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 2013 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 11, 2012
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The Model Institutions for Excellence (MIE) award granted by the National Science Foundation (NSF) 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 (AGMUS), 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. The primary goal of this cooperative agreement with NSF was to increase the number of BS degrees granted to underrepresented students in STEM fields at Universidad Metropolitana. Over 247 UMET STEM majors got their BS degrees and 156 were transfer to graduate school. 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 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.
# SPRING 2013 PRE-COLLEGE RESEARCH SYMPOSIUM

## CONFERENCE AT A GLANCE

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 – 8:15 a.m.</td>
<td>Registration, Breakfast, Poster Session Set-Up</td>
<td>San Cristóbal Foyer, San Cristóbal Foyer, San Cristóbal Ballroom</td>
</tr>
<tr>
<td>7:00 – 8:00 a.m.</td>
<td>Judges Meeting</td>
<td>San Gerónimo Foyer C</td>
</tr>
<tr>
<td>8:00 – 8:20 a.m.</td>
<td>Opening Ceremony, Keynote Speaker: Dr. Ruth Castellanos, University of Virginia, Charlottesville</td>
<td>San Gerónimo Ballroom</td>
</tr>
<tr>
<td>8:20 – 11:00 a.m.</td>
<td>Poster Session</td>
<td>San Cristóbal Ballroom</td>
</tr>
<tr>
<td>10:15 – 11:00 a.m.</td>
<td>Coffee Break</td>
<td>San Cristóbal Foyer</td>
</tr>
<tr>
<td>11:00 – 12:40 p.m.</td>
<td>Oral Research Presentations: Session I, Session II, Session III, Session IV, Oral Research Presentations</td>
<td>Flamingo, Tropical, Conferences 3+7, Session IV, Auditorium</td>
</tr>
<tr>
<td>12:40 – 2:45 p.m.</td>
<td>Lunch, Keynote Speaker: Dr. Ruth Castellanos, University of Virginia, Charlottesville</td>
<td>San Gerónimo Ballroom</td>
</tr>
<tr>
<td>2:45 – 3:15 p.m.</td>
<td>Awards Ceremony and Closing Remarks</td>
<td>San Gerónimo Ballroom</td>
</tr>
<tr>
<td>3:15 p.m.</td>
<td>Symposium Adjourns</td>
<td></td>
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</tbody>
</table>

## WORKSHOPS FOR SCIENCE AND MATH TEACHERS

<table>
<thead>
<tr>
<th>Time</th>
<th>Workshop</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00 – 4:00 p.m.</td>
<td>Beauty and Joy of Computing (BJC), Offered by: “Participating Teachers from the BJC Program”</td>
<td>Salón del Mar</td>
</tr>
</tbody>
</table>
May 11, 2013

Dear Spring 2013 Pre-College Symposium participants:

The Ana G. Méndez University System (AGMUS) is both proud and honored to be part of the Spring 2013 Pre-College Research Symposium, a gathering of scientific minds organized by the AGMUS Student Research Development Center.

The AGMUS Institute of Mathematics Saturday Academy Program and the institutions that have formed the partnership of the Caribbean Computing Center for Excellence (CCCE) Alliance have designed this conference to offer pre-college students the opportunity to disseminate the outcomes of their research experiences in oral and poster presentations.

We appreciate the support that the National Science Foundation has provided through the CCCE Alliance and the Institute of Mathematics grants as well as the guidance provided by the student researchers and the mentors who worked long hours at different facilities throughout Puerto Rico and the US Virgin Islands to provide the experiences necessary to produce quality research.

Congratulations to all of you for your outstanding work!

Yours truly,

[Signature]

Jorge L. Crespo Armajiz, Ph.D.
Vice President for Planning and Academic Affairs
May 11, 2013

Dear students, teachers and parents:

Universidad Metropolitana (UMET) welcomes you to the Spring 2013 Pre-College Research Symposium held at the Caribe Hilton Hotel in San Juan, Puerto Rico. This activity, organized by the Student Research Development Center of the Ana G. Méndez University System, provides student researchers with an opportunity to disseminate the outcomes of their research conducted in the Pre-College Program.

The Pre-College Program integrates student researchers into the world of science by dedicating time to scientific research in a formal environment. The Symposium provides for scientific minds to come together and be part of the wonderful experience of meeting and learning from others who are also committed to the world of science. The research projects presented by the pre-college students are testimonials of the talent of our high school students and their dedication to long hours of work to produce scientific results.

We appreciate the commitment of the research mentors who guided students in this important journey. We are very proud to be part of this valuable experience that impacts youth of Puerto Rico and the US Virgin Islands.

Cordially,

Carlos M. Padrin, Ph. D.
Chancellor
May 11, 2013

Dear participants:

On behalf of Universidad del Este (UNE), we congratulate all of you who have made a commitment to the world of science. You are part of a great achievement: the presentation of your research outcomes during the Spring 2013 Pre-College Research Symposium at the Caribe Hilton Hotel in San Juan, Puerto Rico. This event, organized by the Student Research Development Center of the Ana G. Méndez University System, brings together student researchers from different parts of Puerto Rico and the US Virgin Islands who share their research experiences with scientists, faculty and other students.

We are very proud of the research projects presented by talented pre-college student researchers. It has been an honor to have contributed to the development of scientific research skills in young scientists, an experience that we hope will encourage you to continue your future careers in the fields of science, technology, engineering and mathematics (STEM).

We congratulate all of you because you are all winners. We thank the student and faculty mentors for their dedication and support provided as the student researchers were in this important journey. We commend your commitment and hard work.

Yours truly,

[Signature]
Alberto Maldonado Ruiz, Esq.
Chancellor
May 11, 2013

Dear Participants:

The Ana G. Méndez University System (AGMUS) and Universidad del Turabo are proud to be a part of a very important scientific gathering in your academic and research careers, the Spring 2013 Pre-College Research Symposium, held at the Caribe Hilton Hotel in San Juan, Puerto Rico. The Symposium is organized by the AGMUS Student Research Development Center as a culminating activity for students who have conducted research in the science, technology, engineering and mathematics (STEM) fields.

We are very pleased with the student participation in this Symposium that clearly provides students with an opportunity to share their research experiences in poster and oral presentations. It also helps student researchers meet scientists, faculty members from different fields in science, and young researchers who have been conducting research throughout Puerto Rico and the US Virgin Islands.

We appreciate the commitment of the research mentors for their valuable guidance during the research experiences. We are thankful for their fruitful work and the resulting research projects presented by their student researchers.

Congratulations to all of you!

Sincerely,

Dennis Alicea, Ph.D.
Chancellor
May 11, 2013

Dear Pre-College Students:

The Spring 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 2013, all of you, more than three hundred thirty-one pre-college students from ninety private and public high schools in Puerto Rico worked long hours in the research laboratories of the AGMUS campuses, Polytechnic University, Inter-American University-San GermánBayamón and Metro, the University of Puerto Rico-Mayagüez and Humacao, the University of the Virgin Islands, the Arecibo Observatory and Josefina de León High School-Jayuya, José Aponte de la Torre School-Carolina, with the guidance and mentorship of forty-nine professors and student research mentors in two-hundred thirty research projects in the areas of astronomy, biology, genomics, bio-mathematics, bio-statistics, computational chemistry, computer sciences, applied mathematics, engineering, environmental sciences, applied physics, and psychology.

One of the objectives of the Spring 2013 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 2013 Saturday Academy Program and the Spring 2013 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 2013 Saturday Academy Program and the Spring 2013 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

Student Research Development Center
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Fax: 787.751.5386
Web: http://srdc.suagm.edu
The Ana G. Méndez University System (AGMUS) is home to approximately 43,500 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.

As an Undergraduate Research Institution

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

PROLOGUE

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

The Spring 2013 Pre-College Research Symposium showcases the research experiences of three-hundred thirty-one (331) pre-college students from public and private high schools from Puerto Rico. 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 2013 participants. We hope this Symposium will be a vehicle by which the scientific productivity of high school students from Puerto Rico will be disseminated in future years.
Ruth Castellanos studied at Universidad Metropolitana (UMET) and was awarded the Model Institutions for Excellence (MIE) scholarship. She was part of the research scholar program, where she learned about the beauty of discovering the unknown through using project based learning. She also conducted research during her undergraduate years at the University of California-riverside (2002) and UCLA (2004-2005). She made presentations at symposia in Puerto Rico, at the Society for the Advancement of Chicanos in Science and at different stateside symposia. Ruth was granted a BS in Cellular Molecular Biology in 2005 at UMET, and continued graduate studies at the University of Virginia, Charlottesville, Virginia. She defended with success her Ph.D. dissertation: “RBP-J Regulates the Identity and Plasticity of Renin Cells” a Fundamental Mechanism to Control Homeostasis” on November 30, 2012.
RESEARCH MENTORS

Dr. Fabio Alape

Dr. Fabio Alape Benitez holds a Bachelor’s degree in chemical engineering from Universidad del Valle-Colombia (1990). He received his MSc (1994) and PhD (2004) degrees in chemical engineering from the University of Puerto Rico-Mayaguez Campus (RUM). At present, Dr. Alape is associate professor of the Industrial Chemistry Department at the University of Puerto Rico-Humacao Campus, where he teaches the courses of topics in industrial chemistry, unit operations and mechanics of materials for students of chemistry, chemical technology and engineering. In addition, he has given various conferences and courses in water treatment, air pollution control equipment design, renewable energy, process simulation and numerical methods in Environmental Engineering. Professor Alape is the CoPI of the program BPCA-CCCE/NSF at UPR humacao which serves to schools of the Eastern Area of Puerto Rico.

Mr. Ángel G. Andino Prieto

Ángel G. Andino Prieto was born in San Juan, Puerto Rico. He started with computer programming as a hobby, and android programming in early 2010. In the same year, he started in the Saturday Academy conducting some research in the area of computer science and programming HTML websites. In early 2011, he continued in the Saturday Academy program but working in mobile development with android and windows phones. He also worked with the android application “Mind Creeper,” and at that time he decided to focus entirely on computer science in mobile development. In the summer of 2011, Angel had the opportunity to participate at the Lawrence Berkeley National Laboratory as an intern, conducting research and working with databases and National Lab Servers. In the winter of 2011, he worked in the Saturday Academy implementing research on windows phone developing “Kids Quiz” to teach some shapes and colors to children. After those experiences, Angel started taking courses in robotics and after school programming, developing tools in Python and Java as a hobby. In the spring of 2012, he started creating a platform “Clickers” with the aim to do research in class with students with a local database accessed via smartphones. He presented the “Berkeley Storage Manager” at the 50th Junior Science and Humanities Symposium. In the summer of 2012, Angel had the opportunity to participate at the National Center for Atmospheric Research, creating winter data in Python. He presented “Solid Precipitation Inter-comparison Experiment” at the 2012 AGMUS Research Symposium. He was awarded the Best Poster Presentation; he also presented the research in the New England Science Symposium at Harvard Medical School. He is actually a first year student at Universidad Metropolitana in the Computer Science BS and also a Research Assistant Mentor at the Saturday Academy. Angel is also interested in complementing computer science with many other research areas to start developing applications to benefit society.
Dr. Juan F. Arratia

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.

Juanita L. Boneque

BS Mathematics from the Inter American University, San Germán, Puerto Rico.
MA Education with specialization in Mathematics from the University of Miami, Coral Gable, Florida.
MA Bilingual Education from Universidad del Turabo, Gurabo, Puerto Rico
St. Croix District Mathematics Coordinator
Certified Trainer of Common Core State Standards for Mathematics & Standards for Mathematical Practices
Part time Instructor at the University of the Virgin Islands
Administrator/Advisor for the Mathematics Environmental Science Academy
Program Coordinator for the St. Croix Pre College Research Academy
Virgin Islands State Mathematics Coordinator for the Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST)
Ms. Katherine Calderón
Katherine Calderón Mojica is an undergraduate student of a BA degree in industrial chemistry at the University of Puerto Rico at Humacao (UPRH). In July 2011 she obtained her Associate Degree in Chemical Technology at the University of Puerto Rico at Humacao and is part of the program as as student in Caribbean Computing Center for Excellent. She has made several summer internships related to the area of computational chemistry at Jackson State University in Mississippi, where she received recognition of the second place in oral presentation for the organic chemistry research in the computational chemistry area. She currently works as a computational chemistry mentor in the Computing Broadening Participation Alliance Program (NSF-BPCA) at UPRH. She also works on the UPRH program named CADA (Centro de Apoyo y Desarrollo Académico) to help students in the tutorials of general chemistry and organic chemistry. She wants to continue working towards an MD / PhD in organic chemistry. Her great desire in the professional field of chemistry is to become a professor of organic chemistry.

Mr. Ramón A. Cardona
Ramón A. Cardona is a former practicing architect with five years of experience. In 2010 he enrolled in the Computer Science program at Inter-American University of Puerto Rico. During the summer of 2011 he took part in his first summer internship at Carnegie Mellon University (CMU), working in the field of robotics. His work earned him an award recognition at the 2011 SACNAS National Conference in San Jose, California, and a research paper publication by the Association for the Advancement of Artificial Intelligence (AAAI), as part of the 2012 FLAIRS Conference in San Marco Island, Florida. During the summer of 2012 he returned for a second internship at CMU. His efforts earned him another award, this time at the 2012 AGMUS Research Symposium in San Juan, PR. Ramón has a BA in Architecture from Polytechnic University of Puerto Rico (2005), and a B.Sc. in Computer Science from Inter-American University of Puerto Rico (2012). He currently works at Evertec, Inc. as Java Developer.

Ms. Valerie A. Carrasquillo Meléndez
Valerie Ann Carrasquillo Meléndez graduated with academic excellence from Isabel Flores High School in Juncos, Puerto Rico. She was first at Universidad Del Turabo at Gurabo, Puerto Rico, studying Secondary Math Education. On her second year, she transferred to Universidad Metropolitana and decided to be part of the Bio-Mathematics bachelor’s degree. At present, she is the secretary of the SACNAS association of the university. When she completes her bachelor’s degree, she will continue towards a PhD in Applied Mathematics.
Ms. Laysa M. Claudio

Laysa M. Claudio Gonzalez is an undergraduate student of B.A. Industrial Chemistry in the University of Puerto Rico at Humacao. She graduated from an Associate Degree in Chemical Technology at the University of Puerto Rico in June 2011. She loved the chemistry and wants to learn computational chemistry with a specialty in computational biochemistry in the Computing Broadening Participation Alliance program (NSF-BPCA) in University of Puerto Rico at Humacao. Before becoming a mentor, she was an assistant of mentor in Computational Chemistry. In the future, she wants to obtain an M.D./Ph.D in Surgery. She wants to work in an investigation about cancer, and investigate proteins that are essential in vital processes and the analysis of human DNA but this with focus in chemistry.

Ms. Wilnerys Colberg

Wilnerys Colberg is an undergraduate researcher at UMET working with Dr. Osvaldo Cox, in research projects related to anti-cancer drug development and also in the field of environmental carcinogen monitoring. Some of her academic accomplishments are: being president of SUAGM Mathematics scholar program in 2011, and has been an assistant mentor for the Saturday Academy program in genomics in 2012, and is currently the mentor of the same program. She has learned to play the role as a team leader and learned to have a group of students under her supervision. Her latest research was in 2012 at Alabama State University at Birmingham at the Departments of Bio-Statistics and genetics. Wilnerys worked on a project called “Whole Genome Prediction for Clinical Use.” This project was presented at 2012 AGMUS symposium at Universidad Metropolitana, and was awarded best oral presentation. On June 2011, she worked at Jackson State University with the Department of Computational Chemistry in the research program with Dr. Jerzy Leszczynski. Her research project was “Binding Mode Interaction between Isoalantolactone and Dengue Virus”. This research project won third prize for best oral presentation at Jackson State University. In the summer of 2010, she worked with the MTBI PR. There she studied elementary differential equation to predict an epidemic disease. Working with Dr. Fabio Sanchez from Arizona State University, she prepared a project called “Dengue Fever with Insecticides in Puerto Rico.” It was held at Universidad Metropolitana and won best poster presentation at the symposium held at the Sheraton Hotel in San Juan. Her goals are to study in an MD/PhD program in oncology, where she will do research and study skin cancer (melanoma). She is willing to help others fight against cancer mortality. Hoping one day to offer health care to affected poor people in undeveloped regions and contribute to the discovery of treatments for diseases.
Mr. Joseph Colón
Joseph Colón graduated from Manuela Toro Morice High School, Caguas, Puerto Rico, in May 2011. He received the Pfizer Scholarship for honors in Science and Mathematics, and for excellence. He started as a freshman at Universidad de Puerto Rico, Recinto de Cayey, and transferred to Sistema Universitario Ana G. Mendez, Universidad Metropolitana, San Juan, Puerto Rico, on his second year. He has conducted research since the tenth grade of high school, in the areas of Bio-Mathematics, Bio-Statistics, Climatology, and Computer Programming. These researches were presented at the Pre-College Research Symposium of Sistema Universitario Ana G. Mendez, at the National Center for Atmospheric Research and in the SACNAS National Conference. His latest research is titled: “Mathematical Analysis of Runtime Complexity for Sorting Algorithms on a Spartan 6 SP605 FPGA”.

Ms. Maxine N. González Vega
Maxine N. González Vega is a rising junior and a student at Universidad Metropolitana (UMET). She attended Academia Bautista de Puerto Nuevo and is currently the mentor for the biostatistics division in the Saturday Academy for pre-college students at UMET. From 2009-2010, Maxine attended two pre-college internships, one in Vermont, the EPSCoR Project, and the other at Lawrence Berkeley National Laboratory. In the 2011 summer she was given the opportunity of attending her first undergraduate internship at the University of Alabama at Birmingham to work in the Section of Statistical Genetics. She was also was given the opportunity to participate in a Richard Tapia conference for Computer Science in April 2011 and in October 2011 she attended the SACNAS National Conference in San Jose, California, to present her summer research. She is very interested in pursuing an M.D. /Ph.D in pediatric Neurosurgery.

Prof. Evelyn Haddock
Evelyn Haddock is an Associate professor in the Computer Science and Mathematics Department at Inter American University, Metropolitan Campus. Professor Haddock teaches programming languages and Data Structures to sophomores and juniors at the undergraduate level. She has offered an introductory leadership course in our Educational Computing Master’s Program. Professor Haddock was department chair when this graduate program launched its academic curriculum using distance education. With this initiative, the Educational Computing Master’s Program was the first distance education program to be offered in Puerto Rico, which began in 1999. During her administrative experience as department chair, the Open Information Systems Graduate Program also commenced its academic offering. In this graduate program, Haddock has also offered an introductory multimedia course. For ten years, Professor Haddock taught Computer Science courses at the University of Puerto Rico, Bayamón Campus. Professor Haddock has collaborated in the implementation of various grants. She is actually CoPI of CCCE at the Inter Metro Alliance. She worked at the Medical Sciences Campus of the University of Puerto Rico with a Title III grant training faculty in the creation of multimedia instructional materials and with a Title V grant training faculty in the development of online course materials. She also offered workshops to Math and Science public school teachers through the Technology Innovation Challenge Grant of the Department of Education in Puerto Rico.
Mr. Gilberto Jiménez Orench
Gilberto Jimenez Orench is a computer engineering undergraduate student at the University of Puerto Rico at Mayaguez, minoring in International Relations and French. He started participating in the Saturday Academy as a high school student in 2010, presenting his research about how electromagnetic radiation could possibly affect germination of seeds at two AGMUS Pre-College Research Symposiums. Shortly after, he was selected to be part of a summer research experience at the National Oceanic and Atmospheric Administration (NOAA) and the University Center for Atmospheric Research (UCAR) in Boulder, Colorado in the summer of 2011. Being certified in Lean Six Sigma methods, he started working as assistant mentor for pre-college students at the UPRM, implementing the same strategies in research. He is also a Lockheed Martin Scholar and a DoD coop student, giving him the opportunity to be part of several projects in computer science areas and to help improving student programs on campus. In his free time, he likes to travel, learn new languages and create web design projects.

Eng. Alvaro Lecompte Montes
Alvaro Lecompte is a mechanical engineer (BS), and also a BS in mathematics and physics from the University of Los Andes, Colombia. He has an MS and a PhD in Physics from the University of Vienna, Austria. He has worked as a university professor of mathematics and physics and is currently the Coordinator of the Master Program in Applied Mathematics at Inter American University, San German Campus. His research areas have been focused on mathematical physics, especially in quantum statistical mechanics and mathematical models in science and engineering. During the the last years, he has also worked in quantum information theory and cryptography. He teaches courses both at the undergraduate and graduate level of mathematics and physics.

Kemit-Amon Lewis
Kemit-Amon Lewis was born and raised on the island of St. Croix, United States Virgin Islands. He received a Bachelor of Science degree in Marine Sciences from Savannah State University (SSU) in 2004 and later a Master of Science in Marine Sciences degree from SSU through the National Oceanic and Atmospheric Administration’s Living Marine Resource Cooperative Science Center. Upon returning home to the USVI, he was employed as the territorial Resource Ecologist of the US Virgin Islands Department of Planning and Natural Resources Division of Coastal Zone Management. Currently, Kemit is the Coral Conservation Manager for The Nature Conservancy in the USVI. In this role, he manages the Coral Restoration Program, which propagates threatened elkhorn and staghorn corals used in territory-wide restoration efforts and provides technical advice and assistance to other TNC Caribbean programs and partners. He also coordinates the development of the Virgin Islands Reef Resilience Program, manages TNC’s Sea Turtle Monitoring Program on St. Croix, and is a part-time science instructor at the University of the Virgin Islands.
Mr. Edwin López
Born in Pennsylvania, USA, Edwin C. López Ramos is an assistant mentor at the National Astronomy and Ionosphere Center for UMET’s Saturday Academy. He is currently an undergraduate student majoring in Mechanical Engineering at the University of Puerto Rico, Mayagüez Campus (UPRM). Being a former student of the academy and an IEEE Scholar, López also wants to help students develop the abilities they need in order to achieve all of their goals and eventually become successful professionals in the future. As part of his skillset, he is widely experienced in public speaking, robotics and teamwork. Edwin’s topics of interest are Astronomy, Fluid Dynamics, Physics, Biology and Literature.

David J. Mattera
St. Croix Pre College Research Mentor, Senior Software Engineer with a B.S.E.E and 15+ years experience, including extensive object orientated software applications, digital signal processing, real time data acquisition and control systems, embedded systems, diagnostics, distributed software, firmware and hardware design. Plus teaching experience for math, science and engineering.

Prof. Guillermo Mejía
Prof. Guillermo Mejía is 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. Teaching interest in Electronics, later changed his attention to Networks and multiprogramming, accepted a job teaching computer programming at Inter American University in Puerto Rico since 1985, always working with students interested in Computer Science careers.

Mr. Elvin A. Méndez
Elvin A. Méndez began his research activities in 2009 as a high school student in the Saturday Academy sponsored by the National Science Foundation. Two research publications within the Saturday Academy awarded were “Computational Study of AA Changes on Breast Cancer (BRCA2) and “Computational Analysis on Amino Acid Changes on PTPRB”. Those were awarded Best Oral Presentation at the symposiums. At the Saturday Academy, he also worked with two more scientific publications entitled “Computational Study of AA Changes on ABCC8 Gene” and “Computational Study of Changes in Amino Acid of ATM Gene.” After graduating with a 3.9 GPA from high school, he received an opportunity to participate in an internship at the Lawrence Berkeley National Laboratory, where he worked with Dr. Juan Meza, Dr. David Bailey, and Orianna DeMasi on the research entitled “Distinguishing Communication Patterns of Parallel Codes using Machine Learning Algorithms.” He is currently completing a Bachelor’s Degree in Applied Microbiology at Universidad Del Este. He is also the mentor in the Saturday Academy in the area of Genomics, and Bio-Mathematics at Universidad Del Este. A future goal is to finish a Ph.D. in the area of Microbial Genetics.
Ms. Cristina M. Morales
Cristina M. Morales started as a pre-college student at Universidad Metropolitana, where she participated for three semesters, winning as best poster at her last research, “Music Rookie”. She graduated from the Libre de Música de San Juan, and got accepted at the University of Puerto Rico at Bayamon. She had her first internship experience in her freshman year, and is currently a sophomore from the Computer Science Department, an Assistant Mentor at Universidad Metropolitana, a scholar at the Caribbean Computing Center for Excellence and a member of the National Society of Collegiate Scholars.

Dr. Marlio Paredes
Dr. Paredes was born in Cali, Colombia. He has a B.S. and an M.S. in Mathematics, both from Universidad del 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 Erdős Number List (http://www.oakland.edu/enp/) obtaining Erdős 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 the 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 he is also Mathematics curriculum specialist of the Turabo Math and Science Alliance (AMCT, Spanish acronym).

Mr. Francisco Pérez Laras
Francisco Pérez Laras studied Computer Science at the University of Puerto Rico at Bayamon and graduated in 2012. He is currently scheduled to start his master degree in Information Systems at the University of South Florida. He has participated in two research internships by NSF at Wayne State University and the University of South Florida, gaining hands-on experience in the fields of Super Computing and Ubiquitous Sensing. He currently holds a position as a Developer for Pharma-Bio Serv in Dorado, Puerto Rico. In addition, he has participated in the Saturday Academy for two semesters and his students have obtained awards in Poster and Oral Presentations. His future plans are to continue doing research, graduate from his masters and continue motivating students to study the fields of Science, Technology, Engineering, Mathematics and participate in research internship opportunities.
Dr. Oliva M. Primera-Pedrozo

Dr. Oliva M. Primera-Pedrozo is a professor of Chemistry at the School of Science and Technology at Universidad Metropolitana in San Juan. She has a Ph.D in materials science from the University of Puerto Rico-Mayaguez Campus. She also has a post-doctoral training at Jackson State University in Jackson, MS. Dr. Primera has been involved in research activities related to areas of nanotechnology and synthesis of nanomaterials using the wet-chemistry approach and vibrational spectroscopy for seven years. Her research interests are the synthesis and surface modification of silver and gold nanoparticles and semiconductors as cadmium selenide and lead selenide quantum dots. Also, the IR/Raman spectroscopies and Susurface Enhanced Raman Spectroscopy (SERS) applied to chemical and biological detection. Dr. Primera has several publications in peer reviewed journals and proceedings, and has made oral and poster presentations in national and international meetings. Some important contributions have been disseminated in well-known ACS meetings, NANO-DDS, SPIE conferences in explosive detection sponsored by the International Society for Optical Engineering. In addition, Dr. Primera has a solid experience in mentoring pre-college, undergraduate and graduate students not only in research but also in their academic goals. As part of the formation of her undergraduate students, they are authors and coauthors of some publications. Dr. Primera also has mentored students from universities such as Pittsburg, Northeastern and Polytechnic Institute in NY as part of NSF sponsored REU programs during UPRM-summer sessions. In addition, Dr. Primera has participated in the organization of NanoDays educational activities in Puerto Rico and Mississippi. She currently has start-up funds projects with the Institute for Functionalization Materials (IFN) from the University of Puerto Rico sponsored by the National Science Foundation (NSF). She is a member of the American Chemical Society (ACS) and Material Research Society (MRS).

Ms. Yesenia M. Rivera López

Yesenia Marie Rivera-López, is from Arecibo, Puerto Rico. Her skills are playing the violin, and robotics. She is on her senior year, at the Industrial Electronics workshop of the Antonio Lucchetti Vocational High School, Arecibo, Puerto Rico. She started doing research, last year, at the Arecibo Observatory (AO) Saturday Academy in the Astronomy field searching Luminous Infrared Galaxies (LIRGs), and pulsars; with the poster: “Do Luminous Infrared Galaxies (LIRGs) follow Hubble Law”. That summer, 2012, she had the opportunity to be on an internship in Boulder, Colorado, USA at the High Altitude Observatory. There she conducted the research project: “Performance of the Spar Guider System for the NCAR Boulder Spar” working with to mentors, an astrophysics, and an aeronautical engineering. This poster was presented at the 2012 AGMUS Research Symposium on September 22, 2012; where she was awarded the “Best Pre-College Poster Presentation”. In August, she starts doing her practice as an Electronic Technician at the Electronic Department of the Arecibo Observatory. Also, has been working as an assistant mentor for the Saturday Academies at this institution. This summer, she will travel to an internship at the MIT Haystack Observatory, Massachusetts, USA.
Rosaliz Rodríguez Ríos

Rosaliz Rodríguez Ríos was born in San Juan, Puerto Rico in 1970. After completing his education in the public school system is admitted at Universidad Metropolitana. Rosaliz completed her BA in Natural Sciences with a minor in psychology and began work at Baxter Company until its closing in general. In 1997 he began working as a teacher at the College Saint Francis School, to the present. In 2001, he finished his Master of Arts in Teaching Science curriculum at the University of Phoenix. In 2009 she started working at the School of Science, Mathematics, Technology and Languages known Pa 'Los Duros in the area of Carolina, as Assistant Laboratory of it. This provides support for teachers in student research. She has participated in training workshops for public school teachers specifically in the area of science.

Natalia C. Santiago Merced

Natalia Santiago Merced was a pre-college student at Universidad Metropolitana. Her early research experience was in the Spring 2009 Saturday Academy Pre-College Program at Universidad Metropolitana. She conducted the research “Study of Differences and Consequences in Mutations of the SGSH Gene.” Santiago Merced. In the summer of 2009, Natalia Cristal participated in a research internship at the University of Vermont. She was accepted in the Early Admission Program and was a freshman in the Bio-Mathematics BS at Universidad Metropolitana in the Fall of 2009. Natalia participated in another research in the Fall of 2009 at the Saturday Academy Pre-College Program at Universidad Metropolitana. Santiago Merced conducted the research “Comparison of Phosphorus and Macro-invertebrates in Two Streams Surrounded by Different Ecosystems” and presented it on December 12, 2009 at the Fall 2009 Pre-College Research Symposium. She was awarded the Best Poster Presentation. Natalia Cristal participated in the Spring 2010 Saturday Academy Pre-College Program at Universidad Metropolitana. She conducted the research “Comparison of Phosphorus and Macroinvertebrates in Two Streams Surrounded by Different Ecosystems” and presented it on May 29, 2010 at the Spring 2010 Pre-College Research Symposium. She was awarded the Best Poster Presentation. Natalia start her first year as an undergraduate student and was sophomore in the Bio-Mathematics BS at Universidad Metropolitana in August 2010. In the summer of 2010, she participated in a research internship at the University of Vermont. Natalia conducted the research “Relationship of Lotic Macroinvertebrates Communities to Phosphorus and Suspended Solids” and presented it on some symposiums including XXI Research Symposium and SACNAS. Santiago Merced starts her second year as an undergraduate student and was junior in the Bio-Mathematics BS at Universidad Metropolitana in August 2011. In the summer 2011, she participated in a research internship at Arizona State University and conducted the research “Evolutionary Analysis of Disease-Associated of Fibroblast Growth Factor Receptor 3 Gene (FGFR3 Gene)” and presents it on XXII Research Undergraduate Symposium and SACNAS. Natalia stars her third year as an undergraduate student and was senior in the Bio-Mathematics BS at Universidad Metropolitana in August 2012. In the summer of 2012, she participated in a research internship at Morehead State University and conducted the research “Morphine on Activity and Simple Learning” and presents it on some symposiums including XXIII Research Undergraduate Symposium, 70th Joint Annual Meeting of BKX and NIS, and Eleventh Annual Arizona MGE@MSA/WAESO Student Research Conference. In the latter, she was awarded a Honorable Mention.
Dr. Elba Sepúlveda Cabassa

Elba M. Sepúlveda has a doctorate in Curriculum and Education with a minor in Distance Education, a master in Science and a bachelor’s degree in Theoretical Physics. She is teaching Physics, Astronomy, Research and Technology Principles at CROEM, which is a public boarding high school, specialized in math, science and technology, from the Department of Education. Students with a high GPA are selected from the island. She is the coordinator of the CROEM Solar Team which is a group of students that constructed a real size solar car for competitions and is advisor of CROEM Students participating in the Saturday Academy Research Program. Also she is a professor at the university, giving workshops and professional development for K-12 science teachers at University of Puerto Rico and Interamerican University. During the summer she collaborates with the computational physics department of Dark Energy Survey Project at Femilab. As a Teacher Research Associate she had the opportunity to get information about recent research as well as getting more educational resources for her classes. Elba has a website (www.fisicaenlinea.com) for Latin-American people who want to learn about Physics. This website has more than 100,000 monthly hits. There you can browse to find information about most of the Physics topics, laboratories and educational resources. Her goal is to give her students the best educational experience in classroom.

Ms. Brenda C. Torres

Brenda C. Torres is a first year student from the doctoral program of Environmental Sciences with a concentration in Biology, at Turabo University. She holds a bachelor degree in Computer Engineering, with Mathematics and Statistics as a second concentration, from Escuela Superior Politécnica del Litoral obtained in Guayaquil, Ecuador; country where she comes from. Also, she completed a master degree in Mathematics and Statistics in 2009 in Puerto Rico. Her research was about a statistics model to describe and classify senior people living in Spain according to their leisure time habits. The results of her investigation were presented at the SACNAS Conference in San José, California in October 2011. Her interests about life science motivated her to begin the PhD program at Turabo University in August 2011. She is currently studying stochastic differential equations to model pollution issues. Her strong background and teaching experiences as TA while she was enrolled at the master program, and as former mentor of the AFAMAC program, led her to participate since August 2011 as a mentor in the biostatistics and genomics division at Turabo University. She is also interested in genomics and modeling as fields of research.
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 intention 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.
Edgardo Luis Vázquez Rodríguez was born in San Juan, Puerto Rico. 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 (also known as Escuela Pa’los Duros) in Carolina, Puerto Rico. This specialized school helped Edgardo realize and reach his potential in mathematics. In his last year in the school he had the opportunity of attending the AGMUS Saturday Academy where he worked on two pre-college research projects in the areas of genomics entitled A Computational Study of Amino Acid Substitution in the SMPD1 Gene (2009) and A Computational Study of Amino Acid Substitution in the RASAL 1 Gene (2010) which he later presented in pre-college conferences. Edgardo graduated with honors in 2010 from Saint Francis School and Pa’los Duros. Then he attended his first summer internship at Universidad Metropolitana (UMET) where he conducted his third research entitled Pandemic of AH1N1 Influenza Virus and Vaccination Effectiveness (2010). After the internship, Edgardo started college at UMET studying Bio-Mathematics with a full scholarship from the National Science Foundation. During his freshman year, he attended two national conferences in the United States presenting his summer research - the 68th Joint Annual Meeting of the BKX Honor Society/National Institute of Science (held in Atlanta, Georgia) and the 2011 Richard Tapia Conference (held in San Francisco, California). Later, in the summer of 2011, he attended an the Massachusetts Institute of Technology (MIT), where he conducted his fourth research, Hierarchical Analysis of Music and Spider Silk using Category Theory. Edgardo attended the Society for the Advancement Hispanics, Chicanos & Native Americans in Science (SACNAS) 2011 conference (held in San Jose, California), and the 2012 Joint Mathematical Meeting (held in Boston, Massachusetts). He is currently a mentor in the AGMUS Saturday Academy in the areas of Genomics, Bio-Statistics, and Bio-Mathematics, which is his main major at UMET.

Rosa White
- St. Croix Pre College Research Mentor
- Ph.D Candidate- University of Miami, Miami Florida
- MA – University of the Virgin Islands, St. Croix VI
- MS-Brooklyn College, Brooklyn, NY
- BS-Savannah State College, Savannah, GA
- Approximately forty years as an educator
- Extensive experiences in mentoring students of science
- Extensive experience in Curriculum Development
- Experienced in training teachers of science
- Experienced Labor Leader
- NASA Teacher in Space Finalist
- Extensive work in Environmental Science
Ms. Luisa Fernanda Zambrano Marín

Luisa Fernanda Zambrano Marín was born in Santa-Fe De Bogota, Colombia, she moved to the Commonwealth of Puerto Rico in 1998(USA) to avoid Colombian wars. She finished her secondary education at The Central High for Visual Arts, a High School specialized in Arts where she studied photography. Her goal was to become an Astronaut, for which she did her undergraduate degree in Applied Physics with a scholarship from the National Space Foundation (NSF) Model Institutions for Excellence (MIE) Scholar. She was the first female to graduate from the Physics program at Universidad Metropolitana (UMET) in San Juan Puerto Rico. She has been given various awards for research presentations at the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) and the American Astronomical Society (AAS). As an undergraduate she did research with the Vatican Observatory Group in Castel-Gandolfo for the Kepler Mission. After college she participated in the NSF Saturday Academy Program at UMET as a mentor to high school students in research projects including the development of a scale model of the Luna Gaia Moon based selected by NASA’s last administration. She then moved to Strasbourg, France to do her Masters in Space Studies at the International Space University(ISU) and has been an active member of the Space community ever since. She did her Thesis project at Goddard Space Flight Center under the mentorship Dr. Mario Acuna (1941-2009) relating to the Juno Mission and an analysis of the Voyager 1 and 2 Missions. She worked at the University of Texas at Brownsville, at the Center for Gravitational Wave Astronomy. She managed and aided in the development of the only observatory in the Rio Grande Valley, the Nompuewenu Astronomical Observatory, then as Assistant director of The Teacher Quality Grants Program focused on Astrobiology. Currently she lives in Puerto Rico where she works at Caribbean University as a Special Project Manager for the office of the President. Her main goal is to motivate the coming generations in pursuing education thought the integration of all fields of study by Space Exploration.
ANA G. MENDEZ UNIVERSITY SYSTEM
STUDENT RESEARCH DEVELOPMENT CENTER
CARIBBEAN COMPUTING CENTER FOR EXCELLENCE

The Caribbean Computing Center for Excellence invites you to participate in the workshop for teachers:

The Beauty and Joy of Computing

Offered by:
“Participating Teachers from the BJC Program”
Teachers: Ismael Parrilla, Cynthia Martinez, Suejey Sierra, Sandra Lopez, Claribel Perez, Natalia Martinez, Idelis Baez, Teresa Somoza, Diyari Torres, Carmen D. Adorno, Ivelisse Burgos, Aixa Morales, Yadira Pérez, Lucrecia Pérez and Beatriz Yulfo

Date: Saturday, May 11, 2013
Time: 1:00-4:00pm
Place: Caribe Hilton Hotel
San Juan, P.R.

