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

WINTER 2014 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

SHERATON PUERTO RICO CONVENTION CENTER HOTEL

SAN JUAN, PUERTO RICO

NOVEMBER 22, 2014
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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. One NSF grants, the AGMUS Institute of Mathematics, is the funding tool to implement the mission of the Student Research Development Center in Puerto Rico.

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 transferred 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 grant, the AGMUS Institute of Mathematics goals are reaching institutions outside the AGMUS campuses in Puerto Rico and the US Virgin Islands.

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.
**SUNTRIP 2014 PRE-COLLEGE RESEARCH SYMPOSIUM**

**CONFERENCE AT A GLANCE**

<table>
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<tr>
<th>SATURDAY, NOVEMBER 22, 2014</th>
<th>SHERATON CONVENTION CENTER HOTEL</th>
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<tr>
<td>7:30–9:00 a.m. Registration</td>
<td>Paseo San Juan Foyer</td>
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<tr>
<td>Breakfast</td>
<td>San Juan Corridor</td>
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<tr>
<td>Poster Session Set-Up</td>
<td>San Juan 5-8</td>
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<tr>
<td>7:45–8:45 a.m. Judges Meeting</td>
<td>San Felipe</td>
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<tr>
<td>9:00–9:20 a.m. Opening Ceremony</td>
<td>San Juan 1-4</td>
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<tr>
<td>Dr. Noora Partamies</td>
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<td>Finish Meteorological Institute</td>
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<tr>
<td>Helsinki, Finland</td>
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<tr>
<td>9:20–11:10 a.m. Poster Session</td>
<td>San Juan 5-8</td>
</tr>
<tr>
<td>11:00–11:30 a.m. Coffee Break</td>
<td>San Juan Corridor</td>
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<tr>
<td>11:00–1:20 p.m. Oral Research Presentations</td>
<td>San Felipe</td>
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<tr>
<td>Session I</td>
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<td>Session II</td>
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<tr>
<td>1:20–3:20 p.m. Lunch</td>
<td>San Juan 1-4</td>
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<tr>
<td>Summer 2014 Pre-College and Undergraduate Students</td>
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<tr>
<td>3:20–4:00 p.m. Awards Ceremony and Closing Remarks</td>
<td>San Juan 1-4</td>
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<tr>
<td>4:00 p.m. Symposium Adjourns</td>
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**Workshops for Teachers**

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<tr>
<th>11:00–4:00 p.m.</th>
<th>“The Beauty and Joy of Computing” (BJC)</th>
<th>San Gerónimo</th>
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<tbody>
<tr>
<td>Ms. Claribel Perez, Teacher</td>
<td>sponsored by North Carolina State University, Raleigh, “Star Alliance”</td>
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</table>
November 22, 2014

Dear students, teachers and parents:

On behalf of the Ana G. Méndez University System (AGMUS), welcome to the Winter 2014 Pre-College Research Symposium to be held at the Sheraton Puerto Rico Convention Center Hotel in San Juan, Puerto Rico. This is an event organized by the Student Research Development Center of the Ana G. Méndez University System (AGMUS).

It is both a privilege and an honor to have contributed to the development of the careers of young scientists. The number and the quality of the research projects presented by such a talented group of student researchers makes us very proud. The learning students have acquired through these experiences will pave the way for their future in the fields of science, technology, mathematics and engineering (STEM).

We thank all of those who have supported our young researchers with unique opportunities to expand their knowledge. Congratulations to all of the participants who have worked very hard in excellent research projects and have shared their knowledge with parents, teachers, and the scientific community. Our deepest thanks to the faculty mentors for their commitment and contributions in the development of the future scientists and engineers of our nation.

Sincerely,

[Signature]

Jorge L. Crespo Armaza, Ph. D.
Vice President for Planning and Academic Affairs
November 22, 2014

Dear participants:

Universidad Metropolitana (UMET) is honored to be part of the Winter 2014 Pre-College Research Symposium organized by the Ana G. Méndez University System (AGMUS) Student Research Development Center. UMET is an institution that is known for providing support to early scientific research activities in Puerto Rico. We are very proud of promoting the strengthening of students' skills with research experiences and outcomes disseminated in oral and poster presentations.

The focus of this activity is to motivate you, young aspiring Hispanics, to become involved in the wonderful world of science, technology, engineering and mathematics (STEM). It is also expected that as you become part of the scientific world, you will choose to pursue careers in STEM fields.

Our appreciation goes to the National Science Foundation through the AGMUS Institute of Mathematics grant. We also thank the researchers and the mentors who guided the students at different facilities and supported this important activity to produce young researchers.

Congratulations to all of you participants for your outstanding research projects.

Sincerely yours,

Carlos M. Padín, Ph. D.
Chancellor
November 22, 2014

Dear students,

Universidad del Este welcomes you to the Winter 2014 Pre-College Research Symposium, an experience that will change your life as you participate in presenting the outcomes of your research experiences in poster and oral sessions. We support undergraduates and pre-college students from Puerto Rico who seek opportunities to work towards careers in the science, technology, engineering and mathematics (STEM) fields.

This symposium is organized by the Student Research Development Center of the Ana G. Méndez University System (AGMUS) with the purpose of disseminating the research work of students who have worked in the Pre-College Program. It highlights the importance of sharing the research conducted by all of you, talented high school students who dedicate long hours to scientific endeavors.

The projects you have prepared are true testimonials of this wonderful episode in your journey through high school and early college life. This experience will spark further interest in higher education and a fascination with research and inquiry as you pursue a future career in science.

Our congratulations to all of you who have succeeded in making science an important part of your life.

Yours truly,

Alberto Maldonado-Ruiz
Chancellor
November 22, 2014

Dear students, teachers and parents:

The Ana G. Méndez University System (AGMUS) and Universidad del Turabo (UT) welcome you to the Winter 2014 Pre-College Research Symposium at the Sheraton Puerto Rico Convention Center Hotel in San Juan, Puerto Rico. AGMUS is honored to host an event of this importance organized by the AGMUS Student Research Development Center.

The Winter 2014 Pre-College Research Symposium is a one-day event consisting of the presentation of research projects whose outcomes are shared with parents, teachers, other students and the scientific community. This Symposium promotes the participation and supports the hard work of high school students who have dedicated many hours to the preparation of research projects that may make a difference. Their decision to work with science is a testimonial of the importance of science in their lives.

The support provided by the research mentors who guided the students at Universidad del Turabo facilities and set the foundation for the fruitful research experiences that our students completed is fully appreciated. Their accomplishments make us proud of being able to provide a pathway to a future career in science.

Sincerely,

Dennis Alicea, Ph.D.
Chancellor
November 22, 2014

Dear Pre-College Students:

The Winter Pre-College Research Symposium is the culmination of the activities and dissemination process of the Saturday Academy Program of the Ana G. Méndez University System (AGMUS). For a period of four months, since August 2014, all of you, two hundred nineteen pre-college students from forty-six private and public high schools in Puerto Rico worked long hours in the research laboratories of the AGMUS campuses, Manuel Méndez Liciaga Vocational School-San Sebastián, Bautista de Puerto Nuevo Academy, CROEM High School- Mayagüez, Southwestern Educational Society School (SESO)-Mayagüez and four schools in Finland, with the guidance and mentorship of thirty-seven professors and student research mentors in one hundred fifty-six research projects in the areas of applied mathematics, astronomy, atmospheric sciences, biology, bio-mathematics, bio-statistics, computer sciences, engineering, environmental sciences, and genomics.

One of the objectives of the Winter 2014 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 Winter 2014 Saturday Academy Program and the Winter 2014 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 the student research mentors for their effort and commitment to implement the Winter 2014 Saturday Academy Program and the Winter 2014 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
ANA G. MÉNDEZ UNIVERSITY SYSTEM (AGMUS)

As an Educational Institution

The Ana G. Méndez University System (AGMUS) is home to approximately 45,000 undergraduate and graduate students who are mainly underrepresented low-income minority students from the Metropolitan San Juan area in Puerto Rico. Three institutions form the AGMUS University System: Universidad Metropolitana (UMET), Universidad del Este (UNE), and Universidad del Turabo (UT). UMET has been a teaching institution since its foundation in 1948. Today, however, its philosophy has been changing to address the students’ study needs and the requirements of society. Our President, 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 ten years, a symposium has been organized to present the results of this activity to the university community and to motivate other Puerto Rican students to engage in scientific research.

The Winter 2014 Pre-College Research Symposium showcases the research experiences of two hundred nineteen (219) pre-college students from public and private high schools from Puerto Rico and Finland. 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 Winter 2014 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.
Dr. Noora Partamies is a space physicist at the Finnish Meteorological Institute (FMI) in Helsinki, Finland. She received her PhD from the University of Helsinki in 2004, and achieved a post-doctoral fellowship at the University of Calgary for the following three years. While in Canada she has been participating in auroral imaging campaigns in the Canadian arctic. During her MSc and graduate studies she was an exchange student and a Marie Curie trainee in the northernmost university, the University Centre on Svalbard, located in the Norwegian high arctic in Longyearbyen (78 N). Currently back at FMI, Dr. Partamies is the Principal Investigator of the auroral camera network in Fennoscandia and Svalbard. Her main research interest is in image analysis applications on auroral observations as well as space weather responses in the high-latitude ionosphere. In addition to science and instrument network operational duties, Dr. Partamies has been involved in space physics teaching at the university level and a number of high-school science education projects, such as the space camp for Puerto Rico this year. Outside the work hours, Dr. Partamies is an outdoor enthusiastic and participates in musical ensembles.
ANA G. MENDEZ UNIVERSITY SYSTEM
STUDENT RESEARCH DEVELOPMENT CENTER
CARIBBEAN COMPUTING CENTER FOR EXCELLENCE

North Carolina State University, Raleigh, “Star Alliance” and the Caribbean Computing Center for Excellence invites you to participate in the workshop for teachers:

The Beauty and Joy of Computing

Offered by:
Ms. Claribel Pérez
Computer Science Teacher

Date: Saturday, November 22, 2014
Time: 12:00-5:00pm
Place: Sheraton San Juan Hotel & Casino at the Convention Center District
San Juan, Puerto Rico

For registration, please contact Ms. Wanda Rodríguez at:
Tel: (787) 766-1717, x-6009
Email um_wrodrigu@suagm.edu

All participants attending the workshop will receive a $50.00 stipend. Please confirm.

Limited spaces (20).
Parking not included.
ANA G. MÉNDEZ UNIVERSITY SYSTEM
STUDENT RESEARCH DEVELOPMENT CENTER
AGMUS Institute of Mathematics

PRE-COLLEGE PROGRAM
SATURDAY RESEARCH ACADEMY
SPRING 2015

RESEARCH OPPORTUNITIES FOR
GRADE 10, 11 AND 12 STUDENTS

STARTING DATE: JANUARY 17 – MAY 9, 2015
WORKING HOURS: 8:00am – 12:00n
PRE-COLLEGE RESEARCH SYMPOSIUM: MAY 9, 2015

AGMUS INSTITUTE OF MATHEMATICS SATURDAY ACADEMY SITES:
UMET, UNE, TURABO,
RESEARCH AREAS: BIO-MATHEMATICS, BIO-STATISTICS AND APPLIED MATHEMATICS

FOR MORE INFORMATION CONTACT:
Wanda I. Rodríguez, Institute of Mathematics Coordinator
TEL. 787.766-1717 ext. 6009, 6945
EMAIL. um_wrodrigu@suagm.edu

Requirements:
• GPA ≥ 3.0 or higher.
• Submit an online application.
• Two letters of recommendation from your science or math teachers.
• Authorization form of your parents.
• Authorization form of your school.
• Official transcripts from school.

IM Online Application: http://www.suagm.edu/umet/im/precollege/index.asp
# SCHEDULE OF EVENTS

**SATURDAY, NOVEMBER 22, 2014**

**SHERATON PUERTO RICO CONVENTION CENTER HOTEL**

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<th>Time</th>
<th>Event</th>
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<td>7:30 – 9:00 a.m.</td>
<td>REGISTRATION</td>
<td>Paseo San Juan Foyer</td>
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<td></td>
<td>Breakfast</td>
<td>San Juan Foyer &amp; Corridor</td>
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<td>POSTER SESSION SET-UP</td>
<td>San Juan 5-8</td>
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<tr>
<td>7:45 – 8:45 a.m.</td>
<td>Judges Meeting</td>
<td>San Felipe</td>
</tr>
<tr>
<td>9:00 – 9:20 a.m.</td>
<td>OPENING CEREMONY</td>
<td>San Juan 1-4</td>
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**7:30 – 9:00 a.m.**

- **REGISTRATION**
  - Breakfast
  - POSTER SESSION SET-UP

**9:20 – 11:00 a.m.**

**APPLIED MATHEMATICS, APPLIED PHYSICS,**
 **ASTRONOMY, ATMOSPHERIC SCIENCES,** **BIOLOGY, BIO-MATHEMATICS,** **BIO-STATISTICS,** **COMPUTATIONAL CHEMISTRY,** **COMPUTER SCIENCES,** **ENGINEERING,**
 **ENVIRONMENTAL SCIENCES,** **GENOMICS,** **AND PSYCHOLOGY**

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

**APPLIED MATHEMATICS**

- **Isaac Berríos Villanueva,** C.R.O.E.M. High School, Mayagüez, Puerto Rico.  
  Determining a Number with Equal or Similar Properties as PHI

- **Alanis Del Mar Morales Cuadrado,** CROEM High School, Mayagüez, Puerto Rico.  
  The Math Behind Music

- **Herionexy Mounier,** CROEM High School, Mayagüez, Puerto Rico.  
  Polygons

Applied Math for Comparative Analysis of Coliform Organisms in Beaches


Using Artificial Synthesis to Produce Hydro-Energy

Angelic M. Arzola Roig, CROEM High School, Mayagüez, Puerto Rico.

Lunar Effects on Earthquakes


Sunspots Theory

Jemarie Negrón Losada, CROEM High School, Mayagüez, Puerto Rico.

Stellar Parallax

Jeiselynn N. Ríos Rivera, CROEM High School, Mayagüez, Puerto Rico.

Stellar Spectroscopy

Alejandro J. Vázquez López, CROEM High School, Mayagüez, Puerto Rico.

Possible Effects of the Asteroids 99942 Apophis and (35396) 1997 XF11 on Earth

ATMOSPHERIC SCIENCES

Antonio R. Águila Suárez, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico.

Creating a Smart-Room Application Gadget


Nanobots Cancer Treatment Development

Javier O. Medina Sánchez, CROEM High School, Mayagüez, Puerto Rico.

The Effect of the Sun’s Rays on Mycosphaerella fijiensis

Laura Oliver Martínez, C.R.O.E.M. High School, Mayagüez, Puerto Rico.

Bioremediation Capability of Soils
Lizbeth M. Plaza Torres, CROEM High School, Mayagüez, Puerto Rico. 15

Water Precipitation and Lighting at CROEM

Kevin I. Román Nieves, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico. 16

Developing a Low-Cost 3D Printer

Karla G. Rosado De Jesús, Segunda Unidad Sabana Hoyos School, Arecibo, Puerto Rico. 17

Photovoltaic Energy Application for Industry

Manuel A. Torres Adorno, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico. 18

Development of a Drone to Study Earth’s Geodesy

Paola N. Velázquez Román and Eddie Y. Ortiz Marrero, CROEM High School, Mayagüez, Puerto Rico. 19

Haze and its Relation with the Atmospheric Changes and Diseases

BIOLOGY

Marcos A. Del Valle, Southwestern Educational Society (SESO), Mayagüez, Puerto Rico. 20

No show

Bryan A. Fuentes Reyes and Pedro O. Méndez Fernández, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. 21

Cystic Fibrosis

Alvin Gutiérrez, Southwestern Educational Society (SESO), Mayagüez, Puerto Rico. 22

What Happens When Defective Genetic Material is Passed Down from One Generation to Another?

María A. Limardo González and Alejandro Díaz, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. 23

A Home Remedy for the Treatment of Acne

Salliam Pando Estrada and Bradley M. Morales Justiniano, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. 24
No Show

**Leishla Marie Pérez**, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

How Much of the Brain Gets Eaten Away by Huntington Disease?

**Ambar Pumarada Gamboa**, Southwestern Educational Society (SESO), Mayagüez, Puerto Rico.

The Positive and Negative Effects of Gene Mutation and their Unknown Interactions with Prescription Drugs

**Ambar Pumarada Gamboa**, Southwestern Educational Society (SESO), Mayagüez, Puerto Rico.

The Positive and Negative Effects of Gene Mutation and their Unknown Interactions with Prescription Drugs

**Adriana Severino, Stacey E. Defilló Hernández**, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

The Mystery Mosquito

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**BIO-MATHEMATICS**

**Lauren Anglada Pagán**, Instituto Modelo de Enseñanza Individualizada (IMEI), San Juan, Puerto Rico

**Mariana G. Robles Rondón**, Bilingüe Padre Rufo School, San Juan, Puerto Rico.

Oil Consumption in the United States


The Analysis Mutation Probability of Amino Acid Sequence in the Notch3 Gene by Using SIFT

**Derek Champlin Ayala and Wilmaris Rivera Medina**, Josefina León Zayas School, Jayuya, Puerto Rico.

The Effect of Electricity on Plants: Stage 2

**Viviana De Jesús Morales**, University Gardens High School, San Juan, Puerto Rico.

Mathematical Model: Number of Forests as a Function of Time

**Briyanna N. De’Shea Hughes**, Luterano Resurrección School, Carolina, Puerto Rico.
The Computational Analysis in the Amino Acid Sequence *Muts Homologue 2* Gene by Using SIFT


Analysis of Tolerant Levels in Glycosidase Beta Acid for Amino Acid Substitution by Using SIFT

**Ana B. Ferrer Vega**, University Gardens High School, San Juan, Puerto Rico.

A Mathematical Model for Hearing Depending on Age

**Laura S. García Canto**, University Gardens High School, San Juan, Puerto Rico.

Shoreline Modeling: Illustrating and Predicting Coastal Erosion

**Rubén A. García Reyes**, Christian Nazarene Academy, Toa Baja, Puerto Rico.

Temperature Fluctuations: A Mathematical Model for Global Averages

**Adrián Machado Fournier**, Robinson School, San Juan, Puerto Rico.

Modeling Endangered Species: Their Changes Throughout Time

**Gladayvette Maldonado Pérez** and **Kiara Maldonado Pérez**, Josefina León Zayas School, Jayuya, Puerto Rico.

Facebook Pattern of Use: A Comparison of Middle/High School Versus Post-Secondary Educational Institutions

**Cristina Martes Lugo** and **Claudia M. Ramos Rodríguez**, Josefina León Zayas School, Jayuya, Puerto Rico.

How Can Smoking Affect Relationships?

**Claudia Mulero Fernández**, Notre Dame High School, Caguas, Puerto Rico.

No show

**Giovanni Nazario Arroyo** and **Urayoán A. Torres Pagán**, Josefina León Zayas School, Jayuya, Puerto Rico.

The Need of Stronger and More Fertile Soils to Use in Advances in Agricultural Technology

**Eduardo José Pagán Torres**, University Gardens High School, San Juan, Puerto Rico.
Creating an Encrypted Message Using Circular Prime Numbers and Matrices

Jean A. Pérez Verdejo, University Gardens High School, San Juan, Puerto Rico.

Mathematical Model to Determine the Necessary Voltage on a Citric Electric Circuit

Manuel Rivera Vélez and Mirelys Negrón Ríos, Josefina Leon Zayas School, Jayuya, Puerto Rico.

Do Looks and Smells Affect the Taste of Food?

Christian Romero Vázquez and Gabriel J. Vega Rivera, Josefina León Zayas School, Jayuya, Puerto Rico.

The Use of Allelopathy to Create a Natural Fertilizer

Boris M. Ruiz Pettersson, San Jorge Academy, San Juan, Puerto Rico.

Collatz Conjecture: Processing Massive Integers

Keishla M. Sánchez Ortiz and Josué Martes Villalobos, Josefina León Zayas High School, Jayuya, Puerto Rico.

Allelopathy Effects in a Plant’s Germination

Aryanne C. Torres Ventura, San Juan Bosco School, San Juan, Puerto Rico.

