melanie Cruz Cruz, Antilles Military Academy, Trujillo Alto, Puerto Rico.

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

Ichthyosis is a genetic disorder, known by rare group of skin disorders that is characterized by the excessive amounts of dry surface scales, like a fish. The Ichthyosis is developed by a mutation in the keratin genes (i.e., KRT1, KRT10) that is the cause of this autosomal dominant disorder, in the case of Ichthyosis vulgaris. Furthermore, this genetic disorder does not have a cure, but has a treatment. In addition, these patients must go to a dermatologist every month or as recommended for a safe check of the epidermis, since they can get worse without their products. These people do not have internal problems, but because of the discrimination of people, they have to visit psychologists. This investigation was conducted using PubMed for databases and Fasta, which is connected with NCBI which provided the proteins; EBI for the search of the similarity and homology of the gene in NCBI Blast, ClustalW2 for the sequence analysis; and GeneDoc for the sequence analysis editor; and Mega 4 for the phylogenetic trees of the gene code. Results from Gene Doc demonstrated that the protein had a 42.52 percent of conservation, which means that the gene has barely conserved itself throughout its evolution. In MEGA4, the Homo sapiens’ protein is more similar to the Pan Troglodyte than to the other nine species that were compared. Future research will be to work with this genetic disorder searching if there are any neurological causes that can be affected because of Ichthyosis.
HIV ENVELOPE GLYCOPROTEIN (ENV) SEQUENCE BETWEEN PATIENTS IN PUERTO RICO

Christian Díaz Rivera, Caguas Military Academy, Caguas, Puerto Rico.

Research Mentor: Luis Lebrón Marrero, Universidad del Turabo, Gurabo, Puerto Rico.

HIV is the human immunodeficiency virus that can lead to acquired immune deficiency syndrome, or AIDS. CDC estimates that about 56,000 people in the United States contracted HIV in 2006. HIV infects primarily vital cells in the human immune system such as helper T cells (specifically CD4+ T cells), macrophages, and dendritic cells. HIV infection leads to low levels of CD4+ T cells. Most untreated people infected with HIV-1 eventually develop AIDS. These individuals mostly die from opportunistic infections or malignancies associated with the progressive failure of the immune system. The envelope glycoprotein (Env) of HIV mediates virus fusion and entry into susceptible cells. This study analyzed the ENV gene partial cds. Sequence alignment and protein modeling were used to identify and conserve portions of the protein.

MUTATIONS IN CALPAIN 3 USING A MODELING PROGRAM

Carola Figueroa, Marista School, Caguas, Puerto Rico.

Research Mentor: Luis Lebrón Marrero, Universidad del Turabo, Gurabo, Puerto Rico.

The calpain-3 gene is predominantly expressed in skeletal muscle tissue as a 3.5 kb transcript. Calpain-3 protein (CAPN3) is a muscle-specific member of the calpain family, a group of nonlysosomal calcium-dependent cysteine proteases whose functional role is largely unknown. Limb-girdle muscular dystrophy type 2A (LGMD-2A) is an autosomal recessive neuromuscular disorder. LGMD-2A is characterized mainly by symmetrical and selective atrophy of the pelvic, scapular and trunk muscles, elevated serum creatine kinase and a necrotic regeneration pattern on muscular biopsies. The alteration of a calpain has been identified as being responsible for causing limb girdle muscular dystrophy type 2A. The purpose of this study was to analyze Calpain 3 sequences obtained from NCBI data base using bioinformatics to compare and identify conserved sequences and sequences susceptible to mutations.

SINGLE NUCLEOTIDE POLYMORPHISM IN THE DIFFERENT CLASSES OF DOPAMINE RECEPTORS

Valerie Flores, Thomas Alva Edison School, Caguas, Puerto Rico.

Research Mentor: Luis Lebrón Marrero, Universidad del Turabo, Gurabo, Puerto Rico.

Schizophrenia is a chronic mental sickness. Most of the time it manifests itself at ages 16 to 24 in men and from 20 to 30 in women. Some symptoms that appear during this illness are paranoia, they start hearing voices, and they think other people control their thoughts or read their thoughts. The deregulation of the dopaminergic system has been implicated in the pathophysiology of major psychosis, including schizophrenia, with dopamine receptor genes (DRDs) presently targeted as the most promising candidate genes. Dopamine receptors genes variants have been associated with clinical aspects of schizophrenia. Three dopamine receptor sequences were investigated in order to study common domains and multiple sequence comparisons. The results revealed conserved sequences between the dopamine receptors. This can be used to understand the importance of conserved nucleotides.
THE TYPES OF SOILS AND CROPS IN MAYAGUEZ AND CABO ROJO


There are different types of soil that have different characteristics. Soil consists of many things like weathered rock particles and decayed plant and animal matter. Therefore, soils can be classified into various types such as Sandy, Silty, Clay, Loamy, Peaty and Chalky soil. The general objective of this research was to investigate the relationship between the types of soil and the corresponding types of crops in the Mayaguez and Cabo Rojo areas. Different types of soil require different types of crops. What may grow best in one area, may not grow at all in another area. Can the reasons for this variability be identified? To investigate these reasons, it was decided to choose two areas of interest: Mayaguez and Cabo Rojo. The towns of Mayaguez and Cabo Rojo provided a soil sample and investigate what types of crops are planted in such soil. Differences in soil types and crops were observed. These observations form the basis of this research and were tabulated and documented in the analysis. It is expected that the results of this research may identify the elements to produce more efficient plant growth by matching the soil type and the corresponding crop choice. The key to success is to make decisions based on knowledge of the various elements present in both soil type and crop selection. It is also expected that decisions based on actual field (soil and crop) information will attract young people to undertake farming.

PROTEOMIC ANALYSIS OF THE PSYCHROBACTER ARCTICUS

Keishla González, San Antonio Abad School, Humacao, Puerto Rico.

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

*Psychrobacter arcticus* is a genus of gram-negative bacteria from the Proteobacteria family. This bacteria is capable of thriving at temperatures as low as 0°C in extremely cold habitats such as Antartica. Using the Microsoft Excel Program, five proteins’ amino acids compositions from *Psychrobacter arcticum* were studied. The protein’s amino acid was divided between hydrophobic and hydrophilic. There was no major difference between the proteins’ amino acid compositions, but the main idea was to compare the proteins with their homologous in other *Psychrobacter* species.
ANALYSIS OF EVOLUTIONARY CHANGES OF THE DIPHTHERIA TOXIN

Charlotte Grau, Barbara Ann Roessler, San Juan, Puerto Rico.

Student Research Mentor: Dorielys Valentin, Universidad Metropolitana, San Juan, Puerto Rico.
Student Research Mentor Assistant: Karoline Ríos, Universidad Metropolitana, San Juan, Puerto Rico.

Diphtheria is a bacterial infection that spreads easily and the spreading occurs really fast. It is caused by the *Corynebacterium diphtheriae* bacteria. The area that is most affected by diphtheria is the nose and the throat. Diphtheria affects mostly children under 5 and adults over 60 years old who are at risk for contracting the infection and dying. The objective of this research was to determine evolutionary changes in the Diphtheria toxin in the selected species, and to determine the percentage of conservation between evaluated species by sequence alignment and comparison. The methods used for the research were GeneDoc, MEGA4, ClustalW2, and the NCBI BLAST. The NCBI BLAST finds the homologous sequence of the amino acids. MEGA4 is an integrated tool for conducting sequence alignment, and inferring phylogenetic trees. There are two types of phylogenetic trees: the maximum and the minimum. The maximum phylogenetic tree compares the evolutionary analysis between species and the minimum phylogenetic tree compares the protein between species. ClustalW2 is a multiple sequence alignment tool for the alignment of DNA or protein sequences. GeneDoc is a powerful editor which allows to manually edit and add a wide range of attributes to multi-sequence alignments generated by Clustal W2. It is expected that the results of this experiment will find that there has been a reasonable percentage of conservation where the Diphtheria toxin has changed throughout the evolution of the selected species for the protein comparison.

THE TURNER SYNDROME

Carlos Guillen Staimentz, Nuestra Señora de Guadalupe School, San Juan, Puerto Rico.

Research Mentor: Eduan Martinez Soto, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Maxine González Vega, Universidad Metropolitana, San Juan, Puerto Rico.

The Turner syndrome is a disease that happens in the genes of the organism that carries this condition. To have this condition, it does not necessarily have to be inherited from the parent of the progenitor (Judith Ross et. Al August 2008). This is a problem that occurs in the X chromosomes that causes webbed neck, lymph edema, problem with breast development, infertility, short finger and toes, heart defect, etc. The susceptible organism that has this condition and does not seek treatment before puberty can have serious alterations and expressions of the syndrome and even in some cases leading to death. The Noonan Syndrome is another syndrome that is compares with the Turner Syndrome, but the first one is in women and the other one is in men. In this research, data was collected until 2000 and the MATLAB Programming Language was used to find the trend distribution of the years 2000-2020 years for the Turner Syndrome Population to then predict the future of this illness.
Angelman Syndrome: The Happy Baby Syndrome

José Iglesias, La Piedad School, Trujillo Alto, Puerto Rico.
Research Mentor: Natalia Santiago, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Luis M. Ortiz, Universidad Metropolitana, San Juan, Puerto Rico.

Angelman syndrome is a condition that afflicts children from their birth to their teenage years. It is still much of a medical mystery as many of the symptoms are inexplicable. The reason for such is the way it develops throughout the body into different afflictions that normally have little or nothing to do with each other. They include convulsions, albino eyes, dyslexia, and motor problems, among others. In addition, there is a permanent smile that is found on all diagnosed patients. This smile reflects a seemingly permanent happiness that diminishes with age. Upon entering the teenage years, most of these symptoms fade away, especially the convulsions, but then problems with the spine arise. No cure or proper treatment has been found, but the cause is thought to be an arm deletion on the 15th chromosome cause by a mutation in the protein E6-AP Ubiquitin Ligase. To begin the investigation, the proper FASTA sequence was obtained from PubMed. Afterwards, The European Bioinformatics Institute (EBI) was accessed to utilize the NCBI program, which provides a series of homologous specimens to the gene. The FASTA sequence for each of these was recorded and finally placed in the Clustal W2 program, which produced the proper code to be input into the GeneDoc program. With the amino acids of each specimen color coded, what was now being analyzed was the conservation of proteins. The conclusion was that after the mutation, only 52 percent of the protein remained conserved. Following the information that was obtained, it is possible that the protein has gone through several changes throughout its evolution.

Wireless Signals and Their Effects on Germination of the Phaseolus Vulgaris and Capsicum Annuum

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Research Mentor Assistant: Alvin Peralta, University of Puerto Rico, Mayagüez, Puerto Rico.

Wireless local area network (WLAN or Wi-Fi®) is very common around us. The demand and implementation of wireless capabilities on devices is growing. The Wi-Fi is electromagnetic waves sent by a router are approximately 2.4 GHz. This number is considered the frequency of the waves transmitted to the environment. Higher frequency means greater energy. Walker (2002) explains that the electromagnetic waves within frequencies from 10⁹ Hz to 10¹² Hz are considered microwaves. Wi-Fi has a frequency of 10⁹ Hz, so it is a microwave, and is in the same wavelength as microwaves used to cook food. The effects of wireless signals on animal cells are well studied, such as Sambucci and other scientists’ (2010) research about prenatal Wi-Fi exposure effects. Otherwise, little is known about their effects on plant cells. In this research, fifteen (15) seeds of each species (Phaseolus vulgaris and Capsicum annuum) were exposed to wireless signals during their germination process. Another fifteen (15) seeds of each species were used for the control groups. All the variables were the same for all seeds. The Wi-Fi® was the only different variable between the experimental and control groups. Through the process of experimentation in this research of five (5) days, it was found that the seeds exposed to the wireless signals germinated at a lower rate than the control groups. Seeds in the experimental groups had shorter roots than the control groups. Based on the ANOVA results, it is concluded that germination of these seeds are affected by the Wi-Fi®.
CHANGES IN THE HGD HOMOGENISATE 1,2 – DIOXYGENASE PROTEIN

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HGD or more commonly known as Alkaptonuria is a rare condition in which the urine turns a brownish-black color after it is exposed to air for a period amount of time, dark spots appear in the sclera and cornea part of the eye and the arthritis worsens though out time especially in the spine between others. Pubmed was used to find information about the genetic disorder with Fasta, which is a format used to find the sequences in the amino acids. EBI, which stands for European Bio-Informatics Institute, is a server for multiple sequence alignment on the web. In EBI, BLAST and ClustalW2 were used. BLAST was used to find regions of local similarity between sequences and Clustal W2 is a general-purpose global sequences alignment program for DNA or Proteins. Genedoc is a full featured multiple sequence alignment editor, analyzer and shading utility. Mega 4 is an integrated tool for conducting automatic and manual sequence alignment, inferring phylogenetic trees and mining web-based databases. In the results of Genedoc, HGD had a 61.03 percent of conservation, which means that it had partially conserved itself throughout the years. In the results of MEGA 4 the maximum phylogenetic tree showed the comparison between species. It was observed that Homo sapiens and Pongo abelii were the most similar and Danio reiro were the least similar. The evolutionary analysis of protein sequence between the species is found in the minimum phylogenetic tree and it showed that Homo sapiens and Pongo abelii were the most similar and the least similar was Mus musculus.

HTLV-1 LEUKEMIA/LYMPHOMA VIRUS AND HOW IT CAN AFFECT CANCER GROWTH

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Nowadays one of the greater challenges of the Scientist is the fight against cancer. Cancer is the name for diseases in which the body cells become abnormal and divide uncontrollably. There are some viruses that provoke the growth of cancer in the cell. These viruses are also named retroviruses. They are viruses with a special characteristic that makes them different from normal viruses. Its genetic material or genome is composed of ARN instead of ADN. This information is the principal reason to investigate how a virus makes the cancer grow. An example is the human T-cell lymph tropic virus type 1 (HTVL-1) that provokes Leukemia/Lymphoma. How does it invade the healthy cells? The hypothesis of the project is that these cells multiply as soon as the RNA is affected with these viruses. They affect the nucleus of the same and continue infecting by passing the virus from one cell to the other. This research project is based on that cancer observation, which raises the question about the process of invading the healthy cells. An effort will be made to answer this question by reviewing diverse websites and visualizing the leukemia/lymphoma and its development in the cells. Hopefully, it will clarify the process based on photos, videos and other multimedia. A 3D structure will be used to show the formation of the retrovirus HTLV-1. It is expected that with searches and future analysis a clearer conclusion can be formulated to answer the key question of this research project.
RESISTANCE TO ANTIBIOTIC TREATMENT ON HUMANS DUE TO THE RAPID EVOLUTION OF BACTERIA

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Bacteria are frequently referred to as being resistant to antibiotics, but it is rarely known what that means. Even the most resistant bacterium can be inhibited or killed by a sufficiently high concentration of antibiotic. Patients, however, would not be able to tolerate the high concentration required in some cases. Bacterial species vary tremendously in their susceptibility to an antibiotic substance. This investigation is based on proving which bacteria is recognized for being resistant to common topical antibiotics, liquid antibiotics etc. The main conflict of this theory and investigation is: are common bacteria developing resistance to most antibiotics consumed frequently? Is the growing evolution of this bacterium rapidly happening instead of being inhibited? The hypothesis is that the bacteria are developing resistance due to a substance on the treatment, which causes immunity towards it. Or the bacterium is growing faster and more resistant because the medication is not accurate or strong enough. Or the proper concentration and administration of the antibiotic would be too strong for the patient. To gain a better understanding, a model was made in 3D of different bacteria using the Google Sketch Up program to show part of the process when the bacteria interacts with a certain antibiotic treatment.

BIOINFORMATIC ANALYSIS OF THE SHIGA TOXIN

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Shiga toxin is a toxin that is produced by the E.coli bacterium. It can cause infections in the intestines and if complicated develop other kinds of illnesses, even death. When the shiga toxin enters the cell it holds back the protein synthesis and affects the ribosome, thereby stopping it. The purpose of this research was to have a better knowledge of the shiga toxin by using bioinformatics tools. The MEGA 4 program was used to create two phylogenetic trees; the maximum phylogenetic tree where the evolutionary analysis between species was compared and the minimum phylogenetic where the protein between species was compared. In the maximum phylogenetic tree it was found that Shigella phage and Shigella dysenteriae are very similar, while Rickettsiella grylli is the least similar. In the minimum it was noticed again that Shigella phage and Shigella dysenteriae were the most similar; but Aeromonas caviae was the least. Through Clustaw2 the protein sequences were aligned. By using Gene Doc the percentage of conservation between species was found by viewing the CLUSTAL W2 alignment, where some conservation was expected to be found between the amino acid sequences.
THE EFFECT OF VIDEOGAMES ON THE PREFRONTAL CORTEX

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During the last few years, videogames have improved both visually and technologically, becoming more realistic to a point that made the videogame industry face legal actions due to controversies surrounding the adverse effects of constant gaming in young adults, most commonly, games that are renowned for their graphic violence. Videogames can be addictive and induce total focus on virtual objects or make individuals imitate actions seen during gameplay. The Prefrontal Cortex (PFC) is responsible for reasoning, logic, calculations, decision making, and cognitive reasoning, which is why this research focused around the use of mathematics to further study the effects of videogames on a young mind. Both control and experimental groups consisted of five individuals, from ages 14-16, of varying degrees in experience of gameplay. They solved fifteen mathematical exercises and were monitored during the entire session while answering the exercises; completion time was monitored and each individual was graded on their test. The data was collected and sorted to be tabulated and presented. It is expected that the results will show lower academic achievement by the experimental group.