For registration, go to:

FOR INFORMATION CONTACT:
Tomas Yan, CCCE Coordinator
Tel. (787)766-1717 ext. 6945
Email: sikching@suagm.edu

All participants have to bring an authorization letter from the school principal acknowledging the commitment from the school, those participate attending the workshop will receive a $50.00 stipend.
Please confirm. Limited spaces. Parking Not Included.
ANA G. MENDEZ UNIVERSITY SYSTEM
STUDENT RESEARCH DEVELOPMENT CENTER
AGMUS Institute of Mathematics
CARIBBEAN COMPUTING CENTER FOR EXCELLENCE

PRE-COLLEGE PROGRAM
SUMMER 2013
RESEARCH ACADEMY

RESEARCH OPPORTUNITIES FOR
GRADE 10, 11 AND 12 STUDENTS

STARTING DATE: JUNE 3 – 28, 2013
WORKING HOURS: 8:00am – 12:00n
RESEARCH SYMPOSIUM: SEPTEMBER 14, 2013

ACADEMY SITE:
UMET

RESEARCH AREA: COMPUTER SCIENCE

DEVELOPMENT OF APPLICATIONS FOR ANDROID SMART PHONE AND
TV BOX USING APP INVENTOR

FOR MORE INFORMATION CONTACT:
Wanda I. Rodriguez, Institute of Mathematics Coordinator
TEL. 787.766-1717 ext. 6009,
EMAIL. um_wrodrigu@suagm.edu

FOR REGISTRATION: http://www.suagm.edu/umet/im/precollege OR http://ccce.suagm.edu/

Requirement:
GPA > 3.00
* Interest in sciences and mathematics
* Letter of recommendation for
  science or math teacher
* Official transcript
PRE-COLLEGE PROGRAM
SATURDAY RESEARCH ACADEMY
FALL 2013

RESEARCH OPPORTUNITIES FOR
GRADE 10, 11 AND 12 STUDENTS IN:

RESEARCH AREAS: COMPUTER SCIENCES, INFORMATION TECHNOLOGY, BIO-MATHEMATICS, BIO-STATISTIC, ENGINEERING, NANO-TECHNOLOGY AND GENOMICS

STARTING DATE: AUGUST 24, 2013
WORKING HOURS: 8:00am – 12:00n
PRE-COLLEGE RESEARCH SYMPOSIUM: DECEMBER 14, 2013

SUAGM SATURDAY ACADEMY SITES:
UMET, UNE, TURABO

FOR MORE INFORMATION CONTACT:
Wanda I. Rodríguez, Coordinator Institute of Mathematics
TEL. 787.766-1717 ext. 6009
EMAIL. um_wrodrigu@suagm.edu

Online Application: http://ccce.suagm.edu/Application.asp
## SCHEDULE OF EVENTS

**SATURDAY, MAY 11, 2013**

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<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>7:00 – 8:15 a.m.</td>
<td>REGISTRATION</td>
<td>San Cristóbal Foyer</td>
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<tr>
<td></td>
<td>Breakfast</td>
<td>San Cristóbal Foyer</td>
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<tr>
<td></td>
<td>POSTER SESSION SET-UP</td>
<td>San Cristóbal Ballroom</td>
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<tr>
<td>7:00 – 8:00 a.m.</td>
<td>Judges Meeting</td>
<td>San Gerónimo Foyer C</td>
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<tr>
<td>8:00 – 8:20 a.m.</td>
<td>OPENING CEREMONY</td>
<td>San Gerónimo Ballroom</td>
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Welcome: **Dr. Juan F. Arratia**, Executive Director
Student Research Development Center

Keynote Speaker: **Dr. Ruth Castellanos**, University of Virginia, Charlottesville

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<thead>
<tr>
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<tr>
<td>8:20 – 11:00 a.m.</td>
<td>POSTER SESSION ASTRONOMY, BIOLOGY, GENOMICS, BIO-MATHEMATICS, BIO-STATISTICS, COMPUTATIONAL CHEMISTRY, COMPUTER SCIENCES, APPLIED MATHEMATICS ENGINEERING, ENVIRONMENTAL SCIENCES, PHYSICS, PSYCHOLOGY</td>
<td>San Cristóbal Ballroom</td>
</tr>
</tbody>
</table>

Chairperson: **Dr. Juan F. Arratia**, Universidad Metropolitana

## ASTRONOMY

**Kristopher Álamo Santiago** and **Melissa Rivera Narváez**, Padre Aníbal Reyes Belén School, Hatillo, Puerto Rico.

Cubesat: Educating the Public


Optimization of Lunarcube Attitude Determination and Control System
Nikoll Miranda Carrillo and Johana Mercado Colón, Antonio Lucchetti Vocational High School, Arecibo, Puerto Rico.

The Possibility of the Spectroscopic Emission Known as the Wow Signal to be a Response from a Radio Signal Sent in the 1960’s

Marcos J. Piñeiro Anazagasty and Génesis I. Valentín Rivera, Dr. María Cadilla High School, Arecibo, Puerto Rico.

The Capability of Extraterrestrial Intelligence on the Hydra Constellation

Luis Obed Vega Maisonet, Luis Felipe Crespo High School, Camuy, Puerto Rico.

Javier Oscar Tomas Saavedra, Manuel Ramos Hernández High School, Quebradillas, Puerto Rico.

Jasiel Felipe Rodríguez Acevedo, Antonio Reyes Padilla Vocational High School; Utuado, Puerto Rico.

Role of the Geomagnetic Cutoff and the Solar Cycle in the Modulation of the Number of Cosmic Rays Particle Precipitation Based on Neutron Monitor Stations Data

BIOLOGY

César Agusto Del Valle Rolón, La Milagrosa School, Arecibo, Puerto Rico.

Bana Space Settlement: Personalized Nutritional Plan

Esteban Alemán and Juan Ramírez, Inmaculada Concepción Academy, Mayagüez, Puerto Rico.

The Development and Testing of Saltwater Corals for Cultivation of Mollusks and Crustaceans in Aquaculture

Tathyana Feliciano, Hosanna Christian Academy, Carolina, Puerto Rico.

Science of Facial Expressions
Mariaenid García Torres, San Benito School, Mayagüez, Puerto Rico.

Diabulimia: A High Risk Hidden Symptom: Omitting Insulin Injections is not the Solution

Jennifer Hernández and Gabriela García, CROEM School, Mayagüez, Puerto Rico.

The Use of the Internet in Acquiring Knowledge About Various Topics in the Field of Biology

Rubén Hernández, Santa María del Camino School, Trujillo Alto, Puerto Rico.

Science of Facial Expressions

Niurka López and Marilys Feliciano, Pedro Perea Fajardo Vocational School, Mayagüez, Puerto Rico.

Induction of Memories through Sounds and Smells

Viviani López, Inmaculada Concepción Academy, Mayagüez, Puerto Rico.

Are X-Ray Back Scatter Machines at Airports Safe or Unsafe?

Chelsea Marrero, Christian Nazarene Academy, Toa Baja, Puerto Rico.

Study of Silver Nanoparticles Inhibition Effect on Escherichia coli

Lianis Marrero, San Benito School, Mayagüez, Puerto Rico.

Caffeine Addiction and its Unknown Effects on the Nervous System

María Marrero Ortiz and Shakira L. Avilés González, Pedro Perea Fajardo Vocational School, Mayagüez, Puerto Rico.

Does Music Affect the Blood Pressure?
Astrid M. Martínez Peña, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Study Of Bacterial Growth Inhibition Using CdSe QDs (Light Exposed) with the Kirby-Bauer Antibiotic Testing Method
Kevin Matos, María Teresa Piñeiro High School, Toa Baja, Puerto Rico.  
Synthesis of CDSE, Au and Ag Nanoparticles, and Toxicity Evaluation on *E. coli* Using the Kirby Bauer Method

Jessica N. Ríos Santiago, Santa María del Camino School, Carolina, Puerto Rico.  
Growth Inhibition Study in *Escherichia coli (E. coli)* by the Use of Gold Nanoparticles

Félix Rivera, Inmaculada Concepción Academy, Mayagüez, Puerto Rico.  
The Wet Soap Project: A Comparison Study

Gabriela Rivera, Inmaculada Concepción Academy, Mayagüez, Puerto Rico.  
Study of Melanoma Skin Cancer and How it Can be Prevented

Josie Rodríguez Sánchez, José Collazo Colón School, Juncos, Puerto Rico.  
Gingerol Behavior in Cancer Prevention

Adriana Vélez and Javier Torres, Inmaculada Concepción Academy, Mayagüez, Puerto Rico.  
Comparison of the Colonies, Abundance and Type of Corals in the Bays of Mayaguez and La Parguera

**GENOMICS**

Gustavo D. Acevedo, University High School, San Juan, Puerto Rico.  
Computational Study of Amino Acid Substitution in the ACVRL1 Receptor Type II Gene

Rebecca Agosto Matos, Secundaria Montessori School, San Juan, Puerto Rico.  

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Shideya Parilla, St. Croix Educational Complex, St. Croix, U.S. Virgin Islands.

Recycling, Reusing Rum Waste
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15 a.m. – 11:00 a.m.</td>
<td>COFFEE BREAK</td>
<td>SAN CRISTÓBAL FOYER</td>
</tr>
<tr>
<td>11:00 a.m. – 12:40 m.</td>
<td>ORAL RESEARCH PRESENTATIONS</td>
<td></td>
</tr>
</tbody>
</table>
11:00 – 11:10 a.m. Tatiana Álvarez Díaz, University Gardens High School, San Juan, Puerto Rico.

Marfan Syndrome

11:10 – 11:20 a.m. Alondra Y. Báez, Manuela Toro Morice High School, Caguas, Puerto Rico.

Two Approaches to Study Juvenile Myoclonic Epilepsy (JME) Disease: Amino Acid Mutations Analysis and Inheritance Pattern with Partial Penetrance

11:20 – 11:30 a.m. Eduardo E. Betancourt, Santa María del Camino School, Trujillo Alto, Puerto Rico.

Lipofuscinosis Ceroid Neuronaly 3 (Gen CLN3)

11:30 – 11:40 a.m. Adria Cotto Mulero, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

X-Linked Severe Combined Immunodeficiency (X-Linked SCID)

11:40 – 11:50 a.m. Laura García, University Gardens High School, San Juan, Puerto Rico.

Comparative Evolutionary Analysis of the GBA Gene in Different Species

11:50 – 12:00 m. Arnaldo A. Marcano, Ernesto Ramos Antonini School, San Juan, Puerto Rico.

Does the Number of Vaccines Applied Influence the Increase of Autism Cases?

12:00 – 12:10 m. César R. Negrette Delgado, San José School, San Juan, Puerto Rico.
Computational Study of Amino Acid Changes in the TYR Gene
12:10 – 12:20 m.  **Fabiola B. Negrette Delgado**, María Reina Academy, San Juan, Puerto Rico.

Computational Study of Familial Adenomatous Polyposis Involving Adenomatous Polyposis Coli Gene

12:20- 12:30 m.  **José O. Ramos Carvajal** and **Pedro J. Rodríguez**, University Gardens High School, San Juan, Puerto Rico.

Chediak Higashi Syndrome

12:30 – 12:40 m.  **Jorge Santana-Santini**, CeDIn Laboratory School, Inter-American University, San Juan, Puerto Rico.

Amyotrophic Lateral Sclerosis (SOD1)
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Presenter</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00 – 11:10 a.m.</td>
<td><strong>BIO-STATISTICS</strong></td>
<td>Linear Regression: PDI and MDI in Children with Reparative Heart Surgeries</td>
<td>Natalia P. Caro Malavé</td>
<td>St. Mary’s School, San Juan, Puerto Rico.</td>
</tr>
<tr>
<td>11:10 – 11:20 a.m.</td>
<td><strong>BIO-STATISTICS</strong></td>
<td>Comparison Between Systolic Blood Pressure and Low Weight Newborn Infants</td>
<td>Magda I. Collazo Simonet</td>
<td>St. Mary’s School, San Juan, Puerto Rico.</td>
</tr>
<tr>
<td>11:20 – 11:30 a.m.</td>
<td><strong>BIO-STATISTICS</strong></td>
<td>Acceptance of Kidney Transplants by Ethnicity and Gender and the ROC Curve for Serum Creatinine Levels as a Predictor</td>
<td>Rose Marie Cruz Laboy</td>
<td>Lourdes School, Carolina, Puerto Rico.</td>
</tr>
<tr>
<td>11:30 – 11:40 a.m.</td>
<td><strong>BIO-STATISTICS</strong></td>
<td>Effects of Dieting in Patients with Hypertriglyceridemia</td>
<td>Aley Jenny De León Laboy</td>
<td>Lourdes School, Carolina, Puerto Rico.</td>
</tr>
<tr>
<td>11:40 – 11:50 a.m.</td>
<td><strong>BIO-STATISTICS</strong></td>
<td>Sleep Vs. Grades: A Cohort Study</td>
<td>Mario Ochoa</td>
<td>San Ignacio School, San Juan, Puerto Rico.</td>
</tr>
<tr>
<td>11:50 – 12:00 m.</td>
<td><strong>BIO-STATISTICS</strong></td>
<td>Accuracy of the Swab Test and the Transmission Probability of Chlamydia</td>
<td>Jonathan M. Rodríguez Cruz</td>
<td>Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.</td>
</tr>
<tr>
<td>12:00 – 12:10 m.</td>
<td><strong>APPLIED MATHEMATICS</strong></td>
<td>Accuracy of the Swab Test and the Transmission Probability of Chlamydia</td>
<td>Rosa Janai Andújar Martí and Orlando Emanuel Garces</td>
<td></td>
</tr>
</tbody>
</table>
**Ortega**, San Felipe School; Arecibo, Puerto Rico.  
**Ivonne Yaely Padín Martínez**, Padre Aníbal Reyes Belén School, Hatillo, Puerto Rico.

Online Statistics Of Bana Space Settlement  

Mathematical Model for Retention in Youngsters When Transmitting a Secret Message

**ENVIRONMENTAL SCIENCES**

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker and Affiliation</th>
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<tbody>
<tr>
<td>12:20 – 12:30 m.</td>
<td><strong>Melanie Quiñones</strong>, José Aponte de la Torre School, Carolina, Puerto Rico.</td>
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</tbody>
</table>

Effect of Climate Change on the Macroinvertebrate Population

**ASTRONOMY**

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker and Affiliation</th>
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</thead>
</table>
| 12:30 – 12:40 m. | **Paola Victoria Figueroa Delgado**, La Milagrosa School, Arecibo, Puerto Rico.  
**Carlos Geovanny Declet Nieves**, Luis Felipe Crespo High School, Camuy, Puerto Rico. |

NASA Space Settlement Contest: Bana
<table>
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<tr>
<th>Time</th>
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<th>Title</th>
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<tbody>
<tr>
<td>11:00 – 11:10 a.m.</td>
<td><strong>BIO-MATHEMATICS</strong></td>
<td>Yused Rodríguez</td>
<td>Gigantic Invisible Triangles: Measuring Height with an Inclinometer</td>
</tr>
<tr>
<td>11:10 – 11:20 a.m.</td>
<td></td>
<td>Netsha J. Santiago</td>
<td>Mathematical Model to Predict the Cooling Temperature of a Cake</td>
</tr>
<tr>
<td>11:20 – 11:30 a.m.</td>
<td></td>
<td>Gabriela Trinidad</td>
<td>The Birthday Paradox Theory</td>
</tr>
<tr>
<td>11:30 – 11:40 a.m.</td>
<td><strong>COMPUTATIONAL CHEMISTRY</strong></td>
<td>Hennessy Bas Concepción</td>
<td>Uses of Immobilized Macro Algae for Remediation of Polluted Natural Waters</td>
</tr>
<tr>
<td>11:40 – 11:50 a.m.</td>
<td></td>
<td>Michelle Cristina Pérez-Ayala</td>
<td>Nanohub Online Simulator to Predict Nanoparticles Size: An Experimental and Theoretical Comparison</td>
</tr>
<tr>
<td>11:50 – 12:00 m.</td>
<td></td>
<td>Ricardo J. Rodríguez García</td>
<td>Surface Enhanced Raman Spectroscopy of Adenine in</td>
</tr>
</tbody>
</table>
Solution Using Silver Nanoparticles at Different pH Values
APPLIED PHYSICS

12:00 – 12:10 m.  Agnes Angélica Sastre Rivera, Patricia Piñeiro Avilés, La Milagrosa School, Arecibo, Puerto Rico.
Adrielys Janice Guzmán Morales; Dra. María Cadilla School, Arecibo, Puerto Rico.

Sports in Space

ENGINEERING


The Portable Cardiopad Application: Checking the Heart without Visiting the Cardiologist in Person!

12:20 – 12:30 m.  Reese Johnson, College of Advanced Education Gaudi, Humacao, Puerto Rico.

Design of a Low Cost Night Vision Device

12:30 – 12:40 m.  Diego Orlando Llenza Aponte; San Antonio School, San Juan, Puerto Rico.
Nayrobie Le Rivera Estevez, Miguel Felipe Santiago Echegaray School, Camuy, Puerto Rico.

Bana Kinetic Flooring
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<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00 – 11:10</td>
<td><strong>BIOLOGY</strong></td>
<td><strong>Lorraine Otero</strong>, Cupeyville School, San Juan, Puerto Rico. Understanding Lactose Intolerance</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Emery G. Price Cancel</strong>, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. Toxicity Evaluation of Cdse QDs with Different Capings on E. Coli</td>
</tr>
<tr>
<td>11:40 – 11:50</td>
<td></td>
<td><strong>Frankie R. Cabrera</strong>, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. Auto-Organizer</td>
</tr>
<tr>
<td>11:50 – 12:00</td>
<td></td>
<td><strong>Sahar Daas, Na’amah Leerdam, and Simran Khemlani</strong>, All Saints Cathedral School, St. Thomas, US Virgin Islands. Kenyu: An iOS Application for Enhancing Reading Skills</td>
</tr>
</tbody>
</table>
12:00 – 12:10 m. **Ademyr Rivera**, and **Christopher Alicea**, Ernesto Ramos Antonini School, San Juan, Puerto Rico.

Trigonometry Application for Windows Phone 7


Mobile Colorblind Computer Concept


Application Developed for Users to Learn Self-Defense

12:30 – 12:40 m. **Kenneth Young** and **Isabel Pérez**, José Collazo Colón High School, Juncos, Puerto Rico.

Augmented Reality Educational Game
ABSTRACTS
ASTRONOMY

CUBESAT: EDUCATING THE PUBLIC

Kristopher Álamo Santiago and Melissa Rivera Narváez, Padre Aníbal Reyes Belén School, Hatillo, Puerto Rico.

Research Mentor: Glorimar Castro Noriega, Arecibo Observatory, Arecibo, Puerto Rico.

The cube sat is a miniature sized satellite that studies the atmosphere, climate, and weather of Earth. CubeSats will soon be launched to study the moon’s atmosphere, weather and climate as well. The objective is to find people and motivate them into researching and participating in the development of cubeSats. In order to do this, an educational video was created and developed to accomplish the objective. We aim to develop an optimal video for this matter by creating 2 distinct videos. These videos have only one variation; the quantity of information. One video has only the pictures and the name of each component, and the other video has explanation of each part, component and function. A survey was given to the subjects for the acquisition of feedback information. This information was statistically analyzed in order to determine which video is optimal for the viewers. With the cube sat educational video people will understand, details and learn all about the cubeSat’s parts and components.

NASA SPACE SETTLEMENT CONTEST: BANA

Paola Victoria Figueroa Delgado, La Milagrosa School, Arecibo, Puerto Rico.
Carlos Geovanny Declet Nieves; Luis Felipe Crespo High School, Camuy, Puerto Rico.

Research Mentor: Luisa Fernanda Zambrano Marín; Caribbean University, Bayamón, Puerto Rico.
Research Assistant Mentor: Yesenia Marie Rivera López; Antonio Lucchetti Vocational High School, Arecibo, Puerto Rico.

Since 1977, NASA specialists have established a Design Study for Space Settlements to provide information about space settlement developments. A settlement in space is where people would live for a long period of time. During the past months, the researchers at the Arecibo Observatory have developed a proposal for a sustainable habitat for a human population in space. The innovative settlement named BANA is considered the ideal Utopia (perfect qualities on a community). BANA, means “grand” by the origin of Puerto Rican Taíno native dialectal; and would be a grand place which brings the unexpected thus creating a new life style. Our purpose is to design an attractive, modern and comfortable living space for a colony of great density, based on the best considerations and qualities to create a human-friendly environment in space for humans to live in. This research has been submitted to the NASA Ames Space Settlement Design Contest after reviewing current human requirements and available technologies. The plan consists in four different divisions: engineering, life support, telecommunications, and navigation systems and governance.
OPTIMIZATION OF LUNARCUBE ATTITUDE DETERMINATION AND CONTROL SYSTEM

Karina N. Martínez Reyes, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico.

Research Mentor: Glorimar Castro Noriega, Arecibo Observatory, Arecibo, Puerto Rico.

A CubeSat is a type of miniaturized satellite that is used for space researches. It usually measures 10 cm³ that is equal to 1 Unit. It has the ability to carry in a very small package a variety of payloads. The objective of this research was to find the best payloads for the studies of lunar weather. Also, to learn which ones have the best characteristics for a LunarCube. The first challenge was based on the development of the sensors, machinery and Low Orbit of the Moon, focusing on the Attitude Determination and Control System (ADCS); this has to do with stabilization of a satellite or spacecraft, in this case the CubeSat. By optimizing the LunarCube’s ADCS (magnetometers, lunar sensors, gyroscopes, accelerometers, actuators and algorithms), it is expected to obtain a LunarCube with the exact weight and properties for a correct lunar orbit. Using these results, more than 75 LunarCubes (Lunar CubeSats) will be launched to study the Moon’s weather and climate.

THE POSSIBILITY OF THE SPECTROSCOPIC EMISSION KNOWN AS THE WOW SIGNAL TO BE A RESPONSE FROM A RADIO SIGNAL SENT IN THE 1960’S

Nikoll Miranda Carrillo and Johana Mercado Colón, Antonio Lucchetti Vocational High School, Arecibo, Puerto Rico.

Research Mentor: Glorimar Castro Noriega, Arecibo Observatory, Arecibo, Puerto Rico.

For many years, scientists have been observing the possibility of other civilizations outside Earth. In early 1960’s, a radio signal was sent to outer space with the intention of establishing communication with other civilizations. This research focused on analyzing the data printouts of the radio signals, and determining if they are Wow Signals, the result of a radio signal from the Earth bouncing off on space debris, or radio frequency interference. Here, new algorithms are proposed to analyze the received data in a way to determine their source. Subsequently, data was divided into each of the three hypothesized possibilities through their similarity to the basic emission behavior of each category. In sum, it is expected to find unknown sources, proving the possibility of a Wow Signal.

THE CAPABILITY OF EXTRATERRESTRIAL INTELLIGENCE ON THE HYDRA CONSTELLATION

Marcos J. Piñeiro Anazagasty and Génesis I. Valentín Rivera, Dr. María Cadilla High School, Arecibo, Puerto Rico.

Research Mentor: Glorimar Castro Noriega, Arecibo Observatory, Arecibo, Puerto Rico.

Since the 1980’s, a project called Search For Extraterrestrial Intelligence (SETI), has been analyzing and identifying data from unknown sources scattered across the universe. Its purpose, as the purpose of this project, is to identify the radio waves out of the our solar system for the search of intelligent life. This research focused on the analysis and identification of unknown radio waves and the possibility of the TW Hydrae Star to be the source of said radio waves. The purpose is to develop a new algorithm in order to extract and analyze SETI information and all other information concerning signals from the TW Hydrae Star region. In this way the unique properties of the TW Hydrae electromagnetic waves can be studied, classified and identified as possible sources of the unknown radio wave. It was hypothesized that this star could be emitting extraterrestrial waves due to the magnitude, and unique capabilities of the star. If the results are positive, it can then assume and research the possibility of intelligent life present in the TW Hydrae Solar Region.
ROLE OF THE GEOMAGNETIC CUTOFF AND THE SOLAR CYCLE IN THE MODULATION OF THE NUMBER OF COSMIC RAYS PARTICLE PRECIPITATION BASED ON NEUTRON MONITOR STATIONS DATA

Luis Obed Vega Maisonet; Luis Felipe Crespo High School, Camuy, Puerto Rico.
Javier Oscar Tomas Saavedra; Manuel Ramos Hernández High School, Quebradillas, Puerto Rico.
Jasiel Felipe Rodríguez Acevedo; Antonio Reyes Padilla Vocational High School; Utuado, Puerto Rico.

Research Mentor: Glorimar Castro Noriega; Arecibo Observatory, Arecibo, Puerto Rico.
Research Mentor Assistant: Yesenia Marie Rivera López; Antonio Lucchetti Vocational High School, Arecibo, Puerto Rico

Cosmic Rays are high-energy particles from outer space, which hit the Earth’s magnetic field. Interference with it can cause major problems with communications and power systems. Also, these charged particles interact with the interplanetary magnetic field. When cosmic rays particles bump the magnetic field lines in a vertical way (this normally occurs in the magnetic equator near latitudes) their speed/energy decrease reducing the number of particles that can reach the Earth’s surface. The opposite occurs on Earth’s poles where these particles hit the magnetic field lines on an oblique angle. In this case, the lines do not interfere in the particles’ path, causing a bigger amount of particle precipitation reach the ground. Neutron monitor data collected from 38 stations around the world were analyzed along with the F10.7cm index. Based on the linear relationship (rate) found on the analysis, the role of the geomagnetic cutoff and the solar cycle were evaluated in the modulation of the number of cosmic ray precipitations in different latitudes and longitudes around Earth.
**ABSTRACTS**

**BIOLOGY**

**BANA SPACE SETTLEMENT: PERSONALIZED NUTRITIONAL PLAN**

*César Agusto Del Valle Rolón*, La Milagrosa School, Arecibo, Puerto Rico.

Research Mentor: Luisa Fernanda Zambrano Marín; Arecibo Observatory, Arecibo, Puerto Rico.

Every living organism, both on Earth and in space, must feed in order to maintain life; humans are not any different. The BANA Space Settlement is an innovative prototype of a self-sufficient human colony in space. BANA investigates Earth's problems and proposes solutions in a safe and new environment; food sufficiency proved to be one of those problems. Selecting a group of people and submitting them to an actual physical status check via an online survey and comparing it with a standardized age-height-weight-activity chart created a personalized nutritional chart. Then, they were submitted to fluid testing, in order to learn their current biological status. After monitoring for a week the nutritional value that the people ingest, half of the group was assigned with certain diet changes that should be conducted for another week. Both groups were submitted to fluid testing again to reveal if the nutritional values improved or worsened with changes on the diet.

**THE DEVELOPMENT AND TESTING OF SALTWATER CORALS FOR CULTIVATION OF MOLLUSKS AND CRUSTACEANS IN AQUA FARMING**

*Esteban Alemán* and *Juan Ramírez*, Inmaculada Concepción Academy, Mayagüez, Puerto Rico.

Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentor: Alexandra Maldonado Florenciani, College San Benito, Mayagüez, Puerto Rico.

Aquaculture, also known as aqua farming, is the formation of aquatic organisms such as fish, mollusks (oysters, shrimps, clams, scallops, squid, octopus, and snails), crustaceans (lobsters, crayfish, crabs, and shrimps), and aquatic plants. It involves cultivating freshwater and saltwater populations under controlled conditions. It can be compared with commercial fishing, which is the harvesting of wild fish without intervention. Aqua farming implies some form of intervention in the rearing process to enhance production such as regular stocking, feeding and protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated. In this project, the development of saltwater corals, known as aquaculture, were studied. Two (2) corals per each light were tested. The corals selected were the *Acroporas* (hard corals) and *Acans* (soft corals) that were under observation for a month. The two corals were tested at the same time, but in separate tanks. In each type of light there was one *Acropora* (hard coral) and one *Acans* (soft coral). The development of corals in different types of light and their potential studies were performed. At the same time, different types of corals were cultivated to study which coral develops faster in the light after being cut from its natural colony and were tested. It was expected that the coral will develop faster in the blue light than in the white and pink light. The purpose of this project was to collect information about the development of corals and how different types of lighting affect them.
COMPARING STAGHORN CORAL GROWTH RATES: NURSERY VERSUS TRANSPLANT SITE

America Estepan and Shantae Lewis, St. Croix Educational Complex, St. Croix, US Virgin Islands.

Research Mentor: Mrs. Rosa White, Science Coordinator, St. Croix, US Virgin Islands.

Since the 1970's, due to bleaching, diseases, and hurricanes Elkhorn and Staghorn coral populations throughout the Caribbean have decreased. The recovery of these Caribbean corals from these impacts is difficult because of local threats to coral reefs such as point and non-point sources of pollution, vessel groundings and anchoring damage, lack of herbivorous fishes, and invasive species. In an attempt to restore these corals, The Nature Conservancy’s USVI program established five coral nurseries in the US Virgin Islands. Two are located on St. Croix and three on St. Thomas. The nurseries house Elkhorn (Acropora palmata) and Staghorn (A. cervicornis) coral fragments, broken or damaged as a result of storms and vessel groundings. These fragments are grown and multiplied in the coral nurseries and are then transplanted to coral reefs in an attempt to improve local USVI reefs. This research was based on working with The Nature Conservancy at the US Virgin Islands (TNC-USVI) to compare Staghorn coral growth rates on different nursery structures and on a transplanted site. Block verses tree, block verses reef, and tree verses reef were compared in this study.

SCIENCE OF FACIAL EXPRESSIONS

Tathyana Feliciano, Hosanna Christian Academy, Carolina, Puerto Rico.

Research Assistant Mentors: Anna C. Flores Maddox and Valerie A. Carrasquillo Meléndez, Universidad Metropolitana, San Juan, Puerto Rico.

This research was based on the science of facial expressions. A facial expression is a vital part of communication. It is one or more motions and/or positions of the muscles in the skin. Expressions are closely tied to emotion, so facial expressions are often involuntary. The main focus of this investigation was to figure out the following questions, “How can someone tell how a person is feeling?” “Is it harder to figure out a girl’s expression or a boy’s expression?” “Does the expression get harder to read depending on the age?” Throughout the research, grades from the first grade to the twelfth grade were used. A series of images were taken demonstrating the following expressions: happiness, sadness, fear, surprise, anger, and disgust. After the pictures were taken, each student from each grade was taken one by one and was shown the pictures of the six facial expressions. Depending on the picture, either the eyes or the mouth were covered. The results were documented throughout the research. It can be concluded in this research that females were able to tell the facial expressions better when compared to males. The reason was because they are more open to feelings, and can better express their feelings.
ULTIMATE FERTILIZER

Acassia Ferguson, Natasha Sinanan and Leah Achille, St. Croix Educational Complex, St. Croix, US Virgin Islands.

Research Mentor: Mrs. White, Science Coordinator, St. Croix, US Virgin Islands.
Research Mentor: Mr. Mattera, Manor School Science Teacher, St. Croix, US Virgin Islands.

The main objective of this project was to determine if solid rum waste could be used as fertilizer. In this way, rum industries would have an eco-friendly way to get rid of their waste. Instead of dumping it into marine ecosystems or on different terrains, they could save about 15% of the income they make and also bring in revenue. In this project, it is proposed that they can do this by selling the solid rum waste as fertilizer. In addition, it is suggested that the solid waste would be effective as fertilizer since the extra substances found in the solid rum waste would provide additional nutrients that would boost the plants’ health and growth. The project tested the solid waste fertilizer on okra seeds. The growing rates of the okra seeds grown with the rum waste was compared to the growing rates of the okra seeds grown with the Miracle Gro fertilizer, and the okra seeds grown with no fertilizer or solid rum waste. There were a total of five groups and in each group three plants were grown. In Group 1, the control, the plants were grown with no fertilizer or solid waste only with the soil comprised of no nutrients. Group 2 was grown with Miracle Gro fertilizer and Groups 3-5 where the plants were grown with the solid rum waste as the fertilizer. Group 3 was grown with 2% rum waste and 98% dirt, group 4 was grown with 4% rum waste and 96% soil, and Group 5 was grown with 6% rum waste and 94% dirt. After twenty days, it was found that the okra seeds planted with the 2% rum waste grew the best. They grew about three centimeters taller than the soil, which was the second best out of all the groups. This proves that rum waste can be utilized as a fertilizer and that it actually works better than plants under average condition or with Miracle Gro.

DIABULIMIA: A HIGH RISK HIDDEN SYMPTOM: OMITTING INSULIN INJECTIONS IS NOT THE SOLUTION

Mariaenid García Torres, San Benito School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentor: Kevin Marrero, San Benito School, Mayagüez, Puerto Rico.

Diabulimia is an eating disorder in which people with type 1 diabetes omit insulin injections for the purpose of losing weight. Without insulin, the blood sugar level rises, so that the cells cannot take up glucose and the body, in an attempt to lower the blood sugar, expels the excess glucose in the urine. This disease usually occurs in adolescence and is more common in women than in men with symptoms that match those of uncontrolled diabetes. There are three types of symptoms of diabulimia: short term, medium term and long term. The long term can lead to death. The treatment to be followed is the same as the one for bulimia nervosa but with the addition of insulin injections. The treatment under medical supervision including psychological treatment is: insulin injections as prescribed by the doctor, use of antidepressants such as Fluoxetine or Prozac, individual or group psychological therapies, outpatient treatment at hospitals, imposition of a balanced diet, learning new eating habits, love, support and communication with family. To avoid falling into disorders like diabulimia, it is psychologically better to avoid family scandals, dual personality, food and conversations about the body and calories. Opposed to that, diabulimia can be prevented by saying yes to food as a social act, to the scheduled activities, to a healthy life plan, and to dialogue and communication.
THE USE OF THE INTERNET IN ACQUIRING KNOWLEDGE ABOUT VARIOUS TOPICS IN THE FIELD OF BIOLOGY

Jennifer Hernández and Gabriela García, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentor: Gilberto Jimenez, University of Puerto Rico, Mayagüez, Puerto Rico.

Biology and the craving to gain more knowledge and share it with other people is the inspiration of this research. Internet provides people with the tools to look for information in various topics and acquire more knowledge on them. The scientific field of Biology is a vast world full of many mysteries and interesting details that are not known by the majority of people. In this research the following topics are presented in a website: Microbiology, Genetics and studies on a diversity of species. This website was composed of different sections indicating the specific topic that is presented along with information, pictures or diagrams and articles regarding that specific topic. Some of the themes presented in Biology at CROEM were special topics on bacteria, astrobiology and the human Microbiota as a part of the microbiology section. The genetics section of the page includes a history and biography of Mendeleev (the father of genetics), Punnett squares and their functionality and hereditary diseases commonly known to man. The webpage presents a species section, which includes information on reptiles, mammals and insects including their habitats, variations and survival skills. The articles on the webpage present a rich amount of information regarding the topic and the discussions that arise as a result of the controversies and mysteries that this scientific field brings. One of the benefits that this investigation brings is that it can help people to find information easily because it is all found on one webpage, avoiding having to go through many websites. This project will provide valuable knowledge to the people accessing the website, facilitating their lives and satisfying their yearning for knowledge in their daily lives.

SCIENCE OF FACIAL EXPRESSIONS

Rubén Hernández, Santa María del Camino School, Trujillo Alto, Puerto Rico.

Research Assistant Mentors: Anna C. Flores Maddox and Valerie A. Carrasquillo Meléndez, Universidad Metropolitana, San Juan, Puerto Rico.