Calculating Probability of Mutation in Amino Acid Sequence of the MUTL Homolog 1 Gene Using SIFT

Rafael Torres, Southwestern Educational Society (SESO), Mayagüez, Puerto Rico.

Is Diabetes Reversible? Yes, One Needs to “Retune” the Body to Respond to it More Effectively by Changing the Lifestyle!

Pedro R. Trinidad Pérez, University Gardens High School, San Juan, Puerto Rico.

Fractal Area: Do Polygons Have Specific Patterns?

BIO-STATISTICS

Studying the Controversy in the Usage of Cannabis

Jean P. Andino Alicea, Inés M. Mendoza School, San Juan, Puerto Rico.

Effects of Physical Activity on the Decrease of Body Fat

Ashneidy Bosques Báez, Manuel Méndez Liciaga Vocational High School, San Sebastián, Puerto Rico.

Studying the Preparation of Individuals in the Presence of an Earthquake

Natalie Camacho Vega, Wesleyan Academy, Guaynabo, Puerto Rico.

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Rita Pagán, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

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William A. Vázquez Colón, Inés María Mendoza School, San Juan, Puerto Rico.

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The Sun, its Long-Term Variations and Influence on Space Weather

Coral Martes Villalobos, Josefina León Zayas High School

11:00 a.m. – 11:30 m.  COFFEE BREAK  SAN JUAN CORRIDOR
11:00 m. – 1:20 p.m.  ORAL RESEARCH PRESENTATIONS
BIO-MATHEMATICS

11:00 – 11:10 a.m.  
Valerie N. Acosta Rodríguez and Ana C. Betancourt Morejón, Bautista de Caguas Academy, Caguas, Puerto Rico.

Application of Voronoi Diagram to Model Patterns of Rain in Puerto Rico

11:10 – 11:20 a.m.  
Louie D. Casanova, Sonifel School, Fajardo, Puerto Rico.  
Michael A. González Villamil, Luterano Resurrección School, Carolina, Puerto Rico.

Analyzing Mutation in Amino Acid Sequence for Niemann’s-Pick Disease Type C1 Gene by Using SIFT

11:20 – 11:30 a.m.  
Michael A. González Villamil, Luterano Resurrección School, Carolina, Puerto Rico.

Analysis of the Probability Substitution Mutation in Amino Acid Sequence of the PKLR Gene by Using SIFT

11:30 – 11:40 a.m.  
María Celeste Rivera Villanueva, Sonifel School, Fajardo, Puerto Rico.

Calculating the Percent of Tolerant and Intolerant Changes to Predict an Amino Acids Mutation by Using SIFT

BIO-STATISTICS

11:40 – 11:50 a.m.  
Keyshaly García Torres and Carlos S. Candelas Torres, Georgina Baquero High School, Canóvanas, Puerto Rico.

Analizing Lamin A/C Gene Mutations by a Homology Based Tool

11:50 – 12:00 m.  
Bárbara B. Hernández Rovira, Southwestern Educational Society (SESO), Mayagüez, Puerto Rico.

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12:00 – 12:10 m.  
Vilmette M. Mendoza Mimo, Mater Salvatore School, San Juan, Puerto Rico.

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Mathematical Models to Determine the Quantity of Three Necessary to Balance the Co2 Contamination.


Measuring Sleep Efficiency in Obstructive Sleep Apnea Patients


Analysis of Gene Mutation Probabilities in *Potassium Voltage-Gated Channel, Subfamily H (EAG-Related), Member 2 (KCNH2)*

12:40 – 12:50 m.  **Andrea N. Sánchez Malavé** and **Yaniel Rodríguez Ortiz**, Miguel Meléndez Muñoz High School, Cayey, Puerto Rico.

Statistical Analysis of Traffic in Peak Hours in a School Zone of Cayey, Puerto Rico

**COMPUTER SCIENCES**

12:50 – 1:00 p.m.  **Javier A. Ortiz García**, CIMATEC School, Caguas, Puerto Rico.


Cyberescape: Teaching Code Through Gaming

1:00 – 1:10 p.m.  **Jordan N. Torres Pérez**, CROEM High School, Mayagüez, Puerto Rico.

Math Learning Aid
11:00 – 1:10 p.m. | ORAL PRESENTATIONS | SAN CRISTOBAL
SESSION II
APPLIED PHYSICS, ATMOSPHERIC
SCIENCES, ASTRONOMY AND GENOMICS

Chairperson: Dr. Ángel Arcelay, Universidad del Este

11:00 – 11:10 a.m. | Marcel F. Corchado Albelo, C.R.O.E.M. High School, Mayagüez, Puerto Rico.
Time Dilation

11:10 – 11:20 a.m. | Marcos Joel Marrero Maldonado, CROEM High School, Mayagüez, Puerto Rico.
The Best Electricity Conductor

ATMOSPHERIC SCIENCES

11:20 – 11:30 a.m. | Pedro A. Martínez Machado, CROEM High school, Mayaguez, Puerto Rico.
Device that Measures the Sun’s Energy

ASTRONOMY

11:40 – 11:50 a.m. | Jesús N. Soto, CROEM High School, Mayagüez, Puerto Rico.
For the Discovery of Exoplanets

GENOMICS

11:50 – 12:00 m. | Geraldine Ayala-Sánchez, José E. Aponte De La Torre School, Carolina, Puerto Rico.
Tau Protein and the Negative Effect it has on Our Minds

12:00 – 12:10 m. | Ingrid N. Caraballo López, Fajardo Community Private School, Fajardo, Puerto Rico.
Mutation Probability in Atopic Dermatitis Disease

Mutation Probability in Amino Acid Substitutions in the Interferon Regulatory Factor 6 (IRF-6) Using SIFT
12:20 – 12:30 m.  **Julynice A. Cruz Ramos**, María Reina Academy, San Juan, Puerto Rico.
Rare Disorders: Neurofibromatosis Caused by the Neurofibronim Gene

12:30 – 12:40 m.  **Alexa Pérez Torres**, Bautista de Caguas Academy, Caguas, Puerto Rico.
Analysis and Susceptibility of the “HFE” Gene Regarding Hemochromatosis

Probability of Suffering a Cardiac Arrhythmia According to Genetic Patterns in the Family

12:50 – 1:00 p.m.  **Bianca P. Santiago Figueroa**, Nuestra Señora de Guadalupe School, San Juan, Puerto Rico.
The Biogenetic Effects of Beta-Amyloid on Alzheimer’s Disease

1:00 – 1:10 p.m.  **Samuel Serrano-Tapia**, Fajardo Community Private School, Fajardo, Puerto Rico.
Determination of Mutation of *Dystrophin* by Amino Acid Change Analysis
**ABSTRACTS**

**APPLIED MATHEMATICS**

**DETERMINING A NUMBER WITH EQUAL OR SIMILAR PROPERTIES AS PHI**


Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

This research aimed to find a number with properties similar or equal to the properties as the constant Phi. This study determined a number with equal properties as Phi and other values with, not equal to, but similar properties, as the constant Phi. The methodology of the study permitted to use equations that showed different properties of the new number and compared them to the constant Phi easily. These numbers were equal in properties as they were equal in equations too but with different values. In-depth demonstrations exposed that this new values can be used as a new kind of proportion making new applications in math. All of the results showed that this number has equal properties as Phi, being a different number, and also that it has different proportions. Another finding is that other numbers with, not equal to, but similar properties as the constant Phi and new proportions that can be used in math too. A good application in science is that the obtained number can be used not only in math, but also in anatomy. In the future, an equation like this could be used to make a program or an app for mobile users.

**THE MATH BEHIND MUSIC**

Alanis Del Mar Morales Cuadrado, CROEM High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

Music is the compass of the rhythm that has been thought of as something completely opposite to math. Therefore, for this research, mathematical concepts were found in musical theory. In the study math was found everywhere in music but the purpose of this study was to find math in the musical notation. The musical notation system uses written symbols to visually represent music. There were important terms presented for this research, like the beat or steady, rhythmic, recurring pulse based on time. Rhythm, a systematic arrangement of musical sounds, is based on fractions. All rhythmic terminology is based on a bar containing 4 beats. A bar is what keeps music in place. Each of the musical notes was identified in this research. Afterwards, the research showed how many beats each notes had. Lastly, an equation was made to understand more the musical notation as a whole. The study also looked for segments of songs to create a visual.
POLYGONS

Herionexy Mounier, CROEM High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

The Hero's formula was invented to calculate the area of a triangle by Hero of Alexandria in 150 B.C., in the book *Metrica*. This formula was analyzed to develop a new model to calculate the area of any polygon. This method considers a polygon as the sum of different triangles to find the area of any regular polygon. Ten (10) demonstrations were made to prove the method and find cases that fit the criteria. The use of Hero’s formula, permitted to demonstrate and conclude general equations of areas from 3 to 10,100 and 1,000 sides, respectively. Then, the formulas were evaluated and analyzed as a function, as areas of the figures, depending on the number of sides. After analyzing this function, other cases were made to prove that the areas formed by the triangulation of each side of the polygon, with the radius of the circle, is equal to the general equation of the area of any regular polygon. After this, it was demonstrated that the general formula for any regular polygon is: \[ A = n(s - r)\sqrt{s(s - a)} \], where \( n \) is the number of sides of the figure, \( s \) is the measure of the semi perimeter, \( r \) is the length of the radius, and \( a \), the length of a side of the polygon.

APPLIED MATH FOR COMPARATIVE ANALYSIS OF COLIFORM ORGANISMS IN BEACHES


Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

One of Puerto Rico’s best touristic assets is the abundance of beautiful beaches. Tourists flock to the island from all over the world to enjoy them. People bathing in contaminated water will get sick and be prone to infections that can eventually affect the wellbeing of the entire Puerto Rican community. The bacteria caused by excrements can cause death and induce the mortality rate to skyrocket. This will also minimize the tourism received annually, something Puerto Rico’s economy heavily depends on. The purpose of the study was to analyze the amount and correlation of coliforms in different beaches in Puerto Rico. The use of ANOVA and Student’s t-test were applied as an integral part of beach management statistics. The ANOVA test is a parametric test and as such requires a number of assumptions to be applied correctly. The ANOVA or analysis of variance was used to study the dispersions or variances of the groups, and also their average and the ability to create subsets of groups with equal averages. The student's t-test is a statistical method that is used to see if there are differences between the means of the two data sets. Also, Google Sketchup and Google Earth were used to adequately apply a geographic information system or GIS. The hypothesis was that beaches in Ponce, Mar Chiquita in Manatí and Playa Sucia in Cabo Rojo were highly contaminated but were still be accessible to the public. People have the right to know whether or not their beaches are safe.
ABSTRACTS

APPLIED PHYSICS

USING ARTIFICIAL SYNTHESIS TO PRODUCE HYDRO-ENERGY


Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

Pollution is one of the causes for the use of new greener power sources. Hydro fuel is one alternative energy source for powering devices. To produce hydro fuel, a catalyst is indispensable, for it separates the hydrogen from water so it can be used to produce energy. Commonly composed of platinum, these catalysts are price inefficiently; therefore, not attracting the attention they deserve. This research aimed to explore possible materials that could be used as a catalyst in the near future and design a simulation of a hydro-energy power plant using Google Sketch-up which would be both cost efficient and effective. The results showed how the use of an artificial leaf made of cheap silicon can produce energy. Additionally, the silicone strip is coated with inexpensive metallic compounds -- a cobalt phosphate catalyst that spurs the creation of oxygen gas, and a nickel-zinc alloy that does the same for hydrogen. In the future, tests could be done to check efficiency and indicate if the prototype is reliable enough to be taken to market.

TIME DILATION

Marcel F. Corchado Albelo, C.R.O.E.M. High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

From the beginning of time humans have always tried to define time. In today’s modern society, the unit to measure time is the second. Photons produced by the sun’s light travel across the distance in space at the speed of light to reach this planet and many others. These photons, light itself produced by the sun, is the information the eyes see; this information is later on processed by the brain and creates the images seen. This creates a feeling of present time, which can be described as the particular moment in the dimensions of time and space, affecting individuals. Using an algebraic equation, describing the present time, and the sum of the time one lives in, or the images brought by the brain, prove that the present time is actually in the past. Then using the same algebraic equation as used to calculate the actual present time of this home planet Earth, calculations of the rest of the planets in the solar system are made to compare how far in the past each planet is. Further on, this could be used to calculate, using the nearest star, how long does information that provides light get to there, or how near or far is this planet to the present from that particular star.
THE BEST ELECTRICITY CONDUCTOR

Marcos Joel Marrero Maldonado, CROEM High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

For years professional electrical engineers have been looking for a conductor that can develop the electricity in a fast, efficient and easy way. The reason to have a good electricity conductor is that it provides a better power and eventually it saves more electricity. The list of the best conductors are the following: copper, silver, gold and aluminum. But there’s always a problem and that is the cost of the material. For this research a pure sample of each of the before mentioned conductors was obtained. When the research was done, the efficiency and the cost of each conductor were considered. The hypothesis of this research was that silver is the best conductor because it was found in various electrical machines. The results revealed that the hypothesis was right because a measure of the resistance said that silver was the best conductor with 0.016 Ohms. Second was copper with 0.0175 Ohms. Third was gold with 0.022 Ohms and fourth was aluminum with 0.0278 Ohms. The conclusion is that silver is the best conductor in the market and the price is between the cheapest and the most expensive. A simulation was made using Google Sketch to present the data.

THE PORTEVIN LE CHATELIER PHENOMENON WITH NBB₂

Michelle D. Marrero García, CROEM High School, Mayagüez, Puerto Rico.

Research Coordinators: O. Marcelo Suárez and David Florian, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

This research focused on the study of the Portevin Le Chatelier phenomenon that occurs on aluminum/magnesium alloys. When tensile strength tests are done to those alloys, the phenomenon is visible in the graph. It is thought that the reason for this graph to show the downs is because of the precipitation of the particles and the ups due to the strengthening of the material until it precipitates. The tests were done with wires made of a master alloy of aluminum containing aluminum/magnesium particles. In some samples, nanoparticles of NbB₂ were inserted to study the behavior of the phenomenon. Wires (with and without nanoparticles) got through a heat treatment and aging test to analyze the consequences. This research has many applications, most of them for the fabrication of electrical components, nevertheless the most remarkable would be to use it on car motors. Compared to aluminum-silica, the material used in car parts, aluminum-magnesium has a lower density; something that would definitively be helpful in the fabrication process of electrical components. The preliminary results did not show any kind of pattern in the tensile strength peaks.
ABSTRACTS

ASTRONOMY

LUNAR EFFECTS ON EARTHQUAKES

Angelic M. Arzola Roig, CROEM High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

On August 26, 2013, the Western part of Puerto Rico experienced an earthquake of 4.1 ML (Richter scale). These phenomena happen every day, even if they cannot be felt, because they occur when the inner core of the Earth is subject to increasing pressure and build-up of energy until it erupts. The main factor in the buildup of earthquakes is the movement of the tectonic plates, but there are other factors as well. One of these factors is the Moon, which is in constant motion around the Earth, and its gravitational pull expands and contracts the Earth’s crust, affecting the surface of the planet. This scientific research aimed to find how the Moon affects earthquakes: does the Moon affect the earthquakes in its apogee or perigee, and does the Moon play a significant factor in the buildup of this phenomenon? This research studied whether the position of the Moon could be of influence in the buildup of earthquakes by selecting data from earthquakes from twenty years ago to now (1994-2014) from latitudes 17.00 to 20.00 degrees, and longitudes -69.00 to -63.50 degrees. The earthquakes selected were of magnitude 4.00 upward on the magnitude scale. The earthquakes that happened the day before and the day after the major earthquakes were then investigated. The magnitudes of the earthquakes were then related on a graph to the location and age of the Moon at the time the earthquake happened. The results showed that there was an increase of earthquakes when the Moon was in its apogee, and the majority of the earthquakes happened in the two gibbous phases.

SUNSPOTS THEORY


Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

The theory states that every 11 years there is a striking variation in the number of sunspots. This research focused on getting different sunspots on the surface of the sun during the month of February in two different years, one during the start of sunspot cycle and one that is not as active as the other. During the research a comparison of the amount of solar activity was observed. During the research a detailed observation of solar flares and the erupting effect were also observed. These results helped to understand the theory of sunspots in a better way. These results presented a prediction of solar activities and how these effects will happen on Earth. Further studies can help turn this theory into a new discovery.
TRIGONOMETRIC PARALLAX

Jemarie Negrón Losada, CROEM High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

Trigonometric parallax is a method of determining distances by measuring the angular position of an object as seen from the ends of a baseline having a known length. The purpose of this study was to find the parallax of different stars using the Erastothenes method. The selection of the star was based on availability at the observed time and the similarities to the sun. This method required to have the position of the selected stars from the specific time to another position in the second specific time. Collected data were analyzed to get the distance measured in parsecs and astronomical units. Parsecs (pc) is the distance an object would have to be from the earth so that its heliocentric parallax would be 1 sec of arc, equal to 3.26 ly. The astronomical unit is the distance between sun and the planet Earth. The stars were selected from certified web sites, from which the given parsec was used to fill in the equation. This project is in the first stage with some results. More data are required for a more in-depth study.

STEELLAR SPECTROSCOPY

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Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

Stellar Spectroscopy focuses on stars, and uses this branch of science to classify stars based on the information provided by emission and absorption spectrum graphs. This study on Stellar Spectroscopy focused on the classification of stars using their emission and absorption graphs and what these represent for each star. The main purpose of this study was to study the spectrum of stars similar to the sun in luminosity and temperature using Graphical Analysis ®. To achieve this purpose, data were collected from the spectrum of various stars for their classification. Chemical components were analyzed and Wien’s displacement law was applied. This law states that the wavelength distribution of thermal radiation from a black body at any temperature has essentially the same shape as the distribution at any other temperature, except that each wavelength is displaced on the graph depending of the temperature. This permitted to compare the temperature of Alpha stars to get an equation based on those variables. In the future, a Hetzprung- Russel chart will be used to map how those stars follow the main sequence and to analyze their components.
FOR THE DISCOVERY OF EXOPLANETS

Jesús N. Soto, CROEM High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

Exoplanets are planets which are founded out of the solar system. There are many ways to discover these planets, but not all of them are totally certain and verified. The purpose of this research was to research about the exosolar planets and the techniques to discover them. Another purpose of this research was to understand which one of all the techniques available was the best to discover these planets. In addition, several of these methods were chosen to improve them and find new ones. The methods were put to the test by looking at the discovery of the exosolar planets and how effective the techniques used were. Also, data of each one separately were collected and various results were shown that helped to identify which one worked better. During the process various techniques were combined to collect data. Some of the techniques were chosen and improved to make more certain the discovery of exoplanets. This research was both theoretical and experimental, based on past research and discoveries of exoplanets. The methods that currently exist were tested. In the future, the research about exoplanets will continue to gather more information.

POSSIBLE EFFECTS OF THE ASTEROIDS 99942 APOPHIS AND (35396) 1997 XF11 ON EARTH

Alejandro J. Vázquez López, CROEM High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

This research focused on the studies of asteroids 99942 Apophis and (35396) 1997 XF11. The research consisted on considering the size, trajectory and makeup of the asteroids and the determination of the entry speed and velocity to find out the speed and trajectory of the asteroids in the earth’s atmosphere. Eventually, the effects of the asteroids on the planet earth were determined. The effects were found by measuring the force of the asteroid after it entered the atmosphere. Then the makeup was taken into account, along with the possible landing site of the asteroid, because the effects would be different if the asteroid landed on solid ground or water. It was found that Apophis would land in the Atlantic Ocean, near Africa, with a force of about 750 megatons of kinetic energy. The casualties were estimated to be about 10 million people, and its crash would have no long-lasting effects, like an impact winter, which is when the asteroid creates a cloud of dust that partially blocks out the sun, thus creating it. It was thought that there was a small, but still present chance that XF11 will crash on earth in the year 2028 if it passes through a gravitational keyhole, but that chance has been eliminated. A simulation using Google Sketchup was developed to show the system.
CREATING A SMART-ROOM APPLICATION GADGET


Student Research Mentor: Karina N. Martínez, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico. Student Research Mentor Assistant: Melissa S. Rivera, Catholic University, Ponce, Puerto Rico.