MUTATIONS FROM THE APC GENE IN THE APC-PROTEIN

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The adenomatous polyposis coli gene, also known as APC, is located in the chromosome 5, with base pair size 112,043,217 to 112,181,935. It encodes the protein known as ATC protein. This protein helps control how often a cell divides, how it attaches to other cells within a tissue, and whether a cell moves into or away from a tissue. It also helps ensure that the number of chromosomes in a cell is correct after each cells divides. The APC protein accomplishes these tasks mainly through association with other proteins, especially with those that are involved in cell attachment and signaling. A mutation of the APC gene most often results in colorectal cancer. Colorectal cancer is a cancer that forms in the tissues of the colon, the largest part of the large intestine. SIFT was used, a sequence homology-based tool that helps predict whether the substitution of an amino acid will cause a phenotypic effect such as a mutation. If the level of tolerance of the amino acid substitution is below 0.05 then a mutation will occur. The first 20 positions of the APC protein were used to find the probability of mutation in this gene. An average of 81% was found to be intolerant to amino acid substitutions while 19% was found to be tolerant. Therefore there is a high probability that an amino acid substitution will result in a mutation.
ANALYSIS OF EVOLUTIONARY CHANGES OF HEXOSAMINIDASE A IN TAY-SACHS DISEASE

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Tay-Sachs disease is a deadly disease of the nervous system. It is classified in different stages: infantile, juvenile and adult. The most common is infantile, which leads to death in 4 to 5 years. This happens when the body lacks hexosaminidase A, which breaks down the gangliosides, a chemical in the nerve cells system. Without hexosaminidase the ganglioside builds in nerve cells in the brain. The objectives for this research were establish evolutionary changes in hexosaminidase A, the protein for Tay-Sachs in the selected species by using phylogenetic trees and the percentage of conservation between evaluated species by sequence alignment and comparison. NCBL BLAST was used to find the sequence of the aminoacids, MEGA 4 for the phylogenetic trees, Clustal W2 to align the protein sequence and GeneDoc to edit and find the percentage of conservation in the multi sequence. In both the maximum and the minimum phylogenetic tree, Macaca fascicularis and Oryctolagus cuniculus were the most similar, while Sus scrofa was the least similar. For the percentage of conservation, it was anticipated that the results would be a high percentage.

COMPARATIVE ANALYSIS OF AMINO ACID SEQUENCE IN HHV6A AND HHV6B

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HHV-6 has two variants, A and B. HHV-6A could be isolated in the immune system compromised hosts. It does not have a specific symptom. The herpesvirus-6B causes Roseola infantum, a childhood illness. Both, HHV-6A and HHV-6B may be pathogenic in the settings of transplantation and AIDS. Children are the ones that have this disease, but that does not mean that adults cannot have it. The purpose of this research was to evaluate the evolutionary changes of the sequences by inferring phylogenetic trees and to evaluate the percentage of amino acid conservation by sequence alignment and protein comparison. BLAST was used to find the sequence of amino acids, MEGA 4 to get the phylogenetic trees, Clustal W2 for the alignment of the protein sequences and GeneDoc to manually edit and find the percentage of conservation of the multi-sequence alignments generated by Clustal W2. It is anticipated that the GeneDoc results will have a moderate percentage of conservation because the virus has changed too much through the years.
APERT SYNDROME: A MUTATION IN THE FGFR2 GENE

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Apert syndrome is a genetic defect in which the skull is prematurely fused, affecting both the shape of the face as well as the skull shape. The most common characteristics of this syndrome are low-set ears, a nose with a parrot-beaked appearance, and a mouth area with a prominent mandible, down-turned corners, and a high arched palate. The one characteristic that distinguishes Apert syndrome from other genetic disorders, however, is syndactyly, the fusion of the soft tissues of the first, middle, and ring fingers; often there is also fusion of the bones themselves. At present, there is no cure for this disease. The purpose of this research was to obtain more information on Apert syndrome, particularly on the gene that is affected when this genetic disorder presents itself in an organism, the FGFR2 gene. Research was conducted on the Internet, and Pubmed was used to view the FGFR2 gene; afterwards, EBI was used to analyze areas of similarity within the Fibroblast Growth Factor Receptor 2 protein. The protein alignments were then viewed on GeneDoc. Finally, Mega4 was used to study phylogenetic trees and analyze ancestral sequences. In terms of the study area in this research, the investigation focused on the skull, face, fingers, and toes. Future work will include learning more about Apert syndrome, as well as the FGFR2 gene and ways of helping children with this genetic disorder.

COMPUTATIONAL STUDY OF AA CHANGES ON THE ATM GENE

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The Ataxia Telangiectasia gene provides instructions for creating a protein that is located in the nucleus of cells, with the aim of controlling the rate which cells grow and divide. The protein also plays an important role in the normal development and activity of several body systems, including the nervous system and the immune system. Researchers have identified some mutations in the ATM gene that cause Ataxia-Telangiectasia. These mutations disrupt protein production, resulting in an abnormally small, nonfunctional version of the ATM protein. Cells without any functional ATM protein do not respond normally to DNA damage. Instead of activating DNA repair, the defective ATM protein allows mutations to accumulate in other genes, which may cause cells to grow and divide in an uncontrolled way. This kind of unregulated cell growth can lead to the formation of cancerous tumors. 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. Several positions of the protein were selected to explore if it had mutation or not. Changes in amino acids of 47% were tolerant for mutation and 53% of amino acids changes were intolerant. This means that an average percentage of amino acids changes refuse to go along with the changes and therefore it can cause a mutation.
ANALYSIS OF THE HUNTINGTON DISEASE PROTEIN USING BIOINFORMATICS TOOLS

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Huntington Disease (HD) is an inherited neurodegenerative disorder that is mostly known for behavioral and cognitive impairments. The cells and neurons degenerate. Some of the most common symptoms are uncontrolled movements and balance problems. There is no way to cure HD, but doctors prescribe a number of medications to help control it. The objectives of this study were to compare the species and protein of the homologous by sequence alignment and to determine if there are changes in the gene in the selected species. The sequence of the Huntington Protein (HTT) was acquired in the NCBI Blast database; it was used to find the regions of local similarity between sequences. The sequences alignments were analyzed by the MEGA4 program, obtaining the phylogenetic tree with the purpose of identifying the evolutionary relationships between different organisms. There are two types of phylogenetic tree: the maximum phylogenetic tree that compares the evolutionary analysis between species and the minimum phylogenetic tree that compares the protein between species. In the maximum, Branchromosoma floridae and Xenopus tropicalis were the most similar, while Strogylocentrotus purpuratus was the least similar. The minimum tree showed again that Homo sapiens and Sus scrofa were the most similar; but Strogylocentrotus purpuratus was the least similar. Genedoc, a full featured Multiple Sequence Alignment Editor, Analyzer and shading utility was used to find the percentage of conservation. It was expected to find a moderate percent of conservation where the gene has changed throughout the evolution of the selected species.

BIOINFORMATICS AND EVOLUTIONARY ANALYSIS OF HFE GENE

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The Human Papilloma virus is an infection caused by skin contact and in most times sexual intercourse. The virus is formed by small particles which contain the protein L1 that gives the structure and the protein E2 that gives its persistency. The objectives for this project are to evaluate the evolutionary changes in the protein by inferring phylogenetic trees and to determine the percentage of conservation between the evaluated species by sequence alignment and protein comparison. The methods used were NCBI BLAST that searches for the protein’s homologous sequences, CLUSTAL W2 that aligns the sequences, GeneDoc that finds the percentage of the conservation of the amino acids and MEGA 4 that infers the phylogenetic trees. The maximum phylogenetic tree showed that the species Macaca mulatta and Macaca fascicularis were very similar, while Bos taurus was the least. In the minimum phylogenetic tree the species Macaca mulatta and Macaca fascicularis, while Sus scrofa and the Felis cattis were the least. The difference in them is that the maximum tree evaluates the evolutionary analysis of the species and the minimum tree compares the protein between the species. It was expected that GeneDoc would help find a moderate percentage of conservation where the proteins have changed throughout the evolution of the different species.
EVALUATION AND BIO-INFORMATICS OF THE GSTP1 AND GSTM1 USING CLUSTALW2, GENEDOC AND MEGA4

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Glutathione S-Transferase pi 1 (GSTP1) and Glutathione S-Transferase mu 1 (GSTM1) are two of the main classes of the GSTs gene. GSTs have the official name of Glutathione S-Transferase. The genes are proteins coding that are rated by the biochemical, immunological and structural properties of the gene. GSTP1 is an enzyme that categorizes the hydrophobic compounds. The GSTP1 gene is found most commonly in prostate cancer. GSTM1 has the function of detoxification of electrophilic compounds. GSTM1 is related to squamous cell carcinoma of the head and neck (SCCHN), and to lung cancer. The objectives of the investigation were to determine the percentage of conserved amino acids between species and infer the evolutionary changes between the protein species and their amino acid sequences.

The programs that were used in the research were GeneDoc and MEGA4. GenDoc is a program used for the comparison, visualization and alignments of species; the program 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 between the species; and the minimum is a protein comparison between the chosen species. GeneDoc showed that the percentage of conservation between evaluated species in GSTP1 was 55%, and in GSTM1 was 51%. In MEGA4, the GSTP1 showed that in the minimum phylogenetic tree the *Pongo abelii* and the *Macaca mulatta* were the most similar in the protein sequences than the *Sus scrofa*. The maximum phylogenetic tree in GSTP1 showed the same that the minimum phylogenetic tree, but the relation was between the species. The minimum phylogenetic tree in the GSTM1 showed that *Homo sapiens* and the *Macaca fascicularis* were similar and the *Mus musculus* was the least similar in the protein. The maximum phylogenetic tree in GSTM1, showed that the *Macaca fascicularis* and the *Bos taurus* were the most similar in the species than the *Oryctolagus cuniculus*. In conclusion, GenDoc presented from a 51% to a 55% percent of conservation suggesting that the GSTP1 and GSTM1 protein can tolerate changes in their structure. MEGA4 showed that the relation between each species and the protein was similar.
ANALYSIS OF HLA PROTEIN IN CELIAC DISEASE USING BIOINFORMATICS METHODS

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Celiac disease is a genetic disease that causes several damages in the small intestine. The people who have this cannot eat food that contains gluten. Gluten is a protein that is found in different sources: wheat, rye, barley, and oats. Human Leukocyte Antigen (HLA) is one of the most diverse classes of proteins in all of human biology. The objectives of this study were to determine evolutionary changes in the HLA gene for the selected species by inferring phylogenetic trees and to determine percentage of conservation between evaluated species by sequence alignment and comparison. Two of the programs used were MEGA 4 and GeneDoc. The Molecular Evolutionary Genetics Analysis (MEGA 4) is a program that integrates tools for conducting automatic and manual sequence alignment and inferring phylogenetic trees, estimating rates of molecular evolution, inferring ancestral sequences, and evolutionary hypotheses. MEGA4 was used to compare the HLA gene with different species by inferring the maximum and minimum phylogenetic trees. The maximum phylogenetic tree compares the evolutionary analysis between species and the minimum phylogenetic tree compares the protein between species. In both the maximum and the minimum phylogenetic trees Gorilla gorilla and Pan troglodytes were the most similar, while Macaca nemestrina was the least similar. GeneDoc is a full featured multiple sequence alignment editor and analyser, which was used to determine the percentage of conservation.

BIOINFORMATICS STUDIES OF DOWN SYNDROME USING EST2 AND DYRK1A PROTEINS

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The Down Syndrome is an intellectual disability that affects the human race. This syndrome is caused because of a trisomy that forms in part or all the genes inside chromosome 21. The protein Ets2 is a member of the ETS gene family, with sequence homology and with the retroviral ets sequence of the avian erythoblastosis retrovirus E26 (this protein is located in chromosome 21). The DYRK1A protein is very involved with the cause of Down syndrome, it participates in the pathogenic mechanisms that have to do with the mental and other physical symptoms of the syndrome. The objectives for this project were to establish evolutionary changes in the gene of interest in the selected species by inferring phylogenetic trees and to determine the percentage of conservation between evaluated species by sequence alignment and protein comparison. The methods used were NCBI Blast with which searches were conducted for the homologous sequences, Clustal W2 with which sequence alignment was done, GeneDoc which was used to view the aligned the sequences and the percentage of conservation was found, and MEGA4, which was used to infer the phylogenetic trees. The maximum phylogenetic tree of the DYRK1A protein showed that Xenopus tropicalis and Xenopus levis were the most similar, but that Mus musculus was the less similar. The minimum phylogenetic tree of the DYRK1A protein showed that Homo sapiens and Mus musculus were the most similar, but Drosophila melanogaster was the least similar. On the other hand, both the maximum and the minimum phylogenetic tree of the ETS2 protein showed that Homo sapiens and Bos taurus were the most similar, but Rattus norvergicus was the least similar. In the GeneDoc results it was anticipated that there would be a moderate percentage of conservation where the protein had changed through time.
WHICH PAIN RELIEVER HAS A FASTER DISSOLUTION TIME: BRAND OR GENERIC?

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When an individual is in pain, he or she takes an analgesic, or painkiller to stop that pain. Some of the most common over the counter analgesics are ibuprofen and acetaminophen. Pain is produced by the COX-2 and COX-3; they work by producing prostaglandins, which cause pain and inflammation. Acetaminophen works by inhibiting the COX-3 enzyme, and ibuprofen works with COX-2. Generic medications work the same way and cost less; however, it is not known which dissolves faster. To carry out this research, generic and brand-name gel-filled ibuprofen and acetaminophen were tested. They were placed in a cup with Hydrochloric Acid, the main acid in the stomach, and the process was watched and recorded to find out how much time they took to dissolve. This step was repeated and each result recorded in a table. The results were compared and graphed using MATLAB.

ANALYSIS OF THE DISEASE RESISTANCE GENE RPS4 IN ARABIDOPSIS THALIANA

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Plants use an active innate immune system to defend themselves against potentially pathogenic microbes. One aspect of the response is elevated transcription of defense associated genes. Pseudomonas syringae pv. phaseolicola (Pph) is a pathogen of bean, but is non-pathogenic and induces robust defense responses on Arabidopsis. Pph encodes an effector protein - AvrRps4 - that is recognized by a plant disease resistance protein - RPS4. Interaction of Pseudomonas syringae pv. phaseolicola (Pph) with Arabidopsis elicits strong defense responses in the absence of plant cell death and is a good research model. The transcription factors expressed after Pph infection in Arabidopsis thaliana were obtained. Sequences of transcription factors were selected and analysed using bioinformatics tools in order to identify genes whose expression is affected by RPS4 activation.

THE EFFECT OF TEMPERATURE OVER MACROINVERTEBRATE ABUNDANCE OF TWO STREAMS IN SAN JUAN, PUERTO RICO

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Streams have a great importance in the development and maintenance of different ecosystems, and serve as habitats for many aquatic animal and plant, species. Although it is believed that temperature is an indicator of the macroinvertebrate abundance of a stream, there are not sufficient studies to sustain it. Stream ecosystems are an important source of food in the lower trophic levels and any change in these will have repercussions in the higher levels thus affecting human beings. Hence it is important to understand the behavior of stream ecosystems towards stressing factors as temperature. To prove the relationship between temperature and macroinvertebrate abundance, Total Phosphorus (TP), Total Suspended Solids (TSS), pH levels, water temperature, and macroinvertebrate abundance and richness were measured in two streams with different catchment areas (rural and urban). It was expected that macroinvertebrate abundance in the urban stream would be more affected by temperature than the one in the rural stream; and those macroinvertebrates would have different tolerances to these differences in temperature, and their richness would reflect the impact of temperature upon the stream. This study will allow a better understanding of the consequences that temperature raises will have over stream ecosystems in the next years.
PROTEOMIC ANALYSIS OF THE *PSYCHROBACTER CRYOHALOLENTIS K5*

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The *Psychrobacter* genus is characterized as a separate genus within the gamma-proteobacteria. The *Psychrobacter* species is able to reproduce at very low temperatures. This species has been isolated mostly from low temperature aquatic environments, including Antarctic sea ice, ornithogenic soil, and sediments. The major differences among *Psychrobacter* species is their proteome. Accordingly, it demands the analysis of their proteome. With the bio-informatics application, five *Psychrobacter cryohalolentis K5* proteins were analyzed (hydrophobic and hydrophilic amino acid composition). Important differences between them were not found, but a comparison between homologous proteins from the different *Psychrobacters* are needed and the main idea for better comprehension of psychrophile. A software that atomically analyzes different properties was built. This analysis significantly improved the interpretation of the *Psychrobacter cryohalolentis K5* protein expression at subzero temperatures and growth efficiency.