Facial expression is the behavior of a person when experimenting emotions, but expressed primarily in the face (which are mostly involuntary reactions). The human face can make a lot of expressions. Some of these expressions are anger, disgust, fear, surprise, sadness, happiness and contempt. Expressions can be controlled or uncontrolled, because some people are naturally able to control some or even all their expressions (who are people that have a psychiatric problem of a behavior of habitual or compulsive lying called or related to "pseudologia fantastica" and mythomania), while others are trained, for example, actors. In this research, there was an examination to see if women could identify expressions better than men. It wanted to find out if it was easy to identify facial expressions on children, adults, elders or teenagers. This was done by taking facial photos of the research subjects. But the principal question is: can most or all persons decipher the expression behind a facial image? Yes, most people can decipher an expression through a facial image. There is an average percentage in favor of women identifying facial expressions better than men.
INDUCTION OF MEMORIES THROUGH SOUNDS AND SMELLS

Niurka López and Marilys Feliciano, Pedro Perea Fajardo Vocational School, Mayagüez, Puerto Rico.

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In this research, the induction of memories through sounds and smells was studied. Memories are events that are stored in an area of the brain called the hippocampus. The hippocampus is the region that converts short-term memory into long-term memory. The sound, in humans, comprises variations that occur in the air pressure. The ear makes mechanical waves for the brain to perceive and process. The smells are the impression produced in the smell, the fumes given off by the bodies. How does sound and smells affect memories? Results of this research are expected to be that people achieve successful recall of events in the past through the use of the senses of smell and hearing. It will be based on collecting a number of 10 subjects between the ages of 15 and 20 and make them listen to different sounds and smell different scents.

ARE X-RAY BACK SCATTER MACHINES AT AIRPORTS SAFE OR UNSAFE?

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Security at airports has always been an important issue all over the world. Caused by the different terrorists’ attacks that occurred in diverse countries, the security in airports has been maximized. One of the several things implemented by the United States is the use of the X-Ray Back Scatter in airports. Research has been made to investigate the effects of the passengers being exposed to the radiation that these machines emit. The main purpose of the research was to investigate several studies conducted around the world to support the hypothesis and to help understand the magnitude of the dose levels involved on the X-Ray Back Scatter machines. This research will assess the scientific fundamentals of the actual risk deriving from such doses. This research reviews the effects of the X-Ray Back Scatter machines used at check points in airports because of the emerging consequences of ionizing radiation. Articles presenting the highest level of evidence and the latest reports were preferentially selected. It is expected that the doses of radiation used in airports are not safe and that X-Ray Back Scatters may have long-term Public Health consequences. Direct measurements from several independent sources, including the U.S. Food and Drug Administration, Johns Hopkins University, and the U.S. Army were used. Using information compiled from other studies, this investigation wanted to prove that the X-Ray Back Scatters are unsafe for commercial use.

STUDY OF SILVER NANOPARTICLES INHIBITION EFFECT ON ESCHERICHIA COLI

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Silver nanoparticles (AgNPs) are somewhat unstable since they are oxidazable. They are currently being investigated to try to make them more stable so they can be used in various fields of research and medicine. However, there is lack of information on the effect of silver nanoparticles on living systems. *Escherichia coli* is a bacterium found in the intestines of the human body and animals; it is needed for our system but it is quite harmful itself when it turns into an infection. The bacteria were cultured in the Luria Broth agar and placed on a petri dish where they were left for a few hours. Then, a second plate was filled with the Muller-Hilton agar where the *E. coli* was tested with the AgNPs using the Kirby Bauer Method. Several concentrations of the nanoparticles were tested to analyze the effects on the inhibition. The results clearly demonstrated that the bacteria resisted high concentrations of silver nanoparticles at 24 hours.
CAFFEINE ADDICTION AND ITS UNKNOWN EFFECTS ON THE NERVOUS SYSTEM

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Caffeine is a bitter alkaloid known as \( \text{C}_8\text{H}_{10}\text{N}_4\text{O}_2 \) found especially in coffee, tea and other substances and it is used medicinally as a stimulant and a diuretic. This widely used psychoactive substance is easy to obtain for both adults and children. In this investigation, the purpose of the study was to examine the acute effects of caffeine on the human body. The reason for the development of this research was to show that caffeine cannot only be used as a psychoactive substance, but it can also include negative effects on the nervous system. Most people believe that caffeine helps concentrate, but indeed it alters the brain activity. There are only a few people who are aware of the effect that caffeine creates. The main task to be accomplished in this research was to find a hidden object surrounded by a complex background full of details. For the investigation, eighteen (18) subjects were selected and divided into two (2) sub-groups of nine (9) subjects each. Every subject was evaluated for a set time of three (3) minutes. It was expected to show all the effects that caffeine addiction can cause on the human body and let people know what really is happening in the nervous system.

DOES MUSIC AFFECT THE BLOOD PRESSURE?

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Over time, the effect of music on people has been seen. Music helps people have better concentration increasing levels of self-esteem and decreasing those of stress leaving behind their problems. "Music Therapy" is a process designed to facilitate and promote communication, relationships, learning, movement, expression, and organization to help people. These types of data are collected through blood pressure. In this project, the effects of different types of music on the emotions were studied. A different type of music therapy on different people with different levels of blood pressure was used. The average number of persons involved in this experiment was from 20 to 25 participants. People suffering from hypertension or any type of disease or heart or blood pressure were not selected as part of the experimental group. The music selected for the music therapy was soft, like the waltz, moving like pop, or strong as rock. Blood pressure was taken from these test subjects before starting the experiment. Then, an approximately 20 minute music therapy procedure was applied on them and, finally, their blood pressure was taken again to compare results. As for the environment to be used, in this experiment it was a quiet one. It was expected that people reacted with normal blood pressure, or on low levels of it to soft music. While in the upbeat music, it was expected that people would react with normal blood pressure or on high levels of it. For the loud music, it was expected that people involved in this experiment reacted with a medium high or high blood pressure.
STUDY OF BACTERIAL GROWTH INHIBITION USING CdSe QDs (LIGHT EXPOSED) WITH THE KIRBY-BAUER ANTIBIOTIC TESTING METHOD

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Quantum Dots (QDs) are nano-sized particles (2~10nm) composed of a semi-conducting element that has peculiar electrical and magnetic properties. Cadmium Selenide (CdSe) QDs exhibit a size-dependent fluorescence although they absorb light at the same wavelength, regardless of the size. These properties make them great for some bio applications like biomarkers. Some studies report that these CdSe QDs are toxic, making them less useful in this area. It was decided that toxicity studies of the QDs, exposed to different wavelengths, would be made on Escherichia coli using the Kirby-Bauer antibiotic testing method. E. coli is a rod-shaped bacterium commonly found in the lower intestine of endotherms. This research is a continuation of a statistical study of bacteria growth inhibition using CdSe quantum dots. CdSe QDs were synthesized via wet chemistry using Thioglycolic Acid (TGA) as a coping agent and sodium borohydride (NaBH₄) as the reducing agent. After characterization, several E. coli cultures were prepared on different agar plates and then transferred to Mueller-Hinton agar plates. Five disks were prepared, two controls and three disks of the QDs exposed to light. Results demonstrated that none of the particles caused growth inhibition of E. coli compared to the controls. CdSe QDs in low concentrations have no effect on E. coli growth. A higher concentration is recommended for future experiments.

SYNTHESIS OF CdSe, Au AND Ag NANOPARTICLES, AND TOXICITY EVALUATION ON E. COLI USING THE KIRBY BAUER METHOD

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Nanotechnology is the study or manipulation of matter at a molecular or atomic level, with a dimension ranging from 1 nanometer (nm) to a 100 nm. Particles with these attributes are being more studied for their optimal properties for future applications in the bio-technological and medical fields. This investigation was based on the interdisciplinary combination of material science, chemistry, biology and nanotechnology. The central focus of this research was to synthesize Ag and Au nanoparticles, and to synthesize CdSe quantum dots, and to determine their effect on live beings using gram-negative bacterium, Escherichia coli. The toxicity of the nanoparticle was determined using the Kirby Bauer antibiotic testing method or disk diffusion antibiotic sensitivity testing which consists of preparing wafers impregnated with the relevant substances (Ag and Au nanoparticles, CdSe quantum dots) inside an agar plate with a growing colony of E. Coli bacterium. If the bacteria are susceptible to one of the substances, the area around the specific wafer will become clear creating a zone of inhibition, which can be used to estimate the sensitivity of the bacteria to each of the nanoparticles. The results showed that none of the nanoparticles caused growth inhibition compared to the control groups. This result recommends using higher concentrations for future projects to determine highest tolerance.
UNDERSTANDING LACTOSE INTOLERANCE

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Lactose intolerance is caused by mutations in the LCT gene. This produces a deficiency in the enzyme that breaks down lactose into simple sugars. This inability to digest lactose causes various uncomfortable symptoms for people with lactose intolerance. Some use lactase supplements to process lactose and be able to digest it with no undesirable consequences. In this experiment, the exact quantity of glucose, (simple sugars derived from lactose), present in regular milk was calculated. In addition, the amount of lactose in the milk was calculated. Then lactase was added to the milk to determine the effect on the amount of glucose and lactose. In addition, the amount of glucose in regular milk was compared with that of lactose-free milk, both with and without the lactase. These results demonstrated how the addition of the enzyme would make regular milk digestible for those with lactose intolerance.

TOXICITY EVALUATION OF CdSe QDs WITH DIFFERENT CAPINGS ON E. Coli

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Cadmium Selenide Quantum Dots (CdSe QDs) are most commonly known for their photoluminescence. These particular QDs have a size dependent fluorescence spectrum. Several researches are developing CdSe QDs to be used in biomedical imaging applications. By injecting appropriately prepared CdSe QDs into injured tissue, it may be possible to image the tissue in those injured areas. *Escherichia coli* (*E. Coli*) are rod-shaped bacterium that are commonly found in the lower intestine of endotherms. Most *E. Coli* strains are harmless, but some types can cause serious food poisoning in humans, and are occasionally responsible for product recalls due to food contamination. The main objective of this research was to evaluate the effects that CdSe QDs (Quantum Dots) coated with PVP (Polyvinylpyrrolidone), PEG (Polyethylene glycol) and TGA (Thioglycolic Acid) have on the growth of said bacteria, through mathematical models. CdSe QDs were synthesized using the following materials: Ultra High Pure Water (UHP H₂O), Cadmium Chloride 1.0m (CdCl), Selenium Powder, Sodium Borohydride (NaBH₄) Thioglycolic Acid (TGA), and NaOH Solution. To coat the CdSe QDS, a portion of QDs was separated and mixed with the polymers for 12 hours followed by centrifugation to remove excess of PEG or PVP. In order to identify the effect that the CdSe QDs might have on the *E. coli* bacteria, Kirby-Bauer test cultures were prepared. The purpose of these cultures was to identify the growth inhibition average of the PVP, PEG and TGA coated QDs in comparison with a strong antibiotic. By providing an ideal growth environment for bacteria and by allowing the placement of various experimental variables in the same culture this method allows for the comparison of the inhibition of the different coated QDs. The results demonstrated that both PVP and PEG had less toxicity than TGA-coated CdSe QDs.
GROWTH INHIBITION STUDY IN ESCHERICHIA COLI (E. Coli) BY THE USE OF GOLD NANOPARTICLES

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Nanotechnology allows for the development of high performance products. The use of Gold Nanoparticles (Au Np’s) is a part of the nanotechnology applications. Today, it is used in different applications such as a catalyst, a good electric conductor, a therapeutic agent, and antibody/protein label for immunoassays and biosensors. Its ability to track diseases at early stages has helped to improve the medical diagnosis tools which help to create new forms of treating directly diseases such as tumors, viruses, bacteria. This research studied the effect Gold Nanoparticles (Au Np’s) in the growth of a bacterium. The experiments were performed using Escherichia coli, commonly known as E. Coli. This bacterium can be normally found in the digestive tract of humans and animals. A person can get infected if it consumes contaminated food with feces, unpasteurized milk products and contaminated water. Using the Kirby-Bauer method, the growth inhibition was verified using different concentrations of Gold Nanoparticles solutions. Initially, the E.Coli bacterium was grown in Luria Broth agar. After few hours, a second plate was prepared using the Mueller-Hinton to test the toxicity of the Au Np’s at several concentrations. Its growth inhibition was affected by the Gold Nanoparticles toxicity. Finally, this growth inhibition was measured to determine the antimicrobial effectiveness using the Gold Nanoparticles.

DEVELOPMENT OF THE DENGUE FEVER VACCINE IN THE CARIBBEAN

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Dengue fever is an infectious disease caused by a virus, which is mainly transmitted by mosquitoes from the genus Aedes, principally A. aegypti. It has grown to be a global threat in the world because of the habitat expansion of its vectors. This disease is the leading cause of illness and death in the tropics and subtropics. Dengue vaccines constitute the best control measure for the near future because there are no effective treatments and there has been limited success in the control of vectors. Developing an effective vaccine requires the four serotypes of the dengue fever, which makes the process a challenge. So far, the methods for the development of a dengue vaccine involve clinical treatments. These tests have been conducted in different countries and for different population sectors, among the studied population there are infants, teenagers, adults and the elderly. Other studies have involved the analysis of the whole viral genome of the different strains. Before the widespread release of a new dengue vaccine, it is important to consider using limited supplies of vaccine in an adequate way due to the complexity of the dengue transmission. It is expected that the preliminary vaccine will be produced sometime in the near future. In conclusion, vaccination will have an important role in controlling dengue. Modeling results suggest that children should be prioritized to receive the vaccine, but adults should also be vaccinated to reduce community-wide dengue transmission.
THE WET SOAP PROJECT: A COMPARISON STUDY

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People always take a shower with different types of soaps in the shower or bathtub but, which soap would recover more bacteria from the skin? Which soap could leave the skin with less germs or bacteria? And by washing an already used soap with water before a second use, would it clean out the bacteria from the soap? The purpose of the Wet Soap Project is to learn which soap removes more bacteria or germs from the body. The comparison was performed using Protex and Bebé Castilla soaps, an antibacterial soap and a natural soap. The antibacterial soap is the one that focused on removing bacteria from the skin and the other one focused on leaving the skin smooth.

STUDY OF MELANOMA SKIN CANCER AND HOW IT CAN BE PREVENTED

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Melanoma is a type of cancer that is developed in the basal membrane of the epidermis. It is the result of abnormal cell growth due to mutation in the DNA material of the cell. The most common risk factor that may predispose a person to suffer this malignancy is the exposure of UVA and UVB rays. It is the most aggressive skin malignancy and it is responsible for the death of approximately 9,000 people in the US. Annually, about 120,000 new cases are reported in the US; of these in 2010, 68,000 were invasive melanoma. There are four types of melanoma; superficial spreading melanoma, lentigo maligna, acral lentiginous melanoma, and nodular melanoma. Once a type of melanoma is established, it is subdivided into stages; these stages determine its thickness and invasiveness of the lesion. Stages range from I to IV, the first is the most superficial and the fourth the most invasive. In this research, different information resources were compared to determine the risk factors, the measures used to stage the melanoma, and the studies that prove how this type of cancer can be prevented.

GINGEROL BEHAVIOR IN CANCER PREVENTION

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Ginger has many health benefits. Recently, studies showed that ginger can be used both for the treatment of cancer and to prevent it. Specifically, ginger acts directly on cancer cells in several ways. Ginger destroys malignant cells in a process named apoptosis, in which malignant cells “commit suicide,” leaving the healthy cells intact. Another process associated with ginger is autophagy, by which damaged cells “eat” themselves. This behavior was seen in breast cancer, colon cancer, cerebral cancer, and others. The compound that makes the above processes possible is Gingerol (C17H21O4), and more specifically its functional groups C=O and O-CH3, which have a higher potential energy in the structure of the molecule. These functional groups were studied using the basis set: HF/3-21G* with Gauss View program to determine the electronegative reaction.
In this research, the difference between the abundance of coral species in two different places, one in Mayaguez, Puerto Rico and the other in La Parguera, Lajas, Puerto Rico were analyzed. Three rivers flow through Mayaguez and take sediments to the sea. These sediments are not beneficial to the corals. Meanwhile, the more sediment is found in the water, the less solar power it will get, which it needs for the microscopic organisms that live in them and provide them with oxygen. Some corals can stand the sediment because their structure makes it easy for them to eliminate the sediment, and there are some corals that use the sediment as nutrient. Coral reefs are very important for a lot of reasons. For example, they are natural barriers against waves, tsunamis and water currents. Past research on it had also discovered that corals can be useful for medicine. This experiment helped in the understanding of how water itself could affect corals. It helped to understand the types of coral and the abundance of each type of coral in the reef. After completing this research project, the types of coral in both reefs were compared to see which one had more abundance of coral species. It was expected that the results would indicate more understanding and awareness of marine life in general and its importance in the underwater ecosystem.
ABSTRACTS
GENOMICS

Computational Study of Amino Acid Substitution in the ACVRL1 Receptor Type II Gene

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The ACVRL1 activin A receptor type II-like 1 gene encodes a type I cell-surface receptor for the TGF-beta superfamily of ligands. The members of the TGF-beta superfamily are required to perform many functions such as orso-ventral patterning, mesoderm induction and patterning, limb bud formation, bone and cartilage formation, neuron differentiation, and the development of a variety of different tissues and organs. The deficiency of the encoded protein (ALK1) causes hemorrhagic telangiectasia type 2 (HTT2) also known as the Rendu-Osler-Weber syndrome 2. HTT2 is characterized by the presence of arteriovenous malformations that involve direct connections between arteries and veins with no intervening capillary bed. The purpose of this research was to examine whether an amino acid substitution can affect the encoded protein function using the program SIFT. To perform the experiments, 20 positions of the protein were examined to see if it had a mutation or not. If a high percentage of changes in the amino acids occurred, then it is intolerant; therefore, it can cause a mutation. The hypothesis of this study foresees that changes in amino acids will result in mutations. The results demonstrated after using SIFT that there is a high percentage of intolerant amino acids and it can therefore cause a mutation.

Computational Analysis of the Pendred Syndrome Using SIFT

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The Pendred Syndrome (PDS) is an autosomal recessive disease characterized by congenital sensorineural hearing loss and goitre which causes hearing loss and deafness in children. Children who are born with PDS begin to lose their hearing at birth or by the age of three. Almost all children with PDS have bilateral hearing loss, meaning a loss in hearing in both ears, or one ear may have more hearing loss than the other. The gene responsible for PDS is mainly expressed in the thyroid gland that produces a protein. The thyroid cell-surface protein is responsible for transporting chloride and iodide from the plasma into the thyroid. SIFT (Sort Intolerant From Tolerant) is a program that determines what percentage of amino acid substitutions will cause mutations in the gene and affect the protein function. From the results obtained by SIFT, 66.25% of amino acid substitutions were predicted as tolerant, and 33.75% of amino acid substitutions were predicted as intolerant.
CHEMICAL-PHYSICS PROPERTIES OF DNA EXTRACTION

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Deoxyribonucleic Acid (DNA) is in every living thing, including hair, plants and fruits. DNA is a macromolecule that is very essential to all of the forms of life. In the DNA, all of the genetic information such as the sex, color of hair and skin one may find conditions such as the Down syndrome. The purpose of the experiment was to extract the DNA from a strawberry and a banana to see if they were physically the same; the strawberry has 56 chromosomes and the banana has 11 of them. To extract the DNA, the fruits were squished and a lye solution (a solution to break open the cells) was created. Then alcohol was added and the DNA appeared. More DNA was obtained from the banana than from the strawberry. Though the chemical properties were not the same, the physical properties were, on both cases, white and slimy.

MARFAN SYNDROME

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The Marfan syndrome is a disorder that affects the connective tissue that is caused by a mutation in the gene called FBN-1 on chromosome 15, which encodes for the glycoprotein fibrillin. This defect results in an increase in a protein called growth factor beta, or TGFβ and a decrease of fibrillin into the connective tissue matrix. About 1 out of 5,000 people in the United States has the Marfan syndrome and 3 out of 4 people with Marfan syndrome inherited it from one of their parents. The objective of this work was to use bioinformatics to analyze what is wrong on the gen that causes the protein to damage and create the disease. The methodology was based on the use of some important programs and databases: Pub Med, NCBI-BLAST, UniProt, ClustalW2, Gene Doc, TREEVIEW, Protein Data Bank (PDB), SIFT, Visual Molecular Dynamics (VMD), MEME and NEWT. The results in Gene Doc did not demonstrate that 100 % of the areas were conserved. In the 3D structure of the protein, a complete secondary structure was observed with beta sheets. The polypeptides chains and the alpha helixes in the phylogenetic tree demonstrated that the organisms had 3 different ancestors in common. The only one that had one ancestor was Macaca fascicularis, a crab eating macaque and the motif that predominated was motif 2. This result means that these areas are the most conserved.
BIOINFORMATICS STUDY OF THE METHYL BINDING DOMAIN

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Many genetic neurological disorders, such as Rett Syndrome, Asperger’s Syndrome, Fragile X-Syndrome, Severe Neonatal Encephalopathy, and Angelman’s Syndrome, are linked to mutations in the Methyl Binding Domain Genes, which include MECP2, MBD1, MBD2, MBD3, and MBD4. The Methyl Binding Domain genes have vital functions in a process called DNA Methylation. Gene expression is altered in DNA methylation in order to affect the characteristics of individual chromosomes in separate cells. This is the basis of cellular differentiation, or the process by which equal cells acquire distinctive characteristics that will give them a specialized function in the organism. The purpose of this investigation was to use Bioinformatics to analyze the parallel structures between the Methyl Binding Domain genes. The methodology of this Investigation included the use of the following programs: Pubmed, Blast, ClustalW2, Genedoc, Treeview, and VMD. These programs and databases clarify the structure of this gene family, and identify the motifs of its proteins. The results showed that the Methyl Binding Domain proteins evolved frequently from a common ancestor and became a very extensive network of proteins. This evolution allowed the genes to acquire many changes to their genetic makeup, which allows them to be very tolerant of mutations. Therefore, the most concentrated section of conservation in the multiple alignment, amino acids 240-460, contains the information that is most vital for the normal function of these proteins. This indicates that the mutations for most of these disorders are probably found in these areas of concentration.

TWO APPROACHES TO STUDY JUVENILE MYOCLONIC EPILEPSY (JME) DISEASE: AMINO ACID MUTATIONS ANALYSIS AND INHERITANCE PATTERN WITH PARTIAL PENETRANCE

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What is the flaw that causes a disease? Thanks to scientific research, this question can be answered. This research is focused on Juvenile Myoclonic Epilepsy (JME), a form of epilepsy that develops at early ages. Teenagers and kids with this disorder suffer from seizures, like uncontrolled muscle jerks, usually in the morning. JME is an autosomal dominant disease. Genetic studies revealed that Ala322Asp in GABRA1 gene could be related to the incidence of JME. Nevertheless, not every person carrying the mutation associated to JME disease express the disease. This is known as ‘partial penetrance’ (PP). To develop the present project, two approaches were used: genetic and biostatistics. An NCBI database was used to find the transcript ID for the gene and the protein sequence which is composed by 456aa. The SIFT bioinformatics tool was used to study the tolerance of mutations in the position 322 of the GABRA1 gene. In the mutation process, if Alanine change to Aspartic Acid, the result is "damaging" with a SIFT score of 99%. Also, 13 of the 20 possible point mutations were determined as damaging for human health. Finally, a pedigree chart of JME that included the partial penetrance factor was developed. Using PP- values suggested in the literature, Punnett squares and probability concepts were applied to predict the inheritance of JME when the partial penetrance was present.
THE TYROSINASE GENE (ALBINISIM)

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Albinism occurs when one of several genetic defects makes the body unable to produce or distribute melanin. Albinism is an inherited condition caused by the lack of melanin of the gene Tyrosinase (TYR) and occurs in one out of 17,000 people. TYR is responsible for the first step in melanin production. The TYR gene is located on the long arm of chromosome 11 between positions 14 and 21. More than 100 mutations in the TYR gene have been discovered in people with oculocutaneous albinism type 1. There are two main causes of Albinism: The lack of melanin (mentioned earlier), and a defect on the P gene. The P gene is the protein that transports small molecules like Tryrosine to its destination. The goal of this project was to let people know how Albinism occurs and provide information to family members who blame themselves for this natural process. To perform the experiments, Med scape, Pubmed, NCBI-Blast, ClustalW2, Gene Doc and Treeview were used as Bioinformatics programs. The results in Gene doc showed that from line 1 to line 550 there was no conservation of the protein. The Tree View results demonstrated that most of the ancestors are common. The protein was crystalized and the hydrophobic regions, beta sheets and lines of polypeptides were seen.

COMPUTATIONAL ANALYSIS OF AMINO ACID SUBSTITUTIONS IN THE PSN1 GENE

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The presenilin 1 gene (PSEN1) helps process proteins and cells that are in the nucleus. It also helps to process an important protein in the brain called the amyloid precursor protein. PSEN1, along with other enzymes, helps to cut the amyloid precursor protein into smaller peptides. It is suggested that one of these peptides, the soluble amyloid precursor protein (sAPP), plays a role in the development of neurons in the brain. If the PSEN1 gene mutates, it can create large amounts of toxic protein fragments of the amyloid beta peptide. The fragments can build up in the brain to form clumps called amyloid plaques, which causes Alzheimer disease. The program SIFT was used to sort tolerant amino acids substitutions from intolerant ones. The hypothesis showed that most of the amino acid substitutions will be intolerant to the mutation. Results showed that 73.5% of the amino acid substitutions were intolerant to the mutation, while 26.5% of the amino acid substitutions were tolerant.

LIPOFUSCINOSIS CEREOID NEURONALY 3 (GEN CLN3)

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The CLN3 gene, known as "Lipofuscinosis Ceroid Neuronaly 3" is located on chromosome 16, specifically at the location 16p11.2. Mutation in this gene causes Batten Disease. Batten disease is a serious inherited illness of the nervous system that commences in childhood and is lethal. It does not yet have a specific known treatment that can halt or reverse the symptoms of Batten disease. The objective of the present research was to know which organism affects more and predicts whether an amino acid substitution. Free programs and databases were used to get Fasta file, the organism of each protein, protein sequence, multiple alignments of conservation, amino acid alignments, evolution, models of proteins, comparison of motifs, prediction and visual graphics. Genedoc presents the level of conservation that is maintained in a 60% of conservation in the species. Results on Treeview showed that the species have one ancestor in common. On MEME one was found that is the most conserved in the species. On the 3-D, Alpha Helix, Beta Sheets and Polypeptide Chains were found.
STUDY OF THE NF1 GENE ON LOCATION 1306 RELATED TO NEUROFIBROMATOSIS TYPE 1 DISEASE

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Have you ever wondered how a single substitution on a gene sequence can damage your nervous system? Neurofibromatosis type 1 (NFI) is a genetic disease that affects the nervous system caused by mutations in a tumor suppressor gene located on chromosome 17 (17q11.2). A common consequence of the NF1 mutation is the introduction of a premature stop codon, and the majority of mutant genes encode truncated forms of neurofibromin. Neurofibromatosis type 1 is a dominantly inherited human disease affecting one in 2,500 to 3,500 individuals. The NF1 phenotype is highly variable, and its clinical course is unpredictable. Several organ systems are affected, including the bones, skin, iris, and central nervous system (manifested in learning disabilities and gliomas). The bioinformatic tool SIFT was used to study the amino acid chain and simulate several mutations in the order of these amino acids. Furthermore, by using the SIFT score, mutations were classified as harmless or damaging to human health.

COMPUTATIONAL STUDY OF THE HNF1 GENE DEFECTS CAUSING MATURITY-ONSET DIABETES OF THE YOUNG TYPE 3

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The HNF1 gene encodes a protein that is involved in the production of several liver-specific genes. Defects in HNF1A are the cause of maturity-onset diabetes of the young Type 3, which is a form of diabetes that is characterized by an autosomal dominant mode of inheritance. The onset in childhood or early adulthood (usually before 25 years of age) is a primary defect in insulin secretion and frequent insulin-independence at the beginning of the disease. It is believed that there is a high probability of having a mutation because diabetes is a common genetic mutation in humans nowadays. Some of the symptoms are hyperglycemia, microalbuminuria, macroalbuminuria and non-insulin dependent diabetes. The program SIFT (Sort Intolerant from Tolerant) was utilized to predict whether an amino acid substitution in the ALD-1 amino acid chain can affect its function. As a result in this gene, there is a 79.75% chance of being intolerant and a 20.25% chance of being tolerant of the amino acid substitution being affected. There is a high probability of a mutation occurring since the gene is mostly intolerant.
**X-LINKED SEVERE COMBINED IMMUNODEFICIENCY (X-LINKED SCID)**

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X-linked severe combined immunodeficiency (SCID) is an immune system disorder inherited almost completely by males that affects at least 1 in 50,000 to 100,000 newborns. Over 300 mutations to the interleukin 2-receptor gamma or IL2RG gene, which provides instructions to make a protein that is essential for normal immune system functionality, are what cause X-linked SCID. This research focuses on the damage that mutations to the IL2RG gene inflict on the immune system function, specifically causing X-linked SCID. The research was developed using bioinformatics and different software and databases. Protein sequences were found by using Pub Med, Medscape and the Genetics Home Reference. NCBI-BLAST was used to find other protein sequences similar to IL2RG’s. Afterwards, through CLUSTAWL2, a multiple sequence alignment was created. Then with GENE DOC the conservation zones on the protein were analyzed, which showed conservation zones from 80% and downwards. The results showed two major conservation zones when the motifs were visualized with MEME in groups of related DNA. By using TREEVIEW, a phylogenetic tree was created, which visually allowed to determine that there are three common ancestors. In the Protein Data Bank a file was found of the depicted protein. The presence of alpha helix and beta sheets was visualized by using Visual Molecular Dynamics in a picture of the crystallized protein. Finally, SIFT was used to predict if the substitution of amino acids affected the protein function.

**A PEDIGREE CHART TO STUDY THE HEREDITARY EQUINE REGIONAL DERMAL ASTHENIA DISEASE**

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Genetic studies may show how offspring inherit genetic diseases, but when talking about animal species, does the inheritance process work in the same way? Hereditary Equine Regional Dermal Asthenia (HERDA) - also called Hyperelastosis Cutis- is a disease that affects horses, even though there is a similar disease that also affects humans, cats, dogs and cattle. HERDA is an autosomal recessive disease that enfeebles the connective tissue of equines, making it susceptible to tear apart even only through pressure contact (like the jockey weight while he rides a horse). Currently, there is no cure for this disease and the only option for reducing the incidence of HERDA is the practice of euthanasia in offspring. Thus, the most important question to be answered is what could happen if a breeder mates a HERDA carrier horse with another HERDA carrier horse, or a healthy horse? The Punnett square and probability concept were used to develop a pedigree chart of this scenario. Also, an NCBI database and ensemble database were used to learn about a gene candidate for HERDA.
COMPARATIVE EVOLUTIONARY ANALYSIS OF THE GBA GENE IN DIFFERENT SPECIES

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The GBA gene, also known as the glycosidase beta acid, is a gene that can be found in the 1st chromosome between base pairs 155,204,238 to 155,214,652 at position 21. The GBA gene contains the instructions for the production of an enzyme that is active in the lysosomes of the cells and therefore helps break down cell waste. This process is extremely important to maintain the cell functioning. If this process is deficient, the waste in the cells can accumulate creating a disease called Gaucher’s disease. Gaucher’s is the most common of the lysosomal storage diseases and is not deadly when treated. To have a better understanding of the disease, the relationships between three variables were studied. These variables were: time of evolution, type of species, and mutation rate. To explore this relationship, molecular evolutionary analysis was used, as well as gene data banks. With these programs various evolutionary models were created that were the main results and led to the final conclusions and generalizations.

BIOINFORMATICS ANALYSIS OF THE CREUTZFELDT-JAKOB DISEASE


There are many degenerative mental disorders that affect society and are death causing. Individuals confront mental changes in different ways without knowing the causes and the consequences. Creutzfeldt-Jakob belongs to the family of conditions BSE (neurosciences pathology that slowly affect the brain functions until death). This disorder affects approximately one million individuals worldwide. The principal cause of this disorder is the prion protein. Prion is an infectious agent that is composed primarily of protein. This protein causes normal proteins to fold abnormally. In most of the cases, society does not have the intellectual interest to know more about the disorders that affect life. The goal of this research was to use Bioinformatics programs available online to study quickly the processes of mental deterioration. To achieve this goal, PubMed, Visual Molecular Dynamics (VMD), NCBI-Blast, Tree View, Protein Data Bank (PDB), Gene Doc, Meme and ClustalW2 were used. Gene doc demonstrated that the prion protein had many levels of conservation. Tree View showed the Creutzfeldt-Jakob between the generations in different organisms. Motifs showed the different conservations in the Creutzfeldt-Jakob disease. The VMD gave the protein the structure to visualize better the prion organization.
ANALYSIS OF AMINO AMINO ACID SUBSTITUTIONS IN THE PKD1 GENE

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The Polycystin -1 protein is encoded within the PKD1 gene family. The encoded glycoprotein holds a great N-terminal extracellular region, various transmembrane areas and a cytoplasmic C-tail. It is an integral membrane protein that functions as a controller of calcium permeable cation channels and intracellular calcium homoeostasis. Also, it is involved in cell-to-cell/matrix interactions and may moderate G-protein-coupled signal-transduction pathways. It plays a role in renal tubular development, and mutations in this gene cause autosomal dominant polycystic kidney disease type 1 (ADPKD1). ADPKD1 is characterized by the growth of fluid-filled cysts that replace normal renal tissue and cause end-stage renal failure. Splice variations encode different isoforms that have been noted for this gene. Also, six pseudogenes, closely related in a known copied region on chromosome 16p, have been described. The SIFT program was used to predict whether an amino acid substitution in a protein will have a phenotypic effect by measuring levels of tolerance. Twenty positions of the gene were observed to obtain the levels of tolerance. 63.25% of amino acid substitutions were intolerant, while 36.75% of amino acid substitutions were tolerant.

PROTECTING THE GUARDIAN OF THE HUMAN GENOME USING BIOINFORMATICS

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There are different kinds of cancer, and one explanation for each one. For example, the P53 protein is associated with the cause and cure of cancer. This protein is called the genome guardian, because it protects the DNA development. In a dangerous cell production, the P53 protein works stopping the deficient production and starts to repair the DNA. If the protein suffers a mutation, the deficient cells will proliferate in the genome and provoke a type of cancer. The P53 mutation will be produced by different kinds of factors, one of these would be the radiation. This research used Bioinformatics tools to compare the amino acids sequences of the protein and how conservation has changed through time between different organisms. Then, it determined deficient amino acids that transform the structure of the protein. The results showed a high percent of conservation, indicating the small amount of changes that have occurred through time. Moreover, the presence of not-conserved regions demonstrated the mutations that make possible cancer proliferation.
DOES THE NUMBER OF VACCINES APPLIED INFLUENCE THE INCREASE OF AUTISM CASES?

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Autism is a psychological disorder usually diagnosed in early childhood. This disorder causes problems with social interactions and communication. Before vaccines were applied (or even released), the cases of autism were rare. Now, as years have gone by, the population has increased. The problem is if maybe the increase of the autistic population is a result of the number of vaccines given to kids (5 year olds). The objective of this research was to determine the relationship between the numbers of applied vaccines and the number of autistic cases. In this research, different programs and online databases such as MS Excel and PubMed were used. The results showed that the United Stated has the largest number of applied vaccines to 5 year olds. It still has the first place in mortality rates in 5 year olds and has the biggest registered autism cases compared with other countries. Also, the result showed that it is not possible to conclude that there is a relation. Also, the increase of autistic cases varies per country and cannot be calculated by the number of applied vaccines. The increase in autism is due to many factors: the population, the size of the country, the genetics of the children, and the control of the content in vaccines in every country.