This project is about smart rooms for agricultural benefits. It would save money on food and electricity. The steps on making the system work are to install a solar panel on the roof of the house, then let the solar panel charge for at least one hour. While the solar panel charges, devices are connected via Bluetooth. Then they need to be checked to see if they work. Bluetooth can connect devices from point-to-point, better on security than Wi-Fi. The Apple device would be used and would be connected to the sensor using the app. Because the Future Farmers of America (FFA) is an organization that implements agricultural education to students from middle school to high school, the name of the app would be "FFA All in One". This app would control the functions of the sensors, and two additional features on Apple's new iOS 8 is the biggest release ever. It has the capabilities and functions that developers can create, in this case, an application to control all the sensors used in the smart room. It would satisfy a house owner, and the environment of agricultural benefits.

NANOBOTS CANCER TREATMENT DEVELOPMENT

*Yalevé Cardona Vélez* and *Michael Vázquez Nieves,* Antonio Lucchetti Vocational School, Arecibo, Puerto Rico.

Student Research Mentor: Karina N. Martínez, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico. Student Research Mentor Assistant: Melissa S. Rivera, Catholic University, Ponce, Puerto Rico.

This project is about how nanotechnology, specifically nanobots, can be incorporated in the medicine to fight against various types of diseases. Nanobots could be used as a treatment for cancers, such as leukemia. The design of the nanobots would be biological but with a few mechanical parts. The challenge was to create it with silicon and improve the way that the robot acquires energy. The use of nanobots can prevent side effects such as loss of hair and body pain that are caused by harsh cancer treatments like chemotherapy. The nanobots will be injected through the bloodstream to travel inside the human body and identify the malignant cell. Once the malignant cell is identified, the bot would start disintegrating it slowly until it is completely eliminated from the body.
SOLAR WIND AND ITS INTERACTION WITH EARTH

Krista Heliö, Helena Kaisanlahti, Lotta Mäkelä, Johanna Perkins and Liina Yliheikkilä, SYK High School, Helsinki, Finland.

Research Mentor: Ursula Ahvenisto, SYK High School, Helsinki, Finland.

Our school offered a course related to solar wind and its interaction with Earth to people who are interested in physics and possibly biology. All members of our group are motivated to learn more about space and space weather and this was a unique opportunity to learn more about it in lectures at Aalto University and Finnish Meteorological Institute. We also had a chance to explore measurement equipment in different locations, including Nurmijärvi Geophysical Observatory. The solar wind is a stream of plasma which is electrically balanced and consists almost exclusively of charged particles. Speed, density and proton temperature can be measured using spacecraft. Ions and electrons are counted and interplanetary magnetic field can be measured as well. The solar wind changes the shape of the magnetic field constantly and the biggest changes occur during magnetic storms. The effects of the solar wind can be observed on the surface of Earth in many ways, such as aurora, GIC (geomagnetically induced currents) and interferences in data transfer (for example GPS and radio broadcast).

EARTH’S MAGNETIC FIELD


Research Mentor: Pasi Ketolainen, Järvenpää Upper Secondary School, Finland.

Earth’s Magnetic Field is an important knowledge to understand the joint biology and physics project called the Space weather course. This research was also one of the tasks we needed to do in order to complete the course. Other assignments were for instance shooting a short video related to the subject. The most motivating things that got us to take part on the project are for example getting to see scientists in their everyday work and to maybe compare that to what we have seen and learned before. There is also no doubt that things we might learn could help us in our follow-up studies. If not in the form of physics then at least we can get a nice experience out of this. In our study we concentrate on the configuration and the generation of the Earth’s magnetic field. So the area is pretty much in the near vicinity on Earth and even incide it!
DEVICE THAT MEASURES THE SUN’S ENERGY

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Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

This research aimed to construct a device that could measure the sun’s energy at different times. The objective of this was to see how much voltage is in the moment and the measurements of the sun’s rays. The electromagnetic radiation of the sun emits different radiations while the voltage is the measure. The produced energy or electricity that is passing at that exact moment was collected. A device was constructed with photo resistors to measure the sun intensity in terms of the voltage detected. A conversion equation was created to have the quantity of microwave radiation collected by the device in terms of the voltage received. Also, an app was created to show the right number of microwaves. This app was created using the language of JAVA programming. The methodology required the construction of an instrument that would use a little solar energy receiver. Efficiency tests showed that this type of instrument does exist but not like this one. It will be a new way to investigate the full radiation and the full microwaves. In the future, this device may be very useful for some specific experiments.

THE EFFECT OF THE SUN’S RAYS ON MYCOPHAERELLA FIJIENSIS

Javier O. Medina Sánchez, CROEM High School, Mayagüez, Puerto Rico.

Research Coordinator: María Reyes, CROEM High School, Mayagüez, Puerto Rico.
Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.

The Black Sigatoka caused by the fungus of Mycosphaerella fijiensis Morelet is a common destructive fungus disease known to affect the banana plant (Musa Paradisiaca) and plantain plant (Musa acuminata colla) production around the entire world. A lot of different types of chemical fungicides are the main source for controlling Mycosphaerella fijiensis Morelet but bacteria can become resistant to a substance and interfere with and the fungicide resistance, which increases the control cost. There are different types of electromagnetic spectra in the atmosphere that regulate different kinds of rays. Some of these rays are: Gamma rays, X rays, UV rays, visible rays, infra red, microwaves and radio waves. Since ultraviolet rays affect M. fijiensis, the effect was compared with the different types of rays. Petri dishes were used to grow some samples of the fungus and treat those using X rays. Results were obtained that showed how the electromagnetic spectrum affects the growth of the bacteria. In this research, Mycosphaerella fijiensis Morelet was tested in the X ray chamber to analyze if the bacteria had any reaction to the X rays. Without these bacteria, the world of agriculture in the plantain and banana area would be much more successful because it would let the plant grow strong and the fruit would have all its nutrients. In the future, crops can be planted in space. This study points to the right amount of X rays needed for better agriculture.
BIOREMEDIATION CAPABILITY OF SOILS

Laura Oliver Martínez, C.R.O.E.M, High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez, University of Puerto Rico, Mayagüez, Puerto Rico.
Research Coordinators: Heriberto Monroig, C.R.O.E.M, Mayagüez, Puerto Rico; Delvis Pérez, USDA, Mayagüez, Puerto Rico; and Socorro Martínez, PG, EPA, Caribbean Environmental Protection Division, Guaynabo, Puerto Rico.

This research aimed to characterize the soil samples selected for analysis to determine the impact of the chemical substance and contaminants adhered to specific soil samples and describe the biodegradation capability of the contaminants in soils. To conduct this study, a suite of four types of soil samples previously collected in March 2014 was used. Soil samples were collected from different locations in Puerto Rico and were available for further investigation under the custody of the laboratory of United States Department of Agriculture located in Mayaguez. The four types of soil were classified as: muddy, rocky, river sand and beach sand, and were split into twenty eight soil samples. Six commercial substances: paint, shampoo, bleach, floor detergent, oil, and dishwasher were added intentionally to specific soil samples for comparison of resistance and absorption of pollutants in soils. In a previous research, an analysis of PH was completed. Further analyses were required and completed for elements and conductivity. The rate of biodegradation of contaminants in soils were subject to the physical characteristic and chemical composition of the soils and the interaction with the contaminants. This research addressed the study of the current soil conditions to confirm the presence of the contaminants of concern in the soils. For this purpose, confirmatory soil samples analyses were conducted and samples were analyzed for the same parameter observed in the 2013 investigation. The results demonstrated the biodegradation capacity of the contaminant in specific soils. Based on the results during the study, additional soil sample analyses were conducted.

NORTHERN BOYS AND NORTHERN LIGHTS

Tuomas Orava, Timo Orava, Jere Pernu and Oskari Ylitervo, Kastelli High School, Oulu, Finland.

Research Mentor: Jarmo Sirviö, Kastelli High School, Oulu, Finland.

Finland is located in northern Europe between Russia and Sweden near the arctic circle. We took on the programme in order to challenge ourselves and improve our skills in various aspects of life such as performing in a foreign language and working in groups. We are also expecting unforgettable memories and new friends. In our project we tell you about the beautiful and colorful phenomenon on the night sky that has inspired many Finnish folklores; the aurora borealis, also known as the northern lights. This amazing phenomenon is the result of charged particles released from the sun colliding with the particles in the Earth's atmosphere. Different types of Earth's gas particles cause different colours of the aurora. The colour also depends on the height of the collisions. The most common colour of the aurora is yellowish-green but on rare occasions, one can see an all-red aurora lighting up the sky.
WATER PRECIPITATION AND LIGHTING AT CROEM

Lizbeth M. Plaza Torres, CROEM High School, Mayagüez, Puerto Rico.

Research Assistant Mentor: Gilberto Jiménez University of Puerto Rico, Mayagüez, Puerto Rico.

Hurricanes compose a large part in the climate of the Caribbean. Annually, the Caribbean can get hit by five or more hurricanes. In this research raindrops and the lighting intensity at CROEM were studied. These two variables were chosen because they are major components in hurricanes, which are very common in the Caribbean area. Data pertaining to rain and to lightning were compiled and analyzed in the research. To study the raindrops, a disdrometer was used to collect data concerning the size of the drop, its velocity, and the amount of raindrops that fell in a given period of time. The data were analyzed according to the hour in which it was collected. To study lighting, a special instrumentation was required to measure its intensity and its energy. The data were analyzed according to the hour in which the data were collected to find out the time of day in which lightning strikes and their intensity. This lightning equipment is in the phase of construction and calibration. That is why the data is in the preliminary phase, but with impressive results. In conclusion, the time of day did have an effect on the raindrops and lightning. This can help community by alerting people as well as saving their properties. In the future newer and better data collection methods are going to be applied.

DEVELOPING A LOW-COST 3D PRINTER

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Student Research Mentor: Karina N. Martínez, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico.
Student Research Mentor Assistant: Melissa S. Rivera, Catholic University, Ponce, Puerto Rico.

The project of an affordable 3D printer is the main goal of this investigation. The purpose of making this investigation was to present a project that involved people with 3D digital designs and have a clearer image of their creation and how their ideas could be optimized. This would function by using a guide of the ideas with the most economic 3D printer, The Peachy Printer that costs $100, which makes affordable 3D printer for users. The goal was to associate it with the ideals of the company and make it even more affordable with new upgrades. It would use the x, y, and z axes and it would use hydraulic power to make the system more affordable. Also this product would have easy to handle portability and simple hardware. The 3D printer would have digital drawing capacity. It would be more stable product with less pieces and perfectly working ideas by using variables X and Y and updating Z with hydraulic power by a valve and contact that establishes how the product altitude would be. It would have the option to put in some upgrades. This product should work fine because it is made by using all the variables of errors that can be experimented with constant use.
PHOTOVOLTAIC ENERGY APPLICATION FOR INDUSTRY

Karla G. Rosado De Jesús, Segunda Unidad Sabana Hoyos School, Arecibo, Puerto Rico.

Student Research Mentor: Karina N. Martínez, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico.
Student Research Mentor Assistant: Melissa S. Rivera, Catholic University, Ponce, Puerto Rico.

This project is about photovoltaic energy and how it can be implemented in a system to control efficiently a photovoltaic central. Photovoltaic energy is a renewable energy that uses solar rays to create energy. Control a photovoltaic central entails a lot of things. A system will be implemented for easier control access. This would help industry with the central control. The idea is to create an app with the system. The app would have all the necessary information to know how the central is working. This also would have all the things that a photovoltaic central has and even more. The people who work with the central would have an easier way to work it. It would also have more focused information and more direct connection with the central component. All these things and more in just a system implemented in an app. The industry with a photovoltaic central would have the app. The app would be connected to the industry central, so it would only work with that central. It would have the information and knowledge that the central would need. This is not just an easy way to work, it is a more efficient system.

THE SUN, ITS LONG-TERM VARIATIONS AND INFLUENCE ON SPACE WEATHER

Jenni Saarinen, Mikael Laine, Nella Heikinmäki, Tomi Lahtinen, Peik von Konow and Aare Turunen, Kauriala High School, Hämeenlinna, Finland.

Research Mentor: Risto Matveinen, Kauriala High School, Hämeenlinna, Finland.

Space weather phenomena can be seen in Finland pretty easily and we are interested in learning more about the cause of those phenomena. We chose the Sun as our task, because it is the source of space weather phenomena. Understanding the Sun’s behaviour and composition is very essential when examining space weather. The Sun is the source of space weather phenomena and thus the most important player in space weather. The three layer composition of the Sun and convection of plasma forms a very complicated magnetic field. This explains most of the different phenomena, which take place in the Sun. These are for example sun spots, granules and flares. The solar wind is a stream of particles escaping the Sun’s gravity, which can damage telecommunications and cause northern lights. The Sun’s activity is changing all the time, but roughly in every 11 years in accordance with the number of sun spots. A large number of spots means a greater activity and thus more space weather phenomena.
DEVELOPMENT OF A DRONE TO STUDY EARTH’S GEODESY

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Student Research Mentor: Karina N. Martínez, Antonio Lucchetti Vocational School, Arecibo, Puerto Rico. Student Research Mentor Assistant: Melissa S. Rivera, Catholic University, Ponce, Puerto Rico.

A drone is an unmanned aerial vehicle (UAV) to study geodesy (scientific discipline that deals with the measurement and representation of the Earth) through the aerial photometry, the way to create digital models to scale of an area through photographs. This drone is to be created for traveling dangerous places where humans cannot go. It flies over the affected area, for example, in natural disasters and highly radioactive places. The way that the drone will use several materials with the ability to resist gamma radiation, high temperature and unstable weather; for example, graphene that is pure carbon in the form of a very thin, nearly transparent sheet, one atom thick. It is remarkably strong for its very low weight. This will help humanity by saving lives and the study of the Earth's surface and atmosphere of a place that is unsafe for humans. It will be an efficient tool for life, proving it in high-risk locations to perfect it until it is as accurate as possible with a minimum margin of error.

HAZE AND ITS RELATION WITH THE ATMOSPHERIC CHANGES AND DISEASES

Paola N. Velázquez Román and Eddie Y. Ortiz Marrero, CROEM High School, Mayagüez, Puerto Rico.

Atmospheric particulate matter or haze are microscopic solids or liquid matter suspended in the Earth's atmosphere. Particulates are the deadliest form of air pollution due to their ability to penetrate unfiltered deep into the lungs and blood streams. The climate or atmospheric changes have a relation with the incidence of particulates, and these can be harmful for the human health causing allergies, itching skin, red eyes, physical exhaustion and breathing problems. During this research, adhesive paper was used to collect the samples and they were located in three different locations of the school. The temperature and other climatic variables were collected every four hours. Every 24 hours the contact paper was changed for a period of ten days. After all the samples were collected, the particles were counted and analyzed using a microscope and they were classified by their diameter. The particles found were respirable suspended particle, fine particles, ultrafine particles, soot and suspended particulate matter. In conclusion, the hypothesis was accepted, the atmospheric changes help in the incidence of particulates and these particulates are causing health problems in the population. Futures work related to this research are to analyze particles at different locations on the Island and analyze biological particulates, growing bacteriological cultures to determine the presence of Gram positive and Gram negative bacteria.
ABSTRACTS

BIOLOGY

CYSTIC FIBROSIS

Bryan A. Fuentes Reyes and Pedro O. Méndez Fernández, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Blanca Guemárez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Cystic Fibrosis is not a common disorder, but is killing youngsters frequently. Cystic Fibrosis is a life-threatening genetic disease that primarily affects the lungs and digestive system. The cells that produce mucus, sweat and digestive juices are affected and they are transformed from fluids that are normally thin and slippery to thick and sticky ones. Research through bibliography investigation, interviews, and information based on what different foundations concentrated on this disease revealed that nowadays there is no cure for this disease. It mostly affects white people. The most affected ones are youngsters or babies and they grow with that until they die at a very young age. With this research, the knowledge of this disease has been extended. How many people are being affected in the United States and Puerto Rico and what can be done to decrease that rate until a cure is found?

WHAT HAPPENS WHEN DEFECTIVE GENETIC MATERIAL IS PASSED DOWN FROM ONE GENERATION TO ANOTHER?

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Research Mentor: Prof. Rose Saavedra, Southwestern Educational Society (SESO), Mayagüez, Puerto Rico.
Research Advisor Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.

The objective of this project was to determine which diseases are passed down from generation to generation. There are various contributing factors that may lead to having certain diseases. For instance, if the parent has diabetes and their parents had diabetes also, then it is safe to assume that at one point in the offspring's life they might have diabetes as well. In this project certain diseases were studied to identify the dominant and the recessive diseases. Based on the information found, it is possible to determine which diseases the offspring is most likely to have in the future. Due to the subject’s parentage’s medical history, it was expected that the subject was most likely to have diabetes, high blood sugar and cancer.
A HOME REMEDY FOR THE TREATMENT OF ACNE

María A. Limardo González and Alejandro Díaz, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Michelle Walters, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

If home ingredients are used to treat acne which are more affordable, then big amounts of money do not have to be spent on commercial remedies which are not always effective. The methodology for this experiment included: 1) Cut the white fat in cubes that weight 5-6 grams. 2) Put the white fat cubes in individual Ziplocs. 3) Apply the different ingredients with each white fat. 4) Close every ziploc. 5) Wait 24 hours for results. 6) Check if the white fat absorbed any ingredient making a change in weight. 7) Compare if the “home remedies” worked more effectively than the “pharmacy products”. This was to prove that “home remedies” worked more effectively for the cost. The conclusion can integrate a new substance that will treat acne with the ingredients that worked better and were more affordable.

HOW MUCH OF THE BRAIN GETS EATEN AWAY BY HUNTINGTON DISEASE?

Leishla Marie Pérez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Research Mentor: Blanca Guemárez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Huntington disease (HD) is an incurable neurodegenerative brain disabling disorder. It is localized in chromosome 4. This disease has an autonomic dominant pattern, which means that the disease is inheritable with only one gene, it is caused by a repetition in the CAG gene at chromosome 4. Huntington disease targets nerve cells in the brain causing symptoms like deterioration of tissue, involuntary movements, behavior changes, psychiatric disturbances and dementia. These symptoms start showing up in middle 20s with no gender discrimination. It is commonly misdiagnosed as the early symptoms include personality changes, mood swings and unusual behavior. Up to today there is no treatment and no way to reverse these symptoms. Medication can sometimes manage excessive movement and speech therapy also helps in daily life. The purpose of this research was to analyze the protein and how it is related with the illness. The Genedoc program analyzed and visualized the conservation of the sequence; it showed that the gene HTT had more than a ninety percentage of conservation. Treeview visualized the phylogenetic tree in results of the multiple alignment sequence showing that the common ancestor was G3GWAB CRIGR. VMD visualized the 3D crystallization structure of the protein. The protein seen in VMD was 4CBT in the representation of New Ribbons; the structure was secondary which means that the long protein chains were organized into regular structures also known as alpha-helices and beta-pleated sheet. The MEME analyzed the sequences for similarities among them to produce a description for each pattern it discovered. The results of this research showed that the sequence that underlies the origin of the mutations have not changed thorough generations and the protein was conserved, and tolerant to substitutions of amino acids by not affecting their natural function in people.
THE POSITIVE AND NEGATIVE EFFECTS OF GENE MUTATION AND THEIR UNKNOWN INTERACTIONS WITH PRESCRIPTION DRUGS

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In 2013, approximately 15.7 million people aged 12 or older used prescription-type drugs in the US. People are prescribing drugs on a daily basis, but prescriptions can have dangerous effects. These responses may occur because of genetic mutations, which can also affect the body processes. The purpose of this project was to determine why some gene mutations cause people to react differently to a drug. Research was conducted about the proteins in the body and how they affect and interact with certain drugs. Later on, the effect it has on people without a genetic mutation and people with a certain genetic mutation was determined. This information was obtained through websites and databases. The expected results were that not only the genetic mutations but also the amount of the drug intake affects the body processes and responses to the drugs.

THE EFFICIENCY OF MEDICINAL PLANTS AS DISINFECTANTS

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Research Mentor: Michelle Walters, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Medicinal plants were investigated to determine how homemade repellent could be made with plants. Three plants were used: basil (albahaca), mint tea (Poleo), and rosemary (romero). A comparison was made with a popular commercial repellent. The mint tea should be the most successful plant to work like a repellent because this plant has antibacterial properties. Results include a variation analysis.