WILSON’S DISEASE

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Wilson’s disease is caused by a mutation in the ATP7B gene, also called the Wilson’s disease gene. ATP7B has been mapped to chromosome 13 (13q14.3) and codes for a P-type ATPase that incorporates it into the ceruloplasmin and releases into the bloodstream, as well as removes excess copper by transporting it into bile. Because the mutation in the gene both functions are impaired, it causes copper to accumulate in the liver tissue which can lead to liver damage. The liver also releases copper into the bloodstream. This free copper precipitates throughout the body but some areas are more affected particularly the kidneys, eyes and brain. First PudMed was used to obtain the FASTA format for the protein produced by the gene. After obtaining the FASTA, it was put in EBI’s NCBI Blast to find similar proteins in other species with a margin of difference. Then EBI’s ClustalW2 was used to align the sequence in a way GeneDoc could read it. GeneDoc was used to analyze the alignments. Results from GeneDoc demonstrated that ATP7B had a 64.08 percent of conservation. In conclusion, ATP7B had slightly conserved itself and that it had multiple changes through its evolution.

GENE AND GENOME BASED BIOPROSPECTING

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Research Mentor: Luis Lebrón Marrero, Universidad del Turabo, Gurabo, Puerto Rico.

Exercises related to the discovery of useful genes and genomes from natural environments were conducted. The methods used were DNA-based, though, by analogy, they could be extended to RNA with minor modifications. The project was started with the isolation of DNA from soil and root materials. The DNA was then used for a metagenomic analysis and a directed gene-specific search. In the metagenomic approach, the DNA was prepared from corn field samples for Illumina sequencing and analysis of the sequences using BLAST software and bioinformatics tools. BLAST and sequence alignments were used to investigate structural and phylogenetic diversity of the cloned sequences. These approaches were used for novel genes.
GEOTHERMAL COMPARISON OF THE WASTEWATER TREATMENT PROCESS BETWEEN PUERTO RICO AND CALIFORNIA

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The island of Puerto Rico has sixty-six wastewater treating plants: seven for the primary step, fifty-eight for the secondary step and only one plant for the advanced treatment of wastewater. The island does not have the complete water recycling process available and only some benefits obtained from the recycled water. Right now the government of Puerto Rico along with the Autoridad de Acueductos y Alcantarillados (AAA) is looking for ways of improving the water recycling system. In Caguas, they are expanding the water plant to increase the production from 12 MGD to 24 MGD. This expansion will permit the elimination of approximately forty sewage-pumping stations in the area. The government is also constructing two reserve tanks and is trying to reduce the number of sewers and increase the production of recycled waters. Today the AAA processes around 300 MGD, and this number will certainly increase. In comparison, the state of California has the full three-step process to water recycling. The Laguna Wastewater plant in Santa Rosa generates 21 million gallons a day. The water processed in this plant has a much greater level of disinfection than the one in Puerto Rico because this plant consists of larger reservoirs which permit the water to be stored and processed in the future. The Laguna Wastewater treating plant also consists of the tertiary step to the process that has not yet been established in Puerto Rico. The purpose of this investigation was to create educational materials on the water treatment process in Puerto Rico, and the its contamination. The geothermal process is socially and economically beneficial because it preserves natural resources while giving a beneficial use to the community.
Penicillin-binding proteins are a big group of proteins that are characterized by uniting to beta-lactam antibiotics to reinforce the antibiotic’s efficiency. These proteins have the power of making a beta-lactam antibiotic, such as penicillin, efficient, but an altered PBP, as they are called, can weaken an antibiotic and make it inefficient in completing the disruption of the cell wall synthesis. PBP 1 is a large family of penicillin-binding proteins with a large molecular weight that are involved in the formation of the cross-linked peptidoglycan and may be indispensable in the process of cell growth. PBP5s are essential in defining the molecular shape of some bacteria and determine the overall topology of the peptidoglycan sacculus, which is the stress-bearing structure of bacteria. The purpose of this research was to determine the percentage of conservation in the amino acid sequence of these two penicillin-binding proteins, when comparing those of *Escherichia coli* to nine other species and to infer phylogenetic trees to analyze the evolutionary changes of the selected species. The methodology used in this investigation consisted of NCBI BLAST, which was used to select the species to be used for the comparison, CLUSTALW2, used to align the sequences, GeneDoc, which was used to obtain the percentage of conservation between species, and MEGA4, used to infer maximum and minimum phylogenetic trees. The percentage of conservation for PBP1 was of 77% and for PBP5 it was 72%. The results obtained from this analysis demonstrate that, for PBP1, in the maximum phylogenetic tree, which establishes a comparison between species, the most similar were the *Shigella boydii* and the *Shigella flexneri*, while the least similar was the *Citrobacter youngae*. The minimum phylogenetic tree for PBP1 demonstrated that the species with the most similar amino acid sequences were also the *Shigella boydii* and *Shigella flexneri*, while the least similar was the *Salmonella enterica*. For the maximum and minimum phylogenetic trees of PBP5 the most similar were *Escherichia coli* and *Shigella flexneri*, while the least similar was *Erwinia amylovora*.

**THE MUTATION OF THE X CHROMOSOME CAUSES AARSKOG SYNDROME**

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Aarskog syndrome is an inherited disease that affects a person's height, muscles, skeleton, genitals, and appearance of the face. It is transmitted from parent to child. This illness is a genetic disorder that is linked to the X chromosome. The objective of this investigation was to determine the cause (mutations) of the X chromosome that creates the Aarskog syndrome. In order to accept this investigation, the following programs were used: Pubmed, which helped to convert the proteins into a fasta program; EBI where NCBI Blast was used to find similar organisms that had the same protein and Clustal W2 in order to align the Fasta so that GeneDoc could understand it. Finally, GeneDoc revealed how much the protein had been conserved through time. Thanks to these programs, it was determined that the Aarskog syndrome occurred because of a family genetic disorder.
Long QT Syndrome (LQTS) is a disorder of the heart’s electrical activity in which troubled ion channels disrupt the timing of the ventricle's activity. Long QT Syndrome is caused by the A-kinase protein leading to unexplained fainting, unexplained seizures, unexplained drowning or near drowning, and unexplained cardiac arrest. In most cases, LQTS is inherited, but other causes for this syndrome are: some medicines (decongestants, pills that remove water from the body, antibiotics, antidepressants, cholesterol-lowering, and some diabetes medicines), excessive diarrhea and excessive vomiting which cause the loss of potassium and sodium in the ion channels. The objective for this experiment was to establish evolutionary changes in the A-kinase protein for the LQTS in the selected species by inferring phylogenetic trees and to determine the percentage of conservation by sequence alignment and comparison. The programs used were NCBI BLAST (Basic Local Alignment Search Tool), which was used to compare the primary biological sequences and MEGA 4 (Molecular Evolutionary Genetics Analysis), a tool for conducting automatic and manual sequence alignment and inferring phylogenetic trees. Mega 4 was used to make two phylogenetic trees, the maximum and the minimum. The phylogenetic showed that in both, the maximum and minimum phylogenetic trees, Rattus norvegicus and Mus musculus were the most similar while Bos taurus was the least similar. Clustal W2 was for the alignment of the protein sequences, and GeneDoc was the alignment editor used to find the percentage of conservation. It was expected to find with GeneDoc a low percentage of conservation where the proteins have changed a lot throughout the evolution of the species.

USING BIOSYNCOP TO CREATE A SYNTHETIC PROTEIN COST'S DATA BASE

Proteins, like DNA, are the blocks of life; cells expend Adenine Three Phosphate (ATP) to create this block. Methods and tools to calculate how much ATP a cell spends in synthesizing a protein are needed to better study the psychrophile organism. ByoSynCop is a software used to calculate how much energy (measure in ATP) a cell invests in a specific protein, based on the amino acid sequence. Using ByoSynCop, synthetic proteins were generated a cost database of Psychrobacter arcticus, Psychrobacter PRwf-1 and Psychrobacter cryohalolentis species. A web page was planned and was started where the public can download ByoSynCop and look for protein already in the database. The database only contains different Psychrobacter proteins, but in the future more species will be added to the data base the hydrophobic and hydrophilic amino acid composition will be included.
MONOOXGENASE ANALYSIS IN BACTERIA AND FUNGI WITH AN INSIGHT IN BIOREMEDIATION

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Research Mentor: Luis Lebrón Marrero, Universidad del Turabo, Gurabo, Puerto Rico.

Hydrocarbons in whatever form are generally the most common contaminants that require remediation due to their widespread occurrence and the risks they pose to human health and the environment. Bioremediation is the use of microorganism metabolism to remove pollutants. The end products of the biodegradation of hydrocarbons can be used as an energy source and other important applications. Methane monooxygenase (MMO) is an enzyme capable of oxidizing the C-H bond in methane as well as other alkanes. Methane monooxygenase belongs to the class of oxidoreductase enzymes and has potential applications for converting waste methane into methanol. The purpose of this study was to compare the enzyme sequence of some bacteria with the enzyme sequence of fungi to see the differences. Comparisons were made using the sequence T-COFFE.

STUDY AND ANALYSIS OF THE ASPA GENE IN CANAVAN DISEASE

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Canavan Disease is a gene-linked, cerebral disease, caused when the body produces less of the normal amount of aspartoacylase. The Aspartoacylase or ASPA gene is located on the short arm of chromosome 17 between the end of the arm and position 13. Some of the symptoms that children that inherit this disease can have are: reflux with vomiting, increasing head size, poor muscle tone, among others. It is impossible to determine Canavan Disease in all children, since the symptoms may vary from child to child. It can be inherited from one or both parents. The objective of this research was to determine evolutionary changes of the ASPA gene in the selected species and to establish the percentage of conservation between evaluated species by sequence alignment and protein comparison. CLUSTAL W2 was used to complete a sequence alignment. After that, the Molecular Evolutionary Analysis 4 (MEGA 4) was used to compare the ASPA gene and the proteins of other species by inferring two phylogenetic trees, a maximum and a minimum tree. The maximum tree showed that Homo sapiens and Pongo abelli were the most similar, while Crocosphaera watsoni was the least similar. On the other hand, the minimum tree showed that Homo sapiens and Pongo abelli were also the most similar, but the least one was Photobacterium angustum. In GeneDoc was also used to view the CLUSTAL W2 alignment, and to evaluate the percentage of conservation between the comparison of species and proteins.
EVOLUTIONARY STUDY OF THE HIV-1 GENE

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The Human Immunodeficiency Virus is a condition that destroys the immune system, making it harder for the body to fight against infections. HIV is a chronic medical condition that can be treated, but not yet cured. However, there is a small group of people who develop AIDS very slowly, or never at all. These patients are called long-term non-progressors. There are effective ways to prevent complications and delay, but not always prevent progression to AIDS. Almost all the people infected with HIV will develop AIDS if not treated. The objective for this experiment was to establish evolutionary changes in the CCR5 protein for HIV-1 in the selected species by inferring phylogenetic trees and determining the percentage of conservation between evaluated species by sequence alignment and comparison. NCBI BLAST was used to find the sequence of the amino acids, MEGA4 to get the phylogenetic trees, Clustal W2 for the alignment of the protein sequences and GeneDoc to manually edit and find the percentage of conservation of the multi-sequence alignments generated by Clustal W2. In the maximum, Pygathrix nemaeus and Pygathrix bieti were the most similar, while Macaca tonkeana was the least similar. The minimum tree showed that Trachypithecus francoisi, Pygathrix nemaeus and Nasalis larvatus were the most similar; and Homo sapiens was the least similar. For the GeneDoc results, it is expected that there will be a moderate percentage of conservation because the protein has not changed too much throughout the evolution of the species.

ANALYSIS OF THE PROPERTIES OF THE PSYCHROBACTER SP. PRWF-1 PROTEINS

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The Psychrobacter genus is composed of the psychrophile bacteria that can live in different extremely cold habitats, and are living organisms that are more similar to extraterrestrial life. The biggest differences between the Psychrobacter species is their proteome. Therefore, an analysis of their proteome is required. The differences between Psychrobacter sp. PRwf-1 proteins were analyzed. Using bio-informatics, the differences between their properties (e.g. hydrophobic and hydrophilic) were observed. No great differences were observed between the above proteins. As a future work, the creation of a software that automatically analyses different properties is going to be built. Also, a comparison between homologous protein from different Psychrobacter are going to be made for better understanding of psychrophile. Analysis of the differences in the protein compositions of the several proteins studied may lead to the growth of scientific knowledge, and a better understanding of the extraterrestrial bacteria life.
THE EFFECT OF INDICENCES OF MUONS AS COSMIC RAYS AIR SHOWER DURING THE DAY OVER THE EARTH AND SOLAR FLARES


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Cosmic rays can interact with nuclei in the Earth's upper atmosphere. Showers occur when these particles are extremely energetic, and produce large numbers of other particles mostly of which are pions. These particles also known as secondary particles quickly decay into the particles that strike Earth's surface (Lochner, 2011). During a shower, thousands of these particles can strike an area as large as several square kilometers nearly simultaneously. Cosmic rays are energetic particles originated from the cosmos that then impinge on the Earth's atmosphere and cause a cosmic ray shower (NASA, 2011). This research consisted of counting the amount of muons during the day and during the night. This data was collected by a muon detector located indoors at CROEM. This data was processed by e-lab that can be found at www18.i2u2.org/elab/cosmic. Once the system processed the data a graph was plotted. The graph was based on the amount of muons collected by the detector and the flux in terms of: Flux equal (events/m²/60-seconds). The purpose of this research was to determine if there is a relationship between solar flares and the incidence of muons as cosmic ray air showers. To prove this, one needs to establish and prove that there is a relationship between the Sun’s activity and the incidence of the muons as cosmic rays air showers. The results of this research indicate that there was effectively an amount of difference between the amount of cosmic ray air showers during the day and during the night. It was also revealed that during a solar flare the amount of cosmic ray air showers increase drastically.

LYSOSOMAL STORAGE DISEASE CALLED TAY SACHS

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Tay Sachs is a genetically inherited Lysosomal storage disease that affects nerve cells in the brain and spinal cord, and is caused by a mutation in the 15th chromosome. The mutation occurs in the HEXA gene, which provides instructions for making part of the enzyme beta-hexosaminidase A, located in the cell structure that breaks down toxic substances, the lysosomes. Nevertheless, in the Tay Sachs disease there is an insufficiency or a lack of beta-hexosaminidase A, which translates in the accumulation of toxic levels of GM2 ganglioside, and results in the destruction of the neurons and nerve cells in the spinal cord. Pubmed is a free database that permits the access to life science and biomedical information. This program was used to search for the protein affected by Tay Sachs in Homo sapiens. EBI, the European Bioinformatics Institute, is a program that services and helps with the research in bioinformatics. EBI was used to find the most similar organisms with the protein in question and to convert the proteins’ information to GeneDoc format using Clustal W2. GeneDoc, a sequence alignment editor, was used to read and organize the proteins’ information. MEGA4 (Molecular Evolutionary Genetics Analysis 4) is a program that compares and analyzes genes or proteins sequences among different species. Results from Gene Doc demonstrated that the protein had 81.91 percent of conservation of the Tay Sachs protein throughout evolution, which means that it has gone through little change and has a high percent of conservation. MEGA4 compared the Homo sapiens, Pongo abelii, Bos taurus, Mus musculus and Rattus norvegicus species, and the results showed that the Homo sapiens protein is more similar to that of the Pongo abelii.
CHEMISTRY

IS ACETAMINOPHEN DANGEROUS?

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The hypothesis in this research was based on the fact that a person should not take any overdose of acetaminophen. It is well known that acetaminophen is a medicine that cures and heals different types of pain in the body. It is used in many medications such as Tylenol, Panadol, Advil, etc. Acetaminophen is used with other chemicals to relieve pain, but not everyone knows the secondary effects that this medicine may cause. The purpose of this study was to answer the question of how acetaminophen causes damage to childrens’ livers through a 3D graphics animation.

ANALYSIS OF THE FUNCTIONAL GROUP OF THE ACTIVE INGREDIENT CAFFEINE (MIDOL) USING INFRARED SPECTRUM AND GAUSS VIEW PROGRAM

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

Density functional (DFT) calculations have been carried out to study the interactions and vibration movements of the functional group of the active ingredient Caffeine utilized in Midol pellets. This compound contains covalent bonds that the infrared technique can both detect and determine the frequencies emitted by functional group that characterized the Lorezepam. The compound Caffeine (1,3,7-trimethyl-1H-purine-2,6(3H,7H)-dione, in humans it acts as a central nervous system (CNS) stimulant, temporarily warding off drowsiness and restoring alertness. The nature of these interactions and vibrations movements is further analyzed through the computer infrared spectra and electrostatics.