COMPUTATIONAL STUDY OF AMINO ACID CHANGES IN THE TYR GENE

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The Tyrosinase enzyme is encoded by the TYR gene in humans. This enzyme is located in the melanocytes and is responsible for the first step in melanin production. Melanin production converts tyrosine to another molecule called dopaquinone. Biochemical reactions convert dopaquinone to melanin in the skin, hair follicles, the iris, and the retina. As reported in several works, lack of tyrosinase causes the condition of albinism in humans. This condition disrupts the formal production of melanin. The disruption of the production of melanin in the body is seen in the physical appearance of the person. A person with albinism may have white hair, pale skin and light-colored eyes. This research was based on the use of a computer-based program called SIFT to predict whether the amino acid substitution caused any effects in protein function. It is a sequence homology-based tool that sorts intolerant from tolerant amino acid substitutions and predicts whether an amino acid substitution in a protein has a phenotypic effect. During the experiments, amino acids were classified through color; the ones in black are tolerable amino acids while the red ones are intolerable. The results showed that the amount of intolerant amino acids would be larger than the amount of tolerant amino acids by a difference of 30% or 40%. After analyzing the results, it was concluded that there is a 66% of intolerant amino acids and a 34% of tolerant amino acids. This means that there is a high probability of a mutation occurring.
COMPUTATIONAL STUDY OF FAMILIAL ADENOMATOUS POLYPOSIS INVOLVING ADENOMATOUS POLYPOSIS COLI GENE

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The adenomatous polyposis coli (APC) gene encodes a tumor suppressor gene and serves as an antagonist to the Wnt signaling pathway. This gene helps to protect a normal cell from becoming malignant as well as counteracts the effect of the Wnt signaling pathway. In addition, the aforementioned gene participates in processes, such as cellular migration and adhesion, transcriptional activation, and apoptosis. When some defects are developed in the APC gene, it causes familial adenomatous polyposis, which is an inherited disorder characterized by the development of cancer in the colon and rectum. This cancer development is commonly characterized by the formation of multiple non-cancerous growths. If the disease is not treated, there may be a development of malignant growths. The main purpose of this research was to use SIFT to find the percentage of amino acid substitutions that cause mutation in the gene and affect the protein function. The program is based on the substitution of intolerant from tolerant amino acids and on the principle that protein evolution interrelates with protein function. By using SIFT, the probability of whether mutant activation of alleles in this gene will occur was calculated. According to the data collected about the APC gene and due to the severity of familial adenomatous polyposis, it can be hypothesized that the intolerant alleles will have an 80% probability of mutant activation while the tolerant alleles have a 20% probability. However, according to results obtained from this program, the intolerant alleles actually have a 92.5% probability of mutant activation while tolerant alleles have a 7.5% probability. The results indicated that there is a higher probability for allele mutation and development of the aforementioned disease.

COMPUTATIONAL STUDY OF AMINO ACID SUBSTITUTION IN THE VHL SUPPRESSOR GENE

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The Von Hippel-Lindau (VHL) suppressor encodes a protein that is part of the protein complex that includes elongin B, elongin C, and cullin-2, and possesses ubiquitin ligase E3 activity. It participates in the ubiquination and degradation of the hypoxia-inducible factor, which is important for gene expression by oxygen. A mutation of the VHL gene may result in the VHL syndrome. This syndrome is a dominantly inherited genetic condition that predisposes a variety of benign and malignant tumors. VHL also increases risks of kidney cancer. This project was based on the use of SIFT to determine the percentage of amino acid substitutions that cause mutation in the gene and affect protein function. The results obtained by SIFT indicated that there is a 16.75% of resisting changes in amino acid substitution and 83.25% of not resisting changes in amino acid substitution. The analysis expresses that there is a high probability of a mutation occurring and can result in the VHL syndrome.
PREDICTING AMINO ACID CHANGES OF THE BREAST CANCER GENE USING SIFT

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Breast Cancer Type 2 (also known as BRCA2) is a gene which decodes a protein to support a cell from suffering cancer. It is also known as a tumor suppressor gene. This protein helps cell prevention from developing in an uncontrolled way. When the BRCA2 protein suffers from a mutation, it will not protect the chromosomes and results in a change in its structure. This means that the person would be at risk of having Breast Cancer Type 2. To know the probability of mutation of this gene, a well-known program SIFT (Sort Intolerance from Tolerance) was used to perform the experiments. This program is capable of making a change on the polypeptide chain and calculating the tolerance level to know the mutation percentage of this gene. Twenty positions of the gene were analyzed to obtain the tolerance level. Results obtained by SIFT showed that 79.75% of amino acids changes were intolerant, while 20.25% of amino acids changes were tolerant. It can be concluded that there is a greater probability of a mutation occurring and becoming Breast Cancer Type 2.

MOLECULAR EVOLUTION RATE OF THE NUCLEIC ACID IN THE L1CELL GENE

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The L1CAM (neuronal cell adhesion molecule) is located in the long arm of chromosome X (xq28) from the immunoglobulin supergene family. The principal function of the L1CAM is to give instructions to produce L1 proteins found in the nervous system on the surface of neurons. Deficiencies in L1CAM causes mental retardation-aphasia-shuffling gait-adducted thumbs syndrome (MASA). Another syndrome apparently caused by mutation in the L1 is the X-linked hydrocephalus syndrome, which occurs in 1(one) in every 30,000 (thirty thousand) men. According to GeneCards, spastic paraplegia is a degenerative spinal cord disorder characterized by a slow, gradual, progressive weakness and spasticity of the lower limbs that occurs when the L1CAM is defected[L1]. The objective of this research was to find a pattern in the L1CAM by the molecular evolution rate and the ancestral sequence. This project was developed using the bioinformatics software tool MEGA5. This is a tool that helps infer phylogenetic trees, conduct sequence alignment, and estimate rates of molecular evolution, among others. Also, Excel was used for numerical calculation and data manipulation.
THE COLLAGEN ALPHA 1 & 2 GENE IN RELATION WITH THE EHTHLERS DANLOS SYNDROME –CLASSICAL TYPE

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The Ehlers-Danlos syndrome (EDS) is a group of disorders that affects tissues of sustenance such as: skin, bones, and blood vessels, among other organs. Collagen type 1n is one of the genes that provides information for the construction part of a large molecule and has been found to cause the classical type EDS, and some other diseases like COL1A1 and COL1A2. These two proteins work together to produce rope-like pro-collagen molecules which are made up of two pro-alpha1 chains (COL1A1) and one pro-alpha2 (COL1A2) chain, to be read by enzymes, and result in a mature collagen molecule, in this case Collagen 1. A mutation in the COL1A1 replaces the amino acid arginine with cysteine, thus changing the protein building blocks (amino acids) used to build one of the two pro-alpha1 chains, which rarely results in diseases like the Ehlers-Danlos syndrome (classical type). This research was conducted using databases and programs related to bioinformatics. The objective of this research was to evaluate and understand the relations the COL1A1 & COL1A2 proteins had with the cause of this disease. The multiple sequence alignments showed there are high levels of conservation on both genes meaning they are necessary for various organisms. The motifs showed a clearer image of how both genes have been conserved. The Phylogenetic trees showed that both COL1A1 & COL1A2 have many organisms with similar amino acid sequences, thus showing the number of ancestors they have in common.

CHEDIAK HIGASHI SYNDROME

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The Chediak Higashi syndrome comes from a gene mutation in the lysosomal trafficking (LYST) gene or the Chediak-Higashi Syndrome (CHS1). Up to now, the syndrome does not have a cure and has few treatments. The symptoms are very harmful for the body because the immune systems starts to fail and any other disease can kill the person. The syndrome is an autosomal recessive one; this means that for a person to have it first the parent’s need to be carriers of the mutated gene. The LYST gene is the one responsible for the information to create a protein named lyst or the lysosomal trafficking regulator. The purpose of this investigation was to show the scientific community about this well-known syndrome, and encourage them to investigate the syndrome. The methodology was based on the use of some important programs and databases: Pub Med, NCBI-BLAST, UniProt, ClustalW2, Gene Doc, TREEVIEW, Protein Data Bank (PDB), SIFT, Visual Molecular Dynamics (VMD), MEME and NEWT. The Gene Doc results said that only some amino acids where conserved 100% and 80%, while there were no 60% and the remaining was less than 60% of conservation. Mega 5 was used to see the ancestors of the protein. MEME showed that the amino acids were well conserved especially in motif 10.
COMPUTATIONAL ANALYSIS OF AMINO ACID CHANGES OF THE GALT GENE

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The Galactose-1-phosphate uridylyltransferase (GALT) gene provides the directions to produce an enzyme (Galactose-1-phosphate uridylyltransferase) that processes a sugar called galactose. This sugar has been found in all dairy products and baby formulas in small quantities. Galactose is mainly a part of a large sugar called lactose, which is responsible for converting galactose into glucose, which gives the early energy to the organism. The GALT gene can be disrupted and can stop producing the enzyme. The lack of enzyme production results in a lethal disorder called galactosemia. The most classic cases of galactosemia are errors in metabolism or it may be transmitted as an autosomal recessive trait. In other words, galactosemia can be transmitted genetically, which means that the disease is not activated until it is passed down to the carrier’s child. It has been reported that this disease has no treatment and the action against it involves the substitution of lactose in the child’s diet. In this research, SIFT (Sort Intolerant from Tolerant) software was used to evaluate if amino acid substitution affects protein function. SIFT shows the tolerance when a mutation occurs in a gene by substituting amino acid and affecting protein function. The results obtained by the SIFT program showed that a 68.75% did not resist changes in amino acid and a 31.25% resisted changes in amino acid. These results demonstrated that there is a high probability of a mutation occurring.

STUDY OF CYTOCHROME C OXIDASE DEFICIENCY

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Cytochrome C Oxidase deficiency is a very unusual metabolic disorder that is portrayed by the lack of the enzyme (COX), or the Complex IV, an enzyme that is of vital importance because it activates the subcellular structures that help to regulate energy production. COX is the terminal enzyme of the mitochondrial respiratory chain, catalyzing the transfer of electrons from reduced cytochrome c to molecular oxygen. Deficiency of COX may be limited to the tissues of the skeletal muscles or may affect several tissues, such as the heart, kidney, liver, brain, and/or connective tissue; in other cases, the COX deficiency may be generalized. Mutations have been identified in several COX assembly factors: SURF1 (Leigh Syndrome), SCO2 (hypertrophic cardiomyopathy), SCO1 (hepatic failure, ketoacidotic coma), COX10 (encephalopathy, tubulopathy) and COX15 (similar to SCO2). This investigation was specialized on the gene that causes the Leigh Syndrome that is SURF1 because it is the most common that causes Cytochrome C Oxidase deficiency. The results demonstrated that on Gene Doc they were very conserved. On Tree View it was clearly observed that the 1st and 2nd star had just one ancestor and the 3rd one had two ancestors that are Marmo and Human. Results on the 3D picture showed that the protein was very clustered and had a great concentration of alpha helix and beta sheets and with MEME I results demonstrated that there were no motifs and that means that the protein had many mutations.
ANALYSIS OF SHOX GENE POINT ALANINE MUTATIONS RELATED TO TURNER SYNDROME

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Turner syndrome (TS) is a rare chromosomal condition that affects the development specifically in females. One of the most common features of Turner syndrome is short stature, which becomes evident by about age 5. This syndrome is related to the X chromosome, and it is the result of the absence or the alteration in the structure of one X chromosome in women. Researchers have identified that the loss of one copy of the SHOX gene as the responsible for short stature and skeletal abnormalities in women with TS. This project is a genetic investigation based on the SHOX gene in A170P (where A stands for Alanine and P for Proline) which are 2 of the 20 amino acids. The project was based on the analysis of the SHOX gene point alanine mutations related to Turner syndrome. A170P causes a series of diseases including Lerí-weill dyschondrosteosis, or larger dysplasia. The short stature homeobox gene (SHOX) is a gene on the X and Y chromosome which is associated with short stature in humans if mutated or present in only one copy (haploinsufficiency). When the Alanine is exchanged in the position 170 for Proline, there is a 99% chance of damage that could cause different kinds of diseases, among them, the Turner Syndrome.

COMPUTATIONAL STUDY OF AMINO ACID SUBSTITUTION IN WILSON DISEASE GENE

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The ATP synthase is a multisubunit protein. It is coded by ATP7B ATPase, Cu++ transporting, beta polypeptide gene. It has the following domains, an ATPase consensus sequence, a hinge domain, a phosphorylation site, and at least 2 putative copper-binding sites. The gene contains the genetic information necessary to make a copper transport protein that plays a key role in incorporating copper into ceruloplasmin and moving excess copper out of the liver. Mutations in the gene lead to an abnormal copper transporter that cannot move copper effectively or at all. This protein functions as a monomer, exporting copper out of the cells, such as the efflux of hepatic copper into the bile. Alternate transcriptional splice variants, encoding different isoforms with distinct cellular localizations, have been characterized. Mutations in this gene have been associated with Wilson Disease (WD). Wilson disease is an autosomal recessive disease. To inherit Wilson Disease, both parents must carry one genetic mutation that each parent passes to the affected child. One in 100 individuals in the general population carries one abnormal copy of the Wilson disease gene. Carriers have one normal and one abnormal gene. The main objective of the research was to use SIFT to predict which mutants may have a phenotypic effect before the functional assays are carried out. SIFT takes a query sequence and uses multiple alignment information to predict tolerated and deleterious substitutions for every position of the query sequence. Twenty positions of the gene were observed to obtain the levels of tolerance. 50.25% of amino acid substitutions resulted in being deleterious, while 49.75% of amino acid substitutions were tolerant.
BIOINFORMATICS STUDY FOR ANGELMAN SYNDROME

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There are many types of rare syndromes reported in the literature, one of them being Angelman Syndrome. This syndrome attacks and destroys the nervous system causing many side effects in people. It is caused by the Ubiquitin ligase protein. Through the years, it can be improved. The Angelman syndrome is not a common pathology, but with time the diagnoses are increasing to a point that it is causing alarm. In the research, the main goal was to inform the scientific community and society in general about the damage of this syndrome on the human body. Also, its purpose was to perform a deeper analysis of the Ubiquitin ligase protein. Genomics and Bioinformatics concepts were used. The Bioinformatics programs used in this research included data banks such as Pubmed, which were useful for the whole bioinformatics part. The importance of the gene in the protein synthesis was determined through bioinformatics and genomics. The levels of conservation of the protein were determined.

BIOINFORMATICS ANALYSIS OF NEUROBLASTOMA

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Neuroblastoma is a type of cancer that most frequently happens in infants or children. Neuroblastoma appears when immature nerve cells named neuroblasts multiply in an abnormal way to form a tumor. The disease is caused by mutations in the PHOX2B (paired-like homeobox 2b) gene. This gene is expressed exclusively in the nervous system, in most neurons that control the viscera (cardiovascular, digestive, and respiratory system). To this day there is no cure for Neuroblastoma but there is a treatment for it. Through Bioinformatics, the protein information is discovered and processed. Computer based programs were used such as Pubmed, Blast, Uniprot, Clustalw2, Genedoc, Meme, Tree view, Protein Data Bank, VMD and SIFT. Throughout the analysis of the disease’s protein it is clear that the levels of conservation are very high, which means that there has not been any big mutation within it. The motif results also demonstrated that there is also just one high concentrated area in the protein. The phylogenetic tree shows the evolutionary path of this gene through different organisms.
AMYOTROPHIC LATERAL SCLEROSIS (SOD1)

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Research Mentor Assistant: Greisha L. Ortiz-Hernández, Universidad Metropolitana, San Juan, Puerto Rico.

Amyotrophic Lateral Sclerosis (ALS) is a fatal neurological disease that attacks the nerve cells related to the muscles that commonly affect people between the ages of 40 and 60 years of age. It causes failure of the body’s muscles and within 2 to 10 years can cause death mainly by respiratory failure caused by the failure of the muscles in the diaphragm. It is caused by a mutation of the gene Superoxide Dismutase 1 Soluble (SOD1) which creates a protein that, instead of protecting the body from reactive molecules, can kill nerve cells. The purpose of this investigation was to identify the percentage of conservation of protein motifs, and to observe other living beings that could be used for experimentation instead of human beings and thus have new discoveries or ideas for new discoveries or even cures. The methodology of this investigation required the use of the following programs and databases: Pubmed, NCBI BLAST, Clustalw2, Genedoc, Tree View, VMD (Visual Molecular Dynamics), MEME, NEWT, PDB (Protein data Bank), and Sift. They provide the view of evolution by mutation in the protein, which would help scientists understand its nature or predict aspects of it. The results showed that the protein SOD1 had a high level of conservation in its amino sequences and a high level of motif conservation, which can help find the common aspect that leads to mutation in the gene. Also, to verify the existence of a common factor, Tree view identified the existence of a common ancestor, which can help to trace that common ancestor.

BIOINFORMATICS STUDY OF THE TNF SUPERFAMILY

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Research Mentor Assistant: Greisha L. Ortiz-Hernández, Universidad Metropolitana, San Juan, Puerto Rico.

The Tumor Necrosis Factor (TNF) superfamily consists of many genes and proteins that have different roles in cell activation, proliferation and cell death. In other words, these proteins contribute to the life cycle of cells. They also have important roles in the efficiency of immune responses by controlling the initiation, maintenance and termination of these. It has been found that mutations in the genes that are members of this family are involved in diseases, often considered autoimmune diseases. One of these is Systemic Lupus Erythematosus (SLE). It is manifested 90 percent of the times in women and affects different organs and organ systems in the human body. SLE can be caused by an overproduction of the B-lymphocyte stimulator (BLyS). BLyS is an immune protein that regulates the process in which white blood cells release inflammatory proteins. It is encoded by the tumor necrosis factor superfamily member 13B gene. In this research, bioinformatics tools and databases (Genedoc and Treeview) were used to perform the experiments. An analysis was performed of the B-lymphocyte stimulator and CD40 ligand, encoded by a gene that is member of the TNF superfamily. The results demonstrated that the amino acid sequences of both proteins present a small but significant amount of conservation. So, it can be concluded that both proteins have evolved from a common ancestor.
APPLICATION OF MENDELIAN LAWS AND PUNNETT SQUARE TO STUDY INHERITANCE OF PROGENIA

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Progeria is an autosomal recessive disorder showing precocious senility. The cultured skin fibroblast from both the homozygous affected individual and the heterozygous parents can be distinguished from normal by decreased cell growth in culture. Mitotic activity, DNA synthesis, and cloning efficiency are markedly reduced. The main objective of the present research was to study the inheritance pattern of Progenia within a population. To develop this research, Punnet Square and basic probability concepts were used. Initial conditions were assigned to start the analysis. Probability tree and conditional probability function were used to estimate the probability of an individual in the n-generation to inherit Progenia if an individual in the n-k generation in its family had this genetic condition.
ABSTRACTS
BIO-MATHEMATICS

MATHEMATICAL MODEL THAT DESCRIBES SYSTOLIC PRESSURE


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Blood pressure is the force that acts on the wall of the arteries when the heart pumps the blood through the body. The pressure is determined by the force and amount of blood that the heart pumps through the arteries and veins. It is important to implement techniques that will help to understand the importance of checkup routines that allow people to know if they have a health condition. High Blood Pressure does not have a cure but it has many ways to reduce it or prevent it. This disease can damage the heart, brain and kidneys without showing any symptoms. That is why it is commonly called “the silence death.” The main purpose of this project was to create a model that describes how the systolic pressure is affected, restrained or altered, as time passes.

LINEAR REGRESSION MODEL FOR LEVELS OF CARBON DIOXIDE IN THE ATMOSPHERE

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Carbon dioxide's cycle is one of the various cycles that add carbon to life’s chemical processes. It can be found in oceans, in soils, in the atmosphere, in living beings, among others. Thus, this cycle is concerned with the processes of life on the planet as it is permanently assimilated and released by living creatures in cellular respiration, photosynthesis, and others. The problem is that human activity has altered the carbon cycle, reducing the carbon absorption capacity by removing forests and by releasing large amounts of fossil fuels (hydrocarbons) to the atmosphere at an exaggerated rate. The purpose of this research was to predict how much CO₂ will remain in future years, such as 2014. A linear regression model was created using data previously found.

MATHEMATICAL MODEL FOR THE NUMBER OF SUNSPOTS

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Sunspots appear without any pattern; nevertheless, this occur in cycles of 11 years. Scientists believe that the different movements of rotation of the Sun are one of the main reasons why it has a magnetic field. Since the Sun rotates faster in the equator than in its poles, the magnetic field of the sun deteriorates. Eventually, the twisted field lines cross the photosphere and are present in the form of sunspots. Since the amount of spots occurring in this cycle is unpredictable, a formula is needed to predict the number of spots that will be present in the future. Therefore, the purpose of this study was to create a mathematical model that describes the number of sunspots currently present and even the ones in years to come. The process involved the use of data of sunspots from past years to create a model which will allow to estimate the number of sunspots.
LINEAR REGRESSION MODEL FOR THE MELTING OF ICE IN THE ARCTIC OCEAN

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As time passes, the melting of ice has been increasing and has created concern. This melting is due to global warming, greenhouse gases, and other human activities. These will have a lot of consequences like sea level rising (200ft), more extreme winters around the world, and temperature changes in water bodies around the world, among others. Additional implications include: hundreds of millions of people displaced from their residences at coastal communities or many low lying areas, marine and terrestrial organisms that will disappear and/or become extinct, an economy on these areas that will collapse, among others. The purpose of this research was to create a linear regression model that predicts the disappearance of ice in the Arctic Ocean as time passes.

MATHEMATICAL MODEL FOR BACTERIA GROWTH OF WELLS IN PUERTO RICO

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In Puerto Rico, as in other countries, the water of wells is useful. However, there might be a risk of bacteria contamination in wells. Past investigations revealed that four analyzed traditional fresh water wells in San Juan, Trujillo Alto and Cayey had bacterial contamination. The wells are: Bartolo Well in Trujillo Alto, Cupey Alto Well, the Betancourt Family Well in San Juan, and the Public Well of Cayey in the PR-52 highway. Two bacteria were found in the wells: coliforms and E. coli. E. coli was rejected because it was not found in every well and readings told that they were below one in quantity. The initial number of coliform bacteria in 100 mL sample of water was analyzed using Colilert-18 IDEXX Company. In this investigation, differential equations and initial data were used from the four analyzed wells. Models were created for each well and are compared with each other.

THE DEVIATION BETWEEN A TEAM'S WINNING PERCENTAGE AND ITS PYTHAGOREAN RELATIONSHIP

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Bill James was a famous baseball analyst that presented a formula to predict the winning games percent with a 2% deficiency. This research was performed to figure out the reason why Bill James’ Pythagorean Expectation Formula only satisfies 98% of the predicted cases. The formula is: 

\[ \text{Expectation} = \frac{\text{Points Scored}^2}{(\text{Points Scored}^2 + \text{Points Allowed}^2)} \]

The formula was tested and it determined why it fails by analyzing what factor causes the error. In this research, the process was applied to the 2012-13 NBA season. In this case, the formula’s exponent changes to 14 for an accuracy prediction. To select the experimental sample, seven teams were randomly chosen, one for each of the six divisions in the NBA. The formula was applied to the first game of the 2012-13 season, and it was compared to the performance during the rest of the season. If the formula fails, it means that the team won more or fewer games then one has to determine the reasons. After not having a clear perception on why the formula failed, the answer to the problem was clear. The deviation was due to “human factor,” meaning that one cannot rely on a human tendency when predicting.
DEVISING AN ALGORITHM FOR THE RUBIK’S CUBE

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The Rubik's Cube is a 3D dimensional puzzle invented by Erno Rubik (1974). The Rubik's Cube has six sides that are named in pairs—up-down, front-back, and left-right. The up (U), front (F), and right (R) sides are visible. The remaining sides—left (L), back (B), and down (D) are not visible. It has three types of pieces; they are the center, corner and edge pieces. The Rubik's Cube is well built in such a way that each side, row and column can rotate. The sequence was put to a test to make sure other people can solve the Rubik's Cube using the algorithm. By using this procedure, the present research proved that people could solve the Rubik's Cube a lot faster with than without the algorithm. Some people were taken as subjects taking into account that they did not have any experience solving the Rubik's Cube. Each person was given a Cube and time was measured while they tried to solve it. In the first week they only solved one side of the Rubik's Cube, in under 37 minutes without the Algorithm. In the second week they finished two sides of the Rubik's Cube under 11 minutes with the Algorithm. The results revealed that with this method it was faster to solve the Rubik's Cube than without it.

STUDYING OF POPULATION GROWTH MODEL OF THE BALD EAGLE

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Haliaeetus leucocephalus, more commonly known as the Bald Eagle, is in danger of extinction since the 18th century in the U.S. The population of the Bald eagle has suffered a significant population decrease, dropping from 300,000–500,000 in the early 1700s to less than 10,000 breeding pairs in the 1950s around all of the U.S. In 1967, when it was officially declared “Endangered Species,” the Bald Eagle had been struggling to coexist with man. There have been several acts like the “Migratory Bird Treaty Act” and the “Lacey Act” that protect the species. Up to this date the bald eagle population has been steadily increasing, although not exponentially. This research used the logistic population growth models to predict the behavior of the Bald Eagle population in future years under a control ecosystem. These models are based on differential equations that consist of multiples variables and constants and were used to create a mathematical model in a computational program called VENSIM. The results indicated that the population of bald eagles in the Chesapeake Bay area will increase throughout the next 5 years if the conditions remain controlled. This led to the conclusion that the population of bald eagles in the Chesapeake Bay will continue increasing due to its protective ecosystem and will fully recover during future years.
THE ALTERNATE USE OF SOLAR ENERGY AS A SUSTAINABLE ALTERNATIVE FOR THE GLYCERIN PURIFICATION PROCESS

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The process of biodiesel purification leaves some by-products, in which glycerin is found. Crude glycerin composes a colossal amount of the substance residue; therefore, industries have created many purification procedures. Nonetheless, many of these processes are highly sophisticated, expensive and consume a considerable amount of energy. In this research project, the prices, efficiency and effect on the environment are measured and compared between conventional glycerin purification procedures and the alternate procedure that here is presented. This research presents a sustainable alternative to the process of purifying glycerin, a residue from the production of the biofuel, biodiesel. The purpose of this research was that, by implementing a solar energy system in the process and alternating the materials of the purification procedure, the result will obtain a minimum of 80% of purity in the glycerin product. In addition, there will be a contribution to the economy of the industry as well as to the environment. The methodology of this investigation includes: the heating up of the crude glycerin using solar energy, the application of phosphoric acid to cause the chemical reaction, the separation of the resulting substances, and finally, the decantation process in which pure glycerin is obtained. The results revealed a lower-price and an environmental protection process that obtained 80% of purity in the glycerin.

THE EFFECT OF THE BASEBALL STADIUMS’ DIMENSIONS ON THE BATTING STATISTICS OF THE YANKEES BASEBALL PLAYERS

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In this research, the relation between the dimensions of a baseball stadium and the New York "Yankees" team-batting statistics was studied. The hypothesis states that the dimensions of the parks have a big effect of the players batting statistics. This reflection was stated by J. Read, who in April 16, 2007 said, "If you are trying to evaluate any number in baseball, you have to keep on the mind the stadiums and the effect they will have on the numbers." It has to be taken into account. The Excel program was used for graphs and comparison of the results. The player statistics of “HOME” and "AWAY" were selected from the years 2010, 2011 and 2012. The work was performed with a correlation, which indicates the strength and direction of a linear relationship between two variables and statistical proportionality. The six best players of the Yankees team were selected as ESPN indicates and the data was compared with each other in home and away. With this data, it can be inferred that the dimensions of the parks do affect the batting statics of players, as these have a higher performance in their home park than in the parks visited or away. This research accepted the hypothesis stated by Read. This research can also help players to make a brief analysis of the various dimensions of the parks in order to obtain better batting statistics.
USING DIFFERENTIAL EQUATIONS TO DETERMINE THE PERCENTAGE OF THE ORIGINAL AMOUNT OF C-14 REMAINING IN “THE SHROUD OF TURIN”

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The Shroud of Turin is a cloth that is believed to be centuries old. It is made of linen and it shows the image of a man who can be taken as Jesus of Nazareth. It is the single most studied artifact in human history and is believed to have existed prior to the mid 1300’s; due to this, its original quality has deteriorated. It is a piece that has caused huge controversy throughout the years. The purpose of this research was to discover the quality of the piece by calculating the percentage of the original C-14 left in the cloth. In this project, a differential equation was used to find the amount of the original C-14 left. Because this piece is so old, it was understood that the percentage of the original C-14 remaining in the cloth is low.

BIRTHDAY PARADOX

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The birthday paradox is the questions about the possibility of two people in a set having the same birthday. It means the probability of a randomly chosen a pair of individuals who will have the same birthday excluding the leap years and the twins. In this research, the minimum set size to have 50% of possibilities that two people match his/her birthday was calculated. The theoretical results showed that taken a group of twenty-three people, at least one pair would have the same birthday. Microsoft Excel was used for making the tables and comparing the birthday. For empirical experimentation in this research, eight groups of twenty-three people were selected. 63% of the individuals in the groups had matching birthdays. In the selected groups, there were 6 pairs of people that shared a birthday: 2 masculine, 1 female and 3 mixed that included both male and female.

THE RELATIONSHIP BETWEEN TEAM BATTING STATISTICS AND RUN-SCORING ABILITY

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Since the creation of baseball, it has been a sport that combines individual performance (a batter’s battle with the pitcher) and team effort (when runs are batted in). In baseball, the points are called runs, and they are scored whenever a player reaches home base. It is also a game of numbers. Almost every play can be statistically expressed, such as predicting win percentage, or, obtaining the batting average of certain players. The purpose of this research was to predict run-scoring ability. It was focused on finding, through a correlation analysis, the statistic relation with team batting. The 2012 Major League Baseball (MLB) statistics was used, a correlation analysis with all the batting statistics was performed and the best correlation with runs was selected. Finally, a table was made to compare actual runs vs. predicted runs of each team. The table showed that the statistics that best correlated with runs was OPS (On-base plus Slugging Percentage), with 90%. It also showed that, if trying when predicting a run, it will have a 19.00 standard error in the results. The actual vs. predicted runs also showed the residual between them. In conclusion, the team batting statistic that best predicts run-scoring ability is OPS, because it is the team’s on-base average (run-scoring ability) plus their slugging percentage (run-driving-in ability).
GIGANTIC INVISIBLE TRIANGLES: MEASURING HEIGHT WITH AN INCLINOMETER

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Buildings are nowadays measured with advanced technology such as computer diagrams and/or other advanced methods. Another method uses trigonometry (basic properties of right triangles) tangents, and home-made inclinometers. This is a simple and effective way to measure a building without having to know too much (or anything at all) about construction or about the building itself. After choosing a good sighting location, the inclinometer was used to obtain the degrees of inclination of the hypotenuse of the gigantic right triangle. Then, to get the height, the length of the base line was multiplied by the tangent from the degrees obtained from the inclination of the building. This process was done three times for all five buildings to get the average degree. The approximated height was recorded and compared to the actual height of all five buildings. It is possible, and effective, to measure buildings with gigantic invisible right triangles and inclinometers and gets the approximate height of the building.

MATHEMATICAL MODELS FOR LEATHERBACK POPULATION GROWTH

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This research was based on predicting the population growth of leatherbacks on the coasts of Puerto Rico using a mathematical model. The basic mathematic model used in this research was the logistic model, which is used to determine how a population grows when it is far below, a carrying capacity. The problem is how much the population of leatherbacks will grow on the Puerto Rican coasts? And the hypothesis was that the population will decrease. The leatherback is considered the world’s largest and oldest species of the family of turtles. In the past 30 years, the number of female leatherbacks has declined from 115,000 to 25,000. Biologists estimate that only one in 1,000 hatchlings survives to become an adult reproductive female. The alarming reduction of several populations of sea turtles in the world has led to these species globally threatened or endangered. This research was conducted due to the sharp decline in leatherback population both globally and on the Puerto Rican coasts. This research used the VENSIM program to numerically solve the set of differential equations. Once the model was created and the equations were implemented, the population prediction was obtained. The prediction showed that the population of leatherbacks decreased, indicating that the hypothesis was accepted.

LINEAR REGRESSION MODEL FOR LIFE EXPECTANCY

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Life expectancy is the average number of years to be lived by a group of people born in the same year, if mortality at each age remains constant in the future in a total population that is composed of females as well as males. Also, the life expectancy at birth is a measure of overall quality of life in a country and summarizes mortality at all ages. It can also be thought of as indicating the potential return on investment in human capital and is necessary for the calculation of various actual measures. On the other hand, life expectancy at birth is an estimate of the average number of years that an individual will live. It is one of the indicators of the quality of life most common, but difficult to measure. In this research, a linear regression model was created to predict the life expectancy for 2014. The software that was used for this investigation was R for the linear regression model.
At a crime scene investigation, the most important thing to gather is evidence. Scientists struggle to earn precise proof of someone committing a crime, and are afraid to ruin it, especially with the numerous chemicals they use. These are usually very efficient and stable, but there are other factors that can affect their materials and, most probably, their decisions and results. There are various factors that may affect the rate of a chemical reaction such as the temperature, the surface area, the catalysts and the concentration or amount of the chemical used. For example, copper, iron and its compounds, horseradish, and bleach also cause the solution to glow. The presence of these chemicals at a crime scene affects testing for blood. If a crime scene were washed in bleach, then the whole area would glow when sprayed with luminol, making it necessary to use a different test, to find traces of blood. Unfortunately, luminol may prevent other tests to take place, making the evidence utterly useless. The reverse also holds true.

MATHEMATICAL MODEL TO PREDICT THE COOLING TEMPERATURE OF A CAKE

Imagine if you baked a cake and you want to know when it will cool down at room temperature so you can add the frosting or the fondant without it melting and falling off. The purpose of this investigation was to explain Newton’s Law of Cooling on a cake by using differential equations. The research filling is based on a series of mathematical calculations where a differential equation is solved by using integrals. A cake was baked to conduct this research. The cake’s temperature was measured 2 times. The first temperature was measured as soon as it got out of the oven. The second one, three minutes after the cake was taken out of the oven. The idea was to find a mathematical model in which the temperature is known at any time interval. The model can be used to find how much time it will take the cake to reach a certain temperature, or to know a certain time when the temperature is known.

THE BIRTHDAY PARADOX THEORY

It is said that in a group of twenty-three people, there is a fifty-fifty chance that two people from that group will share the same birth date. This is the so called Birthday Paradox Theory. The sample for this experiment was one hundred high school students with ages ranging between 15 and 18 years of age. This experiment chose different groups of students and recorded their names, sex, and birth dates. After the data collection, the information was gathered and organized. Thirteen pairs of students had the same birth date across all the groups. Six pairs were a mix of males and females; five groups were couples of males, and the same numbers were couples of females. There was not a sign or pattern that the gender or the composition of each couple with the same birthday could be associated to the day of the month or to any particular group. It was concluded that the groups with a higher number of students had a bigger probability of having students sharing the same birth date.
THE EFFECT OF THE ENVIRONMENT IN THE ORANGE’S TEMPERATURE

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The reduction temperature in a body after death is called the process of Algor mortis. The study of this process is used to determine the time of death of a body. This research studied how the environment affects the decrease in temperature on the body by using oranges instead. The principal objective was to determine differences when measuring the time the person died, taking and not taking into consideration environmental influence. The methodology for this experiment used some oranges in place of humans, because oranges have some human characteristics such as: percentage of water, the external skin and also, the different skin layers. The oranges were heated at human temperature and after that they were exposed to different types of environments to estimate how drastic would be the change of the results at the time of death. After this process, the results were that each environment affected the oranges in a different way. When the temperature was estimated ignoring the effect of the surroundings, the results were far away from the truth, the opposite occurred when entering the environment variable.
LINEAR REGRESSION: PDI AND MDI IN CHILDREN WITH REPARATIVE HEART SURGERIES

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Research Mentor: Dayanara Lebrón Aldea, Universidad Metropolitana, San Juan, Puerto Rico.

PDI and MDI are used as a scale to measure the psychomotor and mental development in children who have undergone reparative heart surgeries due to heart abnormalities. Circulatory Arrest and Low Flow Bypass were the reparative heart surgeries used in the subjects to fix their disease. The objective of this research was to compare PDI and MDI scores in the two types of reparative heart surgeries performed to the subjects to observe an abnormality between these indexes in both types of operation. Data was analyzed using Linear Regression to compute the predictive mathematical equation and boxplots to describe the quantitative data. Results showed that PDI and MDI scores where higher for low flow bypass as a reparative heart surgery, inferring a higher operation success and less post-operation deficiencies than low flow bypass.

COMPARISON BETWEEN SYSTOLIC BLOOD PRESSURE AND LOW WEIGHT NEWBORN INFANTS

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Systolic blood pressure is the amount of pressure that blood exerts on the walls of the blood vessels as the heart is beating. It keeps the blood flowing through the blood vessels so that the body’s cells can get the nutrients and oxygen needed; therefore, waste material can be removed. Low weight newborn infants usually weigh less than 5 pounds, 8 ounces. However, there is no information that reports comparison between systolic blood pressure and low weight new born infants. So, the objective of this project was to observe the effect of systolic blood pressure on low weight newborn infants. Data collected estimated the proportion of low birth weight infants whose mothers experienced toxemia during pregnancy. Analysis of data was made using a Z-Score and a Confidence Interval to predict the population range for systolic blood pressure in infants. Results showed that female infants were born with higher systolic blood pressure. Infants with the highest blood pressure were born after 30 weeks of pregnancy. The Z-Score showed that there is only 28.4% of the samples will have a mean greater than 47 which lies inside the populational range systolic blood pressure. The 95% Confidence Interval showed μ values to be between 44.85 and 49.31.
ACCEPTANCE OF KIDNEY TRANSPLANTS BY ETHNICITY AND GENDER AND THE ROC CURVE FOR SERUM CREATININE LEVELS AS A PREDICTOR

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Research Mentor: Dayanara Lebrón Aldea, Universidad Metropolitana, San Juan, Puerto Rico.