THE MYSTERY MOSQUITO

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Research Mentor: Blanca Guemárez, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

Chikungunya is an illness caused by a virus. It is believed to be transmitted by a mosquito. Some of the symptoms caused by the mosquito are: swellings, joint pain, high fever, headaches and a big rash. The symptoms may begin 3-7 days after being infected. There is no medicine to treat it. But by getting plenty of rest, drinking lots of fluids and taking pain killers, the symptoms can be decreased. The first cases registered were in Tarzania in 1952. Human infections in Africa were extremely low, but in 1999-2000 there were many cases reported. The cases that kept increasing were in Asia and Africa, until 2013, when France reported two laboratory-confirmed cases. As of March of 2014, there have been over 8,000 cases worldwide. What is being said about Chikungunya in the news? The different symptoms, cases, deaths, and even the time and place of the first case reported? Was this a virus formed in a laboratory? Was it spread by the first case reported? Can it be transmitted from one person to another? With the information of the different cases registered worldwide a map was created indicating the place of major cases.
APPLICATION OF VORONOI DIAGRAM TO MODEL PATTERNS OF RAIN IN PUERTO RICO

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Research Mentor: Brenda C. Torres-Velázquez, Universidad del Turabo, Gurabo, Puerto Rico.
Assistant Mentor: Amanda M. Crastz Flores, Universidad Metropolitana, San Juan, Puerto Rico.

In Puerto Rico it has not been raining in a normal pattern lately. The average rainfall in September 2013 was in the Northern Coast 6.27”, in the Southern Coast 7.15”, in the Northern Slopes 2.89”, in the Southern Slopes 11.47”, in the Eastern Interior 8.41” and in the Western Interior 8.73”. But, is the unusual pattern of rain showed this year somehow similar to the one from last year? Even more, how alike are rain patterns within the same year (2014), among different sites in Puerto Rico? In order to answer those questions, two main goals were established for this investigation: first, to compare the average rainfall in September 2013 in different parts of the island with September 2014; and second, the application of the Voronoi diagram to develop a graph that displays pattern of rain in Puerto Rico. Data were obtained through the United States Geological Survey website (USGS). STATA V13 was used to study the differences in averages between September 2013 and September 2014. R-freeware and Matlab were used to develop a Voronoi diagram that displayed the pattern of rain in Puerto Rico.

OIL CONSUMPTION IN THE UNITED STATES

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Petroleum is a non-renewable resource that is commonly refined into various types of fuels. This natural liquid is commercially worldwide used as different types of energies, mainly electrical, natural gas and gasoline. The United States is the country with the highest percent of oil consumption in the planet. Approximately 20% of all the petroleum used in the planet is entirely depleted by North America, making the aforementioned the protagonist of this investigation. The main purpose of this investigation was to create a mathematical model that predicted the usage of petroleum in future years for the United States. This model was based on the data collected from the petroleum usage database. A board of statistics which was converted into graphs was used for the analysis, which explains the amount oil consumed in United States since the 1960s and how it has changed dramatically through time.
THE ANALYSIS MUTATION PROBABILITY OF AMINO ACID SEQUENCE IN THE NOTCH3 GENE BY USING SIFT


Research Co-PI: Dr. Ángel R. Arcelay-Gutiérrez, Universidad Del Este, Carolina, Puerto Rico.

Notch is an intercellular signaling pathway that regulates interactions between physically close together cells. Notch3 is a protein-coding gene that plays a role in neural development and involves the gene regulation mechanism and it is one of the four notch receptors. Mutations with this gene cause muscle cell degeneration. In addition, deficiency of this protein impacts vascular tone in arteries, which indicates defects in smooth muscle cells. The focus of this study was to predict whether amino acid substitution causes protein malfunction; while, predicting probability of gene mutations. The mutation probability was obtained by using the program SIFT. Results obtained showed that 50% of amino acid substitutions were predicted to be intolerant which means that the other half were predicted to be tolerant. This protein had a 50% chance of mutations.

ANALYZING MUTATION IN AMINO ACID SEQUENCE FOR NIEMANN'S-PICK DISEASE TYPE C1 GENE BY USING SIFT

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Research Co-PI: Dr. Ángel R. Arcelay-Gutiérrez, Universidad Del Este, Carolina, Puerto Rico.

The NPC1 type c gene codifies a protein whose function is the breaking of lipids. When a mutation occurs, it does not permit cholesterol to be broken down. Cholesterol metabolisms are completed via the binding of cholesterol to its N terminal domain. The gene mutation can mostly be shown in parts of the body such as the liver, spleen and the brain. This protein may also be involved in obesity, since cholesterol cannot be properly regulated. Mutations produce cholesterol irregularity in the body. The program SIFT was used to determine if a mutation probabilities will be tolerant or intolerant by amino acids substitution. The probabilities in this gene to occur a normal mutation that could cause a tolerant or intolerant expression is 0.05% in P value. It was predicted that there would be a higher percentage of tolerant level in the amino acid substitution. Results obtained by SIFT in position 1-5 were 57% intolerant and 43% and in positions 6-10 it was 74% tolerant and 26% intolerant. It was concluded that 58% are tolerant while the 42% are intolerant, which means that mutations will less likely occur in the NPC1 type c gene.
THE EFFECT OF ELECTRICITY ON PLANTS: STAGE 2

Derek Champlin Ayala and Wilmaris Rivera Medina, Josefina León Zayas School, Jayuya, Puerto Rico.

Research Mentor: Olga Cordero Almodóvar, Universidad Metropolitana, Jayuya, Puerto Rico.

During the last year, the researchers developed a study with the purpose of testing the effect of electricity on plants. The results indicated that if plants were exposed to a periodical source of electricity, the plant would increase in size in less time than the natural average progression, with the exception that the electricity only helped the plant in its first stage of growth (germination). The main purpose of this stage was providing this innovative technique of improving the growth of plants with electricity, without using products that could affect either the soil or the plant. For this stage, the researchers were focused on the idea of creating an easy and effective way for society to perform this technique and also give a solid base for future engineers to expand and improve this method. The device consisted of a square shaped electrical camp made with four stakes powered up by solar panels. This machine would produce electricity to the plants approximately 12 hours a day. The results were compared with a control group.

MATHEMATICAL MODEL: NUMBER OF FORESTS AS A FUNCTION OF TIME

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Research Mentor: Joseph Colón Villers, Universidad Metropolitana, San Juan, Puerto Rico.
Research Assistant Mentor: Valerie Carrasquillo, Universidad Metropolitana, San Juan, Puerto Rico.

In recent years, the number of forests has decreased drastically due to many factors, including deforestation and beetle invasions. If measures are not taken to prevent the decrease in forest numbers, these will eventually disappear and, consequently, impact negatively the entire ecosystems. The purpose if this investigation was to model the numerical behavior of forests. Also, the forest’s extinction date was predicted with such model. Data from the FIA Field Data and Reports was plotted and an adequate model for the forest behavior was chosen. Finally, an equation was obtained and verified through the use of the minimum squares regression method, so that predictions could be made accurately.

THE COMPUTATIONAL ANALYSIS IN THE AMINO ACID SEQUENCE MUTS HOMOLOGUE 2 GENE BY USING SIFT

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Research Co-PI: Dr. Ángel R. Arcelay-Gutiérrez, Universidad Del Este, Carolina, Puerto Rico.

The Muts homolog 2 gene codifies to the MHS 2 protein. This protein plays an essential role in correcting the errors during the DNA replication. If a mutation occurs, it can produce Lynch Syndrome also known as hereditary non-polyposis colorectal cancer (HNPCC). This syndrome alerts genes like (MLH1, MSH2, MSH6, and PMS2) in the cells of the human body. The HNPCC has a high endometrial and colon risk due to inhabited mutated mismatch repairs in the DNA. The objective of this study was to calculate the tolerance level in amino acid substitution by using SIFT (sort intolerant from tolerant) program. The expected results by SIFT would be to obtain a higher probability in the intolerance level. Results obtained were the following: the 1-5 amino acid position was 88% intolerant and 12% tolerant, the 6-10 position was 58% intolerant and 41% tolerant. It was concluded that there was a 73% of intolerance and 27% of tolerance, indicating that there is a higher possibility of mutation in the MHS gene.
ANALYSIS OF TOLERANT LEVELS IN GLYCOSIDASE BETA ACID FOR AMINO ACID SUBSTITUTION BY USING SIFT


Research Co-PI: Dr. Ángel R. Arcelay-Gutiérrez, Universidad Del Este, Carolina, Puerto Rico.

The enzyme called beta-glucocerebrosidase is codified by the GBA gene. It catalyzes the hydrolytic cleavage of glucose from the large molecule called glucocerebroside. Glycosidase is active in lysosomes. Mutations in the GBA gene cause Gaucher Disease. Gaucher Disease is a disorder that affects many of the body’s organs and tissues. Without enough of this enzyme, glucocerebroside and related substances can build up to toxic levels inside the cells. Tissues and organs are damaged by the accumulation and storage of these substances, causing the characteristic features of gaucher disease. If it has a low chance of mutation, then Gaucher Disease takes place. SIFT (Sort Intolerant From Tolerant) was used to predict whether amino acid substitutions are tolerant or intolerant for gene mutation. SIFT results showed that 42% was predicted to be tolerant and 58% was predicted to be intolerant. This means this gene had a low chance of mutations.

A MATHEMATICAL MODEL FOR HEARING DEPENDING ON AGE

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Hearing differs from person to person. Some people can hear higher frequencies than others. This is because the hair cells, also known as cilia, get damaged from all the sounds a person hears on a daily basis. Cilia are the cells that capture sound waves and transfer them to the brain. Typically, people can hear between 20-20k Hertz but some of them cannot hear all of those frequencies due to their cilia cells being damaged. An ear age can be determined by the highest pitch a person can hear. Being this said, the purpose of this research was to create a mathematical model to compare ear ages by hearing capacity, gender and age. A survey was conducted and frequencies from 8 to 20 MHz were presented to people from ages 11 to 60 and depending on the highest MHz they heard, their ear age was estimated. The collected data was plotted and analyzed using Excel.
SHORELINE MODELING: ILLUSTRATING AND PREDICTING COASTAL EROSION

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Coastal erosion is the loss of land along the coastline due to natural forces like waves, winds, and currents, or human-induced causes such as canals, buildings, dams, among others. In Puerto Rico, coastal erosion is one of the biggest ecological problems. Currently, not much is being done to minimize it. For such reasons, this investigation proposed to create a mathematical model that would describe quantitatively the erosion of coasts. To do so, data were collected using topographic maps and aerial photographs as principal data. Then, using imagery analysis to measure distances, numerical data were acquired. Subsequently, this data were analyzed and plotted. A mathematical model was chosen, and a final equation was obtained. Based on this equation, predictions for future years were made.

TEMPERATURE FLUCTUATIONS: A MATHEMATICAL MODEL FOR GLOBAL AVERAGES

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Research Assistant Mentor: Valerie Carrasquillo, Universidad Metropolitana, San Juan, Puerto Rico.

Precipitation influences temperatures directly around the globe. Many factors must be considered for the differences in heat on a same location. An important element is the evaporation of water vapor in open sea that creates heavy rain in large groups. Having a preview of this enables users to have access to information they would most commonly find on the Internet. Global fluctuations in temperature occur very often because of numerous unpredictable variables in the environment. For this reason, a mathematical model was developed to find averages on land-surface air temperature anomalies only with the data of past years and months. The Fourier Transform and sinusoidal equations were essential to create the map-style graphs that show stress in higher temperatures in contrast to lower temperatures.

ANALYSIS OF THE PROBABILITY SUBSTITUTION MUTATION IN AMINO ACID SEQUENCE OF THE PKLR GENE BY USING SIFT

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Research Co-PI: Dr. Ángel R. Arcelay-Gutiérrez, Universidad Del Este, Carolina, Puerto Rico.

Pyruvate kinase is an enzyme active in the liver and red blood cells (RBC). This enzyme is involved in the process of glycolysis. Mutations in this gene lead to Chronic Hereditary Anemia, which is caused by a shortage of oxygen in the red blood cells. Anemia symptoms are shortness of breath and extreme tiredness in people who are diagnosed. Sorting Intolerant from Tolerant (SIFT) was utilized to predict whether a change in an amino acid would affect the protein function. The hypothesis was that there would be a higher intolerant level in amino acid substitution. The results from SIFT showed that 64% was tolerant to an amino acid change and 36% was intolerant to a change. This means that there is a higher probability of not having a mutation.
MODELING ENDANGERED SPECIES: THEIR CHANGES THROUGHOUT TIME

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Research Mentor: Joseph Colón Villers, Universidad Metropolitana, San Juan, Puerto Rico.
Research Assistant Mentor: Valerie Carasquillo, Universidad Metropolitana, San Juan, Puerto Rico.

There are thousands of threatened species in the world. In the last years, the number of threatened species has fluctuated drastically. How are the fluctuations changing? What is expected in the coming years? The purpose of this research was to create a mathematical model for the endangered species for the last 14 years. Data obtained from the “Red List” were used. The data were plotted for all species and a mathematical model was chosen. Using rudimentary mathematical techniques, a final equation was obtained. The equation was verified, where a regression using minimum square technique was performed to verify the accuracy of the model. Predictions for future years were estimated.

FACEBOOK PATTERN OF USE: A COMPARISON OF MIDDLE/HIGH SCHOOL VS POST-SECONDARY EDUCATIONAL INSTITUTIONS

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Research Mentor: Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

Which academic level has a greater pattern of use of the Facebook social network site, students of middle and high school in comparison with students of the Bachelor and Master degrees from a post-secondary educational institutions, both located in Jayuya? What leads them to that pattern of use? To answer the question, a sample of students from the Bachelor Degree and Master Degrees level were be selected randomly and asked to answer a questionnaire. Most of questions of this questionnaire were focused on measuring the usage pattern performed with the results of a previous investigation with youths of middle school and high school levels from Jayuya, Puerto Rico.

HOW CAN SMOKING AFFECT RELATIONSHIPS?

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Research Mentor: Olga Cordero Almodóvar, Universidad Metropolitana, Jayuya, Puerto Rico.

Smoking shortens lives, it can cause lung cancer and it can affect a relationship with a partner. Many health problems are developed by smoking but this investigation is about how smoking affects relationships. Young and old couples worry about the health of their partners, some try to help them quit smoking, others end the relationship. In this investigation a lot of couples were interviewed. This research was successful and it was proved that relationships can be damaged if a partner is smoking.
THE NEED OF STRONGER AND MORE FERTILE SOILS TO USE IN ADVANCES IN AGRICULTURAL TECHNOLOGY

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Research Mentor: Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

In this planet Earth, there are a lot of soils. These are different based on their characteristics and their basic functions. Some are stronger than others and others are more fertile, all based on their mineral composition. Most soils are soft but since the advances in agricultural technology, the need of stronger, tougher and more fertile soils has been found. The main types of soil are: sandy (belongs to the light category because it is lightweight and has a grainy texture); clay (referred to as heavy soil, also tends to compact and become cloddy when it is tilled, walked or worked when it is wet); silt (considered to be among the most fertile of soils and is often found in river estuaries, it is also soft and smooth, with individual pieces close together); loamy (loam, for many reasons, is a nutritious and healthy mixture that helps a diverse group of plants and vegetables thrive); peat (is rich in organic materials, though it will absorb and hold a great deal of water, and needs to be drained before it is usable as a garden soil); and chalky (contains high concentration of stone, is of extremely poor quality and does not do well in sustaining plant life, mixed in other soil types to make it suitable for gardening). Most of these soils are soft and have very small particles. This investigation tested the amount of weight a type of soil can handle. The hypothesis stated that the chalky soil was the one able to handle more weight.

CREATING AN ENCRYPTED MESSAGE USING CIRCULAR PRIME NUMBERS AND MATRICES

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Most individuals have the need to hide information from others. To achieve this, they sometimes use cryptography or codification. This ancient method transforms a text with the goal of hiding the message. There exist a lot of ways to encrypt and decode messages, and one way to do this is through the use of circular prime numbers. These numbers are prime numbers that, when re-arranged repeatedly using even permutations, are still prime numbers. Other methods to encrypt messages include matrixes. The purpose of this research was to create a code that encrypts messages using circular prime numbers and matrixes. Matlab was used to create such code. Circular prime numbers were assigned for each letter of the Romanized Alphabet. The code takes in a message, and using the corresponding prime number it creates matrices with determinants equal to those prime numbers. The person who wants to decode the message must calculate the determinants of such matrices.
MATHEMATICAL MODEL TO DETERMINE THE NECESSARY VOLTAGE ON A CITRIC ELECTRIC CIRCUIT

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Recently, people have been talking about citric electric circuits and how they are capable of charging cellphones and turning on other electronic devices. Videos can be seen in YouTube of this kind of circuits and showing that they really work. However, do they work properly? Can these circuits charge or turn on an electronic device without damaging their battery? That is the purpose of this research, to verify the efficiency of an electric circuit on electronic devices. A circuit was built using citric fruits, water, and other electricity conductors. The flow of electricity was measured with a voltammeter and the collected data were plotted. Finally, the data were verified to see if the electricity current obtained from such circuits met the base battery requirements of the devices.

DO LOOKS AND SMELLS AFFECT THE TASTE OF FOOD?

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Research Mentor: Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

From many years, humanity has judged food by its looks and by how it smells. Through this investigation, a research was conducted on whether the presentation and the smell of the foods can affect their taste. Different foods were chosen and some people of different ages. Different dynamics were used like making the people try some foods with their eyes closed and others with their nose closed. This way the research would reveal if it was the taste of food. By doing this experiment, the study would tell whether no smell affects the taste of foods and if that the view helps a person decide if he or she is going to eat the food or not.
CALCULATING THE PERCENT OF TOLERANT AND INTOLERANT CHANGES TO PREDICT AN AMINO ACIDS MUTATION BY USING SIFT

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Research Co-PI: Dr. Ángel R. Arcelay-Gutiérrez, Universidad Del Este, Carolina, Puerto Rico.

The Iduronate 2-Sulfate (IDS) gene provides instructions for producing an enzyme called iduronate 2-sulfatase. Its function is in the lysosomes. It removes a sulfate group from a molecule called sulfated alpha-L-iduronic acid. Mutations in the gene produce a disruption of the normal structure and function of the enzyme. Mucopolysaccharidosis Type II or Hunter Syndrome is a progressively debilitating disorder that affects many different parts of the body and occurs almost exclusively in males. The purpose of this research was to determine whether the gene would be intolerant or tolerant to amino acid substitution by using SIFT. Its prediction was based on the degree of conservation of amino acid residues in sequence alignments derived from closely related sequences. The probability of obtaining a p-Value of 0.05 test statistic result the least as extreme for the one that was actually observed. The hypothesis was that the gene would be intolerant to mutations by the amino acid substitution. Results obtained by SIFT showed that 49% of the amino acids were tolerant to substitution, while the other 51% amino acids were intolerant. These results mean that there will be a higher probability for the mutation to occur.

THE USE OF ALLELOPATHY TO CREATE A NATURAL FERTILIZER

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Research Mentor: Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

Plant allelopathy is everywhere; yet, many people have never even heard of this interesting phenomenon. Allelopathy can have an adverse effect in the garden, resulting in reduced seed germination and plant growth. On the other hand, allelopathic plants may also be considered Mother Nature’s own weed killer and pest management. Allelopathy is a biological phenomenon where one plant inhibits the growth of another. How? Through the release of allelochemicals, certain plants can greatly affect the growth of other plants either in a good way or a bad one by leaching, decomposition, etc. In essence, plant allelopathy is used as a means of survival in nature, reducing competition from plants nearby. Various parts of plants can have these allelopathic properties, from the foliage and flowers to the roots, bark, soil, and mulch. Most all allelopathic plants store their protective chemicals within their leaves, especially during fall. As leaves drop to the ground and decompose, these toxins can affect nearby plants. Some plants also release toxins through their roots, which are then absorbed by other plants and trees. What if somehow the allelochemicals are extracted to produce or create a natural synthetic bio-chemical not only to help the plant have a safety growth, but also to repel cats, rats, insects and other domestic animals and rodents?
COLLATZ CONJECTURE: PROCESSING MASSIVE INTEGERS

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This project focused on solving the main problem occurring when compiling the Collatz Conjecture on a computer using C programming language. The average computer that processes in 64 bit cannot process massive integers such as the multiplication and division of such within the conjecture itself. Therefore, the purpose of this project was to ultimately create a method within the C code that would process integers that exceed the 64-bit limit itself. The method used in this research would be the creation of a function that would process the vast integer into separate sections in order to avoid the integer from overlapping the 64-bit capacity. Depending on the program compiled (such as the C compiler being used to solve this problem), some of the registry slots used to process data were available for use for other functions and processes. The method that approached this problem would use the available registry slots to store the different sections of the integer that were broken down and processed individually in order to efficiently process the conjecture. As a result, the broken down sections of the integer could be later processed as a whole once the combined sections no longer exceed the 64-bit capacity.