VISUALIZATION OF THE COMPONENT NABUMETONE (RELAFEN) USING THE INFRARED SPECTRUM TECHNIQUE (FT-IR SPECTRUM)

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

Density functional (DFT) calculations have been carried out to study the interactions and vibration movements of the functional groups of the active ingredient Nabumetone (Relafen pellets). Nabumetone (4-(6-methoxy-2-naphthyl)-2-butanone) is a nonsteroidal anti-inflammatory drug (NSAID). It relieves pain and inflammation associated with inflammatory arthritis and osteoarthritis. This compound contains covalent bonds the infrared technique (FT-IR Spectrum) can both detect and determine the frequencies emitted by functional groups that characterize the Nabumetone. These compounds are considered as the model systems for the synthesis of 1-naphthaleneacetic acid. The nature of these interactions and vibration movements are further analyzed through the computed infrared spectra and electrostatics.
STUDY OF THE FUNCTIONAL GROUP THAT CONTAINS THE ACTIVE INGREDIENT LORAZEPAM (ATIVAN) USING THE INFRARED SPECTRUM

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Density functional (DFT) calculations were carried out to study the interactions and vibration movements of the functional groups of the active ingredient Lorazepam (C₁₅H₁₀Cl₂N₂O₂) utilized in Ativan pellets. This compound contains covalent bonds that the infrared technique can both detect and determine the frequencies emitted by functional groups that characterize the Lorazepam. The compound Lorazepam ((RS)-9-chloro-6-(2-chlorophenyl)-4-hydroxy-2,5-diazabicyclo[5.4.0]undeca-5,8,10,12-tetraen-3-one) in humans, is used for the short-term treatment of anxiety, insomnia, acute seizures including status epileptics and sedation of hospitalized patients. These compounds are considered as the model systems for the synthesis of Chlordiazepoxide and Oxazepam. The nature of these interactions and vibration movements are further analyzed through the computed infrared spectra and electrostatics.

THE EFFECT OF LEAD IN LIPSTICK TO HUMAN HEALTH


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This research will show the effects of lead in lipstick to human health. Lipstick is one of the most widely used and bought cosmetics in the world. Its sole purpose is to give that necessary shade of color to women in the need of a little zest in their look. But what most women do not know is that what they are applying to their lips is a combination of various hazardous chemicals, but among all of them, the most common is Lead. It is an element with an atomic number 82. It is a soft malleable poor metal, but it is also counted as one of the heavy metals. Lead is a chemical component that, amongst many others, is a carcinogen and in the case of exposure to the chemical causes other major health problems in children, adults, and pre born children, such as mental retardation, meningitis, brain failure, liver failure, etc. Lead is a chemical that when exposed to it, it is undetectable and it stores in different parts of the body; it is accumulative in many different soft tissues, like the brain, bones, or teeth. Over a period of time, the accumulation of lead in the body could start affecting major organs and it could eventually kill a person. According to government sites and verified references, the lead content in lipstick is not a thing to worry about because of the small quantity contained, but for the research, tests were performed to verify the actual lead content in certain brands of lipstick. A statistical study was performed to analyze the approximate lead content that the average lipstick user is exposed to over a long period of time using lipstick. The results will reveal whether lipstick lead content will eventually harm human health as a percentage of lead exposure in the body and whether it is significant enough to affect the body or not.
In the past few years, people have been seeking teeth whitening processes to remove stains to have a better and whiter smile. Various teeth whitening processes may induce more sensitivity in a patient's teeth as well as persistent stains and unexpected results. Some of these whitening processes are laser and home kits. Laser whitening involves the application of a gel based on hydrogen peroxide with laser light applied after that; the effect of the laser-activated gel is what produces the whitening. It is known that the laser treatment involves a greater amount of hydrogen peroxide than home whitening kits, although both cause sensitivity. The laser method is the quickest. Home kits do not require the supervision of a dentist, which can lead to greater risk because the kits chemicals can displace and burn gums. These adverse effects may worsen due to the burning of the gums and increased sensitivity. But not all whitening processes may lead to adverse effects, since not all people have the same reaction to the application of the whitening chemicals. The effects of laser teeth whitening and home teeth whitening kits were compared in this investigation with 3D models built with Google Sketch Up to assess how beneficial or not these treatments are.
COMPUTER SCIENCES

USING ARCHIMEDES’ PRINCIPLE TO HELP PEOPLE ENJOY WATER SPORTS SAFELY

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Research Mentor: Prof. Gerson Restrepo, Universidad del Este, Carolina, Puerto Rico.

Swimming is an activity that many people would love to enjoy. However, several factors including fears, trauma accidents, and the history of drowning prevent many people from enjoying this sport comfortably or safely. The floatability of a body immersed in a medium depends on the density of the medium and the density of the body which in turn is influenced by the relation between the body dimensions and its mass. Bodies denser than water will sink, while less dense bodies will float, since the forces acting on the body control the buoyancy on it. These facts help understand why it is easier for some people to float and swim than it is for others. There is currently data available from Centers for Disease Control relating body dimensions and mass of samples of people from distinct regions. Measurements of body dimensions were taken from different people in a laboratory setup. Newton’s second law and Archimedes’ principle were used to study people’s floatability using these dimensions. These results are intended to be analyzed and combined with tips and exercises to help people improve their floatability. This would be beneficial to allow them enjoy water activities safely and more comfortably.

FINDING CARMICHAEL NUMBERS

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

An algorithm to produce a list of Carmichael numbers that are products of small number of primes was programmed to produce a list of some of those numbers. Carmichael numbers passed the Fermat test of primality, but are not primes. They are characterized as odd, square free numbers, n > 2, such that for a prime factor p of n then p -1 also divides n -1. Carmichael numbers are strong pseudo primes, since they pass every simple primality test. The purpose of this study was to explore the frequency and characteristics of Carmichael numbers.

MAP MASHUPS FOR VISUALIZATION OF STATISTICAL DATA

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

In a map mashup, statistical data of geographical locations is presented in the form of different colors of the localities by categories of the value of the variable. This allows better visualization of trends in the social or economical data. In this work, map mashups were used to show the data of schools in Puerto Rico, color coded on a map in an interactive and graphical way. These graphics were programmed using the Google Maps API. Object-oriented programming and web applications were included in the process.
A COMPARISON OF PERFORMANCE OF SYMMETRIC AND ASYMMETRIC ENCRYPTION ALGORITHMS FOR SMARTPHONE APPLICATIONS

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Research Mentor: Dr. Steven Case, University of the Virgin Islands, St. Croix.

In today’s world, the security and confidentiality of data is of increasing importance. As data is transferred over the Internet from one person to another it becomes less secure. It is important to provide protection for data in the event that a mobile device is lost or stolen or the phone’s data communications are intercepted. Smartphone applications must be concerned with the exchange of voice and data, including data produced from speech recognition technologies. This research investigates the application of symmetric and asymmetric encryption techniques to secure the data transmitted by smartphone applications. The RC4 algorithm was selected as the symmetric encryption solution based on its simplicity and perceived benefits for smartphone implementations. The RSA algorithm was selected as the asymmetric encryption solution based on its overall availability and acceptance. The research methodology included developing an implementation of both algorithms in Java, suitable for running on a smartphone platform such as the Android. The performance was evaluated to determine encryption speeds for the algorithms. Future work will include evaluating security of the algorithms and ease of integration into smartphone applications.

LIFE RATIO OF FACTORS THAT CAUSE HEPATITIS USING CLUSTERING ALGORITHMS

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The term cluster analysis encompasses a number of different algorithms and methods for grouping objects of similar kind into respective categories. The experiment used a data-set by developing and using diverse factors from different aspects of human health to acquire knowledge of things that cause the survival or the death of people with hepatitis. The methods that were used to develop the clustering classification were the K-mean and K-median. The expected results will be discussed.

MIND CREEPER

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

Mind Creeper is a game application which is simple to use. The mobile application is a mental challenge for people. It will be entertaining and also will mold the mind for critical thinking. The Eclipse environment was used with the mobile development for the Android package to create the application.
EFFECTS OF THE Crossover RATE AND MUTATION RATE IN THE OPTIMIZATION BEHAVIOR OF A GENETIC ALGORITHM SOLUTION OF THE RADIO TOWER LOCATION PROBLEM

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The Genetic Algorithm is a search method that imitates evolution by selecting the fittest individuals (solutions) from a set of individuals (solutions) and combining them to find new individuals (solutions). The ways to achieve the combining of the best solutions depends primarily on the crossover rate and the mutation rate. Besides these, other parameters that can affect the performance of the Genetic Algorithm (GA) are the size of the population of solutions and the solutions selection criteria. The selection criteria uses the fitness (or goodness) of each solution to decide whether two or more solutions are candidates for crossover that will create new offspring solutions. In a way, it imitates nature, by being better every time. The project will be observing how the crossover and mutation rate affects the goodness of the solution to a problem, in this case the Radio Tower Location Problem. This problem involves the discovery of the best map coordinates in which to locate a set of radio towers so as to reach the maximum number of towns and consequently their listeners. GA is fit to be used for this problem since it allows the search of multiple solutions corresponding to tower locations at different locations in the map simultaneously. The hypothesis postulates an individual’s intuitive expectations about which range of values of the cross-over rate and the mutation rate leads to the best solutions. A commercial Genetic Algorithm tool known as Evolver from Palisade Corporation was used to carry out the experiment. The Excel spreadsheet program was used to model the problem and to plot the results.

ST. CROIX EDUCATIONAL COMPLEX TUTORING FOR KIDS

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Research Mentors: Dr. Steven Case, Michael Dijamco, University of the Virgin Islands, St. Croix.

Students at St. Croix Educational Complex are expected to complete additional homework and other educational activities at home. Students will sometimes need additional assistance, either because they were absent and are missing homework details or they need additional tutoring in order to understand the material and be able to complete the homework. This creates problems because 1) they have no means to contact the teacher to obtain the details of the homework or 2) they need assistance beyond their friends and family in order to understand the content of the homework. This research project was intended to investigate the potential to use a smartphone-based application to facilitate access to homework assignments as well as access to tutoring service for homework assistance. The project entailed the development of a prototype smartphone application and the eventual evaluation of its effectiveness in improving the ability of students to complete their homework assignments. The prototype application was developed for the Android platform using the Java programming language. The application was provided to selected teachers and students from St. Croix Educational Complex in order to evaluate its overall effectiveness. The application was evaluated in terms of its overall impact on student performance, accuracy of information provided to students, and ease of use for both teachers and students.
THE INTERNAL STRUCTURE OF VIDEO GAMES

Rafael Cabrera Jones, Levittown Baptist Academy, Toa Baja, Puerto Rico.

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

The goal of this project was to make a website that includes the concepts needed to be learned when programming a video game and demos of some examples of programming concepts. How this is all supposed to be displayed in the website? This would be done in an easy to understand tutorial. This tutorial would include step by step instructions on how to begin programming, pieces of code that the reader could just copy and use as examples, and work on further investigation. The purpose of the tutorial was not just teaching you how to program, but also a step by step aid to program a first video game demo.

SYMMETRY OF THE LEGS IN PRIMITIVE PYTHAGOREAN TRIPLES

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

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

A long list of primitive Pythagorean triples was analyzed with the computer to find a formula subjacent in the symmetry of the legs of the triples. The formula allowed to list the triples without the repetition of the symmetric triples and also to find a geometric interpretation in terms of the triangle of the triple and the triangle constructed with its generators.

REAL-TIME CHAT TRANSLATION

Nishmar Cestero González, Episcopal Cathedral School, San Juan, Puerto Rico.

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

In an increasingly globalized world, individuals are limited by a “language barrier” that makes communication difficult unless all speak the same language. The main goal in this project was to research and determine if chat translation is capable of breaking the language barrier and provide an effective way for people world-wide to communicate in real-time. For this purpose, a website with an integrated chat box powered by Google Translate that automatically translates from one language to another was created. The website served as a model for an international chat room, which would enable users who speak different languages to communicate with ease in their respective languages.
EFFECTS OF MUTATION RATE AND POPULATION SIZE IN THE OPTIMIZATION BEHAVIOR OF A GENETIC ALGORITHM SOLUTION OF ADVERTISING MEDIA SELECTION

Cristian Claros, San Jorge Academy, San Juan, Puerto Rico.

Research Mentor: Dr. Othoniel Rodríguez, Polytechnic University, San Juan, Puerto Rico.

This experiment seeks to find how the Genetic Algorithm behaves when two of its configuration parameters are modified while solving the Advertising Media Selection Problem. In the Advertising Media Selection Problem, the most effective advertising plan is sought to reach the largest audience, while meeting a constrained budget of $50,000. The model accounts for the fact that TV and magazines have discounted rates if advertisements are placed in them often. The parameters that can be modified in the GA algorithm are Crossover Rate, Population Rate and Mutation Rate. The experiment explores the effect of two parameters, Population Rate and Mutation Rate on the quality of the solution found. The parameters that will remain fixed as the control variables are the Crossover Rate and the number of trials. The output variable to be measured is going to be the number of viewers reached by the budget assigned to each Media Channel Selected.

BREAST CANCER PATTERNS IN CLUSTERING

Bryan Claudio, Camille A. Price, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Prof. Claudia Talavera, Polytechnic University, San Juan, Puerto Rico.
Research Mentor Assistant: Emmanuel López, Polytechnic University, San Juan, Puerto Rico.

Clustering is known as the classification of data to resolve a problem or answer a question. The information obtained depicts a decline in cancerous tumors from January 1989-November 1991 and the various factors used to diagnose breast cancer. The objective of this study was to classify the information by using the K-means and the K-medians algorithms, graph the information and construct a confusion matrix. Using Microsoft Excel is much simpler to process the information assigned. This program allows one to solve otherwise difficult mathematical equations and provided the opportunity to accurately depict the data using Excel along with the algorithm used. This allowed for its understanding and later being able to communicate the results in a logical and appropriate manner. It is expected that it will provide positive results in which our algorithm is correctly classified.

HOW GAMING CAN BE USED AS A TEACHING TOOL

Kayra Clouden, Sheniah Campbell, St. Croix Educational Complex, St. Croix.

Research Mentor: Laurie Barnwell, University of the Virgin Islands, St. Croix.

Computer-based games are a popular form of entertainment, especially for children and young adults. This research intended to investigate the ability for games to be used not only for entertainment but also for education. The game in process was programmed to help youths learn and understand more easily. Education is a major part in our society, as well as gaming. If the two are linked together, then it will help improve students’ education. The game making tool, “Scratch” was used in order for the game in progress to be a creative, interactive and educational. The game will relate to all audiences and age groups and will supply students with a creative and fun way to learn new things. Students will be able to learn more easily because the game is linked with different learning devices. The team's prediction is that the game will become successful if made correctly. The results are expected to beyond entertainment and to further educate children to learn.
A MINING ROBOTIC SYSTEM

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

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

An enhanced hardware robotic miner was developed from an original software algorithm. This hardware detected metals underground. The system included the following parts: a detector of metals, off-road base, rotating parts, spotlights, and other sensors to scan the environment. A program would be used to send commands to the robot. This project investigated the cost of the hardware parts, the construction time, software programs that are compatible and the mobility of the robotic miner in working areas. The aim of this project was to design a robot that would save human lives or substitute men working underground in mines.

FACTORIZATION OF HYPOTENUSES OF PRIMITIVE PYTHAGOREAN TRIPLES

Tiffany Cruz Marín, Inter-American School, San Germán, Puerto Rico.

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

Analyzing with the computer a long list of hypotenuses of primitive Pythagorean triples, an interesting factorization property of these numbers in terms of primes that are decomposable as sums of squares was found. These primes had been described by Fermat a long time ago as those that have residue 1 when divided by 4. This property allows an algorithm to find directly if a given integer number can be the hypotenuse of a right triangle and to show the different ways to do it. A table with several examples is shown.

A COMPUTER GAME BASED ON GRAECO-LATIN SQUARES

Lina Vanessa Daza Llanos, Inter-American School, San Germán, Puerto Rico.
Valerie Vázquez, Presbyterian Academy, San Germán, Puerto Rico.

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

Graeco-Latin squares consist of arrangements of Latin and Greek letters in a table, in such a way that no letters of each alphabet are repeated in rows or columns. The methods to construct these squares were discussed by Euler long ago. The purpose of this study was to program a game similar to Sudoku, in which some of the cells had some places already filled and the player had to fill the blank cells to complete the solution. The solution had to be unique, but not easy. The computer generated the game by a random choice from preprogrammed complete squares, where also the blanks were chosen randomly.

PRIMES AND FACTORIZATION IN THE GAUSSIAN INTEGERS

Andrea Devaris, Inter-American School, San German, Puerto Rico.

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

Using the characterization of primes in the Gaussian integers as those whose square norm is prime in the real integers, an algorithm to produce a list of the Gaussian primes was developed and programmed. Also, a factorization algorithm for Gaussian integers was programmed and a table with several examples was calculated.
BEHAVIOR OF THE GENETIC ALGORITHM WHEN THE POPULATION SIZE AND CROSS-OVER RATE ARE MODIFIED WHEN SOLVING THE PORTFOLIO BALANCING PROBLEM

Manuel Díaz Corrada, San Ignacio School, San Juan, Puerto Rico.