Kidneys are organs that clean your blood by removing excess fluid, minerals, and wastes. Transplant surgery is the division of medicine that surgically replaces an organ that is no longer functioning with an organ from a donor that does function. Creatinine is a compound found in blood and measured in milligrams percent. It is made by the human body in the liver, kidneys, and pancreas. It is used as a diagnostic tool for detecting potential transplant rejection. An increased of creatinine level is often associated with organ failure. The main objective of this research was to define to what extent a measure of creatinine can reject or accept the transplant by creating a Receiver Operating Characteristic (ROC) Curve. The ROC Curve is a line graph that plots the probability of a true positive result against the probability of a false positive result. Data was analyzed with descriptive graphics to determine the acceptance of kidney transplants by ethnicity and gender. Results per year showed that white ethnicity and white males have a greater percentage of successful kidney transplants which indicates a greater probability of acceptance in people of that rate, and also a greater incidence of suffering from kidney failure.

EFFECTS OF DIETING IN PATIENTS WITH HYPERTRIGLYCERIDEMIA

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Lipoproteins are any complex or compound containing both fat and protein. Three types are Hypertriglyceridemia, Cholesterol LDL and HDL. Hypertriglyceridemia (HT) is defined as an elevation of triglycerides in the blood vessels. Some of its causes are: obesity, excessive alcohol intake, renal failure, genetic history, certain medications, and diabetes, among others. HT in association with Cholesterol forms the plasma lipids originated from consumption of food or made in the body from other energy resources. Nonetheless, there is growing evidence that HT is a marker for increased risk for coronary artery disease; in fact, it can serve as a marker for several atherogenic factors. This research was based on the study of effects of dieting in patients with HT. Data was composed of 10 individuals with HT that were placed on a low-fat, high-carbohydrate diet. Data Analysis was performed by constructing a scatter plot, a Linear Regression and computing the correlation between both variables. The Mathematical Equation to describe the relationship between the two variables was followed by and .5935. These results showed a relationship between the two variables, yet it cannot be stated it was a cause/ effect relationship.

DESCRIPTIVE ANALYSIS OF POLLUTION AND LIFE EXPECTANCY

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Expectancy is a term that seeks to apply information from the past to predict what might happen in the future. Nowadays, the tested statistical average has grown in stature year after year and is now one of the leading health performance metrics in the world. Life expectancy at birth, from a global perspective, is the average number of years a newborn infant would be expected to live if health and living conditions at the time of its birth remained the same throughout its life. Pollution Index is the estimation of overall pollution in the country. The biggest weight in pollution is given to air pollution rather than to water pollution, two main pollution factors. The main purpose of this research was to compare these two factors and check their correlation with the average life of people, and how much influence pollution has on life expectancy.
SLEEP VS. GRADES: A COHORT STUDY

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Sleep is a state characterized by reduced or absence of consciousness, diminished sensory activity, and inactivity of voluntary muscles. Sleep is often thought to help conserve energy, restore and renew the body. Psychologically it helps in the consolidation of memories. Humans should have an average of 8 hours/daily of sleep; less than the average would be defined as Sleep Deprivation (SD), which influences in retention and other cognitive roles. Grades are numerical values that measure retention of information on a specific subject. The main goal of this research was to determine the outcomes of sleep deprivation on grades in high school students. The hypothesis states that sleep deprivation in students who study long hours, causes lack of retention. A survey was used to collect data (n=30) which was later analyzed using a T-Test to prove the hypothesis, and descriptive graphics to display its by the following categories: mood after SD, Hours of Study, Grades, and Reason for Sleep Deprivation. Preliminary data showed a great percentage of sleep deprivation caused by entertainment rather than for study purposes. T-Test compared with α=0.05 value rejected the null hypothesis of Sleep Hours = 0; therefore, students tested were sleeping less than recommended which could be cause of lack of retention in classes.

CAUSES OF ALCOHOLISM IN TODAY’S MEDIUM AGE (25-40) ADULTS

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Alcoholism is a mental disorder caused by the high alcohol intake which decreases the state of consciousness, motor functioning and disables the sensory system. Alcohol is composed of ethanol (CH₃CH₂OH); when it reaches receptors in the central nervous system it can cause loss of equilibrium due to audition loss. It also reduces oxygenation in the brain triggering dizziness and slower reflections. The main causes of alcoholism in the 25-40 age bracket were determined in individuals from the San Juan area. A survey was distributed to 24 subjects in order to collect data; it was composed of 21 questions that pointed to answer causes for alcoholism, total of daily and weekly alcohol consumption, marital status, education and other questions that would give feedbacks about the subjects past in order to find a reasonable cause. Preliminary data showed that 63% of the individual tested have no or little education. One of the primary causes for individuals to drink is for social purposes (46%) followed by the feeling of relaxation that the alcohol produces on their body (21%).
Chlamydia is an infection caused by the bacteria Chlamydia trachomatis and it is commonly sexually transmitted. It is called the silent disease because the person does not experience symptoms as soon as infected. Some of the symptoms include: pain and discharge from the genitals, burning sensation during urination, painful sexual intercourse and liver inflammation. A person who has had Chlamydia is not immune to the disease; the person can be repeatedly infected. Chlamydia is one of the many infections a person can contract and have permanently if not treated correspondingly. The diagnostic test used for Chlamydia is called SWAB and it has been known to give false test results. The specific objective of this research was to evaluate the accuracy of the swab test to identify Chlamydia. The accuracy of this test was calculated with the Bayes Theorem. This theorem uses conditional probability to calculate specificity, sensitivity, false negatives and false positives that the test may give. Two different sets of data were used; Regional data from Cuyahoga County (n=10,304) to compute the transmission probability by gender, ethnicity and age and the diagnostic test data (n=110) to calculate the accuracy of the SWAB test. Analysis of the data by categories showed that women (73%), teenagers (41.80%) and African Americans (67.20%) are most susceptible to Chlamydia. The SWAB test has a higher probability to give false positives (30%) than false negatives (5%). The SWAB diagnostic test has an overall accuracy of 96.4%.
ABSTRACTS

COMPUTATIONAL CHEMISTRY

RECYCLING, REUSING RUM WASTE

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The Cruzan Rum Distillery on St. Croix disposes of its liquid waste into the ocean. A pipe runs to the shore where gallons of waste are released. In U.S. Virgin Islands there are two rum producers, which have become major contributors to its economy. The rum waste can be recycled to produce environmentally friendly products. This research proposes that these companies, Diageo Rum Industry and Cruzan Rum, take their rum waste and use it as biomass. This will produce methane that can be burned to produce electricity, as the Serralles Rum Distillery does in Puerto Rico. So, other rum companies throughout the world can follow their example. The purpose of this study was to create a useful product from the rum waste that currently enters the natural environment, particularly the ocean, when more than hundreds of thousands of barrels of rum are distilled. The results revealed that rum waste partially contains molasses and dead yeast that is biomass and can be put through the process of anaerobic digestion. This is a series of processes in which microorganisms are broken down into biodegradable material in a free oxygen environment. The bacterium digests the raw waste decreasing its organic compound by about 70% and releasing compounds, which are captured. Due to the absence of O₂, CH₄ is released which can then be burned to produce electricity.

STUDY OF CARBON ALLOTROPES BY COMPUTATIONAL CHEMISTRY

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Carbon is the principal component of all natural life on Earth. It is also the fourth most abundant element in the universe (hydrogen, helium, and oxygen are found in higher amounts, by mass). Carbon's ability to combine with other carbon atoms and other elements allows it to produce a vast array of chemical substances. In fact, it is capable of forming many allotropes due to its valency. Therefore, the main goal of this research was to simulate and optimize the molecular structure of some of the carbon allotropes using computational chemistry. The central hypothesis of the proposed research was that different allotropes have different molecular structures and hence different properties. Therefore, molecular models of grapheme, diamond and Lonsdaleite were created and optimized using the chemical computational tool Scigress Explorer Ultra version 7.7.0.47. Also, the dimensions, density, area, volume and potential energy of each of these allotropes were investigated using program Odyssey College Student Lab. 3.4. Calculated values showed very different properties for all of these allotropes.
USES OF IMMOBILIZED MACRO ALGAE FOR REMEDIATION OF POLLUTED NATURAL WATERS

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Water contamination constitutes one of the major problems in the World. Several alternatives have been proposed to address this problem. This study aims to study the absorption through the algae of a percentage of the emergent semi-volatile pollutants found in the Puerto Nuevo River in San Juan, Puerto Rico. To carry out this research, the algae used were Dyctiota, Acanthophora, Glacilaria, Ulva and Sargassum algae were used. These algae were caught from different locations in North America; these are not laboratory algae. They were immobilized with silica and used later to work with the absorption of pollutants, both as a contaminant substance and as the river water samples. The results showed that the algae that had a major percent of absorption of the pollutants were Glacilaria, Acanthophora and Sargassum. Those were the algae that were used for the absorption of pollutants in the river water. The algae that most absorbed the emergent semivolatile pollutants from the Puerto Nuevo River were Glacilaria. Thus, the study revealed that there was a natural way to absorb pollutants from a fresh water ecosystem.

STUDY OF GLUCONACETOBACTER XYLINUS

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Nanorobots are considered nanodevices that offer potential applications to be used for several applications such as maintaining and protecting the human body as anti-pathogens. One of the bio-fabrications is based on Gluconacetobacter Xylinus (GLUXY) that is bacterial cellulose. GLUXY is a type of microbial cellulose that is biocompatible, and non-toxic, making it a good candidate material for biomedical applications. The medical applications are used for internal treatments, such as bone grafts and other tissue engineering and regeneration. Due its potential applications, it is very important to study the behavior of GLUXY based on the characterization with Potential Energy Surface and Electronegativity. All parameters used in Gauss View Program were run with an HF/6-31G** basis set. GLUXY contains the following functional groups: hydroxyl group and methyl group. The atoms more electronegativity were two Oxygens: One with a -7.09 value and another with less electronegativity of -0.489. This electronegativity can be analyzed in terms of the position and the neighbors that the molecule has, which are very important for the behavior. Also, the enthalpy of molecule has a -1277 value Gibbs. By comparing the advantage of the GLUXY with cellulose plant, it was found that it can be grown to practically any shape and thickness or finer and to more intricate structure. So, no hemicellulose or lignin can be removed.
ANALYSIS OF THE B-AMYLOID PLAQUES IN THE PATIENTS WITH ALZHEIMER DISEASE

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Alzheimer's is a brain disease characterized primarily by a loss of memory, since it is irreversible and progressive. Alzheimer's may be caused by the accumulation of β-amyloid plaques (βA) in neurons. The main objective of this research was to analyze the behavior of βA as the main cause for the Alzheimer disease. These analyses were based on theoretical calculations using molecular modeling with Gauss View and the Gaussian Program. Also, Potential Energy Surface (Basis Set: HF/6-31G**) techniques were used to determine the enthalpy and the functional groups in the BA plaques. Finally, the biological behavior of βA was investigated. It was found that the molecular structure of BA is a protein composed of the following amino acids: methionine, valine, and glycine. The functional groups that are present in this molecule are the amine group (NH2), the carbonyl group (CO), and the carboxylic (COOH) group. The theoretical calculus showed that the more electronegative functional group is the carboxyl group (COOH), and the most neutral group is the amine group (NH2). The enthalpy is a heat effect and its value was -2181.54 Gibbs.

STUDY OF CONJUNCTIVITIS EYE DISEASE

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Conjunctivitis is an eye disease caused by an infection produced by a virus, a bacterium that causes swelling of the conjunctiva. The conjunctiva is the outer layer of the eye. Red eye (hyperaemia), swelling of conjunctiva (chemosis) and watering (epiphora) of the eyes are symptoms common to all forms of conjunctivitis. However, the pupils should be normally reactive and the visual acuity normal. Bacterial and viral infections are contagious, commonly are passed from person to person, but can also spread through contaminated objects or water. Conjunctivitis has treatments with corticosteroid eye drops and Tobradex eye drops. The literature lacks information on the differences on structure of both compounds. For this analysis, the behavior of corticosteroids and Tobradex was compared based on calculations using the molecular modeling program Gauss View and Gaussian. Also, IR-Spectroscopy (Basis Set: DFT/3-21G*) and Potential Energy Surface (Basis Set: HF/6-31G**) techniques were used. By analyzing the IR spectra, it was found that some functional groups have the hydroxyl group (O-H) and the carbonyl group (C=O) present as corticosteroids. However, in Tobradex, the hydroxyl group (O-H), and the amine group (N-H) were observed. By means of the Potential Energy Surface with the corticosteroids eye drops, the most electronegative atom oxygen linked to hydrogen atoms was found and was located in the center of the molecule. It is a five-member ring with one of the atoms in the ring being an oxygen atom. Finally, the evidence of conjunctivitis throughout time was studied from 1970 to 2000. The analyses demonstrated that the incidence of conjunctivitis increased with time. Summarizing, conjunctivitis is a highly contagious and dangerous disease but scientists have developed effective drugs for its treatment.
DIFFERING CHEMICAL STRUCTURES OF ANTI-CANCER DRUGS

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Paclitaxel (originally produced commercially by Bristol-Myers as Taxol) is a cancer medication that interferes with the growth of cancer cells and slows their growth and spread in the body. Taxol is used to treat breast cancer, lung cancer, and ovarian cancer. It is also used to treat AIDS-related Kaposi’s sarcoma. Other common cancer drugs are DHA-paclitaxel, Docetaxel and Doxorubicin. The main goal of this research was to simulate and optimize the molecular structure of these compounds using computational chemistry. The central hypothesis of the proposed research was that upon completion of these optimizations, it was possible to establish a relationship between the compound structure and heat formation. Therefore, molecular models of Paclitaxel, Docetaxel and Doxorubicin were created and optimized using the chemical computational tool Scigress Explorer Ultra version 7.7.0.47. Heat of formation and IR transition were calculated for all these models using three different semi-empirical methods (MM3, AM1 and PM5). Furthermore, molecular energy maps were also calculated for all three anti-cancer drugs. Results for two of the drugs, which are Paclitaxel and Docetaxel, revealed that they have a very similar structure; therefore, having a similar yet not exact IR spectra and heat of formation. On the other hand, results for the Doxorubicin drug were different, this one having a simpler structure and a different IR spectra. Finally, all three of the drugs showed distorted branched structures (not flat).

THE EXPECTED EFFECTS OF NON NEWTONIAN FLUID ON NANO-TEX FABRIC

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The purpose of this research was to prove that Non Newtonian Fluid could affect Nano-Tex Fabric. Non Newtonian Fluid is a Shear-Thickening Fluid, a specific type of fluid whose viscosity is dependent on shear stress. In other words, it is a fluid that acts like a solid when it experiences a shear force, like an impact, but when it is treated gently it becomes liquid. A Nano-Tex Fabric is designed to protect fabric from spills and stains. It repeals liquids so they will bead up and roll off fabric. In phase one of these research projects, a Non Newtonian Fluid was made and it was tested to make sure that it is in the correct state. In phase two, the Non Newtonian Fluid was spilled in the Nano-Tex Fabric. In the third and last phase, it was expected to observe changes or results in the Nano-Tex Fabric. It is believed and expected that Non Newtonian Fluid will affect the Nano-Tex Fabric and will get it wet and stained.
NanoHub is an online simulator focused on helping both the fields of Nanoscience and Nanotechnology. The main objective of the present research was to use a tool called Nanosphere Optics Lab, which determines the size of the Silver (Ag) Nanoparticles (NPs), instead of using Transmission Electron Microscopy (TEM) or Dynamic Light Scattering (DLS). The results from both size determination methods were compared in order to validate the model. Hypothetically, these simulations will serve as a perk for every scientist or student working with nanotechnology, placing them at an advantage and will not have the need to use the TEM. Silver (Ag) NPs were synthesized with two different capping and reducing agents, which in turn alters the size and light absorbance and validates the results given by NanoHub. In the first synthesis, Trisodium Citrate (TSC) served as the capping, as well as, the reducing agent. After experimental UV-Vis Characterization of these NPs, they showed a maximum absorption peak value at 400 nm. NaBH₄ served as the capping and reducing agent in this second synthesis. The UV-Vis results showed a maximum absorption peak of 388 nm. TEM grids and DLS analysis of both TSC- and NaBH₄-capped Ag NPs were performed to have the size experimental values. In the Nanosphere Optics Lab the following parameters: Ag NPs (particle composition), water (1.33-medium), and 20nm-100nm (radius of particle) were indicated in the program. The simulations were performed for each nanoparticle size to predict the theoretical UV-Vis and the maximum absorption peak. An Excel graph was constructed for each size and maximum peak giving the equation of: Maximum Peak = 4.6124Size + 269.96. By using the experimental values and this equation, it was found that TSC-capped Ag NPs had a size of ~34nm and NaBH₄-capped Ag NPs gave a size of ~26nm. The results were compared with DLS and TEM experimental results to validate the equations using NanoHub.

Comparison of Drugs for ADHD in Children

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The Attention Deficit Hyperactivity Disorder (ADHD) is a neural disorder typically identified by hyperactivity and loss of attention in children. This disorder is controlled with drugs called neurotransmitters. The neurotransmitters are chemicals that help transmit messages between nerve cells in the brain. The neurotransmitters are divided into two big groups: the methylphenidates and the amphetamines. In this work, the chemicals properties of Concerta (methylphenidate) and Adderall (amphetamine) were compared to determine the most important differences for treatment of the disorder. This difference was obtained through Gauss View and the Gaussian Program, using the technique of IR-Spectroscopy (Basis Set: DFT/3-21G*) and Potential Energy Surface (Basis Set: HF/6-31G**). The behavior of ADHD in children was evaluated, assessing the biological behavior of the brain. Also, the Concerta and Adderall drugs (ADHD medications) were analyzed. The results of Potential Energy Surface demonstrated that the most electronegative group of the Adderall is the amino group and the less electronegative is benzene. The IR spectrum showed the following groups: benzene (358,948 cm⁻¹), CN (1703.53 cm⁻¹), amine (3527.91 cm⁻¹), and CH (3221.37 cm⁻¹). These bands were compared with the Concerta drug in which the most electronegative group is C = O and the less electronegative is the cycle of 6 carbons with NH. In addition, the functional groups for these molecules are: benzene (<1,000 cm⁻¹), NH (>3,000 cm⁻¹), CO (1,300 cm⁻¹), C = O (1,750 cm⁻¹) and CH (<3.000 cm⁻¹). In summary, it can be concluded that the more effective drug to treat ADHD is Concerta, because its behavior is much more effective and faster to obtain the benefits with an enthalpy of -744.38 Gibbs.
SURFACE ENHANCED RAMAN SPECTROSCOPY OF ADENINE IN SOLUTION USING SILVER NANOPARTICLES AT DIFFERENT pH VALUES

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Silver Nanoparticles (AgNPs) are nanosized spherical groups of silver atoms that are linked together by a chemical agent. Their size and arrangement give them different optical and electromagnetic properties like efficient absorbing and scattering of light in the UV-Visible spectrum and are good conductors. These properties provide a wide range of applications such as being used as substrates in Surface Enhanced Raman Spectroscopy (SERS). This is a technique that allows for the identification of compounds at very low concentrations. SERS usually requires the use of a salt in order to maximize the signal, but in this project acid and alkaline solutions were used instead of a salt. Silver Nanoparticles were synthesized using silver nitrate with sodium citrate tribasic dihydrate (TSC 1%) as both a reducing and capping agent. After the characterization, the silver nanoparticles were used in SERS to detect Adenine. Hydrochloric acid (HCl) and Sodium Hydroxide (NaOH) were each added separately to a AgNPs-Adenine solution for testing. The results demonstrated that the acid enhanced the Adenine peak much more than the base and the AgNPs alone. Using an acid environment in this case enhances the signal of the analyte. This is complemented by the speed of the testing (10-20 seconds) and the accuracy of SERS. Future applications of this method may include examination of biological agents and on-the-field testing of analytes. Further work on this investigation should determine the specific acid pH level that is more efficient for the detection of DNA, as well as testing on other DNA components and on more complex analytes.

SEMI-EMPIRICAL CALCULATIONS OF THE MOLECULAR STRUCTURE AND PROPERTIES OF SINGLE-WALL CARBON NANOTUBES

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Carbon Nanotubes are the way of the future. In fact, they have many structures, differing in length, thickness, and in the type of helicity and number of layers. Although they are formed from essentially the same graphite sheet, their electrical characteristics differ depending on these variations, acting either as metals or as semiconductors. For that reason, the goal of this research was to study the properties of four single-wall carbon nanotubes using computational chemistry. In fact, the central motivation for conducting this research was first and foremost the desire to learn about carbon nanotubes and computational calculations. Therefore, molecular models of Zig-Zag (capped and open) and Armchair (capped and open) were created using the chemical computational tool Scigress Explorer Ultra version 7.7.0.47. Geometry optimization and heat of formation were calculated for all these models using three different semi-empirical methods (AM1, PM3, and PM5). In addition, a random motion of the chemical sample at 300K (80.33°F or 26.85°C) was simulated by molecular dynamics using augmented MM3 parameters. Finally, it was found that some models would not be restricted to just one geometric plane, but would be projected throughout three-dimensional planes.
THE STABILITY OF GOLD AND SILVER NANOPARTICLES ON BASE AND ACID ENVIRONMENTS

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Nanotechnology shows very promising results in medical, bioengineering and electrical applications. Gold and silver nanoparticles are some of the most commonly used nanoparticles because of their stability and ability to absorb and scatter light effectively, which are useful for biomedical and diagnostic applications. However, unstable nanoparticles release silver ions (Ag⁺) exhibiting strong toxicity by binding to DNA and disrupting cell replication. It has been demonstrated that gold nanoparticles have a partial toxicity. This investigation studied the effects that pH changes to nanoparticle environments have on their stability. pH changes could affect both toxicities. The hypothesis of the project was that, when exposed to these pH changes, the nanoparticles will change size and precipitate. Nanoparticles have negative and positive charges that are triggered by pH changes. Electrostatic attractions between the nanoparticles can rapidly form aggregates inside the cells, and the aggregates accumulate as the exocytosis is blocked by the increased size. The methodology consisted of: the synthesis of gold and silver nanoparticles, characterization by UV-Visual Spectroscopy, pH changes to their environment by adding NaOH and HCl evaluated at values close to blood pH levels to establish their properties for biomedical applications and dynamic light scattering measurements to determine the particle sizes. Both types of nanoparticles were less stable after the pH changes. The changes of pH had a more drastic effect on the stability of the silver nanoparticles than the gold ones, demonstrated by changes in monodispersity. This confirms that the changes affected their stability concluding that gold nanoparticles are better suitable for biomedical applications.

SURFACE ENHANCED RAMAN SPECTROSCOPY OF 4-ABT: GOLD NANORODS AS A METALIC SUBSTRATE

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Nanorods (NRs) are defined as a nanometer-sized gold (Au) particles that are rod shaped, ranging from 1–100 nm in size. Owing to their unique physical properties, gold nanorods have many attractive applications in several areas, such as life sciences, electronic and electromechanical devices, sensors, and solar cells. These particles can strongly absorb light and dissipate it in their surroundings making them great for manipulating heat. They are particularly useful as substrates in the Surface Enhanced Raman Spectroscopy (SERS), a technique that enhances the Raman signal in order to detect low concentrations of a given sample. Gold nanorods were synthesized in CTAB using HAuCl₄ as the seed and metal source with sodium borohydride (NaBH₄) as the reducing agent. Finally, the NRs were dispersed in UHP water. The NRs were characterized using UV-Vis and Raman spectroscopy. Low concentrated solutions of adenine and 4-ABT were prepared in order to perform SERS tests. Alkaline (NaOH) and acidic (HCl) solutions were added to the samples to enhance the signal reading. Also, NaCl was used to aggregate the NRs and ensure signal amplification. The characterization results confirmed the successful formation of the nanorods due to the 2 characteristic absorbance peaks (width and length). SERS tests did not show any detection of the adenine molecule in either of the environments. Tests with 4-ABT showed a slight signal enhancement in the acidic environment and when NaCl, a stronger enhancement, was observed. Adding HCl to the sample as well as NaCl aggregates to the nanorods made the detection of the analyte easier.
STUDY OF PLATINUM, PALLADIUM, IRON AND COPPER CLUSTERS AND THEIR PROPERTIES

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In the past decades, a new way of studying science has emerged from the smallest but biggest idea in science, nanoscience. It is one of the most recent and fascinating ways of conducting research in science. In this particular research, the objective was to study the properties of four nanocrystals (Platinum, Palladium, Copper, and Iron), which can be used as catalysts for fuel cell applications. The methodology used included the use of the computational chemistry software Scigress Explorer Ultra Version 7.7.0.47 to create cluster models of each of the nanocrystals with dimensions such as 1x1x1, 5x5x5, and 7x7x7 unit cells per cluster. Also the Odyssey College Chemistry Student Edition Version 3.4.2 was used to study the total number of atoms, density, volume, and kinetic energy of each cluster model. Results from these clusters showed that most of the studied nanocrystals like Pd, Pt, and Cu shared the same structure. However, they all had different kinetic energy, density and volume that may be related to their specific catalytic activity. Finally, Fe was the only studied metal with a different crystal structure and therefore exhibited very different properties.

STABILITY STUDY OF GOLD AND SILVER NANOPARTICLES UNDER DIFFERENT TEMPERATURES

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Nanotechnology is a rising field that shows very promising results in various applications in a diversity of areas such as the medical, bioengineering and electrical fields. Gold nanospheres are some of the most commonly synthesized nanoparticles because of their stability, ability to absorb and scatter light effectively and various biomedical and diagnostic applications. Silver nanospheres, as gold nanospheres, are used for their optical properties and biomedical uses, but also because they are good electrical conductors. Gold nanoparticles are versatile materials for a broad range of applications with well-characterized electronic and physical properties due to well-developed synthetic procedures. In addition, their surface chemistry is easy to modify; these features have made gold nanoparticles one of the most widely used nanomaterials for academic research and an integral component in point-of-care medical devices and industrial products world-wide. Near-IR absorbing gold nanoparticles (including gold nanoshells and nanorods) produce heat when excited by light at wavelengths from 700 to 800 nm. This enables these nanoparticles to eradicate targeted tumors. When light is applied to a tumor containing gold nanoparticles, the particles rapidly heat up, killing tumor cells in a treatment also known as hyperthermia therapy. Silver nanoparticles have unique optical, electrical, and thermal properties and are being incorporated into products that range from photovoltaic to biological and chemical sensors. Silver nanoparticles are used in biosensors and numerous assays where the silver nanoparticle materials can be used as biological tags for quantitative detection. The specific aim of this research was to evaluate the stability of the nanoparticles when exposed under different temperatures. The results demonstrated that gold nanoparticles are more stable than silver nanoparticles, which promise their use for bio-applications.
ABSTRACTS

COMPUTER SCIENCES

REMAINDER OF MINIMAL MODULUS IN THE DIVISION OF GAUSSIAN INTEGERS

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In complex integers, there is a division algorithm with quotient and remainder such that the remainder is of smaller modulus than the divisor. However, there are different possibilities to select both of them. In a recent work by A. Lecompte, a standard form for the remainder was proposed which could be directly calculated following congruencies in the real and imaginary parts of the dividend. This remainder is standard in some way and has similarities with the remainder with integers. However, it is not necessarily of a modulus smaller than the modulus of the divisor. A method was programmed that transforms this remainder into other smaller modulus using the congruencies. At all stages the direct division of complex integers was avoided, so this method does not obtain the quotient, which can then be calculated by division. As is already known with the remainder, the division is easily converted to a division by the modulus of the divisor.

A LOGIC SIMULATOR FOR THE DESIGN OF DIGITAL SYSTEMS

Eduardo Acarón Padilla, Interamericana School, San Germán, Puerto Rico.

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

This research was based in an experimentation with the program “logic.ly,” a logic circuit simulator with a graphic interface used to develop logic circuits that help understand a computer’s fundamentals. Binary arithmetic and logic are essential in digital computers and other types of digital systems. It was discovered that logic.ly is an excellent tool to design and simulate logic circuits. It was attempted to construct a basic ALU (Arithmetic-Logic-Unit), and also some types of registers, such as shift registers, up and down counters, flip-flops, and multiplexors. The operation of these elements can be visualized in the graphic interface of logic.

SHOE NEWS APP

Gabriel Alvarado and Kevin Pabón, Caguas Military Academy, Gurabo, Puerto Rico.

Research Mentor: Prof. Jonathan Vargas, Universidad del Turabo, Gurabo, Puerto Rico.
Research Assistant Mentor: Karielys Ortiz and Anthony Bonilla, Universidad del Turabo, Gurabo, Puerto Rico.

The purpose of this project was to design an app for Androids related to shoes. This app was designed with the idea in mind to keep people updated on the latest shoes in the market today. This app had the top four (4) shoe trademarks in the market today. The shoes in the top market were: Jordan, Nike Lebrón, Adidas Rose and Clark. This project was designed using the MIT AppInventor. This app allows people to search for shoes and view their specifications.
MUSIKMUSE

Alejandro Aponte Lugo, Homeschooler, Caguas, Puerto Rico.
Ricardo Tardí Hernández, Homeschooler, San Juan, Puerto Rico.
Alberto Mulero Fernández, Notre Dame School, Caguas, Puerto Rico.

Research Mentor: Prof. Jonathan Vargas, Universidad del Turabo, Gurabo, Puerto Rico.
Research Assistant Mentor: Karielys Ortiz Rosario, Universidad del Turabo, Gurabo, Puerto Rico.

Music is part of history, culture, society and collective interaction. Previous research has shown that the process of learning music can have a remarkable impact on a society. In this learning process, the Internet has become one of the main sources of information about music. However, there is not a website that contains all or at least many of the various topics that revolve around music. MusikMuse was a website developed for this purpose that gathers many principal fundamentals of music. The focus was on the development of a structure that provides easier and simpler ways to browse for topics related music. This website would not only expand what people know about music, but also help increase even further the interest for the musical environment. MusikMuse works as a tool both for the musician’s community and for anyone who has an interest in music.

ANIMATED SIMULATION ON CONVERTING WASTE MATERIALS INTO BIOFUELS

Yash Baja and Sidharth Parwani, All Saints Cathedral School, St. Thomas, US Virgin Islands.

Research Mentor: Chantelle Belmonte, All Saints Cathedral School, St. Thomas, US Virgin Islands.

Biofuels are any type of fuel that is derived from a living or recently living organisms. It can be produced from recycling waste materials from different households. Residues and by-products from industrial, commercial, domestic and agricultural wastes can be a potential feedstock in the production of biofuels. There are different ways of producing biofuels. Plants high in sugar or starch can be fermented to produce ethanol (ethyl alcohol) that can be used directly as fuel. Another method of generating biofuels is to produce cellulosic ethanol from the non-edible parts of plants such as the stalk. Cellulose is a component of lignin, the structural material in plants. This research focused on the processing of waste materials to biofuels and showing how much energy is saved. An animated simulation on the process of converting waste materials to biofuels was developed for a better understanding of the whole process on how to turn trash into treasure. The team focused on Scratch Programming and Adobe Fireworks in developing the animated simulation. Furthermore, a graphical presentation and estimation analysis was made of the amount of waste materials that could help save energy for a specific household. This study will also help the public, specifically the students, to have a better understanding on advantages of recycling waste materials into biofuels by giving them good insights on advantages and disadvantages about the process.
MATH AND SPORT APP

Iancarlo Bauzá and Steven Albaladejo, Santa María del Camino School, Trujillo Alto, Puerto Rico.

Research Mentor: Francisco Pérez Laras, University of Puerto Rico, Bayamón, Puerto Rico.  
Research Mentor Assistant: Ángel Andino, Universidad Metropolitana, San Juan, Puerto Rico.

Mathematics plays a big role in sports. For example, when calculating batting averages, one question asked is how does size affect performance and help athletes improve their performance. The problem is that people may not follow other sports because they do not understand certain things about them. They do not realize that math is always involved and can be useful in some way. The purpose of this application was to show that mathematics plays a different role than a regular classroom experience does. In addition, it helps others to understand more about sports and its relation to mathematics. For example, a basketball may be used to learn algebra, while baseball or soccer may be used to learn physics. The problem is that people ignore or do not pay attention to mathematics in a game because it cannot be seen, but it is there. The proposed solution was to use the Math and Sport App to learn more math while having fun with the game. This app was designed for all ages and all kinds of persons. If users are having problems with a math class but they enjoy playing with their computer, they will be offered the opportunity to play with this application and learn any math equation right through the sport games and levels.

FREQUENCY CONTROL FOR ANIMALS

Anthony R. Bonilla Santiago, José Gautier Benítez School, Caguas, Puerto Rico.  
Kevin O. González Medina, Vocacional de Cidra School, Cidra, Puerto Rico.  
Alec S. Cruz Cruz, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

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

Frequency is the number of occurrences of a repeating event per unit of time. Animals, as well as people, hear sounds across different frequencies. By altering sound frequencies, the behavior of animals or human beings can be altered. By understanding and manipulating this frequency, one can potentially control species. This can be very practical for neighbors or owners of house pets such as dogs and cats which react unpredictably to certain actions. One of the biggest causes of social tension between neighbors is the turmoil caused by these pets. By having the power to cease excessive barking or hyperactive behavior, the quality of everyday life will be much better. However, the benefits of frequency manipulation are not limited to house pets. Animals like hedgehogs, cows, horses and even birds can be manipulated by sound. A device has been developed that allows to do all this and more. It emits sounds at designated frequencies that appeal to the frequency that animals hear. The original purpose was for small situations and animals, but the idea can be expanded, developing it to different animals and situations, even if they are wild. This idea can be applied for a zoo and hunters, among other uses.
AN EFFECTIVE ALGORITHM TO SOLVE THE COURSE SCHEDULING PROBLEM FOR HIGH-SCHOOLS IN THE US VIRGIN ISLANDS

Ronel Brunn and Isaac Anthony, Ivanna Eudora Kean High School, St. Thomas, U.S. Virgin Islands.

Research Mentors: Marc Boumedine and Ackeem Baker, University of the Virgin Islands, St. Thomas, US Virgin Islands.
Research Assistant Mentor: Jamaal Al Ameen, Ivanna Eudora Kean High School, St. Thomas, US Virgin Islands.

The development of course schedules in the Virgin Islands school system is currently produced manually, which takes school administrators hours and even days to produce. This research proposes to design and develop a timetable algorithm that will assist schools in scheduling classes. The scheduling problem consists of distributing effectively the resources available and at the same time avoiding conflicts. Classes require resources (classrooms, equipment, teachers etc.) for a specific duration or period. Classes are assigned at determined time slots without allocating the resources at the same time. A genetic scheduling algorithm solves the schools’ strong and weak constraints, one particular resource at the same time. Examples of strong constraints are: a teacher can offer only one class at a time; a physical classroom can host only one course at a time. Examples of weak constraints are a teacher can teach a topic at a specific period, the course cannot be taught two consecutive days. Some experimental results obtained in testing of the proposed algorithm to the school timetabling are presented. A high-school timetable with temporal arrangement of a set of classes and classrooms in which all given constraints are satisfied is displayed.

2013- LEARNERS PERMIT PUERTO RICO PRACTICE TEST

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Research Mentor: Francisco Pérez Laras, Inter-American University, Bayamón, Puerto Rico.
Research Assistant: Ángel Andino, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Christina Morales, Inter-American University, Bayamón, Puerto Rico.

A learner’s permit is a restricted license that is given to a person who is learning to drive. To obtain the learner’s permit, an individual needs to pass a written test that for some people is hard to pass. The learner’s permit is needed to obtain the driver’s license. To pass the learner’s permit test, individuals need to study a lot and prepare properly. A learner’s permit practice test can help people to be prepared and become familiar with the test. About 42% of people that take their learner’s permit test fail the first time they take the test. One of the most common reasons why people fail this test is because people do not prepare themselves properly. Other reasons are laziness, lack of motivation, nervousness, lack of concentration and problems understanding what they are studying. The main objective of this research was to create an app that will help people who are going to take the test by making it easier for them to study. After the creation of this app, it is expected that people will find easier ways to study and understand what they are studying and the percentage of people that fail this test will be lower.
AUTO-ORGANIZER

Frankie R. Cabrera, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Francisco Pérez Laras, University of Puerto Rico, Bayamón, Puerto Rico.
Research Mentor Assistant: Ángel Andino, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Cristina Morales, University of Puerto Rico, Bayamón, Puerto Rico.

People are very stressed with their jobs and students with their tests or assignments. Every day they have something new to do, and, while some people manage to finish their jobs and assignments, others cannot cope with the responsibilities every day. Most of these people rely on technology to finish their assignments on time. To address this problem, an Auto-Organizer app was developed. This app was designed for Windows Phone using Microsoft Visual Studio to aid not only people with time distribution problems, but anyone who wants a well distributed time schedule. Auto-Organizer allows an individual to enter their jobs or assignments, and their level of priority, and it will create a flexible schedule to suit the user’s needs. Auto-Organizer works like a flexible timer, where you input the estimated amount of time, and the app will base the organization of the schedule on that and priority. When the timer reaches 0, the app will send an alarm, asking if the assignment has been finished. If the answer is yes, the app will simply continue with its pre-determined schedule based on the info the user assigned to each task. If not, the app will reorganize its schedule to extend the base time of the said task. This app can be very helpful to anyone that wants an organized schedule, as well as those who wish to complete jobs and assignments on time. This can be implemented in companies that require many human hands working at the same time, so they know exactly what to do next without being confused. Many people would download this app it will be helpful, aside from the fact that the app is free to download. To those ends, this app is designed to aid people around the world, and allow them to organize themselves and finish their assignments or tasks before the deadline.