ALLELOPATHY EFFECTS IN PLANT’S GERMINATION

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Research Mentor: Olga Cordero Almodóvar, Universidad Metropolitana, Jayuya, Puerto Rico.

Allelopathy is defined as the biological process in which an organism produces allelochemicals that somehow affect positively or negatively the surveillance of other organisms. The goal of this research was to monitor the effects of allelopathy procedures in the germination of tomato, lettuce, and cilantro plants. It was intended to prove if the allelochemicals used in the investigation, which were eucalyptus extract and caffeine, had a positive effect on the growth of the plants during the germination process. Different methods of allelochemical exposures were used in the research. First, the plants were divided in two groups: the control samples, and the experimental samples. The control samples were planted in an oasis, and were not treated with any chemicals. The experimental samples were also planted in an oasis and exposed to the same atmosphere used for the control samples. The experimental samples were divided into subgroups. The plants in the first subgroup were treated with the allelochemicals before the plantation, and the second subgroup was treated during the germination using a water solution. Consequently, all the data collected for the different groups were compared to determine which method caused a more noticeable effect. After analyzing all the data, it was concluded that the allelopathy exposure was indeed a positive method to make the germination process faster in vegetables.
CALCULATING PROBABILITY OF MUTATION IN AMINO ACID SEQUENCE OF THE MUTL HOMOLOG 1 GENE USING SIFT

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The mutL homolog 1 gene provides instructions for making a protein that plays an essential role in DNA repair. This protein helps fix mismatches that are made when DNA is copied (DNA replication) in preparation for cell division. The MLH1 gene is associated with the 50% of Lynch syndrome cases. This increases the risk of many types of cancer; particularly cancers of the colon (large intestine) and rectum, which are collectively referred to as colorectal cancer. The aim of this project was to calculate the probability of a mutation being benignant or malignant in the MLH1 using the program 'Sort Intolerant from Tolerant' (SIFT). SIFT chooses a part of the protein chain of sequence and multiple alignment information to predict tolerant substitutions for each position of the amino acid chain of MLH1. The results obtained by SIFT showed that 86% percent of the amino acid substitutions were intolerant and 14% of the amino acid substitutions were tolerant. This means the there is a higher probability of mutation occurring in the MLH1 gene.

IS DIABETES REVERSIBLE? YES, ONE NEEDS TO “RETUNE” THE BODY TO RESPOND TO IT MORE EFFECTIVELY BY CHANGING THE LIFESTYLE!

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Research Mentor: Prof. Rose Saavedra, Southwestern Educational Society (SESO), Mayagüez, Puerto Rico. Research Advisor Mentor: Prof. Pieter Van der Meer, University of Puerto Rico, Mayagüez, Puerto Rico.

Diabetes is usually a lifelong (chronic) disease where the amount of glucose in the blood is too high, because the body cannot use it properly. This may occur when the pancreas does not produce insulin to help glucose enter the body’s cell (type 1 diabetes) or the insulin it produces does not work properly, known as insulin resistance (type 2 diabetes). In this project the data of health risk factors of complications (current smokers, obesity, etc.) for people who had diabetes in Puerto Rico were compared over several years. It also analyzed a set of demographic stats (age, sex) from the same years in order to back up results. The data collected was also compared with the data of the United States. This project also predicted what the health risk factors of complications would be in 5 years by calculating how the data had been changing over previously analyzed years. The objective of this project was to promote a better lifestyle for potential patients to prevent or reduce diabetes in Puerto Rico and as a result lower the incidence of diabetes. The expected results were that health risk factors and complications for patients with diabetes have increased over the years in Puerto Rico because people are not changing their lifestyle after being diagnosed.
FRACTAL AREA: DO POLYGONS HAVE SPECIFIC PATTERNS?

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A fractal is a natural structure that displays self-similarity on all scales. It is usually found in trees, flowers, roads, mountains, rivers, microchips, the blood stream, lungs and others. This project concentrates on searching and observing a pattern, if any, of the areas bounded inside an Indra’s Pearl fractal. Using a computerized program, pixels were used to determine the length of the sides of the figure to be analyzed. After determining the length of the sides, the area of each interval of the fractal was calculated. Plots were created to aid detection of patterns, and mathematical models were created to explain such behaviors.
**ABSTRACTS**

**BIO-STATISTICS**

**STUDYING THE CONTROVERSY IN THE USAGE OF CANNABIS**


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

Research Assistant Mentor: Kelvin García Muñiz, University of Puerto Rico, Mayagüez, Puerto Rico.

The use of cannabis has been a topic of a lot of controversy throughout the years. While the government claims it is a health issue, cannabis users and defenders claim that the reason for banning cannabis is purely economic. The purpose of this investigation was to find out the health related pros and cons of cannabis and derivate chemicals such as THC and cannabidol. It was also to find out how many people, both in favor and against the legalization, really know the information. A set of questions was asked to both users, supporters and non-supporters of the legalization. The purpose was to show that misinformation might be presented in all parties.

**EFFECTS OF PHYSICAL ACTIVITY ON THE DECREASE OF BODY FAT**

Jean P. Andino Alicea, Inés M. Mendoza School, San Juan, Puerto Rico.

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

Research Mentor Assistant: Luis M. Mestre Caraballo, Universidad Metropolitana, San Juan, Puerto Rico.

Physical Activity is defined as any physical movement or effort that improves overall body fitness and health. Physical inactivity and a sedentary life are one of the leading causes of death along with smoking and increases the probability of developing diabetes, obesity, stroke and cancer, among other diseases. The aim of this project was to estimate the effect of physical activity on the change of BMI in subjects from 18-35 years of age who live a sedentary life. The dataset used belongs to the TIGER Study and is composed of 200 subjects, with diversity of weights. The analysis, done in R, is based on a multiple regression where BMI is the response variable and the covariates are: the heart rate physical activity score, age and gender. It was hypothesized that those individuals whose BMI > 30, will have a greater loss of weight compared with those with a lower BMI.
STUDYING THE PREPARATION OF INDIVIDUALS IN THE PRESENCE OF AN EARTHQUAKE

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An earthquake is a repeated movement of the earth that is caused by the abrupt liberation of energy accumulated in a slow way. On October 11, 1918, an earthquake occurred with the hypocenter in La Mona, Puerto Rico. This caused a great chaos for all Puerto Ricans. In the occurrence of an earthquake of great magnitude, its consequences might produce tsunamis, the falling of buildings, avalanches and fires. Usually, people forget that at any moment an earthquake of a great magnitude can occur and others, on the contrary, think that this is never going to happen. As a consequence, most people do not have an emergency backpack or an evacuation plan to face the presence of a seism. Unfortunately, there is no way to know when this phenomena might occur and for this reason there is an imminent need to be prepared. A survey will be created in which 25 individuals will answer questions regarding their preparation to face an earthquake. Graphs, charts and tables will be used to compare the equipped people and the ones that are not ready.

COST EFFECTIVENESS ANALYSIS OF PFIZER INC. AND ITS SUBSIDIARY COMPANIES

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Research Mentor: Brenda C. Torres-Velázquez, Universidad del Turabo, Gurabo, Puerto Rico.
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The pharmaceutical industry is currently one of the fastest growing industries; medicines are necessary, and many companies that are profiting from the industry are profiting because they make prescription medicines like OxyContin, Xanax, and Opana. These so called "party drugs" are given only with a prescription from a doctor. There is a high epidemic of doctors giving out prescriptions without a proper diagnosis to patients that may not need these medications. Many individuals that are affected by this epidemic end up in addiction or with worse consequences. The purpose of this project was to analyze the effectiveness of pharmaceutical companies to have a better understanding of where and on what the money that these companies gain is spent on and how these companies are distributing the money to create medicines.
IN VIEW OF THE HIGH NUMBER OF DEATHS DUE TO CRIME, CAN THE QUALITY OF LIFE BE IMPROVED IN PUERTO RICO?

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The island of Puerto Rico is 100 miles long and 35 miles wide. It has a population of 3.6 million of habitants. However, the number of deaths is high. There were more than a 1,100 deaths in the year 2013. In this year, crimes included around 800 murders. The most abundant crimes in Puerto Rico involved drugs trafficking, murders, suicides and traffic speeding. People are killing innocents for money to buy drugs and other illegal materials. At the same time, people are hurting and killing for joy or hate. On the other hand, people are killing themselves for they do not know how to deal with their problems. This project includes an investigation for a proposal to change the opinion of people that could make this country a better place to live. Can stats decrease deaths, murders, suicides, drugs and car accidents? This research will make a difference for the entire world.

THE EBOLA VIRUS AND THE CURRENT STATUS OF EPIDEMIC IN WEST AFRICA

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Ebola is a viral infectious disease that causes hemorrhagic fever in humans and primates (monkeys, gorillas, chimpanzees). It is caused by the Ebola virus. It was first discovered in 1976 by Dr. David Finkes. The name comes from the Ebola river in Zaire, Africa. There are five types of Ebola virus: Ebola-Zaire, Ebola-Sudan, Ebola-Ivory Coast, Ebola-Bundibugyo and Ebola-Reston. The Ebola-Reston has caused diseases in primates, but not humans. It is an infection characterized by a high mortality rate. This virus is considered to be a biological weapon. It often occurs in outbreaks or epidemics. Currently there is no approved medication to combat the Ebola virus. Throughout this research, the Ebola virus was investigated in depth and other researches made in relation to it. Finally, the obtained statistics were displayed using charts, graphs and pictures to provide a better understanding of this phenomena and its repercussions.
THE EFFECTS OF VIDEOGAMES ADDICTION ON TEENAGERS

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This research dealt with the addition of video games in adolescence and its short and long term consequences. Today, technology is quite advanced for those who play video games. The electronic games vary, for teens can spend hours playing with their laptop, phone, electrical goods video games, etc. Many teens love to spend time playing with these video game. When a person gets to spend much time playing, the person is known as a cyber-addict or video game addicts. People can spend long hours on their computers no matter the time. This addiction can lead to states of fatigue, discomfort and failure to do their daily work, staying in constant tension that can lead to depression and/or anxiety, as indicated by those working with the mental health of people. Moreover, this way of interacting, alone or in an online community, can cause behavioral disorders, lower their academic activities, truancy, and sometimes have them lose their studies. Teenagers are the most vulnerable to addiction to these games groups, and the consequences can be devastating to their lives in every way. It can lead to the risk of falling into the vicious circle of dependence and develop games gambling addiction. In other circumstances, boys and girls can confuse reality with the fantasy of the game and show signs of aggression, which in extreme situations can have fatal outcomes. Fathers and mothers should seek immediate help from a health professional or mental health specialists, if they see addictive tendencies in their children. If the boy or girl spends more than four hours at the computer, it is an indicator that the child can fall into addiction.

ANALYZING LAMIN A/C GENE MUTATIONS BY A HOMOLOGY BASED TOOL

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Lamin A/C (LMNA) is a gene which is involved in nuclear stability, chromatin structure and gene expression. Mutations associated with the LMNA gene that encodes the protein results in diseases such as: Emery-Dreifuss muscular dystrophy, familial partial lipodystrophy, limb girdle muscular dystrophy, dilated cardiomyopathy, Charcot-Marie-Tooth disease, and the Hutchinson-Gilford progeria syndrome. SIFT is a homology-based tool that predicts if an amino acid substitution along the polypeptide alignment that affects protein function and has a phenotypic effect. Those values obtained by SIFT with less than 0.05 are predicted to be deleterious or intolerable; when greater or equal to 0.05 they are tolerable. It was predicted that results from SIFT would be intolerant to mutation. The amino acid substitutions of 12.5% were predicted as tolerant and 87.5% were predicted as deleterious. This means that there was a higher change of mutations in the encoded protein.
STATISTICAL AND COST-EFFECTIVENESS ANALYSIS OF SPORTS INDUSTRIES

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Poverty is the major cause, and also an effect, of most of the world’s problems nowadays. Sports industries make much money every year. Could these organizations, clubs or also the own athletes donate the remaining money to support and help the community in need due to poverty? This research. Using algebra and a survey, this investigation presented a survey given to persons related to this industry in Puerto Rico. This research contributes to communities in poverty impacting the sport industries about their incomes and outcomes, and how they could use effectively their money to continue supporting the community.

ANALYSIS OF MUTATION PROBABILITY OF MYH7 MYOSIN BY AMINO ACID SUBSTITUTION

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Myosin is a hexameric protein and is being encoded by the gene MYH7. This gene encodes the beta heavy chain subunit of cardiac myosin. It is expressed normally in the human ventricle. It also expressed in skeletal muscle tissues rich in slow twitch type 1 muscle fibers. Mutations in this gene are associated with familial hypertrophic cardiomyopathy, myosin storage myopathy, dilated cardiomyopathy, and Laing early-onset distal myopathy. The purpose of this research is to obtain the probability of mutation using SIFT (Sort Intolerant from Tolerant). This program calculates the tolerance level to know the mutation percentage of this gene. It was predicted that results from SIFT would be intolerant and produce a mutation. Results obtained by SIFT showed that 77.5% of amino acid substitutions were intolerant, while a 22.5% of amino acid substitutions were tolerant. A higher probability of mutation in the MYH7 gene was obtained.
STATISTICAL ANALYSIS OF THE MASSIVE DROUGHT IN THE USA WESTERN COAST

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In January 2014, the Governor of California, Edmund G. Brown Jr, announced that California is facing one of the most severe droughts in history. For that reason, several programs were developed with the objective of making citizens aware of this problem, e.g. “Save Our Water”. Since precipitation is an important source to rivers, lakes, ponds, aquifers and groundwater, the main question that arises is how precipitation is contributing to fill water reservoirs? Furthermore, despite rainfall, what is happening in water reservoirs in California? How are the levels of water in comparison to past years? To develop the present investigation, data were obtained through United States Geological Survey (USGS). Statistical analyses were developed in STATA V13, as well R freeware. Trends for rainfall and water levels in main reservoirs in California were developed in order to explain and establish if there is a statistical significant difference between other years and 2014. At the end of the research, it was expected not only to back up the statement of the Government of California, but also, to determine a model that describes the interaction of precipitation and water levels in 2014.

DEVELOPMENT OF GIFTED CHILDREN: REASONS AND CONSEQUENCES

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Gifted children, often known as geniuses, talented or prodigious, are those children who develop a high understanding of a certain area. Gifted children may develop in different ways; their minds are more developed than their physical growth. These children are found as a result of high scores on IQ tests, of above the 130 IQ range. Gifted children's behaviors are different from children from the same age. They are good learners and show their abilities developed apart from their age-mates .They are known as unique kids because of their extraordinary way of learning. This particular behavior has produced a fear in the grown up society. They have also been rejected, neglected or treated as freaks. This rejecting conduct has been depriving these children from acquiring a higher level of knowledge or receiving benefits for their talents. In this research, their characteristics were studied. Knowing and learning about these unique ways will clarify, reduce and eliminate the fear and the stereotyping in the current grown-up society.
THE EFFECTS OF NUTRITION ON THE DEVELOPMENT OF GENERATIONS

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Have you ever wondered how connected you are with your ancestors and how it connects with future generations? How environmental factors, the food that you and your ancestors consumed could affect the next generations? The secret to this mystery is printed in our human genome. Epigenetics is the study of changes in gene expression caused by certain base pairs in DNA, or RNA, being "turned off" or "turned on" again, through chemical reactions. This means that genomes can be altered through environmental factors and nutrition. Furthermore, it could affect future generations even when known past generations have not presented the problem in the genes. Currently nutrition influences on genome more than people are aware of, and poor eating habits or malnutrition can alter the genome. This can damage the DNA strand, and then be transmitted to the next generation. This research investigated these influences and their effects.

CAUSES AND EFFECTS OF LUMINARIES CONTAMINATION

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Light pollution is emitted any light escaping above the outer line horizontal luminaries skyward. This light does not fulfill any purpose. Any light leaking out of the area that needs to be illuminated light energy is wasted and has adverse effects on the environment. The light polluter produces a glow that illuminates dust particles suspended in the water or air. Some ways to identify light pollution is by viewing the stars and the cloud illuminated. Since the end of the 90s, a group detectives from NOAA and the NASA were using images that captured the light of the night lights of the artificial light on the planet. In addition, the types of light that are used are not apt to the type of country where one lives. People need to use less artificial light so there are more natural lights at night.
EFFECTS OF THE COLORS AND ODORS OF THE FOOD IN THE DAILY DIET

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Have you ever wondered how the color and smells of the food affect the eating habits, hence, of the daily nutrition? Present research had as a main objective to assess how color and odor affect preferences about food. In order to develop the investigation, a survey was carried out. Pieces of bread with different colors and odors - than usual - were used as instruments to measure how their physical characteristics influence preferences at the time one eats. Data were collected through survey. A questionnaire was filled before and after a participant ate the piece of bread served. Data were analyzed using STATA v13. Differences in proportions z-test for dependent samples were used to determine how perception changed after eating the bread served. Probability concepts were used to establish how likely was for a person to actually eat something with a color and odor different from usual.

THE EFFECTS OF THE MICROBACTERIUM BOVIS ON THE IBERIAN LINX

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The Iberian Lynx is the most endangered feline in the world. It lives in the Mediterranean forests of the Iberian Peninsula. This species does not have natural predators other than wolves. Research conducted has revealed that the Bovine Mycobacterium is affecting directly the health and lifestyle of the Iberian Lynx. Bovine tuberculosis is a disease that can be contracted through contact with domesticated and wild animals, cattle milk and infected tissue with the Mycobacterium. Some of the symptoms of this disease are intermittent diarrhea, fatigue, lack of appetite and weight loss. The objective of this investigation was to measure the population growth of the Iberian Lynx while being affected with the micro bacterium bovis. Mathematical models were used to establish mathematical equations that can be later used to predict this population. The following covariates were considered: the population size, birth rates, death rates, immigration and emigrations.
CANCER, GENOMES AND NUTRITION

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Cancer is a term used for diseases in which abnormal cells in the body divide without control and invade other tissues. There are over a hundred types of cancer, but they all start in the cells. Studies have been made to determine the role that nutrition plays on the development of cancer. In the case of breast cancer, it is believed that certain types of fats, such as Omega six, accelerate breast cancer by making the disease worse. Other types of cancer have been linked to Western diets, rich in carbohydrates. The control diet reduces mortality levels and in the future will be adapted to the personal genetic diet that will protect people from cancer. This investigation will involve different types of cancer and their relations with the genomes and the nutrition. To achieve this, information from a valid and trusted resource will be used, as well as other research information and statistics related to this.

THE EFFECT OF PLAYING TABLE GAMES

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People spend hours playing games. Some of them play table games and the people that watch the gamers wonder if they are smarter than themselves. Crosswords Puzzles and Word Searchers are developers of skills such as vocabulary, spelling, reasoning, identification or similar words and phrases. Table games can help children and adults on the mental side (study side). The purpose of this research was to prove if table games have a positive effect on the brain and help students in their classes. An experiment was made by selecting students of both genres. They were divided into those who play these types usually and those who do not. A test involving analytical problems was conducted and the results were displayed in charts and graphs.
MATHEMATICAL MODELS TO DETERMINE THE QUANTITY OF THREE NECESSARY TO BALANCE THE CO2 CONTAMINATION

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During the last 20 years, carbon dioxide contamination has been rising due to the industrialization of the United States of America. Most of the emissions in the world are made in the United States, making it the second country with most CO2 emissions. Taking into consideration the augmentation of emissions made over the years and the decrease in trees due to deforestation, CO2 emissions is the major cause of global warming. During the research, an estimate of the CO2 emissions in 2025 in the USA was made to calculate how many more acres of trees were needed to balance and neutralize contamination to have good air quality in the country. This was done with two programs, R Software and Simile V.6. To solve CO2 problem in United States, the country must decrease the usage of fossil fuels and look for greener ways such as solar panels and wind mills and create more stringent laws about tree plantation to achieve and conquer the CO2 emission problem and drop down the massive emissions made by industries and common citizens.