Research Mentor: Dr. Othoniel Rodríguez, Polytechnic University, San Juan, Puerto Rico.

Many people have wondered how to create an efficient mixture of stocks in order to make an efficient division of the stock market. One possible answer to this problem is the use of Genetic Algorithms. Genetic algorithms are a specific type of search method which includes such modifiable parameters like mutation rate, crossover rate and population size. These parameters allow the Genetic Algorithm to successfully search many different alternative solutions of specific situations. For example the mutation rate, which is the probability of a random change in a solution set member, helps model unpredicted changes in members of natural populations. Although mutation rate adds the unknown factor that could affect an individual, crossover rate is the constant intermixing among the members of the population being evolved. Finally, the last parameter that one can modify is the population size. Population size is the number of solutions to the problem that are being concurrently evolved to find an optimal solution. For example, this could include people, bacteria, toys and any solution that can be easily represented in a compact way in the form that allow easy crossover and mutation. All of these factors were be used to find an optimal solution to the problem of balancing a stock portfolio. The population size was a sub-set of the possible distributions of the 80 stocks among the five portfolios. The crossover rate was how frequently portfolio contents were intermixed with other portfolios. The mutation rate was the frequency with which any of the solutions-set of portfolios- was randomly modified in its individual stocks distribution. The experiment investigated the hypothesis that the larger the population size and the lower the crossover rate, the less optimal the solution found will be. This hypothesis could not be proved conclusively because optimal solutions were found throughout the explored range of the independent variables.

FINDING PROTEIN CONCENTRATION SITE IN YEAST THROUGH THE PROCESS OF CLUSTERING

Xavier Figueroa, Miguel Almodóvar, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Prof. Claudia Talavera, Polytechnic University, San Juan, Puerto Rico.
Research Mentor Assistant: Emmanuel López, Polytechnic University, San Juan, Puerto Rico.

Clustering is the process of organizing objects into groups whose members are similar in some way. The objective in this investigation was to use the process of clustering to determine the protein concentration site in yeast (found in a public repository) using the methods of K-means and K-medians. In order to achieve this goal, the Algorithms were implemented in C++ language and the results were later analyzed and graphed in a calculating sheet to facilitate the process of instant classification. To accomplish the objective of this experiment, all the data gathered was organized to find which cluster (group of data that is similar in some way) has the largest concentration site for proteins in yeast. The organization of the data provided accurate results. It was expected that both algorithms will have an acceptable classification of clusters.
STATISTICAL PATTERNS OF TEXTS AS A PROOF OF AUTHORSHIP

**Joffre Gómez Frontera, Gabriel E. Pagán Avilés**, Inter-American School, San Germán, Puerto Rico.

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

The purpose of this study was to create a program to calculate statistics of letters and signs, length of words, words per sentence and number of sentences in paragraphs, as well as number of usage of each word in a long text. These statistics were used to observe if there are characteristic patterns in an author and if it can be considered that each person has a personal writing style, not just in content but in his statistical patterns. With the program, texts of several authors were analyzed and compared.

ENGINEERING IN ANCIENT TIMES

**Diego E. González, Miguel A. Martell Rivera**, San José School, San Germán, Puerto Rico.

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

Using the computer language Alice, the purpose of this study was to program a tour through the history of engineering and technology that have been the motor driving economical and social evolution of humankind. The language Alice allows mixing photographs and text of a presentation with animation and superposed figures that can enhance it a lot. In Alice, the user begins by making a storytelling guide, and then completes the program by using the different tools or controls, in a process similar to composing a movie. It is easy to learn and apply.

3D VISUALIZATION OF A CITY

**Edwin J. González**, Bautista de Caguas Academy, Caguas, Puerto Rico.

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

Three-dimensional design is an emerging and necessary area that has an impact on diverse academic sectors such as: architecture, planning, and agencies in charge of security and government. While the perception of the complexity that encompasses the structure of a city is converted into an analytical area of great difficulty, the information provided by these models permits the development of analysis regarding the impact of future projects in a simpler visual form. Three-dimensional visualization permits the representation of information in a manner that can be easily exposed through Internet or in exhibitions. There are diverse methods and applications for the design of a 3D city, in particular algorithms in the program AutoDesk Maya that may be used to generate the necessary elements. This project presents one technique for generating models of buildings through the representations at different levels of abstraction.
RANDOM SUDOKU GENERATOR


Research Mentor: Jonathan Vargas, Universidad Metropolitana, Gurabo, Puerto Rico.
Assistant Research Mentor: Joksan Flores, Universidad Metropolitana, Gurabo, Puerto Rico.

Sudoku is a game where a number is placed in a correct position and does not ruin the rest of a sequence. To make this sequence, the process of an algorithm has to be used. In mathematics and computer science, an algorithm is an effective method expressed as a finite list of well-defined instructions used to calculate a function. Algorithms are used for calculation, data processing, and automated reasoning. The Java Programming Language, which is a very complicated programming language based on codes, was used. The program was made with a combination of codes and algorithms put together. The programs were based on the creation of a program where a person could create a Sudoku sheet and pass it to another person. There are more sophisticated algorithms to solve graphs. If Sudoku contains initial data, some boxes have already been filled, and then these go into the assignment before backtracking begins and the vertex sequence includes only the empty boxes.

COMPUTERIZED MODEL OF THE HUMAN INTERNAL PLASMA FILTRATION SYSTEM

William Guzmán, Santiago Apóstol School, Fajardo, Puerto Rico.

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

The kidney is a vital organ for human life. It serves as a natural filter for the human circulatory system components and removes wastes in the excretory system. Renal failure occurs when a kidney fails to adequately filter toxins and waste products from the body. There are two forms of renal failure: acute and chronic. Acute renal failure is a rapid loss of kidney function. Chronic renal disease is a progressive loss in renal function over a period of months or years. A person who is suffering from renal failure has to be treated by a process known as dialysis. This process is very expensive and difficult. The purpose of this research was to create an artificial kidney (controlled by a microprocessor) affordable to patients who suffer renal failure. This system will be designed by structuring a computerized model of the function of the kidneys. The aim of this system is to replace the kidney with all of its vital functions.

WHICH IS EASIER TO USE, ALICE OR GAME MAKER?

K’Jani Hall, Danté Hall, St. Croix Educational Complex, St. Croix.

Research Mentor: Laurie Barnwell, University of the Virgin Islands, St. Croix.

This intent of this research was to investigate which game programming environment is simpler to use for non-programmers when learning programming. Creating a successful, educational game is a complicated programming challenge. This project evaluated two environments that are aimed at helping novice programmers to create effective games. The project developed the framework for an interactive game aimed at young students to teach them the perils of smoking. The project then used this framework to evaluate Alice and Game Maker relative to their ability to implement the game and the ease by which they can implement the game. This research shows that Alice is much easier to use; however Alice use is limited to producing non-interactive videos, whereas Game Maker is much more complicated to use and more difficult to learn but will make a variety of interactive games.
VOICE RECOGNITION FOR MOBILE APPLICATIONS

Whitney Lambert, Steven Browne, St. Croix Educational Complex, St. Croix

Research Mentor: Dr. Steven Case, University of the Virgin Islands, St. Croix

In today’s world, protecting important data has become a difficult, yet necessary task. The security of data is constantly being compromised, and the need for reliable protection has become imperative; that is the motive behind this project. The purpose of this research was to integrate the concepts of speech recognition, encryption, and phone application development into one functional utility that would be able to secure important data within a cellular phone. This branch of the entire project was focused on using speech recognition algorithms with programs such as the Java Speech API and various speech engines such the Dragon Dictate and the Microsoft Speech API. By using these interfaces, a program was made that had the ability to “hear” and “recognize” a voice relative to its respective speaker. This however, was only the first phase of the major project. If the program correctly recognizes the respective speaker’s voice, then it will continue on to the next phase, which is the encryption. Having multiple stages gives data more security.

CLUSTERING CLASSIFICATION FOR WINE DATA SET USING K-MEANS AND K-MEDIANS ALGORITHM

Stacy Lloyd, Janice Acevedo, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Claudia Talavera, Polytechnic University, San Juan, Puerto Rico.  
Research Mentor Assistant: Emmanuel López, Polytechnic University, San Juan, Puerto Rico.

Clusters techniques concerns the organization of the data set in clusters that contain things in common. Through a previous classification of the Data Set obtained from the repositories, the classification obtained from the algorithm K-means and K-median method were compared and used to prove the experiment. K-means was use to find the centroid throughout the arithmetic mean and K-median throughout the median. A confusion matrix de la classification of K-means & K-medians was created where it described the instances they were classified and how many not. For a better visualization of the data set, a graphic was used that was developed for a better understanding of the data set density that was given. With this approach the expected results of the algorithms were positive and with the best classification of the instance. Two attributes out of thirteen were used to visualize the experiment in two dimensions. Depending on the final results, recommendations would be made on the best method to be used.

UNIT CONVERTER

Víctor López, Rexville High School, Bayamón, Puerto Rico.

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

The purpose of this study was to make a simple to use unit converter than those on the apple and android market by just using more frequently used units in the classroom thus leaving for space for larger buttons for easy finding on how to use the app such as arrows and other images with simple meanings. This app was developed on Visual Studio 2010 and the windows phone 7 mobile development tools.
JAVASCRIPT ARITHMETIC EQUATIONS GAME

José O. Maestre Negrón, CIEM Private School, Carolina, Puerto Rico.

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

This research was about the manipulation of codes of HTML and JavaScript through a web page. HTML has many codifications and many symbols. It stands for “Hyper text markup language” and is the predominant markup language for pages. HTML is the basics building block of a web page. The codes that are used with HTML are called tags. JavaScript is the same thing as HTML in terms of codes. JavaScript is an implementation of the SMA script language standard and is primarily used in the form of client side JavaScript, implemented as a part of a web browser in order to provide enhanced user interface and dynamics websites. The goal of this research was to create a simple mini-game, through the use of HTML and JavaScript, in which players solved math equations. This research excellent knowledge in terms of computers.

HTML: RANDOM NUMBERS

Dan-L Martínez, C.I.E.M. Private School, Carolina, Puerto Rico.

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

The goal of this project was to create a mini game through the use of HTML and JavaScript. This will make people more interested in math because it shows them that math is a primary function that helps videogames work. This game let the players guess a series of numbers that included disguised hints.

SIMPLE UNIT CONVERSION TOOL

Gustavo A. Martínez, Homeschool, Carolina, Puerto Rico.

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

Sometimes scientists and engineers face the situation where they have to use different numerical systems in order to do their work, construct projects or analyze a scientific phenomenon. Often those numerical systems are not easy to understand, and sometimes it takes a long time to convert one to another by hand. The purpose of this project was to create a simple tool that people could use to convert among numerical systems and help them save some time. The main motivation for this project was to make conversions among different numeric systems using a very simple Graphical User Interface (GUI). The approach towards solving this problem was to build the GUI, which was programmed to convert from one system to another. (Ex: converting a decimal number, like 82, to a binary number system, which consists of 1’s and 0’s?). At the end of this project, it is expected to have a software application capable of performing these different numerical systems conversions without the need of converting them by hand. This would allow users to have a simple way to use the different numerical systems without having to go through the process of converting them by hand.
CLUSTER ANALYSIS USING K-MEANS AND K-MEDIANS ALGORITHMS

Jean Carlo Martínez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Prof. Claudia Talavera, Polytechnic University, San Juan, Puerto Rico.
Research Mentor Assistant: Emmanuel López, Polytechnic University, San Juan, Puerto Rico.

The term Cluster analysis uses a number of different algorithms and methods for grouping objects of similar kinds into categories. The cluster analysis algorithms used for the research of this investigation are K-means, and K-medians. Given the appropriate data-set from the UCI Machine Learning Repository, the same will be organized and graphed for a better visualization. The expected results on the organized data are the percent of acceptance and non acceptance of the confusion matrix, with the k-means and k-medians algorithm. Any of the two algorithms are expected to be the most efficient; and selecting the best percent will reveal a positive result.

INTEGRATION OF ENCRYPTION AND SPEECH RECOGNITION TO IMPROVE SECURITY OF MOBILE APPLICATIONS

Biko McMillan, St. Croix Educational Complex, St. Croix.

Research Mentor: Dr. Steven Case, University of the Virgin Islands, St. Croix.

In today’s world, protecting important information has become a difficult, yet necessary task. The security of data is constantly being compromised, and the need for reliable protection has become imperative; that is the motive behind this project. The purpose of this research was to integrate the concepts of speech recognition, encryption, and phone application development into one functional utility that would be able to secure important data within a cellular phone. This branch of the project is the “how-to” part of integrating the encryption of sound into the mobile platform. This is an essential part of the project because the scope of this project is to mainly find a way to integrate the protection of information into an important part of everyday life: the cell phone. This project began on the desktop platform and in due course, it was integrated first onto the mobile tablet platform and ultimately it ended up on the mobile platform. This was done because currently, tablets are faster and have more memory than most smart phones. In the future, the coding for the tablet will be transferred to the mobile platform which can be almost effortlessly in view of the fact that the only difference between the software necessary for tablet and mobile application development is the emulator needed to test it.

MUSIC ROOKIE

Cristina Morales, Ernesto Ramos Antonini School, San Juan, Puerto Rico.
Alberto Santiago, María Teresa Piñero School, Toa Baja, Puerto Rico.

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

Music Rookie is an application designed to teach the basics of music to people that do not understand it; like what a music scale is, what the metric is and will also teach how to read music: where each note is and how to play them in a piano. This will teach it in a dynamic and fun way. The application will be created using Visual Studio 2010 with the Windows Phone 7 development tools. XAML will be used for the visual part and C# will be used to make the application work. The application will be divided into three steps: notes, rhythm and a combination of both. The goal of the project was to find the simplest way to explain music and transfer it to a mobile application.
INFLUENCE OF THE GENETIC ALGORITHM'S Crossover Rate AND MUTATION RATE IN THE SEARCH FOR A SOLUTION TO THE TRAVELING SALESMAN PROBLEM [TSP]

Charlott Morel, San Jorge Academy, San Juan, Puerto Rico.

Research Mentor: Dr. Othoniel Rodríguez, Polytechnic University, San Juan, Puerto Rico.

The Genetic Algorithm (GA) is premised on the evolutionary ideas of natural selection and genetics. The Genetic Algorithm simulates the processes of natural evolution, especially those that follow the principles first laid down by Charles Darwin of survival of the fittest. Evolver is a genetic algorithm optimization add-in for Microsoft Excel. It uses genetic algorithm technology to quickly solve optimization problems in multiple areas including scheduling. Thus it can solve the Traveling Salesman Problem (TSP) which is a scheduling problem that seeks to find the order in which to visit a group of towns so that the total distance traveled is minimized. This experiment explores the effect that some of the configuration parameters of the GA will have in finding an optimal solution to the TSP. The independent input variables are the mutation rate and the crossover rate. The dependent output variable is the total distance traveled. The control variables are the population size and the number of generation. The guess is that if the rate of the independent variables is increased, Evolver will find the dependent output in a longer time period but it will be more exact.

GLYCEMIC INDEX CALCULATOR PROGRAM

Davette Nazario, José de la Torre School, Carolina, Puerto Rico.

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

The Glycemic Index (GI) Calculator Program is an advice-giving system that will provide information on the glycemic index (gi) of certain types of foods. GI is a measure of the effects of food sources on blood sugar level. The key intention of this program is to help diabetic people to eat the correct combination of foods to maintain the blood sugar level within acceptable limits. The project was developed using the Visual Basic programming language, and was controlled by means of a graphical user interface (GUI). The user selected from a list of common foods and the program checked the glycemic index of the foods selected and displayed a recommendation telling the user if it was appropriate to eat this meal. The idea was to help the person to eat a balanced meal and stay healthy.

SUCCESS OUTCOME OF VIDEO GAMES

Kevin Ortega Negrón, Santiago Apóstol y Evangelista School, San Juan, Puerto Rico.

Research Mentor: Luis A. Alemán, Inter-American University-Metro, San Juan, Puerto Rico.

Different factors have to be established to decide the success outcomes of a video game. The following factors evaluated were: the interface of the game and the traits of the public that uses the game. The interface consists of the way the game is designed. Such point includes the method that is chosen to develop the game to better enhance its quality. The traits of the public refers to their personality. To prove the hypothesis, a number of people of different ages and education were chosen to play two games that were different in every gameplaying aspect. They later pointed out their opinion on whether they liked the game or not, and why. The results concluded that the success of a game either depended on both factors (its interface or the characteristics of the public), or one of these factors individually. The research revealed that both the interface and the characteristics of the audience did play a part on the success of the game, but their personality was the deciding factor.
INFLUENCE OF MUTATION RATE AND POPULATION SIZE ON THE OPTIMIZATION BEHAVIOR OF A GENETIC ALGORITHM SOLUTION OF THE TRAVELING SALESMAN PROBLEM (TSP)

Giovanni Pacheco Fuentes, San Ignacio School, San Juan, Puerto Rico.