STRATEGY TABLE

Paola Carrión, Antonio Fernós Isern Vocational School, San Lorenzo, Puerto Rico.
Heily Resto, Educación Bilingüe de Cidra School, Cidra, Puerto Rico.

Research Mentor: Prof. Joehan Carrasquillo, Universidad del Turabo, Gurabo, Puerto Rico.
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What are the probabilities of a soccer player scoring a goal? What if a table could tell you? Using probability and statistics, this might be possible. Using C++ for the creation of an algorithm in which users enter the data, they might be able to find out if the players might be able to score a goal. The program took into consideration that the soccer player is already at the goal about to score and that there is a goal-keeper present. In the possible future, this program might be turned into a web-site and/or an app.

PREDATOR- PREY MODEL USING AGENTS IN NETLOGO

Jaychael Colón Aponte and Jorge Muñoz Ramos, Interamericana School, San Germán, Puerto Rico.

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

An ecological system of two species, where one is a predator, such as foxes, and the other is prey, like hares, involves natural reproduction and death of animals, but it also presents the possibility of death by hunger of predators and death by hunting of the prey. A model of this behavior was programmed using a multi agent model in NetLogo, improving an existing model done by the developers of NetLogo. This model is discrete, where both predators and preys can move. The hunt is successful if the predator can get its prey. The great advantage of NetLogo models is its visual capabilities. The user can play with initial numbers of animals, and also with parameters, like birth rates and speed of movements and see what happens in diverse scenarios.
PUSH OFF: PATH PLANNING AND ROBUST DISCOVERY OF TARGET LANDMARKS FOR OBJECT RECOVERY

Joel J. Colón Torres, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Ramón Cardona, Inter-American University, San Juan, Puerto Rico.

Tekkotsu is an accessible source development framework for programming in numerous robot platforms. The goal of this research was to program a robotic behavior for the iRobot Create to move through an elevated PI-shaped platform. It was constructed as a computer-generated environment using Tekkotsu's virtual simulator, Mirage. The robot search for, travel to and execute a push-off the platform for each of the three landmark objects were built into the created world. These simple tasks involve a sequence of low level actions like: visual recognition, path planning, object selection and manipulation, and localization. The Tekkotsu robotics framework handles this entire task in a high level of abstraction, employing tools for coding, debugging and graphic representation in both 2D and 3D to develop the solution. This allows the users to start programming without requiring greater expertise of programming principles. Through extensive use of the framework, a critical aspect of the behavior could be control, such as the robot's turning speed, cliff edge detection and decision-making when reaching a target object.

PROGRAMMING “LEGO-MINDSTORMS” ROBOTS TO CONTRIBUTE TO ATHLETES’ HEALTH

Arlene Colorado Alvarado, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentors: Luis Rivera and Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

Many athletes must receive medical services for injuries related to their sports, injuries that have been registered just by consecutive body movements that eventually cause severe damages and pain. Studies revealed that tennis athletes harm themselves with these movements, not only by the movement of the swing of their arm to hit the ball, but also from the sharp and consecutive movements to pick up the ball, sometimes losing or dropping the ball and going down to the floor a consecutive number of times or bending the back with a very abrupt movement to catch the ball. This research aimed to find a new way to avoid athletes’ injuries. To keep the practice going uninterrupted, the solution is an automated robotic ball collection. The “Lego-Mindstorm Robot” can be programmed to look for the balls and get them to an exact point, using a color sensor to detect them. A special robot was constructed, as well as, a program to pick the balls up and move them to another athletes’ safe point. The robot was tested for efficiency use and best performance program was applied to demonstrate how the robot automated technology could be applied to improve athletes practices using economic resources.
STANDARD REPRESENTATION OF REMAINDERS OF GAUSSIAN INTEGERS

Ángel Cruz Soto and Gerald Almodóvar Méndez, Luis Negrón López High School, Sabana Grande, Puerto Rico.

Research Mentor: Álvaro Lecompte Montes, Inter-American University, San Germán, Puerto Rico.

Gaussian integers have almost the same algebraic properties as integer numbers, including modular arithmetic. However, due to the non-uniqueness of the remainder in the complex division, there is not an obvious selection of a representative in each congruence class. Improving previous research, and using a recent result of A. Lecompte, an algorithm was programmed to obtain a standard representative of each class. In each class (mod z) a number was selected in the set \( \mathbb{Z}_d + \mathbb{Z}_m i \), where \( m = \gcd(a, b) \) and \( d = (a^2 + b^2)/m \). Operations between representatives of the classes were done by the usual rules of complex integers, and the following two rules: 1) Imaginaries are reduced to a real plus, an imaginary being the congruency \( m i \equiv f \pmod{z} \), where \( f = -k a + h b \), for \( h \) and \( k \) such that \( m = h a + k b \). The coefficients \( h \) and \( k \) can be calculated using Euclid’s Extended Algorithm. 2) Each integer can be reduced with the congruency \( d \equiv 0 \pmod{z} \). After these reductions in the set \( \mathbb{Z}_d + \mathbb{Z}_m i \) is closed under the operations and forms a ring.

AUGMENTED REALITY EDUCATIONAL GAME TO IMPROVE MATH SKILLS

Roberto Cruz, José Collazo Colón School, Juncos, Puerto Rico.


The purpose of this project was to create an augmented reality program that retains children's attention to motivate them to learn addition and subtraction of fractions. This educational game was created using the Flash Builder IDE. The ActionScript programming language was used for more efficient implementation across multiple platforms. The FlarManager toolkit was used for its image detection and 3D model libraries implemented making it much easier to build augmented reality in Flash Builder. This augmented reality educational game provides an opportunity for elementary school children to visualize and interact with the numerator and denominator of a fraction resulting in better cognition. Through the child’s natural curiosity, augmented reality inspires and motivates children to learn. A study over a considerable amount of time will be conducted to see whether in fact the knowledge and concentration of the child has improved. The game is currently at its most basic level, but more difficulty levels will be implemented in the future to include children of multiple age groups.

KENYU: AN iOS APPLICATION FOR ENHANCING READING SKILLS

Sahar Daas, Na’amah Leerdam, and Simran Khemlani, All Saints Cathedral School, St. Thomas, US Virgin Islands.

Research Mentor: Chantelle Belmonte, All Saints Cathedral School, St. Thomas, US Virgin Islands.

The 21st generation is also described as a mobile generation where technology research and projects include the next major phase of mobile telecommunications standards beyond the current 4G/IMT-Advanced standards. In this generation, students have phones, ipads, laptops and many different advanced technologies. This project aimed to develop a reading program that would be supplemental to the daily reading class of every student from the beginning of learning to the high school level through an iphone app. The programs used to develop the project were Xcode and Titanium Appcelerator and Adobe Photoshop software in creating different graphic designs. Due to time constraint, this app was made specifically for Apple devices. The app was designed through different graphic designs that encouraged students to learn more. Building vocabulary and improving different reading skills was one of main objectives of this app. The app was designed in a holistic approach and encourages students to be more interactive through multiple-player settings.
iOS MATH APP: AN INTERACTIVE AND HOLISTIC APPROACH FOCUSING ON MASTERY OF MATH SKILLS

Prena Dadlani, Samah Abdallah and Nicole Pichardo All Saints Cathedral School, St. Thomas, US Virgin Islands.

Research Mentor: Chantelle Belmonte, All Saints Cathedral School, St. Thomas, US Virgin Islands.

According to researchers, mind games test an individual’s abilities to lead and help the user to become more efficient in areas such as critical thinking, reasoning, and language and information processing. The purpose of this project was to design and develop an app in order to educate the young children of today’s world. It helps to increase math, reading, and science skills. Cognitive tests are used to examine the core aspects of the brain. The left side of the brain is used mainly for Mathematics and Science; whereas the right side of the brain is used for creative things. By using this app, an individual can test both sides of the brain at once. Creativity was incorporated along with educational resources to help a person work his/her brain into higher, intellectual thinking. The programs used to create this app were Titanium Studio and Xcode. The questions on this app vary greatly to help enhance every necessary aspect of education. There were 50 questions on this app itself to start with. With every update this app has, new questions will be added to keep the game updated in standards and running. This app was made specifically for Apple devices because the complexity of the software for Android devices is much harder and is much more time consuming. In the near future, this app will be available for Androids as well.

RANDOM CHANCE


Research Mentor: Mr. David Mattera, Manor School, St. Croix, US Virgin Islands.
Research Mentor: Mrs. Rosa White, Science Coordinator, St. Croix, US Virgin Islands.

The purpose of this experiment was to produce a set-up that achieves the maximum probability for a coin. This is initially dropped in a heads up configuration that will come to rest on a tails up configuration after having performed a half rotation. The variables in the experiment included the initial height and angle of the coin, as well as, the hardness of the surface that the coin lands on. Analysis of the variables utilized Microsoft Excel and basic principles of physics. An apparatus was set up using a ring stand, a ruler, a protractor, a burette clamp, and a 2012 U.S penny. The coin was dropped ten times at different angles and heights, as well as, on different surfaces. As a result of completing the procedure above, it was found the one height and angle that produced a maximum occurrence of one half rotation and the coin landed on tails.

MODEL FOR ELECTROLYTIC CONDUCTION USING AGENTS IN NETLOGO

Lina Daza Llanos and Rosangelie Soto Oliveras, Interamericana School, San Germán, Puerto Rico.

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

Electric conduction in solutions is carried by the ions that move in the solvent. Both positive and negative ions move toward the opposite sign electrodes, with possibly different mobility, which is also proportional to the voltage. In addition to electric forces toward or away from the electrodes, there are the attractions or repulsions between the ions. A random impulse caused by Brownian forces on the ions was added. To have a visual model of the phenomenon, a multi agent model was created in NetLogo, where there are a lot of agents for the ions, randomly distributed at the beginning. Ions that arrive to the electrodes are eliminated, while any excess charge of one electrode creates a new ion of this sign. This improves a previous model that reproduces approximately the electrolytic conduction. The advantage of programming is the direct visual interpretation of the phenomenon.
VIRTUAL MOVEMENTS USING MIRAGE

José Alberto De Jesús Romero, Saint Francis School, Carolina, Puerto Rico.

Research Mentor: Nicole Ortiz García, Universidad del Este, Carolina, Puerto Rico.

Mirage is a simulation environment that provides Tekkotsu running on a workstation instead of a robot with a virtual world that can be customized. By using mirage, a city or a farm can be made at home. It will use the Mirage virtual world instead of using the physical robot. This project was based on the Tekkotsu robot in the virtual world Mirage. C programming language will be used to program the robot. C programming languages can be used to create programs that control the behavior of a machine and/or that express algorithms precisely. With the commands, the robot can be controlled. The controls will first make the robot go forward, back, left and right. The virtual robot will pass through a labyrinth that is created in Mirage. The labyrinth will have all types of directions to test the program used in the virtual robot. In the future, it will be made to move forward and will be available to move faster. More features like running in zigzags will be used. For the control and the programming of the virtual robot, Ubuntu 12.10 and the version of Mirage v2.0.0 will be used. The robot in real life will use remote control to search or to explore things or people where humans do not fit.

OPERATIONS WITH RESIDUAL CLASSES IN STANDARD REPRESENTATION OF GAUSSIAN INTEGERS

Andrea Devaris, Interamericana School, San Germán, Puerto Rico.

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

Gaussian integers have almost the same algebraic properties as integer numbers, including modular arithmetic. Improving previous research, and using a recent result of A. Lecompte, a standard representative of each class was used. Each class \((\text{mod } z)\) is represented by a number in the set \(\mathbb{Z}_d + \mathbb{Z}_m I\), where \(m = \gcd(a, b)\) and \(d = (a^2 + b^2)/m\). Operations between these numbers are done by the usual rules of complex integers, and the following two rules: 1) Imaginaries are reduced to a real plus, an imaginary with the congruency \(m I \equiv f \pmod{z}\), where \(f = -k a + h b\), for \(h\) and \(k\) such that \(m = h a + k b\). The coefficients \(h\) and \(k\) can be calculated using Euclid’s Extended Algorithm. 2) Each integer can be reduced with the congruency \(d \equiv 0 \pmod{z}\). After these reductions, the set \(\mathbb{Z}_d + \mathbb{Z}_m I\) is closed under the operations and forms a ring. In this work, the ring operations were programmed in this standard representation.
TRAFFIC JAM

Sojourna Ferguson and Brendon James, St. Croix Educational Complex, St. Croix, US Virgin Islands.

Research Mentor: Mr. David Mattera, Manor School Math and Science Teacher, St. Croix, US Virgin Islands.
Research Mentor: Mrs. Rosa White, Science Coordinator, St. Croix, US Virgin Islands.

Many variables can cause traffic jams: inadequate manpower, small road spaces, not following the traffic rules, overtaking tendencies of drivers, but mostly faulty traffic signaling systems that cause prolonged traffic congestion. The purpose of this research was to investigate and identify reasons why a significant number of traffic jams occur at the Sion Farm stoplight on the island of St. Croix. To carry out this investigation, the time of day when traffic is heaviest was included and which direction most of the cars were coming from or going.

The stoplight cycle timing, traffic density (number of cars on the road at a particular time), the delay times, how long it takes to get from point A to point B using a specific road and people’s perspective vs. reality were also studied. Based on the data, the busiest direction was the road going to and from Sunny Isles and Plaza (from East to West). When the green cycle for all directions was observed, the stoplight that conducts the cycle times from Sunny Isles to Plaza Extra lasted the longest and on a worst-case scenario, a person could be in the traffic jam for about 10 to 15 minutes. Also, when comparing people’s perspective to reality, their answers matched the observations of what happens at the Sion Farm stoplight. It was concluded from observations that sensors exist at the road route to make traffic flow quicker. Nonetheless, the traffic still gets heavy with the sensors in place. Therefore, the best way to fix the traffic congestion at Sion Farm is to make an alternate route. However, that intersection already has 2 alternate routes and due to a lack of funds an overpass, a roundabout, and even another alternate route are not possible.

RUBIK’S CUBE SOLVING APP

Andrea Ferrer Vega, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Francisco Pérez Laras, University of Puerto Rico, Bayamón, Puerto Rico.
Research Mentor Assistant: Ángel Andino, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant:Cristina Morales, University of Puerto Rico, Bayamón, Puerto Rico.

The Rubik’s Cube, created by Ernő Rubik, was invented in 1974. Its goal was to teach students about 3D objects in the field of architecture. After a couple of years, the Rubik’s Cube became a puzzle game and a worldwide sensation. Many people try to solve it, but most of them only make one or two sides. Through the years, this puzzle has not lost its appreciation and it still holds an impression in society. With the advances in technology, learning is made more accessible. The proposed application was designed to help people solve the Rubik’s Cube in a fun and easy way. By developing a mobile application people will be able to solve their Cube without the need of learning difficult algorithms.

PIEZOELECTRIC EFFECT AS A PHONE CHARGER

Carmelo E. Figueroa Ortiz, Thomas Alva Edison School, Caguas, Puerto Rico.

Research Mentor: Prof. Jonathan Vargas Rodríguez, Universidad del Turabo, Gurabo, Puerto Rico.
Research Assistant Mentor: Jenipher D. González Aponte, Universidad del Turabo, Gurabo, Puerto Rico.

A piezoelectric sensor is well-recognized device that is based on the piezoelectric effect to measure pressure by converting it to an electrical charge. The piezoelectric effect is an electric charge that accumulates in certain solid materials. It is a reversible process in that materials exhibiting the direct piezoelectric effect (the internal generation of electrical charge resulting from an applied mechanical force) also exhibit the reverse piezoelectric effect (the internal generation of a mechanical strain resulting from an applied electrical field). Most mobile phone chargers are not really chargers, only power adapters that provide a power source for the charging circuitry, which is almost always contained within the mobile phone. When the touch screen panel is touched, a portion of the wave is absorbed. This wave can also be used to charge the same device by the piezoelectric sensor in the touch screen.
TRIGONOMETRY SYSTEM

Nicole Flores, Antonio Fernós Isern Vocational School, San Lorenzo, Puerto Rico.

Research Mentor: Prof. Joehan Carrasquillo, Universidad del Turabo, Gurabo, Puerto Rico.
Assistant Research Mentor: Osvaldo Massanet, Universidad del Turabo, Gurabo, Puerto Rico.

In the fields of research and development time is precious and should not be wasted. In making a triangle geometry calculation system with various tools sets, the number of steps needed to obtain a result are reduced, thus reducing the amount of time a researcher/developer must invest in trivial trigonometric problems. The Trigonometry System revolves around solving trigonometry math problems, problems which the average student hates to solve and the average scientist needs to do. In this project, the Pythagorean Theorem, the Law of Sine and the Law of Cosine are included as well as other necessary additions for the solution of problems related to trigonometry. This system was designed to solve most simple trigonometry problems.

THE PROGRESSIVE AND CONTINUOUS ADDICTION TO ELECTRONIC DEVICES

José García Santiago, Juan Suárez Pelegrina High School, Aguadilla, Puerto Rico.

Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentor: Kevin Marrero, San Benito School, Mayagüez, Puerto Rico.

Electronic addiction is a condition that results when a person engages in an activity that can be pleasurable but the continued use becomes compulsive and interferes with ordinary life responsibilities, such as work, relationships or health. The purpose of this research was to unmask the destructive addiction humans have to technology, more specifically to electronic devices. With the passing of time, humans have become dependent (addicted) to electronic devices. In phase one of this research project, a survey was conducted with people asking them basic questions of their electronic life. Ironically, the research was performed online. In phase two, experiments were performed with humans. They were asked to measure and quantify the maximum amount of time without using any electronic device during daylight hours. Results were summed up and conclusions were formulated as to the degree of addiction of humans to their electronic gadgets. Expected results varied with age and level of education.

HOW CAN CHESS IMPROVE LEARNING SKILLS OF STUDENTS WITH LOW ACADEMIC ACHIEVEMENT?

Yamil González Zuaznabar and Shakira Y. Avilés Gonzalez, Dr. Pedro Perea Fajardo Vocational School, Mayagüez, Puerto Rico.

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

Chess is a two-player strategy board game played on a chessboard, a square checkered game board with 64 squares arranged in an eight-by-eight grid. Each player begins the game with 16 pieces: one king, one queen, two rooks, two bishops, and eight pawns. Each of the six piece types moves differently. Pieces are used to attack and capture the opponent's pieces with the objective of 'checkmate' the opponent's king by placing it under an inescapable threat of capture. There is a lot of evidence that favors the fact that playing chess can improve intellectual abilities, critical thinking skills and behavioral skills in teenagers. Many students from all over the world are having low academic achievement in their school work and scientists and other professionals are looking for new strategies to work with the problem The objective of this investigation was to see how the practice of chess can improve the academic achievement in teenagers. A pilot study was conducted with a population of ten sophomore male and female students with low academic achievement. The academic achievement was measured with the grades obtained by the students during the first 20 weeks of the school year. These students were given chess lessons twice a week for two months, one hour per day. After completing the chess lessons, their academic achievement was measured using the new 34 weeks grades obtained by the students. The study evaluate the academic progress, thus accepting or rejecting the hypothesis that chess improves academic achievement. After completing the study, it is expected to find a significant difference. Seven students should demonstrate a 70% improvement in their academic achievement and 30% should not
show any improvement or a decline in their academic achievement. Note that there were variables that could have affected these results, such as attendance, motivation and interest in the game.

**HOW TO IMPROVE MEMORY SKILLS WITHOUT EVEN KNOWING IT!**

**Yanexis C. Guang** and **Janairís Colón**, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentors: Luis Rivera and Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

One of the most played games in America is memory. It helps to develop a person’s cognitive abilities and memory skills without the person even knowing it. The objective of this research was to create an application for a memory game that can be downloaded online available to players from all over the world. It was designed for ages three and up to help build the human mind. The game is based on day to day objects, using images to make the brain react faster. This project used the computer to create the codes in JAVA programming over Eclipse. The Internet was used to search for and download free pictures and get information to develop the project. The procedure started with the development of the idea and flow charts. Then, Eclipse aided in the process of coding and inserting images over the platform. The final steps were creating the user interface and running the game in order to get the required style. Further efficiency tests were performed to analyze performance. In the future, a game website and interface could be developed. This game will make people more interested, since they are looking at things that they usually like. Furthermore, it will provide entertainment to any person. It is hoped that in the future this project will develop over time and that it will help other people improve their brain skills.

**BEATING THE HOUSE**


Research Mentor: Mr. David Mattera, Manor School, St. Croix, US Virgin Islands.
Research Mentor: Mrs. Rosa White, Science Coordinator, St. Croix, US Virgin Islands.

The purpose of this experiment was to investigate the possible methods for winning games of chance that normally produce far more losers than winners. A BASIC program was used to simulate the gambling method known as doubling that can be applied to the roulette. It shows how it is possible to always eventually win using the doubling method. Winnings are computed along with iteration numbers and necessary funds required. Winnings were set to one million dollars with initial bets of one hundred dollars. Iterations and necessary funds vary every time the program is run, due to the randomness of the odds of winning on any particular spin. Iterations were consistently in the range of 2 spins per win; however, the maximum number of times doubling required was random, but ranged upwards of 20.
CAN THE VIDEO GAME BE MORE FUN?

Edgardo Hernández, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentors: Luis Rivera and Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

This investigation is about how an educational video game can be more fun for youngsters who are not interested in them. Youngsters sometime do not enjoy the games long enough to actually learn something productive from them. Most parents try to use the educational games, but the second they mention they are educational, the children lose interest. Sometimes children start the game but they find it tedious and boring, so they stop playing it early, without the game fulfilling its purpose of teaching them. The question is “Can an educational video game be made to be more fun for the kids that do not respond to it or give up on it?” This investigation studies the things that make video games fun and what makes them tedious or boring. With this in mind a prototype was made following what the studies showed would be a “fun yet educational game”. The investigation was made to find what makes a video game fun and how to apply it to an educational video game. The expected results are that the prototype made from the studies will be more entertaining than any usual educational game.

AQUATIC ROBOT HELPS CLEAN THE SHORES IN PUERTO RICO

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Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

This research proposed the design and construction of a robot that can pick up trash from the shores, using solar energy as the primary energy source. The robot design consists of two mechanical arms and a digger so it can pick up buried trash. With two sensors and cameras installed, one in the front and one in the back, the robot will pick up the objects. The robot sensors make it capable of detecting the trash, so it can be picked up and put in the container, which will be behind the robot. The robot will be assisted by human interface and manual controls to change the direction. It is made of materials capable of sustaining an aquatic environment along the coastline of Puerto Rico. The robot design presented is equipped with track tires for off road environment that will make it able to move on the ocean floor. It will also have a type of anchor to give it stability while picking up the trash. The robot program selects a specific path to travel to pick up the trash. When it comes to the end of the path or area looking for trash, it will come back through the same path. In the future, new programming will be required to make it capable of scanning the area or path for trash, picking up the trash and moving through deep sea area and making it capable of recording the environment with a camera.
DARE 2 READ


Research Mentor: Mrs. Rosa White, Science Coordinator, St. Croix, US Virgin Islands.

An app was created to help ninth graders with their vocabulary based on needs determined by Iowa test scores of ninth and eleventh graders. By doing so, it is planned to help the ninth graders to improve their test scores by the time they reach the eleventh grade. It was observed that there was a lack of reading comprehension in the high school test scores and it is hoped to make a difference by using this app. In the app, links to books for free for each grade level, and also an online dictionary can be included, which will also have a word of the day. In addition, the app will include excerpts from essays high school students should read and have questions for them to answer similar to the format on the reading comprehension section on the IOWA test. Local public high schools in St. Croix usually do not make AYP (Annual Yearly Progress). By developing an app, ninth graders will have benefits and will become active readers and also to promote and help them with their vocabulary skills.

DO MARINE PROTECTED AREAS HAVE HEALTHIER CORAL REEFS?

Carl-Michael James Jr., and Regine Rose Acosta, St. Croix Central High School, St. Croix, U.S. Virgin Islands.

Research Mentor: Mrs. Rosa White, Science Coordinator, St. Croix, US Virgin Islands.

Coral Reefs in the Caribbean have been affected by a number of natural and man-made events, which have led to the decrease in species diversity and abundance. Although there are many threats to coral reefs, climate change impacts have been classified as one of the greatest global threats. To protect important coral reefs from local man-made events, many countries and islands have created Marine Protected Areas (MPA). These sites are managed to reduce or eliminate man-made events such as over-fishing, vessels/anchor damage, and sources of pollution; improving their ability to survive through climate change impacts. To test their effectiveness, coral reefs were surveyed within MPAs and their condition was compared to unprotected sites using Bleach Watch methodology, which includes bleaching, diseases, and predation. Since the law protects MPAs, it is anticipated that they will have a healthier coral reef ecosystem.

LINUX CLOUD SERVER FOR SMALL GROUPS

Adelmarie Jusino Padró and Emanuel A. Rodríguez Rivera, Interamericana School, San Germán, Puerto Rico.

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

Cloud computing is defined as the use of computing resources (hardware and software) that are delivered as a service over a network. A secure system was designed where a small group of people could manage data storage and have plenty of software resources, keeping things fast and efficient. At the same time, they can work together saving time and money through the efficient use of the shared resources. Ubuntu Linux was used; it is a free but sophisticated operating system that makes possible to design a cloud that can be shared by a small group of friends, or people with common interests. Deeper digging into the actual infrastructure options of the cloud has been done so that many people are able to take advantage of these developments.
IMPROVING THE PUERTO RICO PUBLIC TRANSIT SYSTEM

Solomón Kabuka Santiago, Central de Artes Visuales School, San Juan, Puerto Rico.

Research Mentor: Nicole Ortiz García, Universidad del Este, Carolina, Puerto Rico.
Research Co-PI: Dr. Ángel R. Arcelay, Universidad del Este, Carolina, Puerto Rico.

The present Puerto Rican public transit website (dtop.gov.pr) does not offer bus routes, terminals from which buses arrive/depart, or even show any of the buses themselves. Currently, to know how to get from one place to another by bus, people have to go to a bus stop or station and start asking which bus goes where. This is the reason why major improvements are needed in the way that people can take public transportation as an alternative to be moved. The main objective of this project was to create an easy-to-use GPS-like system, which aids an individual using public transportation. The purpose of this project was is to create a better communications system between the general public and the public transportation system. This project aimed to make an interactive user-interface capable of providing the route options to move from one station to another. The system starts with a map that will let the person look up all locations. Also, starting and ending positions thorough a search box can be known. The system will show the two quickest route options to get from the starting destination to the ending destination via public transportation. It will also let a person choose whether to include the train tracks in the suggested routes and check all estimated arrivals and departures station-by-station. It is expected that, once implemented, the use of public transportation as a means of travel will be much more effective.

GARBAGE COLLECTOR: OPTIMIZING THE SOLID WASTE COLLECTION ROUTES FOR THE VIRGIN ISLANDS

Patrick Leonard, Antilles High School, St. Thomas, U.S. Virgin Islands.
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Research Mentor: Ackeem Baker, University of the Virgin Islands, St. Thomas, U.S. Virgin Islands.

Solid waste collection systems have become more complex throughout the United States and other places in the world, including the Caribbean. These systems are driven by concerns for cost and productivity highlighting the need to improve management and route design. In the U.S. Virgin Islands particularly St. Thomas and St. John, steep slopes, narrow roads, unnamed streets and inadequate planning hinder the efficiency of the waste collection process. It is so bad that residents living in some of these areas are required to transport their waste to bin collection sites located throughout the islands because the terrain makes it difficult for the vehicles to pass. As with house-to-house collection, bin collection by the authority is subject to similar circumstances which highlight the inefficiency of the system that can be viewed by the many tourists who visit the islands for recreation and pleasure. The main objective of this research was to seek a computer assisted routing system that will help improve the collection process by defining optimized routes. The tool that was used in the experiment was a Windows based machine compiling the object-oriented language. The studied area was the urban area of Estate Thomas and Sugar Estate. The purpose of this study was to optimize the solid waste collection routes for the Virgin Islands. Currently, the routes used today were established long ago by driver’s intuition. The goal of the project was to determine how effective the A Star algorithm could find an optimal solution to the problem.
FUNCTIONALIZATION OF Ag NANOPRISMS USING 11-AMINO-1-UNDECANETHIOL HYDROCHLORIDE

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Research Mentor: Leonardo C Pacheco Londoño, University of Puerto Rico, Mayagüez, Puerto Rico.
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Nanotechnology has increased the attention to many researchers in the last few years due to the potential applications in several fields such as electronics, environment, sensing, and bio-imaging, among others. In this way nanoparticles have been synthesized using several methods, shapes and sizes. Silver and gold nanoparticles are common used as sensors for chemical and biological detection using Surface Enhanced Raman spectroscopy (SERS) in spheres or rod shapes. However, there is a little information of the use as nanoprims. In this research, silver nanoprisms (Ag ND) were synthesized using laser induction. First, Ag nano-particles (Ag NP) seeds were synthesized. For this, 200 mL of 0.1 mM of Ag⁺ ions in solution and 0.5 nM trisodium citrate (CT) were reduced using droplets of 10 mM of NaBH₄ while UV-VIS spectra were collected during the reduction process. Droplets were added until the absorption band of 400 nm stopped increasing in absorbance. The mode of size of Ag NP was 8.9 nm. Second, laser light (λ = 532 nm) was used for induction of the growth of ND in the Ag NP suspensions. The metallic NP suspensions were originally yellow and then turned blue after the induction process. This change in color was caused by the variation of Ag ND size as it changed into another light absorbed that is different (absorption band is 629 nm). Third, 100 mL of a solution of 7.4 x 10⁻⁵ M of 11-amino-1-undecanethiol hydrochloride (11-A-1-UT-HCl) was added to 900 mL of Ag ND. The UV-VIS results showed that there was a decrease of absorption band. This is an indication that the interaction of 11-A-1-UT-HCl with Ag ND and those which are functionalized with 11AUH (Ag ND-11AUH). Surface Enhanced Raman spectroscopy (SERS) experiments demonstrated the potential activity of the prepared functionalized-nanoprims (Ag ND 11-A-1-UT-HCl) as sensors to detect amino-acids, nitrogenous bases and explosives.

SNAPPER

Francisco Maldonado, Bonneville School, San Juan, Puerto Rico.

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Research Assistant Mentor: Jenipher D. González Aponte, Universidad del Turabo, Gurabo, Puerto Rico.

This application of photography is destined for people who always think that photo apps are always complicated. They think that it is hard to use this application. This application was made for simple uses to take quick reliable photos that will look marvelous and be able to save the photos in photo albums. This application contains a unique feature that no other application of photography has. In addition, it contains an online “locker” for the photos. This helps if a person does not do a back-up of his/her phone and suddenly loses the phone, or it is broken or something else happens to it, they can still have the photos in a secure online place. This place will provide for viewing of photos with the safety combination that will change monthly, and the person will receive notifications of the new code by email.
TIC TAC ZONE

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In this century, most people want to be DJs or music composers; so, an electronic composer is proposed that is based on a similar device called Reactable. The Reactable is considered as a round translucent table that is used in a darkened room, and appears as a backlit display. By placing blocks (tangibles) on the table, and by interfacing with the visual display via the tangibles or fingertips, a virtual modular synthesizer is operated that creates music or sound effects. The main objective of this project was equal as the Reactable, create a sequence of different sounds, and as well add effects. The difference from the Reactable and the proposed project is that the proposed device does not use a video camera to recognize the objects placed on the electronic composer. The intention behind this project was to create something similar to the Reactable, but small and less expensive. The Tic Tac Zone can make all people, no matter the age, create a sequence of sounds.

THE DYSLEXIA SHUFFLE TEST

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Wildalis Martínez, Cohelet Christian Academy High School, Las Piedras, Puerto Rico.

Research Assistant Mentor: Karielys Ortiz, Universidad del Turabo, Gurabo Puerto Rico.

The world has about 15% of the boys and 10% of the girls with dyslexia. The developmental reading disorder (DRD), or dyslexia, occurs when there is a problem in areas of the brain that help interpret language. It is not caused by vision problems and it is not predictable. The symptoms may vary, but some of the most common symptoms include difficulty in learning and recognizing words. In addition, many dyslexic children suffer of psychological trauma and have low self-esteem because they believe that by knowing less or not understanding things like all others, they will be rejected. A treatment for this disorder is private tutoring. Last year, this team designed an app for the dyslexic community to overcome difficulties such as differentiating letters, words, and right from left, among others, and helping overcome symptoms and improve its self-esteem in a fun and effective way. The object of this year’s project was to complete the dyslexic therapy app designed last year using the programming language Java and to create an Android Phone application.

US CITIZENSHIP REVIEWER

Fernando Méndez González, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

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Research Mentor Assistant: Ángel Andino, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Cristina Morales, University of Puerto Rico, Bayamón, Puerto Rico.

According to the 2010 census, there are currently 50,477,594 Hispanics and 17,320,856 Asians living in the Unites States. With 21% of the United States’ population being immigrants, there is a big chance they are living only with their residency. Many immigrants might be trying to study for the U.S Citizenship test but are having a tough time studying since most guides are made only in English or they just are not used to studying that way. Nowadays, people who wish to study for the test may use books, videos, audiobooks, flashcards and/or study guides. Trying to study using only one of these methods can be hard since they either do not have all the information needed for the test or they are not portable. The purpose of this project was to confront these deficiencies. The objective was to make a Windows Phone application that includes all the information that is essential in order to pass the test by using different study methods and having the study guide in both English and Spanish. The application will include videos, a test section and a learning section to help complete and approve the citizenship test.
CURIOUS INFO

Joshua Morales, José Collazo Colón School, Juncos, Puerto Rico.

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Curious Info is a type of social network related to science. The purpose of curious info is to allow individuals to post, expand and gain information from other users. However, the information posted will not always be real. To prevent the user from being misinformed, a voting system was implemented. According to the votes they have, the information will be more or less safe. This page could be used to search or post info universally or by subject (science, space, history and anatomy). This will make it easier to search for publications that a person likes more. Curious Info is not only a page where knowledge can be posed, but it can also publish and discuss hypotheses with other users.

SCHOOL RUSH

Juan Carlos Morales, Levittown Baptist Academy, Toa Baja, Puerto Rico.

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RPGs (Role Playing Games) are based on controlling a protagonist in his adventure through a fictional world. They are one of the first types of games and are still a widely popular genre. Most RPGs are fantasy oriented and do not contain many situations found in real life. School Rush is a game that combines the RPG genre with an actual institution, namely the Universidad Metropolitana in Cupey. This game blended university life with an RPG, as well as elements of stealth and puzzle games. The demo of this project provides the experience of sneaking one’s way into a class at the top floor, avoiding teachers and guards, as well as using items and information from other students to get rid of obstacles in their path. The Scientific Investigation Building at the Universidad Metropolitana inspired the layout for this game. This game will entertain people with a new take on what RPG’s can become.

COMPUTERS TIMELINE ANIMATION USING ALICE

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

The Alice programming environment is a tool that provides the means to accomplish a virtual animation of the exposed issue. This project presents the animated timeline of the evolution of computers, from the beginnings two centuries ago to present day developments. Through the use of technology in education and communications, the experience of students can be enriched and their ability to interact with the learning material, to learn by different audiovisual tools and at their own pace is enriched. This implementation integrates computer science and programming fundamentals, as well as the study of effective presentations to the public.
THE DEVELOPMENT OF THE SMARTPAD APPLICATION FOR WORLDWIDE DISTRIBUTION

Paola M. Morales Ortiz, CROEM School, Mayagüez, Puerto Rico.

ResearchMentors: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.
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Sometimes, writing notes about classes, quotes of favorite authors, grocery shop lists, or things to do during that day, and many other things requires a simple way to record it without any paper. This research is about a new application, the Smartpad. This application presents a smart interface that permits selection of the type of note or just a free note. This program is great for writing any information in a place to easily mark and erase with no worries of losing it. It is like a note one sto make to make to oneself or another person that is made for the purpose of erasing it. One can write about anything. The materials required to make this Smartpad possible are Eclipse software and a computer. The procedure is to make flow charts, make the codes and write the program in JAVA language. When finished, press is played and the program is visible and useful. In the future, this program can be applied to mobiles. A website will be constructed to have it available for users worldwide.

SCHOOL PROGRESS App

Davette G. Nazario-Febres, Apples and Stars Learning Club, Carolina, Puerto Rico.
Kenneth A. Hicks- Ventura, San Antonio Abad School, Humacao, Puerto Rico.