UTILIZING SIFT TO DETERMINE PROBABILITY OF MUTATIONS IN PSEN1

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Research Mentor: Frances M. Rosa Rivera, Universidad Del Este, Carolina, Puerto Rico.

The Presenilin (PSEN1) gene encodes the synthesis of a protein, named presenilin 1. Presenilin 1 is a subunit of the gamma secretase complex involved in the proteolysis of proteins into peptides. This cleavage is an important step in several chemical signaling pathways, as the Notch signaling, essential for normal maturation of hair and skin cells, and also involved in the normal function of the immune system. Mutations in this gene can cause health conditions such as Alzheimer's disease (AD) and hidradenitis suppurativa. Alzheimer’s is a degenerative brain condition and the mutations in the PSEN1 gene are associated for up to 70% of early-onset of this disease. Hidradenitis suppurativa is a chronic skin disease that is characterized by nodules in the skin that progress into hair follicle. The objective of this research was to predict the probabilities of amino acid substitutions in this gene that can cause a phenotypic effect or a disease. SIFT (Sort Intolerance from Toleranc) was used to determine the amino acid substitution probabilities. It was predicted that the substitution was intolerant. The results revealed that there is a 25.5% of tolerance and a 74.5% of intolerance to amino acid changes. This means that SPEN1 has a high probability of mutations.
ANALYZING THE POLYCYSTIC KINDNEY AND HEPATIC DISEASE 1 GENE BY TOLERANT AMINO ACID SUBSTITUTION

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The Polycystic Kidney and Hepatic Disease 1 (PKHD1) gene is responsible for producing fibrocystin. Fibrocystin is present in fetal and adult kidney cells and acts as a receptor interacting with molecules outside the cell and receiving signals that help the cell respond to its environment. Mutations in this gene cause autosomal recessive polycystic kidney disease, also known as polycystic kidney and hepatic disease (PKD). The disease is characterized by fluid-filled cysts that form in the nephrons of both kidneys. It eventually lead to kidney failure in the majority of patients. Polycystic kidney disease is the fourth most common cause of kidney failure. SIFT is a program that predicts tolerated and deleterious substitutions for several amino acids positions. The purpose of this research was to obtain the probability of mutation of the PKD gene using SIFT (Sort Intolerant from Tolerant). SIFT takes a sequence and uses alignment information to predict tolerated and deleterious substitutions for amino acid changes. Results obtained from SIFT showed that 36.5% of amino acid substitutions were predicted to be tolerant, while 63.5% of amino acid substitutions were predicted to be deleterious. In conclusion, results from SIFT showed a higher chance that a mutation could happen.

HEALTH EFFECTS OF DAILY PRODUCTS

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The common citizen use a variety of hygiene products and certain beverages that have become part of many people's everyday lives. Those products look good, taste good and seem to have endless benefits to the people that consume them. These benefits could be fresher breath, a refreshing and satisfying drink, a way of passing time or overall just making people like them. But they are being used every day, and what health effects can these have? It is known that soda causes kidney stones, and toothpaste is said to cause some kinds of memory loss as well as mouth ulcers. But is this really true? In this research an investigation was done by selecting certain products and studying their so said negative health effects. Interviews were done on people that used them, and those who do not use these products to reveal after what age these products’ so called 'side effects' really begin to take place, if they do. Statistics were used to represent on charts a full understanding of the results. This way people that use certain products can limit their usage if not discontinue them all together and focus on healthier ways of obtaining the same or better results.
SIMULATION OF THE EARTH’S GRAVITATIONAL INTERACTION

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The Earth’s gravitational force attracts the objects to the center of its core. This is the concept referred to as gravity. This is true for objects found inside and outside the Earth’s atmosphere that experiment an interaction / force produced by the Earth. The objective was to simulate the trajectory that an object can have under the attraction of the Earth’s gravitational force, by changing its initial position and initial velocity. Observations were made under what circumstances the object would collide in the Earth’s atmosphere, and the velocity needed to keep it orbiting. Simulations were done in Visual Python, where the measurements of the Earth and the iterative calculations of the object’s position and momentum were made.

MEASURING SLEEP EFFICIENCY IN OBSTRUCTIVE SLEEP APNEA PATIENTS

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Obstructive Sleep Apnea (OSA) is a disease caused by the blockage of the airway during sleep, which causes sleep disruption and loud snoring. Sleep efficiency is defined as the ratio of the total amount of sleep time to the time spent in bed. In this investigation, we aimed to calculate average sleep efficiency in obstructive sleep patients under the effects of the CPAP machine. The data set belongs to a clinical trial carried at the University of Iowa, composed of 44 subjects. Analysis was based on results from the ANOVA calculated in the R program, used to compare drastic differences between the control and OSA groups. The sleep time of the patients was measured by actigraphy watches, which were set up according to the patients’ sleeping deepness.

ANALYSIS OF GENE MUTATION PROBABILITIES IN POTASSIUM VOLTAGE-GATED CHANNEL, SUBFAMILY H (EAG-RELATED), MEMBER 2 (KCNH2)


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The KCNH2 or potassium voltage-gated channel subfamily H (eag-related), member 2 gene is composed of HERG (the human Ether Related Gene). This gene encodes the alpha subunit of the potassium ion channel. KCNH2 is also best known for the transfer of electrical currents that pass the cell membrane and classifies them by inhibited or by compromised effects. Mutations in this gene can lead to health conditions as the Romano-Ward syndrome and the short QT syndrome. The objective of this research was to predict amino acid substitutions and their tolerance or intolerance using the SIFT program. This tool helps calculates the amino acid substitution by a percentage in the scale numbers. It was predicted that the substitutions would be intolerant. Results of SIFT revealed that 13% were tolerant and 87% were intolerant to amino acid changes. This means this gene has a high chance of mutations.
ANALYZING THE COL7A1 GENE BY THE USE OF SIFT

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The COL7A1 (collagen type VII alpha 1) gene helps in the assembly of type VII collagen and it makes up most of the skin. Collagens help with the anchoring fibrils of the skin and also strengthens and protects the skin. The mutation in this gene causes epidermolysis bullosa (EB). EB is a group of inherited genetic conditions that cause the skin to be very weak and prone to breakage and severe blistering. It is mostly present in newborns. Additional side effects include disfigured nails, and scarring of the mouth and esophagus which causes problems with chewing and swallowing food. The objective was to determine the tolerance and the intolerance mutations using SIFT (Sort Intolerant from Tolerant). SIFT takes a sequence and uses alignment information to predict tolerated and deleterious substitutions for every amino acid change. It was predicted that results from SIFT would be intolerant to mutation. Results obtained from SIFT showed that 45.25% of amino acid substitution were tolerant, while 54.75% of amino acid substitutions were predicted to be deleterious. In conclusion, results from SIFT showed a chance that a mutation could happen.

ARE YOU BEING SO SOCIAL YOU CANNOT SLEEP?

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Social networking sites started launching in 1987. They have been mostly used to communicate and share data such as pictures, videos, texts, messaging and much more. Recently, a long-term study (2005 to 2013) showed an exponential growth of Internet users across years and age classes, although no statistical test was used to find if this increase was significant across years and age class groups. Currently, 74% of adults online use social networking sites. Some of these studies have looked into the social impact that social networking can cause to people; for instance, in relationships, communication, etc. To determine if sleeping patterns are affected by the use of social networking in different age classes, a survey was created using different grounds from different ages. The data were analyzed by gender and age using statistical tests to determine whether the results were significant or not. The null hypothesis of this study was that sleeping is not affect by social networking sites in any class group or gender.
STATISTICAL ANALYSIS TO COMPARE THE PREFERENCE CHOOSING HASHTAGS IN SOCIAL NETWORKS. CASE STUDY: HASHTAGS RELATED TO “FRIENDSHIP” IN TWITTER

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“It has become appallingly obvious that our technology has exceeded our humanity.” (Albert Einstein) A hashtag is a word or an unpacked phrase prefixed with the number sign (“#”). People use the hashtag symbol “#” before a relevant keyword or phrase (no spaces) in their tweets to categorize them and help users to find easily other tweets using the same hashtag. But topics can be related to many words that have the same meaning, then, if two hashtags related to one topic are chosen, which is more accepted in social networks, hence, is it most used? In order to develop this investigation, two hashtags were chosen: #friends and #bff - which stands for "best friends forever". Since friendship is an important topic in social networks, the main question that arose was, which word is more used nowadays when people are talking about friendship: “friends” or “bff”? Data were collected using the web page hastahs.org. This website saves data of how many times a specific hashtag was used in the last 24 hours, by the hour. Data were consulted for five days. Stata V13 was analyzed to compare the proportions of use for each hashtag, with the initial assumption that the proportions should be the same: 50%.

STATISTICAL ANALYSIS OF TRAFFIC IN PEAK HOURS IN A SCHOOL ZONE OF CAYEY, PUERTO RICO

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The purpose of this investigation was to analyze the peak hours in a school zone. The chosen zone was located in Cayey, Puerto Rico, basically, in front of the Miguel Meléndez Muñoz High School. The traffic in the afternoon, from 3:00 p.m. to 4:00 p.m., was studied during 5 labor days. The objectives was to present the traffic of the school zone in the mentioned peak hours and to suggest alternate routes, which are not used frequently in a heavy-traffic day. As a third objective, this research wanted to determine which day this avenue was more used during the week. Traffic was counted, counting every car, and taking notes and observations. Then, the data were moved to Microsoft Excel to create the graphics and models. The analysis, conclusions and recommendations were made using the graphics,
CARDIOVASCULAR AND PULMONARY DISEASES AS CANDIDATES FOR REGENERATIVE MEASUREMENT IN CARBON NANOTUBES

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Research Assistant Mentor: Gabriela A. Rodríguez Morales, Universidad Metropolitana, San Juan, Puerto Rico.

A carbon nanotube is a tube-shaped material, made of carbon, having a diameter measured on the nanometer scale. These cylindrical carbon molecules have uncommon properties, which are appreciated for nanotechnology, electronics, optics and other fields of materials science and technology. Carbon nanotubes have a strong optical absorption in the near-infrared region, which enables their use for biological imaging applications and photo thermal ablation of tumors. The purpose of the research was to compare different cardiovascular and pulmonary sicknesses, and observe which stand out the most. The results would allow to know the one sickness that is more eligible in the study of carbon nanotubes.

WHAT EFFECT DO SCARY MOVIES HAVE ON CHILDREN?


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Research Assistant Mentor: Kelvin García Muñiz, University of Puerto Rico, Mayagüez, Puerto Rico.

A horror, suspense or scary film corresponds to a genre seeking to elicit a negative reaction from people. There usually is a bad guy who kills for joy or there is an evil monster that is destroying everyone. Most parents use scary topics to scare children. They think that it is the correct way to help children behave better. Although it is common to see some of these conducts in children, the consequences that this phenomena may have are not well known in their development. Possible things children will show are fear of the dark, anxiety, horrible nightmares and possible mental disorders. This research tried to clarify these behaviors and their consequences or repercussions in the future of children. In order to perform this action, a survey was conducted involving parents. In this survey questions related to the children’s fears were presented and answered. Finally, the results were displayed with graphs and charts.
MAJOR SEARCH ENGINES: USE AND RELIABILITY


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This research aims to compare the use of different search engines and their level of reliability. The web or search engines are computer systems that provide the possibility to consult a giant database to find web pages. Seekers provide netizens, which is anyone who uses a web browser and visits web sites, with often used especially for people who are expert navigators, the option to find the information that they need fast, quick and easy information. To access this information, the user must enter a keyword and the search engine will respond with the information in the form of lists of different web pages related to the keyword that the user enters into the web browser. The purpose of this research was to present the most reliable search engines, and also to discover why some search engines are more preferable to others. This will be done through data collection and statistics, among others.

MAIN CAUSES OF CAR ACCIDENTS IN PUERTO RICO IN YOUNG ADULTS

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Car accidents have become a custom in Puerto Rico. The main causes of death are in young adults from 18 to 35 years of age. In Puerto Rico, an average of 43,000 car accidents occur each year. This means that 826 accidents a week resulting in 118 collisions per day, five every hour, according to statistics compiled by the division of traffic police. A total of 37,463 transit accidents were recorded only in 2012 in the island with 8,586 individuals wounded. Which are the greatest distractions when people are driving? From home to work, it includes eating while driving, attending the baby that cries in the rear seat of the car and the most common, texting and driving, among others. But the most common in Puerto Rico and elsewhere are drunk driving and speeding. The purpose of this research was to teach young people and adults that drunk driving, exceeding speed and texting while driving only lead to mortal and fatal accidents.
ABSTRACTS

COMPUTER SCIENCES

BUILD THE PUZZLE

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This project was based on the design of a game for children’s education. This game is mostly for children between the ages of eight to ten based on the concepts they learn during the school years. More specifically, this game implements education in the subject of math and encourages children to learn. The project is educational because children nowadays are always using a technological device yet the majority of games that they play on these devices are not educationally related in any way, but just for fun. The project is an application for children to enforce their abilities in mathematics. The game will be educational and fun for the children, who will be learning mathematics by building a puzzle. The game consist of concepts for children in the 3rd grade and up which are basic problem solving, addition, subtraction, and multiplication. The application has an easy format for the children to understand and a math exercise is given; when it is answered correctly, a puzzle piece will appear on the screen of the device, and if a math exercise is not answered correctly there will be a missing puzzle piece. In the game the children will not be evaluated by score.

SAVING PRIVATE CONPUTRON: EASY WAY TO SOLVE MATHEMATICAL PROBLEMS

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Saving Private Conputron is an action puzzle game with the purpose of solving some mathematics problems. The middle school mathematic was used to create one not too simple but neither too difficult game that is pulled forward by a story line. The main objective was to create an easy and fun way in which the students could learn and feel comfortable with mathematics. This game was created to simplify the learning in mathematics but at the same time having fun. The game relocates the missing data drives of the computer Conputron, which have been stolen by the game’s main bad guy and his group of bandits. The computer is in a security place and the stolen data activate the lock of all the doors of the place. The only way to reopen them is by returning the data drives to Conputron and solving various mathematical problems in order to reboot it. On certain occasions the player is asked to solve a series of increasingly challenging mathematical problems and puzzles. It is expected that this game could help the students to develop mathematical skills and make them learn mathematics in an easy and fun way.
SPACE DANGER: PLAYING UNDER PRESSURE

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Space Danger is a work in progress Puzzle survival horror game where player must find the different pieces of a computer, to Rebuild it and Re program it. This game was built to teach and help players understand computer coding, and engineering. It works by solving puzzles, surviving the deadly alien and seeing how well and quickly a person can work with a limited amount of time under the pressure of either running out of oxygen, getting caught or be consumed by the insanity of darkness. The idea for the video game is to create a game where players have to think quickly, memorize and learn how to program and handle things well under pressure. The way the game goes is to basically try and help players reach this goal, and all while they enjoy the fascinating story and intense gameplay. This game is a reference by Dead Space, following the story of an engineer who survives the horrors of space and escapes the inevitable by playing under pressure and stress. The game was made for players of all gaming genres to involve them in a mind bending and fast paced experience. The programmers want them to experience the thrill of programing while they also enjoy a great story and survival puzzle. Basically the game works by simply pointing, clicking and typing, and also uses audiovisuals as well. The player must move around a ship freely and collect pieces of different computer parts, build them in a specific order and for the final process type in the codes instructed by the computer (A.I.). Everything in this game is timed, from the limit on the oxygen tank, to the deleting of the codes in each built computer, in this case if the player fails, he or she would have to start all over again.

THE EFFECTS OF REPLAY PENALTIES ON THE COGNITION OF TEENS

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The purpose of this research was to investigate the effects of replay penalties on the cognition of teens, using two different versions of the game Run Fast. Run Fast is an iOS racing game developed by the researchers using the programming language Java. The game had two different versions. The first one used replay penalties, meaning that if the player failed, he had to start over the game losing all the progress he made. The second version of the game used checkpoints; in this version, the game was saved the progress even if the player lost a certain number of times. It was intended to prove that the first version of the game would help the players develop a more accurate cognition in order to avoid the replay penalties. Ten teens between the ages of eleven to fifteen years were randomly selected and separated into two different groups. The first group used the first version of the game, and the second group used the checkpoints version. During the sessions, the researchers made observations of the players based on the versions they were using. After analyzing all the data collected, it was concluded that the replay penalties did affect player cognition.
THE ESSAY BUILDER

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The essay has been a very stressed method of grading and evaluating a student. It is an effective way to organize one's thinking, to respond to a problem, support an argument, and gain knowledge on someone's writing skills. This research aimed to create a website to improve students’ writing skills. This website was developed using the programming language HTML and the Dreamweaver ® platform. To test how effective the website has proven to be, different students did a pre-essay and a post-essay, and were evaluated on how much their essay writing had improved thanks to the newly gathered knowledge acquired since they started their use of The Essay Builder Website.

LIFE SIMULATOR: TEACHING PRINCIPLES OF LIFE AND COMPUTER SCIENCES THROUGH SIMS

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The researcher selected the game Sims because they want to show how the family lives. A game called life simulator was created to change the life of avatar. The player needed to help some families through the game. The player could go to the mall, fast food restaurants and travel to others cities, get his own house or apartment to get some rest. He or she can be a police officer, a firefighter, or a company owner. This game would show people how families live. The Programming Language for the Life Simulator was Java, the player needs to get some point use a computer to complete the objectives and mission of the game. While the player completes the missions he will be awarded money. The researcher wanted to prove how the game changed the life of others with computer science by providing a post-test to the 9 th grade students who played the game.
GRAND VIRTUAL WORLD: LEARNING COMPUTER SCIENCE THROUGH GAMES

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The researchers created a game, Grand Virtual World. It is a modification for Grand Theft Auto V be two original worlds will do where this human (Earth) and the Virtual where you enter a specific place called Cafetería Jom's where there will be a computer specifies that only has the power to April portal to the virtual world and there will be all kinds of monsters in this world and you will see the main character was called Mamba Ghost in the virtual world on Earth will be a delivery of Pizza guy called Drake Collins but when you enter the virtual world everything will be very different. Objective-C is programming language of Grand Virtual Game World. The programming language Objective-C is simple designed to enable sophisticated object-oriented programming. Objective-C extends the standard ANSI C language by providing syntax for defining classes, methods, and other structures that promote dynamic extension of classes.

ELECTRO FLOW: PROGRAMMING WITH SNAP!

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Electro flow is a puzzle and educational game; it is a combination between Flow and 2048. Both are challenging and fun games to play. The majority of the games are entertainment but they lack the educational side. The objective was to create a fun, challenging and educational game to teach programming by showing the meaning of the program in “Snap!” using a programmer’s point of view. The player controls three bases in Snap: motion, control, and pen. They have to match the words if they are part of the same groups. For example, in motion the player moves an arrow to match the letters like “move (x) step” with “turn right (x) degrees” that match because they are part of the motion. Control is to start, end, or forever like “repeat until (x)” and “when I am clicked”. The other is the pen used to color, and the matches could be like “pen down” with “set pen color to (x). This game has a square map of 4x4 at the beginning but it will expand to a maximum of 8x8. You have to connect two similar bases at the beginning but later there are three or even four. It becomes more challenging with each puzzle by having more patterns to make it more difficult to complete. At the end of the game it is expected that the user will learn the significance of the letter. Learning programming will help those who want to be programmers in the future.
LOST FANTASY: TEACHING COMPUTER SCIENCE PRINCIPLES THROUGH A GAME

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Lost Fantasy is a way to teach high school students about computer science basics. The game advances with the knowledge gathered through an adventure, and is based on a popular series called Final Fantasy. In Lost Fantasy, the players select an avatar, which determines the game storyline. After that the player will be completes dungeons, fighting bosses according to the selected avatar. In every dungeon there are key enemies and items for the adventure. The enemies ask different types of questions related to computer science. If the player gets the questions right, damage is inflicted, but if the player gets them wrong, the player will get hurt. When the final dungeon is completed, the player will have an additional question that will lead to the ultimate boss and rescue “what was lost,” the knowledge gathered. The game develops R.P.G settings for leveling up and the equipment. When leveled up, the questions get harder and the bosses tougher. The equipment may be improved, which makes some stats go up. The student apply what they learn in future levels and real life, like solving puzzles, mathematics equations, and eradicate malwares. This game helps a lot of students use their knowledge in school, increasing the academic performance of the gamers, and their ability with computers and other digital devices.