Research Mentor: Dr. Othoniel Rodríguez, Polytechnic University, San Juan, Puerto Rico.

This experiment explored the behavior of the Genetic Algorithm while it searches for an optimal solution to the Traveling Sales Problem (TSP). Genetic Algorithms (GA) is a solution search method that seeks for the solution in many places at the same time within the space of solutions. GA avoids the "local maxima" problem. In (GA) possible solutions to a problem are represented in the form of a chromosome; this solution is modified using several mechanisms: mutation, crossover, selection mechanism, and population size. GA imitates Mother Nature because it "evolves" possible solutions by applying a solution-fitness selection criteria. The Traveling Salesman Problem (TSP) is a classical combinatorial explosion problem where the goal is to choose the order in which different cities will be visited by the traveling salesman so as to find the minimal total distance traveled. One method to find solutions to the TSP is by using GA where the shortest route will be evolved until the solution can satisfy the minimal distance. The amount of kilometers in the route to be found will depend on the order in which the different cities will be visited. The purpose in doing this experiment was to explore the behavior of the GA while it searched for a route through twenty (20) towns of Puerto Rico for the shortest distance. To explore the behavior of the GA, multiple values of population size and mutation rate were used. This series of experiments verified whether increasing the mutation rate and population size, while keeping fixed the crossover rate, number of trials per run, and the random number generator seed, takes more time to find the minimal solution.

GAME PROGRAMMING FOR THE AVERAGE PERSON

Kiddany Pérez, Levittown Baptist Academy, Toa Baja, Puerto Rico.

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

The main goal in this project was to create a website that would have a step by step manual on how to make a flash game from scratch using free programs. The website would have a pdf file that would have the manual. The website would also have a series of videos on how to make a flash game so that whoever does not like reading can just watch the videos. The website would help the average person to make a flash game.

SUCCESS FACTORS OF WEB SITES

Denny S. Ramírez, Mónica I. Adorno, Josefina Barceló School, Guaynabo, Puerto Rico.

Research Mentor: Luis A. Alemán, Inter-American University-Metro, San Juan, Puerto Rico.

This investigation analyzed the behavior of Internet users entering a website. It also aimed to identify and compare the influence of personal characteristics with the choice of the web page. For this study, participants had to complete a questionnaire after they visited specific web pages. Three web pages were selected representing a search engine, a communication tool, and a social network. Participants had to evaluate the following characteristics in the web pages: appearance, theme and relevance of information according to their interest. The results indicated that the behavior of online users depends on the type of web page, the function of the web page, and the web page appearance. This study concluded that the users’ interest and age level, determines their preference of web pages usage.
**MEASURE PIC**

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

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

The purpose of this project was to work on an application that helps measure the object of an image. This app can be a very useful to carpenters, architects, engineers, and just the normal person with the curiosity of knowing the measurement of an object. It can become a everyday useful application, that can be easily manageable. The application was created using Visual Studio 2010 with the Windows Phone 7 development tools. XAML was used for the visual part and C# was used to make the application work.

**EFFECTS OF CROSS-OVER RATE AND POPULATION SIZE ON THE BEHAVIOR OF A GENETIC ALGORITHM SOLUTION TO THE RADIO TOWERS PLACEMENT PROBLEM**

**Héctor Ramos Sanez**, San Jorge Academy, San Juan, Puerto Rico.

Research Mentor: Dr. Othoniel Rodríguez, Polytechnic University, San Juan, Puerto Rico.

Genetic Algorithm is used as a problem solving method that searches for an optimal solution closest to the optimum solution by imitating the way genetic information is interchanged between parents and offsprings during reproduction. In order to explore the behavior of the Genetic Algorithm, a Radio Tower Location Problem was used as a test case to experiment with modifying different Genetic Algorithm parameters to see how these affect the generation of solutions. The Tower Location Problem looks to find the best coordinates for multiple radio towers to cover the largest number of towns (and reach the most listeners). Each of the radio towers has a different coverage range and each town has a different population. The GA parameters include the crossover rate, the mutation rate, and the population size. The parameters to be experimented with are the crossover rate and solutions-population size, which are the independent variables. The fixed or control variables are the mutation rate, and the number of trials. The dependent variable is the number of listeners reached by the radio tower signals. The hypothesis investigated was that the higher the cross-over rate and the smaller the solution-population size, the larger the number of listeners was reached by the tower signals given a fixed number of trials. The hypothesis was not confirmed by the experiment.

**ALGORITHM WORKING IN A MAZE**

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

The main goal throughout this whole research was to explain how algorithms are involved in a maze. It was done using the Daedalus 2.3 program, which helped develop a maze. Mazes are in different places whether it is in real life or in paintings such as those from M.C. Escher, whose paintings had sort of a puzzle or maze figure. Algorithm is an effective method expressed as a finite list of well-defined instructions for calculating a function. A maze is a tour puzzle in the form of a complex branching passage, and is often confused with the labyrinth, but technically the maze is distinguished from the labyrinth, as the labyrinth has a single through-route with twists and turns but without branches.
CLUSTERING THE IONOSPHERE’S TYPE

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Research Mentor: Prof. Claudia Talavera, Polytechnic University, San Juan, Puerto Rico.
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The method of data clustering is used to organize groups with similar characteristics of all elements in the data set. The clustering of the algorithms was classified by the K-means and K-median method. The data set of a public repository was used. The radar data was collected from a system that consists of a phased array of 16 high-frequency antennas with a total transmitted power of 6.4 kilowatts. This data was analyzed thought the algorithms. It is expected that this analysis will provide a reasonable classification for them.

THE GLOBAL WARMING EFFECTS SIMULATOR

Juan Rivera Jaca, Ángel David School, San Juan, Puerto Rico.

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

The Global Warming Effects Simulation is an educational system that will provide to the audience a virtual experience on the consequences of the global warming problem. The main purpose of the simulation was to create awareness of the natural phenomena that have been happening more frequently during the last years. Global warming is a consequence of the major climate changes that have occurred in the planet. The simulator will advise people on how they can help to diminish damages as a result of natural phenomena. Education and awareness of any natural phenomena will provide means for people minimize effects from any disaster.

INFLUENCE OF THE GENETIC ALGORITHM’S CROSSOVER RATE AND POPULATION SIZE ON THE SEARCH FOR A SOLUTION TO THE ADVERTISING CAMPAIGN

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Genetic Algorithm (GA) is a series of steps that describe the process to follow to solve a specific problem. It is also a method based on possibilities which helps to find a solution to many problems. Some of the variables used by the genetic algorithm are mutation size, crossover rate and population size. The mutation rate is a genetic diversity from one generation of a population of algorithm chromosomes to the next. The crossover is a genetic operator used to vary the programming of a chromosome from one generation to the next. To explore the behavior of the GA, an advertising campaign optimization problem was used together with the settings of the crossover rate and population size which are the independent variables used and the mutation and the numbers of trials kept unchanged are the controlled variables. The dependent variables were the number of customers reached by the advertising campaign. Evolver was used for the purpose of the experiment. It is an Excel add-in with a built-in genetic algorithm, which will help change the independent variables. The experiment consisted of evaluating the maximum value of customers found for all combinations (10x10=100 total) of the two independent variables under a fixed number of trials or generations. The results did not confirm the hypothesis that the larger the population size, and the larger the mutation rate, the better the solution found for a fixed number of generations.
PERMUTATIONS WITH THE TURNING GRILLE

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

The permutations used in the Turning Grille Encryption were classified and programmed in the computer. The encryption and decryption were then programmed in an easier way for the computer than in the direct manual way of rotating the grille that is easier for humans. This led to describe the possible attacks to this crypto system invented by G. Cardano and widely used until recently.

NUMBER WIZARD

Gilberto Robles, Levittown Baptist Academy, Toa Baja, Puerto Rico.

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

Number Wizard is a Windows Phone 7 game that was developed with C# and xml. It uses mathematical formulas to randomize a number and the user had to guess that number in order to win. The app has a limit of random numbers as well as a timer. The way it was developed, Number Wizard included two game modes. One has the even numbers mode in which the user must guess a number in the even number family within the range of 1-100. The other game mode has the complete mode, which features all the numbers within the range of 1-100.

EFFECTS OF THE CROSSOVER RATE AND POPULATION SIZE PARAMETERS OF THE GENETIC ALGORITHM WHEN IT IS USED TO FIND SOLUTIONS TO THE TRAVELING SALESMAN PROBLEM

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The Genetic Algorithm (GA) is a search method that can find optimal solutions. This project uses the GA for finding the shortest route a person can take when traveling to a fixed number of towns in Puerto Rico. This problem is known in the Computer Science literature as the Traveling Salesman Problem (TSP). The number of possible ways of selecting the order in which the towns can be visited grows exponentially with the number of cities to be visited. For this reason the TSP is used as a test problem for experimenting with many kinds of algorithms. This problem is only a model or a “vehicle” to explore the solution finding behavior of the Genetic Algorithm as a function of its configurable parameters. The hypothesis is stated in terms of how varying some parameters within the GA affect the quality of the solutions found. The genetic algorithm incorporates several parameters which are the Crossover Rate, Population Size and Mutation Rate. Modifying some of these parameters could help achieve an optimal solution. For this experiment the independent input variables chosen are the Crossover Rate and Population Size. The Mutation Rate parameter and the number of trials (or population generations) will be held constant. The total distance traveled will be the dependent output variable which the GA will seek to minimize. The experiment will explore how changing the Population Size and the Crossover Rate will affect the finding of optimal solutions.
The binary numeral system, or base-2 number system, represents numeric values using two symbols, 0 and 1. More specifically, the usual base-2 system is a positional notation with a radix of 2. The way the application works is by the user entering a whole number and the application converts it to a binary number and vice versa. The application will be done using Visual Studio 2010 with the Windows Phone Development Tool. The front-end XAML (the graphical part of the application) will be coded in and the back-end (the functionality of the application) will be coded in C#.

THEORETICALLY ANALYZING GEOLOCATIONS

Axel Sánchez, Bábara Ann Roessler Academy, San Juan, Puerto Rico.

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

The purpose of this study was to explain how to make a simple Geolocation. Geolocation is the identification of the real-world geographic location of an object, such as a mobile phone or an Internet-connected computer terminal. Google uses Geolocations to deliver more relevant ads to its users. The goal of this research was to understand the concepts and make a simple, sample Geolocation by using Google’s Geolocation API. Finally, an example of created Geolocations was researched to analyze the JavaScript.

A FLIGHT THROUGH MODERN ENGINEERING

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

Using the computer language Alice, the purpose of this study was to program a tour through some of the achievements of modern engineering in technology, that have been the motor driving economical and social evolution of society in the last three centuries to this day. Alice allows mixing photographs and the text of a presentation with animation, sound and superposed figures that can enhance it a lot. It is like composing a movie, but with techniques of computer programming very easy to learn and apply.
EFFECTS OF A RADIO TOWER AND THE POPULATION IT REACHES IN THE OPTIMIZATION BEHAVIOR OF A GENETIC ALGORITHM SOLUTION OF THE RANGE PROBLEM

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Research Mentor: Dr. Othoniel Rodríguez, Polytechnic University, San Juan, Puerto Rico.

What a person hopes to achieve is an optimum solution with a system known as the Genetic Algorithms, which is a search method in the field of computer science. The different methods of this genetic algorithm are: mutation, a change in a samples DNA structure and how it is able to adapt in its environment; randomization, a subdivision of mutation which separates and rates which population is most capable of surviving through a random set; and population, which involves the range and the population certain objects and criteria can effect in a way that civilization and population are manifested. Using one or more variations of genetic algorithm one can get this optimum solution or better known as the solution that best qualifies for the progress of a population in its survival. In the problem given of “Radio Towers,” there are three towers presented as A, B and C, each having their different coordinates and range. To be able to solve this problem, a person one must use the method of genetic algorithm that reaches an optimum range of population. The methods used in this problem could be two; either randomization, to get random coordinates and see which one gets a larger population, or population, which specifically deals with range and population. The best solution for this problem is population which deals only with population and range and gets a better solution than randomization. Using this system one gets the most population and range with the towers but at the same time one cannot completely reach its full capacity because for one to progress there must be evolution and in extreme cases mutation.

RECOGNIZING PERFECT SQUARES IN THE GAUSSIAN INTGERS

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

Perfect squares in the Gaussian integers can be described as those in which the real part, the imaginary part and its norm, form a Pythagorean triple. The complex square root can then be directly calculated from the decomposition of one of the legs and that of the hypotenuse. This method led to an algorithm to calculate square roots in the Gaussian integers and to produce a table of several examples.

MULTIPLICATION OF PYTHAGOREAN TRIPLES AS A COMPLEX MULTIPLICATION OF GAUSSIAN INTGERS

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Research Mentor: Prof. Guillermo Mejia, Inter-American University, San German, Puerto Rico.

A formula to explain the symmetry and factorization properties of Pythagorean triples was found using trigonometric identities. This can be better understood as a multiplication of complex numbers, the Gaussian integers, where each triple is written as a Gaussian integer. Pythagorean triples are then those that are perfect squares of other Gaussian integers. This fact was used to generate Pythagorean triples from squares of Gaussian integers.
The capabilities of a robot depend solely on the design of that robot. If a robot is not designed to follow a wall, how does it go about doing so? Through the use of sensors robots are able to gather enough information to follow the wall. However, the camera will be more effective than the infrared sensors to successfully follow a wall. The infrared sensors on the IPRE Scribbler Robot are located in front, which makes looking sideways impossible. Turning every couple of seconds to ensure that the robot is still parallel with the wall can solve the problem. As means of trying to find a more efficient way to follow the wall, an algorithm that uses the camera was implemented, rather than the infrared sensors, on the IPRE robot. The team tested and figured out just how effective an IPRE Scribbler Robot’s camera can be compared to its infrared sensor. In the thinking for this experiment a question amounted as to whether it was possible to actually get the IPRE robot to follow the wall while still being smart enough to not collide with the wall. The team believed that the camera reflects in a triangular ray unlike that of the infrared sensor so in assumption it might lead the robot better. The robot is unable to see from the side as well so the robot was programmed in a way so that ever so often the robot turned and looked to see where it was going. The team cared about this issue because it wanted like to find a way a robot could see from its side then some smart tasks would be able to be done. The possibilities are endless.
APPLIED MATHEMATICS

HOW DOES OXYTOCIN AFFECT HUMANS?

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

Molecules produced by the hypothalamus at the base of the brain regulate many physiological processes such as emotions. Oxytocin, whose Greek origin means “quick birth,” was discovered in 1953 by Vincent Vigneaud (Oxford Neurosciences Revolucionary et al 2009). This enzyme has peripheral (hormonal) and central effects in the brain. The effects are mediated by specific high affinity receptors. The purpose of this project was to explain the oxytocin molecule distribution around the human body and understand its behavior. The increase of concentration percentage and the different situations presented are due to the results measured by oxytocin. According to studies, have suggested that men and women are attracted by this enzyme. Men are easily attracted to other individuals because of the flow and strength that is issued internally by oxytocin. This makes this an astonishing cycle of stimulus needed for the attraction process to occur.

YOU ARE WHAT YOU EAT

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Research Mentor: Eduan Martinez Soto, Universidad Metropolitana, San Juan, Puerto Rico.
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Urine is the waste product secreted by the kidneys, stored in the bladder, then discharged from the body through the tube that carries urine from the bladder to the outside of the body, the urethra. Measuring the pH of urine is very important, because if the pH tilts more to one side, alkalinity or acidity, one will be vulnerable to various types of illnesses or metabolism disorders. High levels of acidity can speed up the metabolism, which helps lose weight, but the brain, blood cells, and other parts can be damaged. Most people do not know the magnitude of not having a balanced pH. Balancing the pH of the body can be very benevolent for health, helps in weight loss and keeps the body energized, while not balancing it out has a big impact, such as developing illnesses. The purpose of this investigation was to develop a diet that contains the right amount of acidity and alkalinity, leading to a healthy life. The research steps were basic, learning about the properties of urine, how acidity and alkalinity affect the body, looking for foods with the right amount of alkalinity and acidity, establishment of a diet, and have it followed by a male and a female in order to perform the experiment. The data was recorded in a table and compared in a linear graph. It was expected that the result of the experiment would be that ingesting acidic food would have stronger results on the male’s health than the basic food. A further step would be to experiment once again, but have big groups composed of people with metabolism disorders, such as diabetes, which will be useful for developing a diet for every type of people, no matter which illness they suffer from.
THE LOGISTIC POPULATION MODEL AND THE UNITED STATES CASE

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Research Mentor Assistant: Melinda Vargas, San Antonio Abad School, Humacao, Puerto Rico.

In this project the Logistic Population Model was presented and the solution of the logistic equation was discussed. Using data from the World Bank, the corresponding parameters of the solution in the United States case were calculated showing that the data of the World Bank are similar to the results obtained by solving the equation. Moreover the model provided the opportunity to make predictions about the population throughout the years and a population limit in the future.