Research Mentor: Nicole Ortiz, Universidad del Este, Carolina, Puerto Rico.
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Research Mentor Co-PI: Dr. Ángel Arcelay, Universidad del Este, Carolina, Puerto Rico.

Nowadays, grades are given by teachers every 3 or 4 months during the academic year. Students know their class progress after these periods. However, this process is not effective for some students because they usually need to know their performance before these reports. Teachers spend a lot of time calculating the final grade for all the students. This affects the student in many ways. For example, the students will not have the chance to improve their grades during the evaluation process. Separately from the grades, the students face other challenges, such as grades from other classes, homework and/or special projects. To solve this problem, a webpage was developed for students to know their progress in class. They can perform “what if” analysis in order to plan their goals. A webpage was chosen since most students have access to the Internet connection in Smart Phones. This webpage was developed using HTML language. Notepad ++ was utilized for compilation. The goal of development of this webpage was to get students more interested in school assignments because they can interact with other students from the same grade, making it easier for them to get work done and studies, exchanging notes, exam reviews, ideas or homework. The student targets were middle school and high school students. This webpage contains the following information: a platform between the same groups of students to remember their homework, projects, and tests or simply calculate their progress in their classes. By entering the score of each test or project each student has an idea of the progress in his or her grades. In addition, the platform has other old-fashioned applications such as alarms and also a remind students of upcoming schoolwork. This way, it will be easier for teachers to give homework through the webpage, giving students constant reminders of their work and performance.
HOW TO MONITOR PROGRESS IN INDIVIDUAL AND CLASS SCORES USING JAVA PROGRAMMING SOFTWARE

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The average has been useful for making a comparison between two or more things; it will be represented in percent. In this project the comparison was based on the correct and the incorrect answers. There is also a comparison between the averages from all the components of one group. With this comparison, the average can be found from every student in the class and the average from the entire class. To make this program, a computer with Java and Eclipse was needed to make the code for the program. These software programs are sufficient to run this project. The program works with twenty subjects. Before the program makes anything, it will ask for the total score. After that it proceeds with entering the incorrect answers of the first student, then the second up to the twentieth student. Every time a score is entered, the score of each student will give the percentage that the student has in his work. When the twenty scores are in, the program will calculate the average for the entire class. This program can be used in a larger project. This one worked just with one class, but it can be used for all the classes from one course, or the entire school. This program is more useful for teachers, but it can be used for other professions that need information based on averages. This project was based on statistical analysis. It makes it easier to know the average for one class or the work of one student.

A MEASURE OF DISORDER IN A PICTURE

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

Pictures are two dimensional arrays of pixels. A picture showing a scene or an image is highly organized, showing shapes or figures that can be distinguished from the background, while a random array of pixels is just random stains or spots of colors, without a background. In order to solve picture puzzles in an effective way, one has to define and have a way to calculate first a measure of disorder in a picture. There is not a unique or best measure, but the logarithm of the number of figures in the picture can be used as a measure. A figure is defined as a subset of contiguous pixels of the same or nearly the same color. The pixels are considered contiguous if they are neighbors or there is a chain of neighbors of the same color between them. The background counts in this definition as another figure. A picture totally white or black measures zero and other totally or alternated white-black pixels have a maximal measure. A method was programmed to find the number of figures in a black-white picture and, therefore, to measure the disorder contained in it.

MATH QUIZ

Juan Pablo Paredes Sánchez, Notre Dame School, Caguas, Puerto Rico.

Research Mentor: Prof. Joehan Carrasquillo, Universidad del Turabo, Gurabo, Puerto Rico.
Assistant Research Mentor: Osvaldo Massanet, Universidad del Turabo, Gurabo, Puerto Rico.

You may ask how we can develop kid’s minds and skills in math. Why kids do not like math or math problems? The purpose of this program was to teach kids that math is fun, good, and also to expand the learning experience in private and public elementary schools in Puerto Rico. Scratch, a programming language, was used to develop Math Quiz. This is a programming language that makes it easy to create one’s own interactive stories, animations, games, music and art, and share those creations on the web. Scratch was created by MIT Media Lab, it is intended to motivate for further learning through experimenting and creating projects, such as interactive animations and games. This quiz was made through scratch using building blocks, sensors, looks, operators, sounds, variables, and controls.
GAME ALERT SYSTEM (GAME A.S.)

Kalid D. Luyando Flusa, Dr. Conchita Cuevas School, Gurabo, Puerto Rico.

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A video game is an electronic game that involves human interaction with a user interface to generate visual feedback on a video device. It is usually undertaken for enjoyment and sometimes is used as an educational tool. Games are very important to people, and have even revolutionized the world. The purpose of this project was to make an application using the computer programming language Java which enables the user to have an alert system, and notify the user when a game of interest to the individual is available in the market, and to know when to go and buy it.

HOW TO ELECTRONICALLY MONITOR TEACHERS, STUDENTS AND VISITORS ON THE PROPOSED ENLARGED CROEM CAMPUS

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At present, the mathematics and scientifically specialized high school, CROEM, is undergoing a transformation, inspired by the 21st century school projects. Currently, whoever enters and leaves the school is being monitored by a system solely involving paper and signatures. This project was executed by creating a computer program that safely places a person’s name in a database when they enter the school and removes it when they leave. The project was performed using a Java software application. It also required the use of tablets and/or computers to test the work (beta version). The first thing that was designed was a system to enter and erase a name to the database. From there, it increased in complexity requiring more complicated programming skills. The end project will then have in the future a system to do many things automatically and be able to make the job at the gate much easier. If possible, it will also add a way to connect the computers and be able to have more people being aware and alert about who is inside and where and who is outside (tracking).

PRE-SCHOOL LEARNING – APP FOR KIDS

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This project began after considering how small children learn basic stuff before or when starting school. It is hard to teach basic stuff to children when they are starting school. The purpose of the project was to teach things such as basic shapes, animals, and colors. The project spans across two different languages, Spanish and English. The languages chosen were English and Spanish because they are the second and third most spoken languages worldwide. The purpose was to have kids develop bilingual skills since they start pre-school. This application was made using the MIT App Inventor; it is the easiest way to make an application when one barely knows programming. With the blocks editor, the sounds and the connection were put to others screens. The sounds were recorded with the computer program Audacity, using various recording devices such as headsets and microphones. This application will help future generations to learn basic stuff in two different languages before they start in school.
TRIGONOMETRY APPLICATION FOR WINDOWS PHONE 7

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Trigonometry is an area of mathematics that is based on the study of triangles. This area is difficult and complicated to understand for some people. It may be because solving triangles is a long process or it may be just because those persons do not like math. Fortunately, there are a high percentage of people who have smart phones with Internet access to download apps and games. Because of the above-mentioned reasons, this project aimed to create an application for the Windows Phone 7 platform. The application allows the user to obtain the missing sides and angles of a triangle, in addition to its perimeter and area, with only submit at least three variables of sides and/or angles. The application will facilitate the studies of trigonometry helping people solve triangles and verify their exercises quickly and efficiently. Additionally, this application will be available in the windows phone marketplace for free so that anyone can download it and it will be the first application in the marketplace that solves triangles simply and easily.

SKATEBOARD BY MAGNETS

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Boys and girls who are skaters commonly fall and break their arms, legs or necks. A solution for this problem would be making magnetic skateboards. The idea is to put a magnet on each end of the skateboard, and the ramps too, so when the skater is doing a trick, he/she will not fall, because he/she is going to levitate and do the trick in the air. The magnet that was used in this project was neodymium, also known as NdFeB, NIB, or Neo. This magnet is composed of iron and boron. Neodymium is a chemical element, an earth metal, a soft silvery metal that tarnishes in air. It is a fairly common element. Metallic neodymium has a bright, silvery metallic luster, but as one of the more reactive lanthanide earth metals, it has the problem that it quickly oxidizes in ordinary air. The oxide layer that forms then peels off, and this exposes the metal to further oxidation. It is one of the most powerful permanent magnets created by man, that was the main reason to be using it in this research project.

UNIVERSITY PROTECTOR

Alejandro Rodríguez and Javier Ortiz, CIMATEC, Caguas, Puerto Rico.

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School shootings are a topic of intense interest in the United States because during the last years there have been shooting attacks at different universities and schools. Some cases have been that of the University of Texas at Austin killings, the Virginia Tech massacre and the Sandy Hook Elementary School massacre, the second-deadliest school shooting in United States history, after the Virginia Tech massacre. Today universities do not have an alarm system that alert students if there is an attack. That is why a system that provides protection to the university and the university staff was developed. The purpose of this is to create a website and an application where, if a potential attack is triggered, a student of that university can publish what is happening in the webpage.
MUSICAL EXPERTISE

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The Internet has replaced various aspects of daily life, one of them being the quality of learning provided by instructors. Knowledge that was obtained in a classroom or by means of teachers can now be accessed online. Nowadays, individuals can go to any music website, watch a tutorial and learn to play an instrument, but users do not learn about the music theory. An audience with any kind of budget can have access to this form of education and that is the purpose of this website, to educate everyone interested in learning musical theory so they can have a base of musical instruction. The theory examines the language and notation of music and seeks to identify patterns and structures in composers’ techniques across or within genres, styles, or historical periods. In a grand sense, music theory distills and analyzes the fundamental parameters or elements of music rhythm, harmony (harmonic function), melody, structure, form, texture, etc. Broadly, music theory may include any statement, belief, or conception of or about music. Since the Internet has become the most used tools for research worldwide, a website was made to educate users about musical theory. This website will focus on explaining everything related to the musical symbols and the rules coordinating both the sound and duration of notes by providing tutorials, classes, tips and tests to help and facilitate the learning experience.

GRAZING-PASTURE MODEL USING AGENTS IN NETLOGO

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Simulation is a technique for preparation and learning that can be applied to many different science problems and real-life situations. An ecological system of two species, where one is herbivorous like sheep and the other is the pasture, involves mainly the natural reproduction of pasture. It was assumed that time is short, enough so that reproduction or death of sheep is not important. Pasture grows after some time if there are no animals in place, but it is eaten by animals. Animals move constantly to new patches of pasture. A model of this behavior was programmed using a multi-agent model in NetLogo, improving an existing model done by the developers of NetLogo. This model is discrete, where animals move and pasture grows in discrete units of time. The great advantage of NetLogo models is their visual capability. The user can play with initial numbers of animals, and also with parameters, like speeds of movement and growth rate of pasture, to see what happens for different scenarios.

OBJECT HANDLING AND AWARENESS: IMPLEMENTING TEKKOTSU'S GRASPERNODE

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Tekkotsu is an open source development framework for programing in several robot platforms. Compared to other known systems, like ROS (Robot Operating System), Tekkotsu uses a high-level of abstraction, reducing the learning curve and widening its accessibility to non-programmers. For the development of the robotic behavior, iRobot Create was chosen to implement the Tekkotsu framework. To control the robot's movements Tekkotsu's Pilot module was used. Also, the MapBuilder module was integrated to compose the representation of the world perceived through the robot's sensors. Both modules work in tandem to determine obstacles and define the optimal navigational path. The Grasper module was used to manipulate target objects. In order to successfully implement this module, the limitations of the robot's arms and the physical characteristics of the target objects needed to be taken into account. For visual recognition, AprilTags was implemented, which are special markers deeply integrated with the framework. These can be implemented to communicate specific instructions to Create in order for it to handle certain actions, like placing a given object in a specified zone.
MOBILE SECURITY DRONE

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Drones are an essential tool for human development in health, education, commerce, and home, among others. Robotics is the branch of technology devoted to the design, construction, operation, structural disposition, manufacturing and application of robots. This combines various disciplines such as: mechanics, electronics, computer science, artificial intelligence, control engineering and physics. It is becoming necessary to use assistive technology where robots allow speed, reliability, and accuracy. The aim of this research was to create an application for android platform systems. An application is a computer program such as tool designed to allow a user to perform one or several types of jobs. In this research, an application was used to control the robot and view the images seen through its camera. The operation of this application is to observe the images that capture the robot and handle the robot’s movement. This application creates a simple and easy way to observe a place without the user having to be present. People would download this application, not only because it is free, but also because it is a simple, easy way to use a security application.

MOBILE COLORBLIND COMPUTER CONCEPT

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In order to develop a helpful tool for the colorblind-impaired, a hands-free device has been designed. The idea was to develop a pair of multi-functional goggles with diverse functionality, comfortable and easy to use with the ability to help the colorblind-impaired to identify colors by identifying colors for them. The Mobile Computer Concept was designed in both hardware and software phases taking the person’s comfort into consideration. From mechanical interaction to electric circuitry, many things were taken into consideration for the optimal interaction of the person using the hardware. The Raspbian operating system and Tekkotsu framework were taken into consideration for this project.

ROBOT GPS TRACKER

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The "I Robot Creator" does not have a GPS, so one cannot have its location or guide from a long range. This harms the robot user because if people handle it too far, the signal can be lost and can be sabotaged so this means that the individual will not know where the last location was. So, this application was created to focus on security, which gives the location of the robot and the surveillance area. To make the application schedules, the Phone gap, Microsoft Expression Web 4, Eclipse SDK and jQuery Mobile programs were used. This is a new beginning for robotics and for their own safety.
PROJECT MANAGER (ONLINE DOCUMENTAL DROP BOX)

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There is always a time when someone needs to work in a group. But sometimes one of the members is missing or lives too far away to physically interact with other members of the group. The solution is to work on the Internet. There are ways of doing this, but most are too slow or unreliable if working in a big group. The purpose of this project was to create an online webpage with the ability to store documents in a server and make them accessible from there. In order to access these projects, a key/password unique to each project would be needed in which the documents would be stored. There would also be a need for a sign up to the page in order to access its functions. The page itself would have a user-friendly system and a chat-like function for groups of more than two people. Each document submitted would stay on the server as a backup copy of the document. Each document uploaded by a user could be downloaded by other members of the group. The page would have a built-in chat in order to discuss with the group the changes needed to be made to the document. Different documents would be uploaded if a group decides to divide the work among them and then they could each upload their respective work and then all the documents could be joined together by one of the members. This was a way to learn more about the HTML and PHP programming languages. The web page and the script were all written in Adobe Dreamweaver CS5.

DEVELOPMENT OF A PRELIMINARY WEBSITE FOR A MOBILE APPLICATION TO COMPLETE STATISTICAL CALCULATIONS

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As technology steadily grows in complexity and in effectiveness, most people find themselves almost dependent or relying on it. Some specific technologies, such as smartphones, have become commonplace in today’s society. There seems to be a mobile application for every conceivable use. The basis of this research was to find a way to improve the efficiency of the use of statistical equations through the creation of a mobile application. By using programming languages such as HTML5 and Java Script to create a website, it can be proved that the efficiency of the use of statistical equations improves. Programming languages such as HTML5, Java Script and the Wix website builder were used to build a preliminary website version of the application. This website presents different statistical equations and calculations, such as mode, medium, mean standard deviation and variance of a probability distribution and the percentile and quartile positions of a group of numbers. Through this website, the successful completion of statistical calculations of a specific group of numbers is more efficient when compared to the completion of these calculations when done by hand.
MATH PROGRESS FOR FUN

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General understanding of mathematics is important as it impacts both the academic and personal life. Students do not like math class and sometimes they think it is boring. Today’s technological advances provide society with tools for one’s daily task. A game was developed where an dog owner is chasing his or her dog. The dog chases a cat throughout the city. In order to catch it, the user must solve multiplication problems. When the owner starts running, the user will need to do a multiplication process to pass to another level and win. The user would win if he makes all the math calculation right and if he or she does it on time according to a set timer. If the user gets it wrong, then the dog owner would have two opportunities to try again. If the user fails, the game is over and the owner cannot pass from that level and needs to restart the game.

IS TECHNOLOGY PART OF EVOLUTION AND PROGRESS OR BECOMING AN OBSTACLE TOWARDS THE INDIVIDUAL AND COLLECTIVE DEVELOPMENT OF THE SOCIETY?

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With the continuity of time, technology has not only proven to be more than an instrument, it has become a very important tool in different areas of science. For example, in the field of medicine, technology has provided advanced machinery that does not only help diagnose several conditions, but also manages to make certain procedures, in some cases, almost painless. It is obvious that information, communication and technology have been responsible for the enormous success of companies and improvement in this economy. Some of the improvements in technology have exceeded expectations to the point that modern society has come to depend on it on a daily basis. After all the steps forward society has taken, the task to ask is: Can today's society live without technology? To answer this question and understand if technology and its advantages have and will have a positive or negative impact, information was collected that would help create an ample vision of the elements as described above. To accomplish this investigation's goal, a survey consisting of various closed and specific questions was created. Then, the collected data was classified, analyzed and tabulated. It was expected that the questions that are received can support the existence of other factors that make this dependence a disadvantage.
APPLICATION DEVELOPED FOR USERS TO LEARN SELF-DEFENSE

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Today's society faces many dangers and most people are not fully aware of the importance of self-defense. Dedicating some time to learning and practicing the art of self-defense can become a great asset. So instead of wasting time searching the Internet for quality self-defense lessons, *The Ultimate Defense Guide* brings it all together, being an easy to use, no-time consuming quality Windows 8 application. *The Ultimate Defense Guide* is designed for the modern-day persons and their busy lives. It has been created to help users learn self-defense and overcome fear in stressful situations, when the time to take “martial arts” lessons is not available. The application proposed in this research will help the basic user learn intermediate and advanced self-defense training. Users can also gain knowledge in home defense and fighting techniques. It also includes information on how to handle guns. Also, they have the idea of when, why and how to use them. It includes a section on how to give first aid to yourself or others. The application will interact with the user and according to their “fear-factor” test results, it will help them overcome situations of panic and distress. Utilizing the resources available on Windows 8 platform, this application includes a variety of self-defense video lessons. The user can also choose different emergency and survival scenarios provided by the application to obtain information on how to overcome them. These types of applications do not exist in the Windows Store.

INTEGRATION OF TECHNOLOGY IN AN ELEMENTARY SCHOOL CURRICULUM

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The problem of elementary school students is that they are discouraged and show no motivation during class. This is something that may be caused by the dull curriculum of some schools. The project’s goal was to make an application that could make a class more dynamic and to motivate the students by making the learning process a more enjoyable experience. A simple calculator application was created providing the user with an interface that has the four basic mathematical operations. In order to create this calculator, the software to be used was NetBeans IDE and the JAVA programming language. Java swing controls and object oriented programming were the resources that were used when writing the source code of this calculator application. Taking into consideration the population that is going to be considered a user of this application, in this case, elementary school students, it is planned for the application to be attractive to their eye. The application was one to have big buttons and an easy-to-understand interface. It is basically a frame with two text fields and five buttons, four of them are the basic mathematical operations and the remaining button has the function of deleting the inputted data in the text fields. Further analyses and efficiency tests will be performed. A demo of the application will be provided to elementary school teachers in order to make their classes more dynamic. After a determined amount of time, the student’s progress will be reviewed to ascertain if the application serves its purpose.
CHEM WHIZ APPLICATION FOR WINDOWS PHONE

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Throughout the decades, Chemistry has played a very important role for human beings and the Earth; therefore throughout time people have been studying how it works. Most high school students in their academic studies are required to learn Chemistry because it is an essential part of life that takes place all around us. Chemistry is a very complex subject due to its extensive nature, making it hard and tedious for people to study and learn about. A Chem Wiz application was developed to teach people basic concepts of Chemistry. It involved taking the basic information on the subject matter and displaying its most important information; it also includes arranging the different topics and subdivisions of Chemistry and the explanations of each one in brief and easy to understand paragraphs including different examples. This application will be efficient and very helpful to any students who want to improve their grades on the topic. In addition, it will be helpful to any person interested in learning more about Chemistry and gain more knowledge. Since nowadays most people have phones, this app will make the information very accessible. The app was created using Microsoft Visual Studio 2010 which is a software that is used to create different types of programs using the C# programming language. The layout of the application was designed with Blend 4, which was used for the development of the application for the Windows Phone 7. It can be downloaded for free and also can be used without the need of an Internet connection, making this app one that can compete with today's advanced marketing technology, as is the Windows Phone Application Market.

HIGH SCHOOL RESEARCH NETWORK (HSRN)

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Even though there are hundreds of investigations done by high school students they are not in any virtual, accessible database. The research papers may be stored in books but these are not very accessible and they are lost easily. If a student’s research paper is accessible by the scientific community, the student will have better and incredible benefits and opportunities in the future. The solution to this problem is to create an accessible database. This project proposed a website that will be divided into four main research areas: Mathematics, Technology, Engineering and Science. It will have a database of the investigation papers done by high school students. Teachers, students and university professors will be able to view the research papers. For example, it will help a student select an investigation topic that has never been done before and aid teachers in finding good candidates to help them with their own research projects. By viewing these papers, universities can offer students more opportunities regarding the research they have done. In order to maintain a professional standard, any research submitted has to be approved by expert peers before it will be viewed by the public on the website. A student who wants to submit a research paper has to create an account to maintain an organized platform. This investigation will give recognition to a high school student’s research. At the beginning of the project, there will only be research papers of high school students. This website will be able to create a network with institutions related to science such as CCCE, NSF and NASA. It can also affiliate with different universities such as UMET, Harvard and MIT. These companies and institutions can sponsor students’ investigations. It is expected that this project will help provide new opportunities such as scholarships, and job opportunities depending on the quality of the work. A future work will be to create another website with the same functionality as proposed here but for college students.
WEB-BASED DECISION MAKING TOOL FOR COMPARING SOLAR AND FUEL CONSUMPTION IMPACT

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Renewable energy is a prevalent energy source which is increasingly contemplated by homeowners and industries as a substitute for non-renewable energy sources such as fuel. However, there is a lack of user-friendly tools showing comparisons between fuel and solar energy in order to help users making informed decisions. This project proposes to design and implement a Web-based decision-making tool to assist in comparing solar and fuel energy sources and their impact on the environment. This tool was designed to be freely available on the Web and was developed using a combination of tools such as HTML5, JavaScript and InfoVis Toolkit. A user-friendly graphical user interface allows examining and comparing solar and fuel energy based on economic and environmental factors. The user is able to interact with the consumption and can visualize impacts on the environment by entering appliance energy usage in kilowatts or BTU. Graphs display environmental impacts including habitats destroyed by mining as well as carbon dioxide emissions. Economic impacts including the cost of fuel per year, and the cost of solar panels per year is also displayed. However, due to the fact that solar panels have a large initial investment, the economic impact graph shows how much the user can pay off the solar panels each year; therefore noting how much money they would spend on solar power, as opposed to fuel for a duration of 25 years. Using information on the energy output of various appliances, and the energy output of solar and fuel energy, the user can know which energy source would be best considered with both economic and environmental factors. This user-friendly web-based energy decision making tool informs and assists users in understanding that energy may come in different forms; however, not all of these forms are as beneficial as they seem.

HELPING PEOPLE TO STORE CONTACT INFORMATION

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Contemporary society communicates through electronic devices, such as cell phones, and different services on the Internet, email accounts and social networks. These kinds of communication methods let people store all their contacts in a base, making it easy for users to find someone they want to contact. Although this contact save-search system is available in all cell phones and Internet services, one is needed for offline computers, which is the goal of the project. The development of such program requires a computer with compiler software, and a computer language. In this case, the compiler used was Eclipse EE IDE for Java language, which was the language used for the compilation of the contact base. The source code for the program contains the elements of the information saved for each contact. These are the contact’s name, phone number and email account. The application can be used to save and find a contact’s information in an offline system, which can be really useful in places where it is difficult to connect to any kind of network. In order to do these tasks, the user inputs the contact’s name, email and phone number in each of the fields given and then presses the “Create” button. After the contact is added to the contact base, it can be accessed by writing the contact’s name in the “Search” field. This action will run the algorithms necessary to find the contact in the database and give an output with the contact information. This application can be used by any kind of person who needs it; from kids in 4th grade who are starting to work with technology to elders who need a database where they can store all the information of a person they contact frequently. Additionally, it is planned to improve the application to store social network accounts information, as well as a calendar with the contact’s birthdays and other special occasions.
PLANTER TRAVEL

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Space is an endless void in which human civilization has yet to completely understand. Thousands of years of technological advancements but, only recently, there are the means and the will to take the next step in interplanetary travel. Recent theoretical discoveries have found ways to even reach 90% light speed and that chemically based rockets are being outfitted for human transportation. Given these discoveries, it can be expected that in the next ten years there will be many major breakthroughs in the scientific community that will make commercially based interplanetary travel available for those who are able to pay. The application in this project will give the user an idea of an interface that will be helpful at the time of choosing a destination and the means of transportation. As an example, the purchasing of a plane ticket and “Space Vouchers” which will give various destinations and means of transportation for an individual to choose from. The goal of this research was to make an application that looked and felt like booking a normal flight; only in this case instead of booking a flight to another country, one would be booking a flight to another planet. This app would inform the user of the different types of propulsion systems available for each trip and also inform the user on the different climates, geography and some facts about each planet. The application’s main objective would be to inform the user on interplanetary travel and some of the technology that they would encounter in the semi distant future. This application is being developed for the Windows phone platform.

SOLUTION APP

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Currently there are difficulties in the search for answers to situations/problems via online. People could have problems like finding “What is the difference between you and others?” People that find the page might bookmark it and later find out that the page no longer exists and then a new problem and question arises: “Now what?” There should be something to make your life easier. What would it be? The Solution App will help people to find the answers in an easier way without having to find it amongst the millions of other links. It will eliminate answers that have no use whatsoever and try to give the quickest and most straightforward answer. The Solution App will also attempt to eliminate time that is very precious because it will do it as soon as possible. Using the app will make possible to have an answer in a shorter time compared to Google search. Microsoft Web Matrix 2 with jQuery-mobile framework programs that were used to do this research. The app is simple and easy to use, it does not require too much use it. It was made in a simple and easy design to help maximize how to find answers. In doing so, people will not have much trouble finding answers that they need. It is hoped that the results of this research will provide good results.
MOBILE COLORBLIND COMPUTER SOFTWARE

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Identifying color is something that is done every day, but for people with color blindness this is not something they can do. Those with the inability to see colors correctly, something which happens to few people, are somewhat afflicted by this handicap. From minor effects (e.g. seeing different shades of color instead of the correct one) to major conditions (e.g. not being able to see any color), this handicap might prove troublesome to the group of people which it afflicts. The Color Blindness Aid, which was built on the Tekkotsu Robotics Framework, uses especially Tekkotsu’s “Color-Segmentation,” and is intended to aid people with this handicap by telling them what kind of color they are looking at by name or by special abbreviations for each color. This proves useful when the user needs to know the color of an important object (e.g. Traffic signs/lights, heavy machinery, poisonous animals, etc.).

AN ERA, AN AGE, A TEXT, A DIFFERENT SOLUTION

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Today’s cell phone models are designed in a general manner. As a result, they do not meet the exact needs of people, making it more complex for them to familiarize with them. Furthermore, a model was needed that adjusted to the needs of the consumers depending on their age and preference. The main aspect of this research was to prove that there are more comfortable ways to text, depending on age. Specific models, like the Blackberry and the I-Phone were used throughout the research, and different groups were put together according to age. Two phones and a text message were given to each person. Then, the time taken to write the text was measured. Finally, the data was compared and conclusions were reached. It was expected that age did affect the ease of texting and that each age group had a preferable way to text. This research can lead to the creation of a cell phone model with diverse keyboards features depending on age.

AUGMENTED REALITY EDUCATIONAL GAME

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

Studies have been conducted that show that children with autism learn with ease if taught with three-dimensional models. Augmented reality technology can be used as a tool to teach these children thereby increasing cognition and academic performance. The project’s goal was to create a book that consists of simple three-dimensional models of letters, objects and animals to be used in education. The book was created using the programs “3dmax studio” for creating and editing 3d models, Flash Builder IDE to write code and compile the program. The FLARMManager Toolkit was used in order to use its image recognition and 3D model libraries. The programming language used in this project was ActionScript which was selected because of its ease of use and versatilility across platforms. This book has created an experience that is both fun and educational for all children. In the future, this project will be presented to “Autismo.pr,” a community website for autistic children in Puerto Rico, in order to gather results on the efficiency of this technique in the early stages of learning.
**ABSTRACTS**

**APPLIED MATHEMATICS**

**PROPER TEMPERATURE OF MILK IN A MICROWAVE FOR KIDS UNDER THREE YEARS**

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A microwave is used every day by parents to heat the milk for their children. There must be a perfect timing using the microwave to get the proper temperature for the milk. Most of the parents sometimes need to heat the milk twice or sometimes the temperature is too high for kids under three years to handle. Getting the proper time that leads to the best temperature will allow parents to be more accurate when giving their kids their everyday meal. The main aspect of this research was to analyze the different temperatures obtained at different times using the microwave. This research could provide ideal times for a microwave to heat in order to get the results parents are expecting. It was anticipated that the proper temperature of milk for kids less than three years of age would be obtained.

**ONLINE STATISTICS OF BANA SPACE SETTLEMENT**

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Ivonne Yaely Padín Martínez, Padre Aníbal Reyes Belén School, Hatillo, Puerto Rico.

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Research Assistant Mentor: Yesenia Marie Rivera López; Antonio Lucchetti Vocational High School, Arecibo, Puerto Rico.

The Internet, in current times, is a key part of advertisement and publicity for all types of business. Companies and industries are using social media to connect with people and inform their offers. The social networks profiles such as Google Sites, Facebook and Twitter created for BANA Space Settlement, were created in order to inform communities around Earth about the development of future colonies in outer space. Multiple organizations like NASA, Planetary Resources, Space X, Space.com, and Mars One have gained more popularity and contacts through the use of social media. The team intends to follow this lead reaching people through these sites. Since the creation of a Facebook Page for the BANA Space Settlement, the website’s statistics have increased, especially in the country of Puerto Rico. The team seeks to do a statistical analysis of the data gathered in these social media outlets. By interpreting and analyzing the data presented BANA’S impact can be measured.

**MATHEMATICAL MODEL FOR RETENTION IN YOUNGSTERS WHEN TRANSMITTING A SECRET MESSAGE**

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Research Assistant Mentor: Prof. Omar Martínez Forestier, Josefina León Zayas High School, Jayuya, Puerto Rico.

It is a fact that the messages change every time they are transmitted and that leads to misunderstandings, happening especially among young people. The purpose of this investigation was to find the capacity and effect that this has on the interest of the majority of people. It also included the limitations of the message before it changed. This investigation consisted of a game. It involved giving a message and passing it through various people until the end to see how it changed. It was expected that age affects the change of the message, and that through the ages of 15-18 the messages has less changes.
DESCRIPTIVE ANALYSIS OF SCHOOL DROPOUTS IN PUERTO RICO

José C. Cruz Ayala and Wilmaris Rivera Medina, Josefina León Zayas School, Jayuya, Puerto Rico.

According to different sociologists, one of the most serious problems that Puerto Rico has been having in the past years is early school dropout. Without a degree, many people are affected economically and the unemployment rate increases, which affects a country socially. The purpose of this research was to find out what motivates students to drop out of school. Using data found locally, a statistical analysis was made with the principal objective of finding reasons for dropping out of Puerto Rican schools. The most reasonable way of preventing school dropout is by changing the school educational structure, adding technical and vocational classes and focusing on the students’ interests. It was expected that this research would show that schools with vocational classes have less dropout students and those that do not have more student dropouts.

THE UTILITY OF A SCIENTIFIC CALCULATOR

André Hernández Espiet, CIMATEC, Caguas, Puerto Rico.
Yomar Zayas, Nuestra Señora del Perpetuo Socorro School, Humacao, Puerto Rico.

Calculators have been convenient since they have first been available to humanity. Since then, calculators have gotten more sophisticated. The purpose of this research was to make a calculator that will do more things than a regular one. A calculator is an electronic device which performs mathematical computations. Some of the basic computations a simple calculator is able to do are: addition, subtraction, multiplication and division. The purpose of a basic calculator is to do these basic functions faster than any ordinary human. In this project, a type of calculator called the scientific calculator will be made. A scientific calculator is a calculator which can handle exponential, trigonometric, logarithmic and other functions which a simple calculator cannot perform. This way, instead of having several calculators which have their own specialization or an expensive graphical calculator, the user can have one calculator which can do more functions than what any ordinary calculator can do.

MATHEMATICAL MODEL FOR TIME OF RESPONSE IN A COLONY OF ANTS

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Gilberto Hernán Pérez Lamboy, José Emilio Lugo Ponce de León High School, Adjuntas, Puerto Rico.

Just imagine having a nice and delicious piece of pizza. In a glimpse of time, while one goes to the bathroom, the piece of pizza has been already eaten. Who did it? Ants. The purpose of this investigation was to find out how much time it takes for ants to notice and go after food. The purpose of this research was to analyze the response time of the ants in their particular place. A small field study was performed in this research. Food was placed in a place known to have ants. The time it takes for the first ones to arrive was measured. It was repeated on different colonies, with the same food. Data was organized and a mathematical model was created.
TRINOMIAL POWERS AND THE NUMBER OF THEIR TERMS

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This research suggests a permanent arrangement for the expanded trinomials elevated to the n power. Trinomial power terms were organized in a logical order based on the binomial theorem. A method to determine its coefficient pattern (as Pascal’s triangle) and organize the terms is treating the trinomial \((a+b+c)^n\), as a binomial \((a+(b+c))^n\). A three-step method is presented to find the number of terms of an expanded trinomial. This is an easier way to find the desired term without multiplying term by term of many trinomials. The coefficients and variables are known in any selected term. After knowing the number of terms that \((a+b+c)^n\) has, the desired term is defined as “t”. By using this method, another process can be applied to find which one is the expanded term. The number of the expanded term is known according to the correct order of the trinomial expansion. The main contribution of the research is the order of the expanded trinomial and the method to find the desired term inside it. Further investigations will be to work with quadrinomials.
ABSTRACTS
APPLIED PHYSICS

COSMIC RAY MUONS: ZENITH ANGLE RELATED FLUX INTENSITY EQUATION AND ENERGY RADIATION COMPARISON

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Cosmic ray muons (μ⁻) and antimuons (μ⁺) are subatomic particles created during weak interaction between highly energetic cosmic rays. Cosmic radiation intensity is proportional to the altitude. These charged particles are affected by Earth’s magnetic field. The first experiment revealed a time dilation in its reference frame (5.5 μs), length contraction (1641 m), lifetime(2.19 μs), and speed of the cosmic ray muons(0.994c) that reach sea level. Muons reach the surface of the Earth with typically constant flux, as the expression of equation[1].

\[ F_\mu = 0.48 \text{ cm}^{-2} \text{min}^{-1} \text{sterad}^{-1} \]  \[ \text{[1]} \]
Particle Data Group (PDG) standard theoretical value.

This research aimed to compare flux data in different latitudes and also search for data needed to measure the Earth’s magnetic field’s influence over cosmic ray muons. For this, the relativistic mass and momentum of the muons, were measured with the Lorentz Factor result from (\( \gamma = 9.14 \)). The relativistic mass: \( \frac{E}{c^2} = m = \gamma m_0 \) Where \( m_0 = \) "rest mass"

Relativistic Momentum: \( p = \frac{m_0 v}{\sqrt{1 - \frac{v^2}{c^2}}} = m_0 v \gamma ^* \)

The results were compared with experimental data acquired from different latitudes and zenith angles. The data used was from Puerto Rico, California, and Illinois. The obtained results sustain how latitude influences energy radiation from space. The muon bundle intensity decreases with the increase of the transverse component of the magnetic field compared with calculations performed under uniformity of the flux, the effect becoming more noticeable with the increase of the location angle.
ANALYZING IMPACT CRATERS OF MERCURY

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In the year 2011, the MESSENGER (MErcury Surface, Space ENvironment, GEochemistry and Ranging) was the first spacecraft to orbit the innermost planet of the Solar System. During its journey, the MESSENGER took over 100,000 pictures of Mercury’s surface. Scientists today are still studying these pictures to better understand Mercury’s mysteries. One way to learn more about Mercury is to measure the diameter and depth of its craters. Thanks to many of the MESSENGER instruments, most of Mercury’s craters can be calculated with precision. To achieve this, accessible materials such as a calculator, a computer, PowerPoint®, and a pen and paper can be used. The process involves the pictures taken by the MESSENGER, which are available on the website http://photojournal.jpl.nasa.gov/ for download plus important data as the product size, resolution, emission angle and incidence angle. The photos are inserted in a blank PowerPoint® slide and multiple circles and lines are placed on the picture to measure in centimeters the crater’s diameter and the length of the shadow cast by the crater’s rim. Then these measures are converted to kilometers by using the product size and resolution of the picture to create a scaling factor. The results would be the actual size of the crater diameter and shadow length in Mercury but does not include the crater’s depth. The incidence angle is the compliment of the angle of the sun above the horizon. Multiplying the shadow length and the tangent function of the compliment of the incidence angle is equal to the crater depth. With this method, 18 craters of Mercury were measured successfully.

SPORTS IN SPACE

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Adrielys Janice Guzmán Morales; Dra. María Cadilla School, Arecibo, Puerto Rico.