CYBERESCAPE: TEACHING CODE THROUGH GAMING

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The purpose of this project was to teach young students, from middle school and high school the basics of programming in a simple and entertaining way. Learning to code at a young age is a necessary skill in order to develop vital problem solving, creativity and communication skills as well as being able to follow a STEM career in the future. Although there are educational games made to teach kids these skills, most of these are designed with children in mind so teenagers might get discouraged and might steer away from playing these games. To address this issue, it was decided to make a game with more interesting and complicated gameplay mechanics. The game should be interesting enough to keep the teenagers playing but educational enough to teach the fundamentals of programming like: control flow, if statements, parameters, loops, and variables. CyberEscape belongs to the platformer genre and the gameplay will be based on controlling the environment to solve puzzles and progress through the levels.
HOW DOES MUSIC INFLUENCE THE COGNITIVE DEVELOPMENT OF THE BRAIN?

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The main purpose of this work was to understand how the various musical genres influence learning and cognitive development. Previous studies have found that when the pulse or heart beat is synchronized with the beat of the music, the agility, retention, and learning in humans was increased. An application using the Java programming language was developed by the researchers in order to test this theory. The app focused on measuring the learning and concentration in teenagers giving them the option of choosing a musical genre while reading and watching different messages and random order of letters appear on the screen. The study was conducted with 90 teenagers between the ages of 14-18 years of age. It was concluded that music has a positive effect on cognitive development, having a greater impact on teenagers between the ages of 16-18 years.

MAGIC CARD TRICK SIMULATOR

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This research aimed to create a simulator for conducting various magic card tricks. The program is able to perform different magic card tricks accurately and precisely just like a magician would perform them. It used different algorithms for the card tricks. They were obtained by analyzing the tricks while drawing the cards. In the first phase probability and statistics were analyzed. This research consisted of a series of phases. Some of them were: the analysis of the card tricks, the probability and the programming of the simulator app. The equations for the different card tricks were obtained through the statistics and were applied before programming the simulator. It was programmed using JAVA®. The equation was obtained and programmed during the last phase of the programming and algorithm creation in order to create the simulation. In the next phases an app for mobiles will be created.
LOOPY PYRAMID

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Loopy Pyramid is a videogame that teaches players to do more critical thinking and analyze concepts by using programming loops. The concepts in this videogame include the basics of programming a character’s movements; for example, move forward, move backward, turn left, turn right, pick up and more. All of these concepts need critical thinking and they will be a key part of the game. The game setting is similar to an Indiana Jones concept where the adventurer is searching for the treasure and encounters many obstacles during the process. This gives a fun experience to the player, since most adventure games bring an abnormal setting and always show puzzles that make the player think. The player will need to make good use of the integrated loops in Loopy Pyramid to reach a place in the game. While the player is progressing throughout the game, each level will appear with higher tasks to do. There is also programming integrated into the characters’ actions, an example being the interaction with an object in the game and after that another object moves. This would be a great 2D strategy game that teaches people different concepts of programming and other subjects.

TEACHING THE WATER CYCLE AND STATES OF MATTER THROUGH WATOPY

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Games are a great way to get kids interested in learning, because they are having fun at the same time. This research was focused on an educational game for elementary or middle school children. Since this generation of children likes to play a lot of games, it was a good choice to create this game to teach them the different stages of the water cycle and the state of matter. The game was developed in Game Maker-Studio and in Stencyl®. It also used Inkscape to edit and design the backgrounds and pictures. It is a 2-D game based on the first Mario platform games. In the created game Watopy, a drop of H₂O is confused and has no idea of its purpose. The objective is for the player to reach certain locations where he or she will pass through different material states. In the game, the player faces different challenges that will make it harder to get to its other states; for example, lava, fire, insects and, its greatest threat, Homo sapiens sapiens. This level was the water’s greatest threat. Efficiency tests showed that the game is good and the level is adequate.
SOURCE CODE: TEACHING COMPUTER SCIENCE PRINCIPLES THROUGH ASSASSIN’S CREED

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The game the investigator created was SOURCE CODE. The game is a modification of Assassin’s Creed (AC), the number one selling videogame franchise from Ubisoft. Using the mechanics from AC, this game brings history and computer science to life in a fun and addictive way. The “animus” was hacked and individuals must fight their way through waves of enemies. Every time a wave or zone is finished, they must enter a computer and hack it answering various questions about computer science. When a player defeats an opponent, it drops loot and in rare cases new weapons. While answering the questions the player learns about algorithms, data structures, etc… The player uses JAVA as the programming language to complete the various challenges. The fundamentals of JAVA come from a programming language called C++. Although C++ is a powerful language, it was too complex. Unlike other adventure action games, Black Source takes a more irrational approach to modern educational games combining computer science and an action twist. At the end of the game a post emerges to see what the players learned if they answered correctly and they get a secret reward.

MATH LEARNING AID

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This project was about the creation of an app to be used for kids ages 4 and up. Technology is an important part of our daily lives and nowadays it is an important resource for students within any level in school. This application was focused on kids in elementary and middle school. The main idea of this application was to help kids learn math in a way they can enjoy and not get tired of learning. The methodology of this study was divided into phases. In the first phase, a program using Java® was developed for the creation of the application frame and the basic color scheme. The coding for this app was created using a Java® code compiler. The second phase of this app was to integrate the mathematical concept into the game by making the coding to add mathematical problems. The last phase of the app was to add all of the images and graphics that would attract children’s attention. After finishing the app, it could be integrated into the elementary math class as study material. This way kids would find math fun. This app would feature kid-friendly art and easy to use user-friendly features. Most of the app would include math problems, from the start screen to the app closing. The coding for this app is extensive due to the features this app includes and the arts and graphics it supports. It was designed to work on multiple platforms such as Windows ®, Linux®, Apple®, and Android ®.
THE EFFECTS OF GAMES IN MATHEMATICAL LEARNING

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Nowadays, students dedicate more time to video games than to school. The purpose of this research was to compare the mathematical learning the students obtain in the classroom versus the learning they can acquire using games. It was intended to prove whether students between the ages of eight to twelve years learn better the mathematical concepts using games than practicing it in the regular classroom. The researchers developed an Android game called “Reach the Human” using the programming language Java. In the game, the players have to reach the human without getting trapped by the obstacles in the game. While playing, the players will encounter different obstacles, to overpass them, the player will have to answer quickly and correctly a mathematical question. Twenty students were randomly selected and divided into two groups: the control group and the experimental group. The control group took a pre-test and a post-test to determine its learning in the classroom. The experimental group played the game, and the researchers saved the scores. After classifying all the data of both groups, it was concluded that games did affect positively the mathematical learning in students.

CIVIL ENGINEERING ON ANOTHER PLANET

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Scientists are concerned about how life is supported on Earth and what would happen if planet Earth became uninhabitable. Astro-Build is a 2D modeled simulator game in which knowledge about civil engineering, astronomy, and geography were necessary. Also the game requires a scenario that presents resources brought from Earth. All of them were used to sustain life in another planet as part of the programmed game. The player must keep in mind that resources were limited and that the atmosphere of the planet is different from the atmosphere of Earth. In summary, the goal of this game was to simulate how life would look like on a planet other than Earth. Another important aspect was whether the program incites astronomical and civil engineering interest in the player. The results showed that it is possible to program all the worlds using Kodu that is a visual programming language. In the future the game will be evaluated.
ABSTRACTS

ENGINEERING

DESIGN FOR A RIVER HYDROELECTRIC PLANT

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Renewable energy will replace the use of conventional fuel, but most ways of acquiring alternative energy are expensive. For example, hydroelectric plants are one of the most used ways of alternative energy, but are highly expensive to construct, which needs to be operating for a long time for it to be profitable, and needs to be built at a high standard. This research intended to design a model for a more efficient hydroelectric plant. The research was divided into two parts, the practical side and the theoretical side. For the practical side of the research, a scale model was made with houses, the turbine and some LED lights to indicate the different household electronic items. The LED lights were of different color coded and different voltages. For the theory side, some calculations were made to get the voltage, amperage and the wattage from the practical side and measurements were taken from the turbine to make a more efficient turbine, taking into consideration weight and size. After the calculations and measurements were done, it was then applied to a real house.

FUEL CELL: A SOURCE OF ALTERNATIVE ENERGY

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A fuel cell is an electrochemical device in which the continuous flow of fuel and oxidants undergoes a controlled chemical reaction that results in the products and supplies electrical power directly to an electrical circuit. This research was made to determine what a fuel cell is and then create metal plates that could separate the protons and electrons in the reaction mixture of hydrogen and oxygen. These were placed in a container full of water and it had a connection in another container with water. With this an energy was created that can function as an electrical device. This energy needs to be further investigated.
CAN A ROBOTIC HAND, MADE FROM ACCESSIBLE MATERIALS, COPY THE MOVEMENTS OF THE HUMAN HAND?

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Every day, humans risk losing arms or hands while performing dangerous activities. For such reasons, this investigation created a robotic hand that copies the movements of the human hand made from accessible materials. This way, humans can use such creations for jobs that put their real hands in danger. As a matter of fact, such things already exist, but this project tried to do so using readily accessible materials, which can be bought on the Internet and/or found on local stores. However this project only tried to make a hand that will only copy basic and simple hand movements. By building a rudimentary prototype (using plastic, motors, sensors, wires, gears, aluminum, etc.), the feasibility of this project was demonstrated. In the future, a more sophisticated model will be created that can copy more complicated hand movements. With this in mind, the robotic hand was created, and as a result, as intended, it could successfully copy the movements of a hand.

VIABILITY OF AUTO-SUSTAINING FAN USING MAGNETS FOR THE MOTION

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In this research the viability of a self-sustaining fan using magnets to create motion and at the same time transforming kinetic energy into electrical energy was studied. By placing some magnets in certain positions, a perpetual motion was produced causing ventilation and electric energy. A power generator was used and was connected to a rechargeable battery. This generator was united to the central axis of the fan which is driven by the magnets. With this fan, no external energy was required for its use, besides being an eco-friendly device that functions as a normal and efficient one.

SELF-SUSTAINABLE HYDROPONIC SYSTEM I

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With all the chemicals food processing factories use today, a way to farm one’s own vegetables and fruits in a controlled environment in the comfort of a person’s home is a good alternative to buying farmed foods that come with harmful chemicals and preservatives. A solution is offered, an easy to build and maintain a hydroponic system that can supply itself with water and minerals. By using gravity the structure can be constructed in a certain angle so that water can flow freely throughout the system. This hydroponic system would work as a controlled river, in this process water would be used and reused by pumping the water that passes through the hydroponic system to a simple filtering compartment where it removes sediment and is sent back to the main tank so it can be used again by the plants.
EJECTABLE SEATS, A GREAT ALTERNATIVE TO SAVE LIVES IN COMMERCIAL FLYING

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Planes do not continually fall and the probability of dying in a plane is low. Most people boarding a plane have feelings of fear, insecurity and even panic. There has always been a fear in people when they are flying either business or even a family trip. Commercial aircrafts do not have parachutes and only have 3 minutes of time to react and survive. This has inspired the question: Why ejection seats are not used on commercial aircrafts? An investigation was performed about having a method for commercial airplanes. It consisted on having a system of ejectable seats for saving lives in a moment of an emergency. This research meant that lives could be saved with this system. The purpose of this study was to seek for a new innovation in aviation technology that would be a big leap on aircraft companies and create safety in people. This system consisted of the pilot having a mechanism that in the moment of an emergency, the aircraft would open the roof and the people would leave the plane effectively in their ejectable seats.

SELF-SUSTAINABLE HYDROPONIC SYSTEM II

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Taking in consideration the “Self-sustainable Hydroponic System I” investigation, the part of sanitation in the food sold that is sold today is important. This investigation presents the way to improve the quality of the food without spending energy power. The water pump moved a water mill and then the water went to the hydroponic and ended again in the water pump. The kinetic energy produced by the water mill was collected in a motor that had a magnetic core, and when an exterior force moved the core, it produced energy. The energy from the mill went to the motor, from the motor to the battery and with a converter to the water pump. With this system better food quality was achieved without consuming energy.

ION REDUCTION TO REDUCE FRICTION IN METALLICS

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Plasma, according to natural science, is one of the four fundamental states of matter (the others being solid, liquid, and gas). When air or gas is ionized, plasma forms with conductive properties similar to those of metals. Plasma is the most plentiful matter in the universe. Plasma can help humanity in different ways that have not been discovered. In this investigation, the change of friction in metals in The Mirror and Cusp Plasma Machine was experimented at the Polytechnic University of Puerto Rico. If different types of metals are placed inside the plasma machine, then the change of friction in the metal can be seen. The methodology included: 1) Finding different types of metals. 2) Placing them on the plasma machine. 3) Analyzing results and verifying the change of the surface, see if there was any.
ABSTRACTS

ENVIRONMENTAL SCIENCES

THE LONG TERM EFFECTS OF HAZARDOUS WASTE

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A hazardous waste is a waste with a chemical composition or other properties that can cause death or serious injuries to living things and potentially harmful to the environment. The advances in industrial processing are what have led to these poisonous by-products, also known as toxic waste. Hazardous waste comes from simple things such as household items to more complex things and processes such as hospitals, constructions, laboratories and farming. When a waste is classified as toxic, it goes through expensive treatments and disposal procedures. Throughout the years the cost of waste disposal has increased and the lands to dispose them have become very limited due to poor regulation and restrictions. Although many alternative production methods are being implemented, the amount of toxic waste is massive. Not only can new waste affect the environment, but also the old waste that has been accumulated, if not handled correctly, could release contaminants to the soil, water, and air. On 2011 in Japan, tons of radioactive waste was dumped into the Pacific Ocean because supposedly there was no other option due to leaks. Society is not well informed of how easily toxic wastes are created, how they are being mishandled and how they are affecting the environment and in specific undeveloped countries. In Excel, formulas, data and worksheets were created, which were helpful to understand the amount of hazardous waste throughout the years and to predict future amounts that could deteriorate more the environment.
ABSTRACTS

GENOMICS

COMPARING TWO SIMILAR DISEASES THROUGH HEXA GENE

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Hexosaminidase is an enzyme that hydrolyzes the terminal residues of N-acetyl-D-hexosaminidase in the N-acetyl-beta-D-hexosaminidosas. A deficiency is the cause of Tay-Sachs and Sandhoff diseases. In the hexosaminidase there are two proteins: hexosaminidase A and hexosaminidase B. Hexosaminidase A is protein that helps break down a chemical found in nerve tissue called gangliosides and Hexosaminidase B is involved in the degradation of mucopolysaccharides, oligosaccharides and globosides. These two proteins have three ganglioside: GM1, GM2 and GM3. G refers to ganglioside, M is for monosialic and the numbers are the monosialic ganglioside discovered. In hexosaminidase A and B one can find two diseases called Tay-Sachs and Sandhoff. The programs used T-COFFEE to compare, and SIFT to predict intolerance and tolerance.

DIFFERENCES AND SIMILARITIES BETWEEN PHENYLKETONURIA AND ALZHEIMER’S DISEASES

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Does having Phenylketonuria increase the risk to develop the Alzheimer’s disease? According to the Fisher Center for Alzheimer’s Research Foundation, Alzheimer is a progressive and mortal brain disease. Also, according to the 2011 Alzheimer’s Disease Facts and Figures from the Alzheimer’s Association, 5.4 million people in the United States have this disease. It is the most common dementia among older people. Phenylketonuria (mostly called PKU) is a disease that is in the PAH gene. The PAH gene provides instructions for making an enzyme called phenylalanine hydroxylase. This enzyme is responsible for the first step in processing phenylalanine, which is a building block of proteins obtained through diet. Phenylalanine is found in all proteins and in some artificial sweeteners. The APP produces the gene mutations PSEN1 and PSEN2. These two gene mutations are developed with the PAH gene. The purpose for this research was to find solutions or cures for Alzheimer’s and phenylketonuria and to observe a possible prediction in the family generations using a pedigree chart. Some genes about the Phenylketonuria Disease have a strange relation with the Alzheimer genes, and the purpose of this investigation was to compare these two diseases and how Alzheimer’s influences the Phenylketonuria disease and viceversa. The programs T-COFFEE, SIFT and Ensembl were used for the analysis.
TAU PROTEIN AND THE NEGATIVE EFFECT IT HAS IN OUR MINDS

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Alzheimer’s and dementia have become a worldwide problem in the minds of our elders. It has now become the 6th leading cause of death in the United States of America. “It is now a fact that every 67 seconds someone in the United States develops Alzheimer’s or dementia. – Alzheimer’s association”. This disease starts when the tau protein is damaged and it stops regulating the microtubules in the neurons. By doing so, this causes the connection from neuron to neuron to be disturbed. The disturbance of the neurons starts to block the direct connection and transportation of thoughts and other general signals developed by the brain’s nervous system. Tau plays a great role in regulating microtubule networks in neurons. It promotes the structure and stabilization in the microtubules. This causes the neurons to have a stable growth and structure. The methodology of this investigation required the use of the following programs and databases: Uniprot, Pubmed, Genedoc, Protein data bank (PDB), VMD, The Journal of Biological Chemistry (JBC), EDinformatics. The purpose of this investigation was to provide useful information to the scientific world. The information may help future investigations to result in a better understanding of the causes of AD and dementia and, most importantly, to find a cure.

MUTATION PROBABILITY IN ATOPIC DERMATITIS DISEASE

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Atopic dermatitis (AD) is an inflammatory skin condition that is marked by intensely pruritic changes that occur chronically with periods of remission and flares. Occasionally traditional treatment options are insufficient or are associated with undesirable side effects; thus, the development is crucial. Using the programs MEGA 6 and SIFT, the phylogenetical tree was examined to find the probability of the gene mutation by amino acid changes in part of the protein. Results obtained by SIFT showed that there were 4.8% tolerant and 95.2% intolerant substitutions. It was predicted that there was a high probability for mutations based on the 95.2% intolerant substitution. There was a 50% linkage obtained from the results from MEGA 6, for the human and Staphylococcus spp. This means that the relation of the bacterium and the lack of protein in the mutation is positive.
MUTATION PROBABILITY IN AMINO ACID SUBSTITUTIONS IN THE INTERFERON REGULATORY FACTOR 6 (IRF-6) USING SIFT


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This research was about the interferon regulatory factor 6 gene, in which mutation probabilities were studied. The IRF6 works with the immune system. Its main function is to block viruses from reproducing in the human body cells. When being affected by a mutation, it may lead to the illness known as the Van der Woude syndrome (VWS). The statistics of the Van der Woude syndrome show that 1 in 35,000 individuals in Asia and 1 in 100,000 in Europe, suffer from this syndrome. It is reported to be the most common syndrome worldwide with an incidence that ranges from 1:100,000 to 1:40,000. Sort Intolerant from Tolerant (SIFT) was used to find the probabilities of the mutations as intolerant or tolerant to the changes in the amino acids positions. It was predicted the substitutions to be intolerant. According to the program, the IRF6 was 19% tolerant, while there was an 81% of intolerant substitution probability. After analyzing the results, it was determined that there was a high probability of a mutation in this gene.