ANALYSIS OF THE CYBB GENE DEFICIENCY DECODING THE CYTOCHROME B-245 PROTEIN

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Student Research Mentor Assistant: Carol J. Díaz, Universidad del Este, School of Science and Technology, Carolina, Puerto Rico.
Student Research Mentor Assistant: Edgardo Vázquez, Universidad Metropolitana, AGMUS Institute of Mathematics, San Juan, Puerto Rico.

The chronic granulomatous disease (CYBB) is a critical component of the membrane-bound oxidase of phagocytes that generates superoxide. Its location is in the X chromosome. It is a principal component of the respiratory protein complex that transfers single electrons from cytoplasmatic NADPH across the plasma membrane to molecular oxygen on the exterior. Mutations in this gene are related with autosomal recessive chronic granulomatous disease (CGD), which is characterized by the failure of activated phagocytes to generate superoxide that is important for the microbicidal activity of these cells. The protein that the CYBB encodes is the Cytochrome b-245 that is composed of Cytochrome b alpha (CYBA) and beta (CYBB) subunits. This protein has been proposed as a primary element of the microbicidal oxidase system of phagocytes. In the CGD disease, there is a decrease in activity of the phagocyte NADPH oxidase. That means that neutrophils are able to phagocytize bacteria but cannot kill them in the phagocytic vacuoles. The program SIFT was used, which predicts whether or not an amino acid sequence substitution in a protein will suffer a mutation was used. The positions that have a probability of less than 0.05 are considered to be deleterious. The program analyzed the positions in four groups of five. The first group had a 66%, the second a 61%, the third a 40% and the last one a 51% chance that the protein would be intolerant. In conclusion the gene had a 51% of chances in the first twenty positions of having a mutation in the protein.
HOW DOES A STAR BECOME A BLACK HOLE?

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Research Mentor: Eduan Martínez Soto, Universidad Metropolitana, San Juan, Puerto Rico.
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A black hole is a region of space that not even light can escape from it because it has so much mass concentrated in it that there is no way for a nearby object to escape its gravitational pull. The stars are suns, gaseous and spherical, composed mainly of hydrogen in their central regions. (Cultural de Ediciones S.A., 1998). When a star collapses, most of the matter in it is blown away by the supernova explosion, and what remains will be a neutron star or, in the case of the largest stars, a black hole. During the process for transforming into a black hole, the star radius can be calculated by the Schwarzschild radius formula. The Schwarzschild radius, also called gravitational radius, is the distance that defines the size at which a spherical astronomical object such as a star becomes a black hole. Any object with a physical radius smaller than its Schwarzschild radius will be a black hole. The principal objective of this research was to obtain the Schwarzschild radius of ten different stars while they turn into black holes and compare them. The data obtained was compared. The analysis will reveal if the radius of some star that is being studied can become a black hole.

AN EXCEL STATISTICAL ANALYSIS OF BATTERY TOXICITY

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

Batteries are an intrinsic component of daily activities, houseware and appliances, including cars. In this project the toxic effects of batteries in nature were examined and a statistical analysis was conducted. Information on how people have been aware of these effects will also be presented. As a minimum, every battery requires an anode, a cathode and an electrolyte. The electrolyte is made of potassium hydroxide. This component when leaked outside the battery, can cause eye and skin irritation. The most toxic batteries are the ones made of Mercury oxide, which have 30% of Mercury. There is evidence that mercury can damage the nervous system, cause heart circulatory system problems and cause cancer. Another kind of toxic battery is the one made of nickel and cadmium. Cadmium is a very dangerous metal but can be rechargeable up to 1000 times. Cadmium can cause kidney damage. The purpose of this project was to help create awareness in people of the toxic effects of batteries in nature; so that they can start recycling batteries instead of throwing them in the trash.
MATHEMATICAL REPRESENTATION OF THE EFFICIENCY OF DEFICIT DISORDER TREATMENT USING ADD

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Attention-deficit disorder (ADD) is a common condition that often results in child and family functional impairments (Brinkman WB et al. 2011). Children who have ADD suffer from many problems including a very poor concentration, slow emotional development, and show difficulties in their studies and their interactions with others. Family preferences also vary and may contribute to variability in treatment utilization (Max Muenke, M.D. et al. 2010). Treatment decisions are preference sensitive and depend on how an informed patient/parent values the tradeoffs between options (Brinkman WB et al. 2011). For the experimentation, the accurate percentage of universal adolescents with ADD was calculated using mathematical equations based on the SIR Model. SIR stands for “Susceptible,” “Infected,” and “Recoverd.” Not only will it calculate the percentage of worldwide adolescents with ADD, but it will also calculate the people who died being susceptible, the people who died infected, and those who died recuperated. The percentage of people who died “infected” will have to have died from other causes, and the people that died “recuperated” will have died from other causes (natural or not), but most certainly not from ADD. The model was developed in the Vensim Program to see the behavior in the population during the years when the infected population was under treatments. The results from this research will be mathematically presented with the S+I+R=N equation as a principal idea.

THE EFFECT OF MUSIC WHILE EXERCISING

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

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Music is used for many purposes. It has various effects on the human body, however many people do not notice those effects. Some of these include: slowing down and equalizing brain waves, masking unpleasant sounds and feelings, among other effects. Those effects will greatly influence a person exercising; they will determine how much exercise is done and how it will be carried out. Nowadays, one of the most popular uses of music is while working out. In this investigation the goal was to figure out how music affects people doing exercise on a treadmill run by comparing the distances ran with upbeat and slow music playing and without any music. To do so, a group of participants was brought to a gym to run on a treadmill under the circumstances that were being tested. The distances ran by each participant were recorded on a table. Then the data was analyzed. With fast-paced music playing the participants increased mileage and with slow-paced music playing they decreased mileage.

H1N1-SIR MODEL

Edgardo Nieves, Bonifacio Sánchez Jiménez School, Cayey, Puerto Rico.

Research Mentor: Prof. Melissa Martínez, University of Puerto Rico-Cayey, Cayey, Puerto Rico.

The global spread of diseases has become a serious threat to human beings. The Vensim software was used to help analyze differential equations concerning the H1N1 disease. For people who have not taken a differential equations course, Vensim is a useful tool for studying changes over time. The data for this project came from different books and science papers. In this project a differential equations Vensim model was used to better see the effects of the H1N1 disease in people over time.
MODELING THE PUERTO RICAN POPULATION

Jennifer Patritti, Manuela Toro Morice School, Caguas, Puerto Rico.


In this project two population models were compared in order to study the growth of Puerto Rican populations, including those in the United States. The models used were the Malthus Model and the Logistic Model. The Malthus Population Model predicts the population growth without bound or inevitable extinction and the Logistic Model, a slight modification of the Malthus Model, predicts the population growth towards a population limit. In both cases data from the World Bank was used to predict the Puerto Rican population. It was observed that the most similar model to the actual data was the Logistic Population Model. The Logistic Model corroborated what the World Bank had established.

FEASIBILITY STUDY TO EVALUATE WIND POWER AS A SOLUTION TO PRODUCE ELECTRIC POWER

Juan C. Pérez, Gilberto Concepción de Gracia School, Carolina, Puerto Rico.

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

Windmill power is an alternate energy source that is used widely in the world, being integrated recently in Puerto Rico. A small windmill system can be used to supply 30% of the energy needed for a functional house on a daily basis. Along with solar panels, it is the modern alternative for clean energy. The increase in cost of electricity could be remediated with the implementation of the windmill system to relieve monthly electricity payment. The cost of natural gas has increased since 1996, and by 2011, it is around 17 cents per kWh. The cost of wind power meanwhile has declined slightly. The windmill is more practical than solar panels for some areas of Puerto Rico, like coasts and central mountains, where the winds speed have enough strength to energize this system. In Europe, there has been a “wind revolution” in the last years with the new micro wind energy generators that cost 1,000 Euros. This project analyzed costs, environment requirements and reliability of this technology compared to other common energy sources.
ANALYSIS OF THE AMINO ACIDS CHANGES IN THE COAGULATION FACTOR VII PROTEIN

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Student Research Mentor Assistant: Carol J. Diaz, Universidad Del Este, School of Science and Technology, Carolina, Puerto Rico.
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Serum prothrombin conversion accelerator is a gene that encodes coagulation Factor VII which is a vitamin K dependent factor essential for hemostasis. This factor circulates in the blood in a form of the zymogen thrombin that is activated by minor proteolysis. The coagulation cascade will be activated by converting Factor X to Factor Xa. Alternative splicing of this gene results in two transcripts. Defects in the gene can cause coagulopathy. However, a deficiency which is a7d is associated to the Factor VII that results in rare hereditary hemorrhagic disease. The main function of the gene is to initiate the extrinsic pathway of blood coagulation. The focus of this analysis was to study the tolerance and intolerance in amino acid changes of this protein by using specific computer programs such as SIFT. Sorting Intolerant From Tolerant (SIFT) is a program that predicts whether an amino acid substitution affects protein function so that users can prioritize substitutions for further study. The result of the program SIFT showed that there was 72.75% of probabilities of a mutation in the Factor VII protein.

POPULATION GROWTH: PUERTO RICO VS. ARIZONA, US

Alexander Reyes, Emanuel Pagán, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

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

The dropout rate is an educational problem with social implications that affect the economy and the community. It occurs for many causes including the disintegration of families, financial problems, and the lack of support, values, and individualized attention, among others. According to the 2000 Census, 25.4% of the Puerto Rican population of age 25 or over has not completed the ninth grade, which represents almost two thirds of those without a high school diploma. The dropout rates for poor communities throughout Puerto Rico was at 46.1%. (Angel Negron et. al 2007). In Arizona, the same is happening in terms of dropout. The analysis was made with the least-squares method which is based on the use of numbers with variables to calculate exactly the distribution of data for each population. The purpose of this study was to make a statistical comparison and have a better solution to this problem. This was calculated with various formulas using the Microsoft Office Excel program such as the linear method, the exponential method and the logarithmic method to get better and conclusive results from the correlation of the data to see where there were more dropouts and teach people that mathematics can be used to solve any social problem, and not necessarily resolve a scientific problem only.
The availability of clean water is routinely among the top environmental concerns. In this research, two sites surrounded by different ecosystems were chosen at the Maracuto stream, located in Carolina, PR. This stream connects with the Rio Grande de Loiza, one of the most important rivers in Puerto Rico and yet highly polluted. The purpose of this research was to document the rise phosphorus, and TSS and find their effects on water conditions. It was also to determine the sources of pollution that may be impacting the water quality in this stream. Macro-invertebrates were analyzed and used as “indicators” of water quality. Urban development surrounding streams can alter the dynamic of the water flow, therefore causing damages to the macro-invertebrate habitat and the ecosystem in the stream. Through this research, the correlation of macro-invertebrates phosphorus and TSS was established. The results of this project will be later combined with other stream data to find strategic solutions to the pollution problems and gain a greater understanding of watersheds. This research is sponsored by the VT EPSCoR Streams.
THE BEST INVESTMENT

Kevin J. Rosario Meléndez, Bonifacio Sánchez Jiménez High School, Cayey, Puerto Rico.

Research Mentor: Prof. Widad Abdalla, University of Puerto Rico-Cayey, Cayey, Puerto Rico.

What would be the best investment an individual makes? Is it better to use the money to play games like *The Lottery* or save it in a bank account? *The Lottery* is a gambling game that was created to generate additional income for the government. The probability of winning this game will only be one hundred percent effective if and only if the person plays all possible combinations, which is technically impossible. Each day, more people get addicted to this kind of game and they are spending a lot of money on it. They play every day because they believe that one day they are going to win something, but the truth is that they are wasting a lot of money. The main objective of this research was to prove that it is better to put the money in an account rather than spending that money buying lottery tickets. The Binomial Distribution Model was used to calculate the probabilities of winning. A comparison was made between these probabilities and the amount of money the person would have in a bank if they saved it. All of these formulas were programmed using MATLAB to facilitate the calculations. The results of this research will be revealed in the presentation.

UNSHAKEN VIDEOS

Alex Roberto Sánchez Escalera, Barbara Ann Roessler Academy, San Juan, Puerto Rico.


The objective of this project was to see how a shacked video would be fixed in MATLAB. It was performed by learning about the pixels and the translations in order to fix the moving video. Pixels are dots used to display an image on a screen or printed matter. Usually the term refers to pixels in a digital context. In order to fix the moving image it is necessary to know the commands and tools for translating and rotating the images. This translation and rotation are generally due to move the image only a couple of pixels in some directions. By uploading this picture into the MATLAB program, the following corrections can be done: change the height and width and take out pixels from an image. The used video in the presentation was a xylophone video. The images in this video were artificially altered a couple pixels upwards or downwards. Some transformations were done to measure one by one image perturbation. These measures permitted to develop a video correction algorithm. This algorithm performs an image perturbation to obtain a better quality video.

TANGLE ANALYSIS OF PROTEIN-DNA COMPLEXES ABSTRACT

Saúl Santiago, Bonifacio Sánchez Jiménez School, Cayey, Puerto Rico.

Research Mentor: Prof. Melissa Martínez, University of Puerto Rico-Cayey, Cayey, Puerto Rico.

A tangle is defined as $n$ strings properly embedded in a 3-ball. Coloring of an $n$-string tangle is a powerful tangle invariant which can be used to differentiate between some tangles. This invariant is an important part of tangle analysis, which can be applied to the study of protein-DNA binding. Coloring matrices were used to determine how the multiplication of two 2-string tangles affects the coloring of the resulting tangle. The coloring matrix was determined by creating equations at each crossing of a given tangle diagram and labeling each arc $x_i$. The two underarcs were given a coefficient of 1 and the overarc is given a -2 leading to the general formula: $x_i + x_j - 2x_k = 0 \mod p$. Results of this study reveal how 2-string tangles affect coloring of another tangle.
MODEL OF MARINE ANIMALS

Elizabeth Torres Rivera, Bonifacio Sánchez Jiménez School, Cayey, Puerto Rico.

Research Mentor: Prof. Melissa Martínez, University of Puerto Rico-Cayey, Cayey, Puerto Rico.

An ordinary equations Vensim model was developed to study competing and predatory interrelations between multiple species. Vensim software is a tool that helps to analyze the changes over time with mathematical equations. This model allowed to predict what occurred in a four different species ecosystem (white shark, bull shark, remoras and marine birds). The data to develop this project was acquired from different biology books, magazines, and the internet. This analysis that was conducted helped in the prediction of how the ecosystem changed over time to predict how this ecosystem behaved in particularly.

PROBABILITY OF FALSE POSITIVES IN A DRUG TEST

Isamar Vives Matos, Yelitza Aponte Rivera, Bonifacio Sánchez Jiménez High School, Cayey, Puerto Rico.

Research Mentor: Prof. Widad Abdalla, University of Puerto Rico-Cayey, Cayey, Puerto Rico.

A drug test is used to detect any pharmacological substance on a person. It depends on probability, which is a part of the whole or a portion overall. It is important to know the probability of false positives in a drug test because these results affect lives; people could lose their jobs and any other moral support. Now, would it be possible to calculate the probability of false positives in a drug test? This project analyzed the population of firemen in Puerto Rico. Using mathematics formulas, the probability of when a person throws a positive result in a drug test, he or she is really a drug user was calculated. In order to facilitate these calculations, the formulas were programmed using MATLAB. After analyzing these formulas it was discovered that the probability of false positives could be calculated, but it depends mainly on the effectiveness of the test and the consumed drug rate.

ANALYSIS OF METHODS TO SOLVE SYSTEMS OF EQUATIONS

Gerardo Zayas Santiago, Juan C. Negrón Santiago, Bonifacio Sánchez Jiménez High School, Cayey, Puerto Rico.

Research Mentor: Prof. Widad Abdalla, University of Puerto Rico-Cayey, Cayey, Puerto Rico.

A system of equations is a group of two or more equations with many variants that form a mathematical problem, consistent in finding the variables that satisfy the equations. There are many methods to solve a system of equations. The most common ones are: substitution, elimination, equality, graphing, Cramer’s rule and using a calculator. A program was created using Matlab to determine the solutions of a system. This program was created using a closed formula. The objective of our research was to determine which of the mentioned methods is the most efficient one in terms of time. Two mathematics major students from UPR Cayey were chosen and measured the time it took them to solve a 2X2 and 3X3 system using all these methods. These students were given the same exercise to solve using the different methods. This way the most efficient method was determined.
STUDY OF BIOGAS LEVELS IN RESIDENTIAL SEPTIC TANKS: DESIGN OF A PROTOTYPE TO MAXIMIZE THE PRODUCTION OF BIOGAS AS AN ALTERNATE ENERGY SOURCE

Julio A. Cedeño Alicea, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Prof. Nelson Ruiz, University Gardens High School, San Juan, Puerto Rico.