Research Mentor: Luisa Fernanda Zambrano Marín, Arecibo Observatory, Arecibo, Puerto Rico.
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At the Arecibo Observatory, students have developed a way to create, perform and prove that Sports in Space can be played. The team has taken the challenge to play Quidditch, a sport created by J.K. Rowlins, author of The Harry Potter Saga. The game was composed of seven team members, using three different balls of different sizes and weights, and six goal posts. The objective of the game was to catch the smaller and autonomous ball to win the game. The physics involved in the game can be determined, taking into account the height of each player, weights of the balls and the players. The students created their own model of the balls and stadium. Through experimentation, the students demonstrated the physics of playing Quidditch in simulated Space (a pool). According to this, Sports will be a part of future space tourism in hotels or space settlements such as BANA. It will include the use of physics, calculus and the imagination to recreate Quidditch in Space and combine it with fantasy and science.
ABSTRACTS
ENGINEERING

OPTIMIZATION DESIGN, IMPLEMENTATION AND MANAGEMENT OF RENEWABLE ENERGY

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Puerto Rico has an energy system that is rapidly becoming obsolete. It consists of various components, among them, six (6) power plants that supply electricity to a large amount of the population on the island. Of those six (6) main power plants, four (4) are petroleum fed, and were created in the 1950’s to 1960’s, era in which the economy was growing healthily, because petroleum was in vast amounts and was cheap. At present, things have changed. As stated before, that system is obsolete due to its inability to accommodate and comply with the dynamic power demands of the Puerto Rico of today in an economical and efficient way. Along with these problems also comes the growing concern of global warming, and how each country’s carbon footprint is increasing. This investigation’s purpose was to create a new energy system running on renewable energy sources for Puerto Rico, which will be efficient, agile and modifiable in order to replace the out-dated energy system that the island is still using with more faults than advantages. The equipment used to carry out this investigation was a calculator, and information about Puerto Rico’s carbon footprint, energy consumed and created, and defects on the energy system; also, individual information about different renewable energy sources that could be/have been implemented in Puerto Rico. After gathering this information, a series of researches and calculations were made, and they were applied to create the new energy system running on renewable resources for future generations to use. The investigation show how the new energy system will benefit Puerto Rico. The energy will be created and distributed in a more economical way, as there will be no use for petroleum and new jobs will be opened. The new energy system will be modifiable, since the power plants will be fed with renewable sources. It will also be more agile, because the plants will be able to satisfy the demands and more. It will be effective too, because there will be less percentage of energy lost, as opposed to today’s system. In conclusion, the new energy system’s goal will be to overcome the inefficiency and inabilities of the current system to supply Puerto Rico’s ever-growing power needs.

KEYSHOT: THE PERFECT TOOL FOR 3D RENDERING AND ANIMATION SYSTEMS

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The project consists of conducting research on the part of designing a building or some type of mechanical robot using computer software. The objective was to find out how much software and how much time it takes to construct a robot or building. The software program is called “Keyshot.” Keyshot helps to do a 3D graphic model of anything to be built or created. This research consisted of creating a 3D robot model in this program. The amount of time it took to create this type of model is an important element in this research. The robot model is able to move its head, arms, and legs at will. In addition, a Basic English Language voice was installed. This research may be tough but it is something that can be developed and refined for a long time to come. It may not be a robot; it may be a program builder or an operating system.
WILL AIR BASED PLASMA INCUR IN LOWER TEMPERATURE AND HIGHER DENSITY DEPENDING ON VOLTAGE?

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A steel wire sphere is inserted into the plasma chamber, where depending on the applied voltage, the density and temperature will either lower or rise. The voltages applied were -450,-500,-550, and -600 eV. Because plasma is an ionized gas, air based plasma was handled. The hypothesis was that the higher the applied voltage, then the temperature will decrease and the density will heighten. Inertial Electrostatic Confinement (IEC) was the method of plasma confinement utilized which shoots high temperature ions. The Single Langmuir probe was used to obtain data and LabVIEW for deciphering it. MATLAB was the program that analyzed data and created graphs while Excel took the mean of the values. In conclusion, air based plasma had lower temperature and lower density as the applied voltage rose.

EXPERIMENTATION TO IMPROVE THE DESIGN OF A FUEL CELL RESPIRATOR

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In order to improve a device that is capable of supplying safe, breathing oxygen to a user, an experiment was designed to test the viability of using the process of hydrolysis to extract oxygen from water. The oxygen from this process is collected to provide breathing air to the user. The process is similar to a reverse fuel cell in which electricity is applied to the electrodes on water to separate elements. The respirator only makes use of the oxygen collected while the hydrogen is wasted. Information was gathered to develop a model that represents the available oxygen for a respirator. The results were that the material used for the model, copper, was oxidizing over time. For this model, other materials will be tested and the one with the best performance will be used in the prototype. The weight of the material and the ability to handle the pressure will be taken into consideration when choosing the material. Also, the design will be improved for better comfort in use, acceleration of the fuel cell process, and increased oxygen output by this process.

THE PORTABLE CARDIOPAD APPLICATION: CHECKING THE HEART WITHOUT VISITING THE CARDIOLOGIST IN PERSON!

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There are many applications (apps) for blood pressure monitoring devices and for electrocardiogram training and monitoring, but the question is why there is not an application or app for both. The purpose of this study was to create the Cardiopad app that can help an individual without visiting the personal cardiologist. This application can take a person’s blood pressure, pulse and a transthoracic interpretation of the electrical activity of the heart and monitor it at the same time. After the test is done it will diagnose whether the person has high or low blood pressure or lack of blood flow to the heart muscle (coronary heart disease), whether the heart beats are too fast, too slow or irregular (arrhythmia), whether the heart does not pump forcefully enough (heart failure), whether there are problems with the heart valves (heart valve disease) and whether there is inflammation of the sac that surrounds the heart (pericarditis) depending on age, gender, height and weight. If the person does not know the meaning of the diagnosis the app will explain what it means. The person using this app can email the results to his or her personal cardiologist in order to get a better diagnosis. If the person does not have a personal cardiologist, the app will give directions and phone numbers to the nearest cardiologist or hospital in order to help the user.
MUSICAL ENERGY

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Any mechanical artifact responds to a force of energy. Taking that into consideration, it is a known fact that many people listen to music. The question that was asked was: Can music be an alternative source of energy? The challenge of this project was the research for alternatives to establish said theory. Music can be measured in frequencies and decibels (which is the magnitude of a wave). Music emits certain mechanical waves (vibrations) that can serve as an energy source. The hypothesis encouraged, the piezoelectric element is sensitive enough to detect the sound waves by forming simple electric charges that accumulate in certain solid materials in response to the applied mechanical stress. With this simple form of science, the project was established. A series of tests that could demonstrate this were made to prove that music can be used as an alternative source of energy.

COLD PLASMA DETECTION TO HEAL WOUNDS

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Plasma is an ionized gas and the fourth state of matter that typically exists at thousands of degrees Celsius. The solution for the treatment of skin infections is not another drug, and works better than antibiotics: cold plasma. Cold plasmas are closer to room temperatures, and can be touched safely. Oxygen and nitrogen are the key fuels of plasma medical applications, and the gases were examined. The plasma parameters investigated were temperature and density to determine which cold plasma was able to reach a lower temperature and density; applying -500 voltages, to determine which was less harmful to human tissues. The results were obtained using Lab View software. The data was saved in Microsoft Word, Excel, and Mat Lab. The results were collected, analyzed and graphed.

MODEL TO CREATE MORE EFFICIENT ELECTRICAL CARS

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A fuel cell is a device that produces chemical reactions to make electric energy, mixing it with the electric car, which is a type of car that uses electric energy replacing gas as the energy source. This is the mix of future and the present to create a better world. Imagine world with cars that do not use petroleum as source of energy and anyone can have his or her own transportation vehicle. That world began with the invention of the electric car, but this type of car depends on electric energy, which depends on petroleum. The question is how to make a car that does not depend uniquely on fossil fuels? The answer to this question is to mix two types of technology to create more efficient cars that do not depend on fossil fuels: fuel cells and electric cars. For example, if you take the Nissan leaf, any car of Tesla Motors or any other type of electrical car and substitute their recharger battery to a clean and light source of electric energy, one will have a car that will be a more efficient car which will make its own energy from any fuel gas, like propane, methane, natural gas, almost any gas that can hold a flame on.
THE USE OF FREQUENCY METERS ON SMART PHONES TO DETECT GUNFIRE AND REDUCE RESPONSE TIME

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The biggest flaw in today’s law enforcement is the response time. When a crime occurs, it takes an average from 10 minutes to an hour for police to receive a report and investigate it. An hour may not seem like much, but it is more than enough time for a criminal to get away or build an alibi. In order to put an officer on the scene of a crime quickly and efficiently, no longer can individuals rely only on 911 dispatch calls which are sometimes slow and inefficient. Gun related crimes have to be responded to quickly and efficiently by cutting out the middle man. This project proposes just that, by running frequency meters redesigned to detect gunfire on most if not all of the general population’s smartphones. The app itself would notify both the user and the police when it detects a gunshot to provide a more efficient process for which the police can respond to the growing number of gun crimes happening all over the world. This app could by itself decrease gun crime. Although it would not eliminate dispatch calls completely, it would lighten the load making response time for others non gun-related crimes more efficient as well.

COMPARISON BETWEEN NITROGEN AND THE CARBON DIOXIDE GAS

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In this experiment, it was essential to create a sphere made out of wires; the diameter of this sphere was approximately 3 centimeters. The wire sphere was then placed inside the vacuum chamber. Once the vacuum chamber was sealed, a valve was opened which allowed nitrogen gas to enter the chamber. After that, the reactor was turned on and a high voltage was applied to the sphere, thus nitrogen plasma was created. In order to acquire data from this experiment, it was necessary to use the Single Langmuir Probe, a high-tech diagnostic tool used to measure the temperature and density of plasma. This same process was done once more but with carbon dioxide gas. The average temperature of nitrogen was 3.6705 eV and its average density was 0.2463 10^16 particles/cm^3. The average temperature of carbon dioxide was 11.578 eV and its average density was 0.4119 particles/cm^3. In conclusion, carbon dioxide plasma has higher temperature and density than nitrogen plasma.
COMPARISON OF NITROGEN AND ARGON PLASMA PARAMETERS

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Plasma is an ionized gas and it is the fourth state of matter. Using the Inertial Electrostatic Confinement (IEC), a concept for retaining plasma using an electrostatic field, the experiment was conducted in a lab at Polytechnic University. A tin sphere of 1 inch of diameter was created; this sphere was inserted in the IEC chamber, and a gas was injected into the same chamber. At this point, a negative potential was applied to the sphere and measurements of temperature and density of electrons were performed. The plasma was created with two gases, nitrogen and argon; measurements were taken of each one with the Single Langmuir Probe. The hypothesis in this experiment was that if nitrogen and argon are used to create plasma, then the plasma created using argon will be denser and hotter than the plasma created using nitrogen. It was found that the hypothesis was both right and wrong. While the plasma created using argon was denser, it was not hotter; the plasma created using nitrogen was. It was concluded that the plasma created with nitrogen was hotter because nitrogen has less electrons; the electrons were able to be energized more unlike with the argon’s electrons which gathered less energy as there were more.

IEC PLASMA PARAMETERS CHARACTERIZATION BY SLP POSITION

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Mentor: Ramón Rivera Varona, Polytechnic University, San Juan, Puerto Rico.

Plasma is an ionized gas. Inertial Electrostatic Confinement is a concept for retaining plasma using an electrostatic field. The Single Langmuir probe is a device that measures the parameters of plasma which include density and temperature. The purpose of this investigation was to see how density and temperature changed in the different points of the cathode where the Single Langmuir Probe was taking its measurements. In this investigation, the wire sphere is created first and a -500V is applied to the cathode. In the experiment the single Langmuir Probe is moved 0.5 cm each time by each measurement. The highest temperature of 33 eV and density of $1.25 \times 10^{15}$ part/cm$^3$ were obtained outside the sphere. Two areas of hot electron peaks were detected in the energy distribution function. This temperature and densities obtained are great for hardened metals and to start a plasma torch.

DESIGN OF A LOW COST NIGHT VISION DEVICE

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

This project focuses on the development of a compact, low-cost night vision device. The motivation of this project was to enable campers to fabricate their own night vision device out of their old photographic cameras. The camera used on this project had the capability of video which allows for an instantaneous night vision view with the help of an infrared lamp. The camera was adjusted by removing the infrared filter of the lens to enable the infrared lamp to enter the lens of the camera. An infrared light source was created using an array of infrared LEDs connected in series and powered by a single 5V source. In the future this project can be replicated onto a cellular phone to reduce the weight and size of the device. By extending this project to cell phone devices, the availability of night vision technology will be improved.
BANA KINETIC FLOORING

Diego Orlando Llenza Aponte; San Antonio School, San Juan, Puerto Rico.  
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Maintaining a self sufficient Space Settlement (SS) is a difficult task; a fact that poses a challenge for BANA due to the lack of resources in sustaining life for a prolonged time in space. One of the key needs for a SS is energy, since the majority of technology depends on it. Energy could be produced in a SS easily with solar panels, but this is not the only solution for acquiring large amounts of usable energy. Students from BANA SS decided to integrate technology and kinetic energy. The use of large platforms composed of piezoelectric material that generates electricity was proposed when it is compressed by stepping on it. BANA introduced kinetic floors, an efficient way for acquiring electricity in space, based on the Pavegen (TM) system. This research demonstrated that all the floors made up of piezoelectric material generated electricity stored in the same battery where the solar panel’s electricity was held. This innovative redundancy of power storage will aid current flow in BANA by increasing the available power in the settlement producing a great amount of energy in a friendly environmental way.

ISOLATION OF BIOLUMINESCENT BACTERIA IN COASTAL WATERS OF PUERTO RICO

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Research Assistant Mentor: Prof. Yiria E. Muñiz-Costas, José Aponte de la Torre School, Carolina, Puerto Rico.

Marine bacteria that emit luminescence have been found around the world. This bioluminescence can be used as biosensors for the detection of toxins that pollute the ocean water. Puerto Rico is a Caribbean Island that has the Atlantic Ocean at the north and east and the Caribbean Sea on the south and west. The presence of bioluminescent bacteria was investigated by taking samples from eight beaches representing all four cardinal directions: two on the west (Parcelas and Espinal), two on the east (Seven Seas and Punta Santiago beach, Rincón beach and Aguada beach.), two on the north (Chatarra and Escambrón), and two on the south (Guancha and Pozuelo). These samples were diluted and placed in Petri dishes rich in nutrients and, especially Sodium (Na), for the growth of bacterial colonies. The colonies were analyzed in an illuminometer & luminometer to detect if there is bioluminescence.

MOBILE COLORBLIND COMPUTER HARDWARE

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Assistant Research Mentor: Osvaldo Massanet, Universidad del Turabo, Gurabo, Puerto Rico.

Have you ever wondered if you can get a mini-computer in a pair of glasses? This project is based on creating computer monitor glasses that can be carried everywhere one goes. The benefit of this is that a mini-pc it is actually lighter than a desktop or even a laptop. It consists of a circuit giving power to each component making possible to connect auxiliary devices like cameras, optical keyboards and other accessories to be projected. This project gives colorblind-impaired people the opportunity of carrying their own solution for their impairment. The project was focused on them being able to see the names of the colors even if they cannot see the colors.
WAVES – A SOURCE OF RENEWABLE ENERGY

Joshua Meléndez and Michael Ocasio, Caguas Military Academy, Gurabo, Puerto Rico.


The purpose of this project was to create awareness of an energy source that is not being used, thus wasting its potential. This source of energy is produced by the marine currents, the waves and the temperature of the sea. This energy is divided into wave energy, ocean thermal energy and tidal energy. The first, wave energy, is produced by the effect of the wind over the sea surface. Ocean thermal energy is used taking advantage of the difference between the temperature of the surface and the bottom of the ocean. And finally, the tidal energy is based on taking advantage of tides and currents between the high tide and low tide. It needs steep slopes or strong tidal currents. There are only 4 models to absorb energy. The energy of the sea is varied each passing day. This is because the energy production is dependent on the state of the sun or the moon. At night the tides are stronger, depending on the state of the moon. As an example, with a full moon, the waves will be stronger. This may help because the existing technology is advancing very fast. An analysis was made of how much energy this could produce if the full potential of the waves were used, and it was hypothesized that it could produce around 10 percent of the energy that is actually spent.

WIND SPEED AND HEIGHT CORRELATION

Tatiana J. Miranda and James Stuart, Josefa León Zayas High School, Jayuya, Puerto Rico.


The aim of this research was to correlate wind speed and height so they can be used essentially on the installation of wind turbines. A vortex wind sensor anemometer was used to gain the data of wind velocity at specified heights. Hellmann’s exponential law and the wind profile power law relationship were applied. The data obtained from this research can be applied to a wind turbine installation. Vertical wind-speed profiles result in different wind speeds at the blades nearest to the ground level compared to those at the top of blade travel, and this in turn affects the turbine operation. Jayuya is located in the mountainous area of Puerto Rico, where there are many air currents, making wind direction a variable. The wind profile of the atmospheric boundary layer (surface to around 2000 metres) is generally logarithmic in nature. It is best approximated using the wind profile equation that accounts for surface roughness and atmospheric stability. Using the wind profile power law relationship \( \frac{u}{u_0} = \left(\frac{z}{z_0}\right)^{\alpha} \), the results were precise. This research can be useful for meteorological reasons. It can be of importance to wind energy engineers and wind turbine installers in the area.

FLUID ENERGY


Over the past few years, scientists have been researching to find cleaner energy to change the generation of convectional energy. Due to this knowledge, a study of a method to obtain energy by the use of fluids was made. The study consisted of putting 1 electric fan on the inside of a PVC pipe and then pumping non-conducting fluids inside so the fan moved and generated energy. The study, if successful could lead to a way to generate energy from within certain locations of plumbing like vertical pipes where the fluid(s) go downwards. This could help people all over the planet.
COMPARING TEMPERATURE AND DENSITY OF ARGON AND OXYGEN PLASMA

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Research Mentor Assistant: Ángel Vázquez Calvo, Polytechnic University of Puerto Rico, San Juan, Puerto Rico.

Plasma is the fourth state of matter. It is an ionized gas where all the electrons have come loose from their respective particles. The purpose of this study was to determine the density and temperature of plasma produced by argon and oxygen. First a sphere was made and inside the chamber a -500 volt charge was applied and the chamber was filled with each respective gas, the results were calculated and analyzed and it was determined that argon was the hottest and oxygen the densest. The results of the plasma parameters obtained in this experiment were analyzed with Matlab and data acquisition by Labview. In conclusion the hypothesis was supported by the results.

HOW DOES THE DIAMETER OF THE SPHERES AFFECT THE TEMPERATURE AND DENSITY OF THE PLASMA?

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Plasma is considered the fourth state of matter and is actually a "dynamic condition" where neutral gas atoms, ions, electrons and photons exist in a near balanced state simultaneously. The goal of this project was to investigate how the diameter of the sphere (cathode) affects the temperature and density of the plasma. Using Inertial Electrostatic Confinement (IEC), a concept for retaining plasma applying a -500V was performed. Argon is the fuel to be ionized with three different spheres sizes 1", 1.5", and 2". An analysis was done to gather an average temperature of 79.33 eV and an average density of 6.8x10^15 part/cm^3. The hypothesis was: If there is a bigger diameter of the sphere, then the temperature and density of the plasma will be higher. With the information collected, the conclusion was that the bigger the size of the sphere, the higher temperatures of the plasma will be reached, and the smaller the size of the sphere, the more dense the plasma will be.

CREATING A VIRTUAL WORLD WITH THE MIRAGE SIMULATOR MODE ON TEKKOTSU

Keylianie L. Socía Martínez and Joey Pagán Nieves, Ángel P. Millán School, Carolina, Puerto Rico.

Research Mentor: Nicole M. Ortiz García, Universidad de Puerto Rico, Bayamón, Puerto Rico.
Research Mentor Assistant: Joel Ramkhelawan, Universidad del Este, Carolina, Puerto Rico.
Research CO-PI: Dr. Ángel R. Arcelay Gutierrez, Universidad Del Este, School of Science and Technology, Carolina, Puerto Rico.

Tekkotsu (Iron Bones) is an open source framework supporting software. The software is used to program robots that could develop human skills in high level practice. C++ language is the basic tool to program the Tekkotsu robot. Mirage is a virtual world or environment simulator for Tekkotsu that provides the robot with a virtual place where it can be managed without having trouble or incidents that might damage or break Tekkotsu. This program can also be adapted to be run for other simulations, such as a robot or another electronic vehicle that has not been developed yet. The hypothesis for this study was based on the fact that Mirage could create a small city for the robot, which will find and identify buildings for their unique structure or color.
DESIGNING A MOBILE ROBOTIC ASSISTANT

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Juan Herrera, Pedro Aguilar High School, Yabucoa, Puerto Rico.

Research Mentor: Schatzi Miranda, Universidad del Turabo, Gurabo, Puerto Rico.
Research Assistants Mentor: José Barreras and Emanuel Torres, University of Puerto Rico, Humacao, Puerto Rico.

This project focused on the design of a prototype for a mobile robotic assistant that will enable the user to call on the robot using their cellular phone and the robot immediately moves to the user’s location. This project can be implemented across various fields in which something needs to be delivered to a particular location. The robot’s movement is based on GPS coordinates, which he then uses to calculate a path to its requested destination. Arduino is the main processor used for this project because of its ease of use and multiple libraries available to use in programming. To simulate communication between user and the robot, in this prototype, a keypad is included in which the coordinates for the robots’ destination are added as input. DC motors connected in a gearbox are used to enable the robot’s mobility. The design of an AppInventor Android Platform application was completed in order to get the current coordinates of a user. In the future, an RF module can be added to the robot to enable communication without having to input the coordinates via keypad.

PROJECT BORU, THE GAME APP

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The use of mobile games has rapidly increased over the last decade. As reported by Com Score in 2008, 98.4 million persons in the United States and Western Europe are using mobile games. Due to this fact, a new gaming experience was developed. To develop this new experience, the Game Maker: Studio was used. This studio was created in 1999 by Mark Overmars and was written in Delphi (version 7), a high-level, compiled, strongly typed language that supports structured and object-oriented design. Its benefits include easy-to-read code, quick compilation, and the use of multiple unit files for modular programming. Boru, the game, consists of a ball moving arbitrarily through the screen. The objective of the app was to not let the ball reach the bottom of the screen. Once the player touches the bat, the ball is going up till the level is complete and moves on to the next level, and so on. As a future work, a multiplayer mode will be developed where smartphones can synchronize and the user can play the same game in two different smartphones, the ball will be going through a smartphone to another smartphone, like a game of table tennis.
ABSTRACTS
ENVIRONMENTAL SCIENCES

COMPARISON OF THE CONCENTRATIONS OF NITROGEN, PHOSPHORUS AND POTASSIUM ON THE SOIL OF THE MARACUTO STREAM

Anamar Blanes Díaz, José Aponte de la Torre School, Carolina, Puerto Rico.

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Research Assistant Mentor: Rosaliz Rodríguez, José Aponte de la Torre School, Carolina, Puerto Rico.

Nitrogen, Phosphorus, and Potassium are chemicals usually found on soils near a body of water. If these chemicals are found in high levels, they can limit the production of plants in the area where they were found. The purpose of this project was to measure the concentrations of Nitrogen, Phosphorus and Potassium (N.P.K.) on soils from the Maracuto Stream. For this project, three samples from both upstream and downstream were taken. After each sample was taken, the LaMotte Nitrogen, Phosphorus and Potassium (N.P.K.) kit Code. 3-5880 was used. The results found varied depending on the location. Downstream the levels of the chemicals varied between low, medium and high, depending on the soil sample used. Upstream the results were almost the same except they mostly were either low or high. The soil from the upstream area (forested) of the Maracuto Stream was found to be better than the soil from the downstream area (urban) of the river.

CORRELATION BETWEEN WATER QUALITY AND THE PRESENCE OF MOLLUSKS IN BEACHES OF PUERTO RICO

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Water contamination is one of the major environmental issues under study. The water quality of five rocky beaches was tested. Beaches were selected randomly using a GPS. Water was tested onsite, for: pH, ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, alkalinity, carbon dioxide, salinity, and dissolved oxygen. The presence of mollusks was observed. Results showed that Isla de Cabras was the only beach with alarming pollution, including high ammonia, low dissolved oxygen, low pH and high alkalinity. It had no presence of any mollusk.
STABILITY EFFECT OF LIGHT EXPOSURE ON GOLD NANOPARTICLES

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Research Mentor PI: Dr. Oliva M. Primera-Pedrozo. Nanomaterial Science Lab, School of Science and Technology, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor: Marcos R. Rodríguez, Universidad Metropolitana, San Juan, Puerto Rico.
Research Mentor Assistant: Maxine González, Universidad Metropolitana, San Juan, Puerto Rico.

The nanotechnology field shows very promising results in various types of applications such as the medical, bioengineering and electrical fields. Gold nanoparticles (Au NPs) are some of the most commonly used nanoparticles due to the stability and ability to absorb and scatter light effectively. In the biomedical field, gold nanoparticles are used to target tumors and provide treatment. These nanoparticles are usually photosensitive meaning that their stability could be compromised when exposed to prolonged times to light and lower their biocompatibility. Working with living organisms usually requires a sterile environment, which could mean the constant exposition of these nanoparticles to UV light. The specific aim of this research was to evaluate the influences of UV light exposure on the stability of the nanoparticles. An evaluation was also done to observe any change in absorbance. Gold nanoparticles were prepared using a wet synthesis method. HAuCl₄ (gold source) was reduced by tribasic sodium citrate (TSC) that also served as the capping agent. The nanoparticles were then purified in order to eliminate excess reagents and they were characterized using a UV-Visible spectrometer, which also served as the control. Three aliquots were then prepared and each sample was exposed to 20 minutes of a different light, including sterilizing UV light. The NPs were characterized after exposure with the same spectrometer. Results showed no significant change neither in absorbance intensity or wavelength absorbance peak compared to the control. No precipitation or change in color was observed. The Au NPs synthesized in the laboratory proved to be stable even after being exposed to light for a prolonged time. These nanoparticles showed great stability that makes them reliable for bio-applications.

KINETIC ENERGY RECOVERY SYSTEM BENEFITS IN HYBRID CARS

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Research Mentor: Prof. Yiria E. Muñiz Costas, José Aponte de la Torre School, Carolina, Puerto Rico.

It is a worldwide mission to have lower pollution percentages on Earth by having a full hybrid car. The purpose is to try to avoid the use of fuel in cars nowadays. The kinetic energy recovery system (KERS) is currently being used in modern Formula One cars. The KERS system is a flywheel made of steel and carbon fiber that rotates at over 60,000RPM inside an evacuated chamber. This system’s flywheel is connected to the transmission of the car on the output side of the gearbox via several fixed ratios in the clutch and a continuously variable transmission. This system is currently used at 60 KW power transmissions in either storage or recovery, but the system has a 400 Kj of usable storage. The system uses the kinetic energy created when braking and it goes through a wired connected to the KERS Device to store it. Nowadays, hybrid cars use fuel at a certain speed but they use electricity at lower speeds. This system weights about 25 Kg, and it has a total packaging volume of 13 liters. With this system, it would have to possibility to support a fully electric car helping the economy and lowering the pollution levels.
THE EFFECTS OF URBANIZATION ON FRESHWATER QUALITY

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It is believed that urbanization can have some effect on freshwater quality. This work analyzes how urban development is one of the main causes for the diminishment of the quality of water. The purpose of this study was to validate if the quality of the water was affected by the growth of the cities around rivers, streams, lakes and aquifers. In these systems, the water’s management should be special so that its quality is preserved. A series of analyses were carried out in the water of two rivers: the Maracuto River located in Carolina, P.R. and the Puerto Nuevo River located in San Juan, P.R. Valuable information to perform this research was the observation of the ways that the analysis factors affect the erosion and sedimentation, the stem flow in urban areas and the spilling of the drainage on account of the urbanization. The evidence from the Maracuto River was from the downstream and upstream part of the river. The results showed that human activity has a direct impact on the quality of the water.

HYDROGEN, THE MOST VIABLE OPTION TO ELIMINATE DEPENDENCE ON FOSSIL FUELS


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Hydrogen is a gas present in the air mixed with the oxygen that is breathed. It is the most abundant element in the environment. Hydrogen is the first element of the periodic table, represented by the symbol H and the atomic number 1, because it is in the IA group and acts as a metal. It is less polluting than gasoline and does not emit pollutants into the environment. The purpose of this research was to become aware of the fact that less contaminant fossil fuels in transportation systems can replace conventional gasoline. Another alternative to the problem of replacing gasoline is bio-oil which is made from seaweed, among others. One of the main benefits of using hydrogen as an energy source is that it can be an energy source for computers and entire schools, and one of the consequences is that the formation of various compounds such as water and their separation requires large amounts of energy whose production pollutes in most cases. This change in the economy would consist of the reduction of $4 billion annually. It began in the United States with the Hydrogen Fuel Initiative in 2001 with President George Bush and the help of Governor Arnold Schwarzenegger. It turns out that one of the problems facing this change is that a gallon of gasoline has 17 times the energy capacity than the same volume of hydrogen (uncompressed); therefore, 17 billions units of hydrogen are needed to replace gasoline. Hydrogen has been called the fuel of the future because it is cleaner, abundant and easier to find, in contrast to gasoline, which is not any of the last three. Hydrogen is naturally essential for planet Earth.
EFFECTS OF SILVER NANOPARTICLES ON BEAN PLANTS

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Silver nanoparticles (Ag NPs) have certain properties that make them useful in a vast range of applications. Their thermal and electrical properties make them good for photovoltaics. They also exhibit unique optical properties that make them good sensors among other uses. These nanoparticles have proven to be so useful that some types have already been commercialized. However, some studies show that unstable nanoparticles are toxic due to the release of silver ions, which in large quantities can be harmful to life. To this day, no official laws or regulations have been passed regarding the industrial waste management of these nanoparticles. In this investigation, research was conducted on the effects that Ag NPs have on bean plant development. The nanoparticles were synthesized via wet chemistry by reducing silver nitrate (AgNO₃) with tribasic sodium citrate, also the capping agent. Five concentrations were done diluting with different quantities of water. The synthesis was then characterized in a UV-Vis spectroscopy. Beans were then chosen according to their weight (m=.30g - .39g), color and size. They were covered in cotton balls and planted in petri dishes and treated under the same conditions, adding 1mL of each dilution daily for a period of 5 days. Color, size and general development were considered. All the plants germinated and grew, and results showed no serious effect overall, although small changes in color and leaf development were observed. Silver nanoparticles have no growth effect on this type of plant on a short period time, but color change can be seen and this could lead to more adverse effects. A more prolonged study and bioaccumulation studies are recommended to determine toxicity.

EFFECT OF CLIMATE CHANGE ON THE MACROINVERTEBRATE POPULATION

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Research Assistant Mentor: Rosaliz Rodríguez, José Aponte de la Torre School, Carolina, Puerto Rico.

The Maracuto River located in Carolina, Puerto Rico, was visited prior to a significant rain event. Macroinvertebrates were collected and data of the temperature and pH were taken, along with water samples to measure nitrogen, phosphorus and total suspended solids. After the passing of a storm event or significant rainfall the river was again visited twice to determine how the macroinvertebrate populations were affected. After significant rain events, the macroinvertebrate populations were greatly reduced and there was a great presence of catfish, indicators of pollution. Macroinvertebrates populations were significantly affected after the intermittent rain event and climate change.
EFFECT ON CLIMATE CHANGE IN MACROINVERTEBRATE POPULATION IN THE MARACUTO STREAM

Melanie Quiñones, José Aponte de la Torre School, Carolina, Puerto Rico.

Research Mentor: Yiria E. Muñiz Costas, José Aponte de la Torre School, Carolina, Puerto Rico.

This study focuses on identifying how climate change affects reproduction. There was presence of bioluminescence bacteria in two out of the macroinvertebrates populations of the classes: Insecta, Gastropoda, Malacostraca and Arachnida. Three collections of macroinvertebrates were performed in the Maracuto River located at Carolina, Puerto Rico. The first collection took place at the beginning of the storm season in Puerto Rico. The second and third collections were performed after a significant rainfall event. These three collections of macroinvertebrates were compared with the first collection in eight beaches. This was conducted prior to the passage of the storm Sandy through the Caribbean in late October 2012. The decrease in the reproduction of macroinvertebrates was evident. There was no correlation between the first and the third pickup. Several average colony forming units, water physical-chemical parameters such as pH chemistry, and temperature were performed at each visit to the river. There was detection of bioluminescent colonies in the beaches, suggesting that results do not determine what factors cause the apparition of these bacteria.

AR-10, THE WEAPON OF THE FUTURE THAT CAN END A WAR BEFORE IT EVEN STARTS

Ronald Rivera Torres, San Benito School, Mayagüez, Puerto Rico.


Just imagine a weapon that can neutralize an entire country without using a nuclear explosion or killing anyone. The AR-10, an Electromagnetic Pulse (EMP) generator is presented in this project. It is quite well known that the EMP already exists, but the problem is that it is only produced by a nuclear blast, which does not only kill thousands of people but also leaves a high level of radiation in the atmosphere. To solve this problem, a plan was made to design a mobile molten salt reactor (MSR) that will be able to charge the EMP. The energy resource is Thorium, a life time energy supply in the palm of anyone’s hand. This research project expects that Thorium can power an EMP generator capable of fitting on a vehicle. But to make this possible, it is required to make a reactor fit on a vehicle. Thorium does not need water to produce energy limiting the amount of required space. If in the near future the relations between U.S. and other nations fail and a nuclear war threat is imminent, the AR-10 can be used to attack the weakest areas of the enemy nation such as stock exchanges, disabling the computer systems that operate in the building weakening the nation’s economy, forcing it to withdraw. It is expected that this technology can be small, easy to carry out, mobilize, build and capable of disabling entire buildings making it the most terrifying weapon in the hands of any country.

BIOMASS AS A RENEWABLE ENERGY

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Research Mentor: Prof. Yiria E. Muñiz Costas, José Aponte de la Torre School, Carolina, Puerto Rico.

Biomass is biological material derived from living, or recently living organisms. This can be applied equally to animal or vegetable derived materials. The difference between fossil fuels and biomass is that of a different time scale, affecting the amount of energy each one produces. It is considered to be carbon-neutral because it uses the sun’s energy to absorb the same amount of carbon from the atmosphere as it releases during combustion, therefore making it a common and numerous energy source when submitted to chemical processes. The main objective of this research was to study biomass as a renewable energy. No overall increase in levels of CO₂ indicates this is a good resource for a cleaner and healthier energy source. Raw materials used for biomass are widely available in many sources and numerous forms since waste and decaying objects create methane gas, which is a gaseous energy source. Wheat, corn, and other crops may be used to extract different numbers of liquid fuels.
ABSTRACTS
PSYCHOLOGY

ARE VIOLENT VIDEO GAMES CAUSING VIOLENCE BETWEEN SOCIALLY MISGUIDED KIDS BY THEIR FAMILY?

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Research Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico. 
Research Assistant Mentor: Kevin Marrero, San Benito School, Mayagüez, Puerto Rico.

Violent Video Games, such as Call of Duty, Halo, Gears of War, GTA, and other 1st and 3rd person shooter games have been the most popular games for modern gamers. These games encourage the player to kill and cause chaos. Many people, including teenage children, own these games, which are rated as M for Mature (17 years and up) by the Entertainment Software Rating Board (ESRB). Video games are said to be like training simulators that help an individual in hand and eye coordination in real life, enhancing the ability of someone to use a gun, for example. These games are being blamed for all the violence between children nowadays, but there are other things that influence violence in children’s minds, such as movies, books, TV shows, society, and other media. Most of the youth have been misguided, according to the general public, due to the addiction they might have to video games, but mental illness is not the reason behind this problem. The objective for this research was to suggest that video games are not the main cause for violence among young people. Some questions have been examined such as: why are parents not being responsible with the games they buy for their children and why are children getting more and more violent? Behavior between parent and children will be discussed in this project such as the dominance some children have over their parents both in the store and at home. It is very obvious, scientifically and socially, that those kids are not being controlled by their parents if the little interest they have for what their children do or watch is shown.
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 2013 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 2013 Pre-College Research Symposium possible.

**Keynote Speakers:**

Dr. Ruth Castellanos, University of Virginia-Charlottesville
Dr. Sarwan Dhir, Fort Valley State University

**Judges and Session Chairmen:**

Juan M. Aguayo, Traikon Associates LLC
Felipe Alvear, Universidad del Turabo
Javier Antonsanti, Santa María del Camino School
Yarelis Ares, Universidad del Turabo
Jorge A. Arroyo, Universidad Metropolitana
Rima Asmar, Polytechnic University
Nomar Avilés, Universidad del Turabo
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