RARE DISORDERS: NEUROFIBROMATOSIS CAUSED BY THE NEUROFIBRONIM GENE

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What is neurofibromatosis? Neurofibromatosis is a rare hereditary genetic disorder. It is the alteration of the neurofibromin gene, which acts as a tumor suppressor (also known as the NF1 gene). This disorder appears in both sexes. Generally diagnosed during childhood, it becomes more noticeable during puberty, and in some women during pregnancy. Neurofibromas, depending on their location and size, can be removed surgically if they become painful, invasive or infected, but there is no evidence that removal of dermal neurofibromas will increase the appearance, decrease it or cause different cancerous tumors (Children’s tumor foundation; Bruce Korf, MD, Ph.D.; 2007). As any cancer, neurofibromatosis, does not have a certain cure but it can be treated. This research focused on the development and the alteration that causes the disorder. When analyzing the amino acids in Genedoc, it was shown that most amino acids were from 80% to 100% conserved. Also, this gene can be recessive for generations until it collides with another abnormal gene that complements it and activates the NF1gene. The disease’s database and methodology were facilitated by: Pubmed, BLAST, Clustalw2, Genedoc, VMD; which help analyze the structure and genetic changes throughout generations. The disorder depends on many factors including the person and the family history.
COMPARISON OF DISORDERS ASSOCIATED WITH MUTATIONS IN CHROMOSOME 8

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Mutations in chromosome 8 are responsible for many disorders related with the genes in it. Chromosome 8 contains about seven hundred genes that provide instructions for making proteins. A mutation on one single gene can cause a disorder. Not only is a gene responsible for the disorder, but the protein that was affected in it. This research found out that many of these disorders cause bone abnormalities, noncancerous or benign tumors, and others similar symptoms. There is a large list of disorders related to this chromosome, so only five of them were selected. The disorders selected were: Langer-Giedion Syndrome, Charcot-Marie-Tooth Disease, Pfeiffer Syndrome, Werner Syndrome and Nijmegen Breakage. These disorders were caused by the loss of genes located in different places in the chromosome 8. The purpose of this research was to do a comparison of these disorders to determine if there were similar causes for each one. The comparison was made using the protein sequences of each disorder. The program used to do the comparison was T-COFFEE. This program is used to evaluate and manipulate multiple alignments of DNA, RNA and protein sequences. A supposition can be that different disorders caused by mutations in the same chromosome have a lot of similarities in their protein sequences. Once the comparison was made, the research found the percent of similarities and differences.

THE EFFECTS OF HER2/NEU-NEGATIVE ON BREAST CANCER

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One in eight women in the U.S will be diagnosed with Breast Cancer in their lifetime (National Breast Cancer Foundation, 2013). Her2/neu is the protein that is involved in the growth factor of cells. It is a kind of receptor from the Tyrosine Kinase. When HER2/neu-negative is involved, the tyrosine kinase of the cancer cell is almost non-existent which makes it difficult for the treatment to kill the cancer cell. The aim for this research was to see the effects of the HER2/neu-negative protein using bioinformatics tools. The methodology required the use of the following programs: Pubmed, NCBI BLAST and Protein Data Bank (to gather information), Clustalw2, Genedoc (to create the sequence of the protein), and VMD (the crystallization of the protein).
COMPARISON OF TREACHER COLLINS SYNDROME AND PIERRE ROBIN SYNDROME

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Treacher Collins Syndrome (TCFS1) is a syndrome that affects the tissue and bones strokes of the face. When the Treacher Collins Syndrome is causeD by mutations in the TCFS1 gene and it is considered an autosomal dominant condition. The Treacher Collins causes mutations in other syndromes in this gene. The SOX9 is a protein that causes Pierre Robin Syndrome but changes in the DNA near the SOX9 and is the most common genetic cause of the syndrome. The Pierre Robin syndrome is a sequence that also affects the bones of the face, the jaw and the chin and is presented since birth. The objectives of this study were to compare the two syndromes to observe how common they are and to know the probability of tolerance or intolerance using the programs T-COFFEE, SIFT and Ensembl. This investigation can help observe if the syndromes worsen with every alteration, mutation and intolerance.

CONTROLLING SYMPTOMS OF LRRK2 ON PARKINSON’S DISEASE

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Have you ever imagined how many calls pass through the cables in the city, and how fast they go? Well imagine that a million times, that is what is happening in the brain with neurons. Neurons can live a 100 years but they can degenerate by diseases or injuries. In Parkinson’s disease, neurons die and as a consequence cannot be reproduced or replaced. In a part of the brain called “black substance” dopamine is produced and dies gradually. That is why persons with Parkinson’s disease produce less dopamine. The focus of the research was to try to control the symptoms like tremors and muscle stiffness. Parkinson’s cannot be cured but it can be controlled by drugs treatments depending on the stage of the disease. Some of the most common drug treatments are levodopa, selegiline, anticholinergics and amantadine. In some specific cases Parkinson’s can be treated with surgery and be effective, but there are some specific requirements to be able to proceed with surgery such as extreme functional incapacity, absence of dementia and an age not older than 70. The research compared which process was more effective with Parkinson’s depending on the stage and the age of the person.
EFFECTS OF THE THYROID-BINDING GLOBULIN ON METABOLISM

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About 4.6 percent of the U.S. population ages 12 and older has hypothyroidism, but it is most commonly found in people older than 60 years, in particular women. Hypothyroidism may be originated from a mutation in the gene SERPINA7, which creates a TBG deficiency. The gene SERPINA7 is localized on chromosome X, meaning it is an X-linked disorder, and the trait is recessive. The protein codified by the gene is the thyroid-binding globulin (TBG), also known as thyroxine-binding globulin. TBG is a protein that is in charge of the transportation of the hormones T4 and T3, which regulate metabolism. If there is a deficiency in thyroid-binding globulin, the amount of circulating thyroid hormones is reduced, and this creates Hypothyroidism. This disorder is characterized by a lack of energy, coldness in limbs and weight gain. The purpose of this research was to learn the variable effects of having a problem with thyroid-binding globulin. The appropriate methodology included the use of the following programs: PubMed, NCBI BLAST, Clustalw2, Genedoc, Protein Data Bank (PDB) and VMD. The programs mentioned proved that TBG consists of a single polypeptide chain of 395 amino acids. Also, more specifically, TBG is inherited as a defect in a single gene copy located on Xq22. Most TBG variants are produced by an amino acid substitution (premature termination) or a point mutation. The disorder produces three known phenotypes: complete TBG deficiency, partial TBG deficiency and TBG excess.

ECTODYSPLASIN-A IN EDA-1 - EDA-2, ECTODERMAL DYSPLASIA

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There are three skin layers: the epidermis or outer layer, the dermis which is the second skin layer and finally the hypodermis which is the third layer of skin. Ectodermal Dysplasia is a genetic disorder located on the X chromosome. It is diagnosed because of thin or loss of hair, dry skin, and also affects nails, and sweat glands. If a children get Ectodermal Dysplasia and they are the first in their family to get it, then they suffer a mutation in their genetics. The ectodysplasin-A is a type II membrane protein of the EDA. Ectodysplasin, a member of the tumor necrosis factor family, is encoded by the anhidrotic ectodermal dysplasia (EDA) gene. Ectodermal Dysplasia (EDA) has a lack of proteins, one of them is ectosyplasin-A. Ectodermal dysplasia is divided into EDA1 (ectodysplasin-A), and EDA2 (ectodysplasin-A). EDA-A1 and EDA-A2 are two isoforms of ectodysplasin that differ only by an insertion of two amino acids. This insertion functions to determine receptor binding specificity, such that EDA-A1 binds only the receptor EDAR, whereas EDA-A2 binds only the related, but distinct, X-linked ectodysplasin-A2 receptor (XEDAR). In situ binding and organ culture studies indicate that EDA-A1 and EDA-A2 are differentially expressed and play a role in epidermal morphogenesis (Agnieszka Kobielak, 2003). This research revolves around looking for natural supplements and a combination of vitamins, amino acids and proteins to control situations and find a possible long range alternative for the disease control.
ANALYTICAL COMPARISON OF TRYPANOSOMIASIS VARIATIONS

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Trypanosomiasis is a disease that is caused by a protozoan parasite belonging to the group Trypanosoma. There are two types of trypanosomiasis, the *Trypanosoma cruzi* (American trypanosomiasis) that causes the Chagas Disease and the *Trypanosoma brucei* (African trypanosomiasis) that causes the sleeping sickness. Also, there are two types of subspecies of *T. brucei* that are morphologically indistinguishable causing distinct disease patterns in humans: *T. b. gambiense* that causes West African sleeping sickness and *T. b. rhodesiense* that causes East African sleeping sickness. The purpose of this investigation was to know about the disease trypanosomiasis, how it affects humans and what changes occur in the diseases according to their geographical location. Also, using the program T-COFFEE, it was to study and compare one of the vectors that transmits trypanosomiasis to the same species of vectors that transmits other diseases.

PROMYELOCYTIC PROTEIN (PML) FUNCTION IN LEUKEMIA

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One of the top dangerous diseases in 2014 has been Leukemia. Each year, this disease is diagnosed in about 29,000 adults and 2,000 children in the United States (*National Cancer Institute*). This cancer is part of the body’s blood forming tissues, including the bone marrow and the lymphatic system. The blood stem cells can be divided into two groups, although the focus was on the myeloid stem cells. The myeloid stem cells can develop in the red blood cells, granulocytes, monocytes or platelets. The focus was primarily on how the Promyelocytic protein (PML) helps as an antiviral for this disease. This protein has an antiviral activity against viruses that affects DNA and RNA. This research focused mainly on how this protein can fight that disease. The purpose of this research was to know how the PML will help as an antiviral in the myeloid stem cells. The different programs that were vital in this research to gather information were the following: Uniprot, Clustal W2 and NCBI AST to study the protein sequence and function and Gendoc for the alignment of the protein. In this program there were some amino acids found that are essential in the protein function. It is vital to understand the importance of promoting this research about the Promyelocytic protein (PML) because it helps fight disease. It will also bring more knowledge of how this protein can be combined with other elements to find the cure for leukemia and decrease the actual number of deaths.
ANALYSIS AND SUSCEPTIBILITY OF THE “HFE” GENE REGARDING HEMOCHROMATOSIS

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With a record of 1 million current victims, Type 1 Hemochromatosis is one of the most common genetic disorders in the United States (Genetics Home Reference, 2014). The HFE gene provides instructions for producing a protein that plays an important role on the absorption, regulation and storage of iron in the body. Some mutations in the gene cause Type 1 Hemochromatosis, which is a disease that causes the digestive system to absorb too much iron from ingested food. The excess iron is stored in the body's tissues and if left untreated it may cause organ failure due to the overload. The purpose of this research was to analyze and compare the susceptibility of the gene to the mutations that cause type 1 Hemochromatosis. To achieve the best results, genomic tools such as: M-Coffee and SIFT were used.

CONGENITAL INSENTIVITY TO PAIN AND ANHIDROSIS

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Congenital Insensitivity to pain or CIP is a rare or strange disease. The syndrome is hereditary; in definition it is an anomaly that affects the nervous system. This anomaly occurs in chromosome 2, in the SCN9A gene. Also, this mutation regulates the nervous impulses in the neurons that take painful stimulus. With this mutation, signals are not sent to the brain, they gets blocked and do not perceive pain. There is another syndrome similar to CIP; the difference would be that besides the inability of feeling pain, individuals cannot sweat. The human that has Congenital Insensitivity to Pain with Anhidrosis, CIPA, has an inability of sweating, meaning that they cannot regulate their body temperature. The syndrome called Hereditary Sensory Autonomic Neuropathy type IV, HSAN IV, affects the peripheral nervous system resulting from the mutations in the gene. This anomaly occurs in the long arm of chromosome 1, in the NTRK1 gene. The gene provides instructions for the essential protein, called TrKA, for the survival and development of neurons. The purpose of this research was to compare CIP and HSAN IV to see the differences between these anomalies using the program T-COFEE.
ANGELMAN SYNDROME

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Have you ever heard about the Angelman Syndrome? The Angelman Syndrome can be considered as a rare disease that affects one in every 20,000 births. It is a disease characterized by neurogenetic developmental delay. The educed or no language ability affects one in 15,000 children and does so without distinction of sex or race. The program T-COFFEE was used to compare the syndrome with the Prader-Willi Syndrome.

PROBABILITY OF SUFFERING A CARDIAC ARRHYTHMIA ACCORDING TO GENETIC PATTERNS IN THE FAMILY

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Did you know that a heart normally beats with a regular rhythm of 60 to 100 beats per minute? In a healthy lifestyle, the rhythm of the heart is stable. When the heart start having abnormal rhythms, it is known as arrhythmia. Arrhythmia has a lot of causes including genetic ones. In this research, the focus was on two genetic arrhythmias, which are: Brugada Syndrome and Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy (ARVD/C), for comparison to determine which one of them has more probability of being eradicated in a family using the programs T-COFFEE and the Phylogenetic Tree.

THE HARMFUL EFFECTS OF THE PROTEIN SPINDLIN1 ON OVARIAN CANCER

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Ovarian Cancer is the most common cancer in women. In 2002, this cancer was the eighth leading cause of death in women. Approximately, 125,000 women were dying worldwide. In early stages it is highly curable. There are several theories about the causes of ovarian cancer. Scientists know that most of the time this disease arises from the malignant transformation of epithelial cells. Some researchers believe that pregnancy and contraceptive pills are associated with reduced risk of ovarian cancer. Even so, the cause and origin of this disease is currently unknown. There exist many treatments such as surgery, chemotherapy, hormone therapy and radiotherapy. The most effective is surgery. The focus of this research was on the SPINDLIN1 protein. In the process of this investigation there were different programs used to carry this research. Among them were GeneDoc, Crustal W2 and VMD for protein crystallization. The positions 84 and 99 of the protein activate the molecule TCF-4 that promotes the growth of cells, in this case, ovarian cancer. The purpose of this research was to know how the ovarian cancer-related protein works in women’s bodies and how it affects them.
THE BIOGENETIC EFFECTS OF BETA-AMYLOID ON ALZHEIMER’S DISEASE

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Alzheimer’s disease (AD) is a world wide phenomenon that affects over 35 million people every year. It is a biogenetic disorder that juggles memories out of place and eventually causes loss of track of time and the abilities that come with those memories. AD is caused by the Beta-Amyloid protein (AB), part of this protein being amyloid plaques, mainly detected in the brains of Alzheimer’s patients which are fairly dangerous because when these plaques clump together they block the cells from signaling neurons on where they need to go and it causes them to get lost in the brain. The aim of this research was to further understand how this protein can affect the brain so much it misplaces the memories of the everyday person, it disrupts that person’s ability to do the standard things learned as an infant. Basically the main question is: How can this protein help people forget who they are and how they live? The methodology of this investigation required the use of the following programs and databases: Pubmed, NCBI BLAST, NEWT, Clustalw2, Genedoc, Tree view, protein Data Bank (PDB), VMD and MEME. It has been proven that the protein can be measured semi-quantitatively, and that the location can also be determined. This shows that the protein can manifest itself in many different ways throughout the brain’s cerebral cortex as in other areas. Certain types of methods compromise contacting the cell with a substance, interacting with, for example, the amino acid sequence lysine-glycine-lysine (KGK) or lysine-glycine-alanine (KGA), wherein the substance binds to the p75 nerve growth receptor, resulting in the inhibition of the AB protein or even the AB peptide binding to and/or the activation of the p57 nerve growth factor receptor.

DETERMINATION OF MUTATION OF DYSTROPHIN BY AMINO ACID CHANGE ANALYSIS

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The Dystrophin (DMD) is a rod-shaped cytoplasmic protein that is a vital part of a protein complex that connects the cytoskeleton of a muscle fiber to the surrounding extracellular matrix through the cell membrane. Mutations associated to the gene are related to Becker Muscular Dystrophy (BMD). BMD is an inherited disorder characterized by a slowly progressive muscle weakness of the legs and pelvis. The purpose of this research was to know the probability of mutations of the DMD gene using the program SIFT which will sort tolerant from intolerant amino acids substitutions. It was predicted that the gene mutations to be intolerant. SIFT results revealed that 66.5% of amino acids substitutions were intolerant and 33.5% were tolerant. This means this protein has a high chance of mutations.
ANALYTICAL COMPARISON BETWEEN BRUCELLOSIS, WEST NILE AND INFLUENZA B

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Can a bacteria, an insect disease, and a virus be similar? Bacteria belong to the Kingdom Bacteria, the insect (mosquito) belongs to the Kingdom Animalia but the virus does not belong to any kingdom. The purpose of this research was to observe, analyze and compare if a disease of the Kingdom Bacteria and Kingdom Animalia can be distinguished from one that does not belong to a kingdom, in this case a virus. It is difficult to differentiate between them since they can have the same features. The diseases that are observed in this research were Brucellosis, Wet Nile virus and Influenza B. These three diseases can be distinguished by several factors; for example, the symptoms. The diseases are not treated with the same medications. T-COFFEE is used to align the protein sequence of the diseases in order to know how similar the diseases are.

CADASIL

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CADASIL which stands for Cerebral Autosomal Dominant Arteriopathy with Subcortical Infarcts Leukoencephalopathy is a disorder caused by a mutation in the Notch3 gene. The abnormal Notch 3 proteins are accumulated in the brain which causes a lack of blood in the white matter of the brain. This leads to multiple small and deep infarcts which cause memory loss, impairments, dementia, death, etc. It is an inherited disorder specifically autosomal dominant. The main symptoms of CADASIL were divided and then compared with other diseases that have that specific symptom in common. After using different programs such as SIFT (Sorting Intolerant From Tolerant) and T-COFFEE, the diseases were chosen and then compared to the main syndrome, CADASIL. The use of Ensemble was needed to acquire the transcript ID of the Notch3 gene. The transcript ID was used on SIFT to identify the possible mutations. That process was used on all the diseases chosen to compare on this investigation. The final part of the investigation consisted on searching which continent was more likely to have the syndrome CADASIL.
ANALYSIS OF AMINO ACID SUBSTITUTION MUTATION OF THE GAP JUNCTION OF THE BETA 1 (GJB1) GENE

Nelson D. Vélez-Espinet, University Gardens High School, San Juan, Puerto Rico.

Research Co-PI: Dr. Ángel R. Arcelay-Gutiérrez, Universidad Del Este, Carolina, Puerto Rico.

The members of the gap family protein are encoded by the GJB1 (Gap Junction Beta 1) gene. The mutations associated with the gene cause X-linked Charcot-Marie-Tooth disease (CMTX). CMTX is the most common inherited neurologic disorder that affects 1 in 2,500 people worldwide. It is characterized by slowly progressive distal muscle weakness and atrophy of the muscles resulting in characteristic step page gait with pes cavus deformity, decreased deep tendon reflexes with sensory loss. Sort Intolerance from Tolerance (SIFT), was used to predict whether an amino acid substitution affects protein function. This is based on the degree of conservation of amino acid residues in sequence alignments. The hypothesis was that there will be a higher percent of intolerant to tolerant substitution. For the first five positions, the results obtained by SIFT were: 72% intolerant and 28% tolerant, positions 6-10 84% intolerant and 16% tolerant & positions 11-16 were 53% intolerant and 47% tolerant. It was concluded that the substitution of amino acids of 1 to 16 is a 30% tolerant and 70% intolerant. This means that it is a higher probability that a mutation occurs.

PROBABILITY OF SUBSTITUTION MUTATION IN THE AMINO ACID SEQUENCES OF PROTEIN C (PROC) GENE

Patricia J. Victoriano-De La Cruz, Luterano Resurrección School, Carolina, Puerto Rico.

Research Mentor: Frances M. Rosa-Rivera, Universidad del Este, Carolina, Puerto Rico.
Research Co-PI: Dr. Ángel R. Arcelay-Gutiérrez, Universidad del Este, Carolina Puerto Rico.

Protein C (PROC) is a gene that encodes a vitamin K dependent plasma glycoprotein, which is attached to its active form by the thrombin – thrombomodulin complex. PROC is a zymogenic inactive protein. Its active part plays an important role in regulating blood clotting, inflammation and cellular processes. PROC mutations are linked to thrombophilia due to protein C deficiency, causing purpura fulminans and venous thrombosis. During this research, the SIFT program was used to determine if amino acids were tolerant or intolerant to changes in specific positions. SIFT helps determine whether an amino acid substitution affects protein function. It was predicted that the substitutions were intolerant. As a result, SIFT revealed that 44% were tolerant and 56% were intolerant to substitutions. This means that the gene has a high probability of mutating.
ACKNOWLEDGMENTS

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