Every day, there are catastrophic damages caused by the emission of gases into the atmosphere. In part, this is due to the dependence on polluting fossil fuels, such as petroleum. The purpose of this study was to consider the possibility of power generation in a residential septic tank for domestic use and to design a more effective prototype in the generation of biogas. In the study, gas chromatography tests were performed in two (2) samples and two (2) septic tanks to identify the presence and proportions of certain gases in them. The data collected from the samples was adapted to the size of an average residential septic (1,000 ft³) to estimate gas generation in a residential sealed septic tank. In addition, an outline of the transformation of gases in a residential septic tank to electricity was prepared. Based on field data, a conventional residential septic tank cannot generate enough biogas to power a 1,500 watts generator (motorized by biogas), due to its open infrastructure. On the other hand, completely sealed samples showed significant proportions: 0.055 (cattle) and 0.033 (human) m³ of biogas. The data collected was very useful because, as expected. It is possible to generate energy with the use of gases in a residential sealed septic tank. Thus, the prototype could be applied to homes so that they could generate the energy that they consume.

A MODEL FOR CHANGES IN SURFACE TENSION DUE TO MAGNETIZATION

Michael Hicks, Santiago Apóstol School, Bayamón, Puerto Rico.

Research Mentor: Prof. Gerson Restrepo, Universidad del Este, Carolina, Puerto Rico.

Changes in water physical properties such as flow, dielectric constant, and conductivity can be a consequence of the type of magnetic fields applied when measured. I. Ibrahim demonstrated that increasing the strength of magnetic fields will cause a decrease on the rate of flow, the electric conductivity and the dielectric constant. Technology, to this day, allows the availability of potent magnets made from rare earths (Samarium cobalt or Neodymium). These magnets were very useful for this project. The purpose of this study was to use a rotating magnetic field to study variations occurring on water’s surface tension. The methodology included incorporating rare earth magnets of neodymium into the rotating system of a blender placed in opposite diametrical sides to induce magnetization of water. The force needed to separate a wet ring from the surface of a sample of magnetized water, which is related to surface tension, was measured. This force was measured by using conventional methods such as using a ring and a balance scale. The measurement of magnetized water’s surface tension was compared with that of an untreated sample of water. It was expected that magnetized water will exhibit lower surface tension than untreated water.
Contamination is one of the major problems of modern society. Today’s electronic industry has left a number of deadly poisons that covers our Earth. Today's oceans are heavily polluted because of the continuous discarding of waste throughout the world. One of such poisons includes metals, petroleum derivatives and toxic elements such as mercury. Mercury produces lot of damage if it enters into the body, but many people remain unaware of it. Some of the damage it causes is the degeneration of the nervous system, DNA and chromosomal damage, allergic reactions, negative effects on reproduction and abortions in pregnant women. The main source for mercury to enter and stay in the bodies is by consuming contaminated fish. It is of primary concern to be aware of this source, since fish is consumed more than ever and in the future it will be the main source of food. The way mercury enters finally to the body is through industrial waste, water contaminated when people throw wastes of fluorescent lamps, thermometers, and other contaminants. This water reaches lakes and rivers and goes to the ocean, where it finally accumulates on fish. When a person eats contaminated fish, then the individual becomes vulnerable to poisoning and can die. The purpose of this project was to educate people about the mercury contamination cycle. Dramatic images of the damages caused by these contaminants on oceans, landscapes and people were used.
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 Spring 2011 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 Spring 2011 Pre-College Research Symposium possible.

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<table>
<thead>
<tr>
<th>NAME</th>
<th>SCHOOL</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christian Acevedo</td>
<td>Dr. Pedro Perea Fajardo Vocational School, Mayaguez</td>
<td>29, 69</td>
</tr>
<tr>
<td>Janice Acevedo</td>
<td>Bautista de Puerto Nuevo Academy, San Juan</td>
<td>32, 81</td>
</tr>
<tr>
<td>Mónica I. Adorno</td>
<td>Josefina Barceló School, Guaynabo</td>
<td>34, 85</td>
</tr>
<tr>
<td>Fabiola Agramonte</td>
<td>Maria Reina Academy, Carolina</td>
<td>30, 72</td>
</tr>
<tr>
<td>Alfredo Aldebol</td>
<td>Inter-American School, San Germán</td>
<td>30, 72</td>
</tr>
<tr>
<td>Yaromie Alemañy</td>
<td>Lola Rodriguez High School, San Germán</td>
<td>30, 72</td>
</tr>
<tr>
<td>Marisol Almestica</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>30, 73</td>
</tr>
<tr>
<td>Miguel Almodóvar</td>
<td>Bautista de Puerto Nuevo Academy, San Juan</td>
<td>39, 78</td>
</tr>
<tr>
<td>Brayan Alvarado</td>
<td>Antilles Military Academy, Trujillo Alto</td>
<td>24, 43</td>
</tr>
<tr>
<td>Edrick Alvarado</td>
<td>CROEM School, Mayaguez</td>
<td>29, 68</td>
</tr>
<tr>
<td>Edwin Alvarado</td>
<td>Caguas Military Academy, Caguas</td>
<td>37, 43</td>
</tr>
<tr>
<td>Jean P. Alvarez</td>
<td>Santa Rosa School, Bayamón</td>
<td>39, 73</td>
</tr>
<tr>
<td>Karla Alverio</td>
<td>Thomas Alva Edison School, Caguas</td>
<td>24, 44</td>
</tr>
<tr>
<td>Angel Andino</td>
<td>Santa Gema Schol, Carolina</td>
<td>30, 73</td>
</tr>
<tr>
<td>Yelitza Aponte</td>
<td>Bonifacío Sánchez Jiménez School, Cayey</td>
<td>36, 100</td>
</tr>
<tr>
<td>Marcus I. Arroyo</td>
<td>Josefa Barceló High School, San Juan</td>
<td>35, 92</td>
</tr>
<tr>
<td>Nicole Arroyo</td>
<td>San José School, San Germán</td>
<td>34, 89</td>
</tr>
<tr>
<td>Jorge Bauzó</td>
<td>Santiago Apóstol School, Bayamón</td>
<td>24, 44</td>
</tr>
<tr>
<td>Jaleel Benjamin</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>35, 91</td>
</tr>
<tr>
<td>Jean C. Bernal</td>
<td>San Juan Apóstol School, San Juan</td>
<td>30, 74</td>
</tr>
<tr>
<td>Melissa Bramble</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>30, 74</td>
</tr>
<tr>
<td>Isardo Braverman</td>
<td>José Aponte de la Torre School, Carolina</td>
<td>41, 98</td>
</tr>
<tr>
<td>Steven Browne</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>32, 81</td>
</tr>
<tr>
<td>Rafael Cabrera</td>
<td>Bautista de Levittown, Toa Baja</td>
<td>30, 75</td>
</tr>
<tr>
<td>Rommy L. Cáceres</td>
<td>Emilio R. Delgado School, San Juan</td>
<td>24, 44</td>
</tr>
<tr>
<td>Melissa Calderón</td>
<td>Inter-American School, San Germán</td>
<td>31, 75</td>
</tr>
<tr>
<td>Sheniah Campbell</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>31, 76</td>
</tr>
<tr>
<td>Aldrin M. Cañals</td>
<td>Calasanz School, San Juan</td>
<td>25, 45</td>
</tr>
<tr>
<td>Rafael V. Cañals</td>
<td>Calasanz School, San Juan</td>
<td>41, 92</td>
</tr>
<tr>
<td>Zahira C. Caraballo</td>
<td>Lourdes School, San Juan</td>
<td>25, 45</td>
</tr>
<tr>
<td>Néstor Carrasco</td>
<td>Petra Mercado School, Humacao</td>
<td>37, 46</td>
</tr>
<tr>
<td>Lizander Carrasquillo</td>
<td>Corporativa de Integración Social Academy, San Juan</td>
<td>25, 46</td>
</tr>
<tr>
<td>William A. Castillo</td>
<td>Dr. Pedro Perea Fajardo School, Mayaguez</td>
<td>25, 46</td>
</tr>
<tr>
<td>Julio A. Cedeño</td>
<td>University Gardens High School, San Juan</td>
<td>36, 101</td>
</tr>
<tr>
<td>Nishmar Cestro</td>
<td>Episcopal Cathedral School, San Juan</td>
<td>39, 75</td>
</tr>
<tr>
<td>Cristian Claro</td>
<td>San Jorge Academy, San Juan</td>
<td>31, 76</td>
</tr>
<tr>
<td>Bryan Claudio</td>
<td>Bautista de Puerto Nuevo Academy, San Juan</td>
<td>39, 76</td>
</tr>
<tr>
<td>María A. Claudio</td>
<td>Bautista de Puerto Nuevo Academy, San Juan</td>
<td>25, 47</td>
</tr>
<tr>
<td>Kayra Clouden</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>31, 76</td>
</tr>
<tr>
<td>José Colón</td>
<td>Caguas Military Academy, Caguas</td>
<td>37, 47</td>
</tr>
<tr>
<td>Joseph Colón</td>
<td>Manuela Toro Morice School, Caguas</td>
<td>35, 93</td>
</tr>
<tr>
<td>Ediel E. Corujo</td>
<td>Antilles Military Academy, Trujillo Alto</td>
<td>37, 48</td>
</tr>
<tr>
<td>Jairo A. Cruz</td>
<td>Discípulos de Cristo Academy, Bayamón</td>
<td>31, 77</td>
</tr>
<tr>
<td>Melanie Cruz</td>
<td>Antilles Military Academy, Trujillo Alto</td>
<td>37, 48</td>
</tr>
<tr>
<td>Tiffany Cruz</td>
<td>Inter-American School, San Germán</td>
<td>31, 77</td>
</tr>
<tr>
<td>Lina V. Daza</td>
<td>Inter-American School, San Germán</td>
<td>31, 77</td>
</tr>
<tr>
<td>Shalimar J. Delgado</td>
<td>Bilingüe Padre Rufo School, San Juan</td>
<td>41, 93</td>
</tr>
<tr>
<td>Andrea Devaris</td>
<td>Inter-American School, San Germán</td>
<td>31, 77</td>
</tr>
<tr>
<td>NAME</td>
<td>SCHOOL</td>
<td>PAGES</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Bryanda Díaz</td>
<td>Saint Francis School, Carolina</td>
<td>42, 102</td>
</tr>
<tr>
<td>Christian Díaz</td>
<td>Caguas Military Academy, Caguas</td>
<td>25, 49</td>
</tr>
<tr>
<td>Manuel Díaz</td>
<td>San Ignacio School, San Juan</td>
<td>39, 78</td>
</tr>
<tr>
<td>Zaibeth Díaz</td>
<td>Bautista de Caguas School, Caguas</td>
<td>29, 69</td>
</tr>
<tr>
<td>Ahriyah Fearon</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>35, 91</td>
</tr>
<tr>
<td>Carola Figueroa</td>
<td>Marista School, Caguas</td>
<td>25, 49</td>
</tr>
<tr>
<td>Xavier Figueroa</td>
<td>Bautista de Puerto Nuevo Academy, San Juan</td>
<td>39, 78</td>
</tr>
<tr>
<td>Valerie Flores</td>
<td>Thomas Alva Edison School, Caguas</td>
<td>25, 49</td>
</tr>
<tr>
<td>Natasha de los A. García</td>
<td>Dr. Juan José Osuna School, San Juan</td>
<td>41, 94</td>
</tr>
<tr>
<td>Joffre Gómez</td>
<td>Inter-American School, San Germán</td>
<td>31, 79</td>
</tr>
<tr>
<td>Diego González</td>
<td>San José School, San Germán</td>
<td>39, 79</td>
</tr>
<tr>
<td>Edwin J. González</td>
<td>Bautista de Caguas School, Caguas</td>
<td>31, 79</td>
</tr>
<tr>
<td>Jenipher D. González</td>
<td>Bautista de Caguas School, Caguas</td>
<td>32, 80</td>
</tr>
<tr>
<td>Josué González</td>
<td>Pedro Perea Fajardo School, Mayagüez</td>
<td>25, 50</td>
</tr>
<tr>
<td>Keishla González</td>
<td>San Antonio Abad School, Humacao</td>
<td>26, 50</td>
</tr>
<tr>
<td>Charlotte Grau</td>
<td>Barbara Ann Roessler Academy, San Juan</td>
<td>26, 51</td>
</tr>
<tr>
<td>Carlos Guillen</td>
<td>Nuestra Señora de Guadalupe School, San Juan</td>
<td>26, 51</td>
</tr>
<tr>
<td>William Guzmán</td>
<td>Santiago Apóstol School, Fajardo</td>
<td>32, 80</td>
</tr>
<tr>
<td>Danté Hall</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>32, 80</td>
</tr>
<tr>
<td>K'Jani Hall</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>32, 80</td>
</tr>
<tr>
<td>Yolianna Hernández</td>
<td>Bautista de Puerto Nuevo Academy, San Juan</td>
<td>34, 87</td>
</tr>
<tr>
<td>Kenneth Hicks</td>
<td>Santiago Apóstol School, Fajardo</td>
<td>35, 94</td>
</tr>
<tr>
<td>Michael Hicks</td>
<td>Santiago Apóstol School, Bayamón</td>
<td>36, 101</td>
</tr>
<tr>
<td>José Iglesias</td>
<td>La Piedad School, Trujillo Alto</td>
<td>37, 52</td>
</tr>
<tr>
<td>Gilberto Jiménez</td>
<td>CROEM School, Mayagüez</td>
<td>26, 52</td>
</tr>
<tr>
<td>Whitney Lambert</td>
<td>St. Croix Educational Complex, the Virgin Islands, St. Croix</td>
<td>32, 81</td>
</tr>
<tr>
<td>Viviana M. Lebrón</td>
<td>Calasanz School, San Juan</td>
<td>41, 95</td>
</tr>
<tr>
<td>Nykos Linares</td>
<td>Inter-American School, San Germán</td>
<td>34, 88</td>
</tr>
<tr>
<td>Stacy Lloyd</td>
<td>Bautista de Puerto Nuevo Academy, San Juan</td>
<td>32, 81</td>
</tr>
<tr>
<td>Glory López</td>
<td>Bautista de Carolina Academy, Carolina</td>
<td>26, 53</td>
</tr>
<tr>
<td>Katia V. López</td>
<td>Bautista de Puerto Nuevo Academy, San Juan</td>
<td>25, 47</td>
</tr>
<tr>
<td>Linnette López</td>
<td>Isabel Flores High School, Humacao</td>
<td>29, 69</td>
</tr>
<tr>
<td>Natalie López</td>
<td>Inmaculada Academy, Mayagüez</td>
<td>26, 53</td>
</tr>
<tr>
<td>Víctor López</td>
<td>Rexville High School, Bayamón</td>
<td>32, 81</td>
</tr>
<tr>
<td>José O. Maestre</td>
<td>CIEM Private School, Carolina</td>
<td>32, 82</td>
</tr>
<tr>
<td>Liz Malavé</td>
<td>Bautista de Caguas Academy, Caguas</td>
<td>37, 46</td>
</tr>
<tr>
<td>Alexandra Maldonado</td>
<td>San Benito School, Mayagüez</td>
<td>26, 54</td>
</tr>
<tr>
<td>Delmarie Marrero</td>
<td>Levittown Baptist Academy, Toa Baja</td>
<td>26, 64</td>
</tr>
<tr>
<td>Kevin J. Marrero</td>
<td>San Benito School, Mayagüez</td>
<td>26, 55</td>
</tr>
<tr>
<td>Miguel A. Martell</td>
<td>San José School, San Germán</td>
<td>39, 79</td>
</tr>
<tr>
<td>Dan-L Martínez</td>
<td>C.I.E.M. Private School, Carolina</td>
<td>32, 82</td>
</tr>
<tr>
<td>Gabriela Martínez</td>
<td>La Piedad School, Trujillo Alto</td>
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<td>Homeschool, Carolina</td>
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<td>Bautista de Puerto Nuevo Academy, San Juan</td>
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<td>Episcopal Cathedral School, San Juan</td>
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<td>38, 57</td>
</tr>
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<td>NAME</td>
<td>SCHOOL</td>
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</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------------------------------</td>
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<td>San Jorge Academy, San Juan</td>
<td>33, 84</td>
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<td>31, 79</td>
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<td>American Military Academy, Guaynabo</td>
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<td>Del Pilar School, Canóvanas</td>
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<td>Angel David School, San Juan</td>
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<td>Inter-American School, San Germán</td>
<td>34, 88</td>
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<td>University Gardens School, San Juan</td>
<td>28, 61</td>
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<td>Laura Roldán</td>
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<td>Joshua M. Rolón</td>
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<td>Notre Dame School, Caguas</td>
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<td>Levittown Baptist Academy, Toa Baja</td>
<td>28, 38, 63, 64</td>
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<td>Jorge Rosado</td>
<td>Antilles Military Academy, Trujillo Alto</td>
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<td>María Teresa Piñero, Toa Baja</td>
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<td>Joseph Santiago</td>
<td>Petra Mercado School, Humacao</td>
<td>28, 65</td>
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<tr>
<td>NAME</td>
<td>SCHOOL</td>
<td>PAGES</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------</td>
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<td>Saul Santiago</td>
<td>Bonifacio Sánchez Jiménez School, Cayey</td>
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<td>Lurgea Central College, Toa Baja</td>
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<td>San Ignacio School, San Juan</td>
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<td>Valerie Vázquez</td>
<td>Presbyterian Academy, San Germán</td>
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</table>
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